



CHAPTER 02

What is Design?



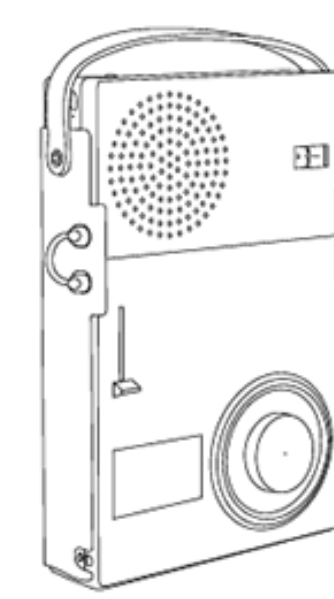


WHAT IS DESIGN?

Make a list: Identify 4-5 things which define or describe design. Consider the engineering context!

WHAT MAKES A GOOD DESIGN?

- Inclusive
- Stress-free
- Intuitive
- Solves the problem
- Sustainable
- Friendly
- Satisfies the senses
- Appropriate to the environment



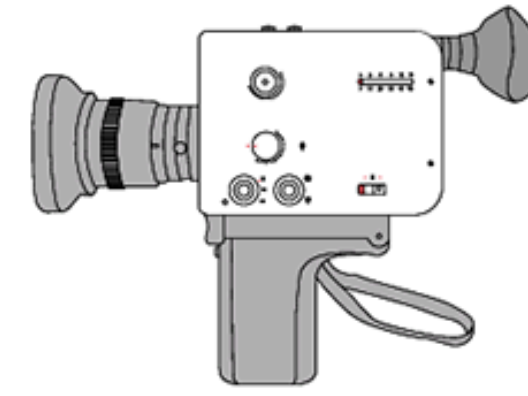
1 Good design is innovative.

The possibilities for innovation are not, by any means, exhausted. Technological development is always offering new opportunities for innovative design. But innovative design always develops in tandem with innovative technology, and can never be an end in itself.



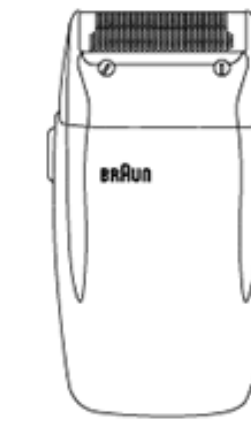
2 Good design makes a product useful.

A product is bought to be used. It has to satisfy certain criteria, not only functional, but also psychological and aesthetic. Good design emphasizes the usefulness of a product whilst disregarding anything that could possibly detract from it.



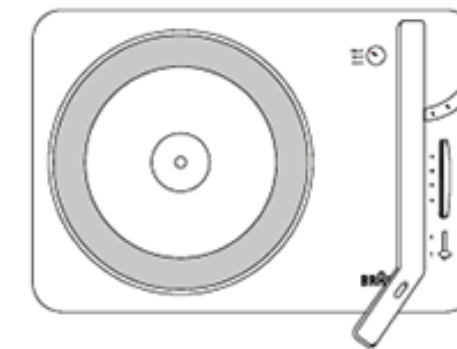
3 Good design is aesthetic.

The aesthetic quality of a product is integral to its usefulness because products we use every day affect our person and our well-being. But only well-executed objects can be beautiful.



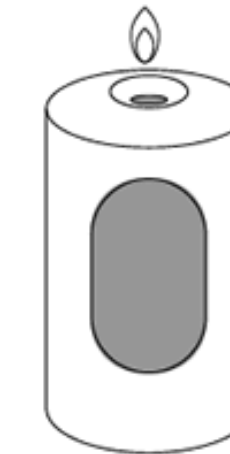
4 Good design makes a product understandable.

It clarifies the product's structure. Better still, it can make the product talk. At best, it is self-explanatory



5 Good design is unobtrusive.

Products fulfilling a purpose are like tools. They are neither decorative objects nor works of art. Their design should therefore be both neutral and restrained, to leave room for the user's self-expression.



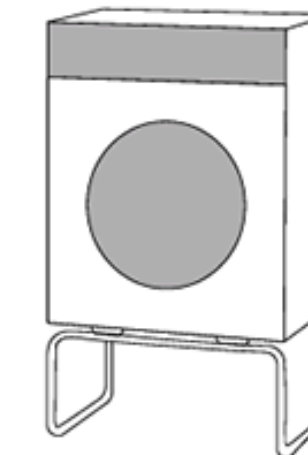
6 Good design is honest.

It does not make a product more innovative, powerful or valuable than it really is. It does not attempt to manipulate the consumer with promises that cannot be kept.



7 Good design is long-lasting.

It avoids being fashionable and therefore never appears antiquated. Unlike fashionable design, it lasts many years – even in today's throwaway society.



