

concept creation

Riverton and District High School



Systems Engineering



What is a “System”



- The collins Concise Dictionary, 5th 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?



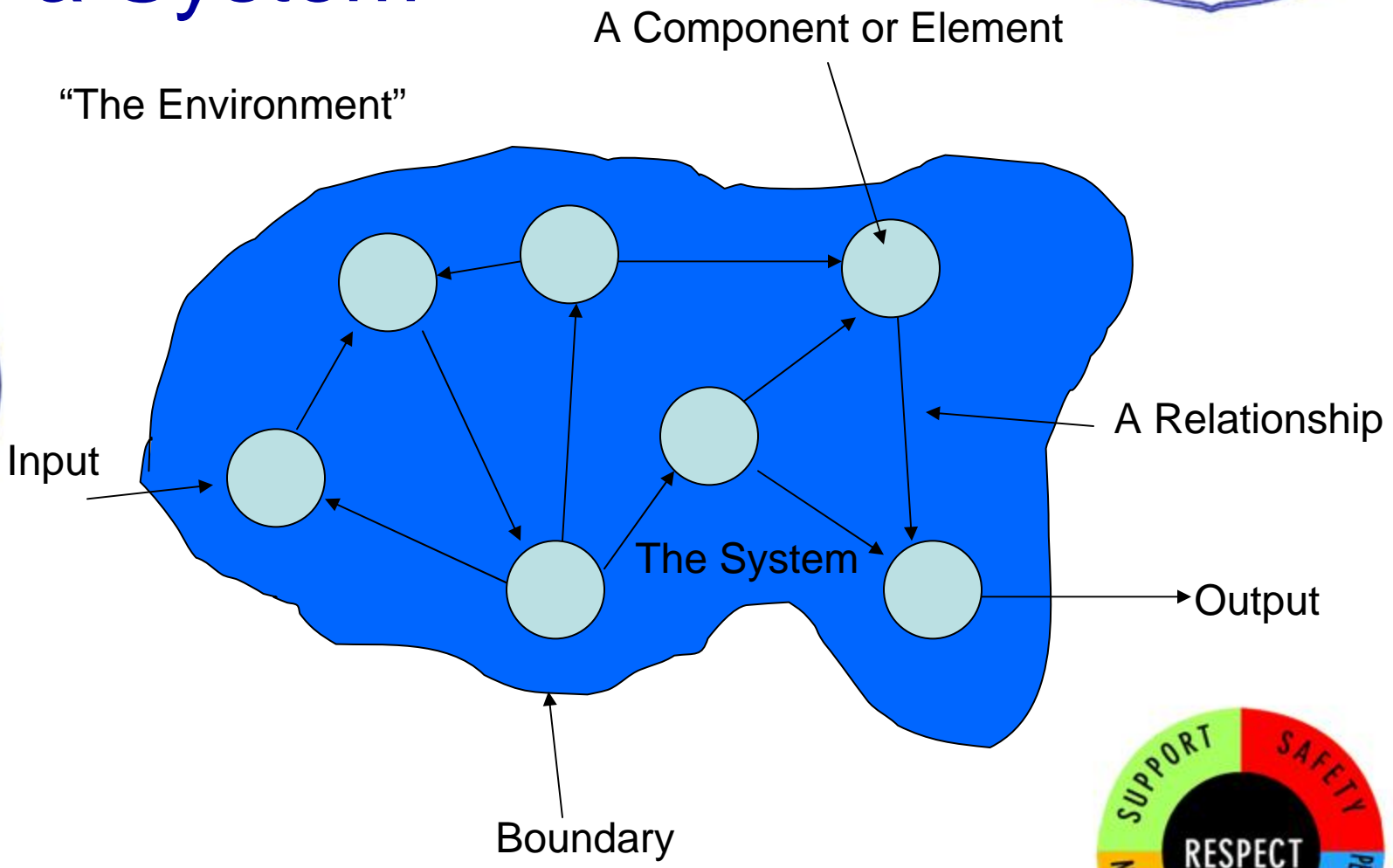
Key System Contacts



- **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?



