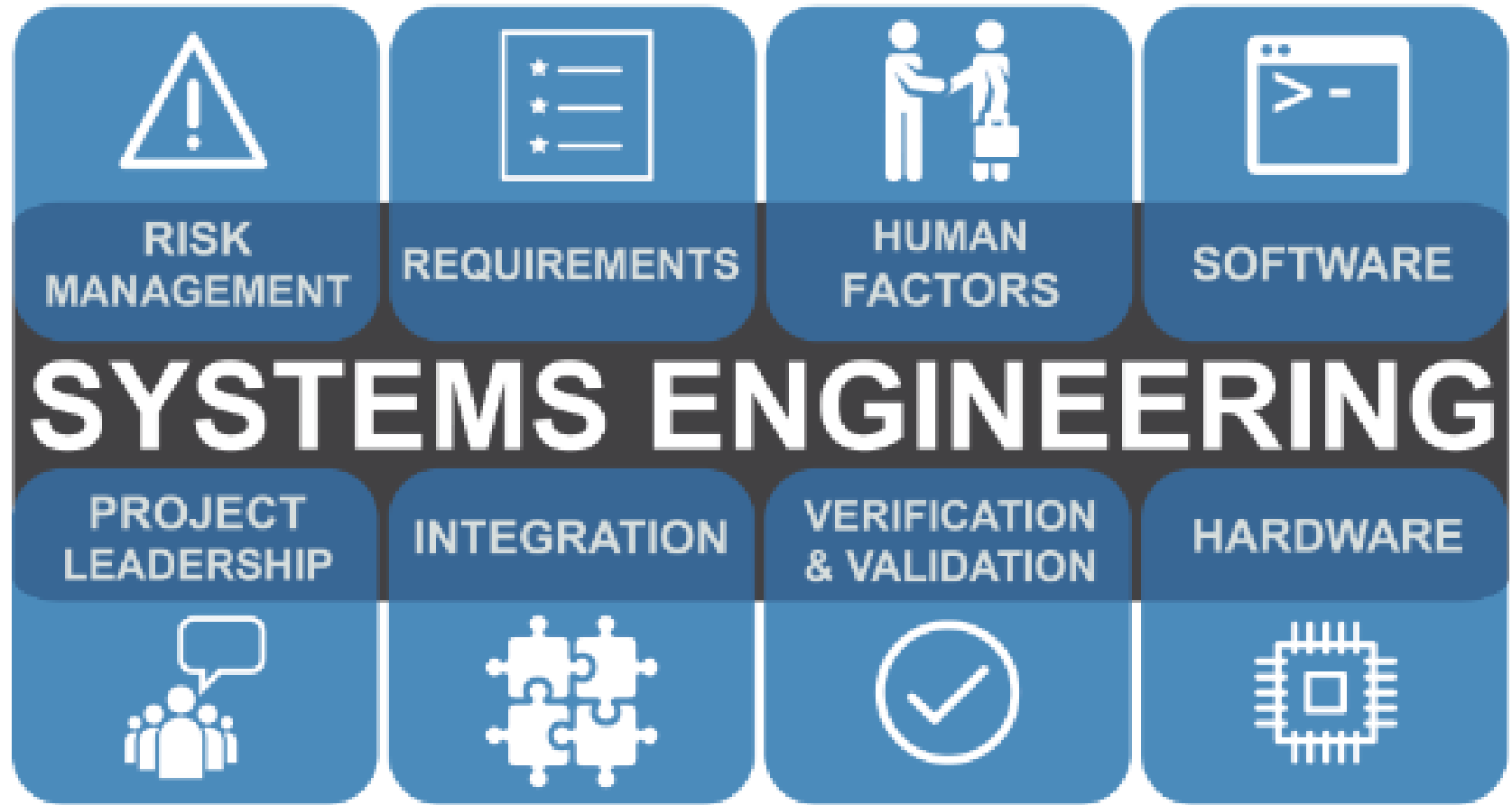


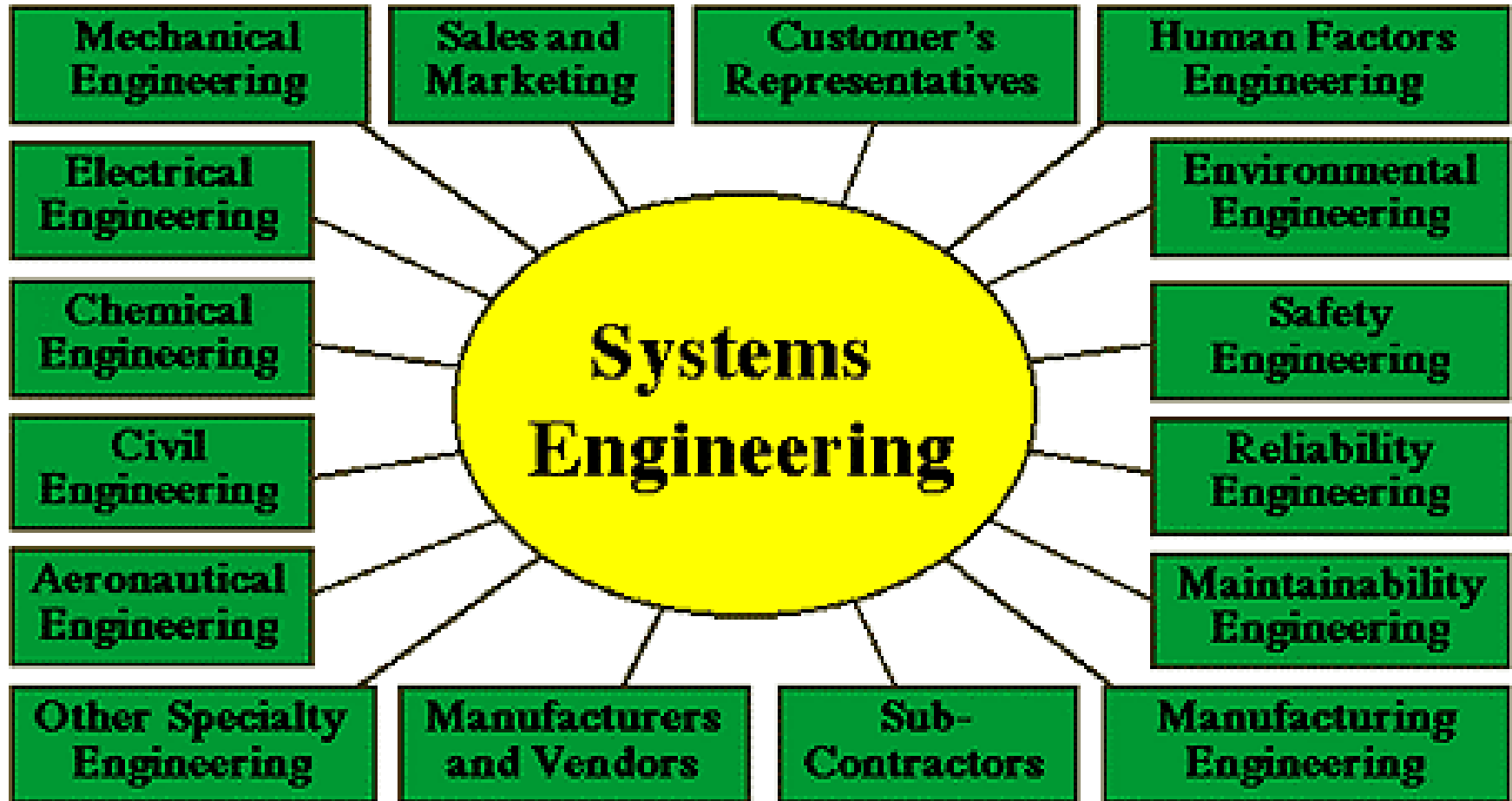
Definition of Systems Engineering

Systems Engineering is a **interdisciplinary** and **integrative** approach enabling the successful realization, use, and retirement of **engineered systems**, using **systems principles and concepts**, and scientific, technological, and management methods.

What is Systems Engineering?



Disciplines Associated with Systems Engineering



The Responsibilities of Systems Engineers

Managing and **monitoring** all installed systems and infrastructure.
Installing, configuring, testing and **maintaining** operating systems, application software and system management tools.
Ensuring the highest levels of systems and infrastructure availability.

Risk Management



Risk Management

Quality Nightmares

by MasterControl



Risk Analysis

Colored Cells are the Risk Categories	Low Risk	Medium Risk	High Risk

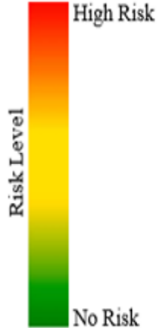
Frequency of Scenario	Severity of Consequences		
	Low Severity	Medium Severity	High Severity
High Frequency	Medium	High	High
Medium Frequency	Low	Medium	High
Low Frequency	Low	Low	Medium

Critical Analysis

Criticality analysis of the rotating components in a centrifugal pump.

