VALUE ENGINEERING AND VALUE ANALYSIS

AN INTRODUCTION TO VALUE ANALYSIS & VALUE ENGINEERING

- In 1961, Lawrence D Miles in his book 'Techniques of Value Analysis Engineering' defined Value Analysis as "an organized creative approach which has its purpose the efficient identification of unnecessary cost i.e. cost which provides neither quality nor use nor life nor appearance nor customer features."
- VA is also defined as application of recognized techniques to identify the functions of a product! or service and provide those functions at the lowest possible cost.
- Value Analysis is a standardized, multi - disciplined team approach that identifies the lowest cost way and ensures the highest worth to reliably accomplish the functions of a product, process or service.
- Value analysis assesses product functions and value – to – cost ratios, and explores opportunities for reduction.
- It uses a job plan, is function based, and requires that a product be generated result of the study.

How is VA different from VE ?

- Traditionally Value Analysis (VA) is used to describe the application of the 'techniques to an existing product or services or after the fact.
- Value Engineering (VE) has been used to refer to the design stage or before the fact. Value Engineering (VE) approach is used for new products, and applies the same principles and techniques to pre-manufacturing stages such as concept development, design and prototyping.
- Value Analysis and Value Engineering (VE) is a powerful Change Management and Problem Solving' tool with over a century of worldwide application track record.
- VE is used to create functional breakthroughs by targeting value mismatches during product, process, and project design.

How is VA different from VE ?

- VA is also a vital tool to deal with post product release problems and process improvement innovation.
- Value Analysis (VA) is considered to be a process, as opposed to a simple technique, because it is both an organized approach to improving the profitability of product applications and it utilizes many different techniques in order to achieve this objective.
- The techniques that support VA activities include 'common' techniques used for all VA exercises and some that are appropriate for the product under consideration.
- A few other names for VA / VE are - Value Management, Value Planning, etc.

How is VA different from VE ?

- Value Analysis process attacks unnecessary costs and is thus one of the most effective ways to increase an organization's profitability.
- However that is only doing half the job.
- A truly effective value improvement program cannot only reduce costs, but also improve operations and product performance.
- The VA approach can be effectively used to analyze existing products or services offered by manufacturing companies and service providers alike.
- The VA / VE methodology involves function analysis and everything has a function.
- Therefore the methodology has universal application.
- Value Analysis / Value Engineering can be applied with equal success to any cost generating areas.

HISTORICAL PERSPECTIVE OF VALUE ANALYSIS

- Larry Miles, an engineer by training, is known as the father of the VA / VE concept. He developed the technique at General Electric (GE) in the late 1940s.
- Larry Miles moved from design engineering to purchasing for General Electric (GE) shortly before the United States entered World War II.
- Later (about 1943), he was assigned to be the procurement officer for a GE manufacturing plant.
- He developed a reputation of great enthusiasm for conceiving cost-effective operations and using unusual methods for problem solving.
- Due to the competition for raw materials, products, personnel, and other resources in the time of war, Mr. Miles developed a procedure for procuring, designing, and using components and products.
- This procedure used "functions" as its basis.
- Mr. Miles found that he could more readily obtain what he needed if he used his new procedure, rather than specifying standard designed components., (For example: the required product to be provided must translate a rotational force into a lateral force. It must be able to withstand these stresses, fit within the area allowed, and connect to these other parts.)
- This new "function" based procedure was so successful that it was possible to produce the goods with greater production and operational efficiency, and less expensively.

HISTORICAL PERSPECTIVE OF VALUE ANALYSIS

- The terms value analysis / value engineering originated in the early days development of the techniques.
- The first approach was rather than reduce costs, to increase values.
- Hence the need to analyze value.
- Soon after Miles developed this systematic methodology, his concepts were acknowledged as a powerful approach to problem solving through function -based techniques, and they found their way outside GE into areas such as industry, healthcare and government services.
- Miles' techniques resulted into huge savings for design engineers, manufacturing engineers, purchasing agents, and service providers exhibiting to the users " why so much unnecessary costs exists in everything we do and how to systematically identify, clarify, and demarcate costs which have no relationship to customers' needs or desires."
- The name Value Engineering has subsequently become most universally accepted name for the "function" based procedure.
- Mr. Charles Bytheway , in 1960's , during his work for Sperry UNIVAC, created functional critical path analysis procedure that highlighted the logic of the activity under value study.
- A diagramming procedure called the "Functional Analysis System Technique" (FAST) was later on adopted as a standard component of the Value Method.

WHAT IS VALUE ANALYSIS AND VALUE ENGINEERING?

- VA / VE is an orderly and creative method to increase the value of an item. This "item" can be a product, a system, a process, a procedure, a plan, a machine, equipment , tool, a service or a method of working.
- Value Analysis / Value Engineering is defined as 'the professionally applied, team based, function - oriented, systematic application of recognized techniques (function analysis) which -

3. Identify the "function of a product, process, project, facility design, system or service,
4. Establish a monetary value for that function,
5. Provide the necessary function (defined by the customer to meet his / her requirements),
6. Consistent with the specified performance and reliability needed at the lowest life cycle cost (cost over the expected life).
7. And thus Increases customer satisfaction and adds value to the investment.

WHAT IS VALUE ANALYSIS AND VALUE ENGINEERING?

- Value analysis involves identifying product function (s) relating to cost and price analysing the design and construction with an eye for eliminating elements not contributing to function.
- Some designers think VA undermines good design. If the design was sound the start VA is redundant. Yet designs and technology change.
- Sound, innovative designs age and become uncompetitive - rivals catch up.
- Remember car windscreens are today glued into place by robots (adhesive technology).

THE VALUE EQUATION

- Value analysis is evaluates a product utility, esteem and market values, each of which are defined below :
- **Utility value** – how useful / functional the product is seen to be.
- **Esteem value** – the value that customer / user gives to product attributes, not directly contributing to utility but more relating to aesthetic and subjective value. Esteem issues and functionality should not be overlooked or compromised.
- **Market value** – what market is prepared to pay for the product.
- Market value = Utility value + Esteem value

OBJECTIVES OF VA

- The VA / VE objectives is to find and improve on value mismatches in products, processes and capital projects.
- Find important functions – define necessary versus un - necessary functions
- Find and improve on low performing functions.
- Define and segregate the necessary functions from the unnecessary functions and thereby creatively develop alternative means of accomplishing the necessary functions at lower total (life cycle) cost.

