Value Engineering Explained: From Function Analysis to Innovative Solutions

John Corcoran PE, CVS®, PMP

Value Management Strategies, Inc.

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Introduction – John Corcoran

- Bachelor of Science in Civil Engineering, New Jersey Institute of Technology (NJIT), January 1995
- Professional Engineer, State of New Jersey, 2003
- First Value Engineering Study, 2004
- Began Certification Process, 2014
- Certified Value Specialist, SAVE International, 2019
- Current Member SAVE Value Summit Committee
- Project Management Professional, Project Management Institute, 2023
- Current Member PMINJ Construction LCI

What is Value Engineering (VE)?

The systematic application of recognized techniques by multi-disciplined teams* which

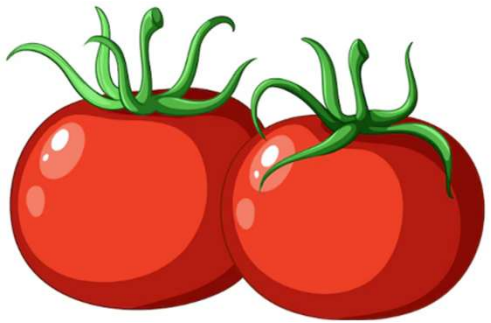
- Identifies the function(s) of a product, project, process, or service;
- Establishes a worth for the functions;
- Generates alternatives using creative thinking;
- Fulfills the needed functions at the greatest value

*VE team - an extension of the design team

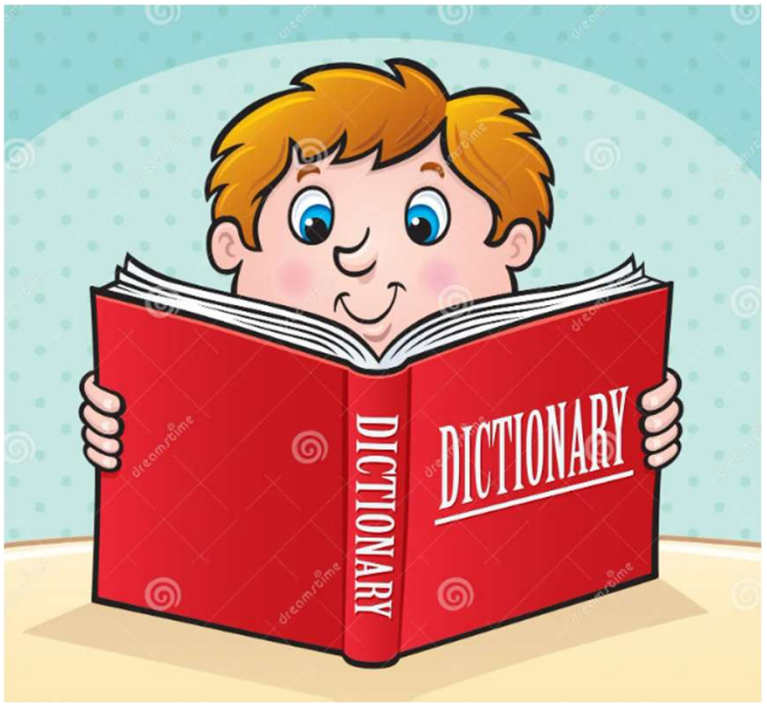
What is Value Engineering (VE)?

Several different terms exist for the same process

- Value Engineering
- Value Analysis
- Value Management



You say tomato, I say tomato



What is Value Engineering (VE)?

Value Engineering is NOT:

- A cost-cutting exercise
- A check-the-box exercise
- A magic wand

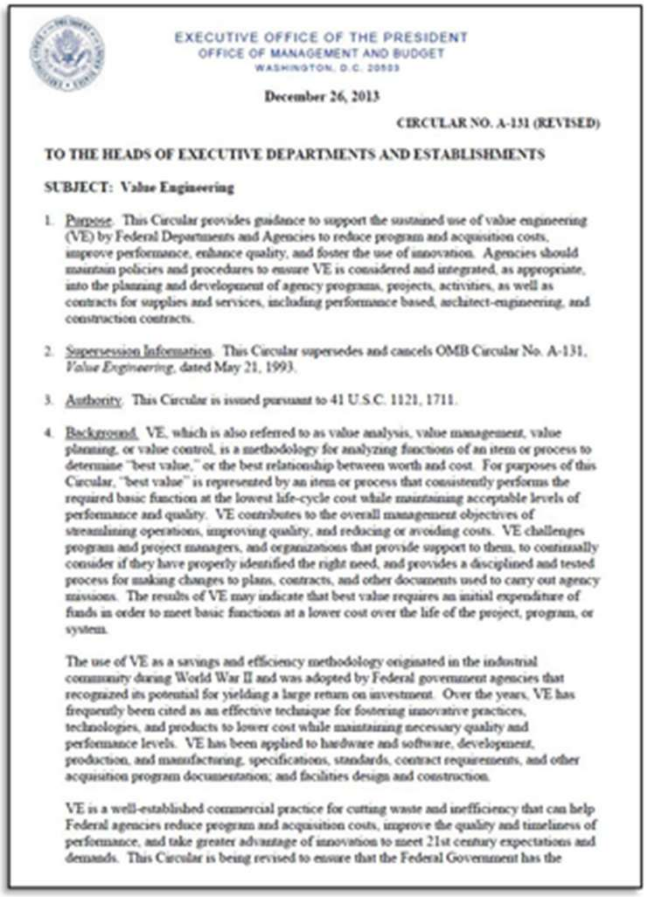
Value Engineering Code Requirements

United States Army Corps of Engineers (USACE)

OMB Circular A-131

Federal Highway Administration (FHWA)

Value Engineering Analysis 23 U.S.C. 106(e) and 23 CFR 627



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

December 26, 2013

CIRCULAR NO. A-131 (REVISED)

TO THE HEADS OF EXECUTIVE DEPARTMENTS AND ESTABLISHMENTS

SUBJECT: Value Engineering

1. Purpose. This Circular provides guidance to support the sustained use of value engineering (VE) by Federal Departments and Agencies to reduce program and acquisition costs, improve performance, enhance quality, and foster the use of innovation. Agencies should maintain policies and procedures to ensure VE is considered and integrated, as appropriate, into the planning and development of agency programs, projects, activities, as well as contracts for supplies and services, including performance based, architect-engineering, and construction contracts.

2. Supersession Information. This Circular supersedes and cancels OMB Circular No. A-131, *Value Engineering*, dated May 21, 1993.