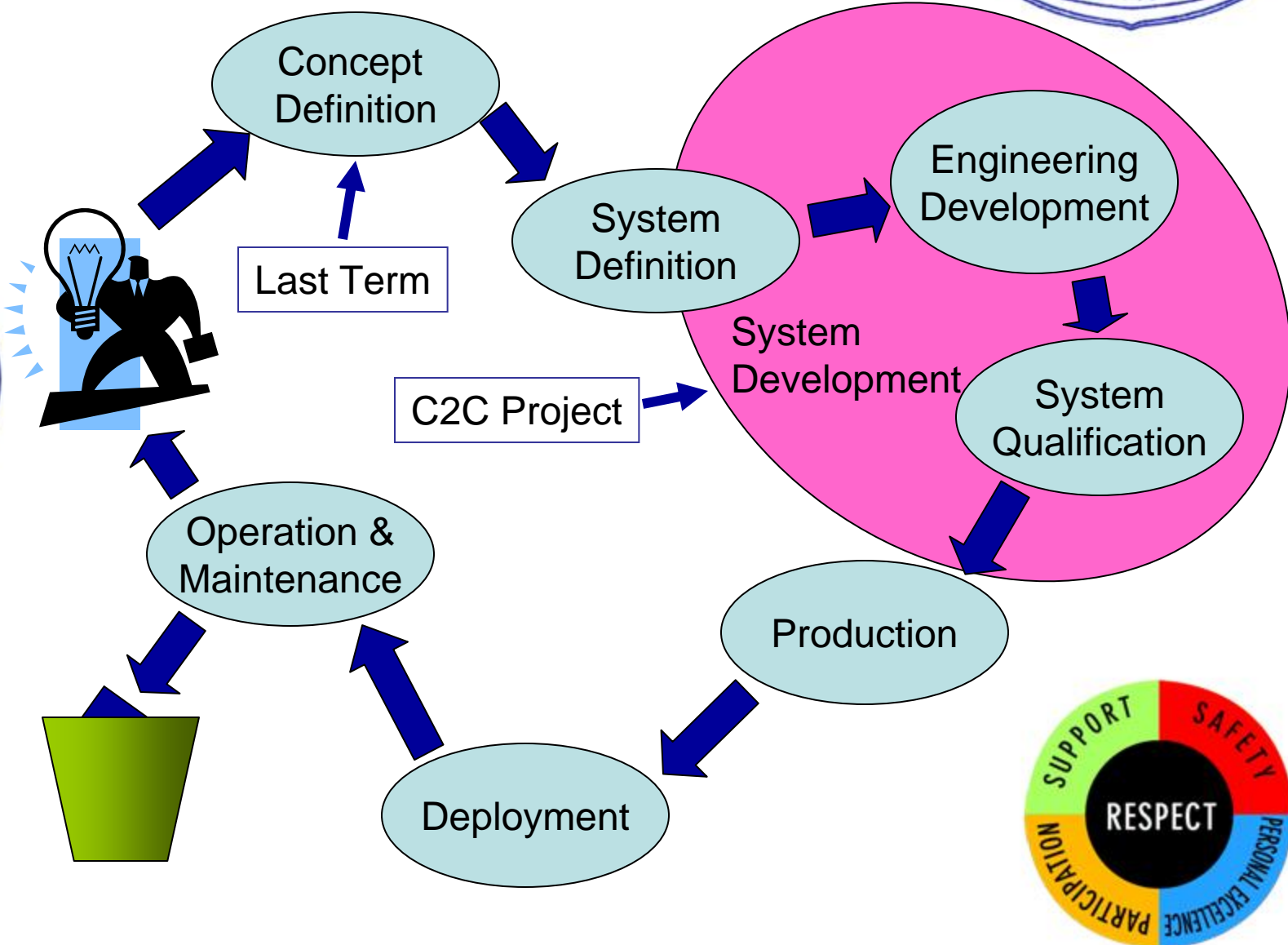
- Will it exist within an external environment?
- Will it receive inputs from that environment?
- Will it send outputs to that environment?
- Will it consist of components (sub-systems) that interact in some way?
- Will those components (sub-systems) themselves consist of smaller, interacting parts?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



