

Common Design Slides

The Design Process



Mechanical
SCIENCE AND ENGINEERING

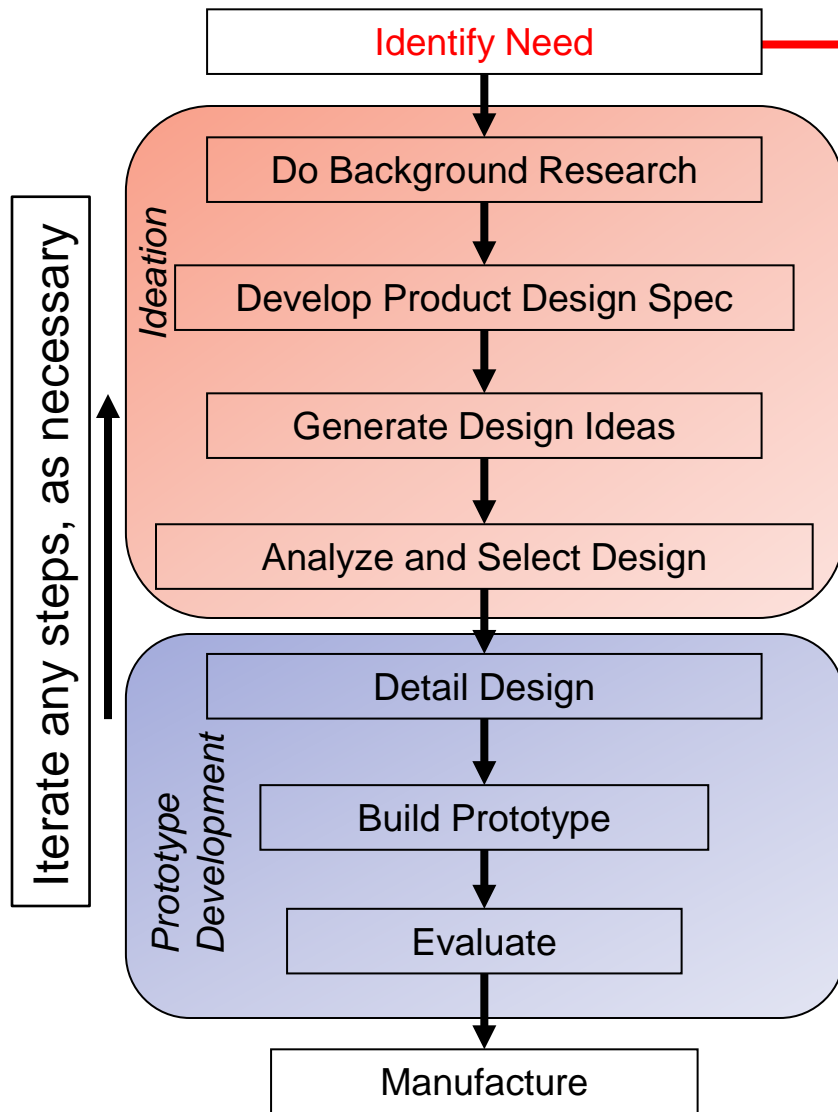
MechSE Design-Related Courses

- ME170: Computer-Aided Design
- ME199 DES/SAE: Competition Design Projects
- TAM252: Solid Mechanics Design
- ME270: Design for Manufacturability
- TAM302: Engineering Design Principles
- ME370: Mechanical Design I
- ME371: Mechanical Design II
- ME470: Senior Design Project