3. Authority. This Circular is issued pursuant to 41 U.S.C. 1121, 1711.

4. Background. VE, which is also referred to as value analysis, value management, value planning, or value control, is a methodology for analyzing functions of an item or process to determine "best value," or the best relationship between worth and cost. For purposes of this Circular, "best value" is represented by an item or process that consistently performs the required basic function at the lowest life-cycle cost while maintaining acceptable levels of performance and quality. VE contributes to the overall management objectives of streamlining operations, improving quality, and reducing or avoiding costs. VE challenges program and project managers, and organizations that provide support to them, to continually consider if they have properly identified the right need, and provides a disciplined and tested process for making changes to plans, contracts, and other documents used to carry out agency missions. The results of VE may indicate that best value requires an initial expenditure of funds in order to meet basic functions at a lower cost over the life of the project, program, or system.

The use of VE as a savings and efficiency methodology originated in the industrial community during World War II and was adopted by Federal government agencies that recognized its potential for yielding a large return on investment. Over the years, VE has frequently been cited as an effective technique for fostering innovative practices, technologies, and products to lower cost while maintaining necessary quality and performance levels. VE has been applied to hardware and software, development, production, and manufacturing, specifications, standards, contract requirements, and other acquisition program documentation; and facilities design and construction.

VE is a well-established commercial practice for cutting waste and inefficiency that can help Federal agencies reduce program and acquisition costs, improve the quality and timeliness of performance, and take greater advantage of innovation to meet 21st century expectations and demands. This Circular is being revised to ensure that the Federal Government has the

Key Definitions

Function:

- That which a project, product, process, or service must do to make it work and meet the customer's needs
- Expressed in two-word combinations of an active verb and measurable noun
- The verb answers the question, "What does it do?"
- The noun answers the question, "What does it do it to?"

Key Definitions

Examples of Functions:

Bridge	Span Obstacle
Lighting	Illuminate Space
Structures	Support Loads
Drainage	Convey Runoff

Key Definitions

Resources:

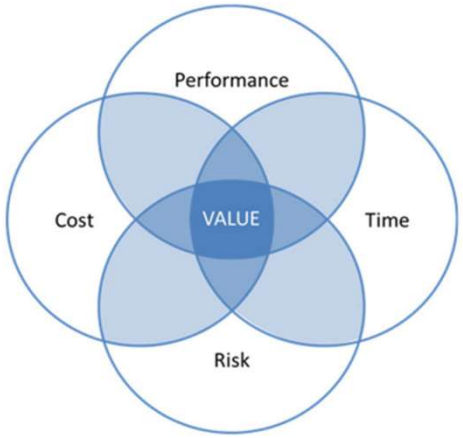
- All expenditures of cost, time, energy, space, materials, labor, price, etc. required to accomplish a function
- Almost always cost or time

Key Definitions

Value:

- An expression of the relationship between function and resources where function is measured by the reliable performance of functional requirements of the customer and resources are measured in costs, materials, labor, price, time, etc. required to accomplish those functions
- Value = Function / Resources

$$V = F / R$$



Examples of Value Improvement

$$V = F / R$$

Scenario 1: Increased Function for the Same Resources

- Cost reduction in one part of the design allows for additional spending for another part of the design, i.e. wants, nice-to-haves, bid options
- Improved efficiency
  - Building floorplan, adjacencies
  - Site circulation

Examples of Value Improvement

$$V = F / R$$

Scenario 2: Same Function for less Resources

- Overall Cost savings




Examples of Value Improvement

$$V = F / R$$

Scenario 3: Schedule Reduction for Same Overall Product

- Design Schedule Reduction
- Construction Schedule Reduction

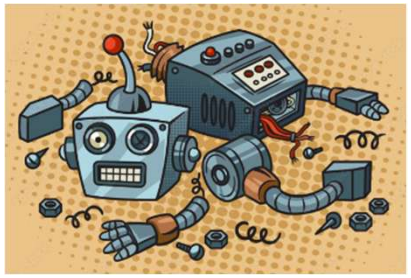
Examples of Value Improvement

$$V = F / R$$

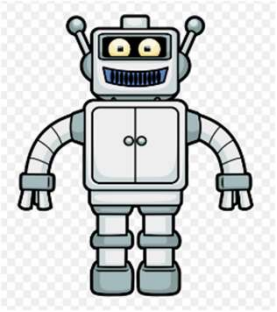
Scenario 4: Increased Construction Cost but Operational Cost Savings

- End user participation is particularly beneficial
- Life Cycle Cost Analysis (LCCA) if feasible
- Return on Investment (ROI)
- Example: Increased equipment cost for improved reliability

Standard equipment



Premium equipment



Examples of Value Improvement

$$V = F / R$$

Scenario 5: No benefit to immediate project but programmatic benefit

- Benefits to similar projects
- Benefits to nearby projects
- Example: Combine environmental and utility services for adjacent or consecutive projects
- Example: Alternative could be applicable for current project and other similar projects

