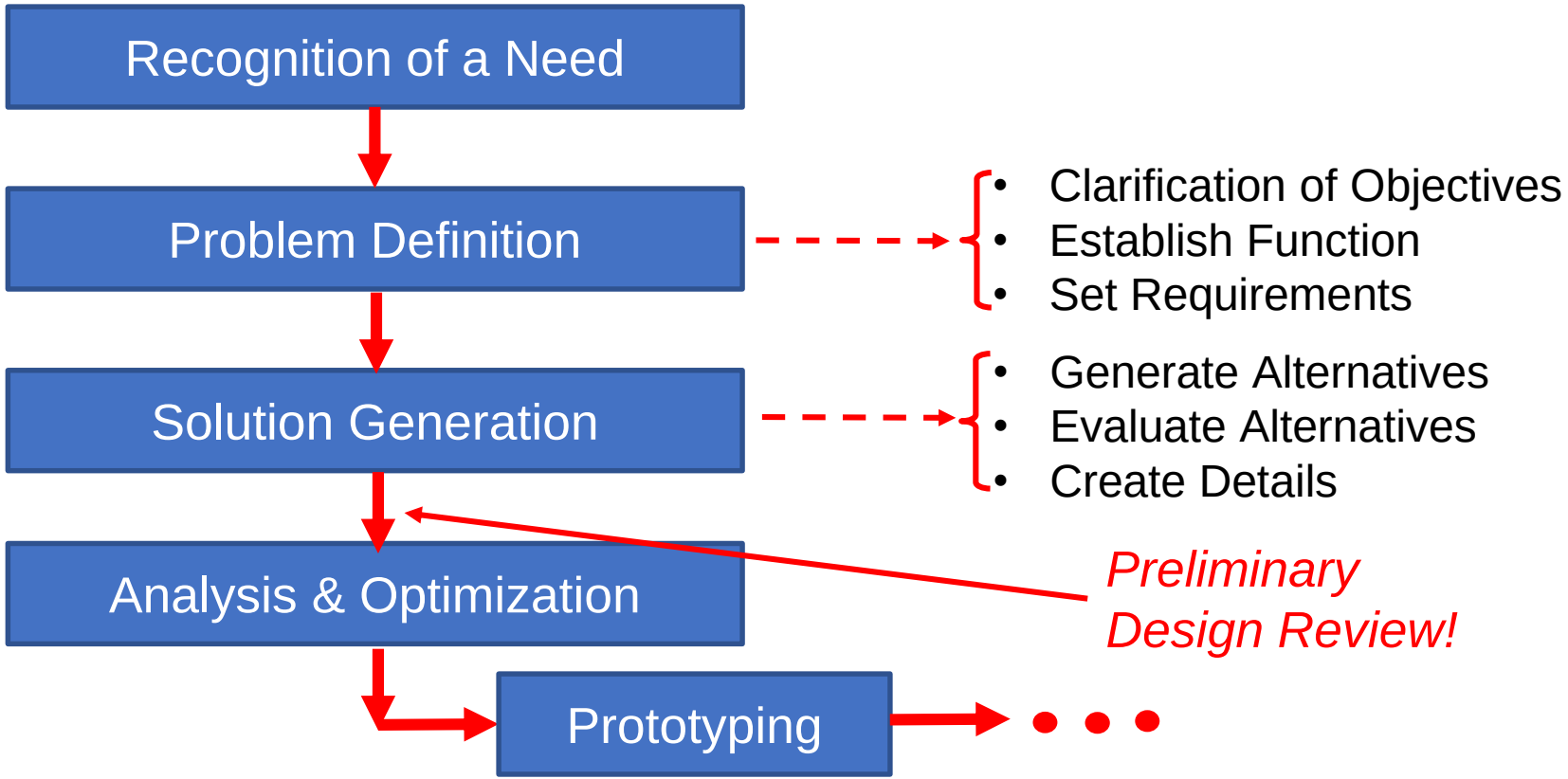
CS/EE/ME 75(a)

