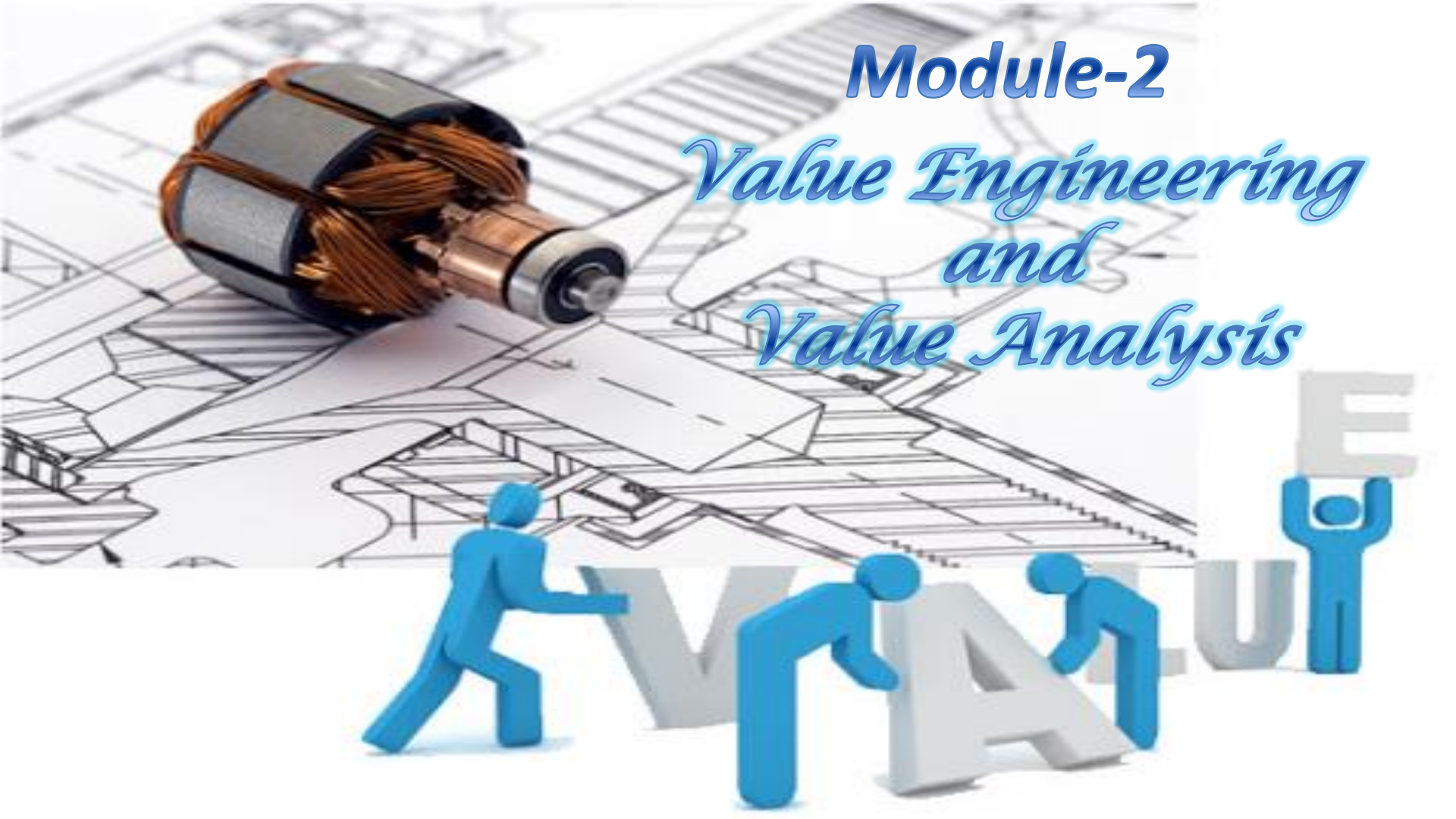


## Module-2

# *Value Engineering and Value Analysis*





# Content

- Distinction between value engineering & value analysis and their Significance.
- Steps in value engineering & analysis and Check lists.



# Course Outcome

1. Illustrate the need for optimization of resources and its significance
2. ***Develop ability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.***
3. ***Demonstrate the concept of value analysis and its relevance.***
4. Manage and implement different concepts involved in method study and understanding of work content in different situations.
5. Describe different aspects of work system design and facilities design pertinent to manufacturing industries.
6. Illustrate concepts of Agile manufacturing, Lean manufacturing and Flexible manufacturing



# Introduction

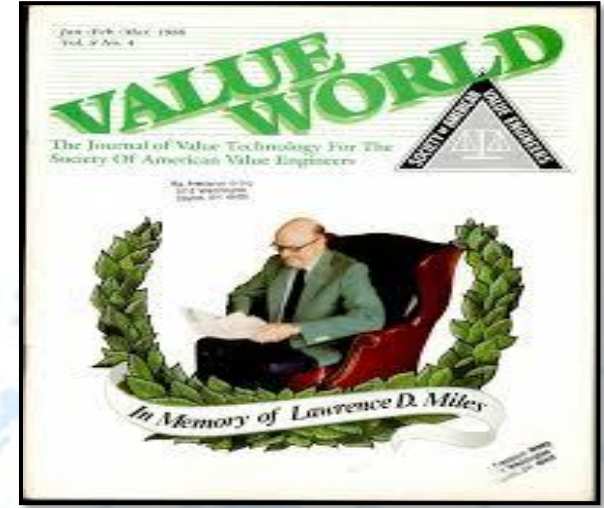
- The Value Engineering (VE) or Value Analysis (VA) is an important and powerful tool for improvement in the performance of the products, systems or procedures
- The terms VE and VA are used almost interchangeably. Other terms used to convey the same concepts are Value Assurance and Value Management (VM) It is a cost effective approach which improves the performance without damaging the function(s) and without compromising on quality, reliability etc
- Value methodology deals with functions rather than products
- L. D. Miles defined Value Analysis in his book, *Techniques of Value Analysis and Value Engineering* (1961) as "an organized creative approach which has for its purpose the efficient identification of unnecessary cost. i.e. cost which provides neither quality nor use, nor life, nor appearance, nor customer features".
- The basic objective of VE/VA is to achieve equivalent or better performance at a lower cost while maintaining all functional and quality requirements
- It is identifying and eliminating hidden, invisible and unnecessary costs





# History

- Value Engineering had its origin at the General Electric Company (GEC).
- As a result of World 'War II, many materials were in short supply and L.D. Miles was associated with a committee to identify substitute materials without sacrifice in quality and performance
- L. D. Mile's problem was that he could not get strategic materials to produce the turbo-supercharger for the B-17 and P-47
- Larry and his team determined the function of each part in the turbocharger. Found more cost effective materials to achieve the necessary functions
- Lawrence D Miles is considered as the pioneer figure or the leading figure in the field of value engineering
- He launched an effort to make the concept systematically
- Establishment of Society of American Value Engineers SAVE in 1959





# Value Engineering

An organized study of **FUNCTIONS** to satisfy the **USER'S NEED** with a **QUALITY PRODUCT** at the **LOWEST LIFE CYCLE COST** through **APPLIED CREATIVITY**

*Function is what the product or service is supposed to do*



# Value Engineering

## *Definition:*

- An analysis of materials, processes and products in which functions are related to cost and from which a selection may be made so as to achieve the desired functions at the lowest overall cost consistent with performance.
- An organized, creative, cost search technique for analyzing the function of a product with the purpose of value enhancement without compromising with its quality, performance and efficiency.



# Value Engineering

- VE is function oriented , systematic team approach and study to provide value in a product, system or services
- VE technique can be applied to any product, process, procedure, system or services in any kind of business or economic activity including health care, governance, construction, industry and in service sectors
- VE focuses on those value characteristics which are most important from the customer point of view
- VE is a powerful methodology for solving problems and/or reducing costs while maintaining or improving performance and quality requirements





# *Value Analysis*

- Value Analysis (VA) is concerned with existing products.
- It involves a current product being analyzed and evaluated by a team, to reduce costs, improve product function or both.
- Value Analysis exercises use a plan which step-by-step, methodically evaluates the product in a range of areas.
- These include costs, function, alternative components and design aspects such as ease of manufacture and assembly.



# Value Analysis

- A significant part of VA is a technique called Functional Analysis, where the product is broken down and reviewed as a number of assemblies.
- Here, the function is identified and defined for each product assembly.
- Costs are also assigned to each one.
- This is assisted by designing and viewing products as assemblies (or modules).
- As with VE, VA is a group activity that involves brainstorming improvements and alternatives to improve the value of the product, particular to the customer.