8 Good design is thorough to the last detail.

Nothing must be arbitrary or left to chance. Care and accuracy in the design process show respect towards the user.



9 Good design is environmentally friendly.

Design makes an important contribution to the preservation of the environment. It conserves resources and minimizes physical and visual pollution throughout the lifecycle of the product.



10 Good design is as little design as possible.

Less, but better – because it concentrates on the essential aspects, and the products are not burdened with non-essentials. Back to purity, back to simplicity.



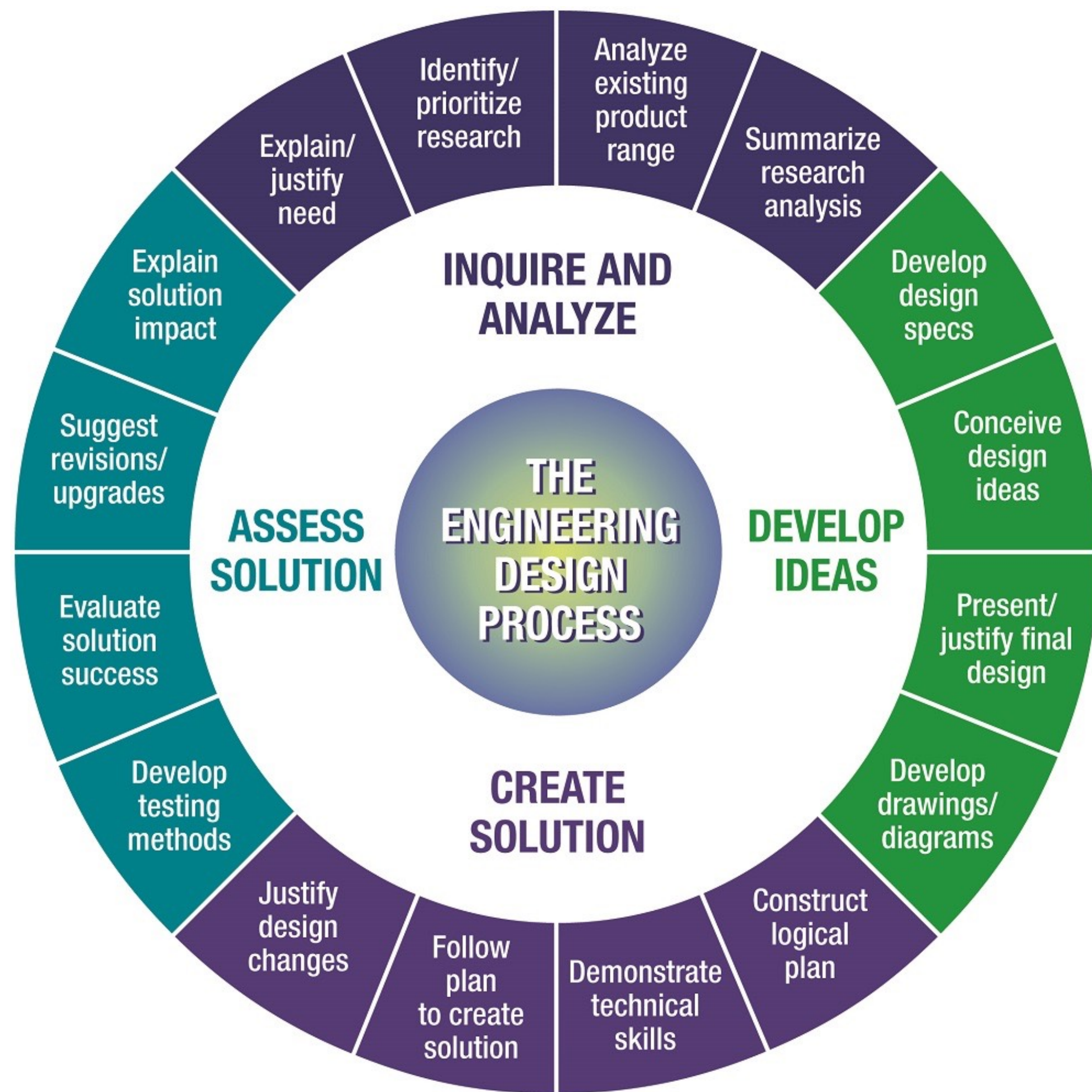
THE ENGINEERING DESIGN PROCESS IS...

- Creative
- Problem solving
- Seeing the big picture...and the smallest details
- Open-ended: There's no single "correct" solution
- Encompassing: Technical aspects are only a small part



ELEMENTS OF THE DESIGN PROCESS

- Recognize the need
- Define the problem
- Plan the project
- Conceptualize alternate approaches
- Evaluate the alternatives
- Select the best alternative
- Communicate the design
- Implement the preferred solution



DEFINE THE PROBLEM

- “Define the problem” means many things
- Mostly, it means “define the real problem”
- Design failures can often be traced to inadequate or incomplete problem formulation
- Cost of change increases as design progresses



America's taste just got better.