Nov. 19, 2018

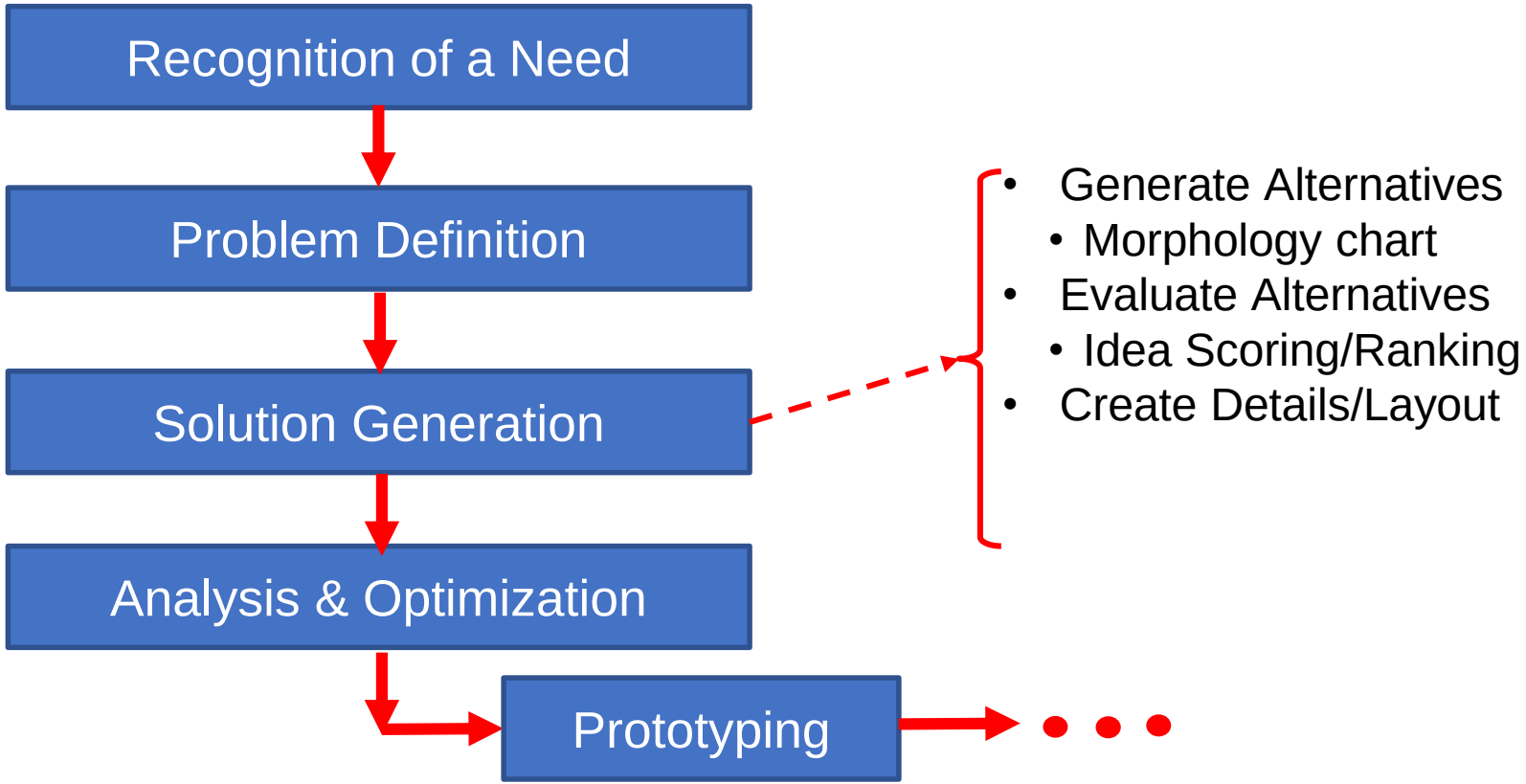
Today:

- Updates
  - Brett Lopez
    - JPLer in charge of flight
    - blopez391@gmail.com
  - Ben Morrell
    - JPLer in charge of localization/mapping
    - benjamin.morrell@jpl.nasa.gov
- Evaluate Alternatives
- Layout & preliminary Details
- Homework
- Get ready for PDR!