Criteria for Criticality Index		
Criteria	Levels	Weight
Impact on Operations	Low (1), Moderate (2), High (3)	40%
Impact of Safety	Low (1), Moderate (2), High (3)	40%
Cost of Component	Low (1), Moderate (2), High (3)	20%

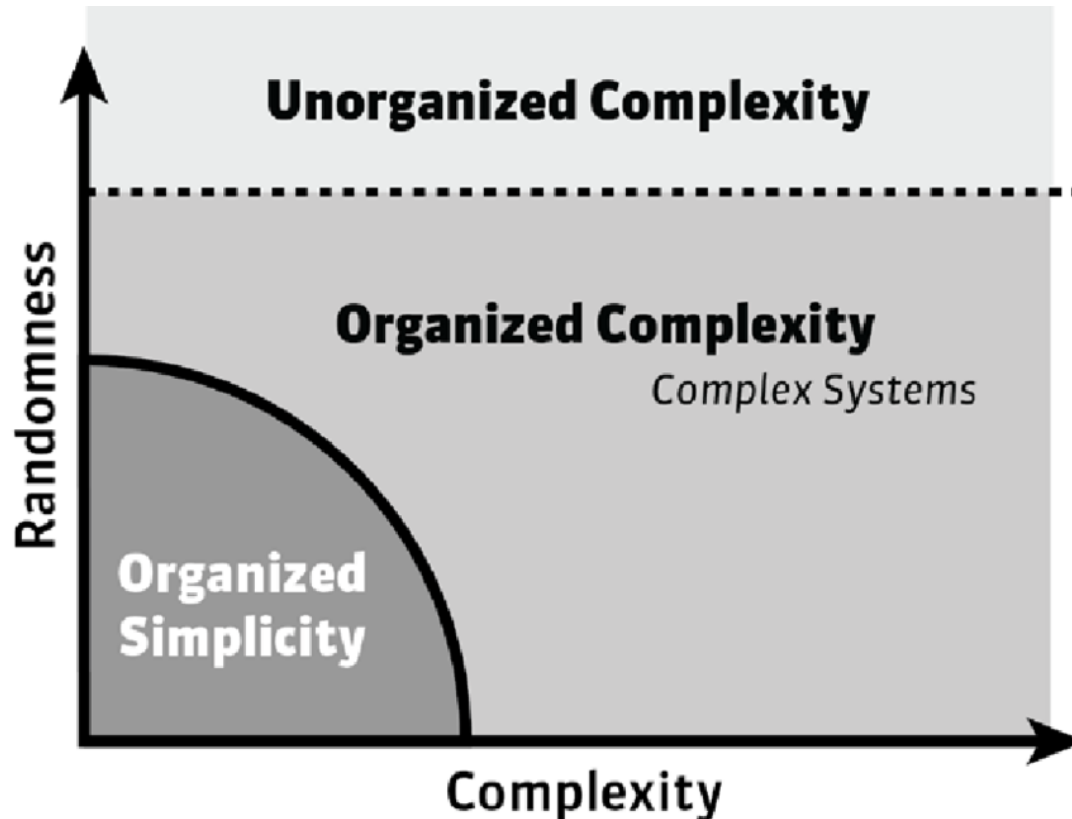
Criticality Groups	
Group	Criticality Index
1.	2.5-3
2.	2-2.5
3.	1.5-2
4.	1-1.5



Risk Level: High Risk (red) to No Risk (green)

Failure Mode (System)	Component	Failure Mode (Component)	Criticality analysis			Criticality Index	Group
			Safety	Operations	Cost		
Loss of Pumping Capacity	Drive Shaft	Worn	1	1	2	1.2	4.
		Deformed	2	2		2	2.
		Fractured	3	3		2.8	1.
	Bearings	Seized	2	3	1	2.2	2.
		Broken	3	3		2.6	1.
		Misaligned	2	2		1.8	3.
	Seals	Leakage	3	3	1	2.6	1.
	Impeller	Surface defects	2	2	3	2.2	2.
		Deformed/unbalanced	2	2		2.2	2.
		Fractured	3	3		3	1.

Complex Systems



Complex Systems belong to the category of "Organized Complexity", those are the problems too complex to solve analytically, but that have a certain structure by which it is possible to observe behaviors and properties.

Industrial and Commercial Perception



"TB or not TB, that is the question."

To be, or not to be, that is the question:

Whether 'tis nobler in the mind to suffer

The slings and arrows of outrageous fortune,

Or to take Arms against a Sea of troubles,

And by opposing end them: to die, to sleep;

No more; and by a sleep, to say we end

The heart-ache, and the thousand natural shocks

That Flesh is heir to? 'Tis a consummation

Devoutly to be wished. To die, to sleep,

To sleep, perchance to Dream; aye, there's the rub,

For in that sleep of death, what dreams may come,

When we have shuffled off this mortal coil,

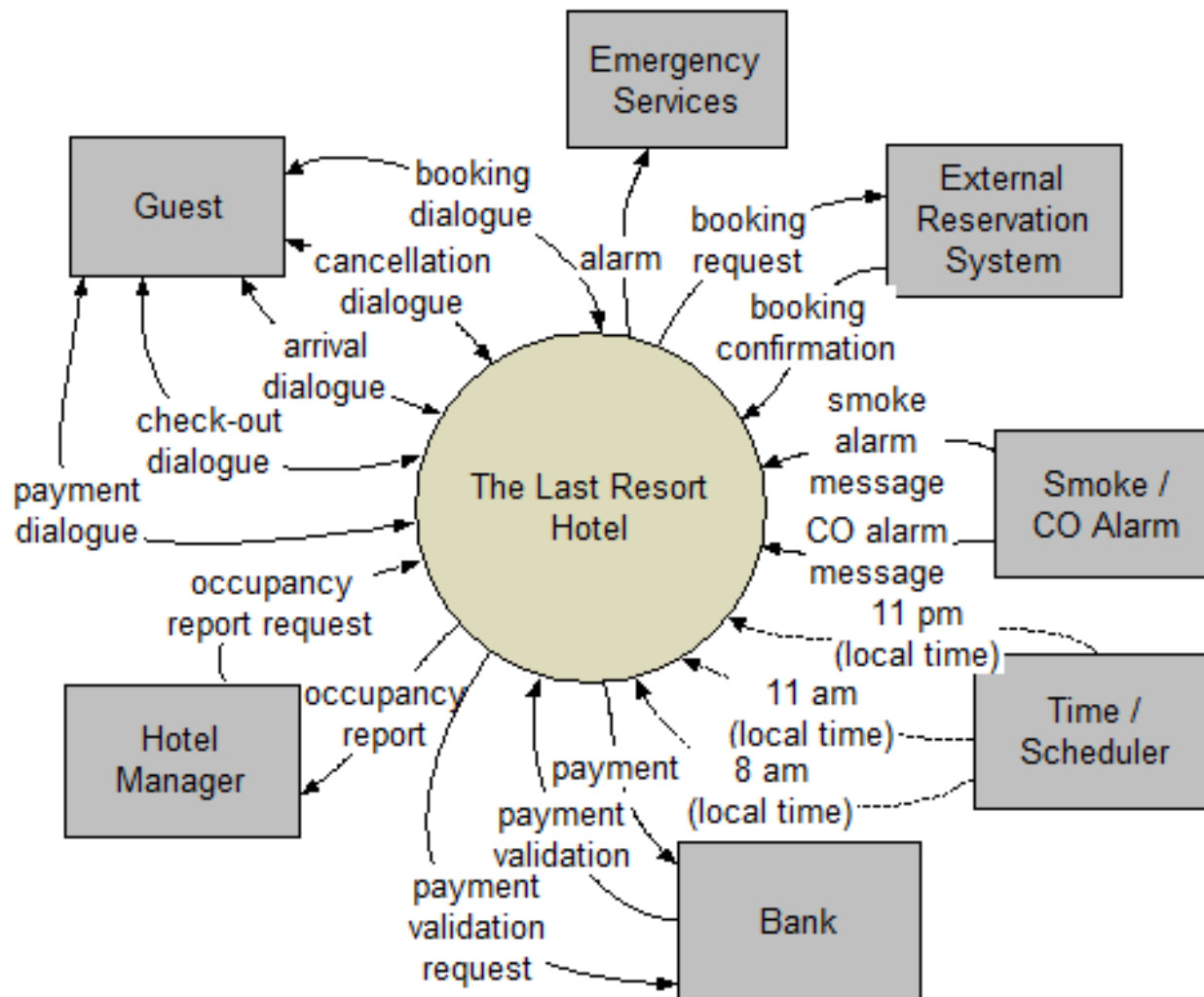
Must give us pause.

