

concept creation

# Riverton and District High School



## Systems Engineering



# What is a “System”



- The collins Concise Dictionary, 5<sup>th</sup> Edn (2001):
  - 1. “a group or combination of interrelated, interdependent or interacting elements forming a collective entity” – *a railroad system, the digestive system, a business information system, an exploration system;*
  - 2. “any assembly of electronic, mechanical, etc., components with interdependent functions, usually forming a self-contained unit” – *a communication system, a telemetry system*



# NASA Mars Exploration Rover System



- Watch this video simulation of the recent Mars Exploration Rover (9 mins)
- While you watch, think about the “system”
- Is a group of interrelated, interdependent and/or interacting elements forming a collective entity?
- If you were “designing” this system, what sort of things would you need to think about?



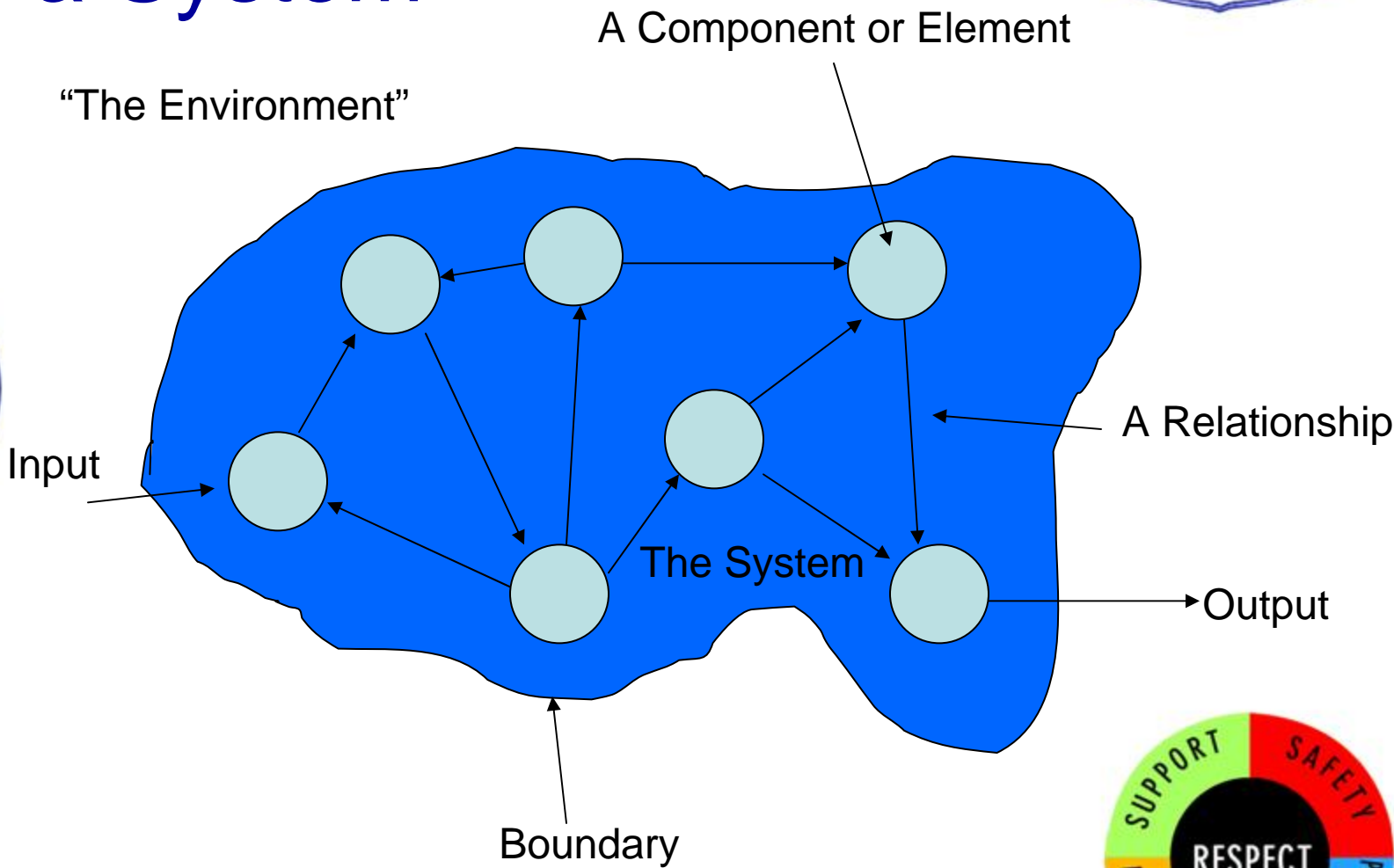
# Key System Contacts



- **Holism** – the need to consider the whole entity when reasoning, designing, analysing