Structured Design Method(s)



Structured Design Method(s)



Generate Solutions

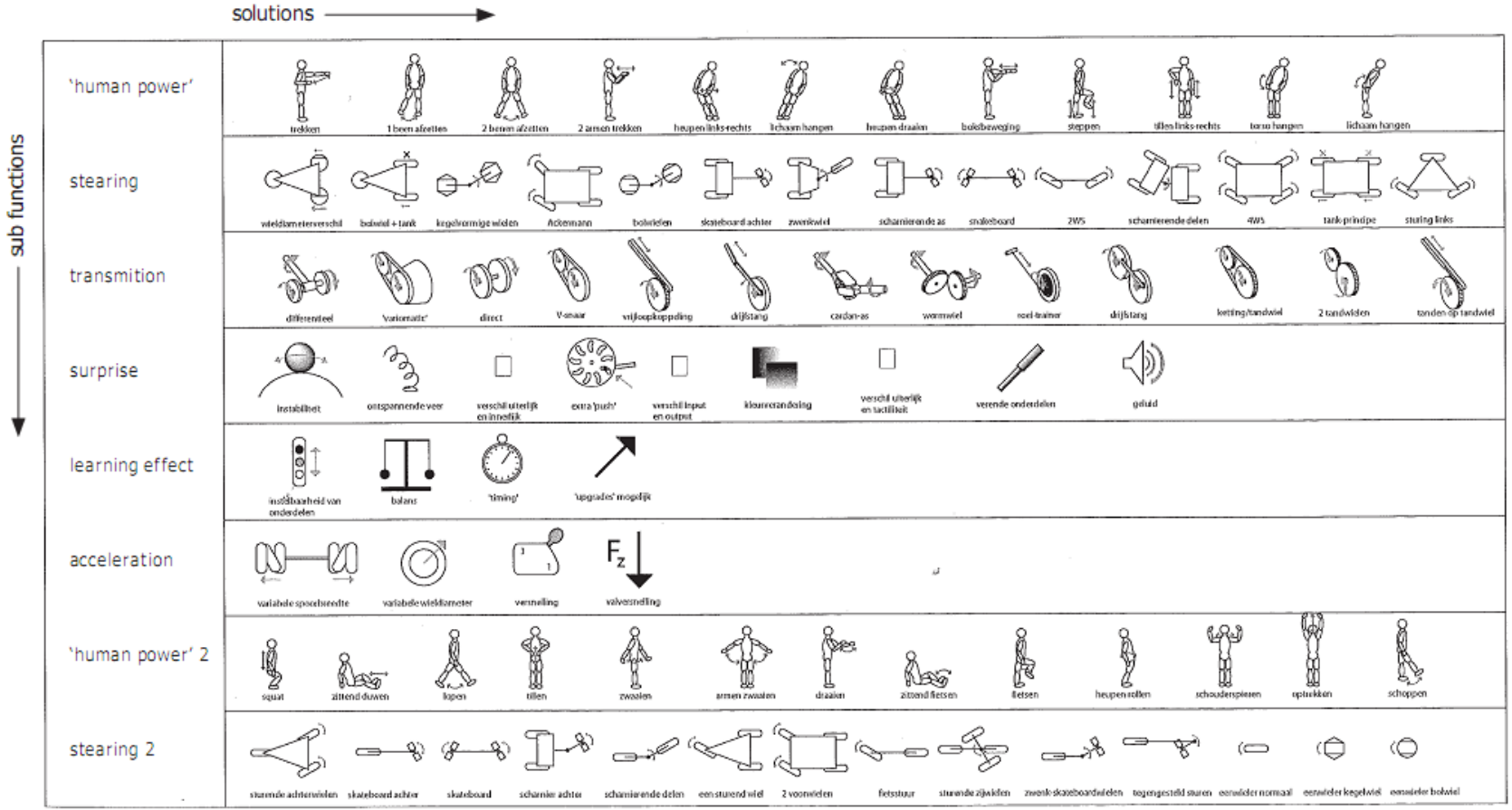
Goal:

- Create as many distinct solutions as possible.
- Create many possible alternative rearrangement of components
- Organize alternatives for future evaluations
- Classify alternatives

Morphology Chart (best for electromechanical design problems):

- Required functions/features along rows
- Different design alternatives and combinations along rows.
  - Phrases or sketches to capture the concept
- Sometimes other alternatives, such as concept diagrams or classification trees, are better suited to a given problem

Morphological Chart



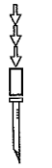
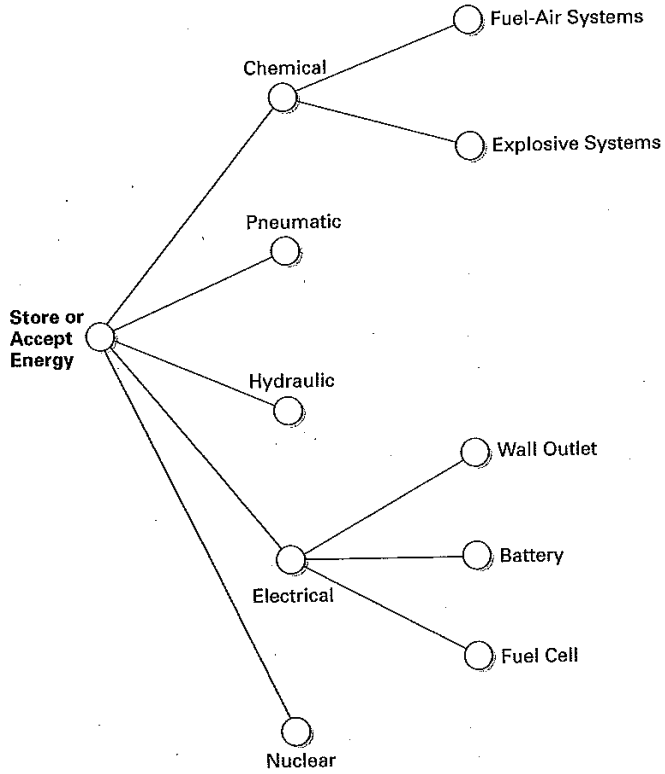
Solutions to Subproblem of Storing or Accepting Energy	Solutions to Subproblem of Applying Translational Energy to Nail	
• Self-regulating chemical reaction emitting high-pressure gas • Carbide (as for lanterns) • Combusting sawdust from job site • Gun powder • Sodium azide (air bag explosive) • Fuel-air combustion (butane, propane, acetylene, etc.) • Compressed air (in tank or from compressor) • Carbon dioxide in tank • Electric wall outlet and cord • High-pressure oil line (hydraulics) • Flywheel with charging (spin-up) • Battery pack or tool, belt, or floor • Fuel cell • Human power: arms or legs • Methane from decomposing organic materials • "Burning" like that of chemical hand warmers • Nuclear reactions • Cold fusion • Solar electric cells • Solar-steam conversion • Steam supply line • Wind • Geothermal	Single Impact	
	Multiple Impacts (tens or hundreds)	
	Multiple Impacts (hundreds or thousands)	
	Push	
	Twist-Push	

