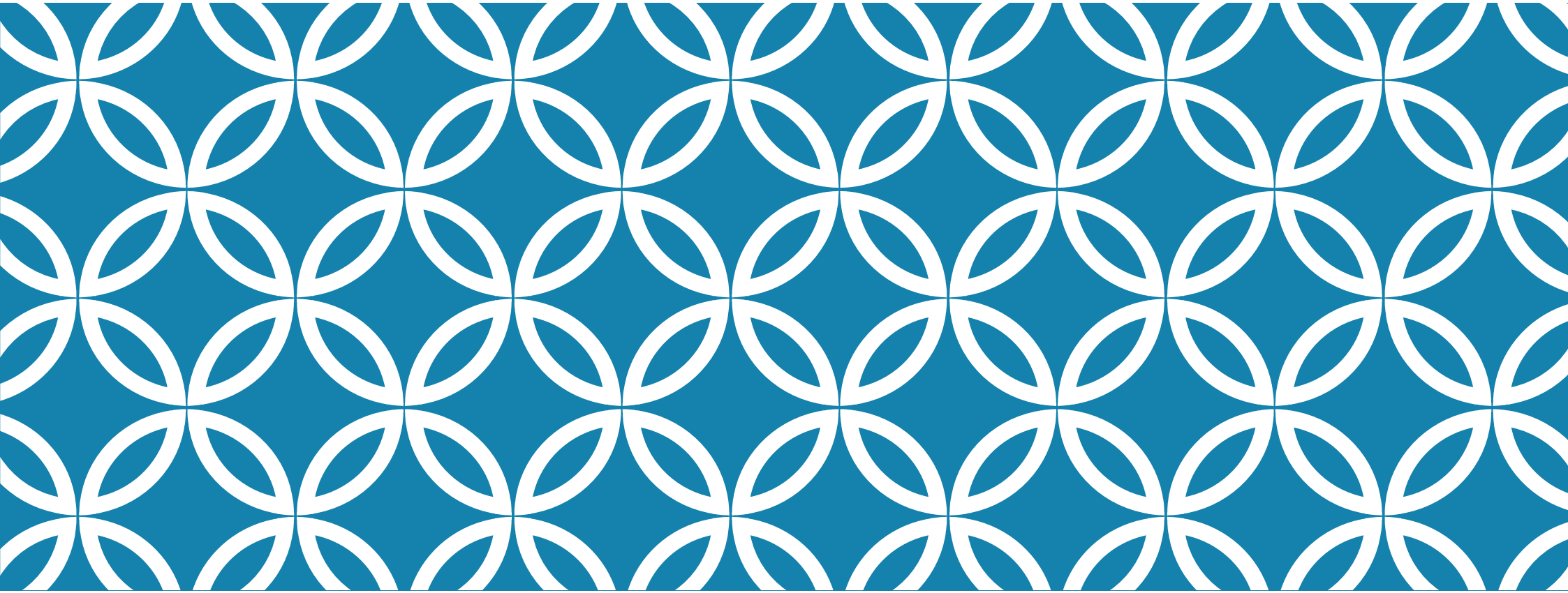
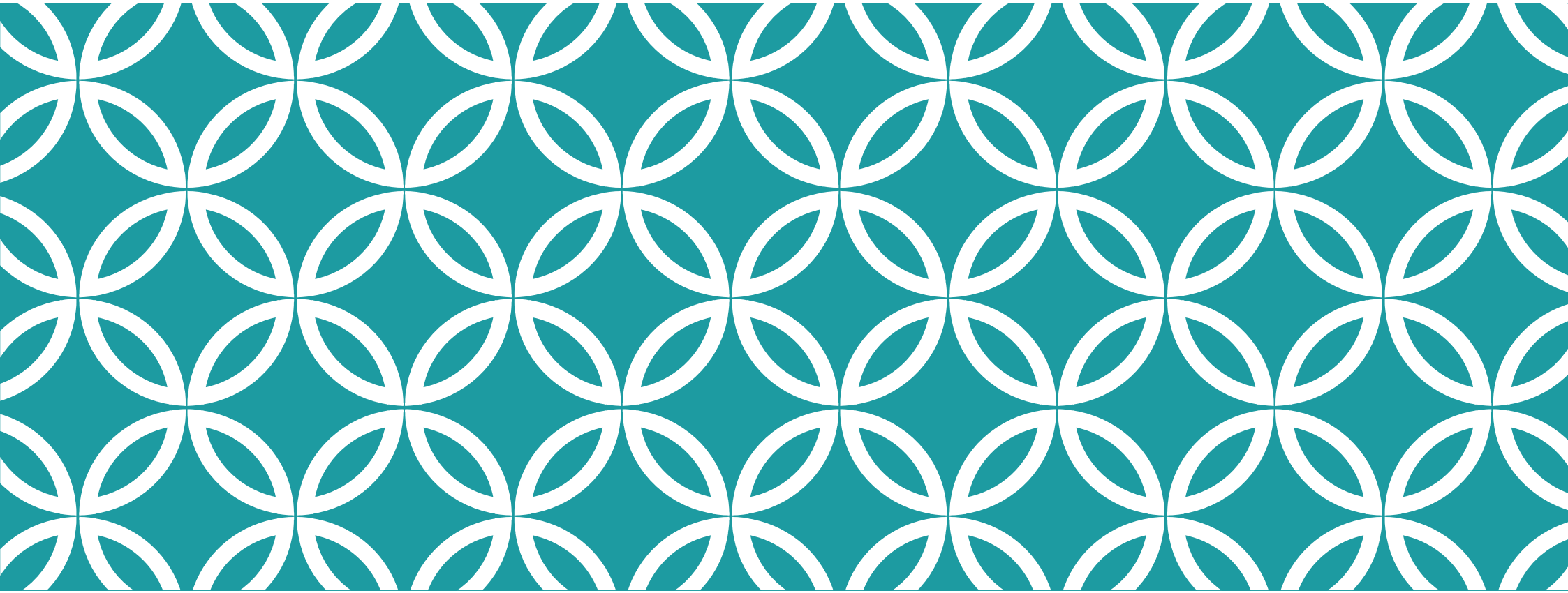