Essential Qualities of an Engineer

- **Creativity**
- **Attention to Detail**

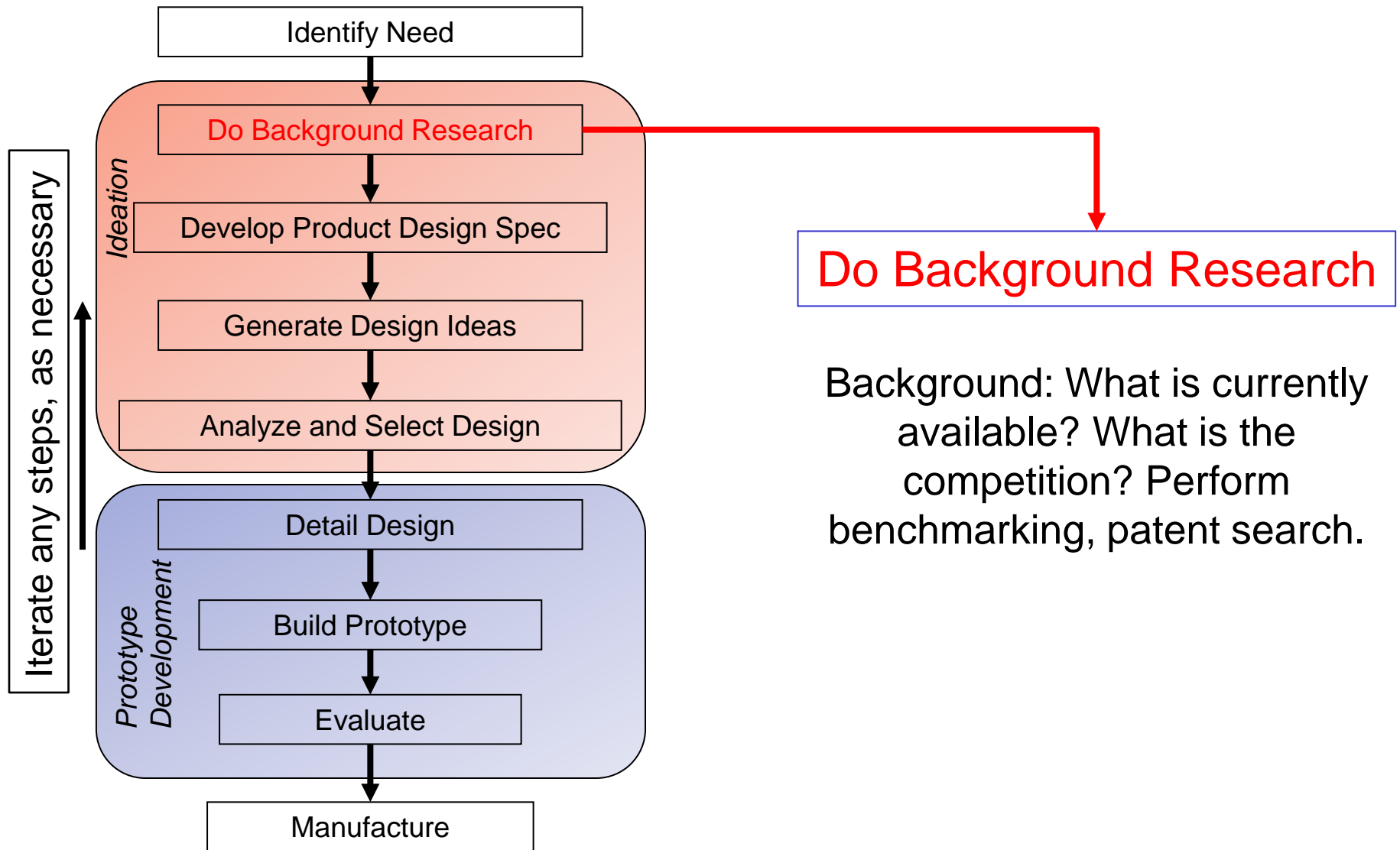
Stages of the Design Process



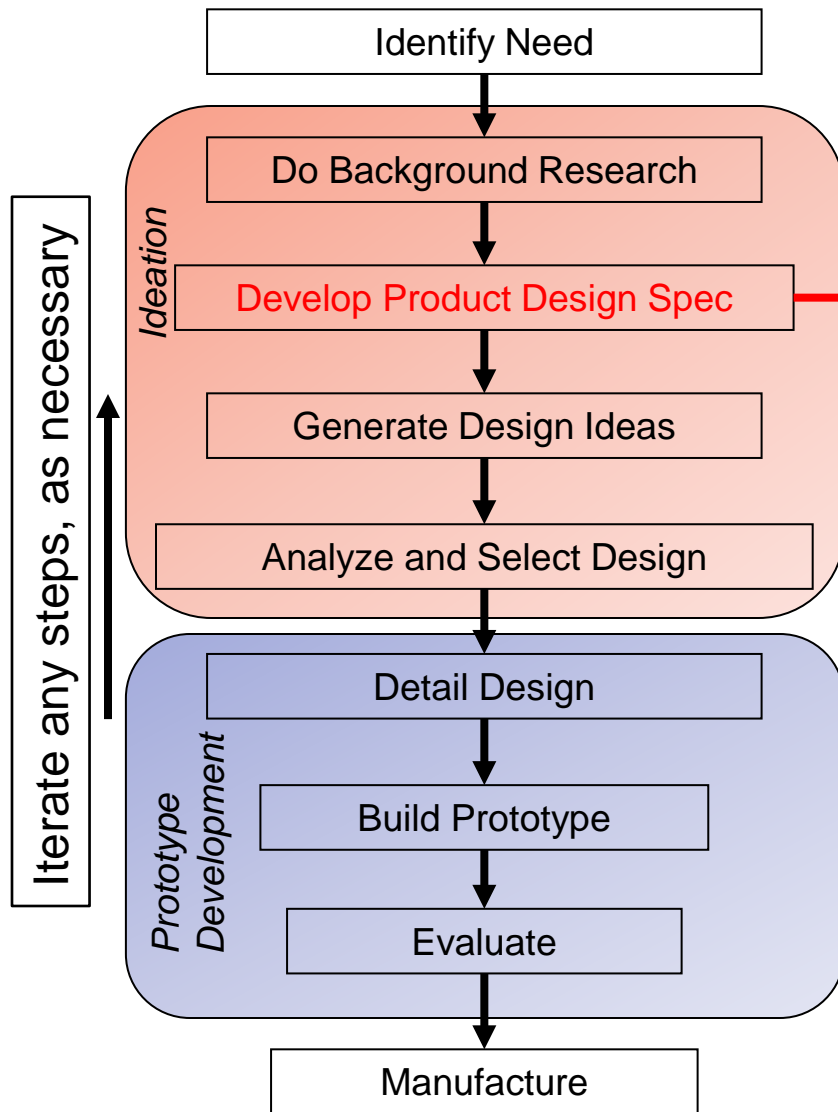
Identify Need

Need: driven by marketing or business plan, customer request, cost reduction, design improvement