  - **Hierarchy** – a system comprises identifiable parts which are in turn often composed of identifiable parts
  - **Complexity** – systems are inherently complex
  - **Emergence** – systems are more than the sum of their parts
  - **Synergy** – requires interaction between the parts
  - **Interdependence** – the value added by the system is created by the relationships among the parts; i.e. how they are interconnected
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- Can you recognise these in the Mars Rover?
  - Can you see how these relate to your project?



# A General Concept of a System



# Is Your Project a System?



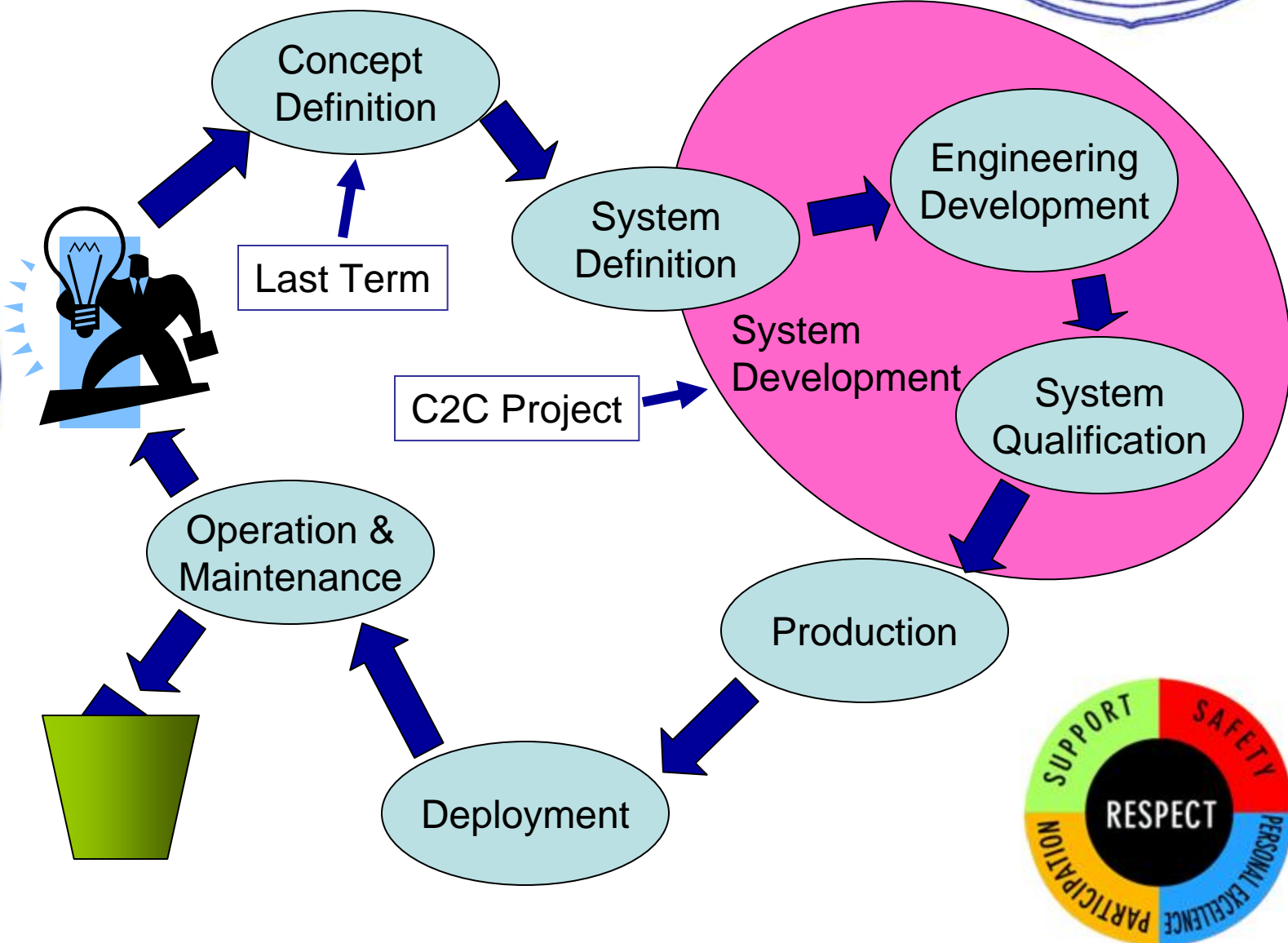
- Will it exist within an external environment?
- Will it receive inputs from that environment?
- Will it send outputs to that environment?
- Will it consist of components (sub-systems) that interact in some way?
- Will those components (sub-systems) themselves consist of smaller, interacting parts?
- Will it do things that the sub-systems on their own can't do?
- Is it a “system”