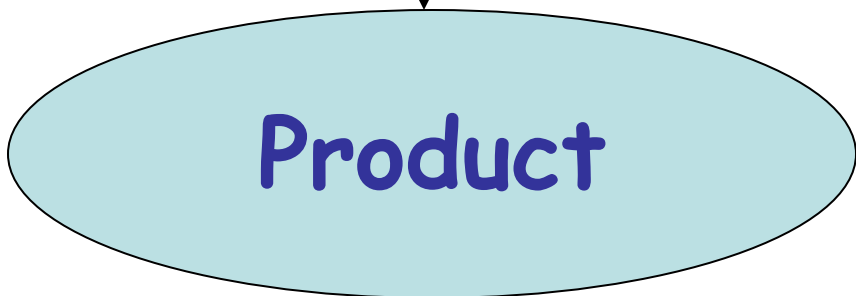
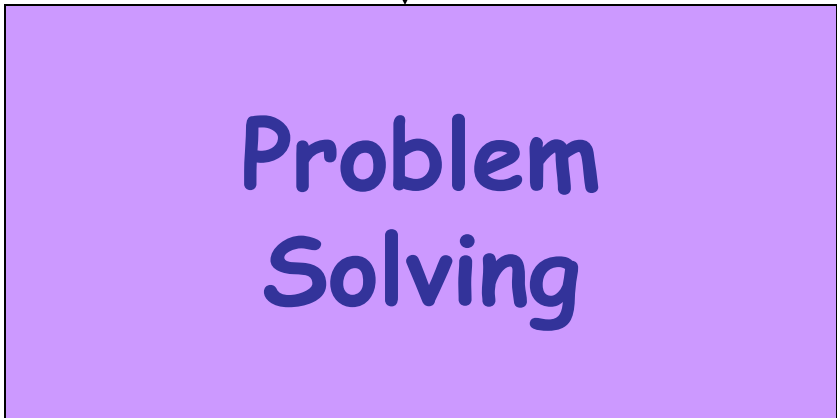