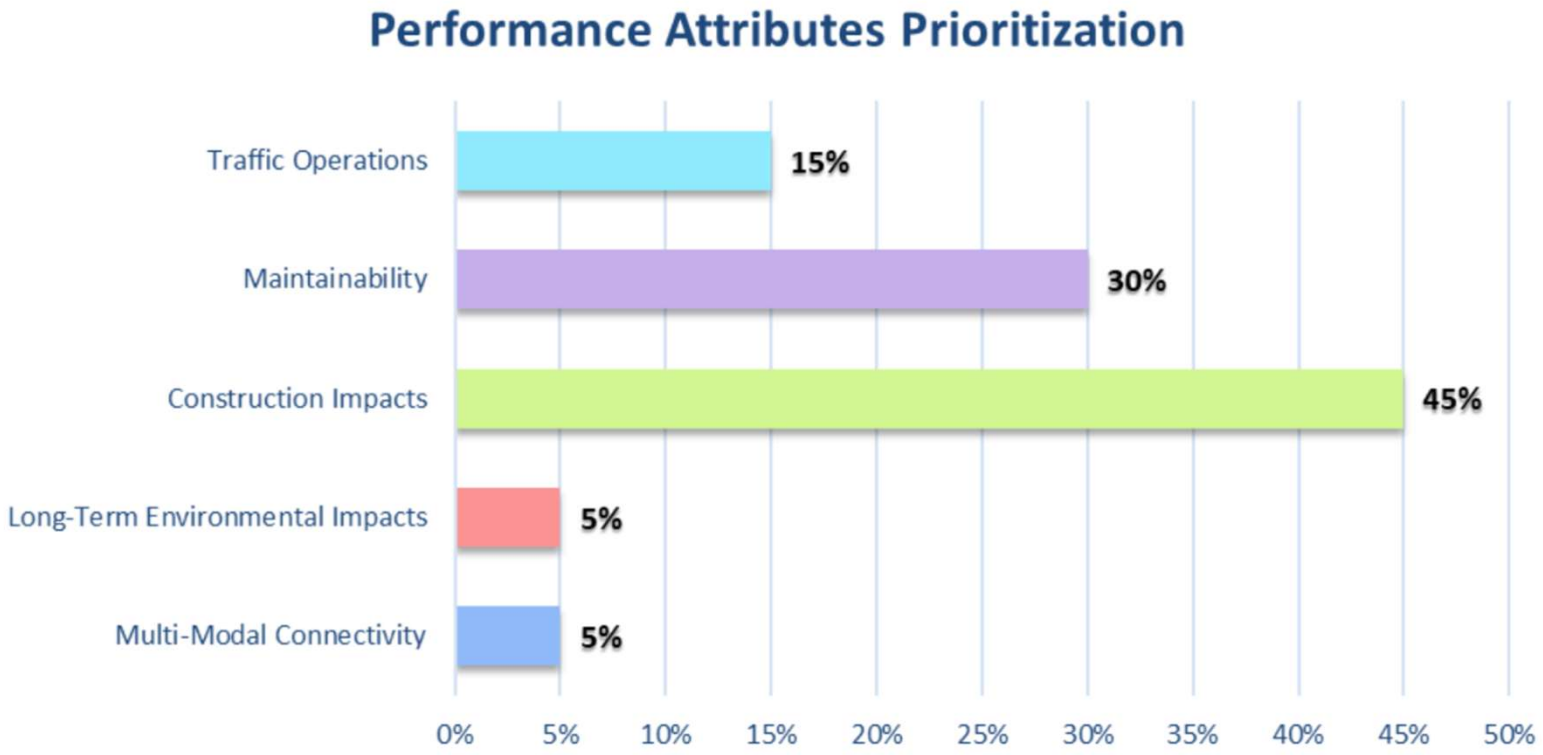
Performance

- Performance offers a degree of quantifiability to function which is somewhat subjective
- Typical performance attributes for transportation clients
  - Multi-Modal connectivity
  - Maintainability
  - Long-Term Environmental Impacts
  - Construction Impacts
  - Traffic Operations

Performance

Performance Attributes Prioritization

Example: Tube Ventilation Upgrade



Performance

Performance Attributes Scoring

Rating	Label	Description
8-10	Ideal	The highest reasonable level of performance is achieved.
6-8	High	A high level of performance is achieved.
4-6	Medium	A medium level of performance is achieved.
2-4	Low	A low level of performance is achieved.
0-2	Minimum Acceptable	The minimum acceptable level of performance is achieved.

Performance

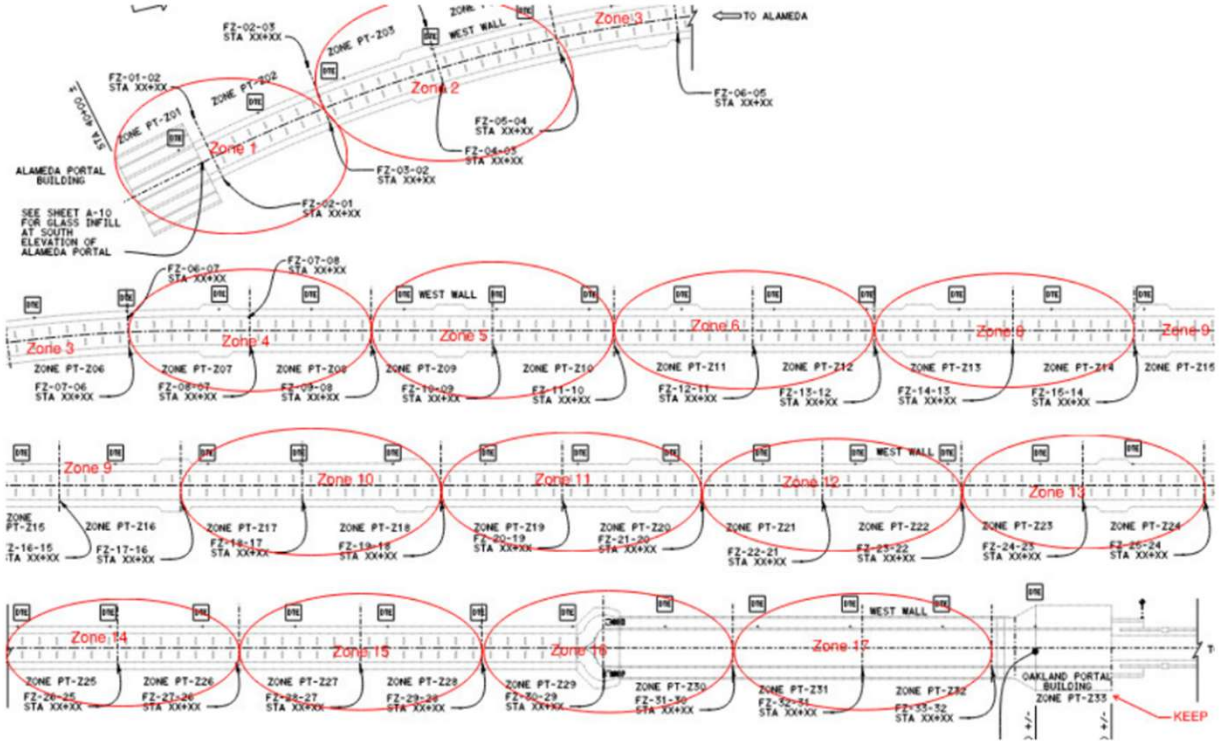
Performance Attributes Scoring

Performance Attribute	Description	Baseline Performance	Baseline Performance Rationale
Traffic Operations	How well traffic flows through this corridor. Lane widths/shoulders.	3.0	No civil improvements in scope. Improvements during emergency situations. Variable message sign being added to Webster.
Construction Impacts	How are users affected as well as the surrounding environment during construction (Short Term)	5.0	Preliminary staging details completed. Staged construction, traffic handling and TMP plans not fully vetted.
Environmental Impacts	How is surrounding affected (Long Term). Disruptions to habitats, Soil Disturbance, Cultural Impacts Etc.	2.0	Little environmental impact anticipated, except in the case of an emergency. Improvements intended to mitigate smoke.
Maintainability	How often does it need to be maintained? Is it less or more maintainable?	4.0	Increased O&M scope due to new components. Sprinkler system being added. Sprinkler water requires mitigation. New equipment is easier and safer to maintain for maintenance crews. Overall reduction in fire risk.
Multi-Modal Transportation	How does it affect the pedestrians/Cyclists of this system.	3.0	No civil improvements in current scope. Existing sidewalk is very narrow. Pedestrian access is similar to Traffic Ops post-emergency.

Performance

Performance Attributes Scoring

Increase size of deluge zones to reduce number of zones and subsequent maintenance.



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New table

Traffic Operations	3.0	No major impact.
Construction Impacts	6.5	Major deluge station quantity reduction.
Environmental Impacts	1.9	More water usage during a fire.
Maintainability	5.5	Major deluge station quantity reduction significantly reduces maintenance.
Multi-Modal Transportation	3.0	No major impact.

Performance

Performance Attributes Scoring

Increase size of deluge zones to reduce number of zones and subsequent maintenance.