Stages of the Design Process



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Develop Product Design Spec

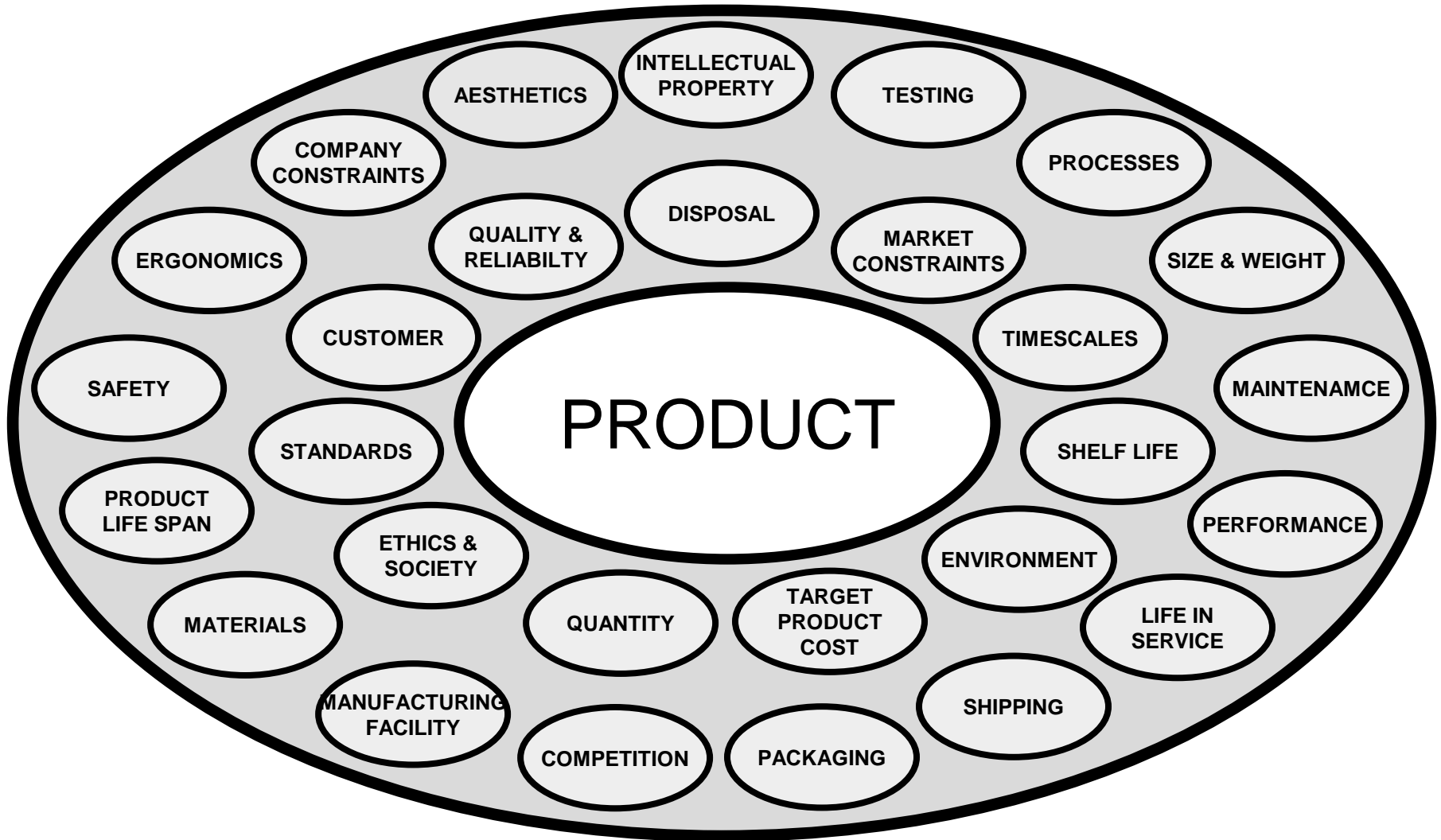
Product Design Specification (PDS)

- Identify product/design requirements
- Review all **29** Primary Elements from performance through cost, to disposal/recycling requirements
- **Objective/measurable - with units (metrics)**