THE VALUE ANALYSIS TERMINOLOGY

- **Need :** These are users expectations, may be expressed explicitly, or may be latent.
- **Value :** Value is an imprecise word, its meaning depends both on the user and on the context.
- For example a typewriter ribbon or a word – processing package may have good value while the typewriter or computer may not have.
- In an engineering context the distinction can be important, as any cosmetic changes brought about by Value Analysis or by means of any other technique are waste of time if the total product is unacceptable to the market.
- Value is a quantity, which enhances customer satisfaction or slashes the expense attributable to the product

THE VALUE ANALYSIS TERMINOLOGY

- In value method terms :
- Value = Worth / Cost

  OR
- Value of an item = Performance of its function / Cost

  OR
- Value = Σ (+) / Σ (-) = Σ (Benefits) / Σ (Costs)

7. Value greater than 1.0, the item is perceived to be fair or having good value.
8. Value is less than 1.0, the item is perceived to be having poor value.
9. When an item has a perceived worth that far exceeds the life – cycle cost, we usually consider purchasing the item.
10. An item that does its function better than another, has more value. Between two items that perform their function equally well, the one that costs less is more valuable.

THE VALUE ANALYSIS TERMINOLOGY

- Different customers will interpret the value of a product in different ways.
- The “performance of its functions” could include that it is beautiful (where needed) or it lends an image to the user / possessor (where desired)
- Its common characteristic is a high level performance, capabilities, emotional appeal, style, etc. relative to its cost.
- This can also be expressed as maximizing the function of product relative to its cost :
- Value = (performance + capability / cost
  = Function / cost

THE VALUE ANALYSIS TERMINOLOGY

- **Function:**
- The use of functions and a function - logic process to describe needs, purposes and consequences is at the heart of Value Engineering.
- The use of function - logic helps people realize and overcome many of the preconceived biases.
- Function allows definition of each task in a process or one of its activities in terms of end goals and not solutions.
- A function is described by a verb (action) and an object / noun (preferably measurable).
- Placing those functions in a decision - logic diagram helps reach a common understanding.
- This powerful verb- noun combination helps remove people from the "I want" position to the basic needs involved.
- It also helps people see what parts of their decisions rely on critical features, and where decisions are requiring substantial support to maintain them (potential value-mismatches).
- This assists in focusing upon a precise understanding of the value involved.

THE VALUE ANALYSIS TERMINOLOGY

- **Function:**
- Value analysis defines a "basic function" as anything that makes the product work or sell.
- A function that is defined as "basic" cannot change.
- Secondary functions, also called "supporting functions", described the manner which the basic function(s) were implemented.
- Secondary functions could be modified or eliminated to reduce product cost.
- Value is not a matter of minimizing cost.
- In some cases the value of a product can be increased by increasing its function (performance or capability) and cost as long as added function increases more than its added cost.
- The concept of functional worth important.
- Functional worth is the lowest cost to provide a given function.
- However, there are less tangible "selling" functions involved in a product to make it of value to a customer.

THE VALUE ANALYSIS TERMINOLOGY

- Function analysis is the starting point of VA, without a genuine function nothing work and can sell.
- All problem solving techniques, attempt to change a condition means of a relevant and unique solution.
- Too detail thought on the objectives, tempts to describe a solution and we may miss the opportunity to engage in divergent thinking about other alternatives.
- When trying to describe problems, we must guard against getting locked in to a course of action without realizing it, because of our bias.
- This underlines importance of abstraction and divergent thinking.
- This high level of abstraction can be achieved by describing what is to be accomplished with a verb and a noun pair.
- The verb answers the question, "What is to be done?' "What is it to do?" , i.e. it defines the required action.
- The noun answers the quest "What is it being done to?" i.e. it tells what is acted upon.
- However, identifying function by a verb-noun is not as simple a matter as it appears.
- Identifying the function in the broadest possible terms provides the greatest potential for divergent thinking because it gives the greatest freedom for creatively developing alternatives.
- A function should be identified as to what is to be accomplished by a solo and not how it is to be accomplished.
- How the function is identified determines the scope or range of solutions that can be considered.

THE VALUE ANALYSIS TERMINOLOGY

- That functions designated as "basic" represent the operative function of the item or product and must be maintained and protected.
- Determining the basic function of single components can be relatively simple.
- By definition then, functions designated as "basic" will not change, but the way those functions are implemented is open to innovative speculation .
- When purchasing a product it is assumed that the basic function is operative.
- The cost contribution of the basic function does not , by itself , establish the value of the product.
- Few products are sold on the basis of their basic function alone.
- Although the cost contribution of the basic function is relatively small, its loss will cause the loss of the market value of the product.

THE VALUE ANALYSIS TERMINOLOGY

- The customer's attention directed to those visible secondary support functions, or product features, which determine the worth of the product.
- From a product design point of view , products that are perceived to have high value first address the basic function's performance and stress the achievement of all of the performance attributes.
- Once the basic functions are satisfied, the designer's then address the secondary functions necessary to attract customers.
- Secondary functions are incorporated in the product as features to support and enhance the basic function and help to differentiate and sell the product.
- The elimination of secondary functions that are not very important to the customer will reduce product cost and increase value without detracting from the worth of the product.
- Eliminating or combining as many secondary functions as possible helps achieve one objective of value analysis or function analysis, Le. to improve value by reducing the cost - function relationship of a product.

THE VALUE ANALYSIS TERMINOLOGY

- If we consider any product then it is likely that we could list functions in that product in terms of Nouns and Verbs pairs.
- Example: 1

PRODUCT	WASHING MACHINE		
FUNCTIONS	Verb	Noun	Function type
Remove	Dirt	Primary / essential	
Rinse	Content	Supportive	
Extract	Water	Supportive	

- Example: 2

PRODUCT	INCANDESCENT BULB		
FUNCTIONS	Verb	Noun	Function type
Produce	Light	Primary / Essential	
Protect	Filament	Supportive	
Provide	Decorative	Aesthetic	
Be	Interchangeable	Supportive	

- Example : 3

PRODUCT	FOUNTAIN PEN		
FUNCTIONS	Verb	Noun	Function type
Enable	Writing	Primary / Essential	
Discharge	Ink	Supportive	
Refill	Ink	Supportive	
Protect	Nib	Supportive	

THE VALUE ANALYSIS TERMINOLOGY

- The above examples list only a few of the more important functions, If possible it is to restrict the number of functions to between 5 and 8.
- If the number of functions listed works out to be more than this it is prudent to break down the project into sub-assembly.
- A good example of this is the motorcar.
- If we ask a random sample of population to list the functions that they desire of a motor vehicle and their respective rankings, a list somewhat similar to the one given below emerge.
  1. Transport people
  2. Provide safety
  3. Provide comfort
  4. Transport luggage
  5. Provide protection
  6. Provide controls
  7. So on
- The functions listed above are isolated and too large for consideration and it is better consider the vehicle as two sub-assemblies.