VALUE ENGINEERING LECTURE 3

Ahmed Elyamany



WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

Purpose:

Understand the project from a functional perspective; what must the project do, rather than how the project is currently conceived.

Fundamental Question:

What are the functions and how are they related?

WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

Common Activities:

- Identify the project functions (team format strongly encouraged)
  - **Tools:** Random Function Identification
- Classify project functions
- Develop function models
  - **Tools:** Function Analysis System Technique (FAST), Function Tree

WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

Common Activities:

- Dimension the model with cost drivers, performance attributes and user attitudes to select value mismatched functions to focus the creativity phase
  - **Tools:** Cost to Function Analysis(Function Matrix), Failure Measurement Error Analysis (FMEA), Performance to Function Analysis, Relate Customer Attitudes to Functions

WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

Common Activities:

- Estimate worth of functions to select value-mismatched functions on which to focus the creativity phase.
  - **Tools:** Value Index (function cost/function worth)

WORKSHOP (JOB PLAN) ACTIVITIES
FUNCTION ANALYSIS PHASE

Typical Outcome:

- This phase focuses the team on validating that the project satisfies the need and objectives of the customer.
- It provides a more comprehensive understanding of the project by focusing on what the project does or must do rather than what it is.
- The team identifies value-mismatched function(s) on which to focus in order to improve the project.

FUNCTION ANALYSIS

Function Analysis: The process of defining, classifying and evaluating functions.

FUNCTION: The original intent or purpose that a product, service or process is expected to perform. It is expressed in a two-word **active verb/measurable noun** structure.

FUNCTION ANALYSIS
1. DETERMINE THE FUNCTIONS

The ***verb*** should answer the question, **"What does it do?"**
For example, it may generate, shoot, detect, emit, protect, or launch.

The ***noun*** answers the question, **"What does it do this to?"**
The noun tells what is acted upon, (e.g., electricity, bullets, movement, radiation, facilities, or missiles).

FUNCTION ANALYSIS
1. DETERMINE THE FUNCTIONS

Products	Design construction	Services
provide power	provide spec	establish criteria
contain liquid	vary shape	validate action
protect user	reduce creep	communicate information
reduce effort	minimize errors	translate information
control temperature	support load	receive results
vary capacitance	establish grade	verify compliance

FUNCTION ANALYSIS
1. DETERMINE THE FUNCTIONS

Two Words ensure:

- Focuses on function rather than the item.
- Encourages creativity.
- Frees the mind from specific configurations.
- Enables the determination of unnecessary costs.
- Facilitates comparison.

FUNCTION ANALYSIS
1. DETERMINE THE FUNCTIONS

- Defining the mission of the product, process, service, or organization.
- Brainstorm all possible functions necessary to accomplish the mission. Identify functions with high costs and/or poor performance-function.
- Build a Function Analysis System Technique (FAST) Model to help identify any missing functions and show dependencies.
- Assign costs to functions - function costs

FUNCTION ANALYSIS
2.**CLASSIFY THE FUNCTIONS**

- Functions grouped into two categories, basic and secondary.
- **Basic function** is the required reason for the existence of an item or a product, and answers; **"What must it do?"**
  - A basic function is the primary purpose or most important action performed by a product or service. The basic function must always exist.
- There may be more than one basic function.

FUNCTION ANALYSIS
2.**CLASSIFY THE FUNCTIONS**

Secondary functions answer the question **"What else does it do?"** Secondary functions are support functions and usually result from the particular design configuration. Generally, secondary functions contribute greatly to cost and may or may not be essential to the performance of the primary function:

There are four kinds of secondary functions:

FUNCTION ANALYSIS
2.CLASSIFY THE FUNCTIONS

1. **Required:** A secondary function that is essential to support the performance of the basic function under the current design.

2. **Aesthetic:** A secondary function describing esteem value.

3. **Unwanted:** A negative function caused by the method used to achieve the basic function such as the heat generated from lighting which must be cooled.

4. **Sell:** A function that provides primarily esteem value. For marketing studies, it may be the basic function

FUNCTION ANALYSIS
2.**CLASSIFY THE FUNCTIONS**

- **FUNCTION WORTH:** The lowest overall cost to perform a function without regard to criteria or codes.
- **HIGHER ORDER FUNCTION:** The specific goals (needs) for which the basic function(s) exists.
- **LOWER ORDER FUNCTION (ASSUMED or CAUSATIVE):** The function that is selected to initiate the project and is outside the study scope.