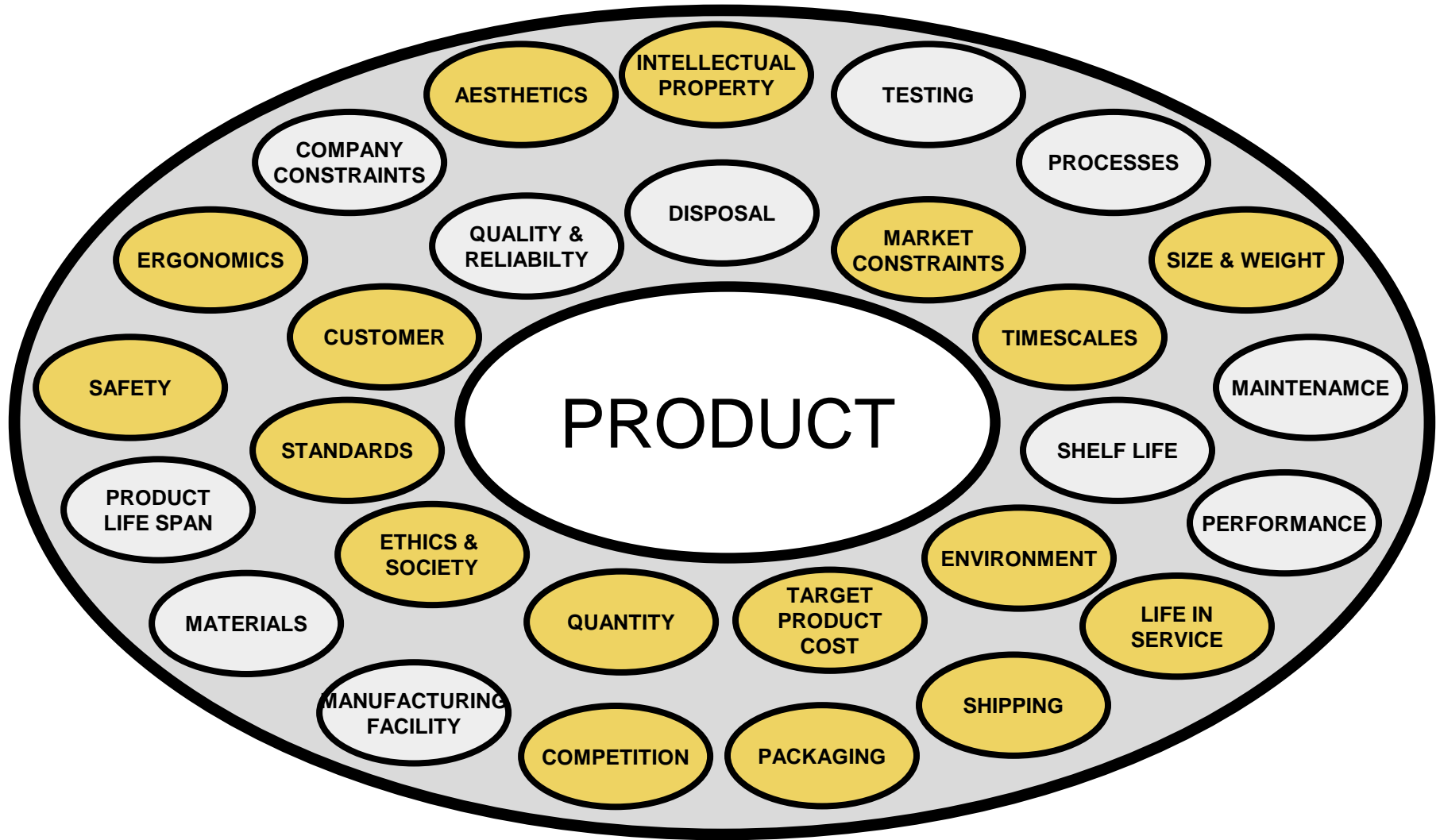
For example:

- Able to support 500 N of vertical force
- Produce flow rate of 200 gal/min
- Maintain operating temperature of 32°
- Simple (no) → Requires no tools (yes)