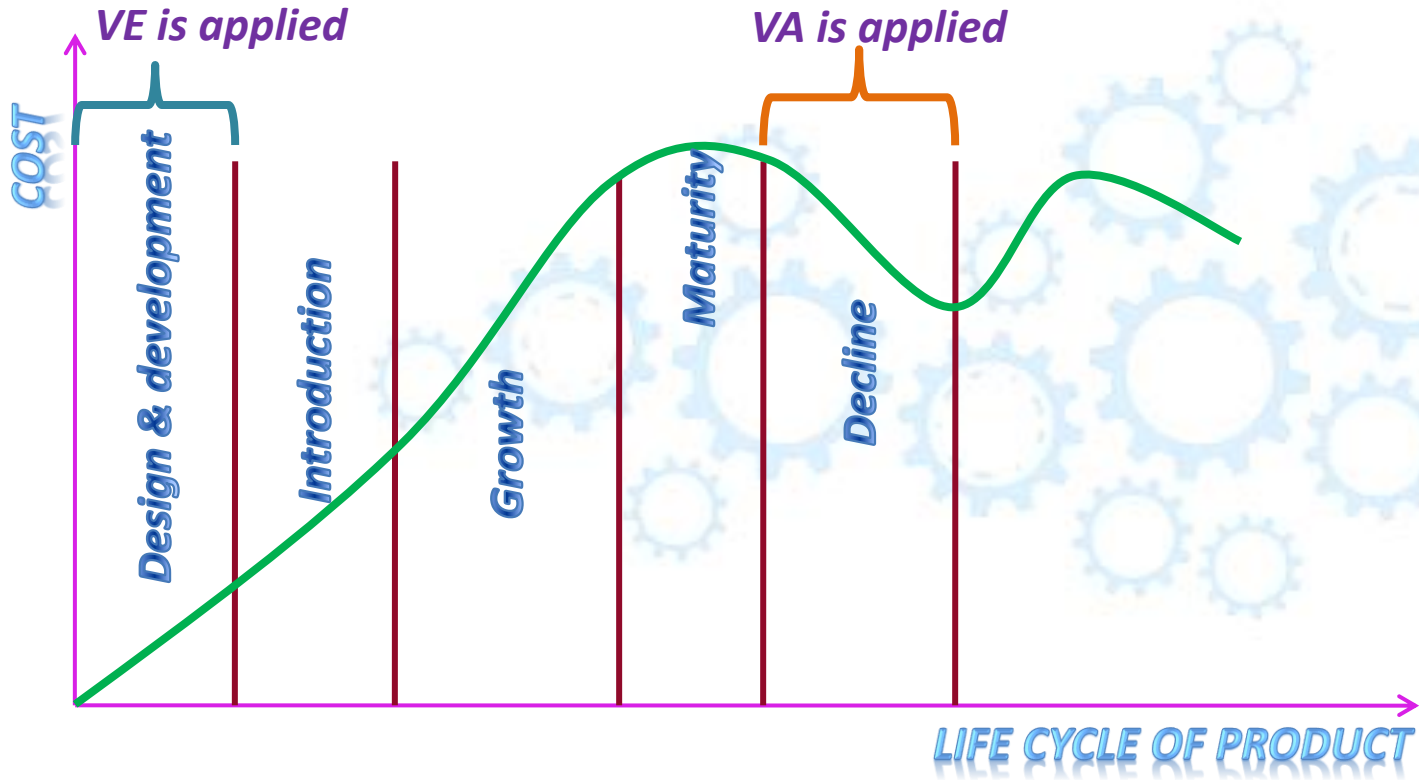


# Value Engineering vs Value Analysis

Value Engineering	Value Analysis
Value Engineering is the application of some set of techniques to a <b>new product</b> at the design stage , project concept or preliminary design when no hardware exists	Value analysis is the application of set of techniques to an <b>existing product</b> with a view to improve its value
Value Engineering is thus a <b>preventive process</b>	Value Analysis is thus <b>a remedial process</b>
Value Engineering is an <b>early stage</b> process	Value Analysis is done <b>after the birth</b> of the product
Value Engineering provides <b>better engineering results</b>	Value Analysis is done to have <b>better optimized commercial output</b>



# Application of VE and VA





# *Reasons for poor value...*

- Lack of and/or poor coordination among the designers
- Failure to network with customer - poor definition of needs and wants
- Design based on habitual thinking or mistaken beliefs
- Outdated or inappropriate design standards
- Lack of relevant information
- Incorrect assumptions based on poor information
- Fixation with previous design concepts





# VE v/s Cost reduction Techniques

## **Value Engineering**

## **Cost Reduction Techniques**

**1. It is**

**Function based**

**Equipment/material based**

**2. Focuses**

**Poor value functions**

**Big cost items**

**3. Results**

**Increases value**

**Scope (cost, quality..etc) reduction**

**4. Optimizes**

**Overall design**

**Local design**

**5. Clarifies**

**Client requirements**

**Nothing**



# *Use of Value Engineering*

- It is a cost prevention as well as cost elimination technique thus reducing cost of product
- Helps employees for better understanding of their jobs and orients them towards creative thinking
- Balance the cost and performance
- Prevents over design of components
- Motivates employees to come out with creative ideas
- Increases the profits and decreases costs
- Helps to satisfy the customer with company's product



# Value

- In the most fundamental concept of VE, the value defined by the following basic equation :

$$\text{Value} = \text{Worth} / \text{Cost}$$

- To measure worth, the product or process is first translated into the functions it performs and then the user acceptance of those functions is measured
- Worth is composed of “first impression plus experience”.
- Cost is also not simply the initial price but must also include follow-on costs during the life cycle of the product.
- The equation of modern VE includes all these factors :  
$$\text{Value} = (\text{user's initial impression} + \text{satisfaction in use}) / (\text{first cost} + \text{follow on costs})$$
$$= \text{Utility} / \text{Life cycle cost} = \text{Performance} / \text{Cost} = \text{Function} / \text{Cost}$$
- The value may be increased by :
  - Improving the utility without change in cost
  - Retaining same utility for less cost
  - Combining improved utility with less cost



# *Types of Value*

- **Use Value** :The properties and qualities which accomplish a useful purpose or service
- **Esteem Value** :The properties, features or attractiveness which causes us to want or own it
- **Cost Value** :The sum of labour, material and various other costs required to produce it
- **Exchange Value** :The properties or qualities which enable us to exchange it for something else we want



# Function

- FUNCTIONS which can be specified in terms of technical performance, reliability, life, appearance, maintainability, safety, weight, etc.
- VE defines function as that which makes a product or service to work or sell
- Function is certainly the end result or action desired by customer
- Value is measured by the relationship of these functions to the cost of providing them





# Function

- Many a time poor value may result in because the functions have not been precisely understood and redundant or unnecessary functions have been imposed
- **Questions that helps to achieve functions :**
  1. What is the purpose of a product?
  2. What does it cost?
  3. What is it worth?
  4. What alternative would do the same job?
  5. Is it exactly the same what it does for the customer?



# Function

- Function can be identified by two words: Verb & Noun
- Verb: Describes the specific action to achieve indented purpose
- Noun: Describes the object onto which the action operates
- E.g.

Product	Verb	Noun
Electric cable	Conducting	Current
Chair	Provide	Seat
Shaft	Transmit	Torque
Watch	Show	Time
Nail cutter	Cut	Nail
Pencil	Make	Mark



# Function

- Functions can be of two types:
  - a) Primary function b) Secondary functions

<i>Primary function</i>	<i>Secondary functions</i>
<i>Basic functions</i>	<i>Supporting function</i>
<i>Can not be changed</i>	<i>Can be modified or eliminated</i>
E.g.- Electric kettle	
Boil water	Indicate water level
	Water filtration
	Power indication
E.g.- Mobile phone	
Provide phone call	Camera
Text message	Games
Portability	Music and other apps