So much better you won't believe it.

We're rushing to bring you the
greatest Coca-Cola® you ever had!

Get set for a surprise.

It's Coke – all Coke – but a giant step better.

Better tasting. Smoother feeling.

More refreshing, more inviting than ever.

New Coca-Cola will soon be dressed in its
brand-new best. Meanwhile, look for cans and
bottles marked “NEW!” That's your Coke.

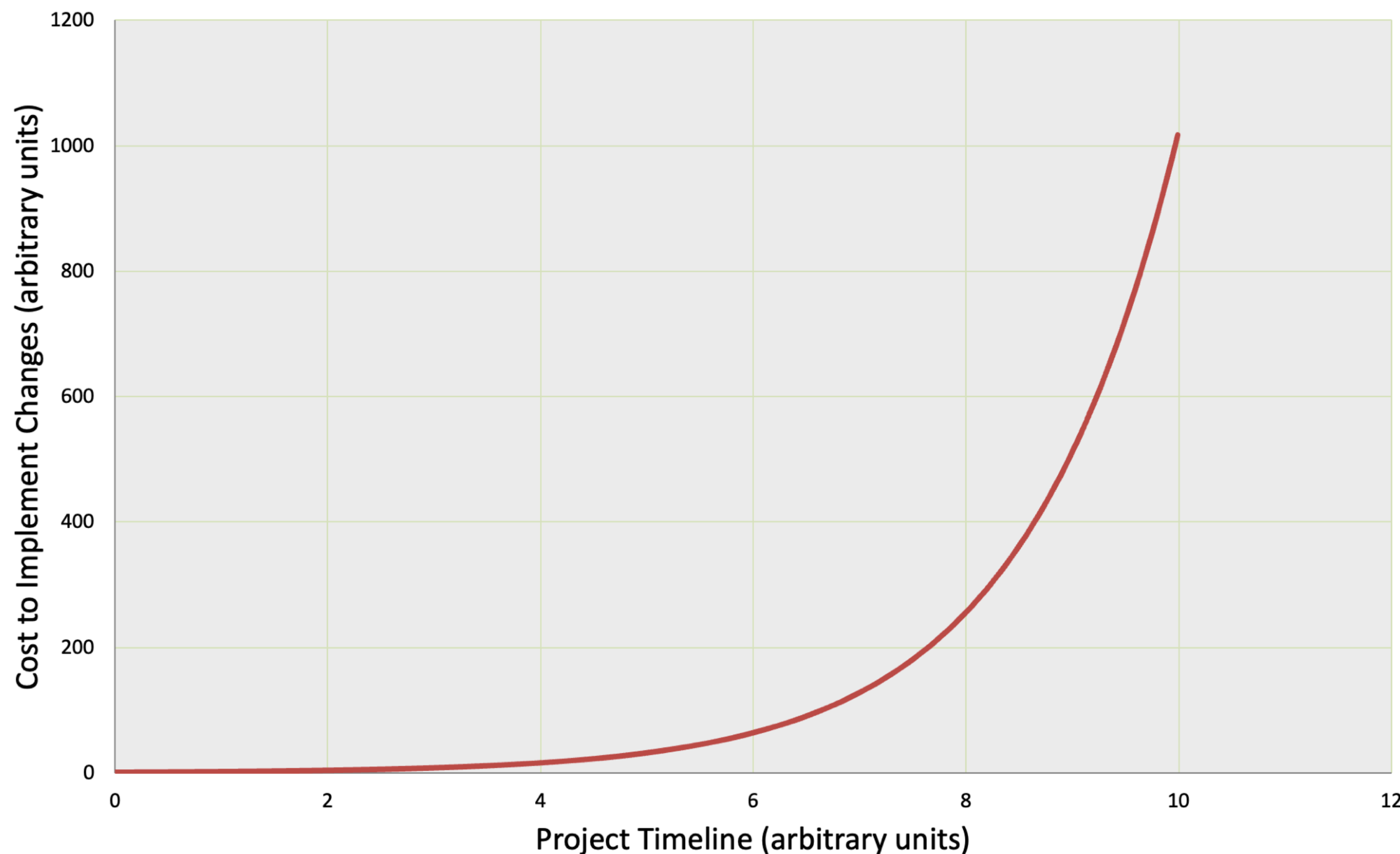
Now, more than ever...

Coke is it!®

THE COST OF DESIGN CHANGES

- Double the time does not equal double the money!
- Not a linear relationship
- Costs increase exponentially as the project lifetime increases

Time is Money



Notice that it only took 3 months for the Coca-Cola Company to get the original drink back on the shelves!