V = Value P = Performance t = Time

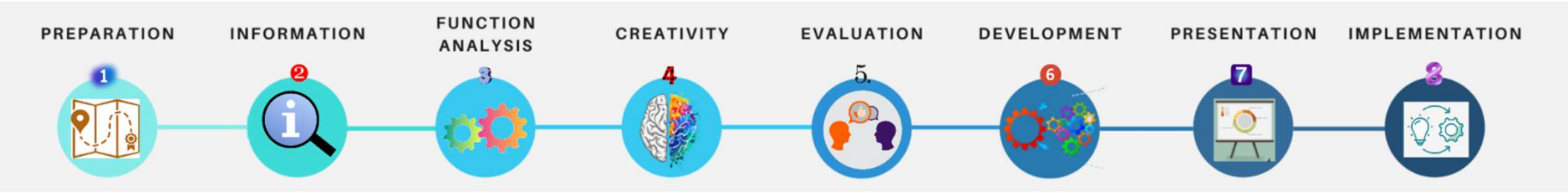
f = Function C = Cost α = Risk

$$V_f(P, C, t)_{total} = \frac{\sum_{n=1}^{\infty} P_n \cdot \alpha}{\sum_{n=1}^{\infty}[(C_n \cdot \alpha) + (t_n \cdot \alpha)]}$$

Performance increased by 27%

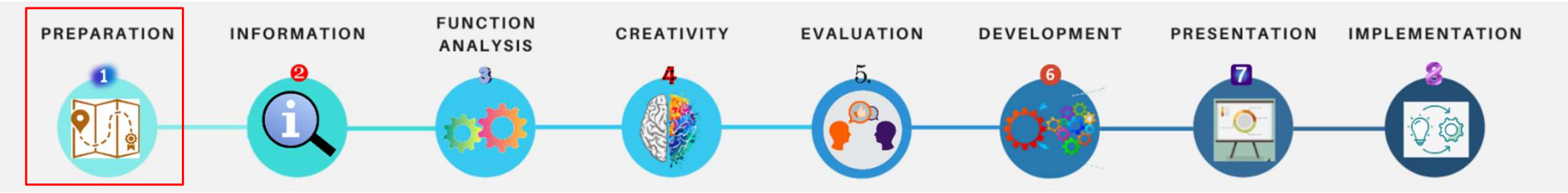
Value Engineering Job Plan

- Pre-Study - Preparation
- VE Study Job Plan
  - Information Phase
  - Function Analysis Phase
  - Creativity Phase
  - Evaluation Phase
  - Development Phase
  - Presentation Phase
- Post-Study - Implementation



Pre-Study - Preparation

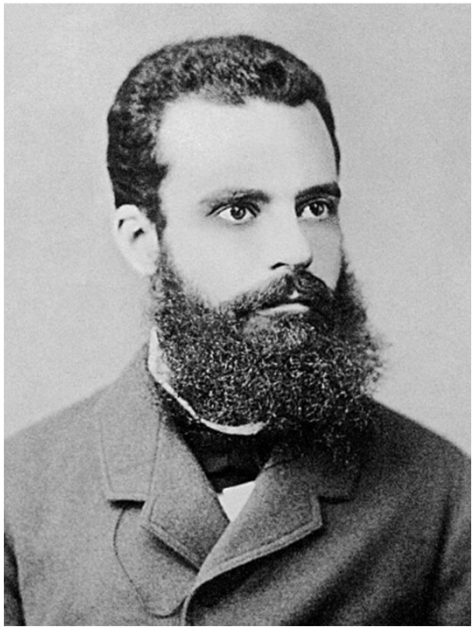
- Agenda
- Study Site Selection
- Site Access and Logistics
- VE Study Team Selection
- Distribution of VE Documents
- Stakeholder and End User Participation
- Agenda Review and Revision
- Cost Model



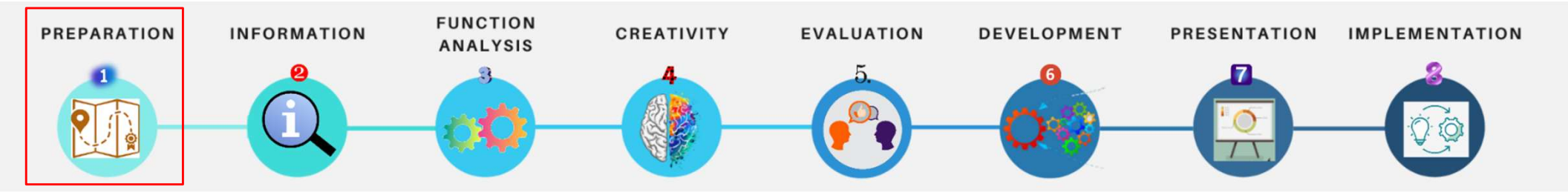
Pre-Study - Preparation

Cost Model (Pareto Sort or 80/20 Rule)

- 80% of the effects come from 20% of the causes
- 80% of the cost come from 20% of the line items



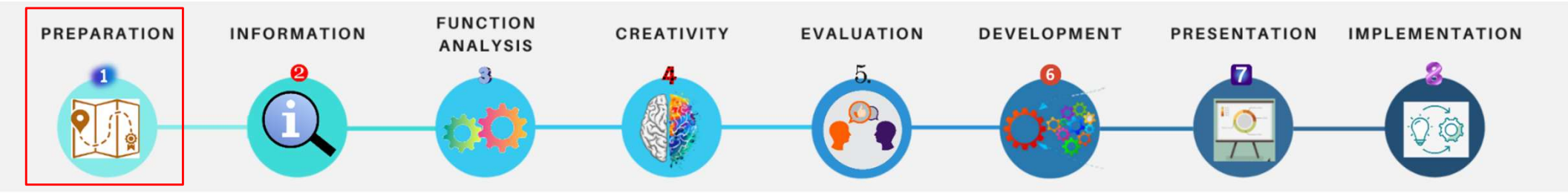
Vilfredo Pareto



Pre-Study - Preparation

Cost Model (Pareto Sort or 80/20 Rule)