COMMON KNOWLEDGE

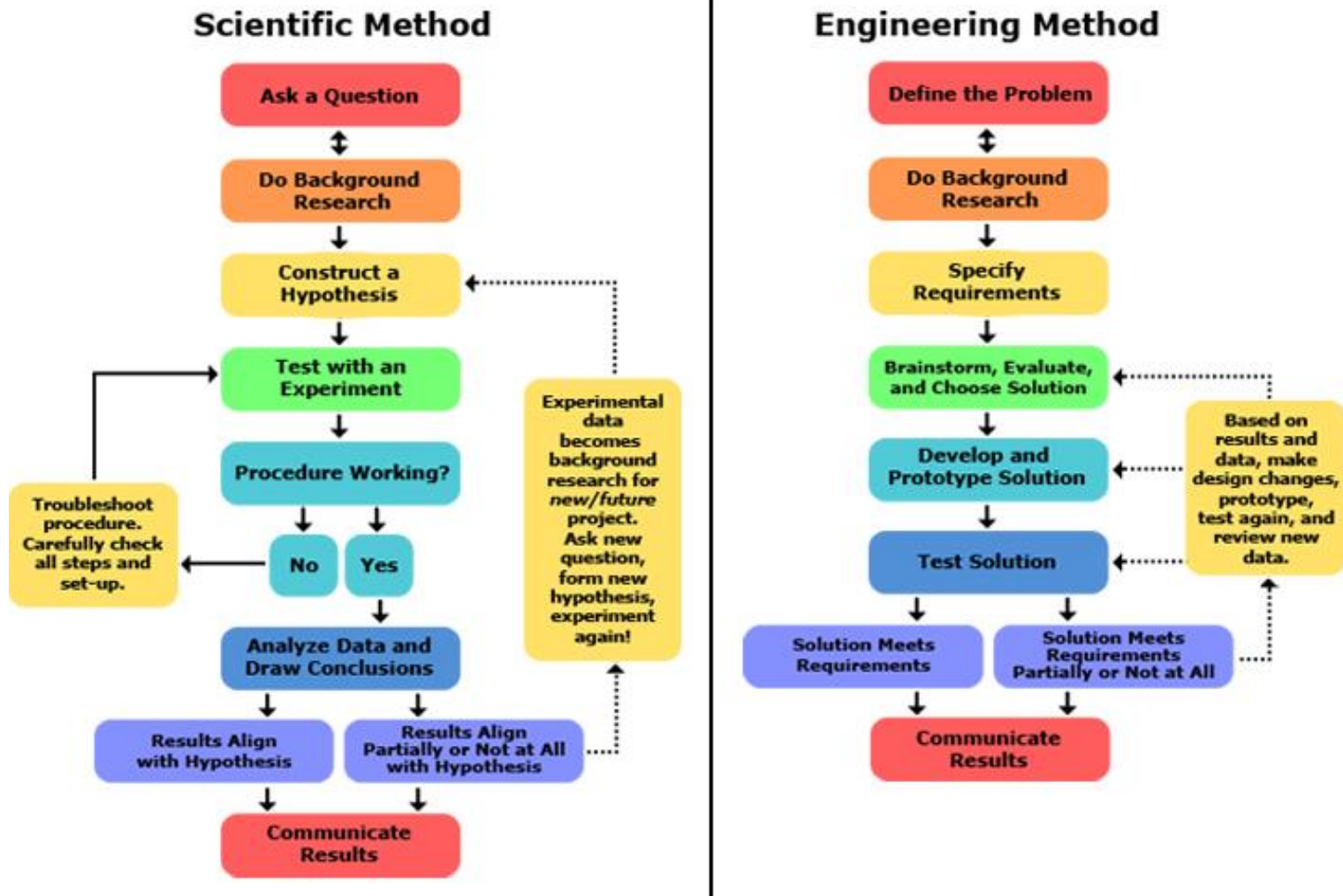
KNOWS SOMETHING

EXPERT

System Context Diagram



Engineering and Scientific Design Methods

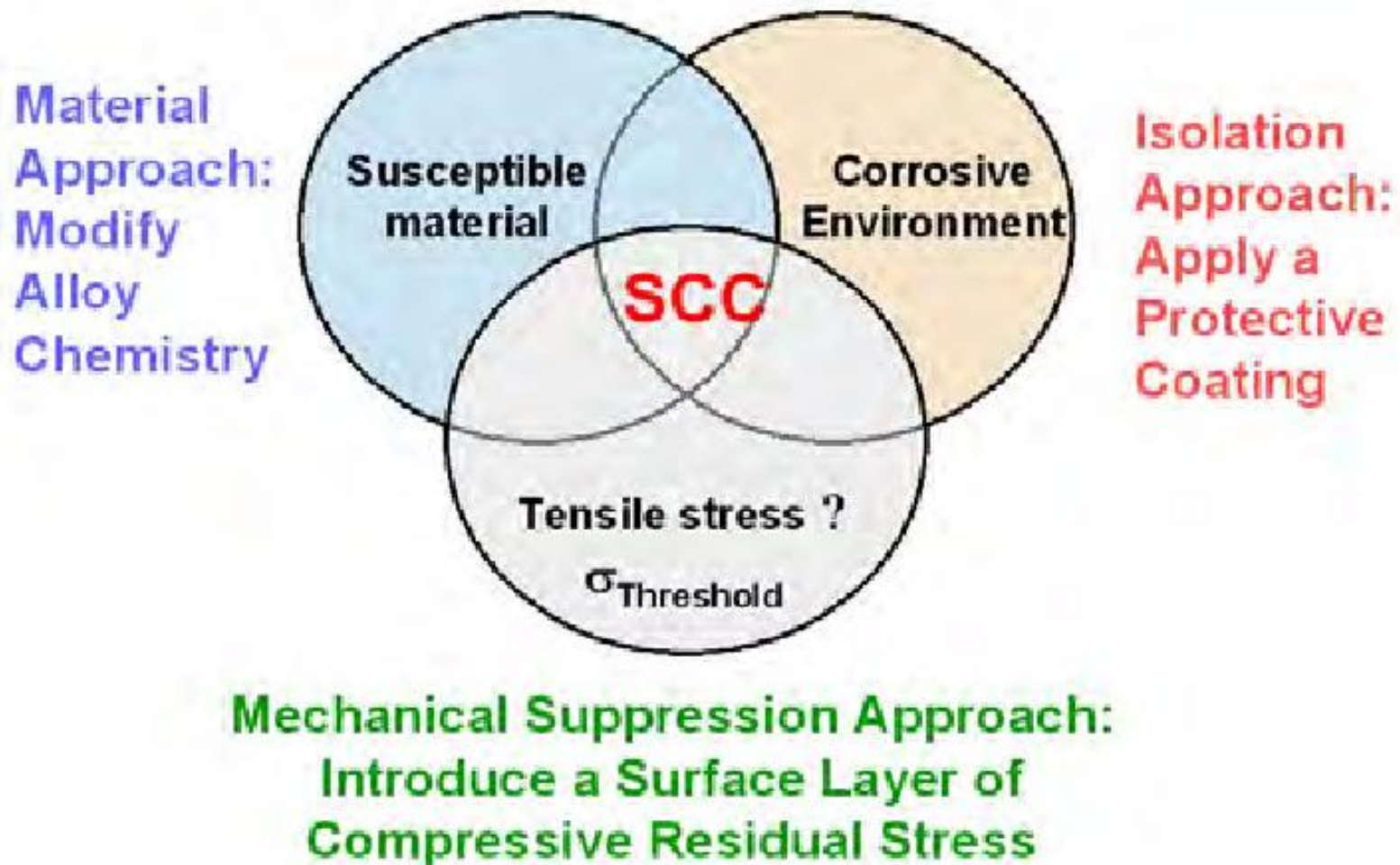


Venn Diagrams

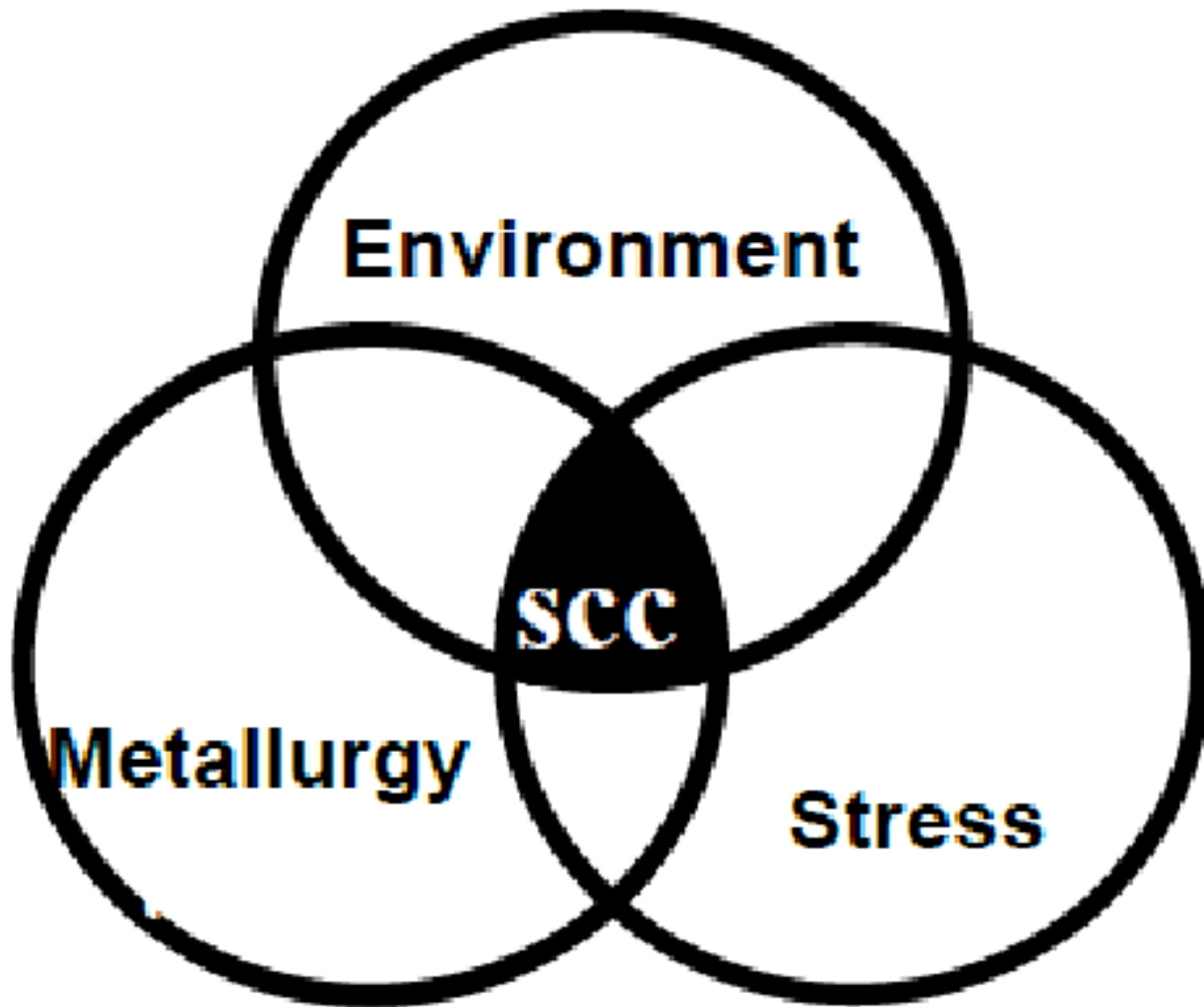
Venn Diagram



Stress Corrosion Cracking Venn Diagram



Stress Corrosion Cracking Venn Diagram



Venn Diagram Problem with 3 Circles

VENN DIAGRAM WORD PROBLEMS WITH 3 CIRCLES