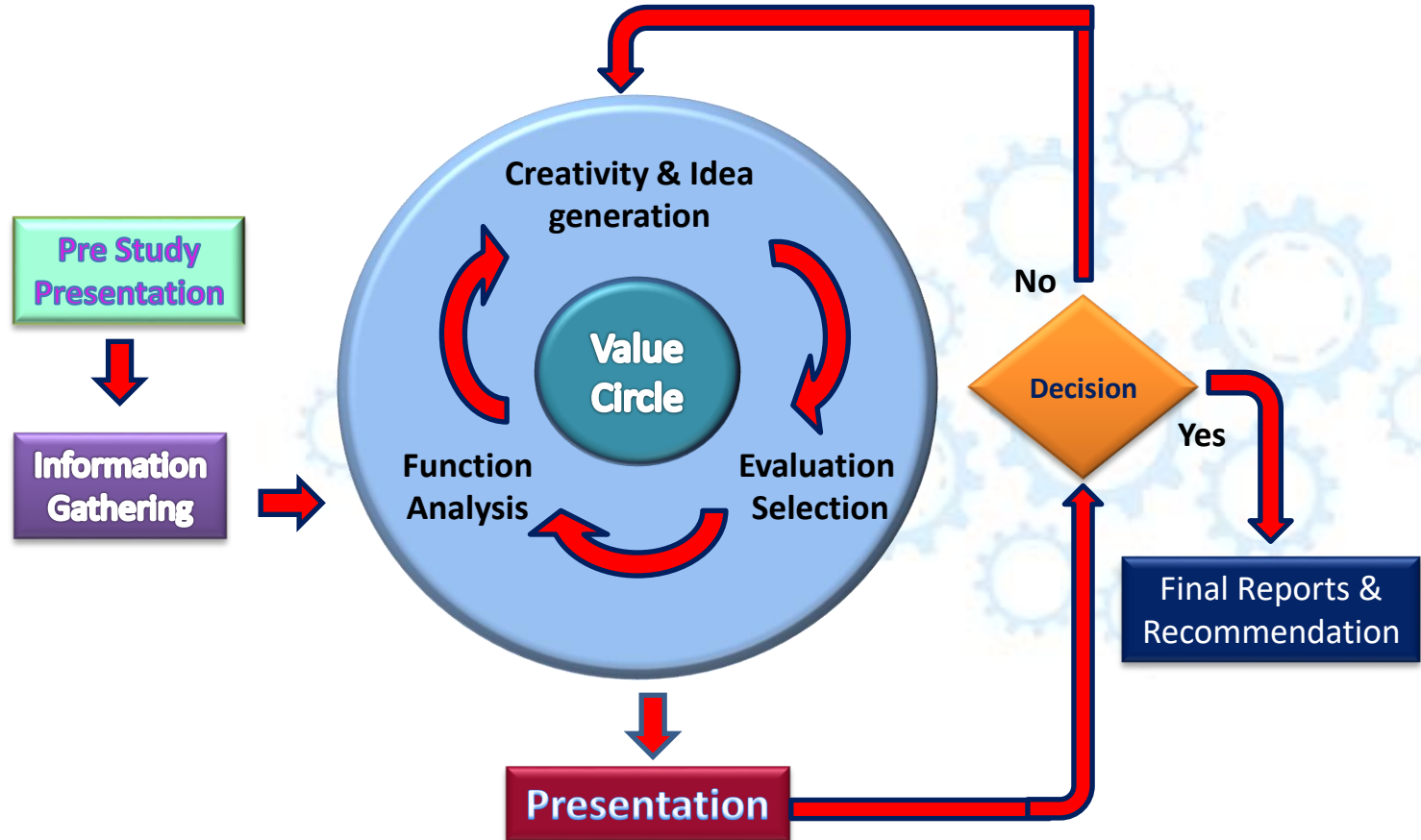
# Function

## Functions Analysis- Example- Lamp post

	<i>Part</i>	<i>Function (Verb, Noun)</i>	<i>Primary</i>	<i>Secondary</i>
1.	Foundation	Support Load		✓
		Resist load		✓
		Transfer load	✓	
2.	Anchor Bolt	Transfer load	✓	
		Hold pole		✓
3.	Base	Hold pole		✓
		Support pole	✓	
		Cover bolts		✓

	<i>Part</i>	<i>Function (Verb, Noun)</i>	<i>Primary</i>	<i>Secondary</i>
4.	Extension arm	Hold fixture		✓
		Spread light	✓	
		Protect wire		✓
5.	Housing	Hold bulb	✓	
		Transfer electric power		✓
		Diffuse light	✓	
6.	Light bulb	Reflect light		✓
		Produce light	✓	
		Dissipate light		✓

# Value Engineering /Analysis Cycle





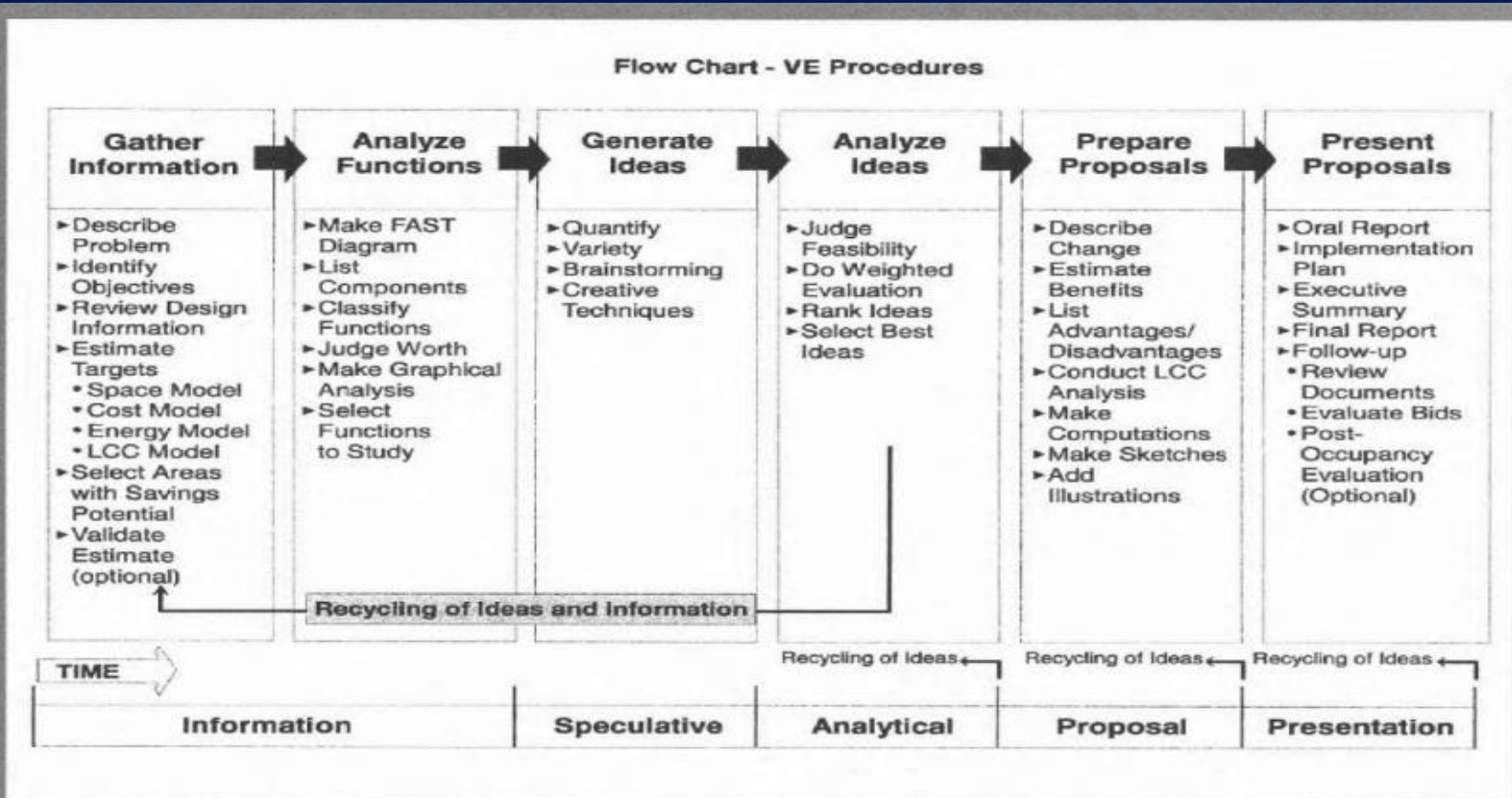


# Value Engineering Job Plan

- The VA Job Plan is the structured set of steps, or phases which are followed during the Value Study. The job plan includes a combination of creative and analytical techniques.
- The following six-phased job plan is as recognized by SAVE International
  - Information Phase
  - Function Analysis Phase
  - Creative Phase
  - Evaluation Phase
  - Development Phase
  - Presentation Phase
- Some organizations may elect to define the Job Plan as having more or less phases, but the overall methodology remains unchanged. The value study Job Plan typically includes pre-workshop, workshop, and post-workshop activities.



# VE procedure flow chart





# Steps in Value Engineering / Analysis





# Orientation/ Preparation

- Identify what is to be analyzed. This will typically be one of:
  - A manufactured item. This can be anything from a screw to an engine, although a more complex item is likely to result in a more complex and time-consuming analysis.
  - A process or service. Again, all levels can be analyzed, from a hand assembly process to a complete customer service organisation.



# *Orientation/ Preparation*

- Key Questions “WHY”
- What Is The Problem?
- Why Is It A Problem?
- Why Must It Be Solved?
- Why Was It Solved As Proposed?
- What Does It Cost?

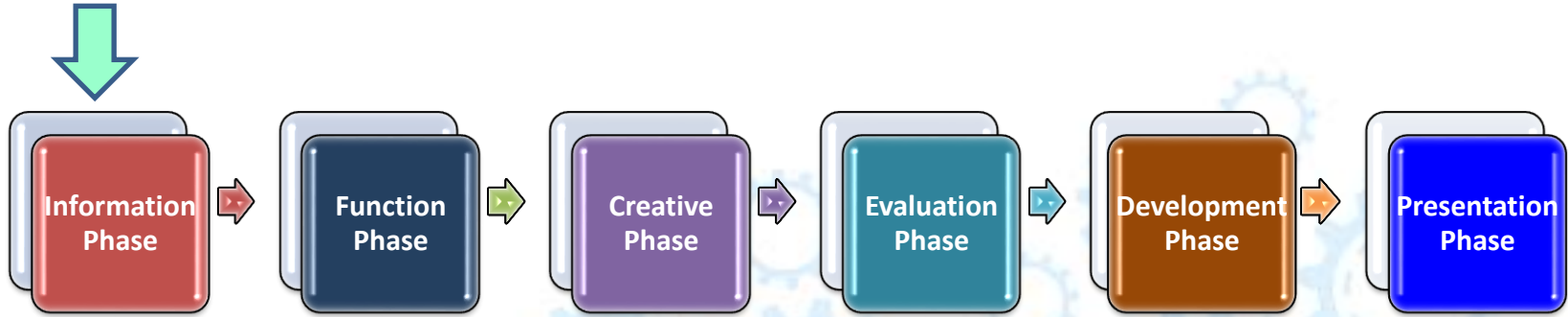




# Information Phase

- The purpose of the Information Phase is to gain an understanding of the problem and any solutions that have been proposed.
- Project related information and data is reviewed to help the team establish a thorough understanding of the objectives and the context.
- This asks what the requirements are for the object. Function analysis, an important technique in value engineering, is usually done in this initial stage. It tries to determine what functions or performance characteristics are important. It asks questions like; What does the object do? What must it do? What should it do? What could it do? What must it not do?
- The complexity of the project, the amount of information and time available will influence the level of effort, and time devoted to the Information Phase.
- The success of a Value Analysis Study is dependent upon on having relevant, accurate information that is significant to the project, product or service under examination.