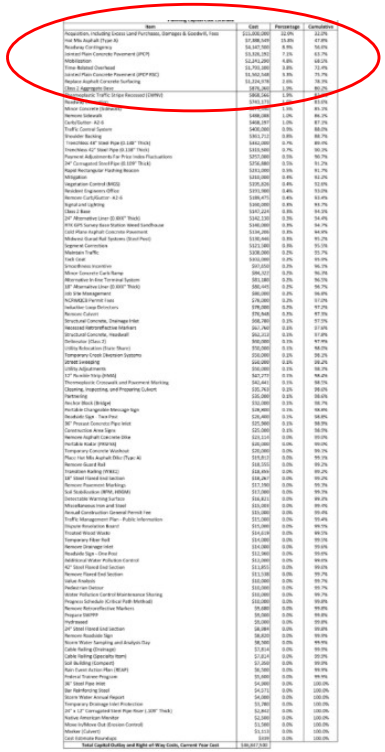
Item	Cost	Percentage	Cumulative
Pavement Structural Section	$ 15,141,000	32.3%	32.3%
Right of Way	$ 15,050,000	32.1%	64.4%
Roadway Contingency	$ 4,147,500	8.9%	73.3%
Specialty Items	$ 2,632,500	5.6%	78.9%
Roadway Mobilization	$ 2,241,300	4.8%	83.7%
Traffic Items	$ 2,113,900	4.5%	88.2%
Time-Related Overhead	$ 1,793,100	3.8%	92.0%
Drainage	$ 1,501,600	3.2%	95.2%
Earthwork	$ 743,200	1.6%	96.8%
Supplemental Work	$ 628,300	1.3%	98.2%
State Furnished	$ 574,400	1.2%	99.4%
Environmental	$ 280,700	0.6%	100.0%
Total Capital Outlay and Right-of-Way Costs, Current Year Cost	$ 46,847,500		

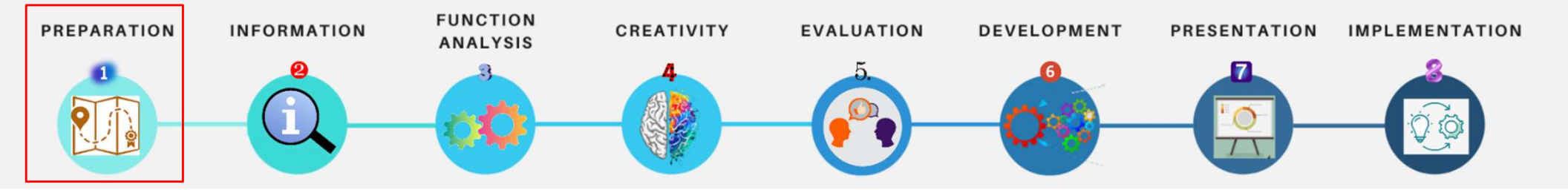


Pre-Study - Preparation

Cost Model (Pareto Sort or 80/20 Rule)

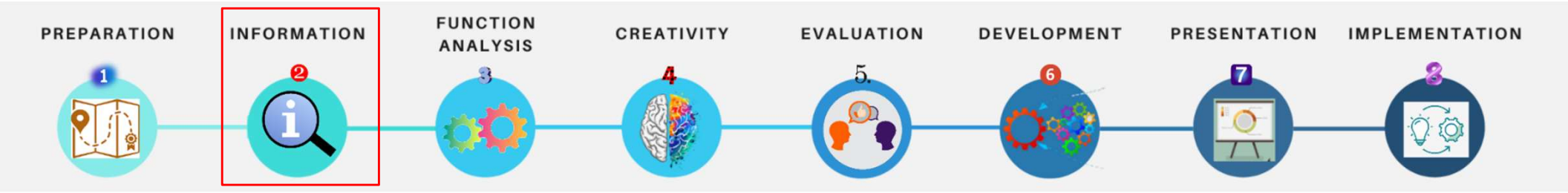
Item	Cost	Percentage	Cumulative
Acquisition, including Excess Land Purchases, Damages & Goodwill, Fees	$15,000,000	32.0%	32.0%
Hot Mix Asphalt (Type A)	$7,388,549	15.8%	47.8%
Roadway Contingency	$4,147,500	8.9%	56.6%
Jointed Plain Concrete Pavement (JPCP)	$3,326,192	7.1%	63.7%
Mobilization	$2,241,290	4.8%	68.5%
Time-Related Overhead	$1,793,100	3.8%	72.4%
Jointed Plain Concrete Pavement (JPCP RSC)	$1,562,548	3.3%	75.7%
Replace Asphalt Concrete Surfacing	$1,224,978	2.6%	78.3%
Class 2 Aggregate Base	$876,360	1.9%	80.2%





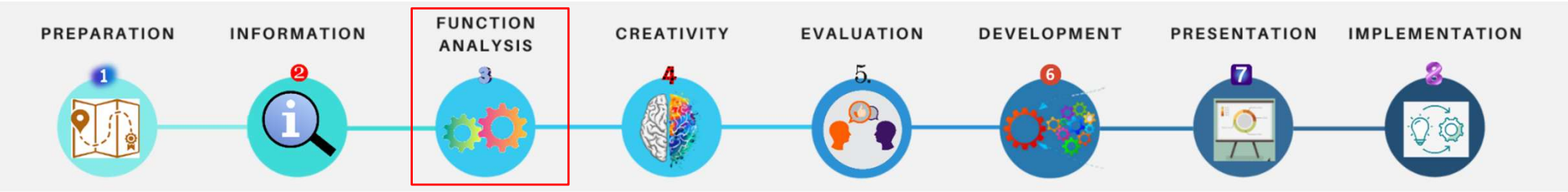
Information Phase

- Kickoff Meeting - Design Team Project Update and Summary
  - Project Summary
  - Constraints
  - Issues, Challenges, and Risks
  - Cost and Schedule
  - VE Study Focus Areas
- Optional Site Visit
- VE Team Q&A