THE VALUE ANALYSIS TERMINOLOGY

- **Example**
- Taking the chassis as a sub-assembly determines the functions it supports

1.	Produce	torque	(engine)
2.	Control	direction	(steering)
3.	Provide	retardation	(brakes)
4.	Convert	torque	(transmission/gears)
5.	Provide	flexibility	(suspension)
6.	Control	fuel	(pump accelerator etc.)
7.	So on		

- To drill drown further each of these functions represent a sub-assembly in itself 1 can be further studied in detail, and if taken to its logical conclusion we could analyse function of the car down to its last component level and beyond.
- The underlying objective of determining the functions of a product is that it becomes possible to determine a cost of the function.
- **Cost:** Cost is the expenditure economically justified by production or resource utilization (product, service or combination of the two),
- Costs attributable to a function activity represent the total necessary or approved expenditures for the realization function.

THE VALUE ANALYSIS TERMINOLOGY

- **THE COST FUNCTION MATRIX**
- The cost function matrix is designed to cost an existing product, service or system by function.
- This is in addition to the cost of component parts.
- Attributing cost to function brings in perspective the costs to satisfy a function.
- That is by this approach it is possible to determine if second order functions are costing the most to achieve.
- An additional advantage from costing by function is that it forces the value analysts to rigorously examine and understand the nature of the product being investigated .
- **How to construct/use the matrix:**

8. In the left hand column vertically list all the different parts, sub-assemblies under investigation.
9. In the next column fill in the costs appropriate to each part listed in the first column .
10. Across the top in the first row list functions desired to be performed.
11. Establish which part(s) is satisfying such function and to what extent,
    For example one part will often contribute towards more than one function.
13. Apportion the cost of each part amongst the functions to which it contributes – where one component
    interacts with several functions, the proportion of its interaction needs to be determined.
15. Total the cost of each function at the bottom of each function column.

THE VALUE ANALYSIS TERMINOLOGY
UTILITY OF THE COST / FUNCTION MATRIX

- **Utility of the cost / Function Matrix ;**
- **The cost function matrix demonstrates that an apparently minor function is responsible for a major part of the total cost, or vice versa.**
- **In terms of parts, too, it may show that something relatively unimportant is costing too much.**
- **Cost may or may not include overheads.**
- **Provided that the costs are ascertained consistently this will make little difference, although it is advantageous to eliminate overheads to avoid the potential of anomalies.**

THE VALUE ANALYSIS TERMINOLOGY
UTILITY OF THE COST / FUNCTION MATRIX

- Utility of the cost / Function Matrix ;
- Worth: The worth of a product has multiple dimensions such as - benefits received, services obtained, product performance, quality, safety, convenience, status / esteem, possession, etc.
- The worth of the product is an indicative measure of what is in it for the customers.
- It is a measure of how well the end product meets the desired core needs and the peripheral desires of those that have a say in the product selection or its use.
- Remember the core and peripheral needs are as perceived by the user and these may change with different users and even for the same user these may change with time.
- Every product has to satisfy the core need failing which its worth will be poor or even negative.

Utility of the Cost / Function Matrix:

- Utility of the cost / Function Matrix ;
- **Animator:** He is a person in charge of the organization and the execution of a value analysis study.
- **Decision-maker:** Person who ultimately decides on VA / VE team's recommendations
- **Value analysis team :** A group of expert6s representatives of and concerned about the objectives of the analysis.
- **Life-Cycle Costs:** The true cost of an item is not just the one time purchase cost in terms of the amount of money that one pays at the time of purchase.
- Much more is at stake.
- The purchase of any thing, takes into account its long-term utility / effects / costs.
- The initial costs plus these long-term costs are called life-cycle costs.
- This includes things like the time, the manpower needed (number, expertise, training/retraining, and so on), the degree of difficulty involved, availability of money or other resources, the frequency maintenance needed and its associated expenses, the spares costs, etc.

APPLICATIONS OF VALUE ANALYSIS

- From a generic point of view, VA / VE

2. Enables people to pinpoint areas that need attention and improvement.
3. Provides a method of generating ideas and alternatives for possible solutions to concern.
4. Provides a means for evaluating alternatives. .
5. Allows one to evaluate and quantify intangibles and to compare apples with oranges.
6. Provides a vehicle for dialogue by allowing large amounts of data to be

   summarized in concise form, allowing new and better questions to be asked, and using numbers to communicate in an information-searching mode.
8. Documents the rationale behind recommendations and decisions.
9. Materially improves the value of goods and services.

APPLICATIONS OF VALUE ANALYSIS

- Value Analysis has been successful in several domains and its application is only limited by the users creativity.
- Some application areas are - Defense; Automotive; Aeronautical; Software development; Water treatment; Civil engineering; systems and procedures, venture analysis, forecasting, resource allocation, marketing, Client services; Work processes; Documentation; Organizational development; etc.
- ***Customer satisfaction and value perception*** -- The most common application of Value Analysis is what many have called the "state – of – the – art " customer satisfaction and value perception study.
- Here are some of the ways the study pays off for clients:
- They need to be competitive on the "Basics" (high satisfaction/low value) – not allowing any weaknesses in, but not investing more than necessary in them. .
- They need to dominate the "Value" Issues (high satisfaction/high value). .
- They need to know the Value "Opportunity" Issues (low satisfaction/high value) to know what to invest in for future growth.
- They need to know the "Irritations" (low satisfaction/low value) to know where to innovate.
- ***Identifying At Risk Customers*** - A big issue today is the so-called "At Risk" customer (those likely to defect).
- Value Analysis findings help to determine why a company's customers are At Risk.
- And, firms can learn why major competitors' customers are At Risk so they can be targeted.
- ***increasing Employee Loyalty*** - Value Analysis studies are conducted among employees to identify things they expect from any company they work for (The Basics), things they value, things that irritate them and things they don't care about.