# Information Phase



*Gathering of all  
information  
related to product  
or service*

## ***Techniques***

- Function Analysis
- Categorize Functions
- Function Logic FAST diagram
- Value Index (Worth to Cost)

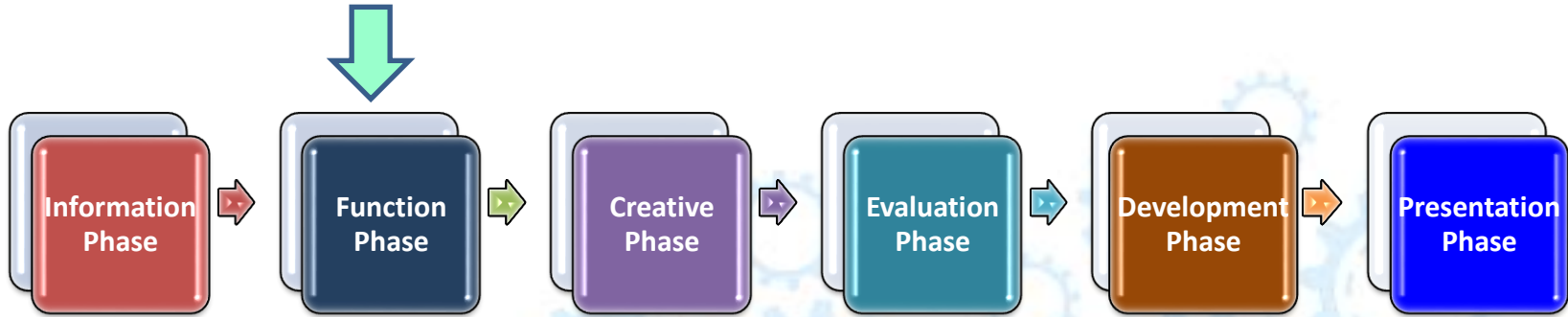


# *Function Analysis Phase*

- Function Analysis is a technique used to identify and understand the needs of the project, product or service, (what does it do, what must it do)
- In Function Analysis, functions are described in two- word Verb - Noun definitions that describe the needs of the project, product or service being examined.
- The two words used to describe a function include an active verb and a measurable noun.
- The measurable noun identifies something that can be described and quantified.
- Although the function of a project, product or service could be provided in a descriptive paragraph, a verb-noun definition ensures concise descriptions that focus on one function at a time.



# Function Analysis Phase



*What must be  
done versus how  
is it being done?*

## ***Techniques***

- Function Analysis
- Categorize Functions
- Function Logic FAST diagram
- Value Index (Worth to Cost)

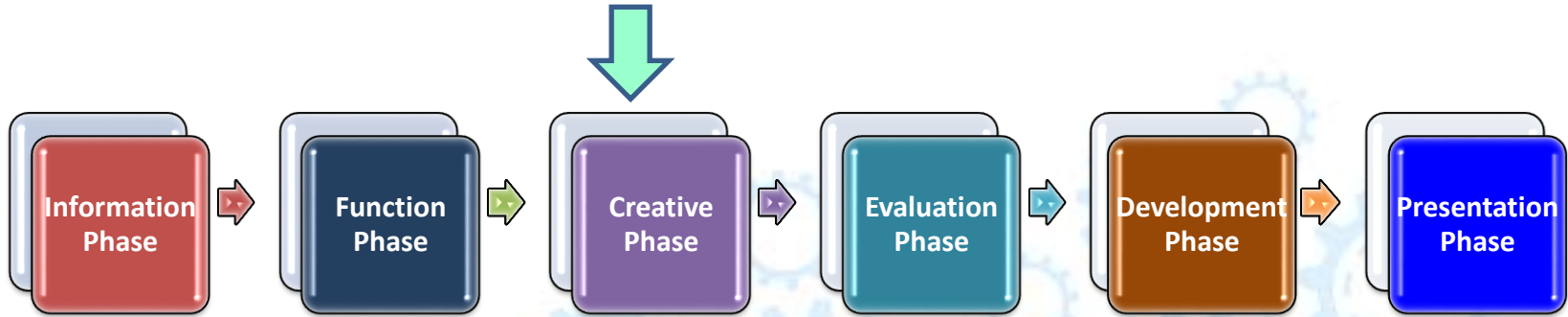


# Creative Phase

- The Creative Phase is an opportunity for the team to use their creativity and produce alternate means of performing the functions associated with the product, service or project.
- The goal is to generate as many ideas as possible in a short period of time.
- This can be accomplished through Function-based Brainstorming.
- The Creative Phase, using Function-based Brainstorming, ensures that many ideas are generated based on the project needs or functions.
- Objective is to Generate as many alternate ideas as possible for accomplishing the functions. The greater the number of alternatives produced, the more likely that value can be improved.
- In this stage value engineers ask; What are the various alternative ways of meeting requirements? What else will perform the desired function?



# Creative Phase



*What Else Will  
Accomplish the  
Basic  
Function(s)?*

## *Techniques*

- Creative Thinking - Brainstorming
- Set aside policies & rules
- Depart from the Norm
- Good Human Relations

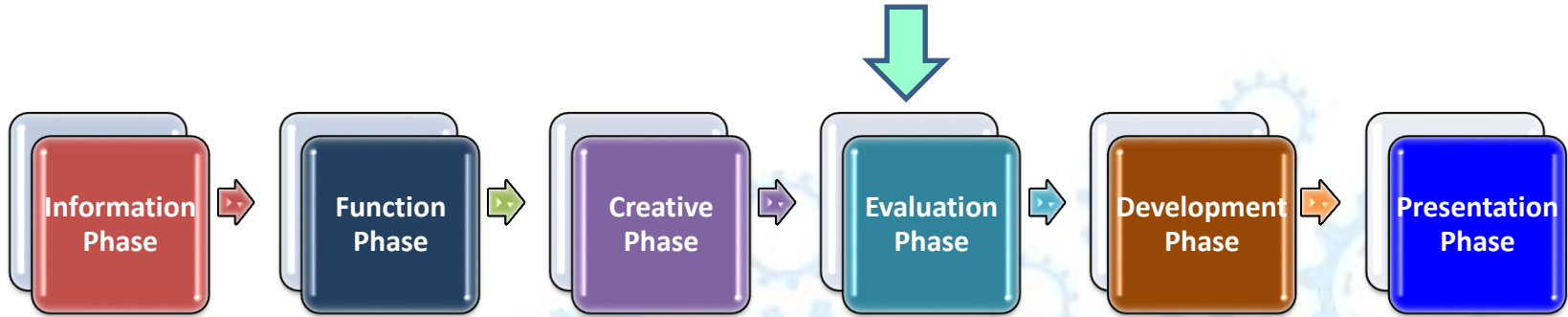




# Evaluation Phase

- This is where the ideas generated from the Creative Phase are systematically evaluated, screened prioritized and short-listed for their potential to save cost and/or value.
- In this stage all the alternatives are assessed by evaluating how well they meet the required functions and how great the cost savings will be
- There is not enough time during a VA to develop all the good ideas from the Creative Phase. This means that the team must focus on the best ideas for development in order to achieve the best value.

# Evaluation Phase



*Select “the Best Ideas for Development”*

## *Techniques*

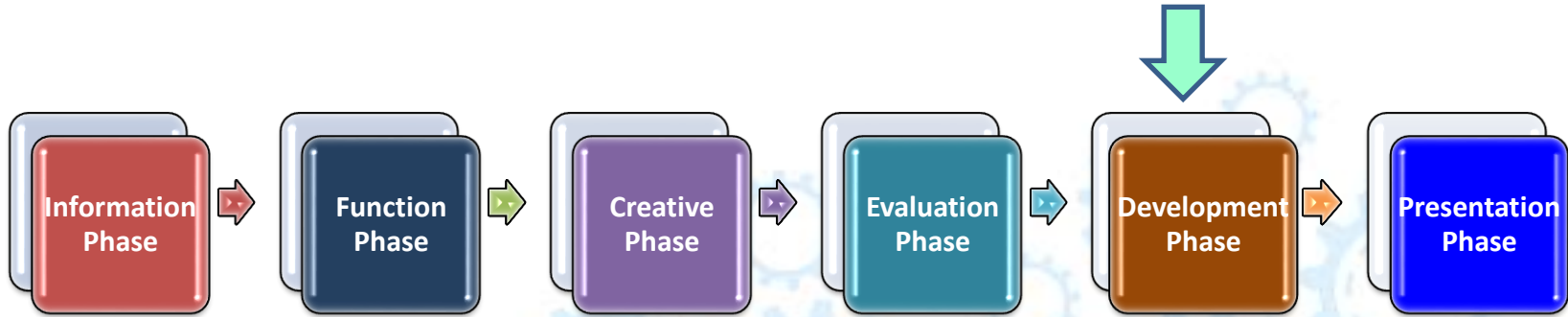
- Analysis Matrix
- Voting
- Voting with Discussion
- Consensus



# *Development Phase*

- The Development Phase involves exploring in detail the ideas selected in the Evaluation Phase.
- The process involves obtaining costs, creating drawings, schedules and any other data that will allow the idea to be compared to the original solution.
- The objective of the Development Phase is to develop the idea/alternative in sufficient detail for the idea to be compared the originally proposed solution.
- This will enable the owner or decision maker to make a knowledgeable decision on whether to accept and implement the proposal.

