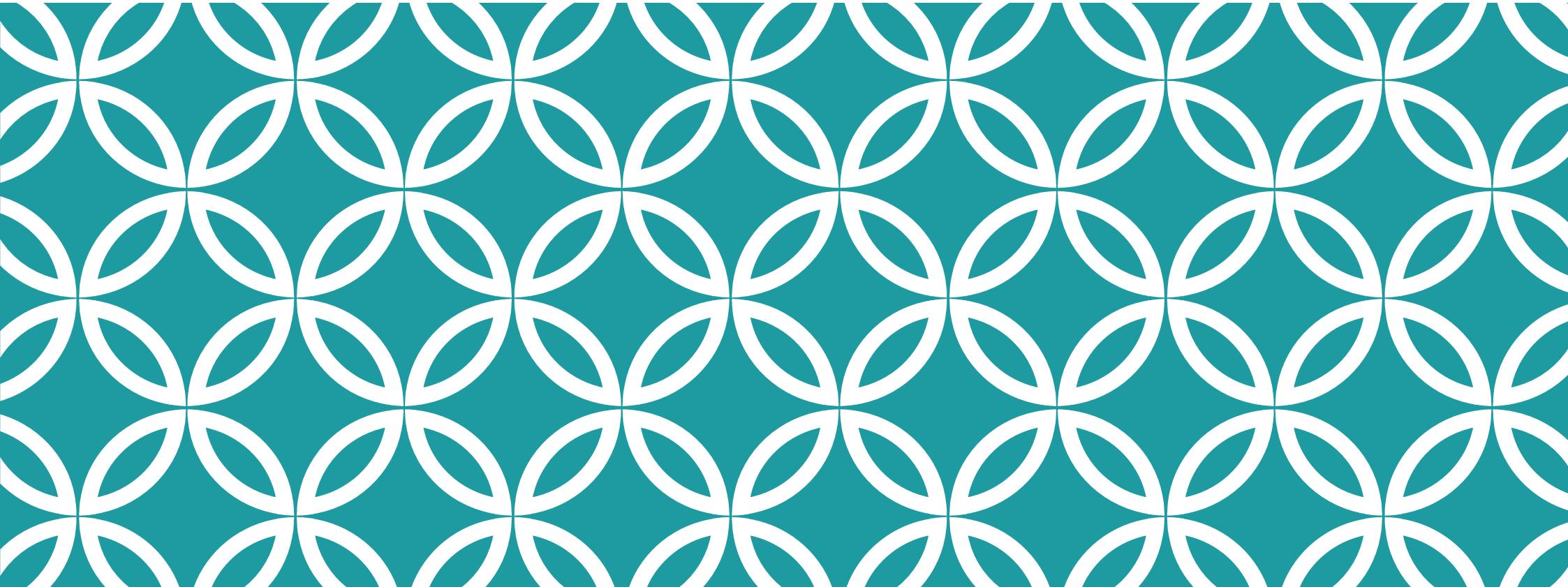




# **VALUE ENGINEERING**

## **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

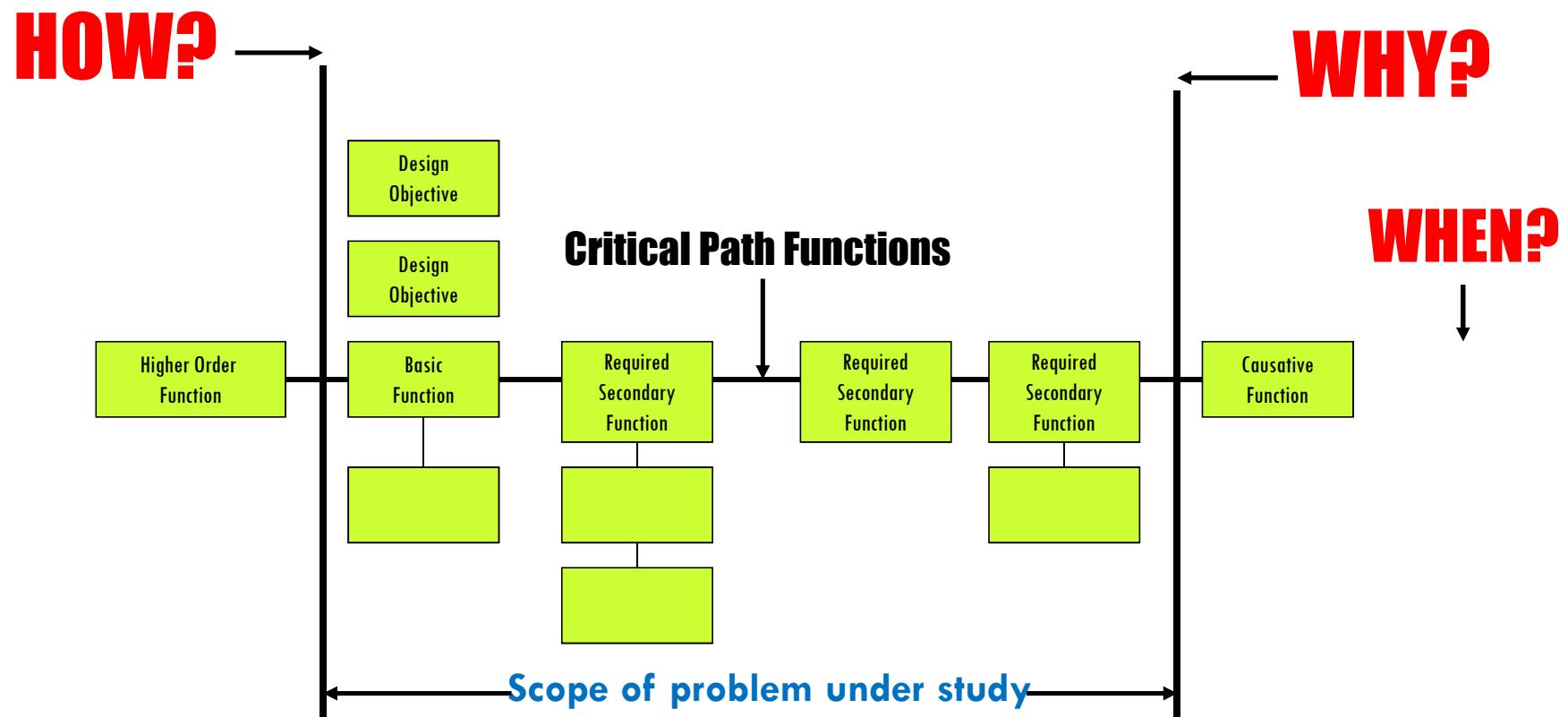
**FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST)**