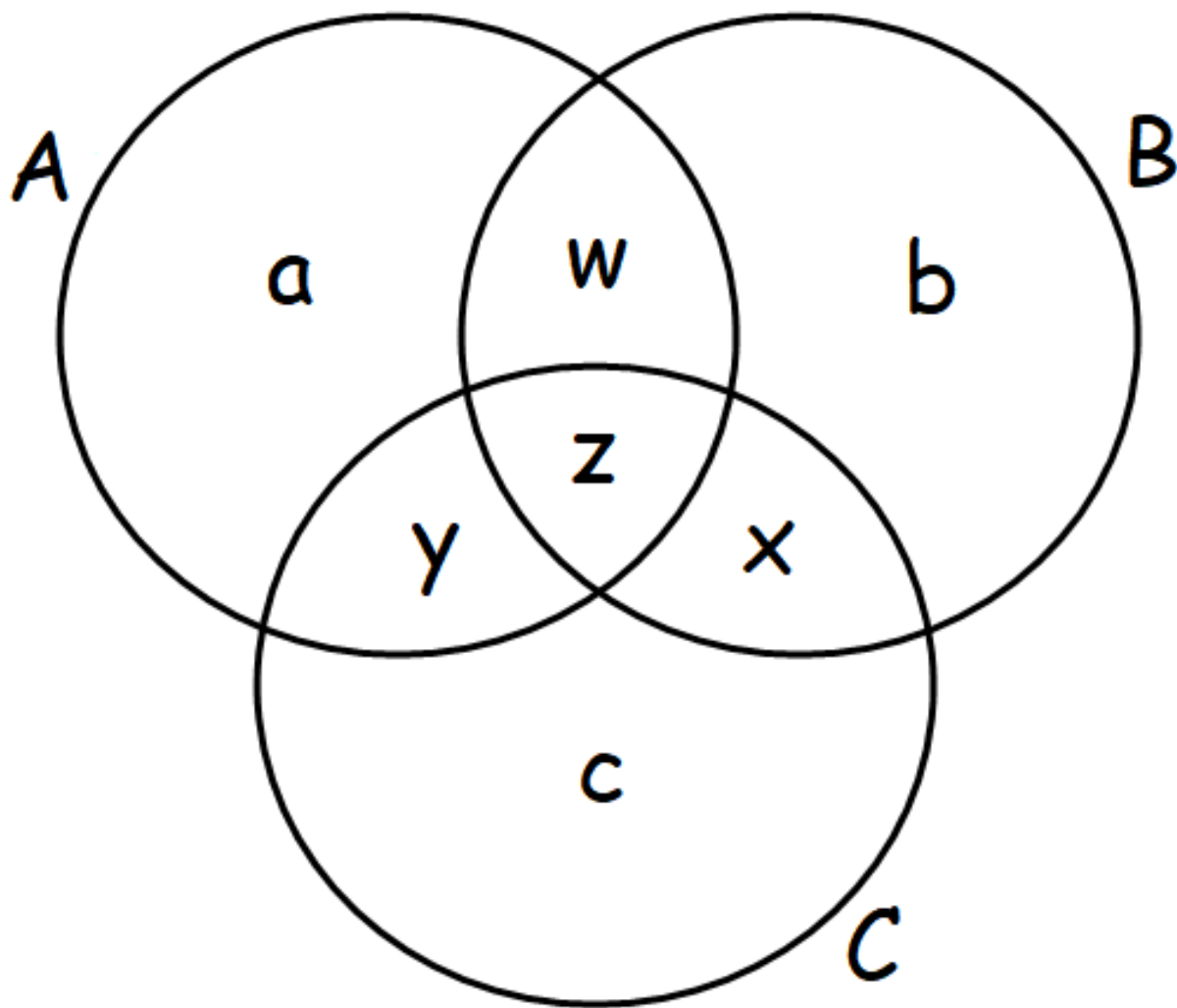
Consider the three sets A , B and C .

Set A contains a elements, B contains b elements and C contains c elements.

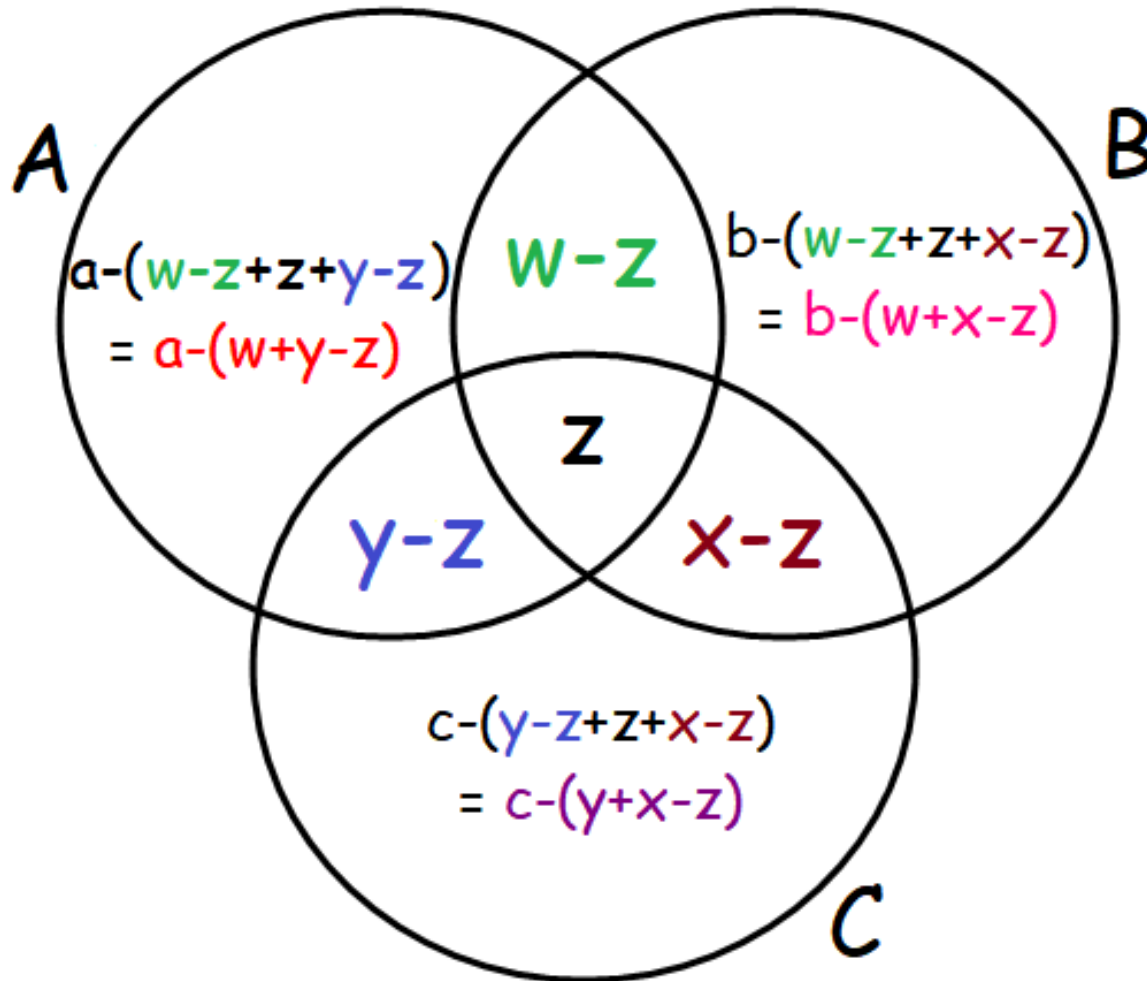
Both A and B contains w elements, B and C contains x elements, A and C contains y elements, all the three sets A , B and C contains z elements.

We can use Venn diagram with 3 circles to represent the above information as shown below.