1886
Coca-Cola officially goes on sale; cocaine is an ingredient

1903
Cocaine removed from Coke



1916
Iconic glass bottle design introduced



1923
Coke invents the six-pack



1982
Diet Coke introduced



1985
New Coke launched on April 23
Original Coke brought back on August 11



1992
Coke II launched

2002
Coke II discontinued



2005
Coke Zero introduced



2014
Coke Life introduced



PROBLEM IDENTIFICATION: GOALS

- Brief, general, and ideal statement
- “How are we going to address the need?”
- Example Goal: Design a portable device for listening to music

PROBLEM IDENTIFICATION: CRITERIA VS. CONSTRAINTS

- Criteria are quantifiable objectives which must be met in order to satisfy a challenge/need
- **Criteria** are what you **must** do
- Constraints are factors that limit how you can solve a problem
- **Constraints** are what you **cannot** do





DESIGN CRITERIA

An iPod must <fill in criterion>, or it does not succeed as a product

Make a list: Identify at least 4-5 criteria for an optimum digital music player

- Play music
- And??

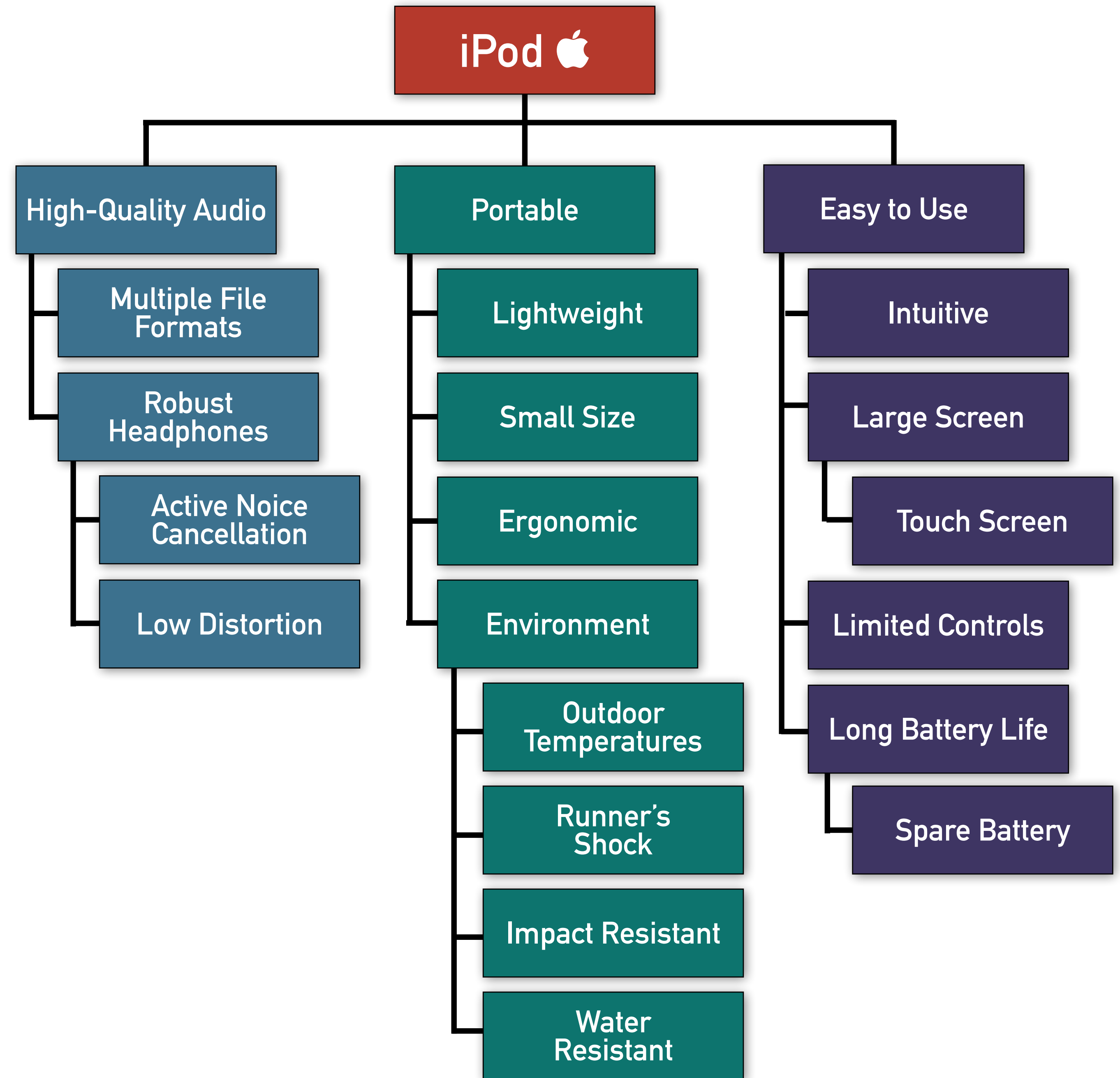
NEEDS IDENTIFICATION



- What is the problem?
 - Collect information
 - Interpret information
 - Organize a needs hierarchy: Determine the relative importance of needs
- Needs may be either criteria or constraints!