# 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](#).

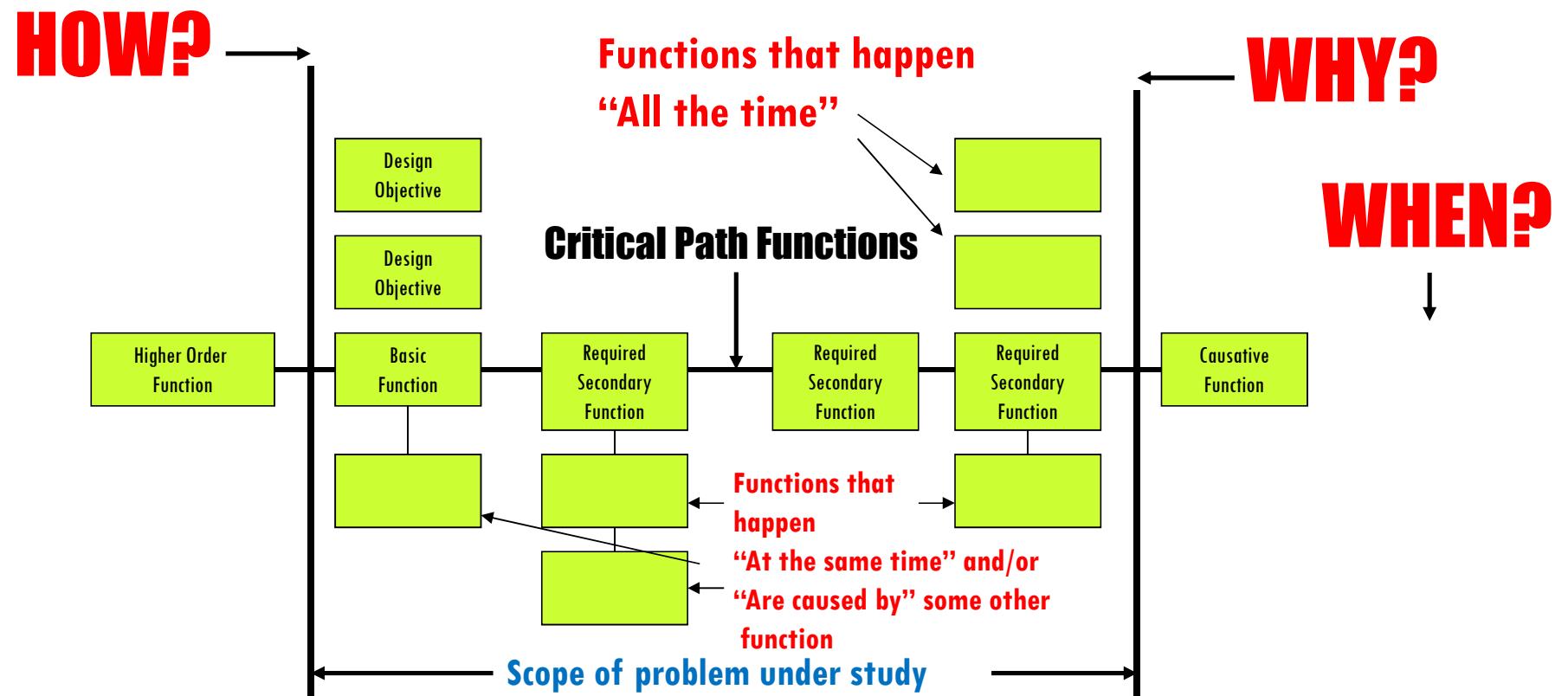