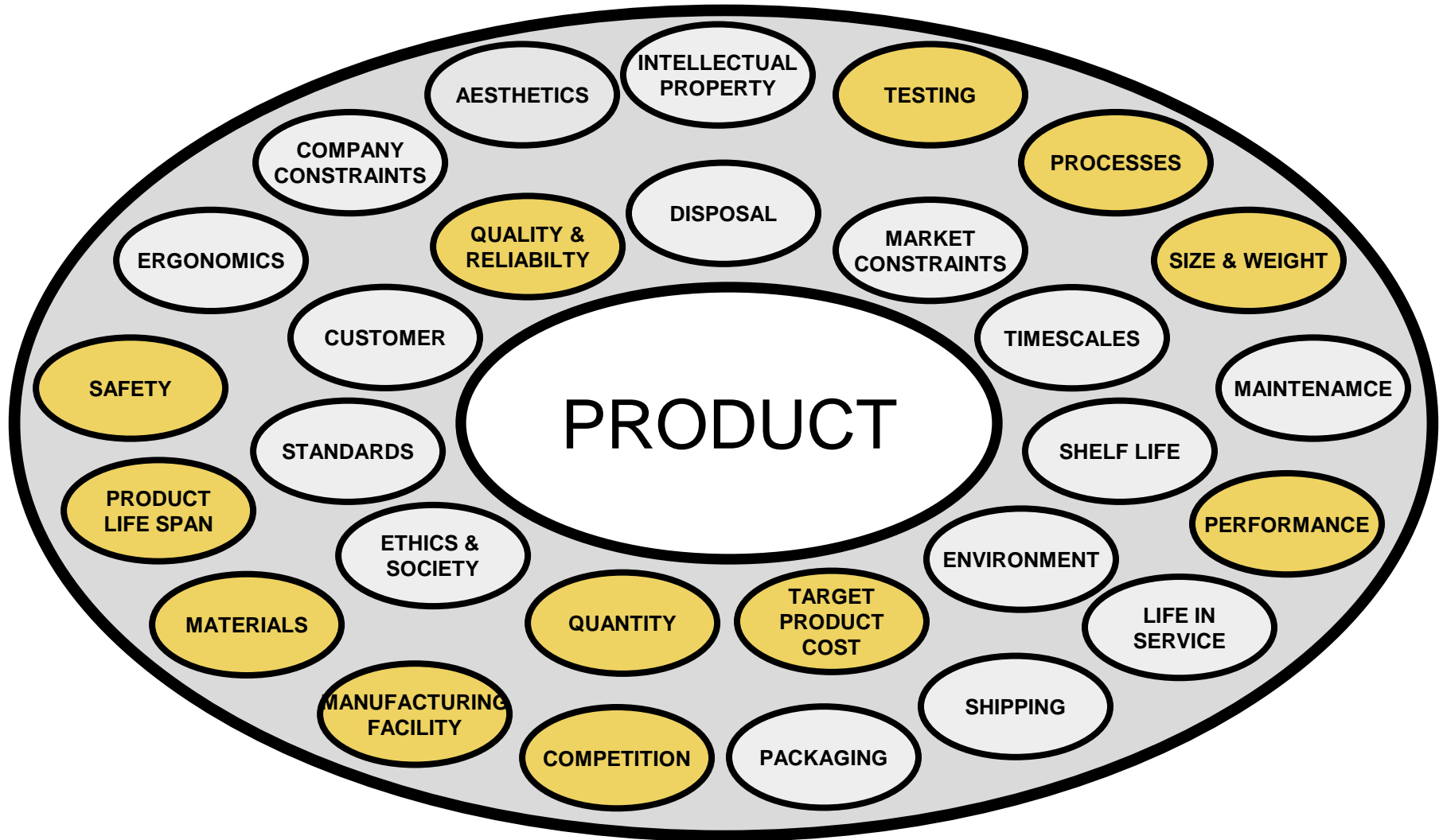
Primary Elements of PDS



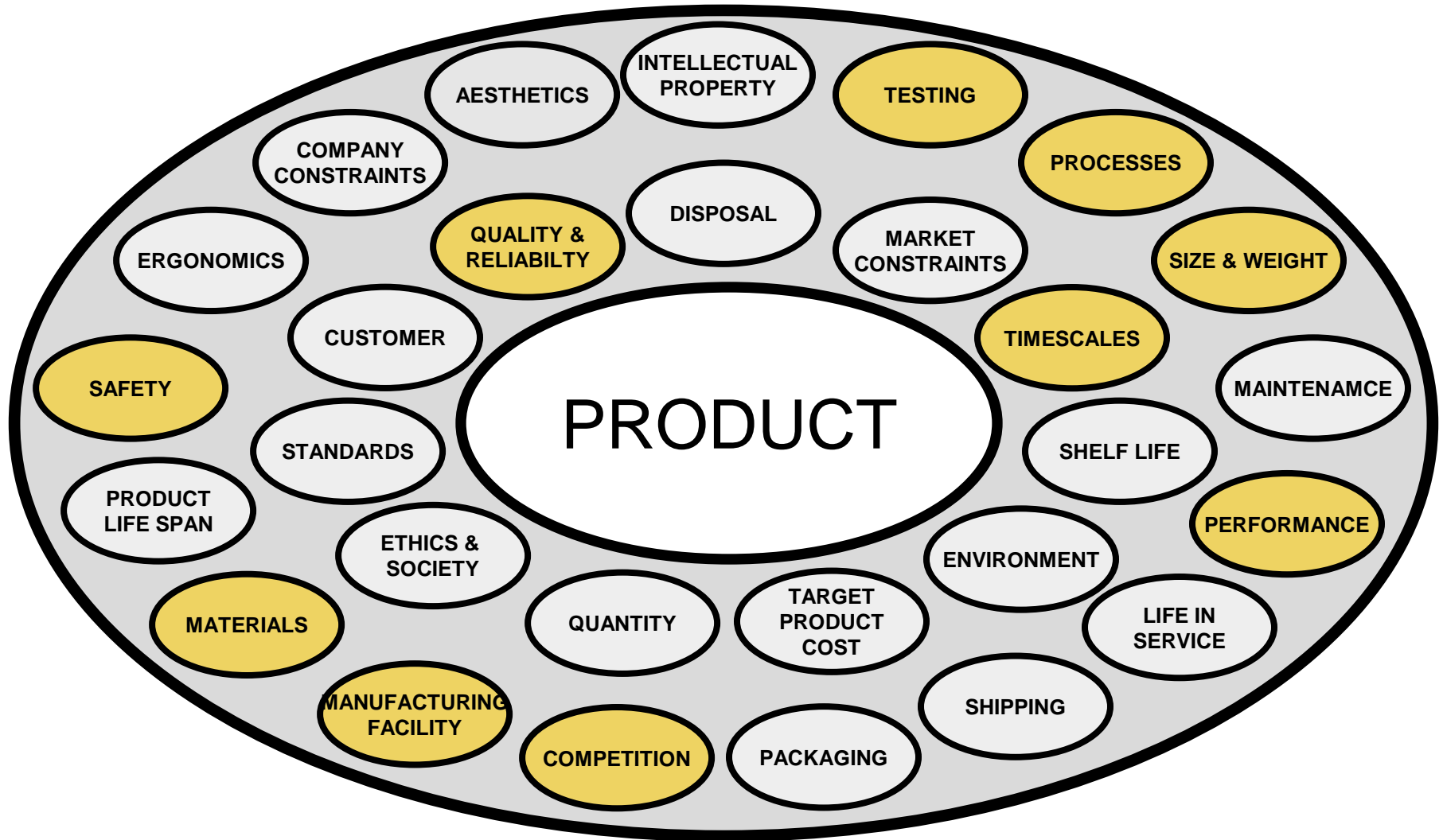
Primary Elements of PDS – ME 170



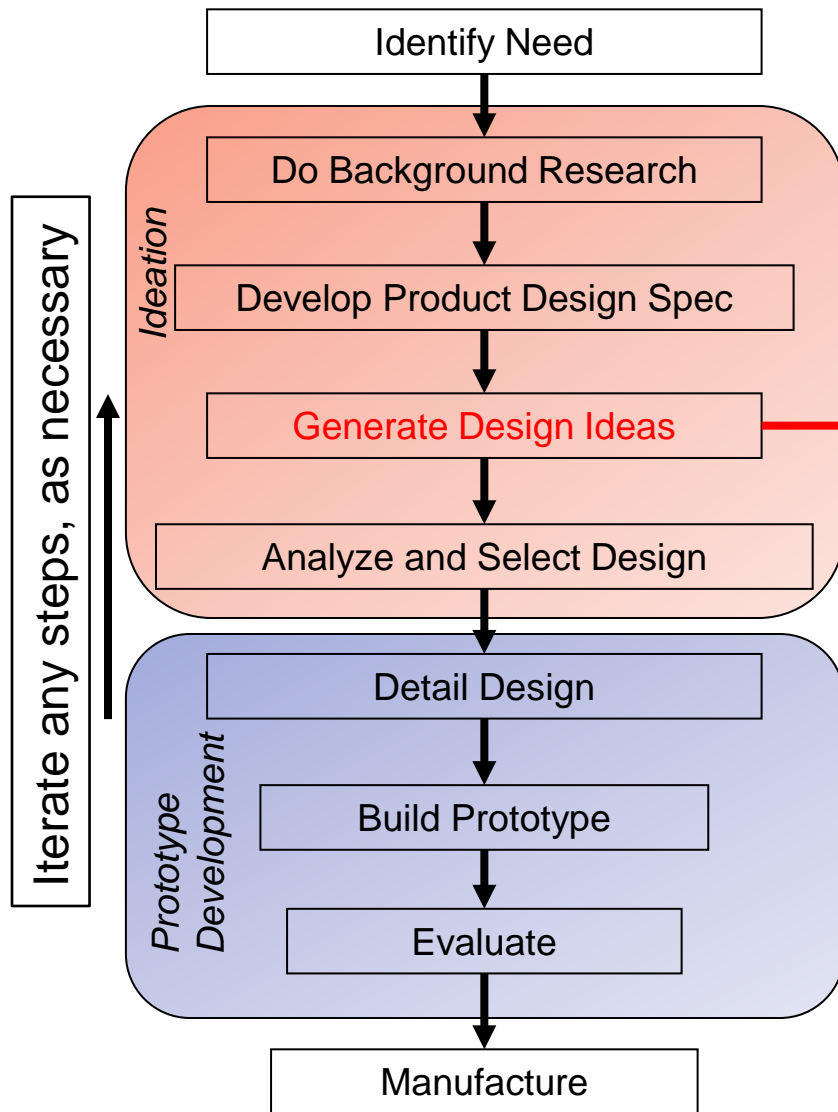