Venn Diagram Circles



Venn Diagram Equations



Venn Diagram Calculations

Number of elements related only to A is

$$= a - (w + y - z)$$

Number of elements related only to B is

$$= b - (w + x - z)$$

Number of elements related only to C is

$$= c - (y + x - z)$$

Number of elements related only to (A and B) is

$$= w - z$$

Number of elements related only to (B and C) is

$$= x - z$$

Number of elements related only to (A and C) is

$$= y - z$$

Number of elements related to all the three sets A, B and C is

$$= z$$

Total number of elements related to all the three sets A, B and C is

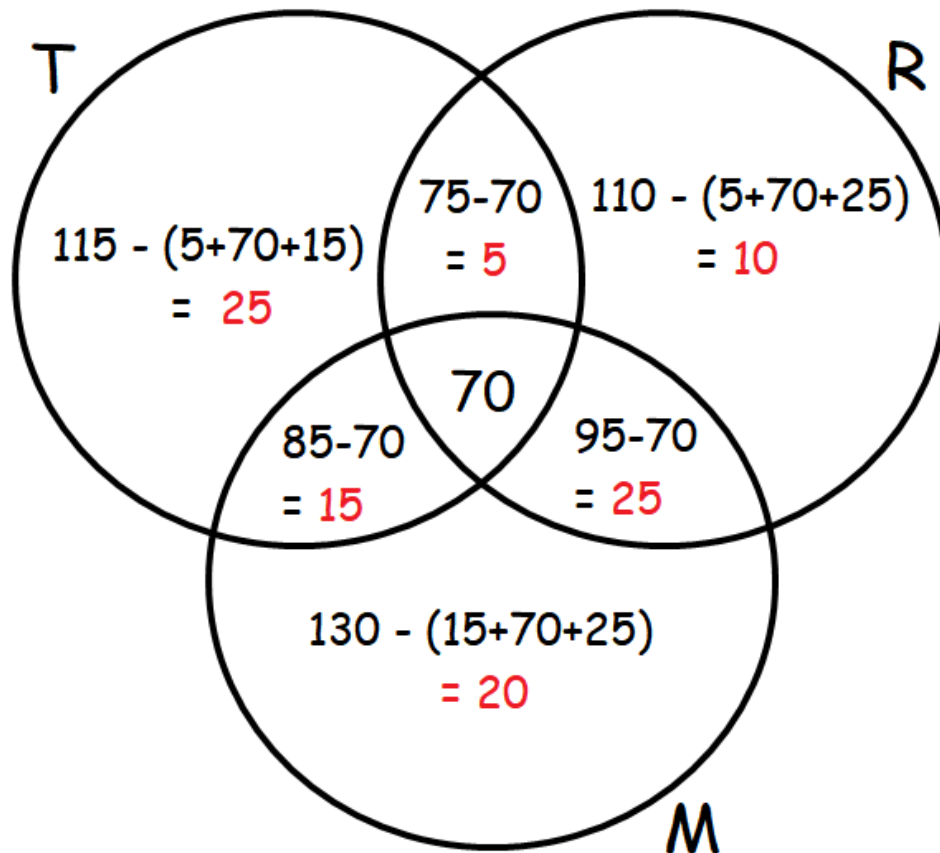
$$= [a - (w + y - z)] + [b - (w + x - z)] + [c - (y + x - z)] + (w - z) + (x - z) + (y - z) + z$$

Venn Diagram Example

An advertising agency finds that, of its 170 clients, 115 use **Television**, 110 use **Radio** and 130 use Magazines. Also 85 use Television and Magazines, 75 use Television and Radio, 95 use Radio and Magazines, 70 use all the three. Draw Venn diagram to represent these data. Find

- (i) how many use only Radio?
- (ii) how many use only Television?
- (iii) how many use Television and Magazine but not radio?

Venn Diagram Solution



(i) Number of people who use only Radio is **10**

(ii) Number of people who use only Television is **25**

(iii) Number of people who use Television and Magazine but not radio is **15**.

Motor Failure Venn Diagram Problem

A number of new prototype motors failed in service due to the following factors:

85% failed due to faulty wiring

40% failed due to oversize/undersize shafts

20% failed due to overheating

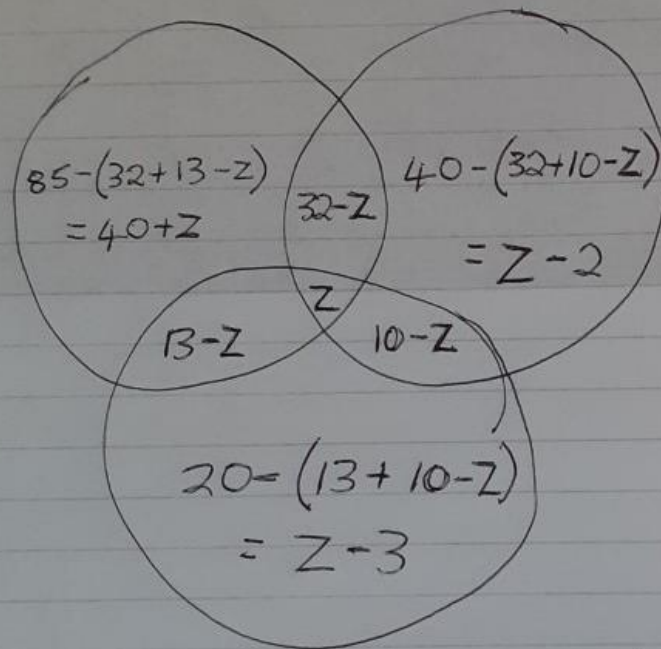
32% failed by both faulty wiring and oversize/undersize shafts

13% failed by both overheating and oversize/undersize shafts

10% failed by both faulty wiring and overheating.

Find the percentage of motors which failed on all three accounts

(8 marks)



$$\therefore 100\% = 40 + \cancel{Z} + 32 - \cancel{Z} + \cancel{Z} + 13 - \cancel{Z} + 10 - \cancel{Z} + \cancel{Z} - 2 + Z - 3$$

$$\therefore 100\% = 95 - 5 + Z$$

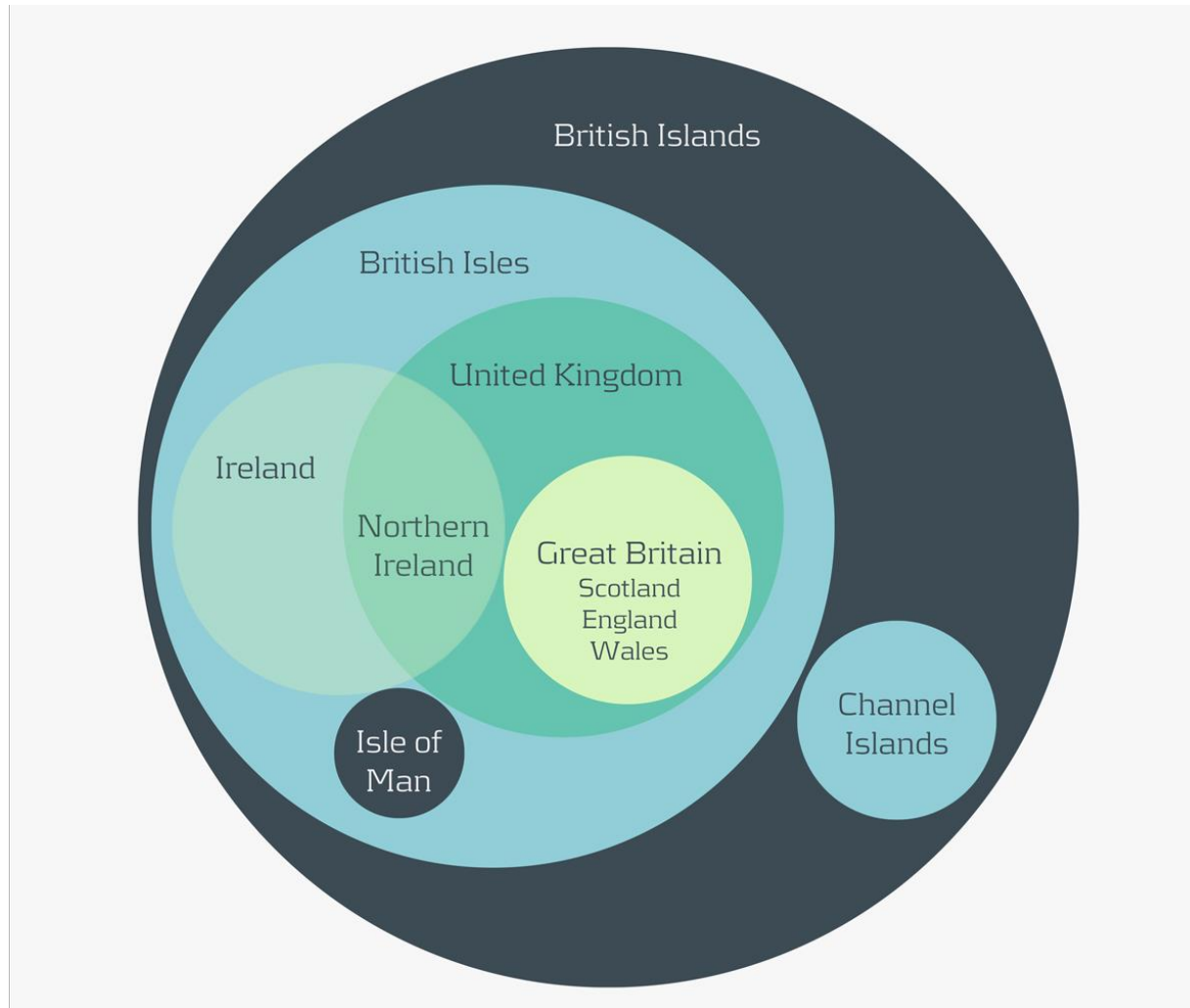
$$\therefore Z = 100 - 90 = \underline{\underline{10\%}}$$

Create Venn Diagram Using SmartArt Shapes

SmartArt option is the way Excel helps you to express your data visually. It lies under the insert tab with its various chart alternatives and is ready for your use. If you have your Excel sheet opened, then follow the right steps to make Venn diagrams by using SmartArt.