# CLASSIC FAST MODEL



# 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.

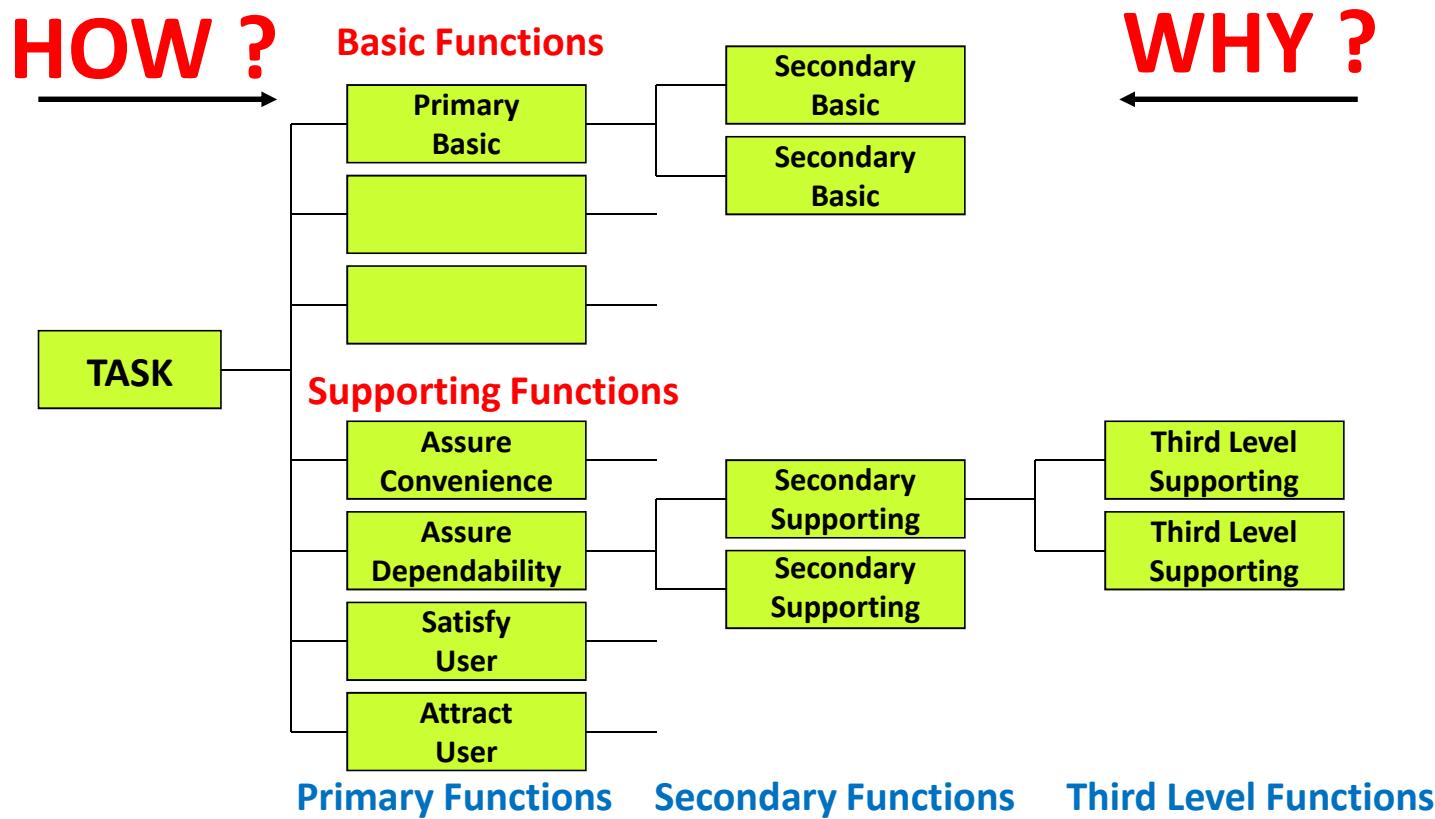