FUNCTION ANALYSIS
2.CLASSIFY THE FUNCTIONS

Basic/Secondary/Unnecessary function

Item	Function	Basic Function	Secondary Function
Flashlight	Provide Light	X	
Lens	Focus Light, Protect Bulb		X
Front Glass	Protect Bulb		X
Front cap	Hold Glass		X
Rear Cap	Retain Spring		X
Bulb	Provide Light	X	
Cell	Provide Energy	X	
Thread on Cap	Permit Access		X

ANALYSIS OF EACH COMPONENT

1. Can the item be eliminated without impairing the operation of the complete unit?
2. If the item is not standard, can a standard item be used?
3. If the item is standard, does it completely fit the application?
4. Does the item have greater capacity than required?
5. Can the weight be reduced?

ANALYSIS OF EACH COMPONENT

6. Is there a similar item in inventory that could be substituted?
7. Are closer tolerances specified than are necessary?
8. Can you make the item less expensive in your plant?
9. If you are making it now, can you buy it for less?
10. Can cost of packaging be reduced?
11. Are suppliers contributing suggestions to reduce cost?

FUNCTION ANALYSIS
3. DEVELOP FUNCTION RELATIONSHIPS

Relationships between functions are developed using
FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST)

Different types of FAST

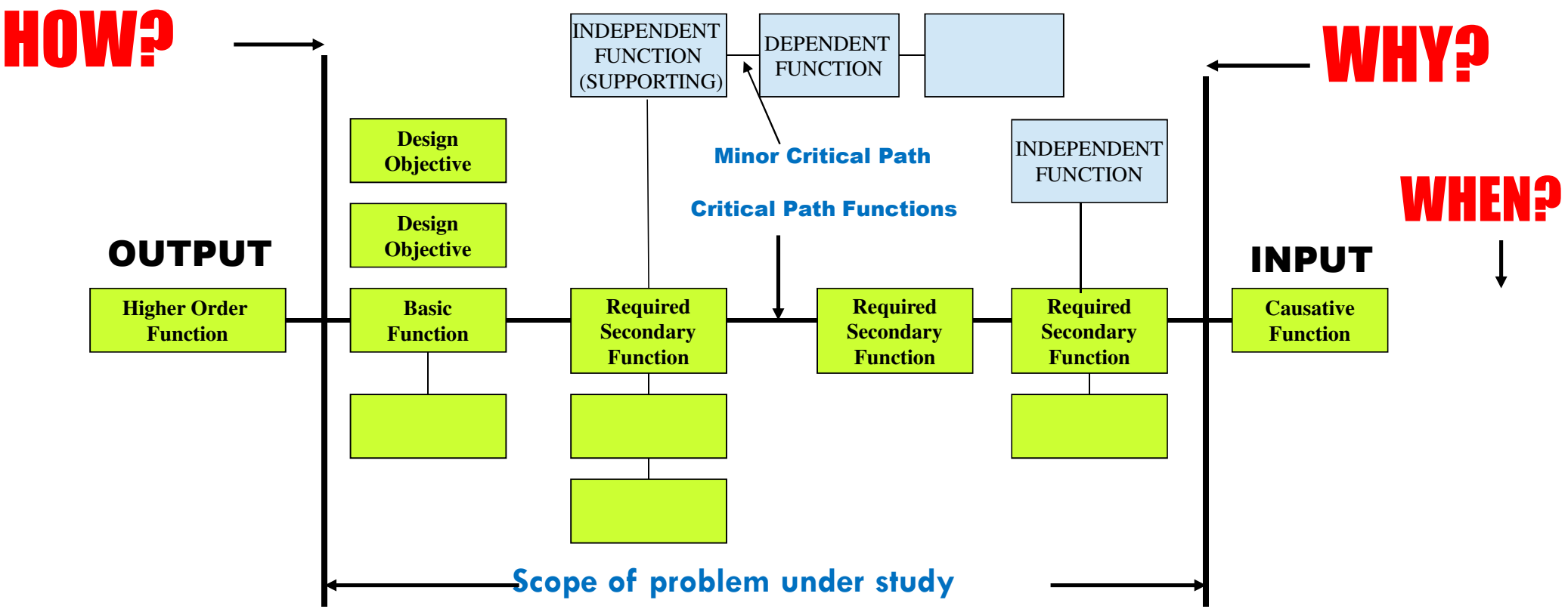
1. Classic FAST
2. Technically Oriented FAST
3. Customer Oriented FAST

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

A graphical representation of the dependent relationships between functions within a project.

- ***Classical FAST Model:*** A function displaying the interrelationship of functions to each other in a "how-why" logic. This was developed by Charles Bytheway.

CLASSIC FAST MODEL



HOW TO DRAW A FAST DIAGRAM

CLASSICAL FAST MODEL

1. Prepare a list of all functions.
2. Use verb and noun to define a function.
3. Write each function in a small card.
4. Involve the whole team in the diagramming exercise.
5. Select the card which appears to be a basic function.
6. Apply logical question ‘how’ and ‘why’ on selected function to determine functions to right and left on this selected function.
7. Functions satisfying ‘how–why’ logic are ‘Major Critical Path’ functions to be put in line.