IPOD NEEDS HIERARCHY

Check the shared spreadsheet
for the hierarchy we created!



CONSTRAINTS

An iPod cannot
<fill in constraint>

- Economic
- Environmental
- Ethical and Legal
- Health and Safety
- Manufacturability
- Political and Social
- Sustainability



Make a list: Identify at least one example of each of the categories of constraint shown on the left

REQUIREMENTS SPECIFICATION



- Identifies requirements design must satisfy for success
 - **Engineering:** Technical aspects, performance specifications
 - **Manufacturing:** Existing infrastructure, materials availability
 - **Marketing:** Customer needs, how to communicate product to the people who need or want it



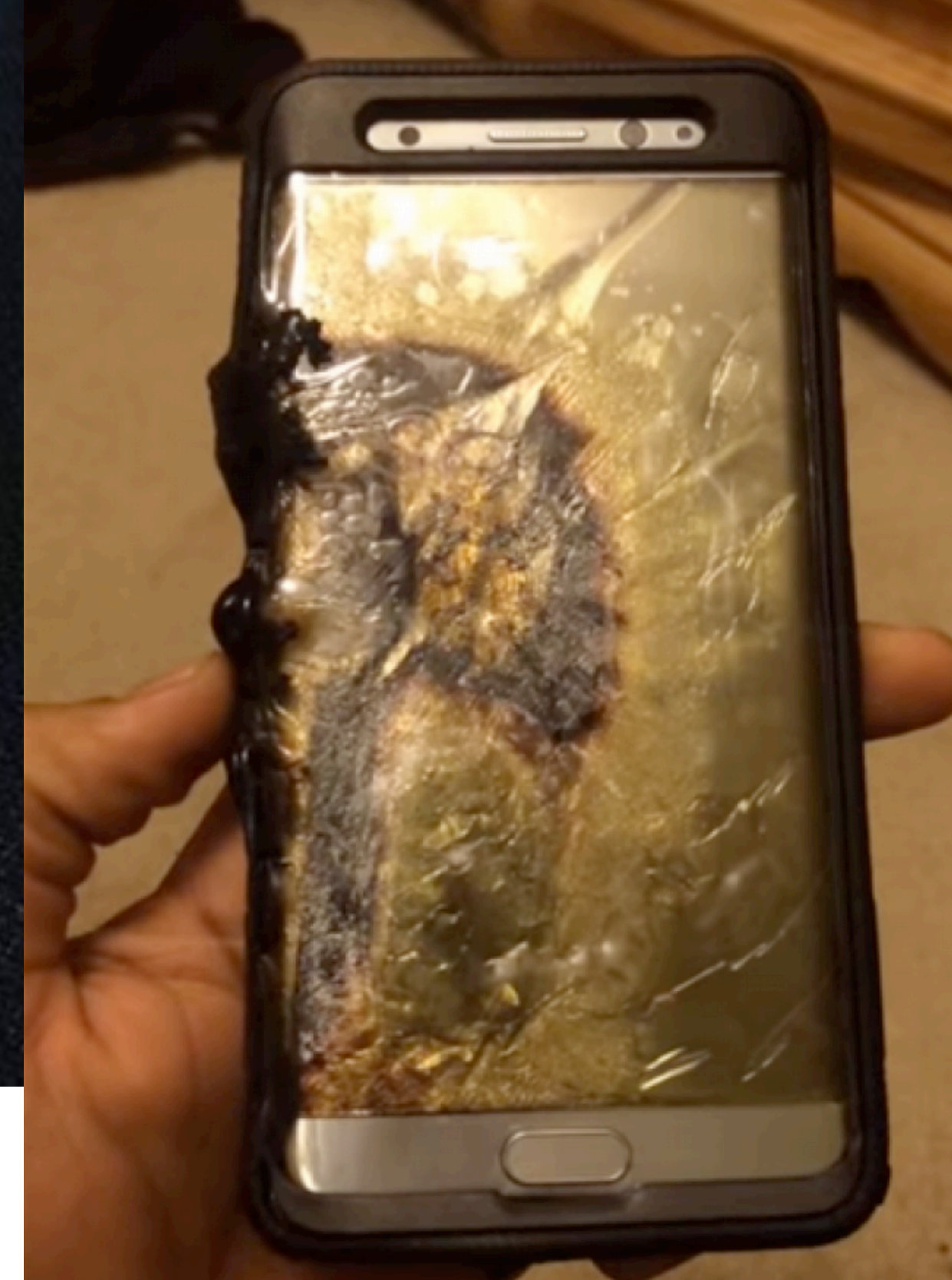
EXAMPLE ENGINEERING REQUIREMENTS

- Functionality
- Performance
- Reliability
- Energy Use
- Effective Lifespan

Make a list: Identify at least one example requirement for each of the categories of requirements shown above