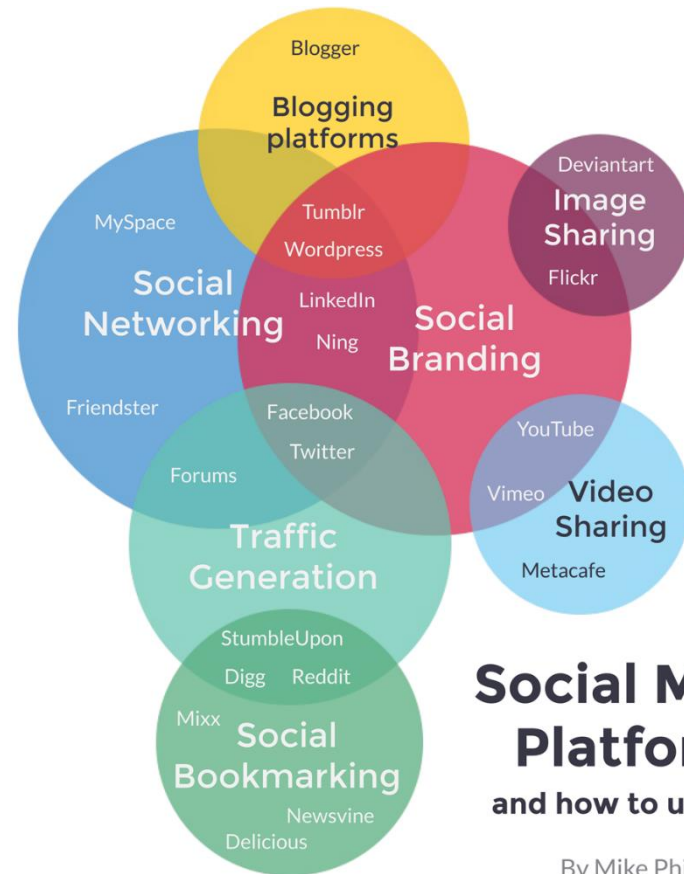
- Go to the *Insert* tab, select *SmartArt* in the illustrations section.
- From the “Choose a SmartArt Graphic” window, click *Relationships* and you will see the different Venn diagram types among the options.
- To create a simple one, select *Basic Venn* and click *OK*. Then the diagram will appear on your worksheet.
- Type your text by clicking [Text] parts in the circles; or open the text pane by clicking the arrow next to the diagram and type/paste your text there.
- Your basic Venn diagram is ready, but we are not finished yet. Now according to your data, you can add more texts or circles and modify your diagram.

Cylindrical Venn Diagram



Complex Venn Diagrams

Differing
sized circles
Venn
Diagrams



**Social Media
Platforms**
and how to use them

By Mike Phillips
@imjustmike

SOURCES:

<https://www.flickr.com/photos/imjustmike/4170472696/>

CREATED BY:

Your Name / Company Name



Requirements Capture and Analysis



How the customer explained it



How the project leader understood it



How the engineer designed it



How the programmer wrote it



How the sales executive described it



How the project was documented



What operations installed



How the customer was billed



How the helpdesk supported it



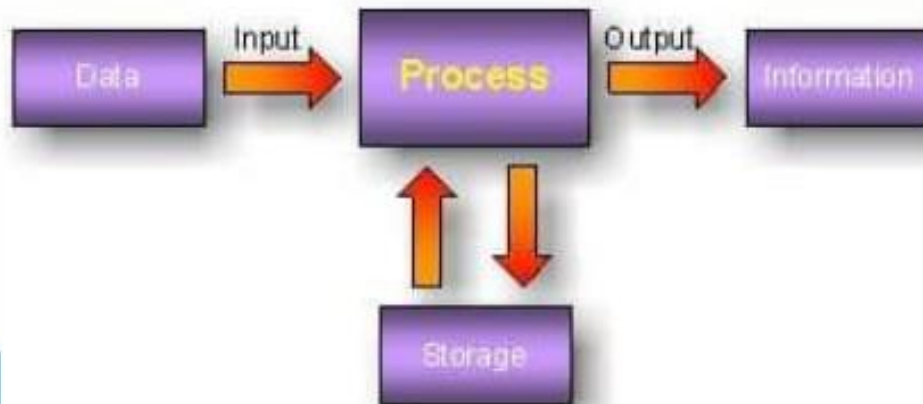
What the customer really needed

Functions and Functionality

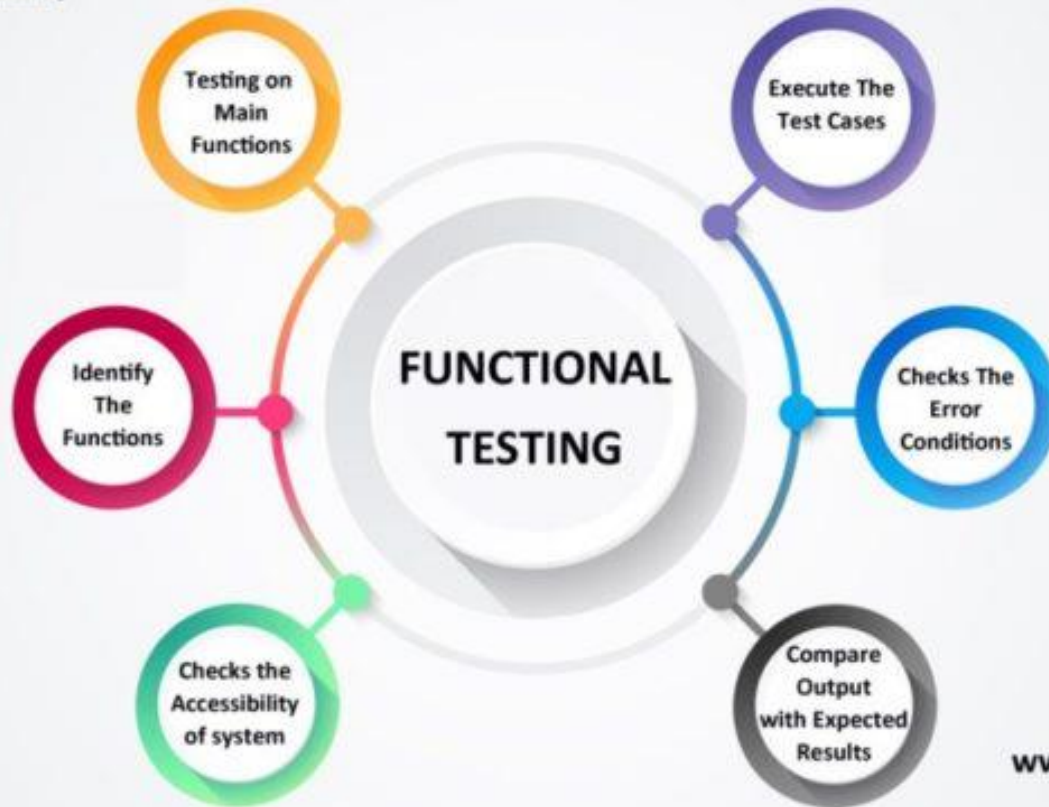
FUNCTION OF A COMPUTER SYSTEM

Any digital computer carries out five functions in gross terms:

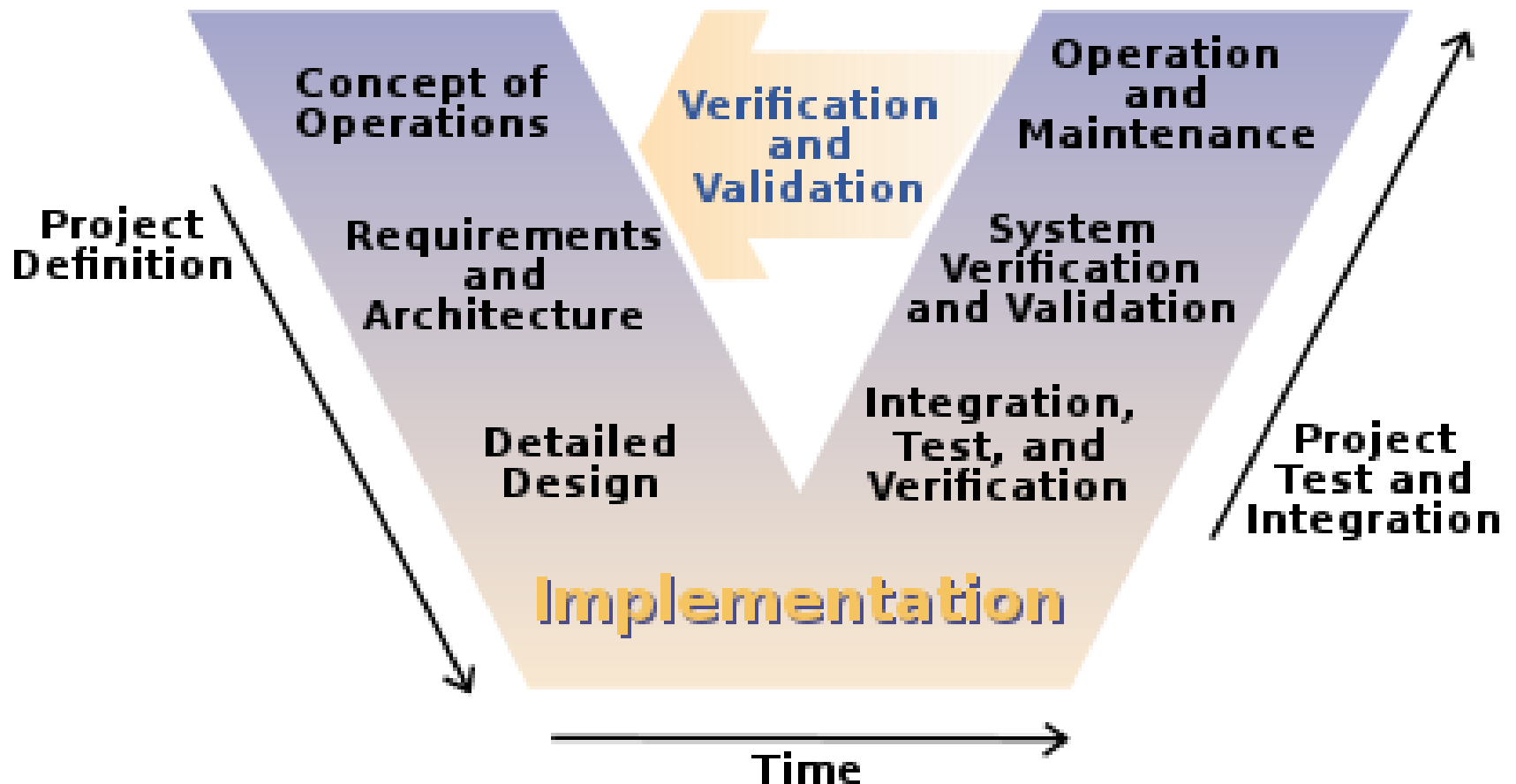
- Takes data as input.
- Stores data/instructions
- Process the data and converts it into useful information
- Generate output