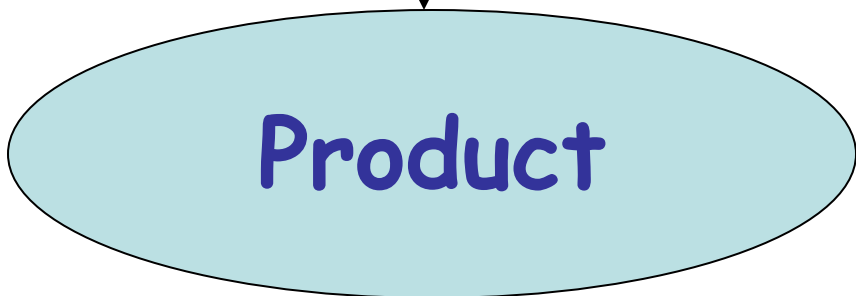
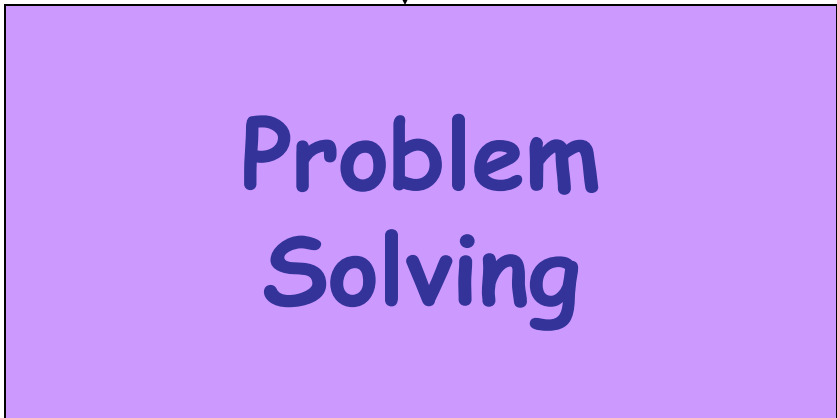