# Development Phase



*Turn Ideas into  
Supported  
Recommendations  
for Change*

## **Techniques**

- Explain & Validate Concepts
- Develop Scenarios to compare to base case
- Make Comparisons – measure performance & cost of scenarios and base case



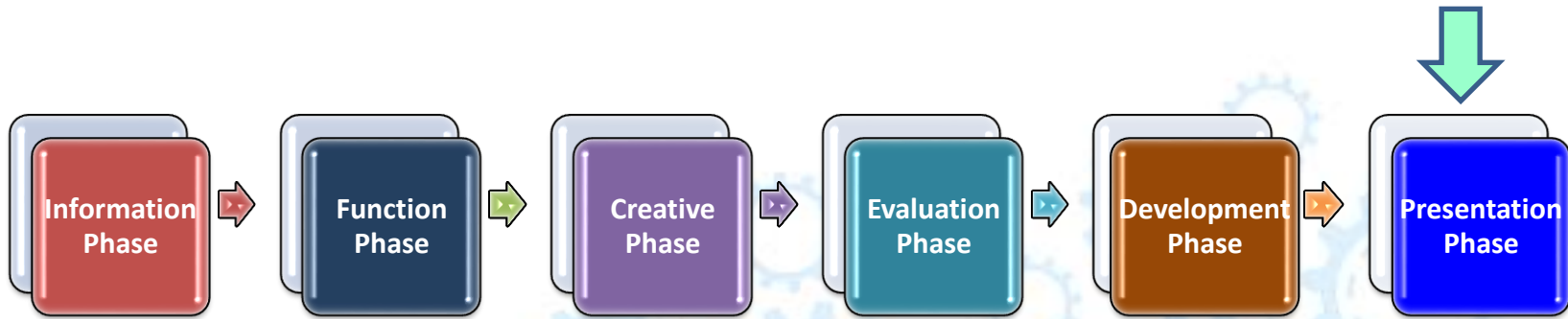
# Presentation Phase

- The Presentation Phase is the team's opportunity to present the proposals they have generated, and that they believe represent better value than the originally proposed solution.
- The Presentation Phase is also an opportunity for decision makers to question the team and assess the depth of analysis that has taken place.
- The presentation of credible recommendations that improve value substantially increases the likelihood of a proposal being implemented.
- Confidence in the value team and their recommendations flows from a carefully structured presentation.
- Questions raised by decision makers and stakeholders highlight the depth of analysis.
- Objective is to Demonstrate depth, knowledge, and thoroughness in order to sell ideas and Provide opportunity for decision makers to question team and assess recommendations.





# Presentation Phase



*Present Results  
of Study to the  
Owner or  
Management*

## ***Techniques***

- Oral Presentation
- Written Report
- Answer Questions
- Discover Oversights





# FAST

- Functional Analysis System Technique (FAST):
- **Charles Bytheway** developed the **FAST diagrams** in **1964**
- FAST diagrams are **FUNCTION ORIENTED** **not time oriented**
- FAST **permits** people with **dissimilar technical background** or from diverse technical backgrounds to effectively **communicate** and **resolve the issues** that require **multi-disciplined consideration**
- FAST **builds** up the value analysis by **linking** the simply expressed **verb noun function** to describe the **complex system**
- FAST is **not** an **end product** or result, but **rather** a **beginning**

## First Fast Diagram...by Charles Bytheway





# Functional Analysis System Technique (FAST)

- **Visual layout** (Tree Diagram) of **products function**
- **Starts** with the **basic function** and builds to the right with the supporting or the **secondary function**

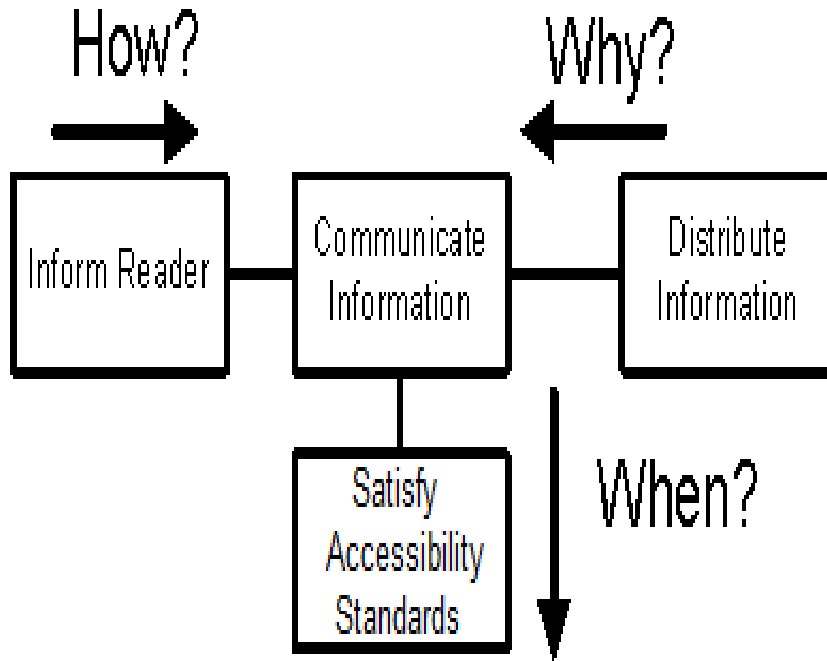
Why do we need to draw FAST diagram?

- To understand the functions
- so to be eliminated or improved
- to deliver the basic functions

*A technique to develop a graphical representation showing the logical relationships between the functions of a project, product, process or service based on the questions “How” and “Why”.*



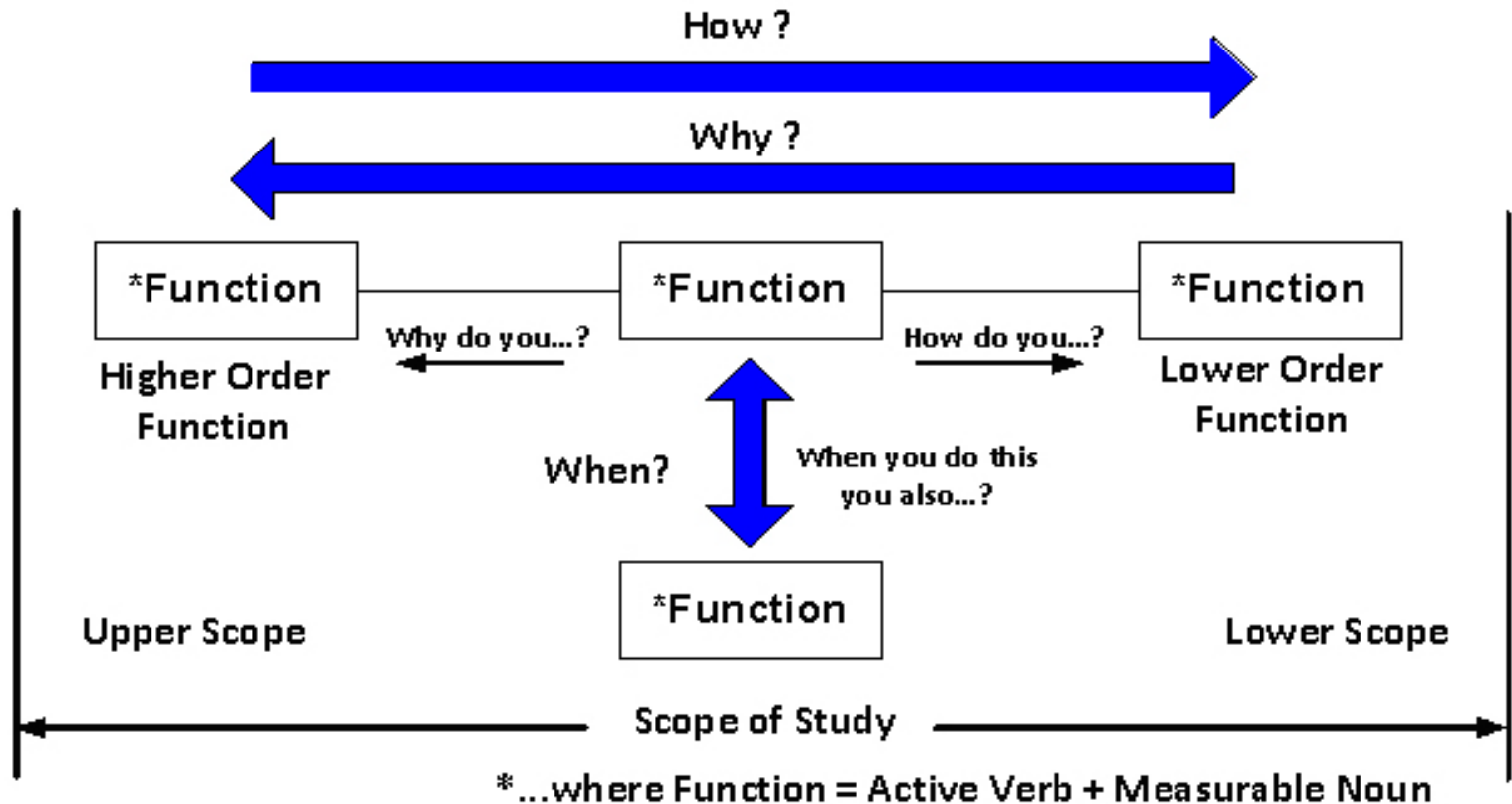
# Functional Analysis System Technique (FAST)



- Three key questions are addressed in a FAST Diagram:
- How do you achieve this function?
- Why do you do this function?
- When you do this function, what other functions must you do?