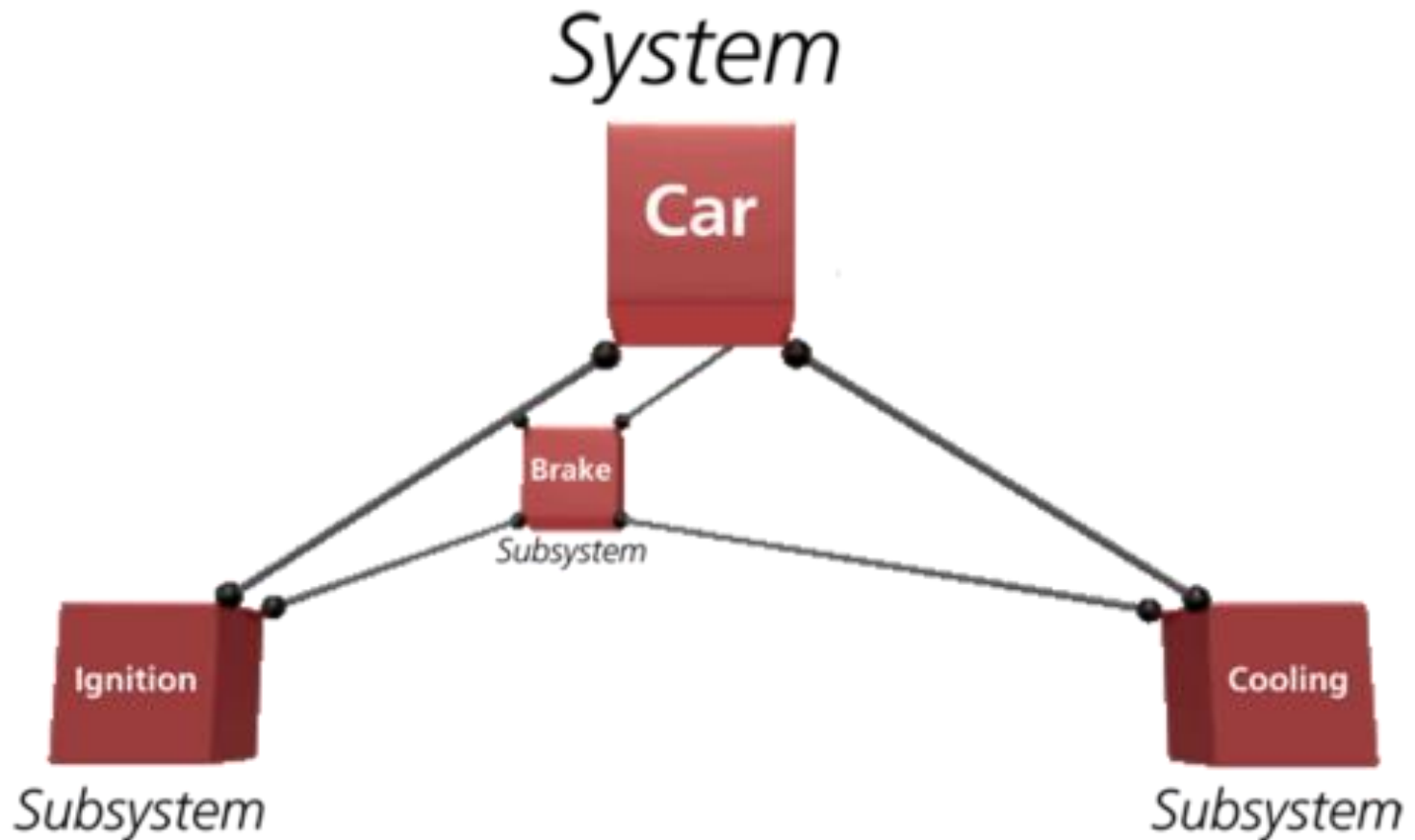
Functionality



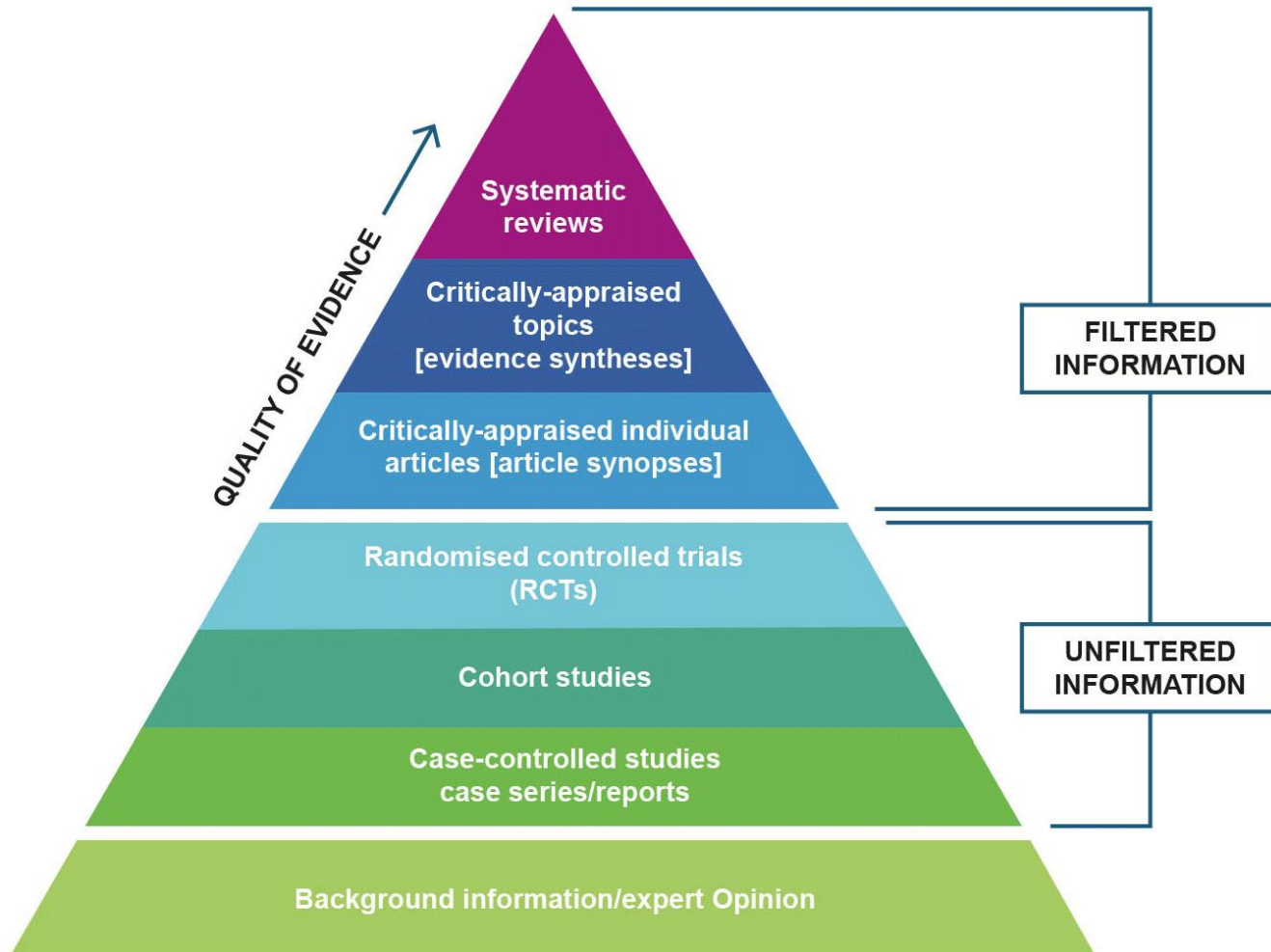
Concept Design



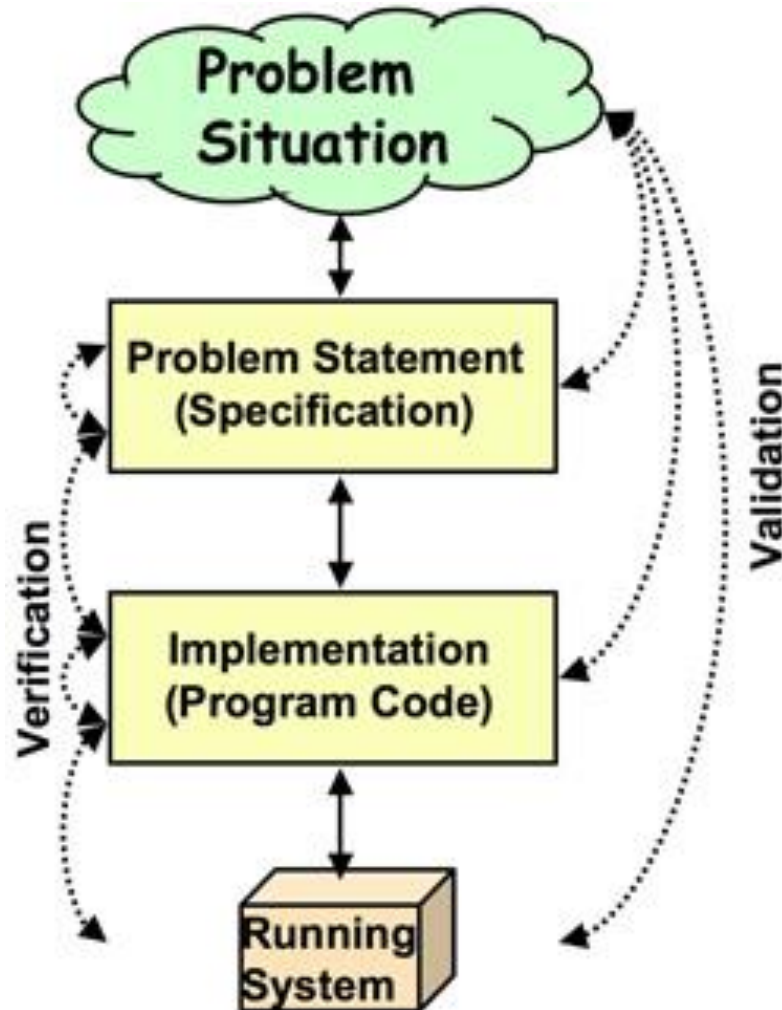
System and Subsystems



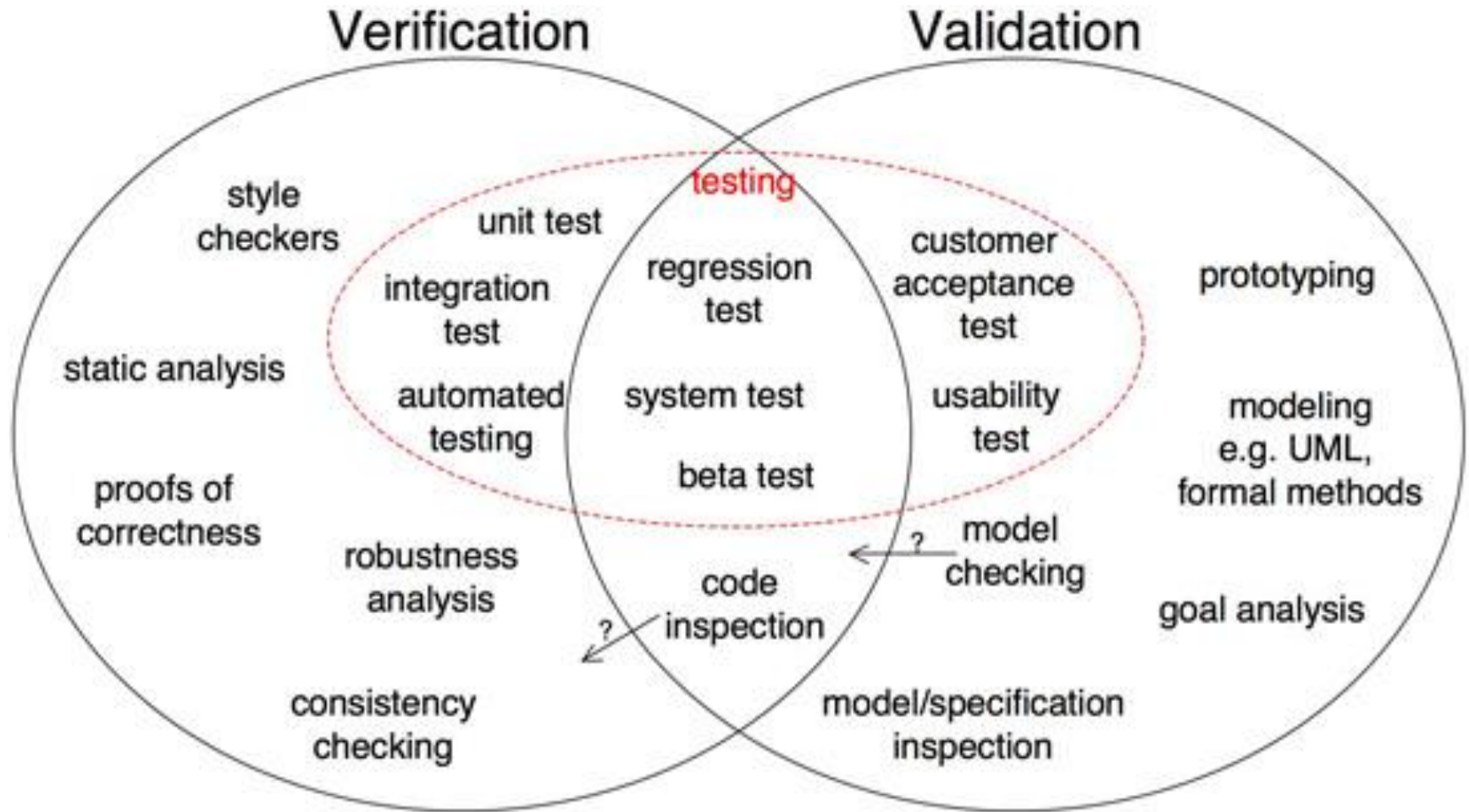