# The System Lifecycle

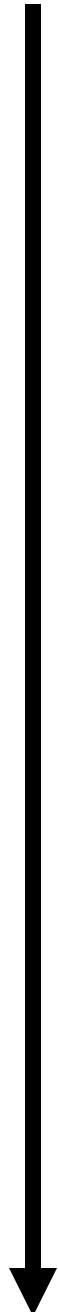
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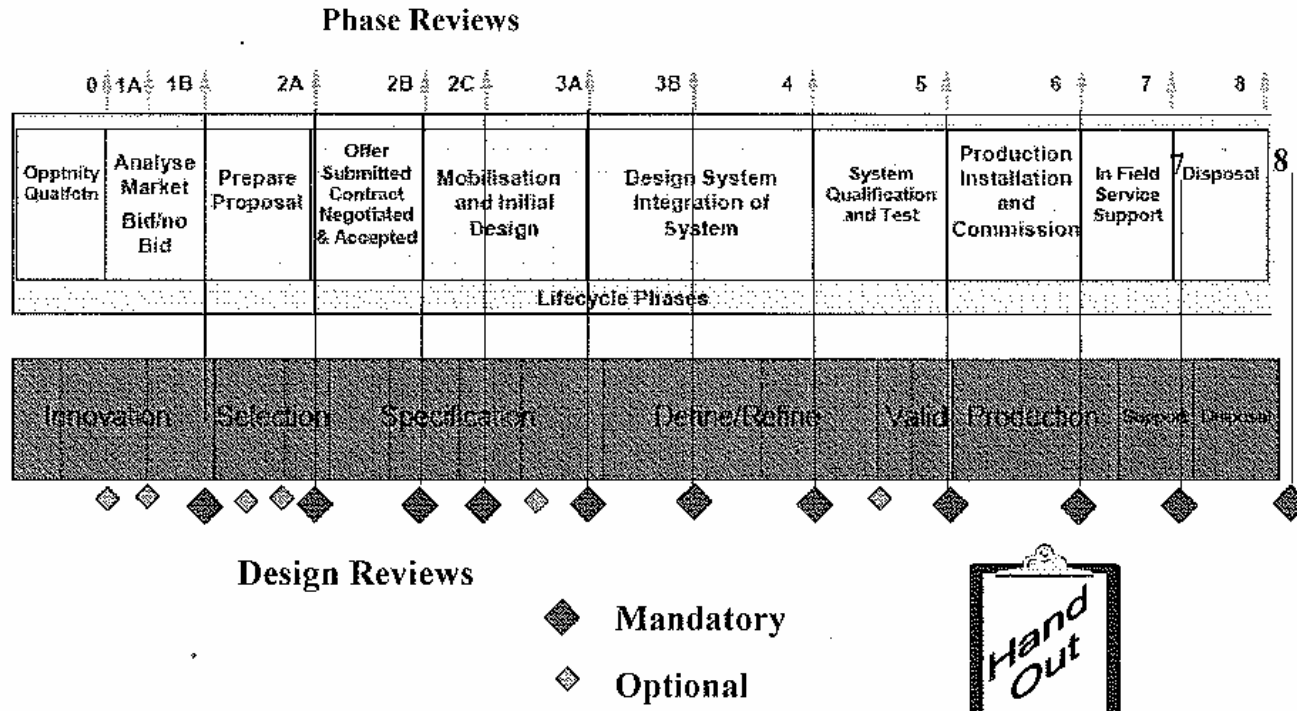
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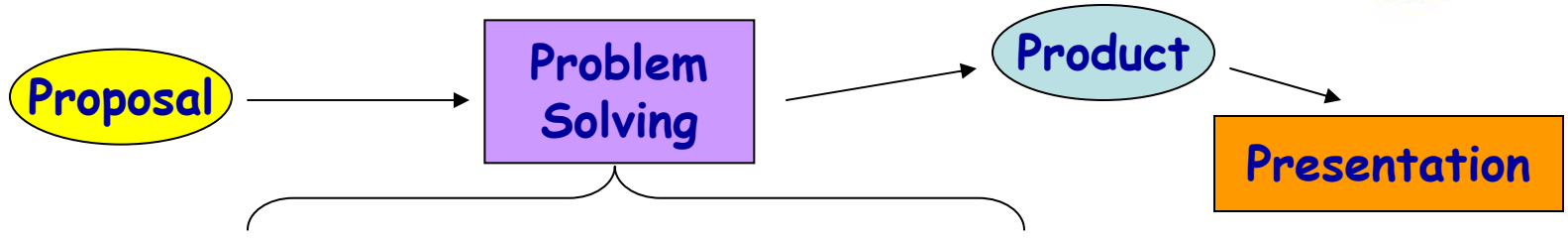
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# The Engineering Lifecycle