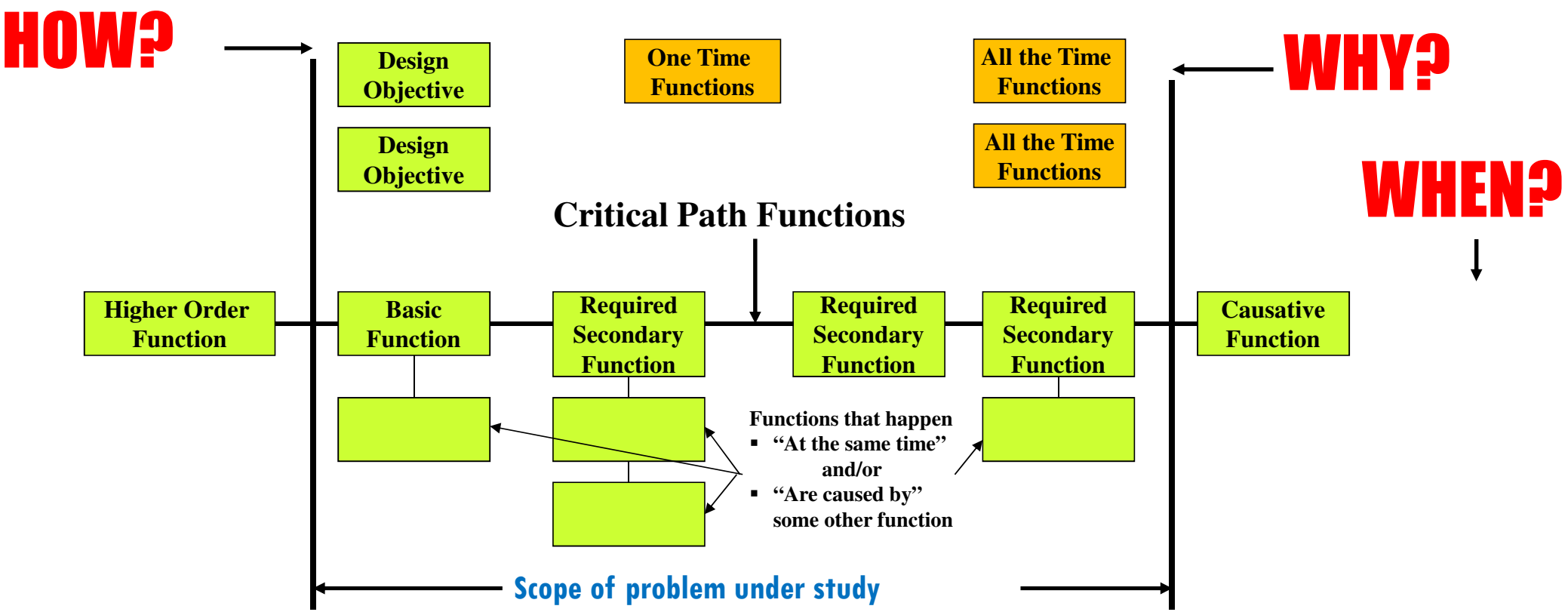
HOW TO DRAW A FAST DIAGRAM
CLASSICAL FAST MODEL

8. Draw scope line (dotted line) on left side of basic function.
9. Place higher order functions on the left side of scope line.
10. '**Independent function**' can branch out from the function of the Major Critical Path.
11. '**Dependent function**' may come from the independent function. This path is called Minor Critical Path.
12. '**Design objectives**' is placed above the basic function.
13. Right scope line (dotted) to be drawn left of function that is suitable input to the system.
14. Function right to the right side of right scope line is lower order/causative function

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

- ***Technical FAST Model:*** A variation to the Classical FAST that adds "**all the time**" functions, "**one time**" functions and "**same time** " or "**caused by**" functions.

TECHNICALLY-ORIENTED FAST MODEL



HOW TO DRAW A FAST DIAGRAM

TECHNICAL FAST MODEL

1. Prepare a list of all functions.
2. Use verb and noun to define a function.
3. Write each function in a small card.
4. Involve the whole team in the diagramming exercise.
5. Select the card which appears to be basic function.
6. Apply logical question ‘how’ and ‘why’ on selected function to determine functions to right and left on this selected function.
7. Functions satisfy ‘how–why’ logic are ‘required secondary’ functions to be put in line.

HOW TO DRAW A FAST DIAGRAM

TECHNICAL FAST MODEL

8. Draw scope line (dotted line) on left side of basic function.

9. Higher order function on the left side of scope line.

10. ‘All time function’ to be placed in right hand top corner above critical path.

11. ‘Design objectives’ is placed above the basic function.