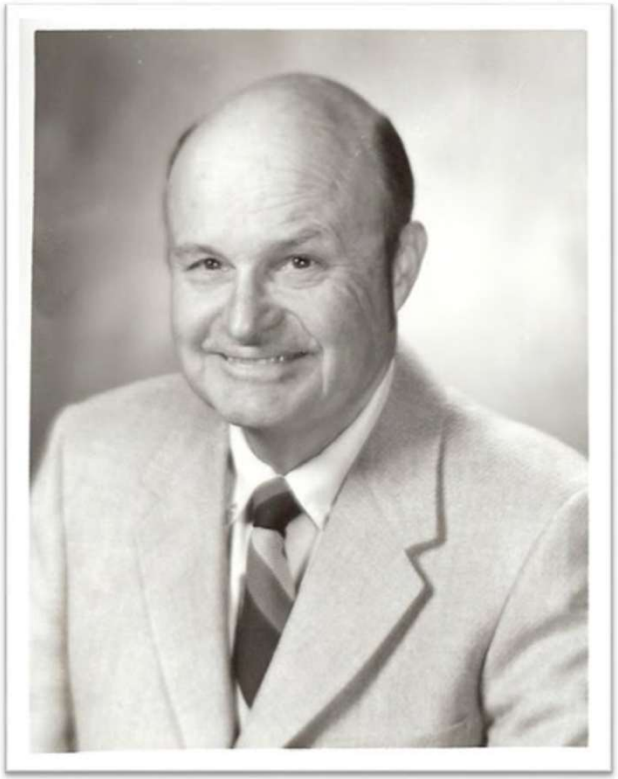


Function Analysis Phase

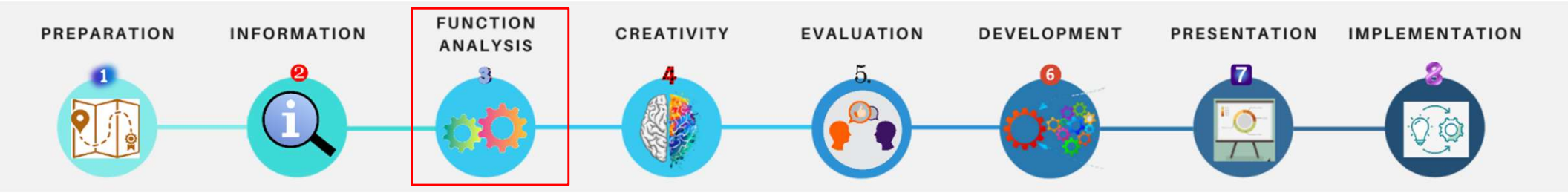
- Separates Value Engineering from Cost Cutting
- Functions expressed in two-word combinations of an active verb and measurable noun
- Function Analysis must be 6.25% of agenda time (total hours divided by 16)
- Random Function Identification for project and components
- Optional FAST Diagram
- Identify functions of overall project and all key subcomponents



Function Analysis Phase

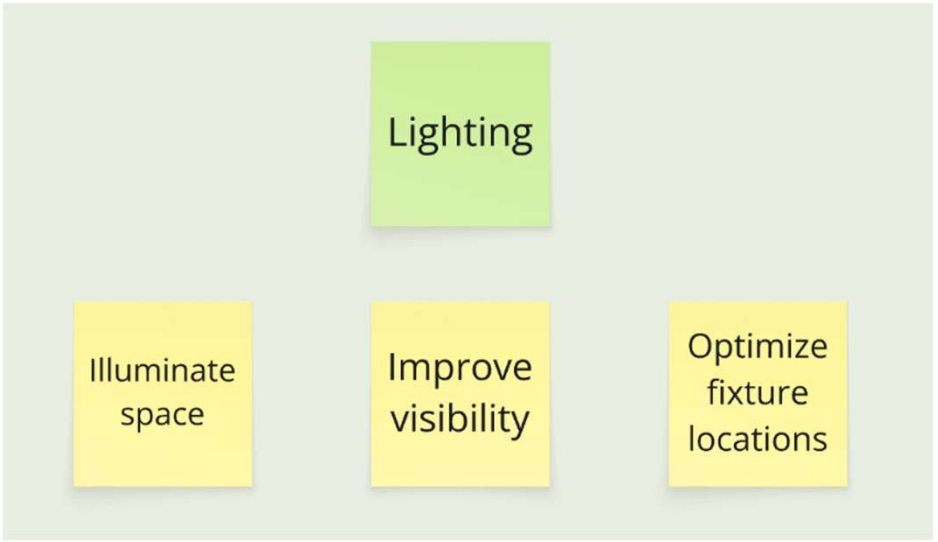


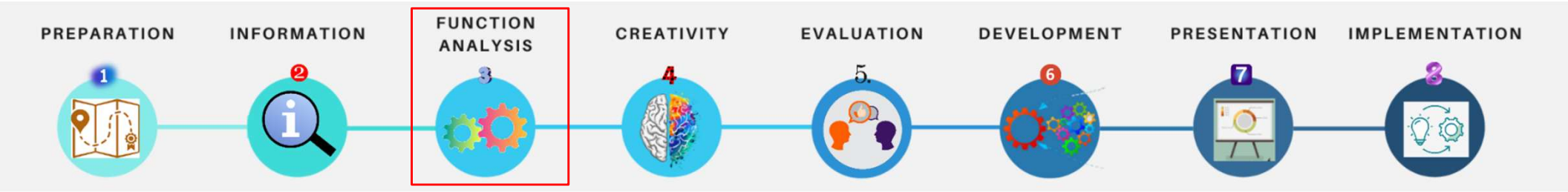
*Larry Miles – If we **can't get the material**, we need to find a different way to **satisfy the function** that the material fulfills.*