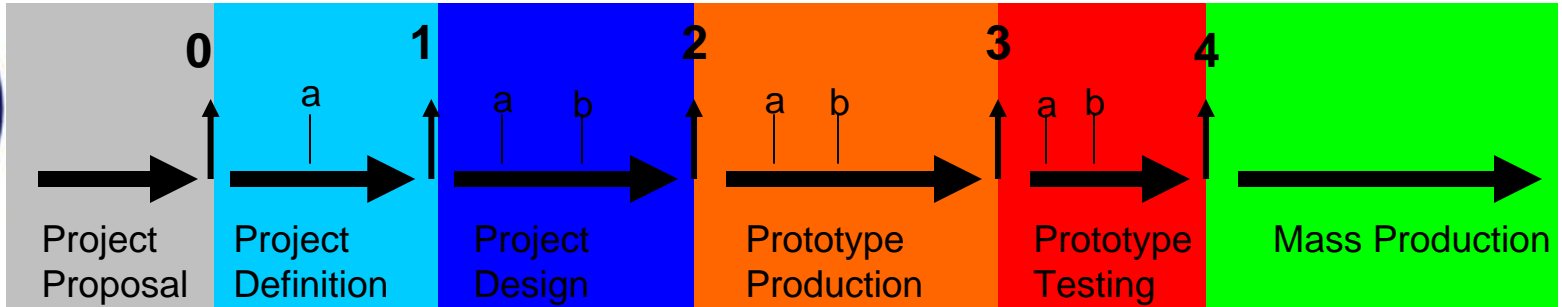


# Phase Diagram



Project Acquired

Expo



2 weeks

1 week

2-3 weeks

6-8 weeks

2 weeks



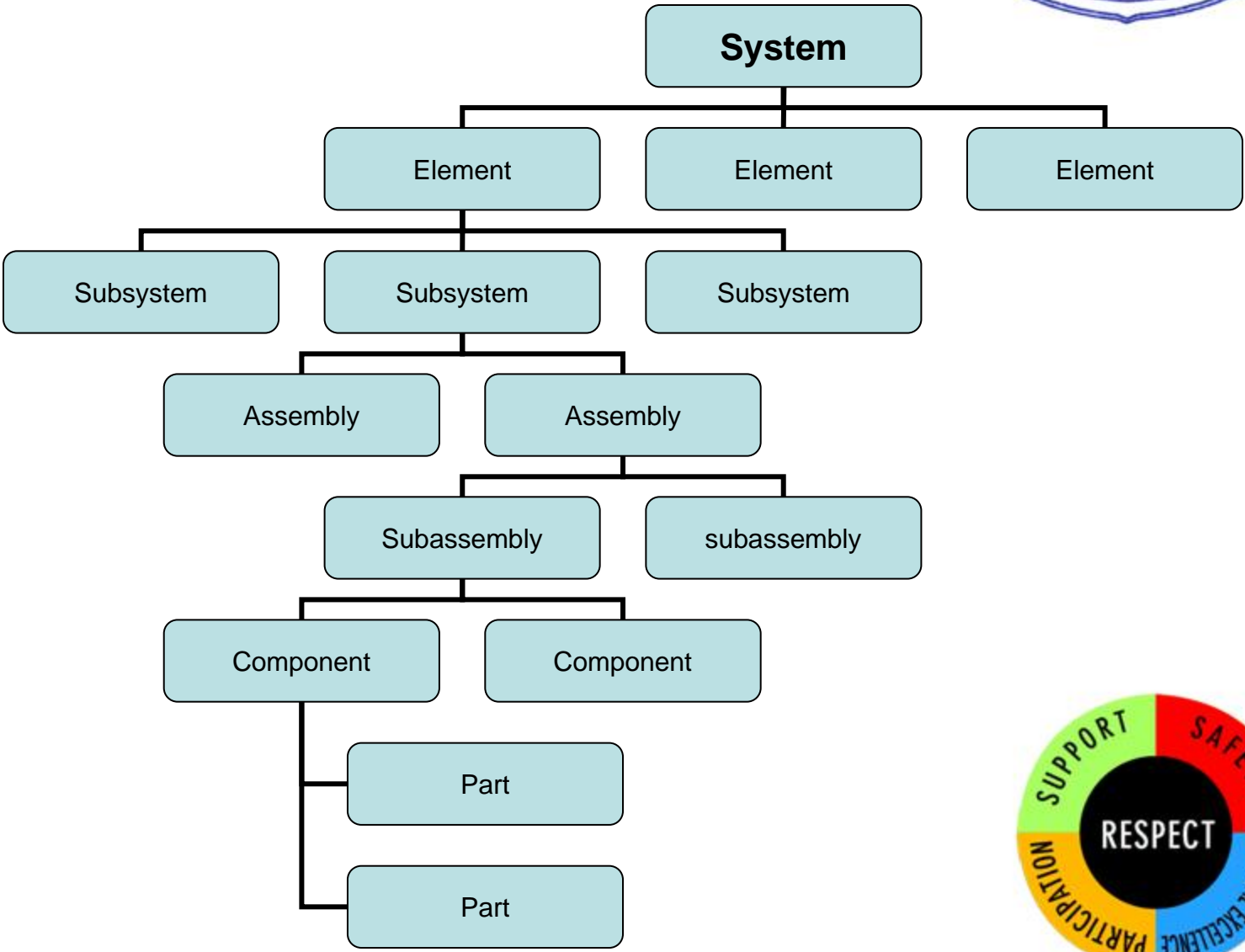
# The System Hierarchy



- System
  - Information System
- Element/Segment
  - Computers, Network, Printers, Data Storage, personal
- Sub-system
  - Data processor, Operating System, Software
- Assembly
- Subassembly
- Components
  - I/O, CPU, RAM, ROM
- Part