# TECHNICALLY-ORIENTED FAST MODEL



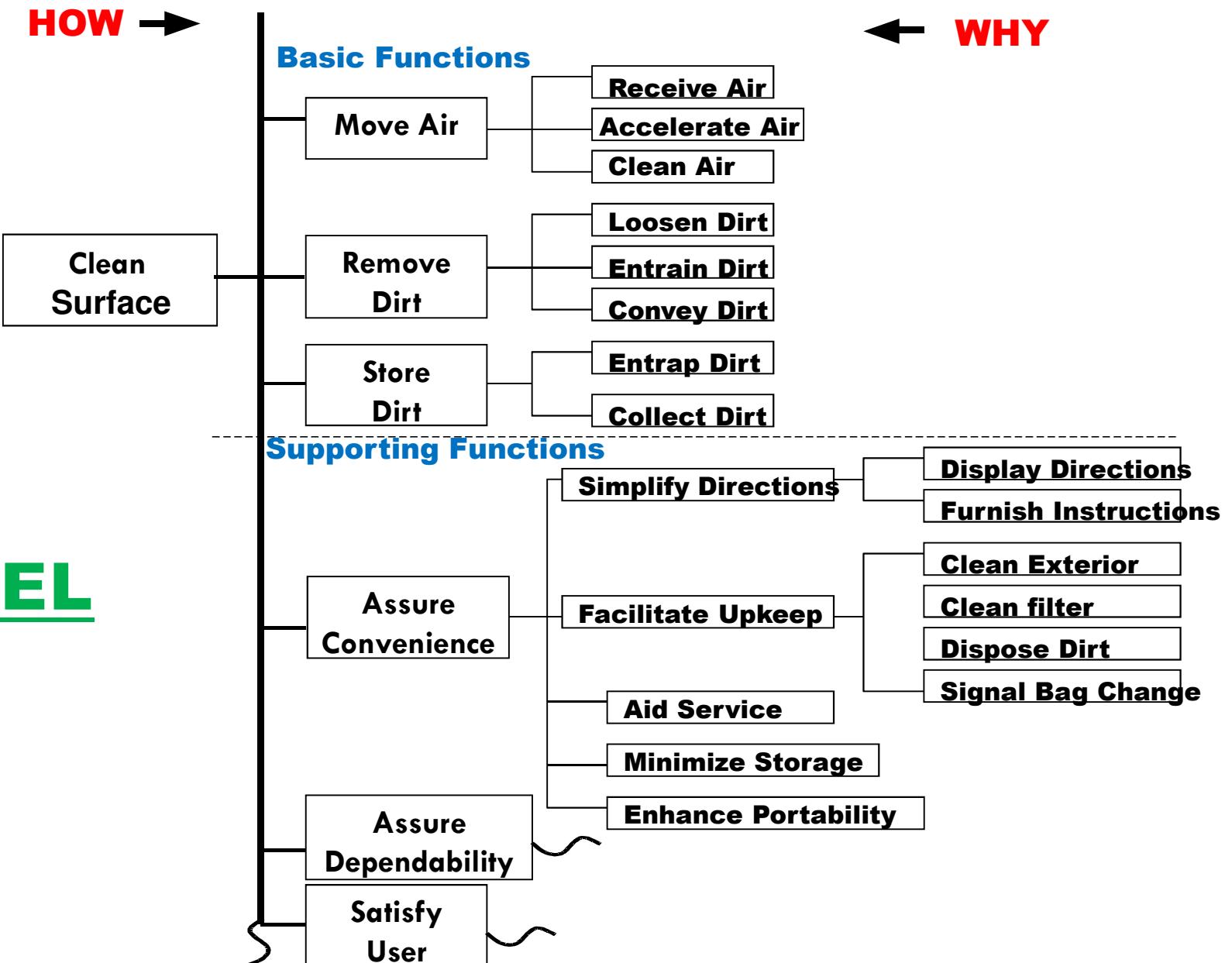
# FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