# How To Create a FAST Diagram





# Steps in constructing the FAST Diagram

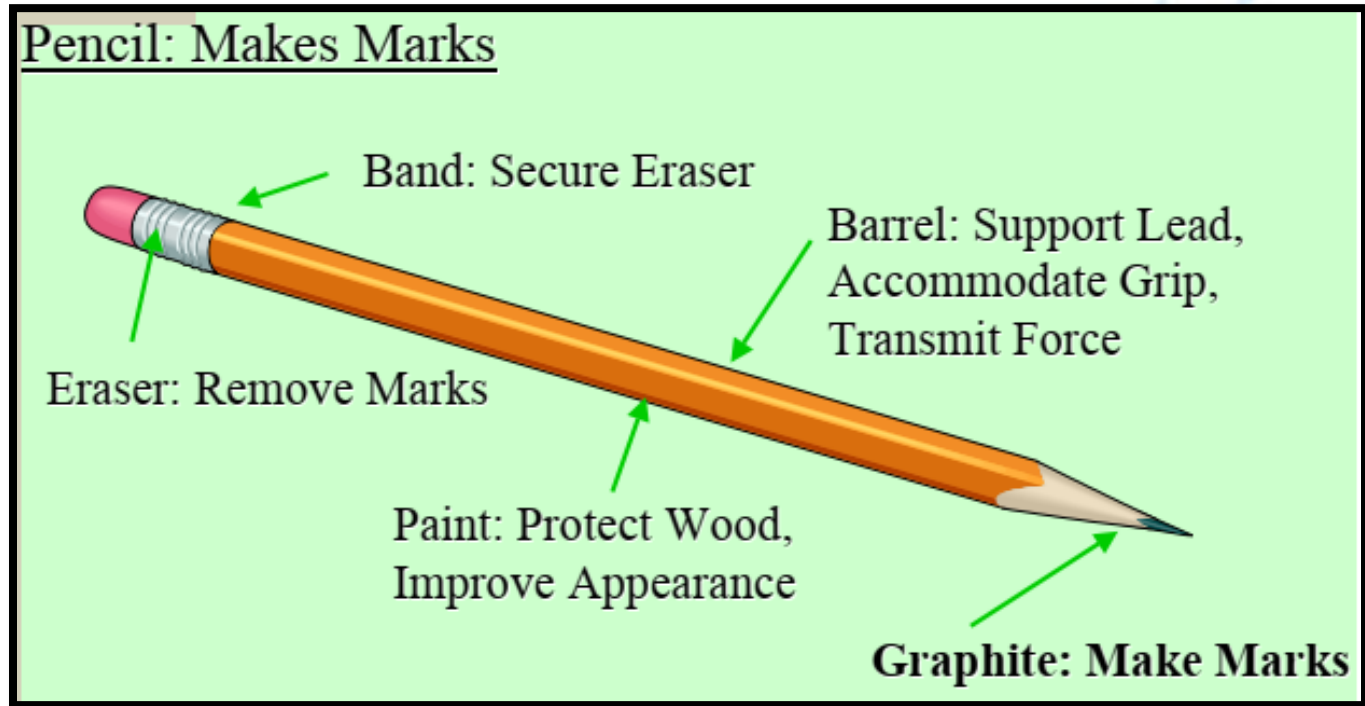
Start with the Functions as identified using Function Analysis:

- Expand the functions in the "How" and "Why" directions:
- Build along the "How" path by asking 'how is the function achieved'? Place the answer to the right in terms of an active verb and measurable noun.
- Test the logic in the direction of the "Why" path (right to left) by asking 'why is this function undertaken?'
- When the logic does not work, identify any missing or redundant functions or adjust the order.
- To identify functions that happen at the same time, ask "when this function is done, what else is done or caused by the function?"
- The higher order functions (functions towards the left on the FAST Diagram) describe what is being accomplished and lower order functions (functions towards the right on the FAST Diagram) describe how they are being accomplished.
- "When" does not refer to time as measured by a clock, but functions that occur together with or as a result of each other.



# Example Fast Diagram: Pencil

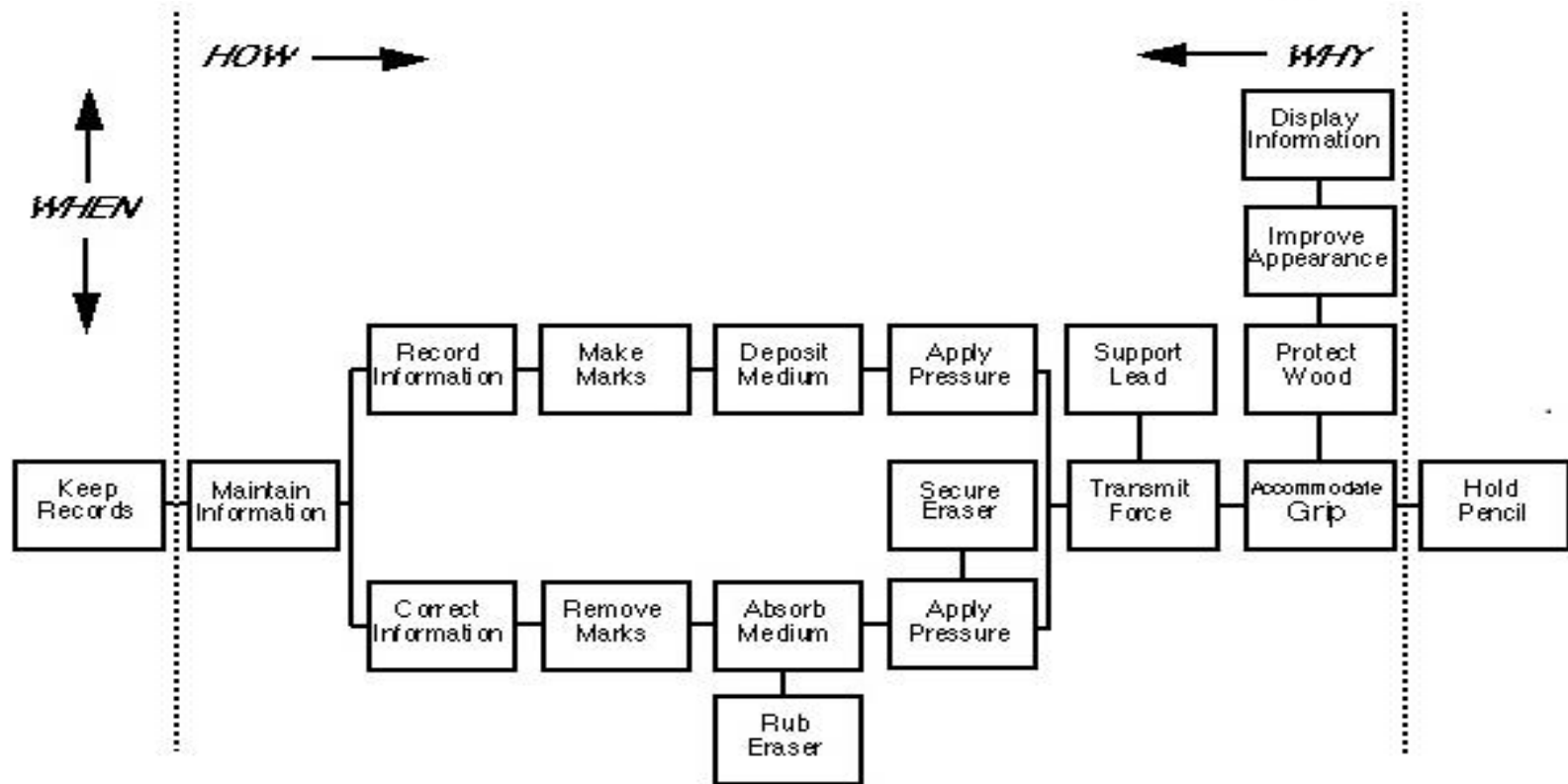
- What is the function of a pencil?