GOOD DESIGN VS BAD DESIGN

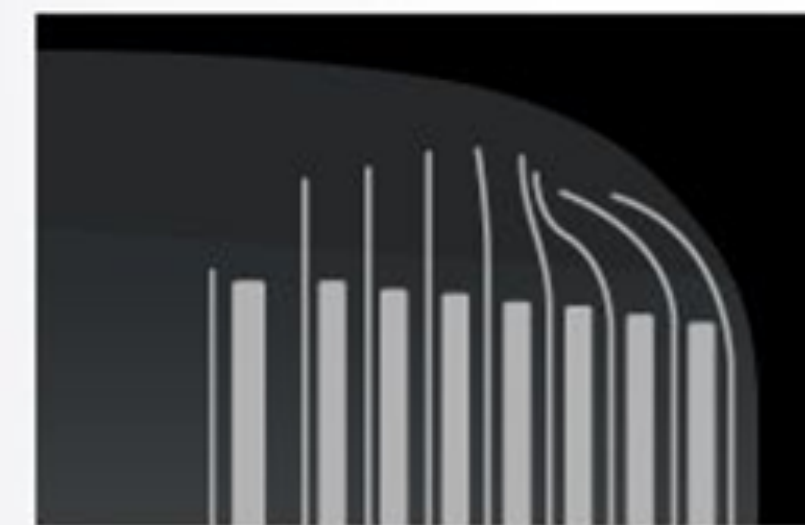
- Meets all technical requirements
- Works all the time
- Meets cost requirements
- Requires little or no maintenance
- Is safe
- Creates no ethical dilemma



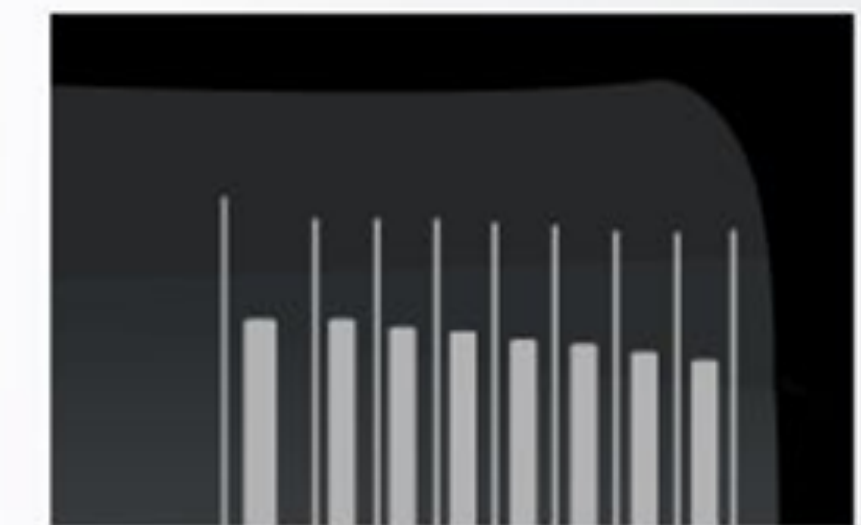
Abnormal

Normal

Main Cause



The negative electrode was deflected in the upper-right corner of the battery



The negative electrode is not deflected

CONCEPT GENERATION



AND EVALUATION

- Explore many solutions
 - Train-of Thought
 - Brainstorm
- Exercise creativity
- Seek innovation
- Choose the best solution
 - Base selection on needs and constraints

HOW TO BRAINSTORM

3. CREATIVE IDEATION

Most creative ideas generated from new, divergent thoughts, breaking free from existing conventions or obvious context.