APPLICATIONS OF VALUE ANALYSIS

- ***New Product / Service Development*** **- Every marketer has been involved in a study where consumers "say" they are "very interested in trying a new product which subsequently fails in the marketplace.**
- **Failure is often considered the consumer's fault whereas it really results from asking the wrong question.**
- **People don't buy what they are "interested" in, they buy what they value.**
- ***The reason most new products fail is that they don't provide enough "new value" to consumers.***
- **Value Analysis will show which tangible and intangible aspects of a new product consumers value and which they do not care about**

CHARACTERISTICS OF THE VALUE METHOD

- Several characteristics differentiate the Value Method from other techniques.
- These help ensure that the customer obtains the kind of product they need and want, whereas the firm benefits' by means of cost reduction and profitability.
- The prominent characteristics of the value method are -
- Value-based decision process,
- Uses functional approach
- Follows a very systematic, formal and organized job plan. It is not haphazard or informal and it is a management activity that requires planning, control and co-ordination..
- Directs efforts towards maximum possible alternatives through creativity techniques.
- Taking the appropriate action at the appropriate time so as to produce good results.
- Systematic and organized.
- The Value Method process uses tested and successful procedures that are directed toward achieving success in meeting the purposes for the "project" by all involved. The process instills "common understanding", generates high production and high performing team activities, reduces the time necessary to obtain a product; and focuses the efforts on the purposes behind the project or activity being studied. A standard job plan is used to guide the entire process.

PRINCIPLES OF THE VALUE METHODOLOGY

- The philosophy of VE is implemented through a systematic rational process consisting of a series of techniques, including;

1. Function analysis to define the reason for the existence of a product or its components,
2. Creative and speculative techniques for generating new alternatives, and
3. Measurement techniques for evaluating the value of present and future concepts.

- Value Analysis is based on the fundamental principle that the customer is always looking for the best pr9duct. at the least cost.
- Value is the connection between customer satisfaction and price.
- Value, then, is an essential parameter for improving a process by reducing costs while always maintaining or increasing client satisfaction.

PRINCIPLES OF THE VALUE METHODOLOGY

- This method analyses a process not as a collection of people or actions, which contribute to product realization, but as a collection of functions, which need to be satisfied, by a process with the goal of responding to the needs of the customers.
- **Phase I - Selection Phase:**
- To make a value analysis a study group of 4 to 6 persons is formed.
- More number of members complicates matters, degenerates discussions, and delays decisions.
- The team must be interdisciplinary, incorporating a balance of different backgrounds, viewpoints and departments.
- The members should be from equivalent levels in the organizational hierarchy to minimize peer pressure and politics.
- At times, it is helpful to have a decision maker on the team to gain commitment for the implementation of the VE results.
- One or more members of the team must be well versed with the VE process, or else an outside facilitator can be inducted in the team.
- One of the members should be an expert on the subject matter (product /service / process / etc.) of the VE process.
- The team members must have an open mind and be result oriented.

PRINCIPLES OF THE VALUE METHODOLOGY

- **Then we select the item to be studied. The VE study should ;**

2. **The item should be one that gives the impression that its cost is too high or that it does not do its function well.**
3. **Solve a problem. The need should be real and be supported by the management.**
4. **The selected item should have a good probability of success and implementation.**

   Complex, multi-component products may give the best returns (scope for simplification). Products with large usage offer greater savings overall. Old products may benefit from new technical developments. The team must target products, services and administrative procedures offering the largest potential savings.
6. **Have credible objectives.**
7. **Be important to the people in the area being studied.**
8. **Have the commitment of the requestor and the VE team.**
9. **Have receptivity in the organization, for effective implementation the sponsor and / or decision maker must be receptive to change.**

PRINCIPLES OF THE VALUE METHODOLOGY

- **Phase II - Information Phase:**
- In the information phase, the main function and the secondary functions of an item are studied.
- The functions are classified into "basic" and "secondary" functions and the cost of realizing each function is ascertained.
- Accurate marginal cost data is needed because VA aims to reduce costs.
- However apportioning overheads is difficult generally these are excluded from the VA exercise (unless it is the overhead elements themselves that are being analyzed)
- The first action of the group should be to gather all the information about the item.
- Identify and define the components - understand them and their characteristics.
- Ask the best specialist of the field, not the person most accessible.
- Get a detail of costs.
- Collect drawings, specifications, all the written data on the item.
- Don't be satisfied with verbal information.
- It is better to collect too much information than collect too little.
- The attitude of a value analyst should be critical, aggressive, nonconformist, never satisfied with what she / he receives for the money given.
- He must challenge traditional assumptions.

PRINCIPLES OF THE VALUE METHODOLOGY

- The whole team should be involved in doing this. Use brainstorming to challenge assumptions. Identify functions that the customer may be looking for, not just those that the operations manager thinks are essential or non-essential.
- A Cost Function Matrix or Value Analysis Matrix is prepared to identify the cost of providing each function by associating the function with a mechanism or component part of a product.
- Product functions with a high cost-function ratio are identified as opportunities for further investigation and improvement which are then brainstormed" analyzed, and selected.
- The objective of the Function Cost Matrix approach is to draw the attention ,of the analysts away from the cost of components and focus their attention on the cost contribution

  of the functions.
- Detailed cost estimates become more. important following function analysis, when evaluating value improvement proposals.
- The total cost and percent contribution of the functions of the item under study will guide the team, or analyst, in selecting which functions to select for value improvement analysis.