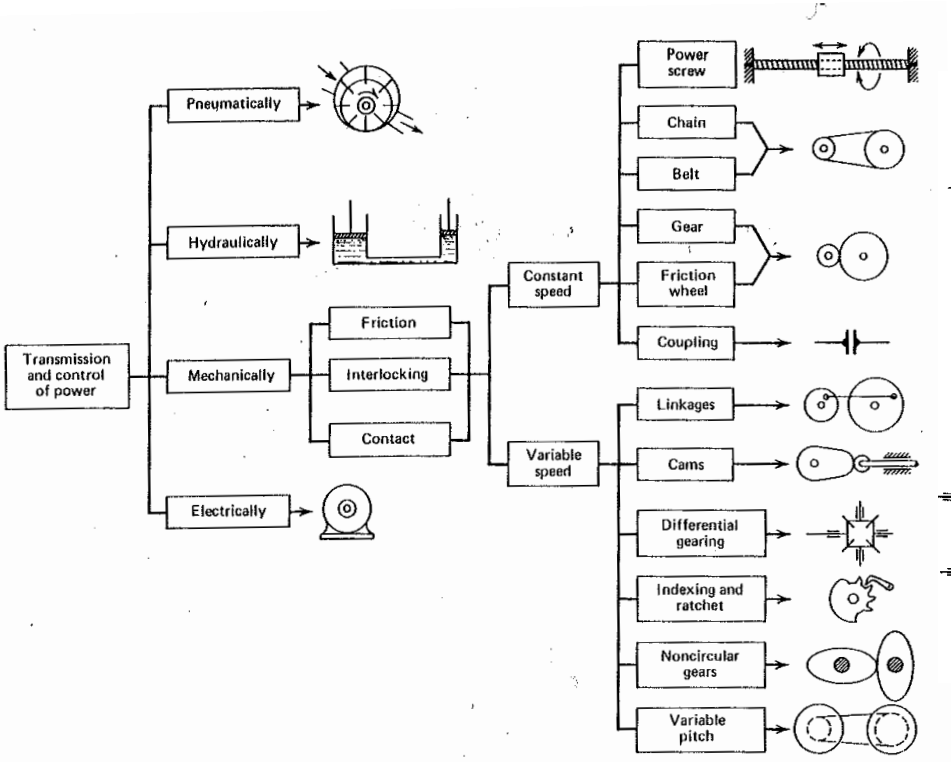
EXHIBIT 6–6

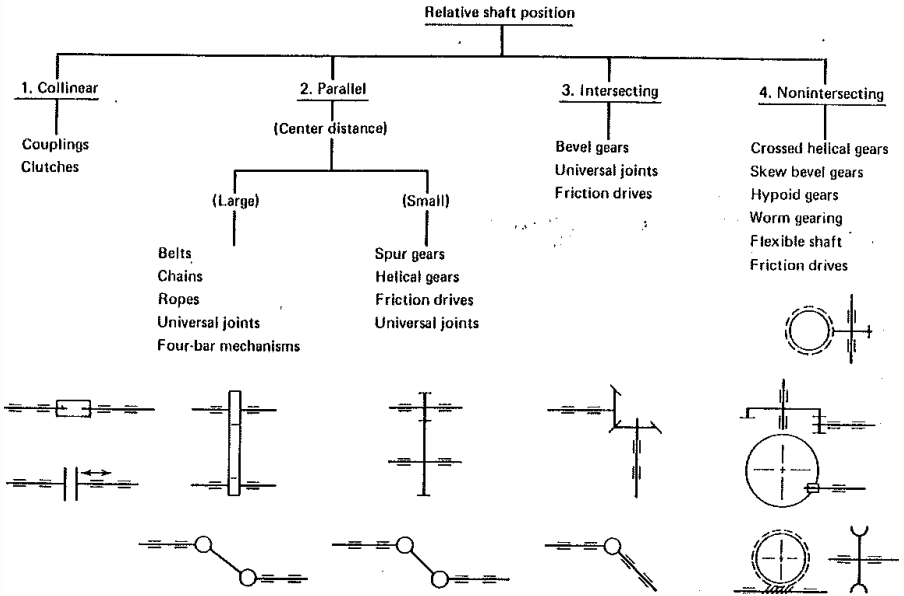
Some of the solutions to the subproblems of (1) storing or accepting energy and (2) delivering translational energy to a nail.