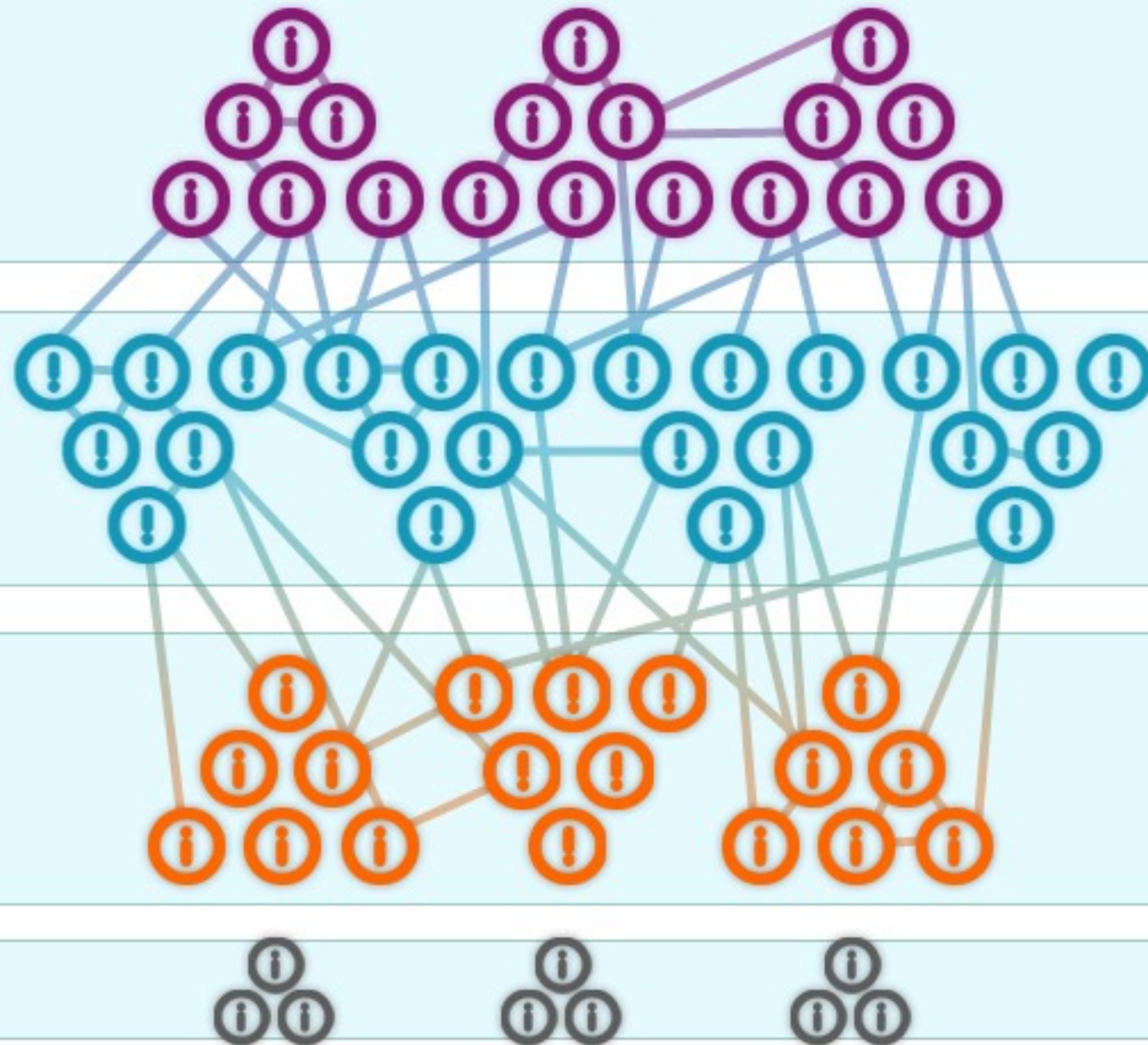
2. DIVERGENT THINKING

Ideas inspired by one or two 'obvious' thoughts generated by the braindump, as well as new insights inspired by creative 'flow'

1. THE BRAINDUMP

More or less spontaneous ideas generated within close personal or obvious context

0. WARMING UP



- No holding back: Any idea may be brought to the floor at any time
- No boundaries: An idea is never too outrageous to mention
- No dismissing: An idea may not be discounted until after group discussion
- No restrictions: Participants may generate ideas from any field of expertise
- No limit: Another idea is never one too many.
- No criticizing: An idea may not be criticized until the final discussion phase
- No shame: A team participant should never be made to feel embarrassed for contributing an idea