Function Analysis Phase

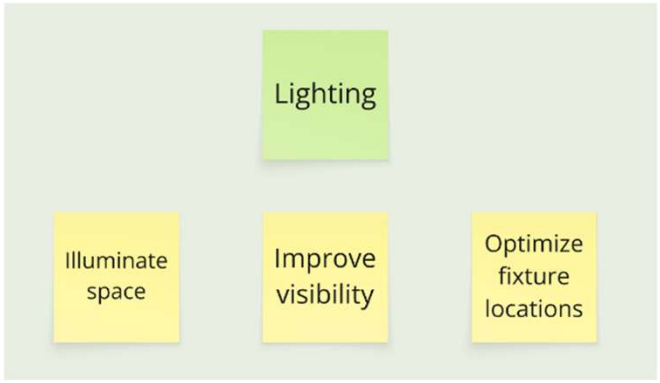
Random Function Identification

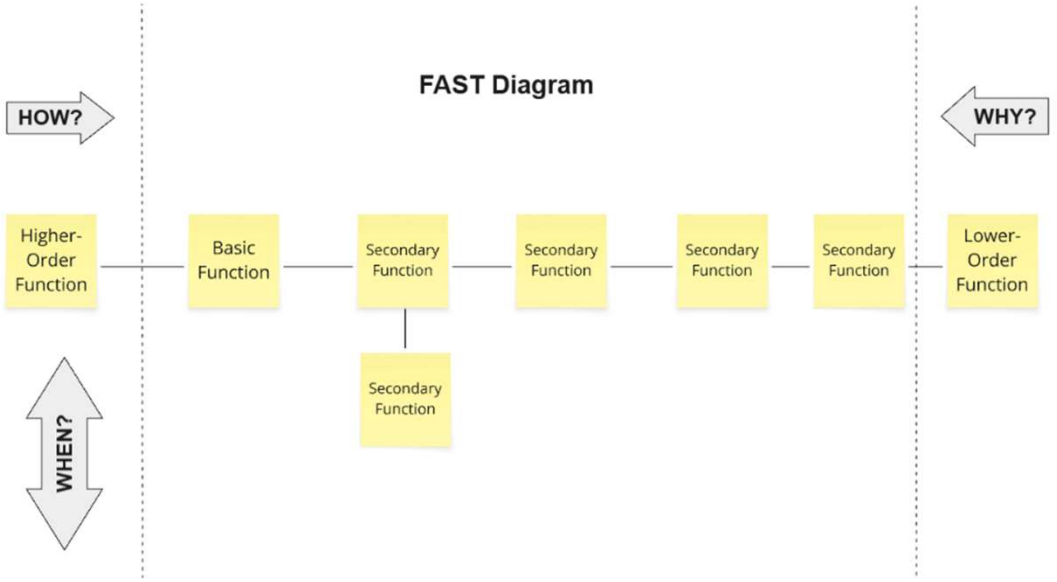


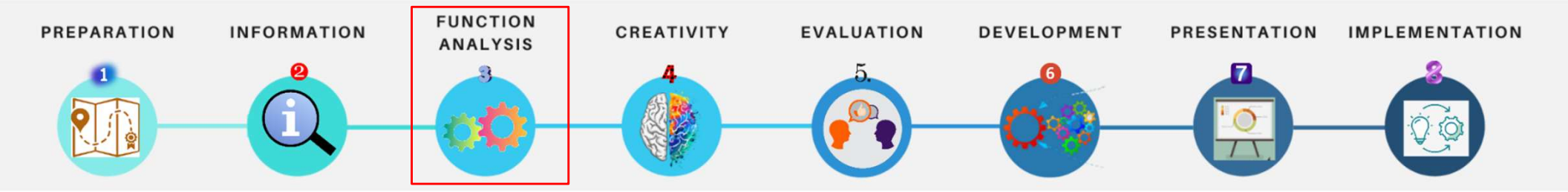


Function Analysis Phase

Function Analysis System Technique (FAST) Diagram







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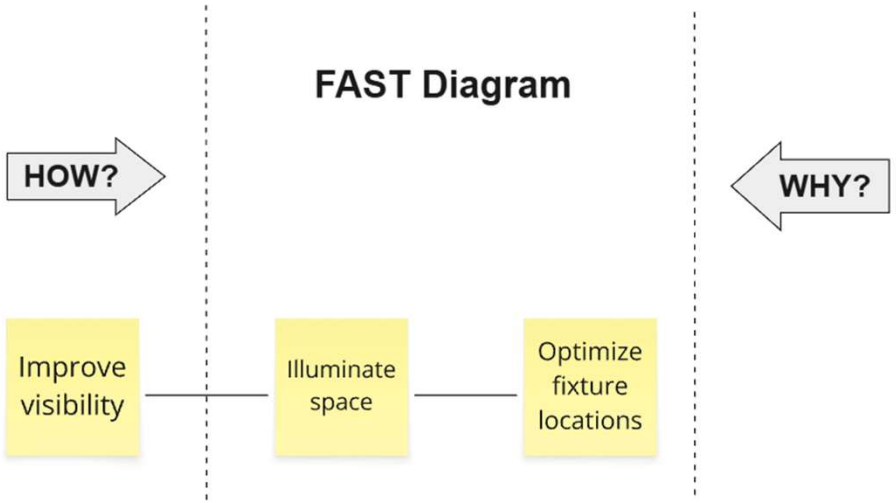

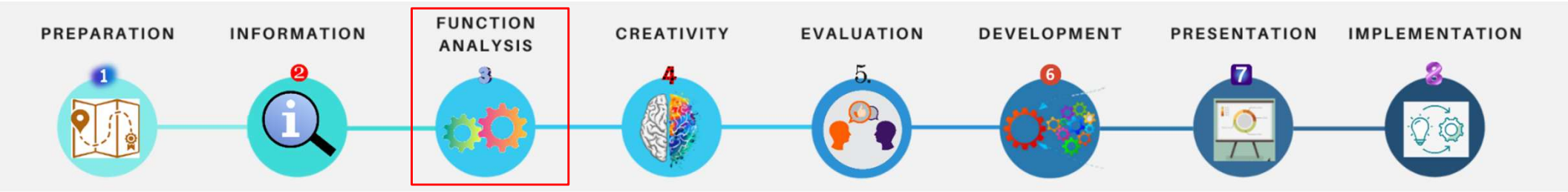

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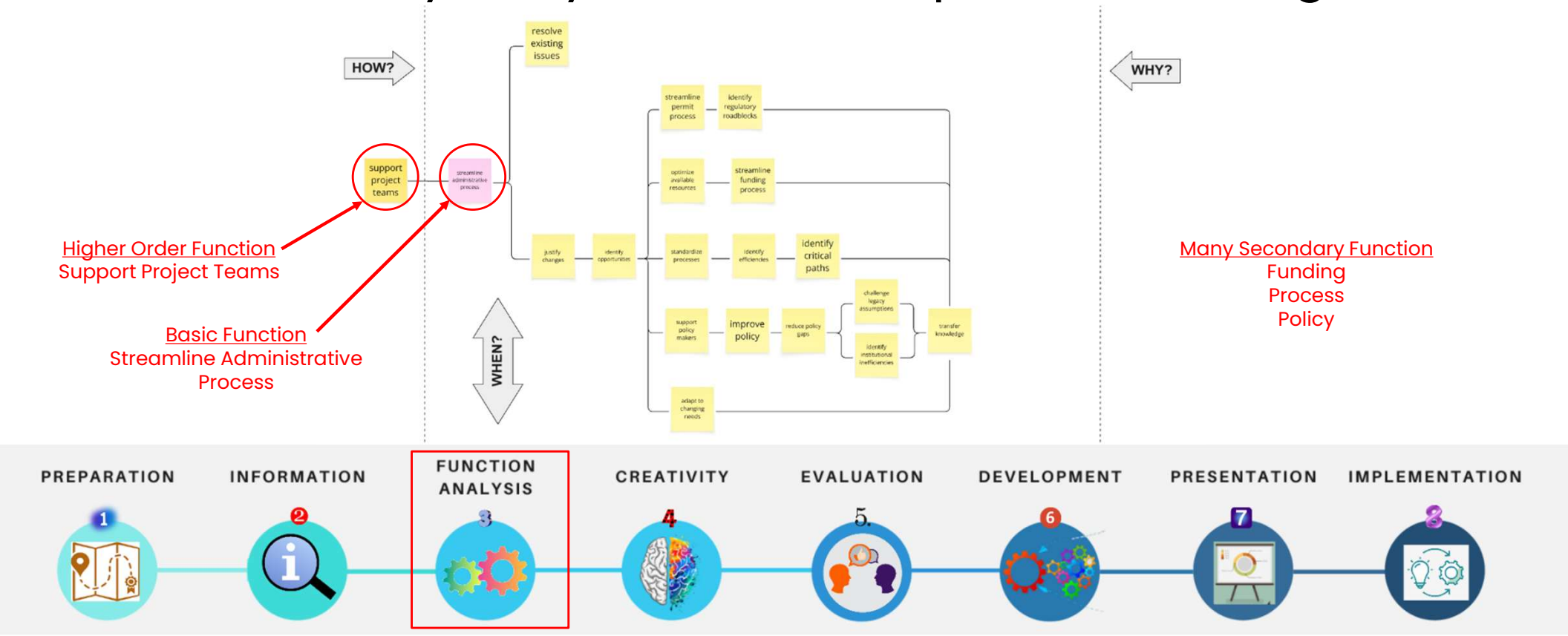
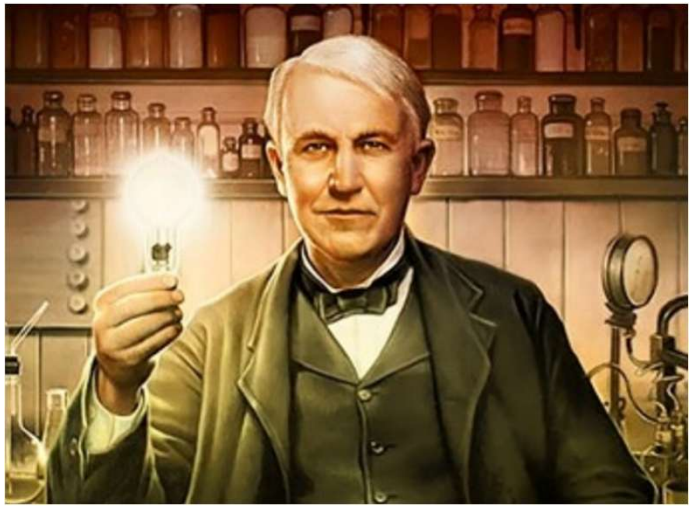
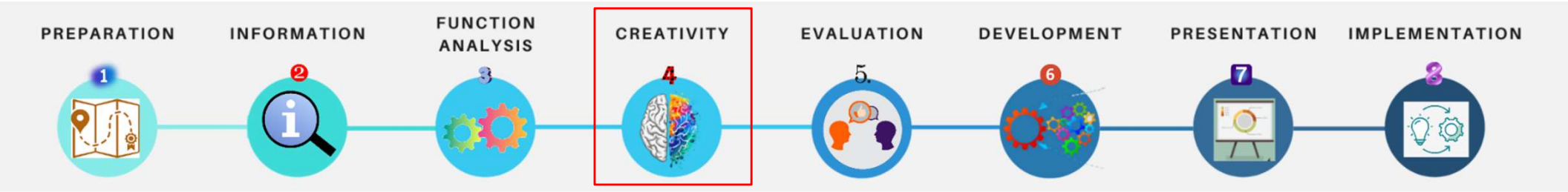


