

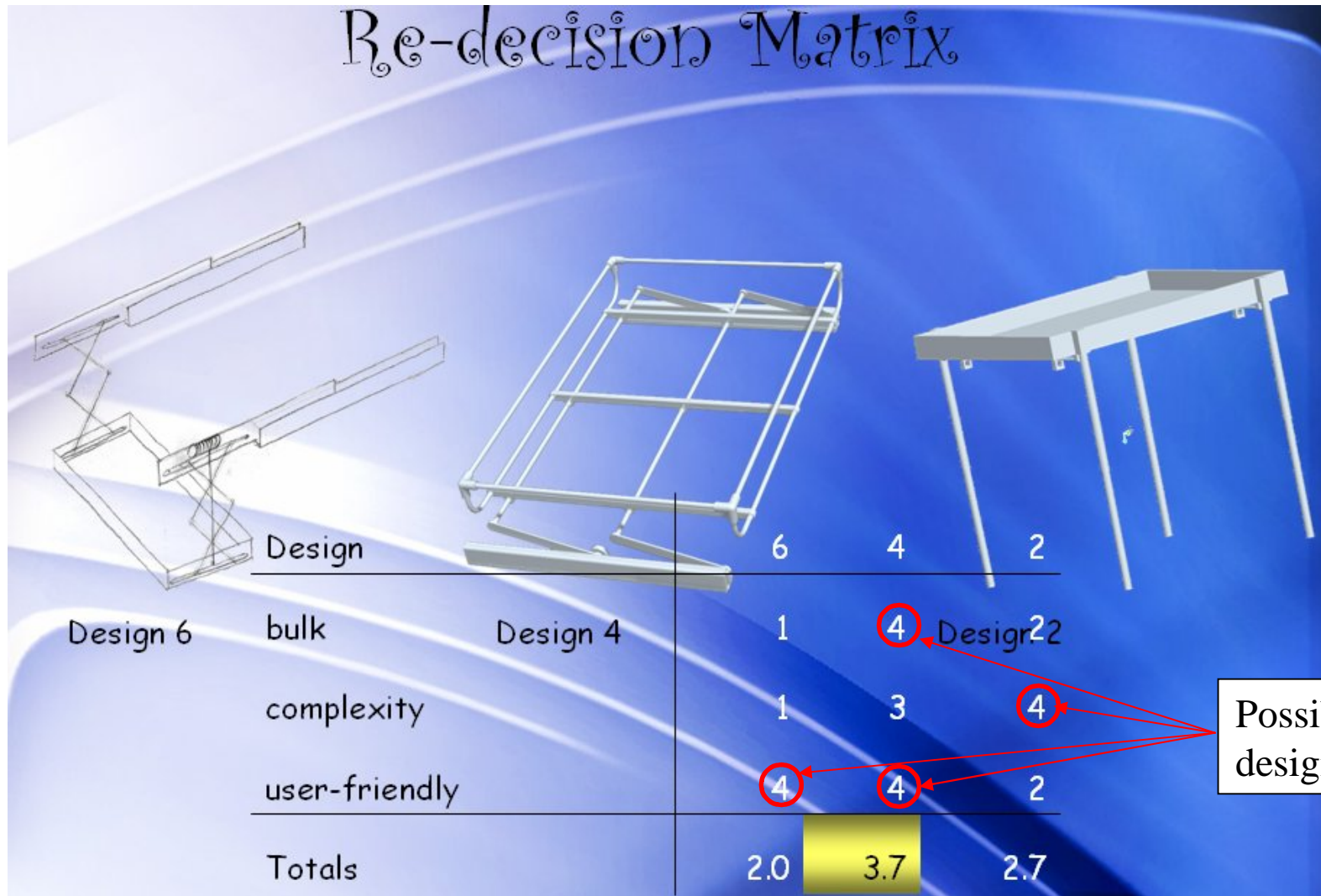
# The Product Development Process

- Trade Study and Down Selection



# The Product Development Process

- Trade Study and Down Selection

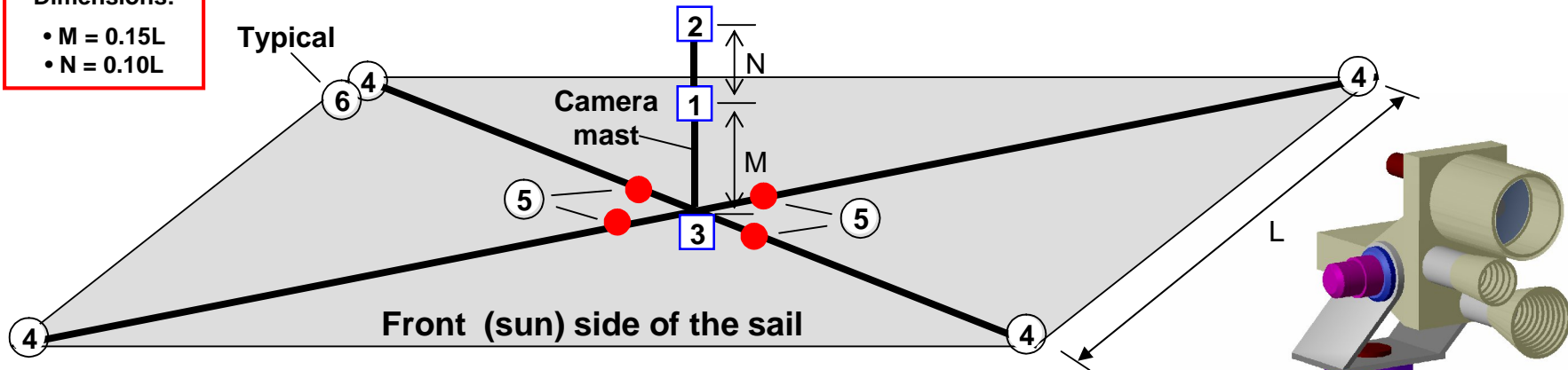


# The Product Development Process

## • Preliminary Design

### ODS Baseline Concept

Baseline Dimensions:  
•  $M = 0.15L$   
•  $N = 0.10L$

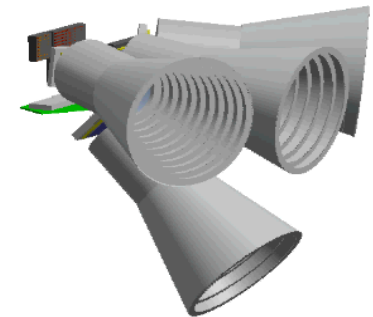