12. Functions that happen ‘at the same time’ placed below that function.

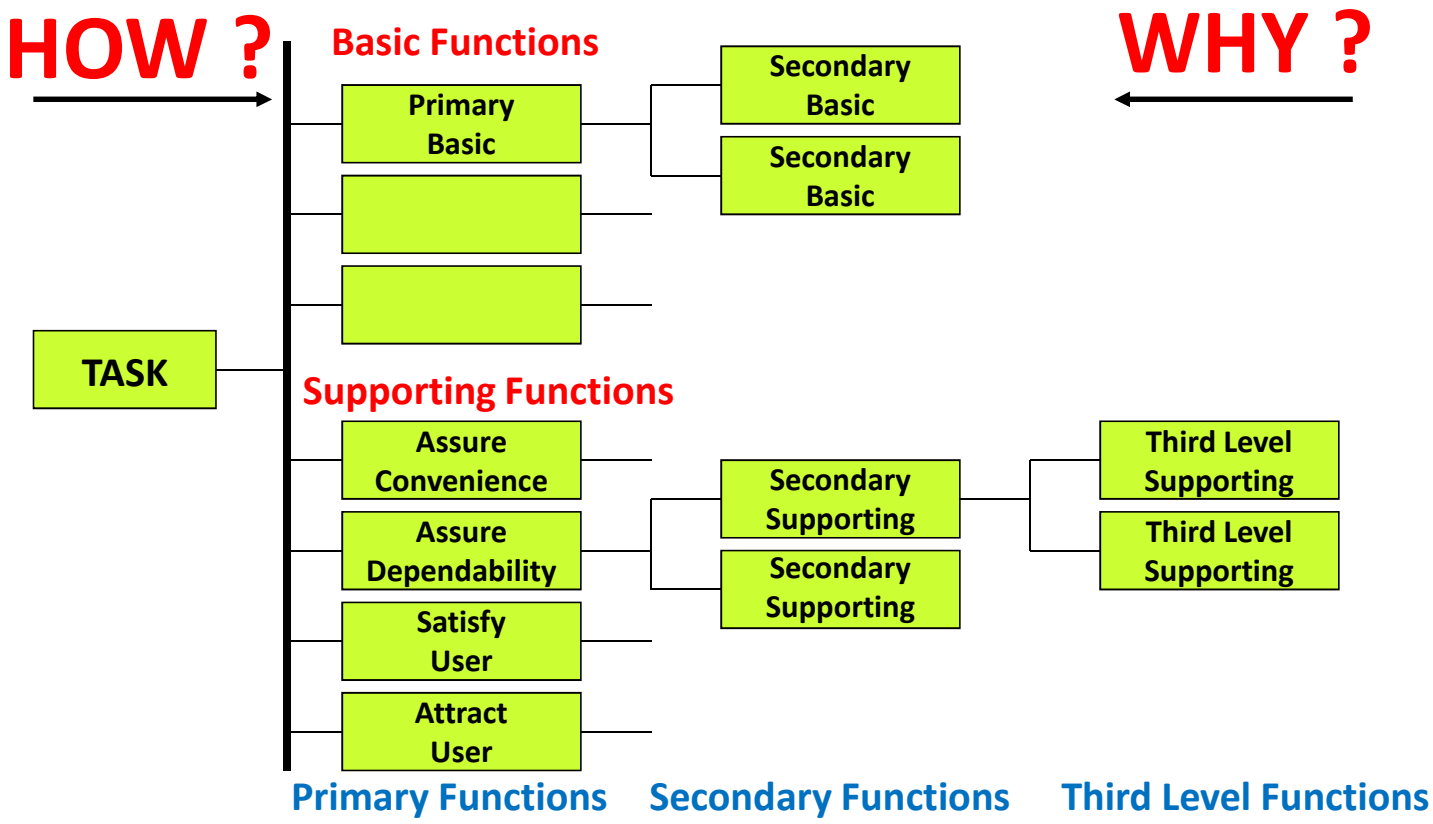
13. Right scope line (dotted) to be drawn left of function that is suitable input to the system.

14. Function right to the right side of right scope line is lower order/causative function

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

- ***Customer-Oriented FAST Model:*** This variation of the FAST diagram was developed to better reflect that it is the customer that determines value in the function analysis process. Customer-oriented FAST adds the supporting functions: **attract users**, **satisfy users**, **assure dependability**, and **assure convenience**. The project functions that support these customer functions are determined by using the **how-why** logic.

CUSTOMER-ORIENTED FAST MODEL



HOW TO DRAW A FAST DIAGRAM
CUSTOMER-ORIENTED FAST MODEL

1. Prepare a list of all functions.
2. Use verb and noun to define a function.
3. Write each function in a small card.
4. Involve the whole team in the diagramming exercise.
5. Select the card which appears to be basic function.
6. Apply logical question ‘how’ and ‘why’ on selected function to determine functions to right and left on this selected function.
7. The logical question ‘why’ to basic function will provide ‘task’.

HOW TO DRAW A FAST DIAGRAM
CUSTOMER-ORIENTED FAST MODEL

8. Draw scope line (dotted line) on left side of basic function.

9. ‘Task’ will be on the left side of scope line.