PRINCIPLES OF THE VALUE METHODOLOGY

- **For a pencil, for instance:**
- **What is it? (a pencil)**
- **What is it for? (make permanent marks)**
- **What is the main function? (make marks, write lines)**
- **What is the method, material or procedure that was used to realize the main function? (a graphite stick and wood)**
- **What are the corresponding secondary functions?**
  ("transfer graphite to paper“ and "facilitate holding the graphite"
- **What does the item cost and how can we distribute the cost of realizing the main function into each secondary function?**
- **Comparing these costs to an item of a similar function, how much should each function and the total cost?**
- **(This example, the pencil, is already a high value item**

PRINCIPLES OF THE VALUE METHODOLOGY

- It is not important that the individual costs assigned are imprecise.
- Because even an imprecise numerical value is much better than an expression such as "very costly" or "of low cost".
- ➢ The value of each secondary function is measured :
- Does it contribute value? (Is there something that does not contribute value?).
- Is the cost in proportion to the function realized.
- Does it need all its parts, elements, procedures?
- Is there something better to do the same function?
- Is there a standard part that can do the function?
- ➢ The cost of each function is investigated and a monetary numeric value is assigned tolerances and strict specifications outlined.
- What's necessary is separated from what is nice to have.
- The guiding principle is : All that does not contribute to the main function is waste and should be eliminated.

THE VA PROCESS (JOB PLAN)

- The key component of VANE process is its use of a carefully crafted and thoroughly tested job plan.
- Adherence to the job plan focuses efforts on its specific decision process: that contains the right kind of emphasis, timing and elements to secure a high quality product.
- The job plan and its sub-elements do this by highlighting and focusing everyone on the involved issues, essential needs, criteria, problems, objectives and concerns.
- The eight-step job plan are displayed below.

❖ QUESTIONING TECHNIQUES –

- Various questioning techniques are used in VA / VE process.

➢ The Primary Questions

- ❑ The questioning sequence used follows a well-established pattern which examines -
- ❑ the *PURPOSE* for which the activities are undertaken
- ❑ the *PLACE* at which the activities are undertaken
- ❑ the *SEQUENCE* in which the activities are undertaken
- ❑ the *PERSON* by whom the activities are undertaken
- ❑ the *MEANS* by which the activities are undertaken with a view to activity
- ❑ ELIMINATING
- ❑ COMBINING
- ❑ REARRANGING
- ❑ SIMPLIFYING

THE VA PROCESS (JOB PLAN)

- In the first stage of the questioning technique, the Purpose, Place, Sequence, Person, ' Mean of every activity recorded is systematically queried, and a reason for each reply is sought.
- PURPOSE : PURPOSE
- What is actually done?
- Why is the activity necessary at all?

  in order to ELIMINATE unnecessary parts of the job.
- PLACE
- Where is it being done?
- Why is it done at that particular place?
- SEQUENCE
- When is it done?
- Why is it done at that particular time?
- PERSON
- Who is doing it?
- Why is it done by that particular person?

  in order to COMBINE wherever possible or REARRANGE the sequence of operations! for more effective results.
- MEANS
- How is it being done?
- Why is it being done in that particular way. in order to SIMPLIFY operation.

THE VA PROCESS (JOB PLAN)

- **The Secondary Questions**
- The secondary questions cover the second stage of the questioning technique, during which the answers to the primary questions are subjected to further query to determine whether possible alternatives of place, sequence, persons and/or means are practicable and preferable as a means of improvement over the existing method.
- Thus, during this second stage of questioning, having asked already, about every activity recorded, what is done and shy is it done, the method study man goes on to inquire what else might be done?
- And, hence: What should be done?
- In the same way, the answers already obtained on place, sequence, person and means are subjected to further inquiry.
- Combining the two primary questions with the two secondary questions under each of the head: purpose, place, etc. yields the following list, which sets out the questioning technique in full:

- **PURPOSE**
  - What is done?
  - Why is it done?
  - What else might be done? What should be done?

THE VA PROCESS (JOB PLAN)

- The Secondary Questions

- **PLACE**
- Where is it done?
- Why is it done there? Where else might it be done? Where should it be done?
- **SEQUENCE**
- When is it done?
- Why is it done then?
- When might it be done?
- When should it be done?
- **PERSON**
- Who does it? Why does that person do it? Who else might do it? Who should do it?
- **MEANS**
- How is it done? Why is it done that way? How else might it be done? How should it be done? .
- Do not be distracted by mere aggregate functions such as the rubber on a pencil's end' or the ice producing part of a refrigerator.
- These were functions added since it was. economical or easy to do so.
- They have no relationship with the main function.

THE VA PROCESS (JOB PLAN)

- **Phase III - Creativity Phase –**
- **In this phase the objective is to find a better way to do the main function, by finding a different material, or concept, or process, or design idea, that realizes the main function .**
- **A simple brainstorm procedure to stimulate creativity is stated below:**

1. **State the main function clearly and shortly on paper or a blackboard (verb and noun), so that the group can rivet its attention on it. The physical object or the specific process is purposively not mentioned. Secondary or aggregate functions are not stated.**

THE VA PROCESS (JOB PLAN)

1. The leader of the group says "We begin now" and when the ideas do not flow so fast anymore (about 15 to 20 min.) The leader says "That's all".
2. Members of the group 'think loud' about any potential solution to the problem.

- It is very important that they do not analyze their own thoughts or those of others.
- They should not smile or react when exotic, improbable or senseless ideas are stated.
- They should not criticize or speak with others.
- They should only let their imagination run wild and state ideas.
- An idea can be inspired by a previous idea. (If no rare ideas are stated, then the members are analyzing, not making a brainstorm) .

8. The leader registers all ideas on paper or a blackboard.
9. When the session is finalized, if there is any doubt what was meant by an idea, the leader clarifies the idea with the help of members.

- He does not analyze or discard any idea.
- This finalizes the brainstorm.
- Other creativity techniques that are popularly used are -
  - Gordon technique
  - Nominal Group Technique
  - Morphological synthesis
  - Attribute listing technique

THE VA PROCESS (JOB PLAN)

- **Phase IV - Analysis Phase:** The evaluation should be done after an interval, at best about two days after the brainstorm, to allow the group to gain perspective .
- Now the group analyzes each idea.
- They group similar ideas.
- When evaluating, they de not think why the idea would not work, why it is not possible.
- Each idea is developed, making it more practical, making it function better.
- A very approximate cost for each idea is estimated and ideas with an apparently low cost are investigated carefully.
- When an idea is canceled, that should be based on facts, not opinions.
- **A few points to be remembered in this phase are -**

1. Identify barriers and eliminate them tactfully.

- Barriers are excuses or preconceived ideas that can not be substantiated with numbers, facts, detailed and precise information or experimental evidence.
- Barriers can be honest beliefs.
- Normally there is gold behind a barrier. Select about two to four ideas.