- 1 4 front-side 90-deg FOV camera clusters (16 cameras)
- 2 1 front-side inspection camera cluster with pan-tilt (3 cameras)
- 3 4 cameras at hub, one looking down each boom (4 cameras)
- 4 3 accelerometers at each boom tip (x & y bending, torsion)
- 5 Boom root strain sensors
- 6 Membrane tension sensors

#### Also:

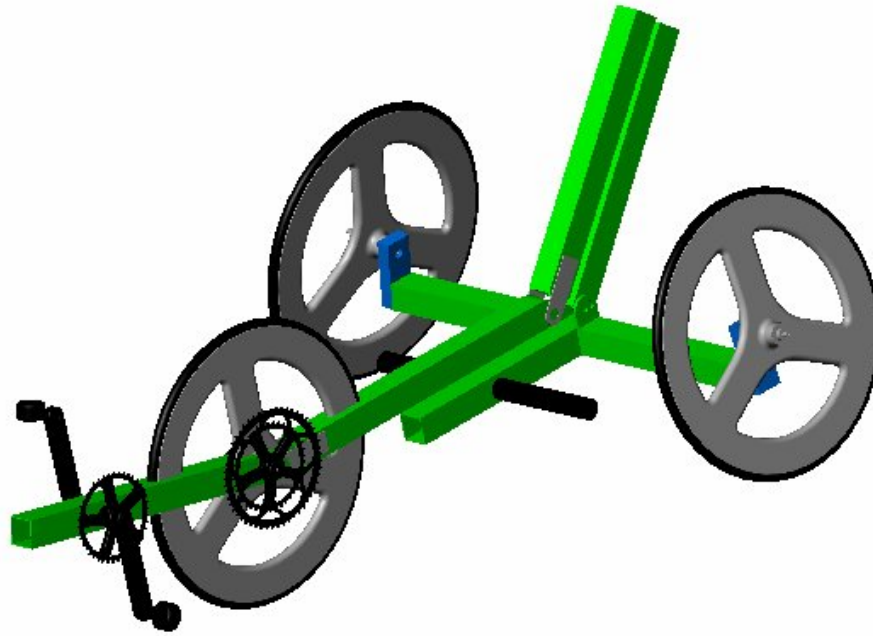
- Infrared thermography cameras on back side mast?
- Piezoelectric actuators for dynamic excitation?