EXHIBIT 6–7

A classification tree for the nailer energy source concept fragments.




Transmission and control of power
Pneumatically
Hydraulically
Mechanically
Electrically
Friction
Interlocking
Contact
Constant speed
Variable speed
Power screw
Chain
Belt
Gear
Friction wheel
Coupling
Linkages
Cams
Differential gearing
Indexing and ratchet
Noncircular gears
Variable pitch

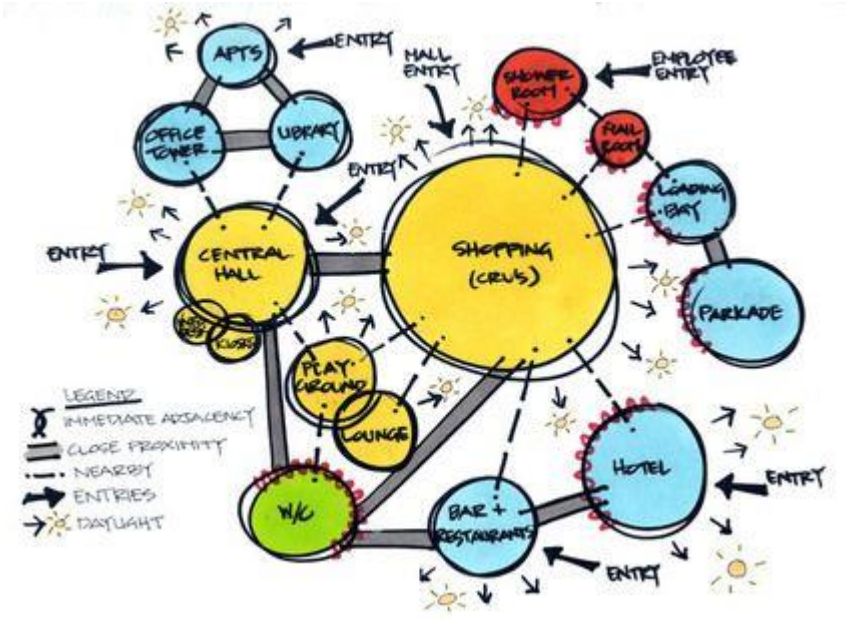

Relative shaft position
1. Collinear
Couplings
Clutches
2. Parallel
(Center distance)
(Large)
Belts
Chains
Ropes
Universal joints
Four-bar mechanisms
(Small)
Spur gears
Helical gears
Friction drives
Universal joints
3. Intersecting
Bevel gears
Universal joints
Friction drives
4. Nonintersecting
Crossed helical gears
Skew bevel gears
Hypoid gears
Worm gearing
Flexible shaft
Friction drives