# System Hierarchy



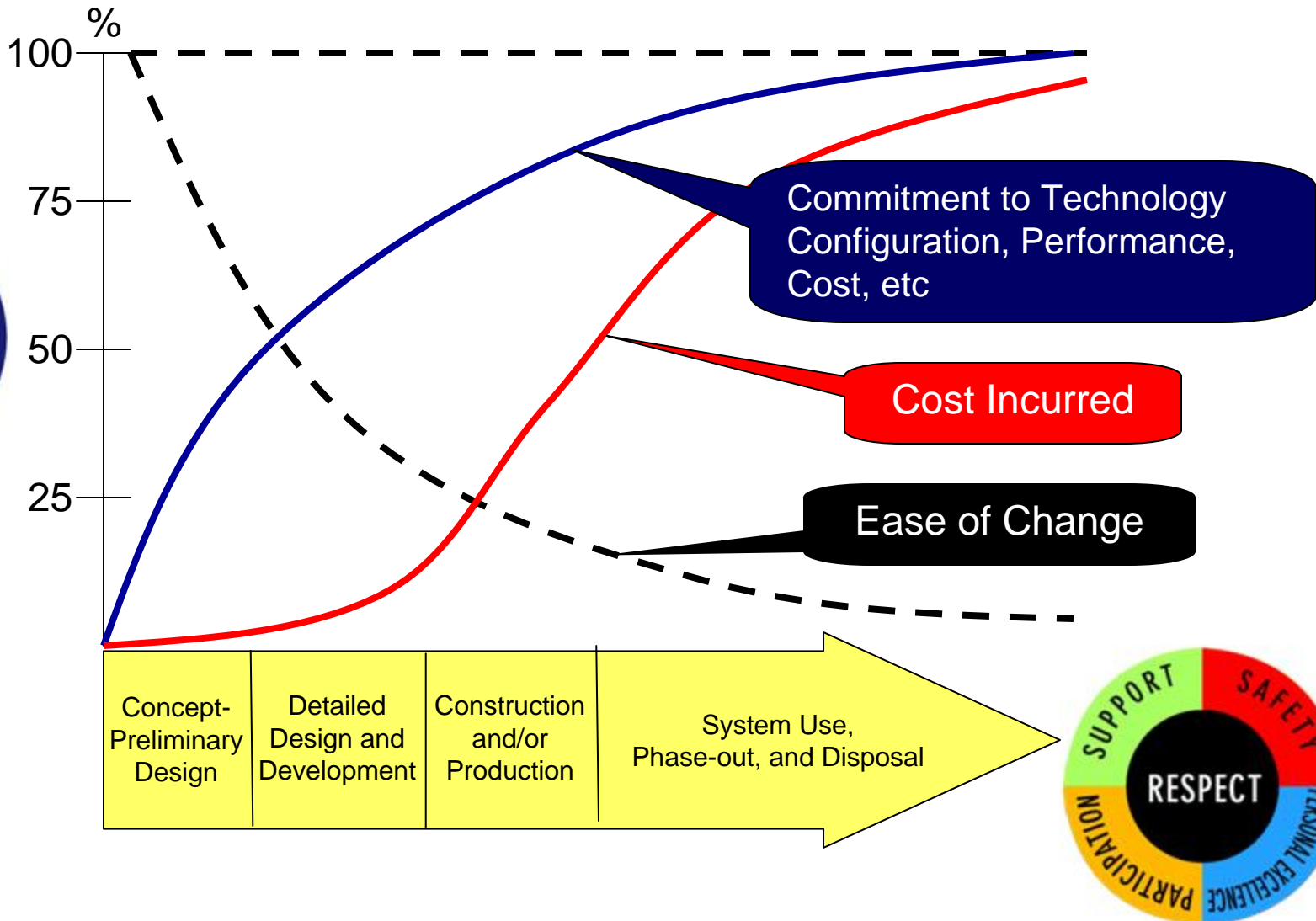
# Creating a System



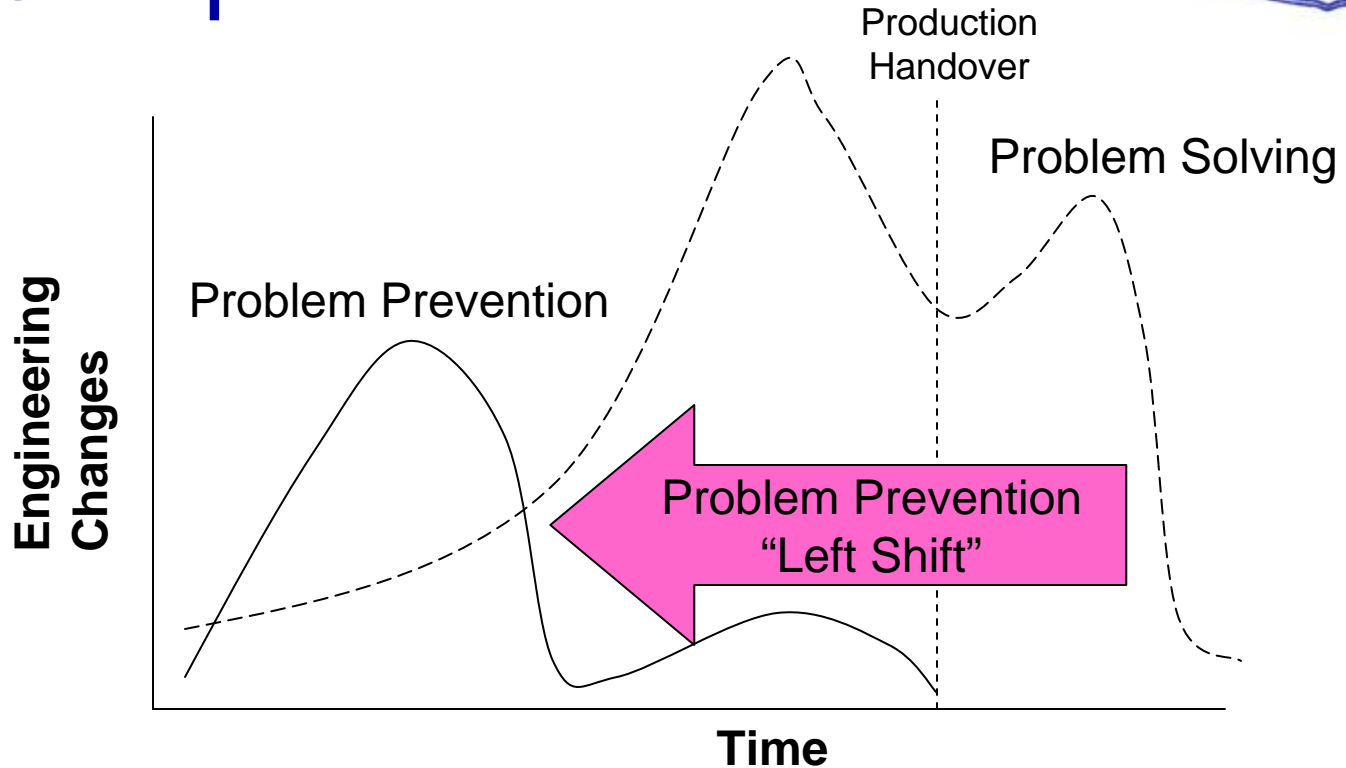
- First step in developing a system:
  - Rush off and start building?
  - Find out more?
  - Mistakes are much cheaper to fix now, before we've build anything, than later, when we've constructed an expensive prototype
- What does the customer really want?
- Your project???
  - Yes, but is that all there is to it?
- **Who** is the customer(s)?



# Characteristics of the system lifecycle



# Engineering Change Comparison



Problem Solving: Waits for errors to cause problems and fire – fights

Problem Prevention: Proactively seeks errors which are removed or their effect minimised



# Needs Analysis - OCD



- Typically start with Operational Concept Definition (OCD):
  - **What** will the operational (working) system do?
  - **Why** does it need to do it (rationale)?
  - **How Well** does it need to do it (performance)?
- But **NOT**: How (no solution yet)
- Project Proposal
- Talking to the customer???
- Thinking, looking, etc?



# Your Go Your Project

- Use the information so far to start describing your system.
  - What
  - Why
  - How Well
- Remember the customer



# Trade Study



- What is out there?
  - Does it meet the customers need?
  - What are the good points?
  - What are the bad points?
  - Can we do it better / cheaper / smaller / bigger, etc?
- Must do before starting to develop the design



# What is a Black Box view?



- Black Box View
  - Can't see in the box (like user)
  - Description of the system in response to interactions with external agents without regard to implementation details.
- Clear description of:
  - Interfaces: Interactions with external agents
  - Environment in which the system needs to perform
  - Functions: Transformation of external inputs into outputs
  - Performance: How well the functions have to perform



# What is a White Box view?



- Can see in the box (like designer)
- Description of the system's internal behaviour and construction to:
  - Meet the requirements defined by the black box view
  - A level sufficient for subsystem identification



# Your Project



- You will need to have a Black Box view setup so the group understand the requirements
- You will need to develop a White Box view so individuals can work on the identified subsystems



# The End



- This is a brief introduction to Systems Engineering
- Hope it can help the development of your project
- It is all about planning before you build
- Left shift!