The System Lifecycle

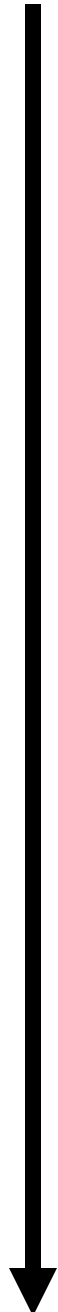
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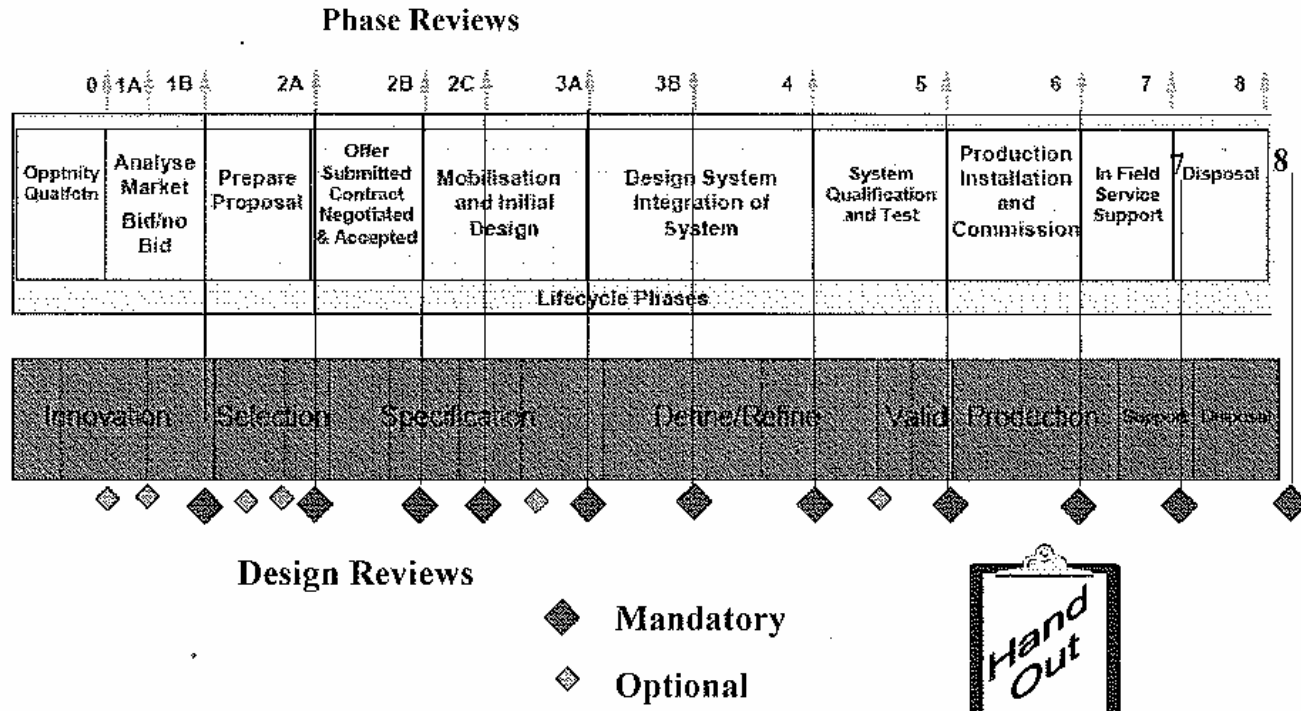
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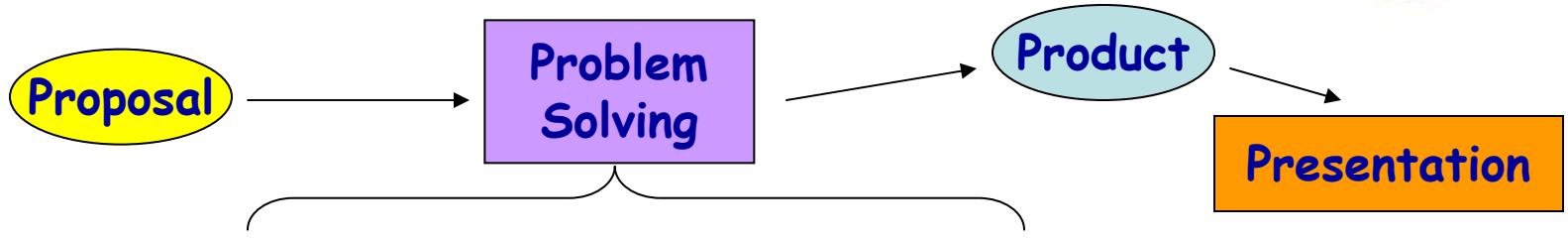
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The Engineering Lifecycle