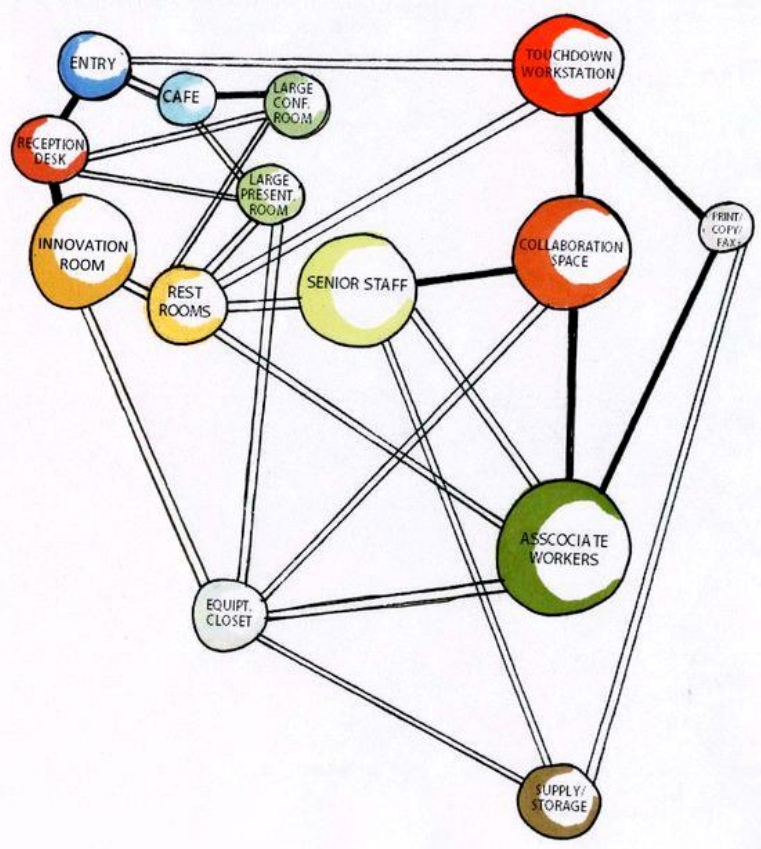
Pugh Analysis, Pugh Matrix

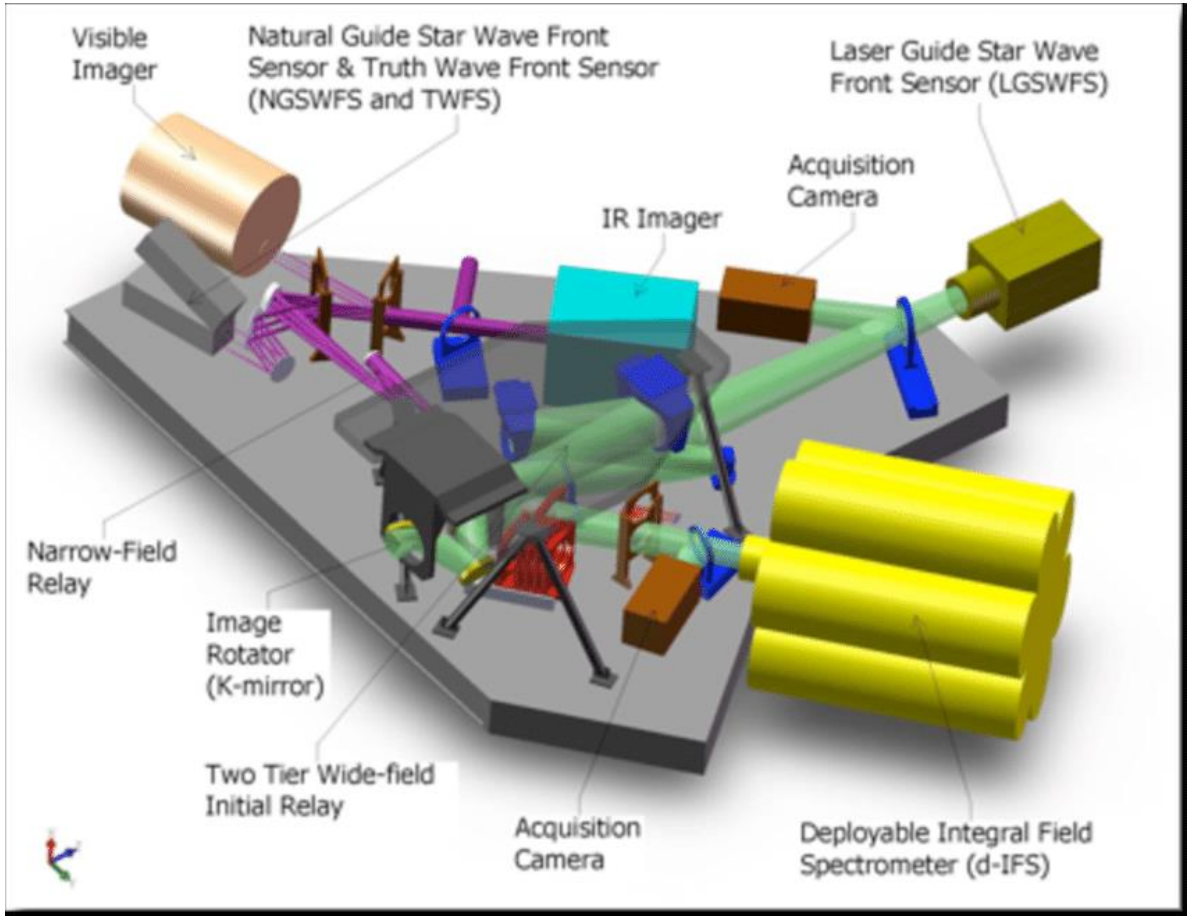
	Baseline	Alternative Solution		
Criteria	**Current Solution**	**Alternative 1**	**Alternative 2**	**Alternative 3**
Feasibility	5	1	1	1
Cost	4	-1	-1	0
Long Term Benefit	1	0	-1	1
Maintainability	3	0	0	-1
Availability of Resources	2	1	0	-1
Sum of all Positives		7	5	6
Sum of all Negatives		4	5	5
Sum of all Neutrals		0	0	0
Total		**3**	**0**	**1**