Primary Elements of PDS – ME 270



Primary Elements of PDS – ME 370



Stages of the Design Process



Generate Design Ideas

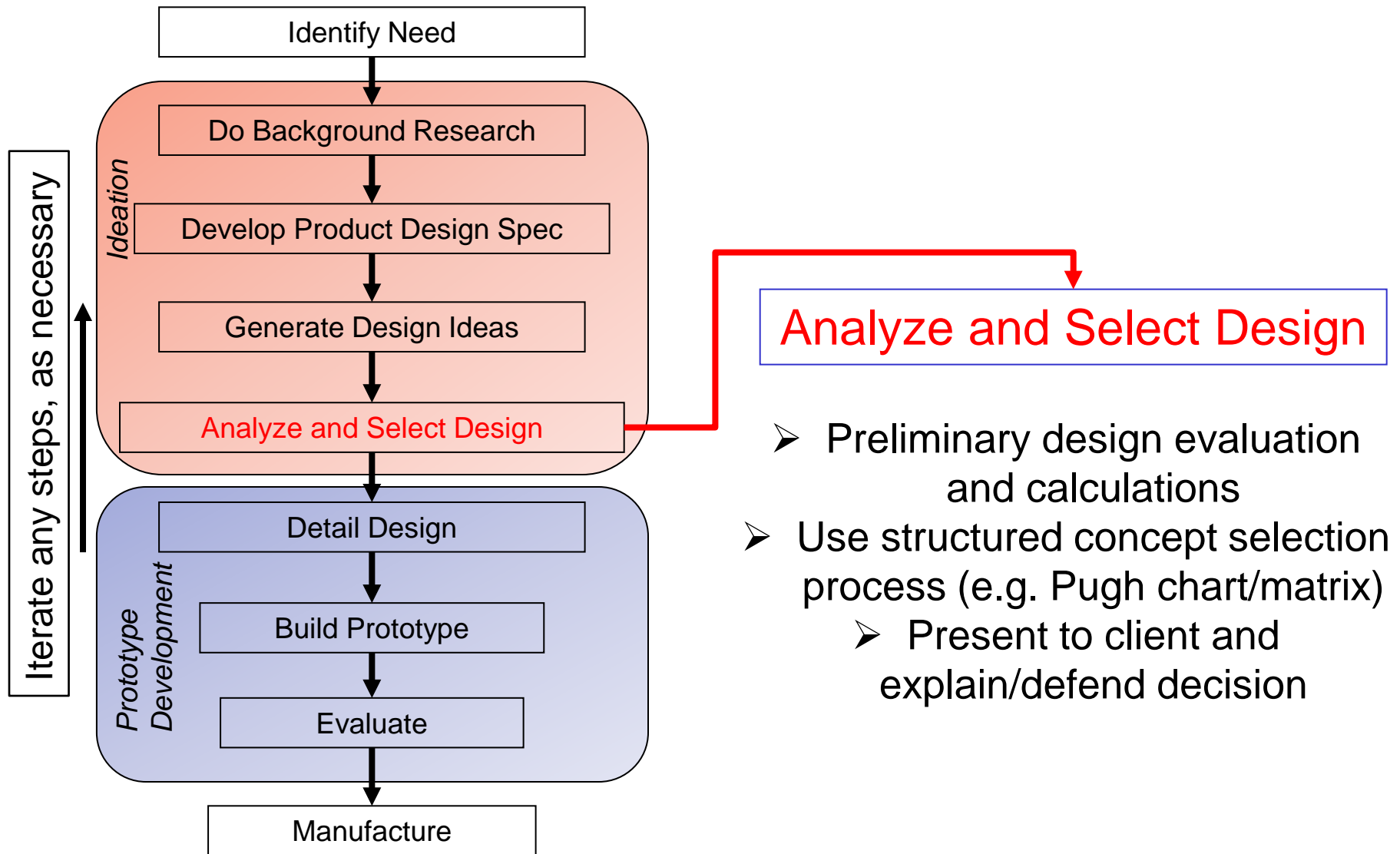
Idea generation:

- BRAINSTORMING – individual and as a team
 - Post Its (organizing your ideas)
- SKETCH IDEAS – initial simple 2D, then Refine to 3D
- Rough Prototyping with expendable materials (e.g. paper, card board, foam),

Rules of Ideation

- No criticism or ridicule
- Free flow of ideas
- Record ALL suggestions
- Do not prejudge idea

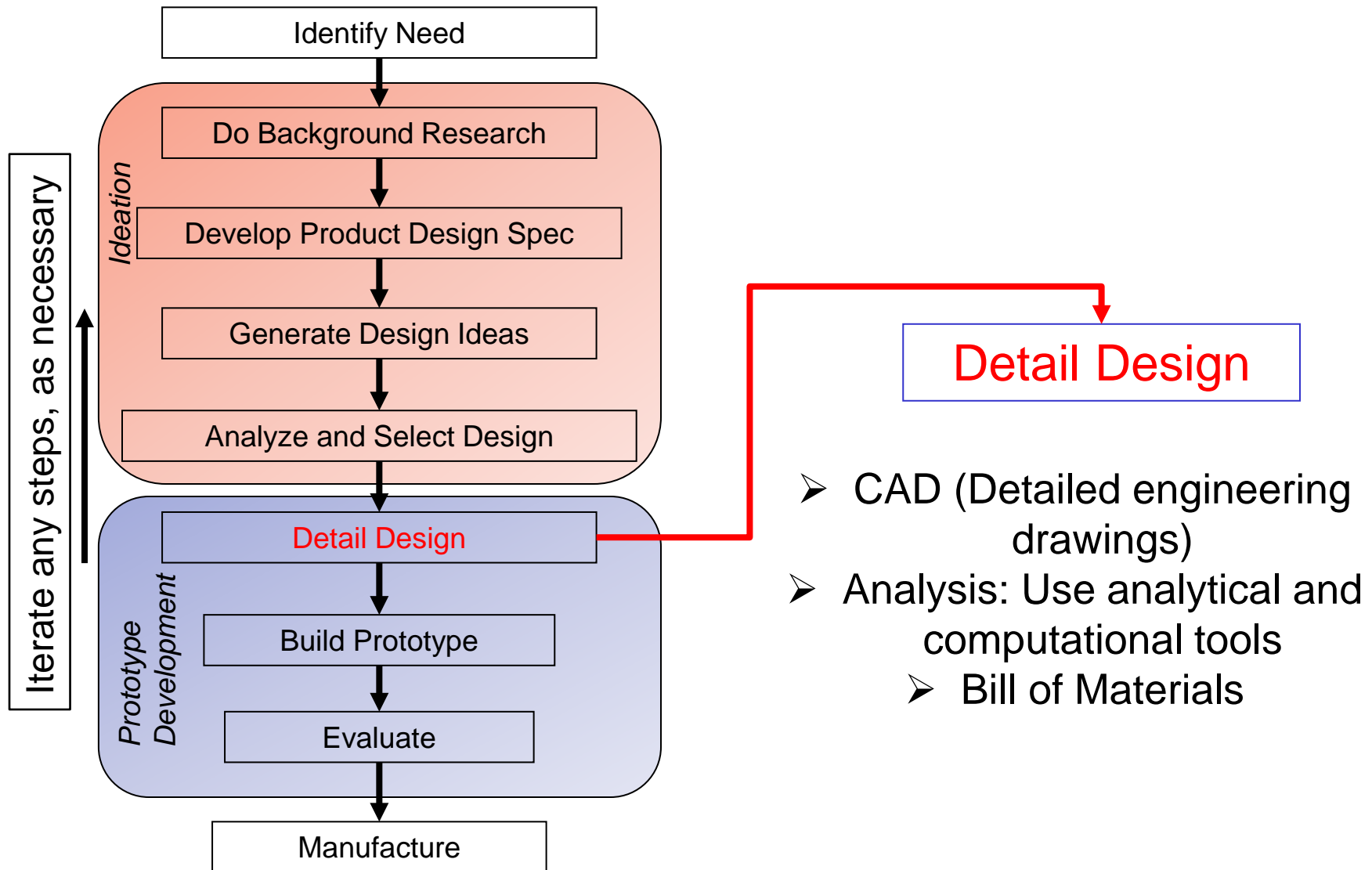
Stages of the Design Process



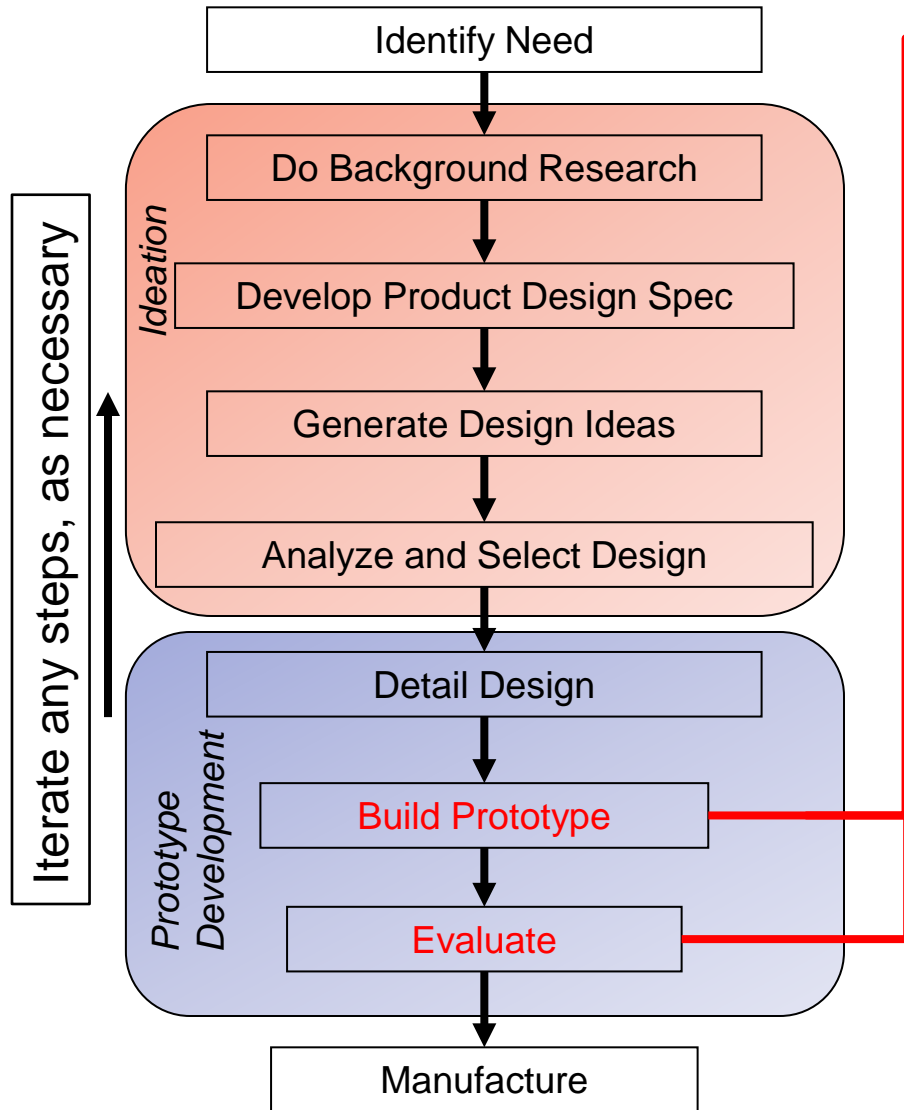
Example Pugh Chart

| CONCEPT \ CRITERIA | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|--|---|----------|----------|---|----------|----------|----------|-----------|-----------|----------|-----------|-----------|----------|----------|
| Ease of achieving 105-125 DbA | | S | - | | + | - | + | + | - | - | - | - | S | + |
| Ease of achieving 2000-5000 Hz | | S | S | N | + | S | S | + | S | - | - | - | S | + |
| Resistance to corrosion, erosion and water | | - | - | O | S | - | - | S | - | + | - | - | - | S |
| Resistance to vibration, shock, acceleration | D | S | - | T | S | - | S | - | - | S | - | - | - | - |
| Resistance to temperature | A | S | - | | S | - | - | - | S | S | - | - | S | S |
| Response time | T | S | - | | + | - | - | - | - | S | - | - | - | - |