10. Support functions should be placed below the basic function.

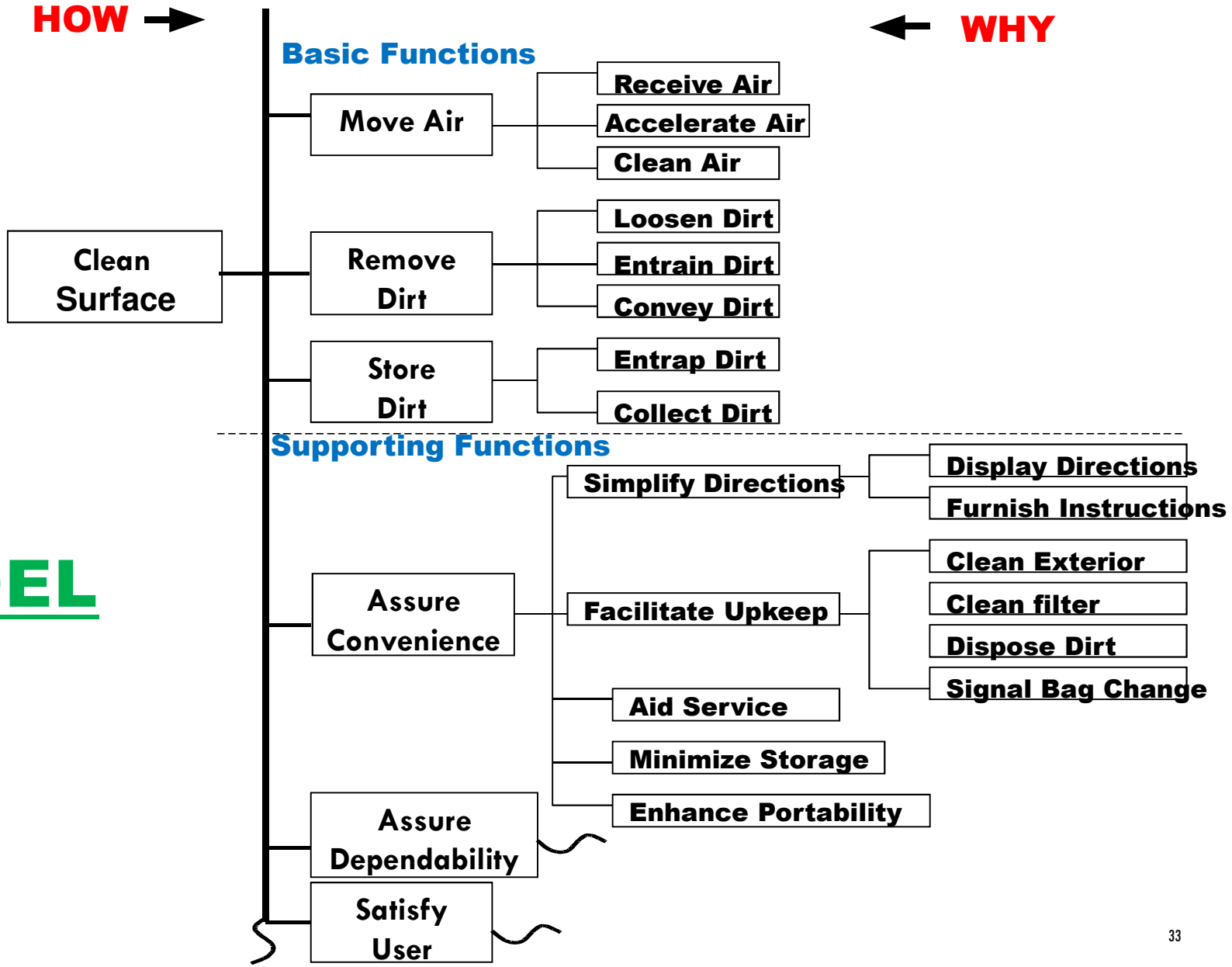
11. There are four supporting functions at the primary level.

12. They are: ‘assure convenience’; ‘assure dependability’; ‘satisfy user’; ‘attract user’.

13. Each supporting function will branch out to secondary level function.

14. Secondary level functions will branch out to third level functions

FAST MODEL VACUUM CLEANER



F.A.S.T MODEL
OVERHEAD PROJECTOR

HOW? → ← WHY?

WHEN

OUTPUT

INPUT

CONVEY Information

FACILITATE PORTABILITY

ALLOW SAFETY

OBJECTIVES OR SPECIFICATIONS

PROJECT IMAGE

(concept)

(concept)

FOCUS IMAGE

SUPPORT IMAGE

AMPLIFY IMAGE

GENERATE LIGHT

CONVERT ENERGY

GENERATE HEAT

DISSIPATE HEAT

GENERATE NOISE

RECEIVE CURRENT

TRANSMIT CURRENT

4. ESTIMATE FUNCTION COST

The cost of the original or present method of performing the function (i.e., the cost for each block of the FAST diagram) is determined as carefully and precisely as possible given the time constraints for preparing the estimate.

5. DETERMINE THE BEST OPPORTUNITIES FOR IMPROVEMENT

The objective of this activity is to select functions for continued analyses.

This is often accomplished by comparing **function worth** to **function cost**, where:

Function Value = Function Worth / Function Cost

5. DETERMINE THE BEST OPPORTUNITIES FOR IMPROVEMENT

- Cost data aid in determining the priority functions.
- Costs are usually distributed in accordance with Pareto's Law:
  - 20 % of the items represent 80 % of the total cost.
  - 80 % of the items represent only 20 % of total costs.
- Savings potential in low-cost areas may not be a worthwhile.
- High-cost areas may be indicative of poor value, and are prime candidates for initial function worth determination.

FUNCTION WORTH

The Function–cost–worth analysis is an excellent tool to identify the value improvement potential in any function. This tool will not only help to identify the potential but will also give some creative ideas as to how to achieve that. This may also be considered the first step towards creativity.

FUNCTION WORTH
CONCEPT OF WORTH

1. Worth is the minimum cost of achieving a function.

2. Worth is an indispensable element of VE.

3. Worth varies with time.

5. Worth is usually determined by thinking of other methods of performing functions.

6. Worth is just a technique, not an absolute value.

7. Where an item has several functions, determine worth of

each function separately and add them to get overall worth.

FUNCTION WORTH
PROCEDURE FOR COST ALLOCATION

1. Split the product into components and system into activities.

2. Define functions of components.

3. Divide the total cost of product into components cost.

4. Component provided to achieve particular function; cost allocated to that function.

6. Component accomplishes more than one function; allocation should be based on weight, volume, surface area and length.

7. Hold each function in isolation of the others to do this.

FUNCTION WORTH
VALUE GAP AND VALUE INDEX

- The difference between cost and worth is known as ‘value gap’.
- It indicates the scope of possible value improvement.
- The value index is the ratio of cost by worth.
- In other words, it is the cost per unit of worth.
- Value Index >1, means there is potential for value improvement.
- The ultimate aim of the Function–cost–worth analysis is to find out the value improvement in various functions. Based on these findings, the team will approach the problem.