THE VA PROCESS (JOB PLAN)

2. Obtain information for analyzing and developing an idea.
- Do not work in isolation.
- Once the group has advanced as far as it can on its own, make contact with specialists.
- This may be necessary in the selection and also during the development of ideas.
- The value analyst is a coordinator of specialists, of groups of experts in other companies.

3. Obtain information from the best source, not the nearest or most accessible one.
- Do not take into account an answer by a person or specialist that lies outside his field of expertise.
- The use of specialists is a powerful way of tearing down barriers. Avoid generalizations. Do not accept second hand information. Ask for copies of documents.

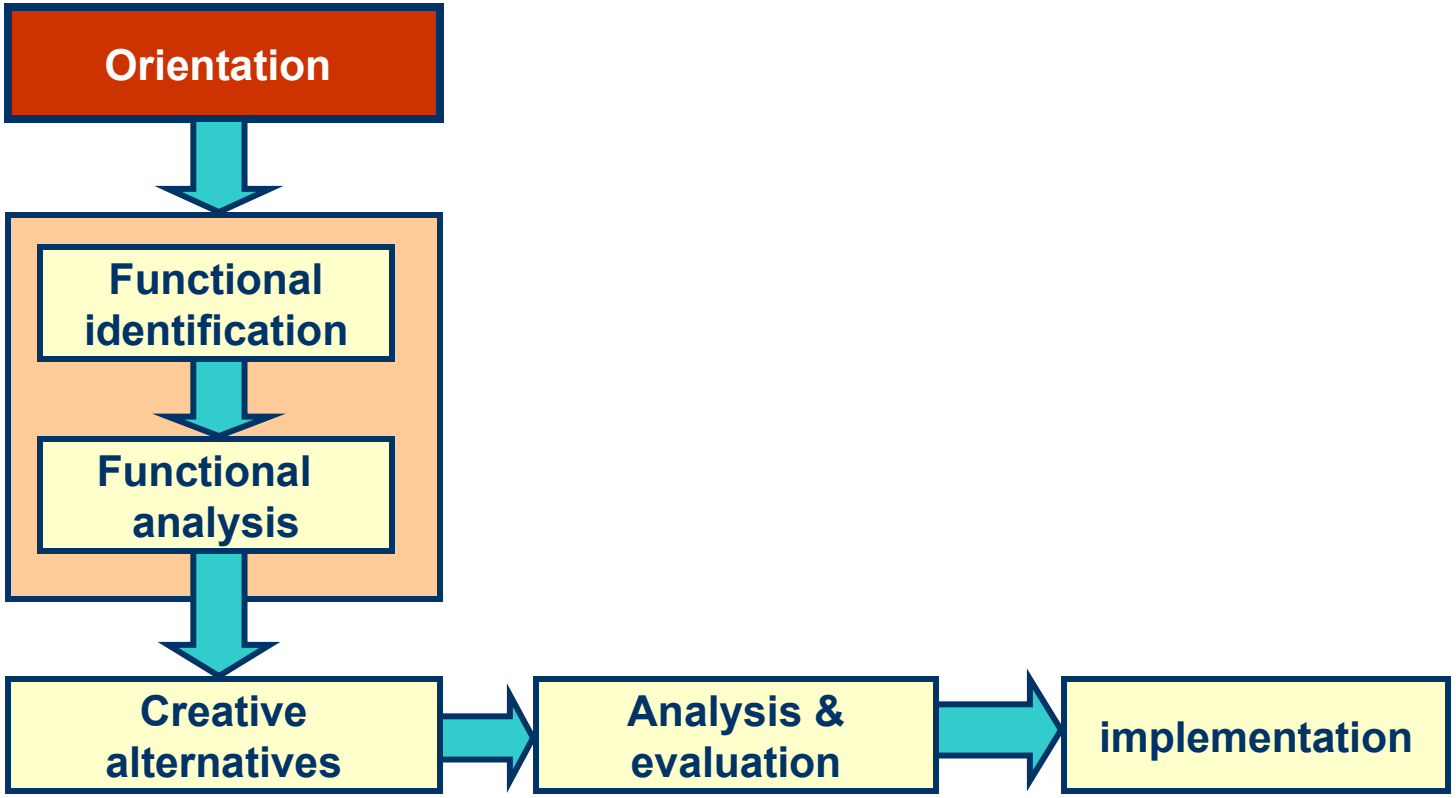
THE VA PROCESS (JOB PLAN)

- **Phase V - Development Phase:** This phase attempts a further development of the two to four ideas selected earlier.
- A real effort to develop the ideas of lowest cost that do the main function is attempted.
- Tests, prototypes, quotations of cost, costs of short term, long term alternatives and of any new ideas alternatives, prove to be useful at this stage.
- At the end of this process, the idea of least cost should have been identified..
- Ask yourself: Would I spend my own money on this solution? If not, modify it.
- **Phase VI - Presentation Phase:** The team must ensure that the person really interested in applying the solution and the decision maker get to see it.
- Present the final solution in writing, in a concise format, stating the savings, costs and a detailed plan for implementing the idea. to the person that should implement it.
- Give a copy to his boss. It should have all the information needed.
- The value analysis group should not itself implement the idea, if this is outside its normal area of work.
- As with variety reduction, complacency and ingrained practices can block new implementation.
- The VA team must communicate and sell their case effectively (with detailed costings and savings, implementation plans, models or prototypes).

THE VA PROCESS (JOB PLAN)

- **Phase VII - Implementation Phase:** Value analysis is not a method of controlling the work of others or of investigating errors.
- Normally the amount of work to implement an idea is greater than the amount of work needed to produce the idea.
- Therefore it is good procedure to let the people that implement the idea get most of the praise and merit.
- This produces excellent work relations.
- **Phase VIII - Verification Phase:** It is necessary to ensure that the group that implements the idea informs of the savings produced and other benefits. If needed, the VA team helps them to establish the way the implementation will be checked and the savings calculated.
- Every step of the process is geared toward obtaining a result that increases the ROI (return on investment) or value for the client (ourselves, our employer, etc.).
- The VA team must have a record of the results and a series of "fall back" positions to use as the Project progresses.