Inspection Camera Concept



# The Product Development Process

- Preliminary Design



# The Product Development Process

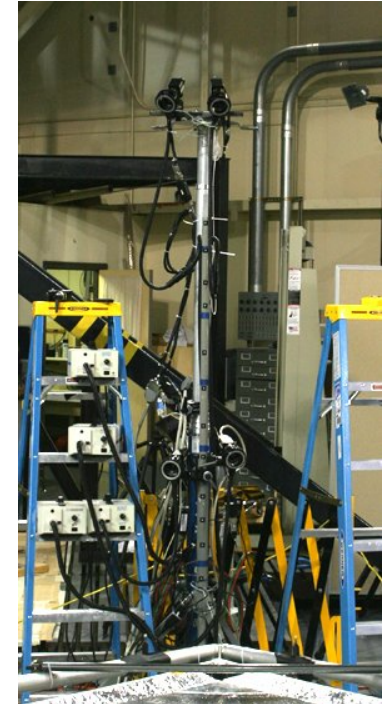
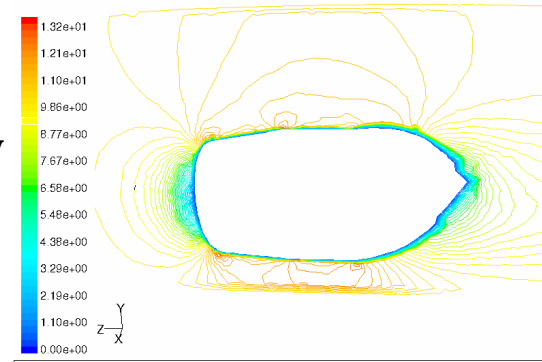
## • Detailed Design

Structural analysis, thermal analysis, fluid analysis, kinematic analysis, ...

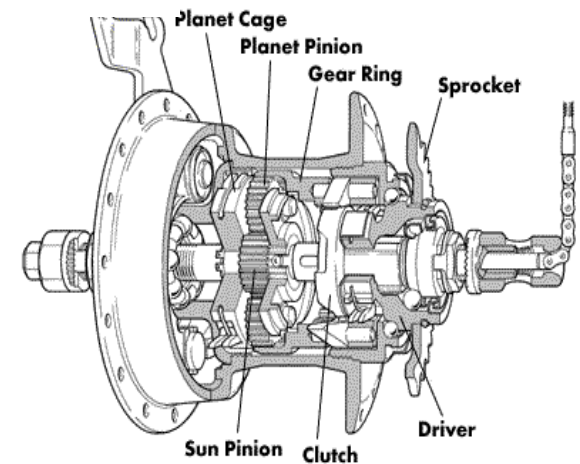
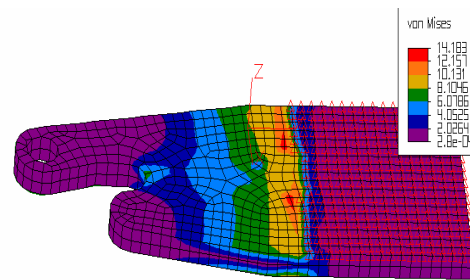
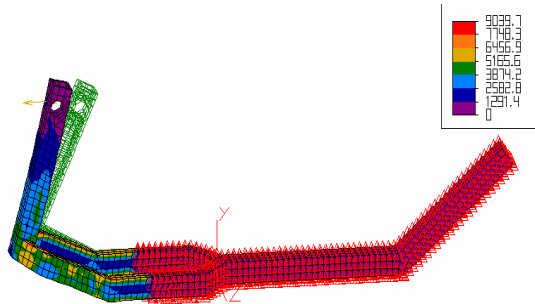
Interface design