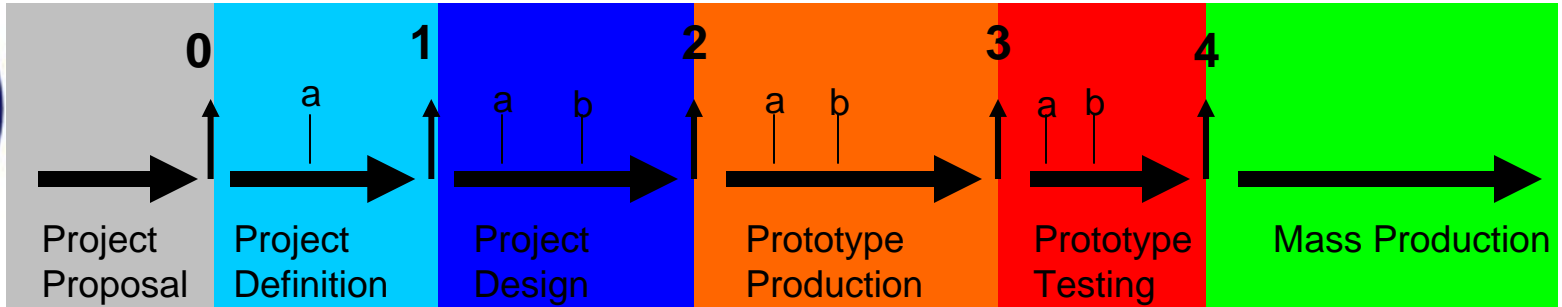


Phase Diagram



Project Acquired

Expo



2 weeks

1 week

2-3 weeks

6-8 weeks

2 weeks



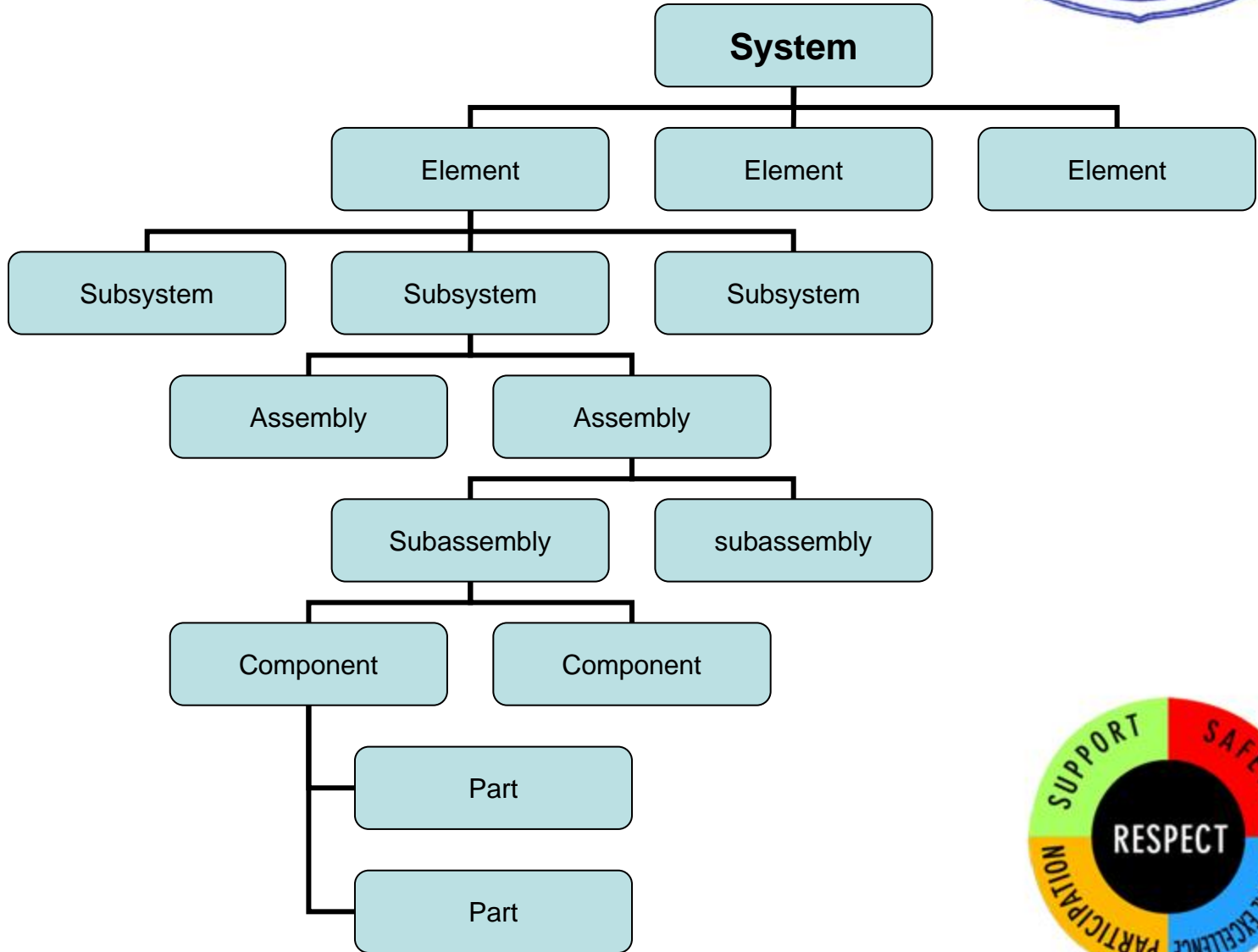
The System Hierarchy



- 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