FUNCTION WORTH
VALUE GAP AND VALUE INDEX

The following steps are required to draw the Function–cost–worth matrix:

1. Write down all functions for the project as a whole.

2. Divide the project into parts.

3. Function(s) of each part to be defined in two words.

4. Apply three tests to identify the basic and secondary functions.

1) Is this function what users are looking for?
   - **Yes: Basic** **No: Secondary**

2) If this function is eliminated, will the item continue to do the job?
   - **No: Basic** **Yes: Secondary**

3) Will the function disappear, if the design approach is changed?
   - **No: Basic** **Yes: Secondary**

FUNCTION WORTH
VALUE GAP AND VALUE INDEX

5. Cost of each part to be ascertained.

6. Cost of the part to be transformed into function.

7. Check whether the cost of the functions are equal to the sum of the costs of the parts.

8. Assess the worth (least cost of achieving) functions. First list all functions and costs in descending order. Then ask the following questions:

- Will you pay if it is your money?
- If not, what do you consider reasonable?
- By whom or where a similar function is available at lower cost?
- What should you do to obtain the function within that cost?

FUNCTION WORTH
FUNCTION–COST–WORTH MATRIX

Item/ compo-nent	*Function*			*Present cost (Rs)*	*Worth*		*Value index/ value gap*
	Verb	*Noun*	*Type*		*Tent. Alt*	*Est. cost of Alt (Rs)*	
Rice	Supply	Carbo-hydrate	Basic	15.00 per kg	Tapioca	5.00 per kg	Rs 3/ 10.00

VALUE INDEX

V.I. = Total Costs/Critical Path Costs

- Critical path costs : the absolute minimum cost to perform the higher order function by the method under consideration

If V.I. ≤ 1.5

- The costs are still too high
- You must find another way to perform the higher order function - another basic function

FUNCTION ANALYSIS TECHNIQUES

- Mismatch functions
- Pareto analysis
- Cost/Function Matrix

MISMATCH FUNCTIONS

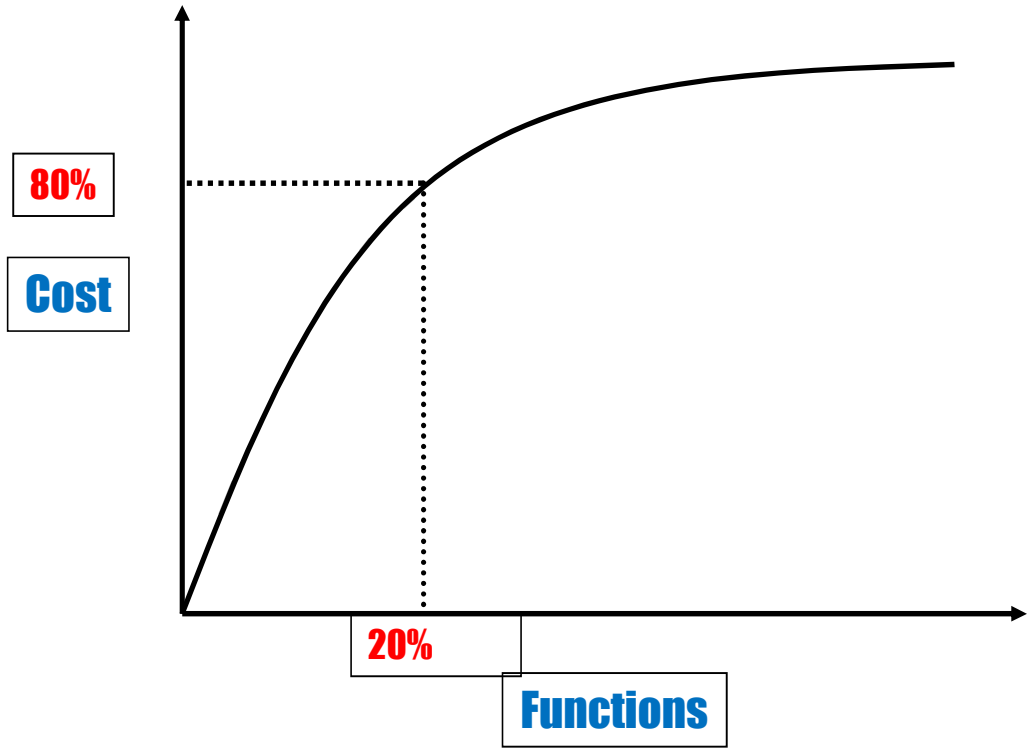
Indicators of **mismatch function** include:

- Having several functions but many contributor to the overall objective
- **Few functions** fulfilling the basic need
- **Too much effort** being spent to achieve a few function
- **Worth** is greater than cost or costs are greater than worth
- Value of some functions are not contributing to the **overall value**

PARETO ANALYSIS

"In a large number of elements, a small number of these elements will account for the most cost."