Design for manufacturing, design for assembly

Test and validation



## FMEA



# The Product Development Process

## • Failure Modes and Effects Analysis (FMEA)

FMEA - Quick Reference Guide

System		Potential		Failure Mode and Effects Analysis		FMEA Number:						
Sub System		Failure Cause(s)/		Design Responsibility		Page 1 of 1						
X Component: Generic Decision		Mechanism(s) Failure		ASG Renaissance (Design FMEA)		Prepared by: Lee Dawson						
Model Year/Vehicle(s): 98.5				Key Date: Engineering Rel 2/3/98		FMEA Date (orig.): 11/14/97 (rev.): 12/21/97						
Core Team: M. Moore, M. Weber, L. Dawson												
Item	Potential Failure Mode	Potential Effect(s) of Failure	S e v e r i t y	O c c u r r e n c e	D e t e c t i o n	R e c o m m e n d e d Action(s)	Responsibility & Target Completion Date	Actions Taken	Action Results			
Must provide an FMEA which determines design risk and addresses potential significant and critical characteristic selection. Measurables: • Reduced RPN • Number of significant and critical characteristics. • Number of design actions.	FMEA not adequately performed; high risk remains	• Product liability • Customer dissatisfaction • Reduced performance of system or component • Potential risk of injury	10	Y C	5	• Design verification, planning and testing • Training	Design team leader or project manager; ASAP	FMEA performed under the supervision and leadership of an expert/certified FMEA facilitator	10	2	2	40

**Planned tests**

- Transfer to or from DV Plan
- evaluations
- builds
- checks

Note: Must have written instructions

**Actions should:**

- eliminate failure mode SEV=9/10
- eliminate causes on YS
- reduce occurrence
- improve tests

"Detection reduction last option"

**Name of team member to carry issue.**

- Name of champion
- Date action desired completion

**Brief action result description**

Date action taken

**Recalculate RPN, after action has been taken**

- occurrence
- detection

Note: severity will likely stay the same unless failure mode is eliminated

**Potential Critical & Significant Characteristics Action Guidelines**

Actions are Required: (by Priority)	10 9 8 7 6 5 4 3 2 1	1.) YC - Potential Critical Characteristics; Action Required	2.) YS - Potential Significant Characteristic; Action Required	3.) RPN-Top 20% by pareto
1.) When a YC exists (Initiate process FMEA to verify)				
2.) When a YS exists (Initiate process FMEA to verify)				
3.) For the top 20% Failure Modes (Pareto by RPN)				

**Top 20% of Failure Modes by RPN**

**FMEA EXPRESS™**

- Complete FMEAs more quickly
- Address high-risk potential failure modes first
- Use a cross-functional FMEA team approach

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**For FMEA assistance call:**

**Quality Associates**

(888) FOR-FMEA  
Lee Dawson  
www.quality-one.com

# The Product Development Process

- **Final Design and Development**

Table 8. CRT and TriLok Requirements Compliance

NRA		CRT		TriLok	
		Value	Method	Value	Method
Length	30m	50m	Design	50m	Design
		8.5m	Built	7m	Built
Scalable	>100m	>100m	Assess	>100m	Assess
Boom Mass	<75 g/m	60 g/m	Measured	68 g/m	Measured
Bending Stiffness	1000 Nm <sup>2</sup>	1400 Nm <sup>2</sup>	Tested	1500 Nm <sup>2</sup>	Tested
Packing Factor	<10	<8 @ 30m	Measured Modeled	<10 @ 30m	Measured Modeled

**CUSTOMER REQUIREMENTS :**

- Functional specifications
- Project constraints (CRR)



CRR = Customer Requirements Review  
PDR = Preliminary Design Review  
CDR = Critical Design Review  
PRR = Project Readiness Review

**Typical Design Reviews and the Product Development Process**

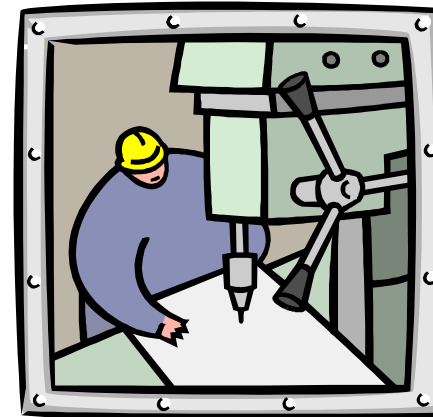
**DESIGN :**

- Preliminary (PDR)
- Detailed (CDR)