Integration and Evaluation



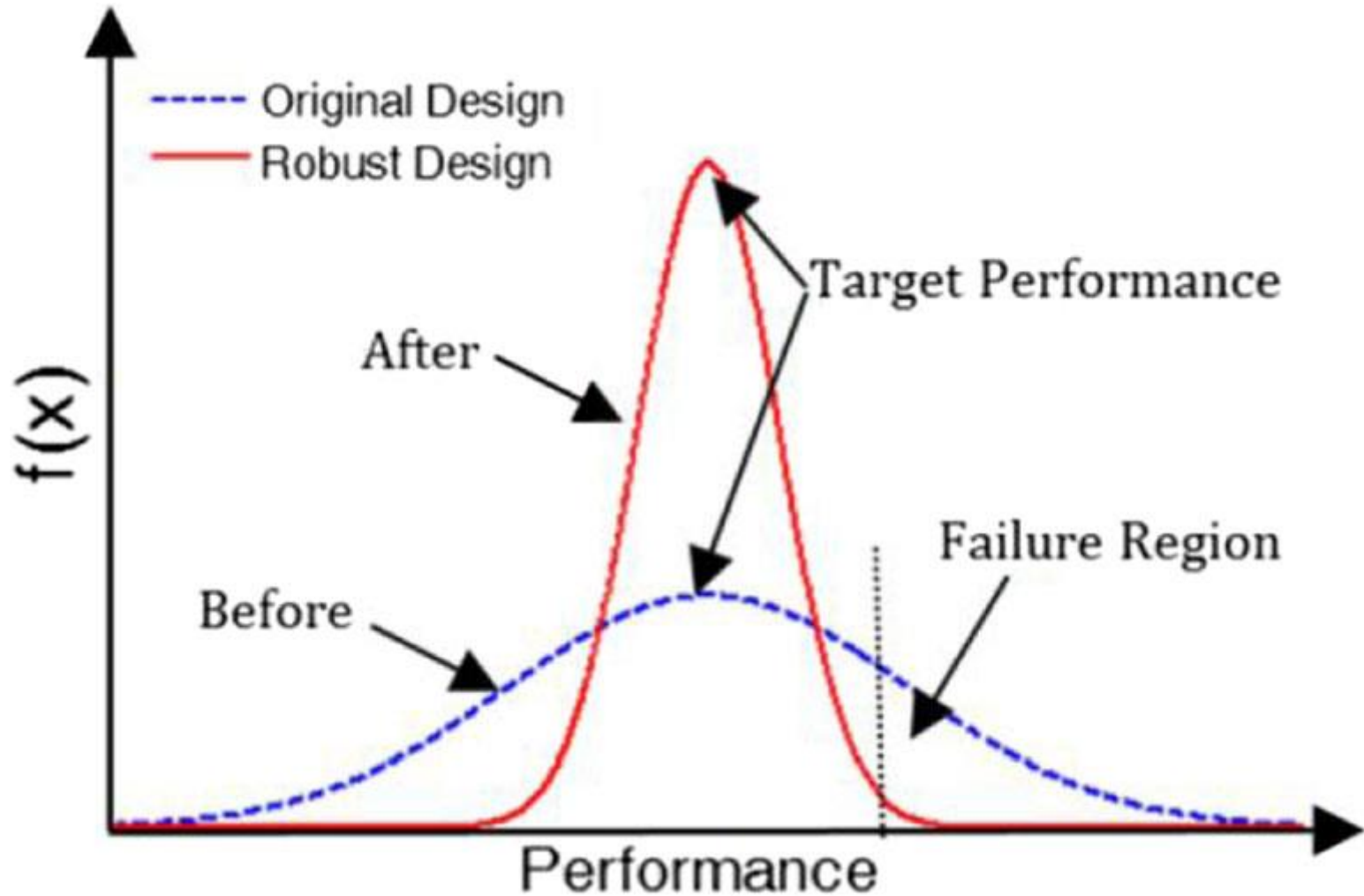
Validation and Verification



Validation and Verification Differences



Robust Design



Systems Engineering Management