THE VA PROCESS (JOB PLAN)



BEHAVIORAL AND ORGANIZATIONAL ASPECTS OF VA / *VE*

- VA is a systematic, rational and structured process. Yet its foundation is based on the effective use of people in the form of teams.
- This foundation itself possess some formidable challenges to the successful implementation of VA / VE,
- Some of which are ;

4. VA teams can waste time, be overly conservative and avoid decisions.
5. The members of the VA team are already saddled with other responsibilities and in that sense are busy.
6. Strong narrow - minded interests are common. .
7. The results from a VA study may be threatening, especially to the current

   planners, designers, and decision makers.
9. Emotional as well as rational conflict of interest is usually generated.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- Function Analysis System Technique is an evolution of the value analysis process.
- FAST permits people with dissimilar technical back grounds to effectively communicate and resolve issues that require multi-disciplined considerations.
- FAST builds upon VA by linking the simply expressed, verb-noun functions to describe complex systems.
- FAST is not an end product or result, but rather a beginning.
- It describes the item or system under study and causes the team to think through the functions that the item or system performs, forming the basis for a wide variety of subsequent approaches and analysis techniques.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- FAST contributes significantly to perhaps the most important phase of value engineering: function analysis.
- FAST is a creative stimulus to explore innovative avenues for performing functions.
- The FAST diagram or model is an excellent communications vehicle. Using the verbnoun rules in function analysis creates a common language, crossing all disciplines and technologies.
- It allows multi-disciplined team members to contribute equally and communicate with one another while addressing the problem objectively without bias or preconceived conclusions.
- With FAST, there are no right or wrong model or result.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- The problem should be structured until the product development team members are satisfied that the real problem is identified.
- After agreeing on the problem statement, the single most important output of the multi-disciplined team engaged in developing a FAST model is consensus.
- Since the team has been charged with the responsibility of resolving the assigned problem, it is their interpretation of the FAST model that reflects the problem statement that's important.
- The team members must discuss and reconfigure the FAST model until consensus is reached and all participating team members are satisfied that their concerns are expressed in the model.
- Once consensus has been achieved, the FAST model is complete and the team can move on to the next creative phase.
- FAST differs from value analysis in the use of intuitive logic to determine and test function dependencies and the graphical display of the system in a function dependency‘ diagram or model .

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- Another major difference is in analyzing a system as a complete unit, rather than analyzing the components of a system.
- When studying systems it becomes apparent that functions do not operate in a random or independent fashion.
- A system exists because functions form dependency links with other functions, just as components form a dependency link with other components to make the system work.
- The importance of the FAST approach is that it graphically displays function dependencies and creates a process to study function links while exploring options to develop improved systems.
- There are normally two types of FAST diagrams, the technical FAST diagram and the customer FAST diagram.
- A technical FAST diagram is used to understand the technical aspects of a specific portion of a total product.
- A customer FAST diagram focuses on the aspects of a product that the customer cares about and does not delve into the technicalities, mechanics or physics of the product. A customer FAST diagram is usually applied to a total product.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- There is essential logic associated with the FAST HOW-WHY directional orientation.
- First, when undertaking any task it is best to start with the goals of the task, then explore methods to achieve the goals.
- When addressing any function on the FAST model with the question WHY, the function to its left expresses the goal of that function.
- The question HOW, is answered by the function on the right, and is a method to perform that function being addressed.
- A systems diagram starts at the beginning of the system and ends with its goal.
- A FAST model, reading from left to right, starts with the goal, and ends at the beginning of the "system" that will achieve that goal.

FUNCTION ANALYSIS SYSTEM TECHNIQUE - FAST

- Second, changing a function on the HOW - WHY path affects all of the functions to the right of that function.
- This is a domino effect that only goes one way, from left to right.
- Starting with any place on the FAST model, if a function is changed the goals are still valid (functions to the left), but the method to accomplish that function, and all other functions on the right, are affected.
- Finally, building the model in the HOW direction, or function justification, will focus the team's attention on each function element of the model. Whereas, reversing the FAST model and building it in its system orientation will cause the team to leap over individual functions and focus on the system, leaving function "gaps" in the system.
- A good rule to remember in constructing a FAST Model is to build in the HOW direction and test the logic in the WHY direction.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- The vertical orientation of the FAST model is described as the WHEN direction.
- This is not part of the intuitive logic process, but it supplements intuitive thinking.
- WHEN is not a time orientation, but indicates cause and effect.
- Scope lines represent the boundaries of the study and are shown as two vertical lines on the FAST model.
- The scope lines bound the "scope of the study", or that aspect of the problem with which the study team is concerned.
- The left scope line determines the basic function(s) of the study.
- The basic functions will always be the first function(s) to the immediate right of the left scope line.
- The right scope line identifies the beginning of study and separates the input function(s) from the scope of the study .
- The objective or goal of the study is called the "Highest Order Function", located to left of the basic function(s) and outside of the left scope line.
- Any function to the left another function is a "higher order function",
- Functions to the right and outside of right scope line represent the input side that "turn on" or initiate the subject under study and are known as lowest order functions.
- Any function to the right of another function is a "lower order" function and represents a method selected to carry out the function being addressed.

FUNCTION ANALYSIS SYSTEM TECHNIQUE – (FAST)

- Those function(s) to the immediate right of the left scope line represent the purpose mission of the product or process under study and are called Basic Function(s).
- Once determined, the basic function will not change.
- If the basic function fails, the product process will lose its market value .
- All functions to the right of the basic function(s) portray the conceptual approach selected to satisfy the basic function.
- The concept describes the method being considered, elected, to achieve the basic function(s).
- The concept can represent either the current conditions (as is) or proposed approach (to be).