Approximately, **80%** of cost by **20%** of the items rank order functions



PARETO ANALYSIS

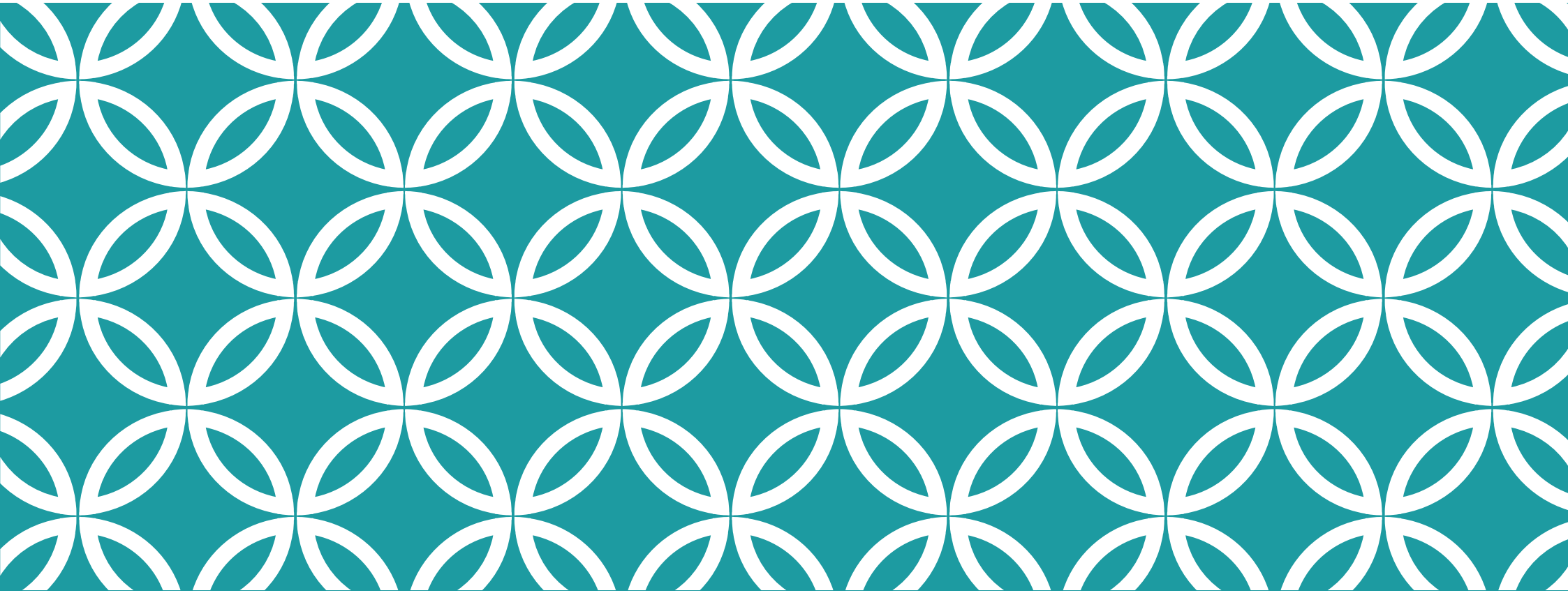
1. List the most costly functions in descending order until you have accounted for approximately 80% of the total cost
2. Look for functions where cost is out line
3. Don’t overlook functions for which the performance is unacceptable

COST/FUNCTION MATRIX

- Position critical path functions on the top of the matrix.
- Use costed activities that relate to the functions.
- Allocate cost to each function.

REGULATORY POLICY AND GUIDANCE
COST/FUNCTION WORKSHEET
DIRECT FUNDED ACTIVITIES

ACTIVITIES,		FUNCTIONS (VERB-NOUN)										
OPERATIONS,	ACTIVITY	ESTABLISH	DISSEMINATE	SUPOORT	ISSUE	RESOLVE	DEVELOP	INTERPRET	IDENTIFY	REVIEW	PROGRAM	
ASSEMBLIES,	COST	POLICY &	ENV.	COMPLIANCE	POLICY	COMPLIANCE	REGULATORY	REQUIREMENTS	APPLICABLE	REGULATIONS	ADMIN	TOTAL
OR PARTS		GUIDANCE	INFORMATION	ATTAINMENT	STATEMENTS	ISSUES	POSITIONS		REQUIREMENTS			
Serve as Focal Point for Reg. Ccontacts & Track Contacts	25,732					25,732						25,732
Represent Company In Reg. Audits; Respond to Alleged Violations	125,817					125,817						125,817
Identify New & Proposed Changes to Laws Impacting Company	61,150								61,150			61,150
Provide indepth Analysis of Reg. Requirements to Determine Applicability	23,907							23,907				23,907
Dev. Env. Guidance, Policies, Implementation Plans & Assist in Dev. Strategies	126,386						126,386					126,386
Resolve Site-Wide Environmental Issues	270, 528					270,258						270, 528
Track Dev. of Fed. & State Matters; Participate in Fed. & State Committees to Effect Regulations	41,082									41,082		41,082
Track Non-Deficiency Comments	7,094					7,094						7,094
Provide Research & Distribution of Env. Requirements	30,918		15,459				7,729.50	7,729.50				30,918
Provide Expertise & Coordination For Computer Application	17,116								17,116			17,116
Provide Environmental Metrics to Lockheed Martin Corp.	11,314					11,314						11,314
Provide Env. Mgt. Oversight & Expertise, Priotitize Issues & Define Compliance Program	148,327		37,082		37,082	37,082	37,082					148,327
Provide Work Package Management	29,475										29,475	29,475
TOTAL	648,318	-	52,541	-	37,082	457,567	171,198	31,637	78,266	41,082	29,475	648,318
	% of Total		8%		6%	71%	26%	5%	12%	6%	5%	100%
Ranking of High-Cost Functions ----------->>>>>			4			1	2		3			



THANKS FOR LISTENING