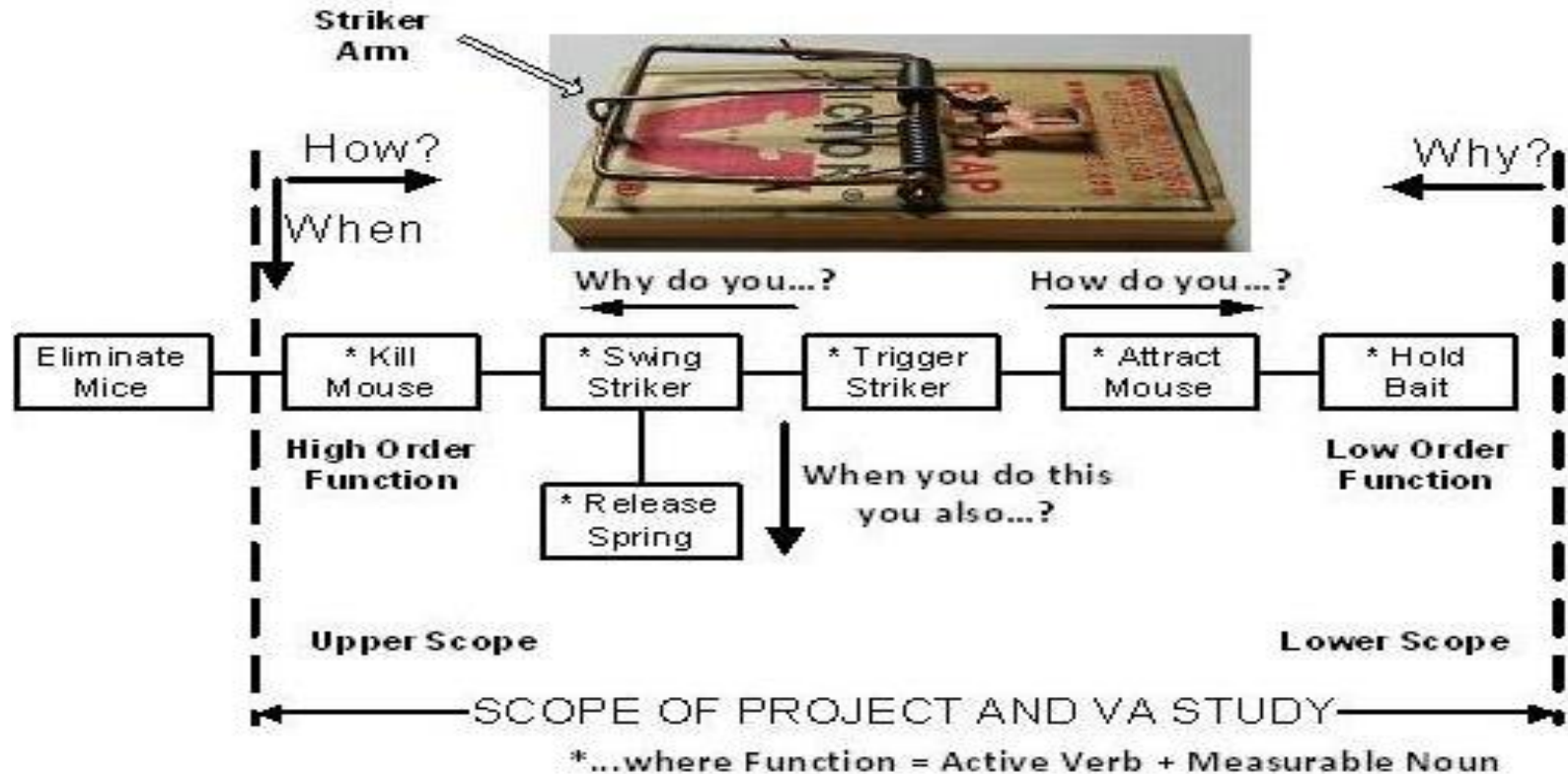


# Example Fast Diagram: Pencil



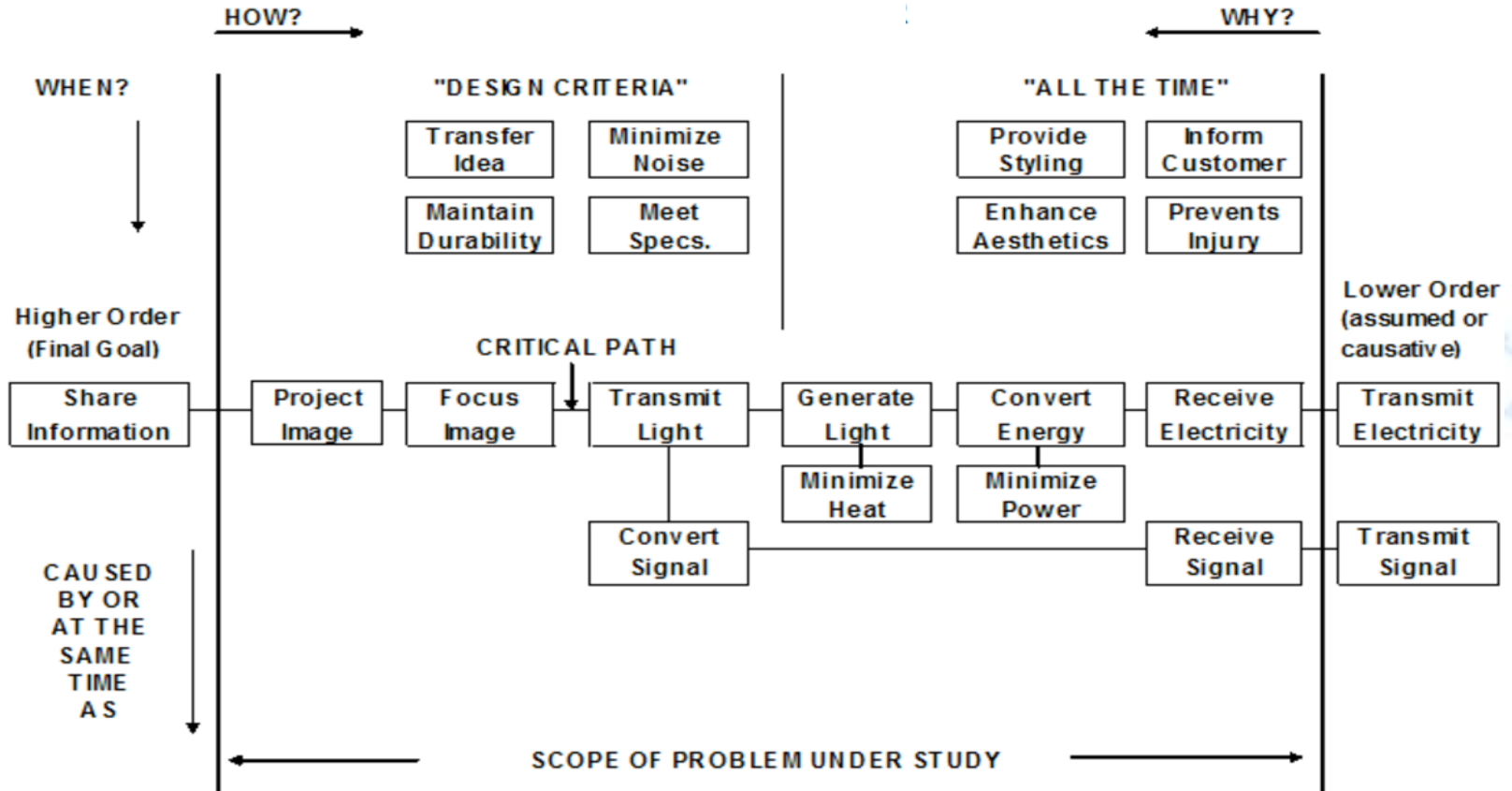


# Example Fast Diagram: Mouse Trap

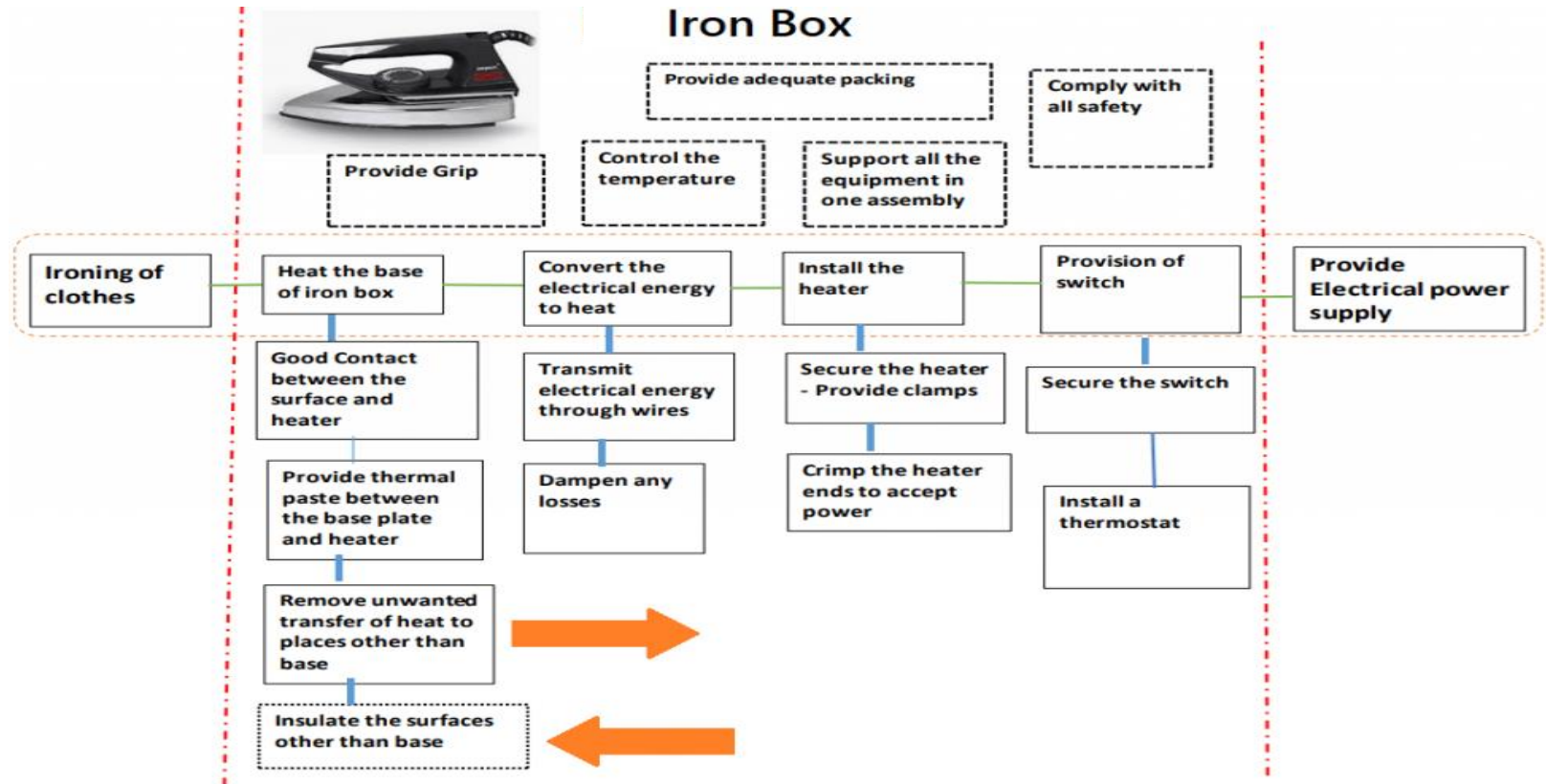




# Example Fast Diagram: PC Projector

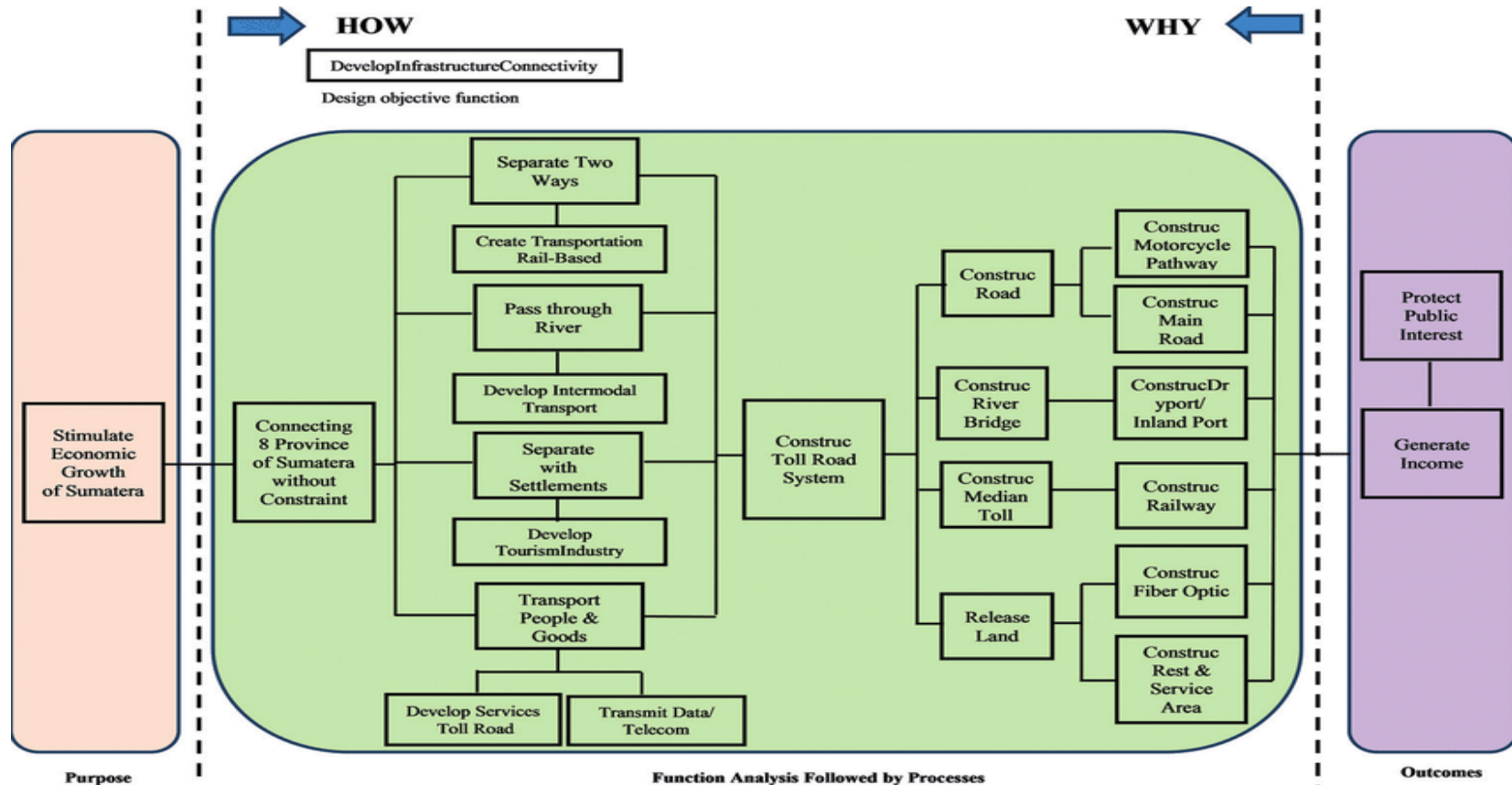


# Example Fast Diagram: Iron Box





# Example Fast Diagram: Highway Project







# *Functional Analysis System Technique (FAST)*

## ***Benefits of FAST:***

- The development of a FAST diagram is a creative thought process which supports communication between team members.
- The development of a FAST diagram helps teams to:
- Develop a shared understanding of the project
- Identify missing functions.
- Define, simplify and clarify the problem.
- Organize and understand the relationships between functions.
- Identify the basic function of the project, process or product.
- Improve communication and consensus.
- Stimulate creativity.



# Value Engineering Benefits

- Value Engineering helps in improving efficiency as well as effectiveness of products, systems and procedures

## *Value Engineering :*

- *Enables people to pinpoint areas that need attention and improvement*
- *Provides a method of generating ideas and alternatives for possible solution to a problem*
- *Provides a means of evaluating alternatives including intangible factors*
- *Provides a vehicle for dialogue*
- *Documents the rationale behind decisions*
- *Materially improves the value of goods and services*



# *Application of VE in organization*

- Value Engineering has been very extensively applied in product design, systems and procedures and a very large number of case studies have been reported in books and journals on VE
- In many of these case studies, large amounts of savings have been reported
- In Indian industries, VE applications have been reported from TISCO, Hero Honda, Escorts, TELCO, Kelvinator, Indian Railways and other units in Public and Private sectors
- It is also known to have been applied in Indian Army and Navy
- **For example:**
- **Problem** : Reduce the number of guards by combining entrances to classified areas.
- **Function** : Monitor doors
- **General explanations and solutions** : It was difficult to reduce the number of doors to the classified areas. However, it was found that each guard could monitor and control two entrance doors by using close-circuit television (CCTV) and electric door locks.



# Checklist

- A checklist is a type of informational job aid used to reduce failure by compensating for potential limits of human memory and attention
- It helps to ensure consistency and completeness in carrying out a task