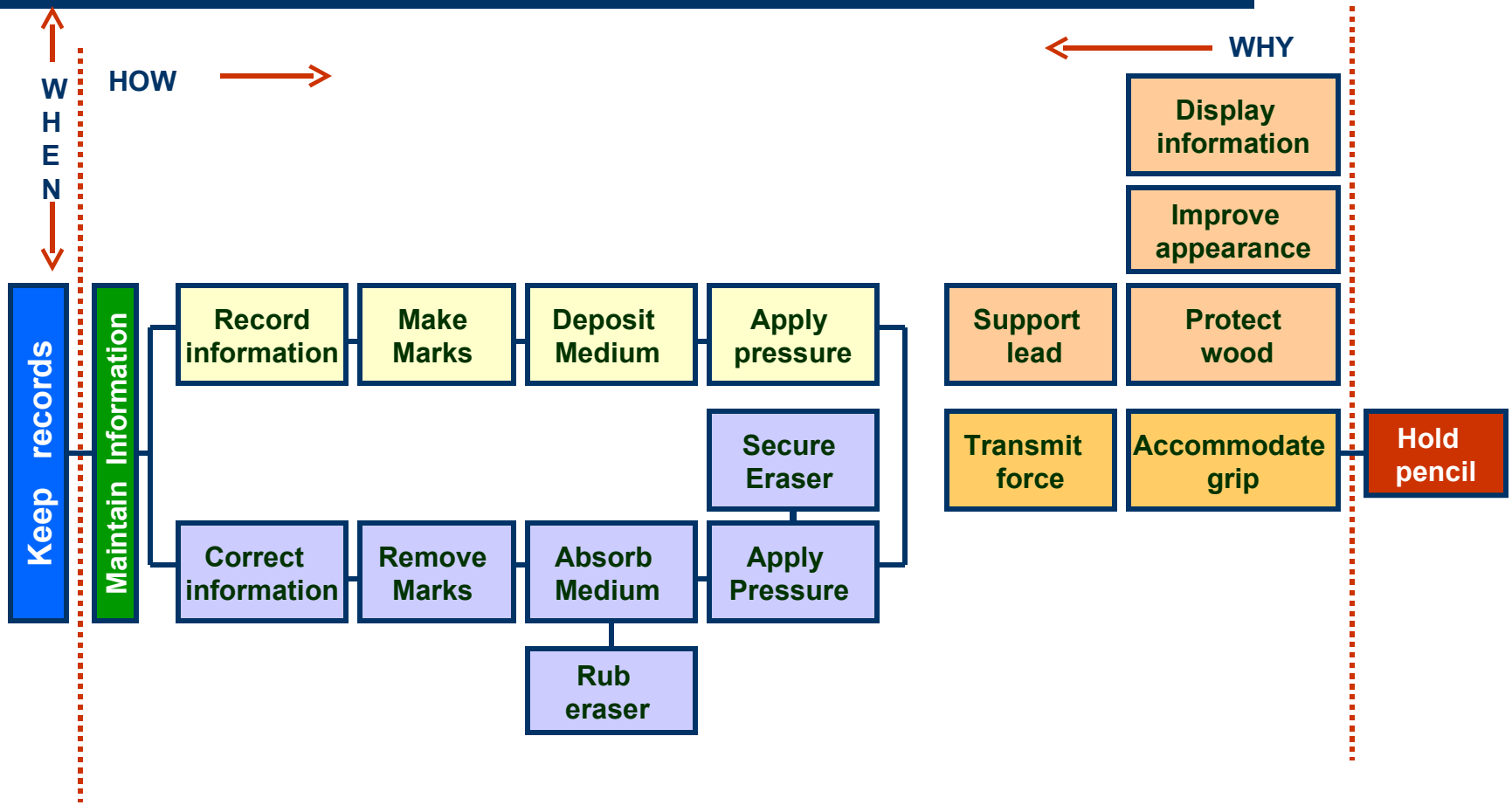
FUNCTION ANALYSIS SYSTEM TECHNIQUE - FAST

- As a general rule, it is best to create a "to be" rather than an "as is" FAST Model, even if the assignment is to improve an existing product.
- This approach will give the product development team members an opportunity compare the "ideal" to the "current" and help resolve how to implement the differences.
- Working from an "as is" model will restrict the team's attention to increment: improvement opportunities.
- An "as is" model is useful for tracing the symptoms of problem to its root cause, and exploring ways to resolve the problem, because of the dependent relationship of functions that form the FAST model.

FUNCTION ANALYSIS SYSTEM TECHNIQUE

- Any function on the HOW-WHY logic path is a logic path function.
- If the function along the WHY direction lead into the basic function(s), than they are located on the major logic path. If the WHY path does not lead directly to the basic function, it is a minor logic path.
- Changing a function on the major logic path will alter or destroy the way the basic function is performed.
- Changing a function on a minor logic path will disturb an independent (supporting) function that enhances the basic function.
- Supporting function are usually secondary and exist to achieve the performance levels specified in the objectives or specifications of the basic functions or because a particular approach was chosen to implement the basic function(s).
- Independent functions describe an enhancement or control of a function located on the logic path.
- They do not depend on another function or method selected to perform that function.
- Independent functions are located above the logic path function(s), and art considered secondary, with respect to the scope, nature, level of the problem, and its logic path.
- An example of a FAST Diagram for a pencil is shown below.

FUNCTION ANALYSIS SYSTEM TECHNIQUE
FAST DIAGRAM PENCIL



FUNCTION ANALYSIS SYSTEM TECHNIQUE - FAST

- The next step in the process is to dimension the FAST model or to associate information to its functions.
- FAST dimensions include, but are not limited to: responsibility, budgets, allocated target costs, estimated costs, actual costs, subsystem groupings, placing inspection and test points, manufacturing processes, positioning design reviews, and others.
- There are many ways to dimension a FAST model.
- The two popular ways are called Clustering Functions and the Sensitivity Matrix.
- Clustering functions involves drawing boundaries with dotted lines around groups of functions to configure sub-systems.
- Clustering functions is a good way to illustrate cost reduction targets and assign design – to – cost targets to new design concepts.
- For cost reduction, a team would develop an "as is" product FAST model, cluster the functions into subsystems, allocate product cost by clustered functions, and assign target costs.
- During the process of creating the model, customer sensitivity functions can be identified as well as opportunities for significant cost improvements in design and production .
- Following the completion of the model, the subsystems can be divided among product development teams assigned to achieve the target cost reductions.
- The teams can then select cost sensitive sub-systems and expand them by moving that segment of the model to a lower level of abstraction.
- This exposes the detail components of that assembly and their function/cost contributions.

CREATING A FAST MODEL

- **Creating A Fast Model**
- The FAST model has a horizontal directional orientation described as the HOW-WHY dimension.
- This dimension is described in this manner because HOW and WHY questions are asked to structure the logic of the system's functions.
- Starting with a function, we ask HOW that function is performed to develop a more specific approach.
- This line of questioning and thinking is read from left to right.
- To abstract the problem to a higher level, we as WHY is that function performed.
- This line of logic is read from right to left.