➤ **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



# **FAST MODEL VACUUM CLEANER**

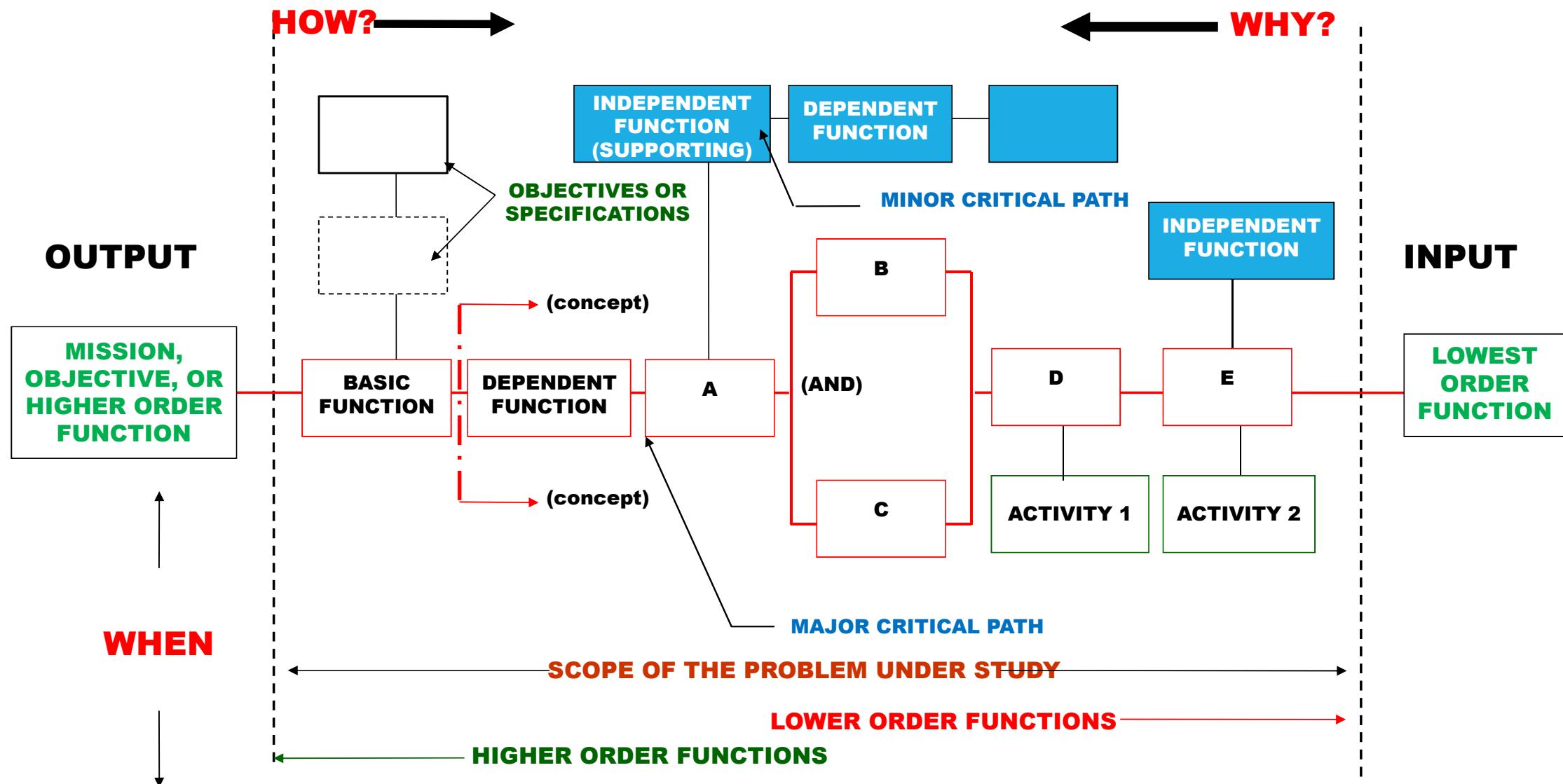


# **FAST DIAGRAM STEPS**

1. List **components/functions**
2. Put functions on 2" \* 3" cards
3. Sketch skeleton **FAST**
4. Establish **critical path functions**
  - Those functions that are absolutely necessary in order to achieve what the user (customer) wants done