SELECTION CRITERIA	CONCEPT VARIANTS							
	A	B	C	D	E	F	G	REF.
Ease of Handling	0	0	–	0	0	–	–	0
Ease of Use	0	–	–	0	0	+	0	0
Number Readability	0	0	+	0	+	0	+	0
Dose Metering	+	+	+	+	+	0	+	0
Load Handling	0	0	0	0	0	+	0	0
Manufacturing Ease	+	–	–	0	0	–	0	0
Portability	+	+	–	–	0	–	–	0
PLUSES	3	2	2	1	2	2	2	
SAMES	4	3	1	5	5	2	3	
MINUSES	0	2	4	1	0	3	2	
NET	3	0	–2	0	2	–1	0	
RANK	1	3	7	5	2	6	4	
CONTINUE?	Yes	Yes	No	No	Yes	No	Yes	

Initial Layout: Bubble Diagram






Visible Imager
Natural Guide Star Wave Front Sensor & Truth Wave Front Sensor (NGSWFS and TWFS)
Laser Guide Star Wave Front Sensor (LGSWFS)
Acquisition Camera
IR Imager
Narrow-Field Relay
Image Rotator (K-mirror)
Two Tier Wide-field Initial Relay
Acquisition Camera
Deployable Integral Field Spectrometer (d-IFS)

Homework

Team Tasks: (all unit levels)

- Choose 3 functions/objectives of your project
- Create a morphology chart for each function/objective
- Develop a scoring system for your morphologies & Design Alternatives
- Score and Rank your alternatives. Select, as appropriate, ideas for continuation
- Initial Layout

Put your work product on the GitLab server in your team directory!

Homework

Team Tasks: (6+ unit level)

- **RC Car:**
  - Meet with Jake/Anushri to learn how to drive the car: NUC available on Monday?
  - Mechanical design of Elmo bolt-down pad
  - Layout for superstructure and key sensing/computing/power/cabling components

- **Drive-O-Copter:**
  - Contact Brett Lopez
  - Develop plan with Arnon Lewinstein (lewinstein@gmail.com) to produce chassis
  - Contact Luis Pabon (lpabonma@caltech.edu) to get “flex” chassis design, and make plan to produce prototype.

- **Extreme Localization:**
  - Follow up with Ben Morrel (Benjamin.morrel@jpl.nasa.gov) to learn about UWB efforts
  - Optical localization vs. UWB localization
  - What about stairs and multi-levels?