| Complexity: number of stages | U | - | + | E | S | + | + | - | - | - | - | + | + | - |
| Power consumption | M | - | - | V | + | - | - | + | - | - | - | - | S | + |
| Ease of maintenance | | S | + | A | + | + | + | - | - | S | + | + | S | - |
| Weight | | - | - | L | + | - | - | - | S | - | - | - | - | + |
| Size | | - | - | U | S | - | - | - | - | - | - | - | - | - |
| Number of parts | | S | S | A | + | S | S | - | - | + | - | - | S | - |
| Life in service | | S | - | T | + | - | S | - | - | - | - | - | - | - |
| Manufacturing cost | | - | S | E | - | + | + | - | - | S | - | - | - | - |
| Ease of installation | | S | S | D | S | S | + | - | S | - | - | - | S | - |
| Shelf life | | S | S | | S | S | - | - | S | S | S | S | S | S |
| FIGURE 4.4 | | 0+ 6- | 2+ 9- | | 8+ 1- | 3+ 9- | 5+ 7- | 3+ 12- | 0+ 11- | 2+ 8- | 2+ 13- | 2+ 13- | 0+ 8- | 4+ 9- |

Stages of the Design Process



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Prototyping and Evaluation:

- Measure performance
 - Does it work as predicted?
- Compare against design specs & pre-set metrics
- Redesign prototype as necessary
- Debug prototype and manufacturing processes.
- Determine prototype vs. production cost ... is it scalable?

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