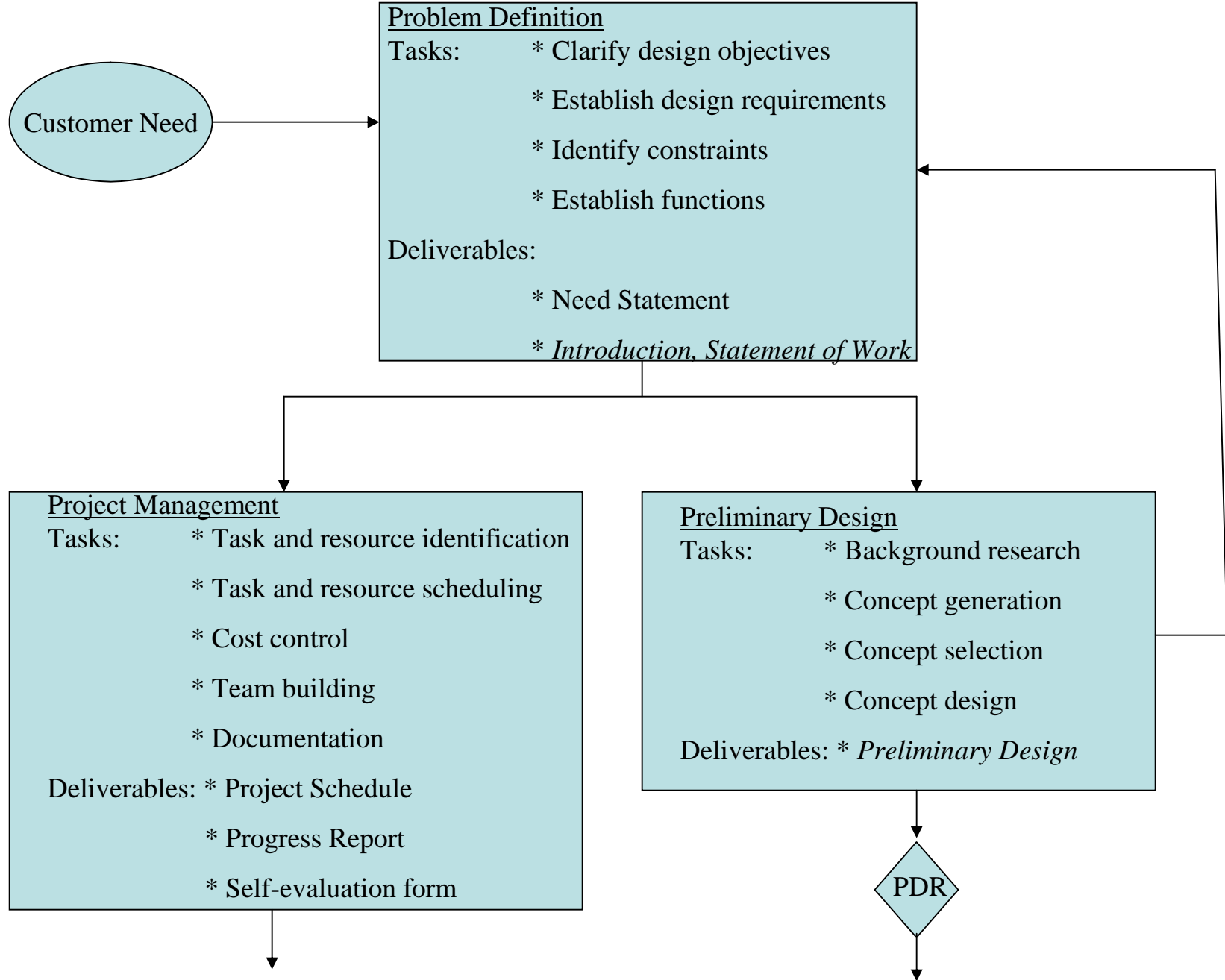
**DELIVERABLES :**

- Product (PRR)
- Archival information





# The ME 403 Design Process



# The ME 403 Design Process