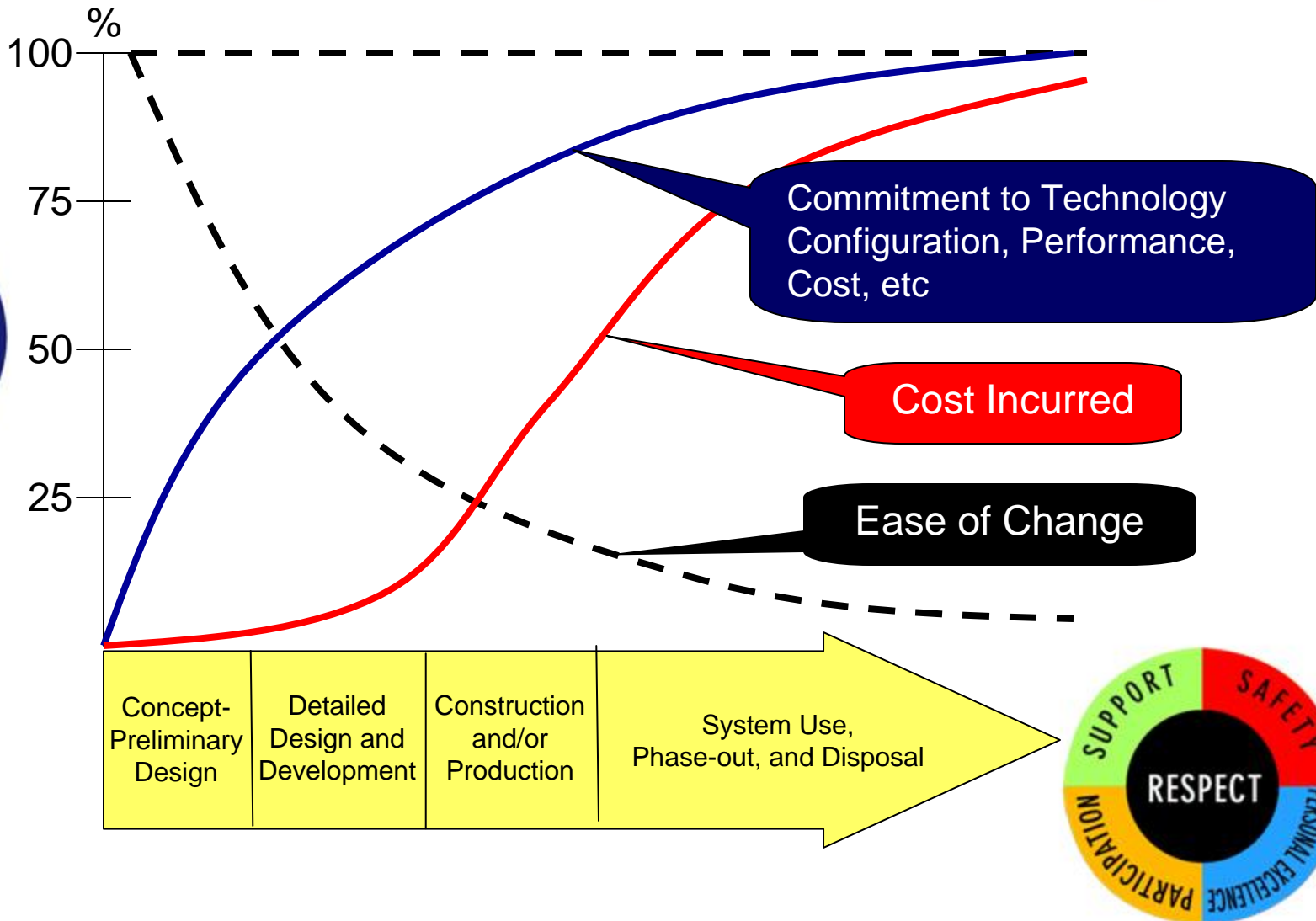
Creating a System



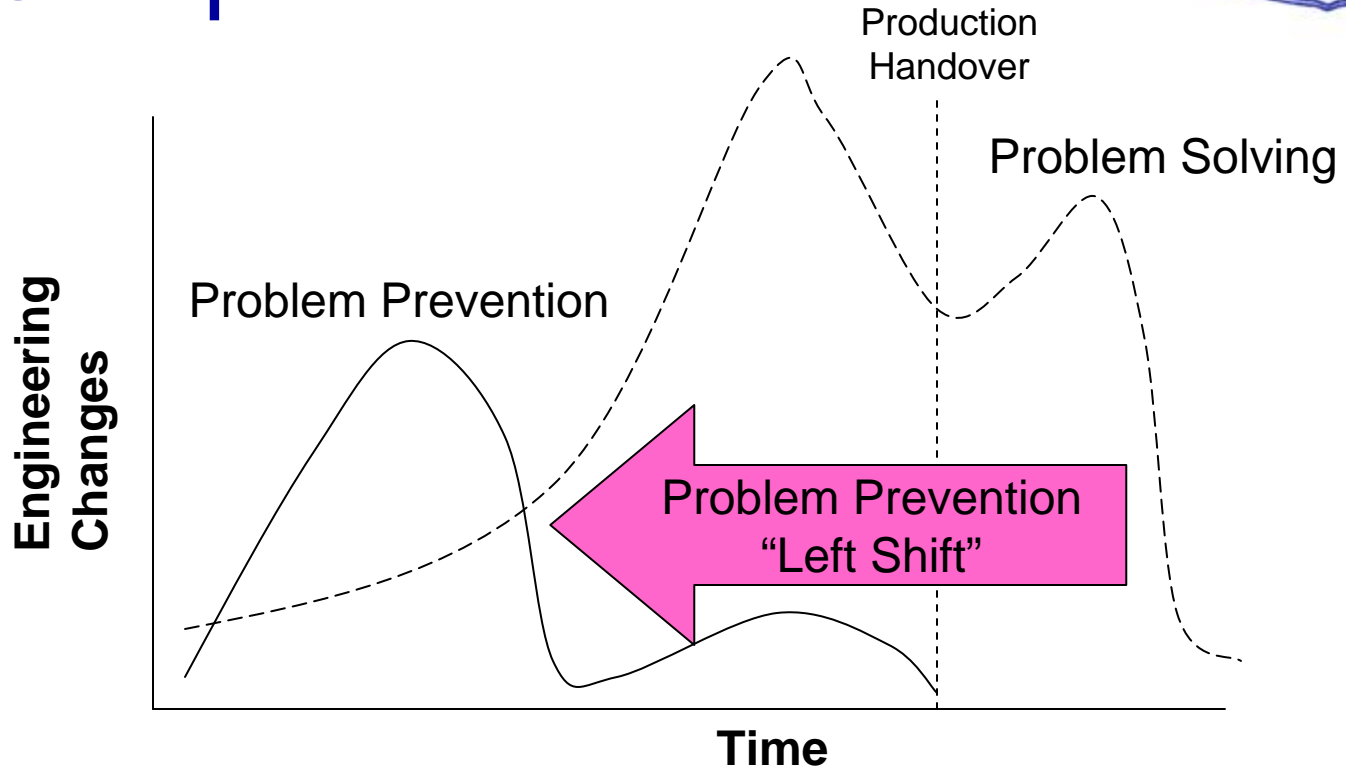
- First step in developing a system:
 - Rush off and start building?
 - Find out more?
 - Mistakes are much cheaper to fix now, before we've build anything, than later, when we've constructed an expensive prototype
- What does the customer really want?
- Your project???
 - Yes, but is that all there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