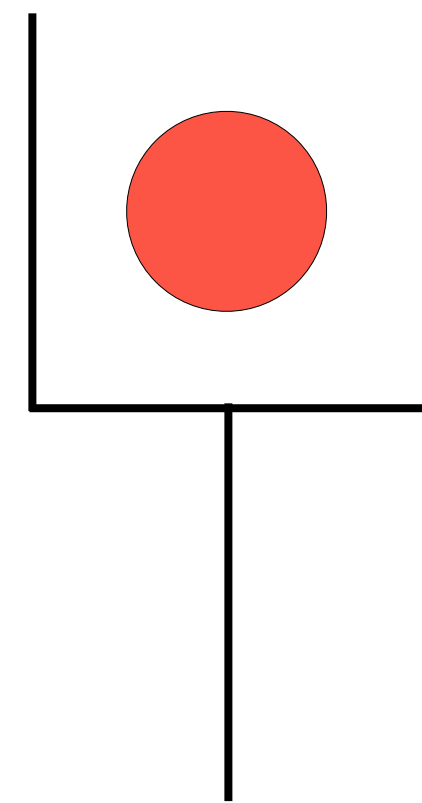
BARRIERS TO CREATIVITY



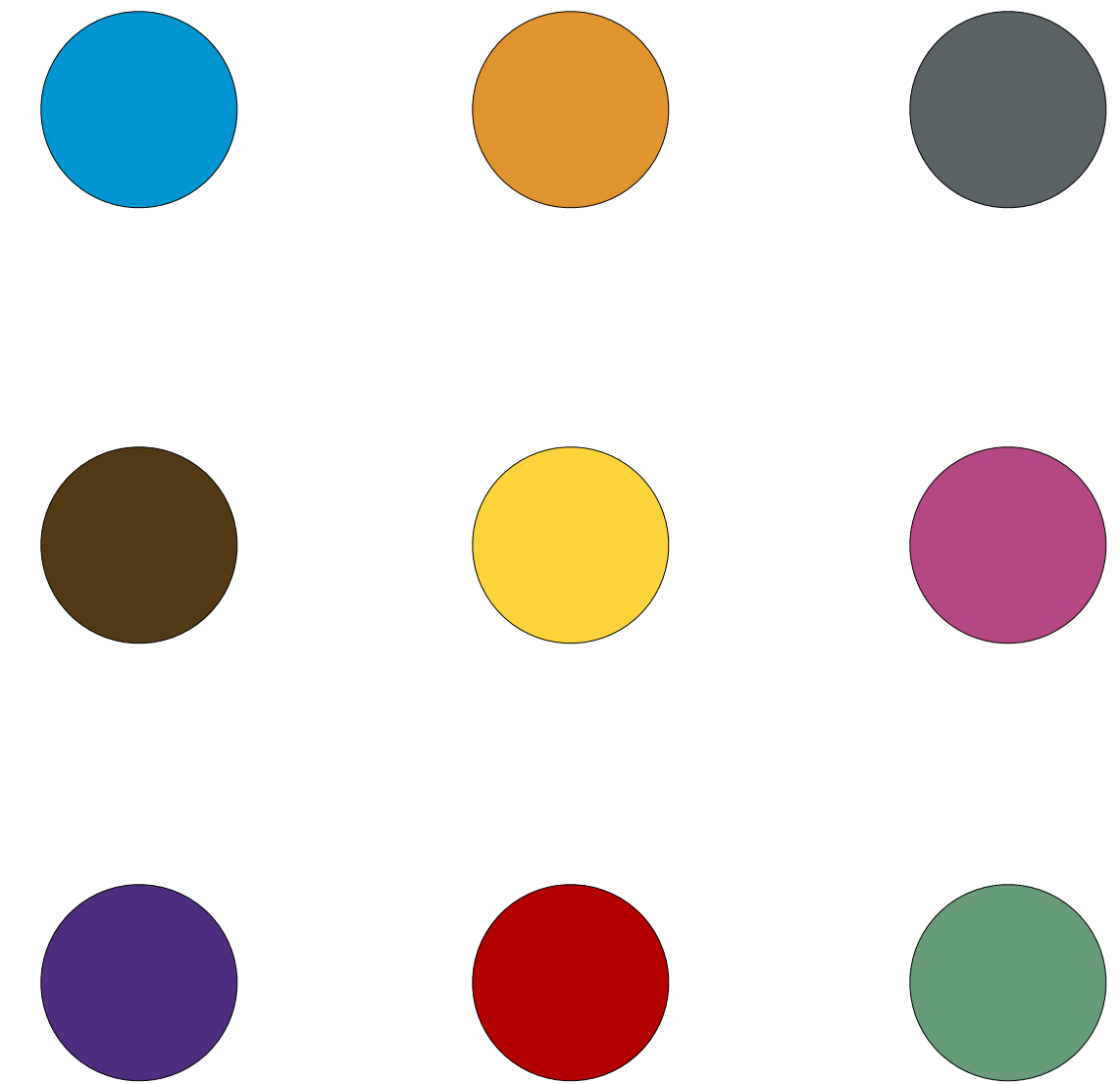
- Perceptual blocks
 - Limiting problem space
- Emotional blocks
 - Fear of failure – “fail early and often”
- Environmental blocks
 - Engineering cultural bias
- Intellectual or expressive blocks
 - Understanding the tools

STRATEGIES TO ENHANCE CREATIVITY

- Question
- Practice
- Allow time
- Suspend judgment
- Lateral thinking
- Think like a beginner



Shovel Problem:
Move only two lines
so that you still have
a shovel, but you are
not scooping the
coin.



Nine-Dot Problem: Connect
the dots using only 4 lines;
do not cross any dot more
than once (lines can cross)

NINE DOTS, TWO WAYS