- A basic example is the "to do list."
- A more advanced checklist would be a schedule, which lays out tasks to be done according to time of day or other factors
- A primary task in checklist is documentation of the task and auditing against the documentation



# Checklist

The following list of issues should be considered during this stage:

- A. Material Specification and Content
  - 1. What material is used
  - 2. Why is this material used
  - 3. Can the materials be substituted with another, material
  - 4. Can the dimensions be reduced
  - 5. Oversize by calculation





# Checklist

- B. Material & Manufacturing
  - 1. How much of the basic material is wasted in conversion
  - 2. What are the causes of the waste
  - 3. Can the waste be reduced
  - 4. Can alternative methods
  - 5. Can the materials be provided in a different format
  - 6. Can parts be made for many products
- C. Standardization
  - 1. Is the component made from the standard raw material
  - 2. Is the component standard
  - 3. Can the special parts be replaced with standard parts



# Checklist

- D. Direct Labour Costs
  - 1. What are the labour operations involved
  - 2. What are the direct labour costs
- E. Tolerances & Finishes
  - 1. What tolerances have been specified and why were they specified as control items
  - 2. What are the critical limits
  - 3. Are all specified tolerances relaxed to ease manufacture, to allow an alternative method of manufacture or
    - permit a lower purchase costs
- F. Costs of material
  - 1. What parts are bought-out?



# University Questions

1. Short Note: Value analysis and its significance
2. What is value analysis? What are its objectives? How does it differ from value engineering?
3. Define value. State how it can be increased? Describe various types of values
4. What are the different cost incurred while increasing the value of the product?
5. Draw a FAST diagram considering the example of a 'Pen'
6. What is value analysis ? What are its objectives? How does it differs from value engineering?
7. Define value. State how it can be increased ? Describe various types of value.
8. What is FAST diagram? Construct a FAST diagram for a ball point pen
9. Define value engineering. Steps in the value engineering. Distinction between value engineering and value analysis
10. Explain in detail the concept of value engineering and value analysis with the steps in implementation of the same.
11. What are the steps to be considered in value analysis? Explain with the help of example.
12. What are the different cost incurred while increasing the value of the product?