# FAST DIAGRAM STEPS

5. Determine “higher order function”
  - A. Determine **supporting functions**
  - B. Establish “**caused-by**” or “**at-the-same-time**” functions
  - C. Establish “**design objective**” functions
  - D. Establish “**all-the-time**” functions
6. Verify the FAST diagram by asking “**why**”



**HOW?**



**OUTPUT**

**WHEN**  
**CONVEY**  
Information

## F.A.S.T MODEL OVERHEAD PROJECTOR

**WHY?**



**INPUT**

**FACILITATE PORTABILITY**

**ALLOW SAFETY**

**PROJECT IMAGE**

**FOCUS IMAGE**

**SUPPORT IMAGE**

**AMPLIFY IMAGE**

OBJECTIVES OR SPECIFICATIONS

(concept)

**GENERATE LIGHT**

**CONVERT ENERGY**

**RECEIVE CURRENT**

**GENERATE HEAT**

**DISSIPATE HEAT**

**GENERATE NOISE**

**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:

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

## **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 ANALYSIS PROCEDURE

1. Review cost allocation to see that everything is correct
2. Collect costs by the function
3. Put costs on FAST
4. Summarize costs by %
5. Add function category costs
  - Critical path costs
  - Design objective function costs
  - All-the-time function costs
  - Caused-by function costs

# 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.  $\leq$  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

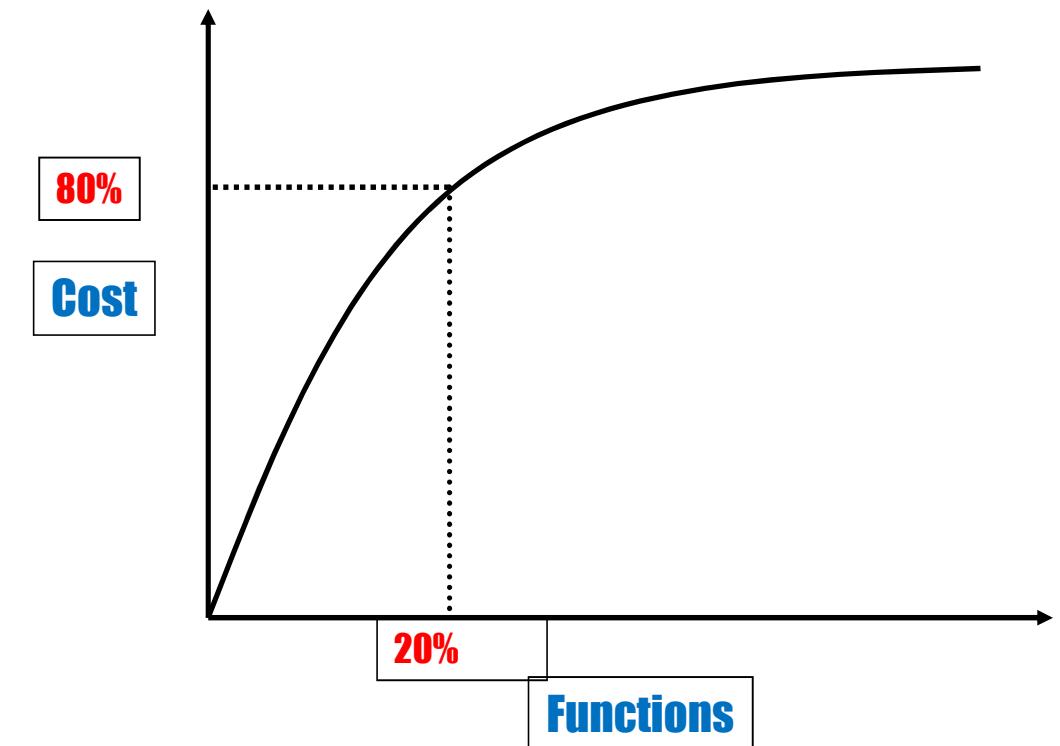
Indicators of **mismatch function** include:

- 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



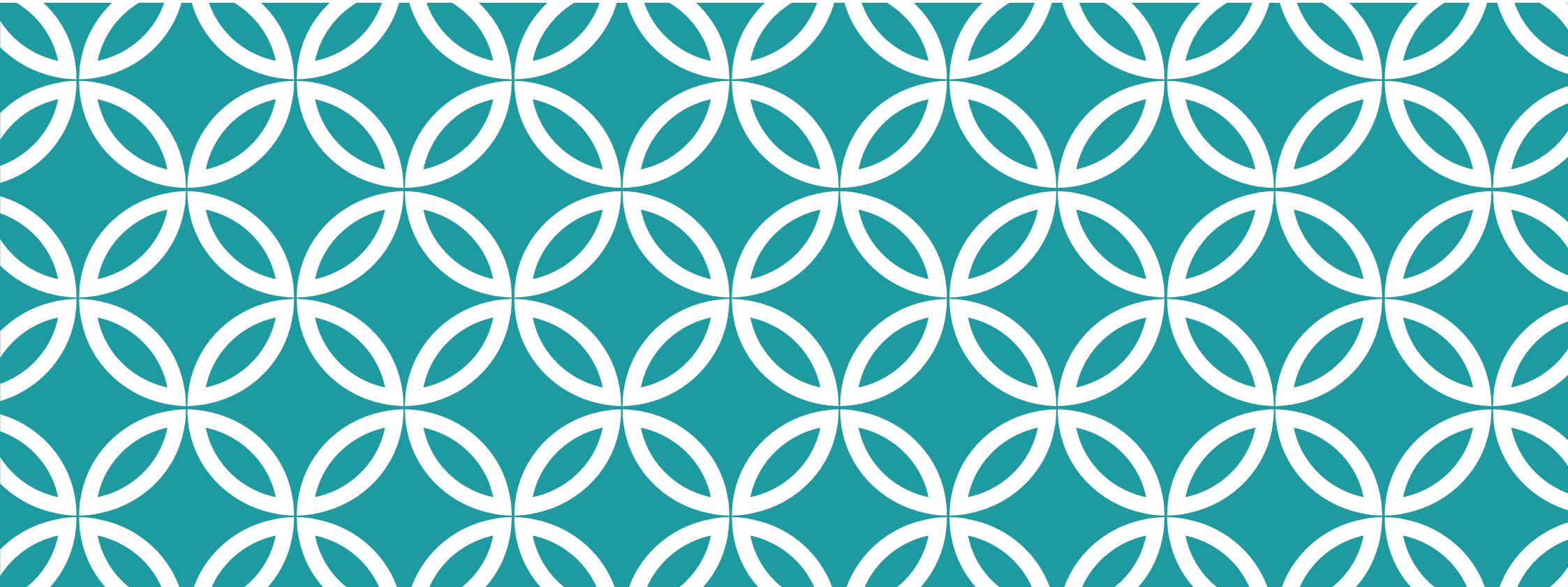
# PARETO ANALYSIS

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, ASSEMBLIES, OR PARTS	ACTIVITY	ESTABLISH	DISSEMINATE	SUPPORT	ISSUE	RESOLVE	DEVELOP	INTERPRET	IDENTIFY	REVIEW	PROGRAM	TOTAL
		POLICY & GUIDANCE	ENV. INFORMATION	COMPLIANCE ATTAINMENT	POLICY STATEMENTS	COMPLIANCE ISSUES	REGULATORY POSITIONS	REQUIREMENTS	APPLICABLE POSITIONS	REGULATIONS	ADMIN	
Serve as Focal Point for Reg. Contacts & 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, Prioritize 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
<b>TOTAL</b>	<b>648,318</b>		<b>52,541</b>		<b>37,082</b>	<b>457,567</b>	<b>171,198</b>	<b>31,637</b>	<b>78,266</b>	<b>41,082</b>	<b>29,475</b>	<b>648,318</b>
Ranking of High-Cost Functions ----->>>		% of Total	-	8%	-	6%	71%	26%	5%	12%	6%	5%
				4			1	2		3		100%



**THANKS FOR LISTENING**