Creativity Phase (Brainstorming)

- Alternative solutions for accomplishing functions
- No limit on number of ideas
- Outside-the-box ideas are encouraged
- Review risk matrix and cost model
- NO JUDGEMENT OF IDEAS

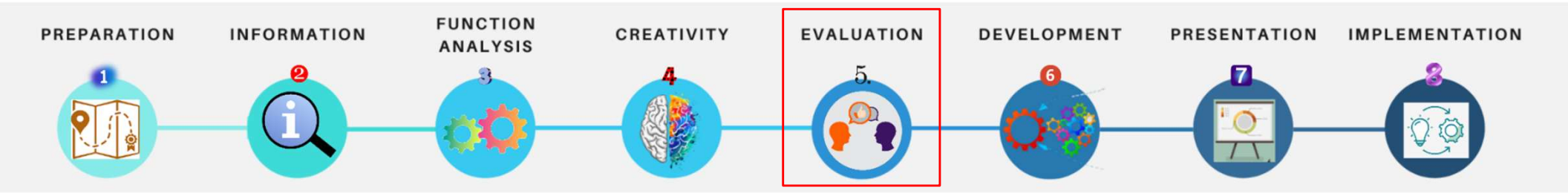


Thomas Edison - "I have not failed. I've just found 10,000 ways that won't work."



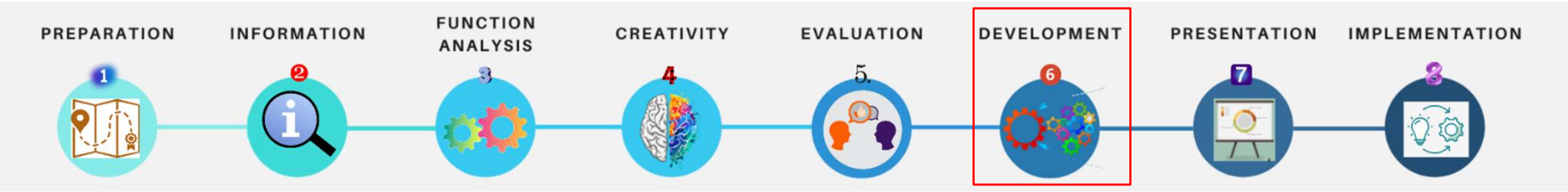
Evaluation Phase

- Evaluate the merits of all ideas
- Analyze advantages and disadvantages
- Filter large pool of ideas down to shortlist of the best ideas
- Discuss all ideas individually or vote by category
- Midpoint review meeting



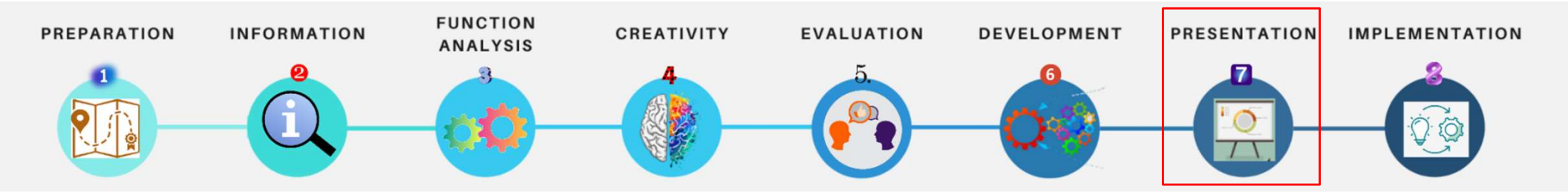
Development Phase

- Remaining VE alternatives are distributed among VE team members for development
  - Elaborate on VE concept, develop narrative
  - Develop images, sketches or graphics to support narrative
  - Analyze cost impact
- Facilitator develops PowerPoint presentation
- Longest phase of the agenda



Presentation Phase

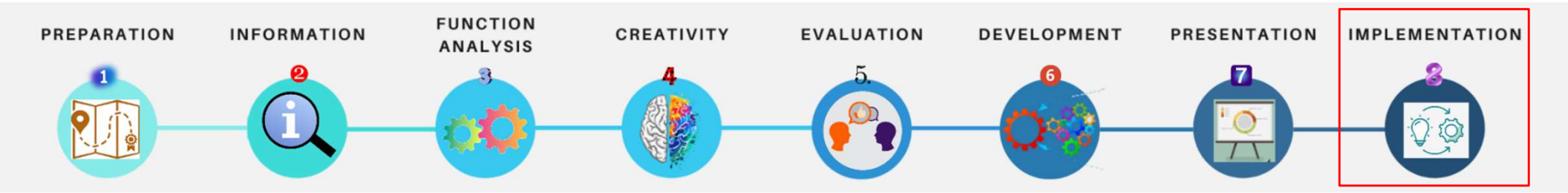
- VE Team shares their findings with the design team
- Questions from design team and stakeholders are encouraged



Implementation Phase

Design team arrives at a consensus for each VE alternative

- Accept
- Accept with Modifications
- Reject
- Hold for Further Consideration



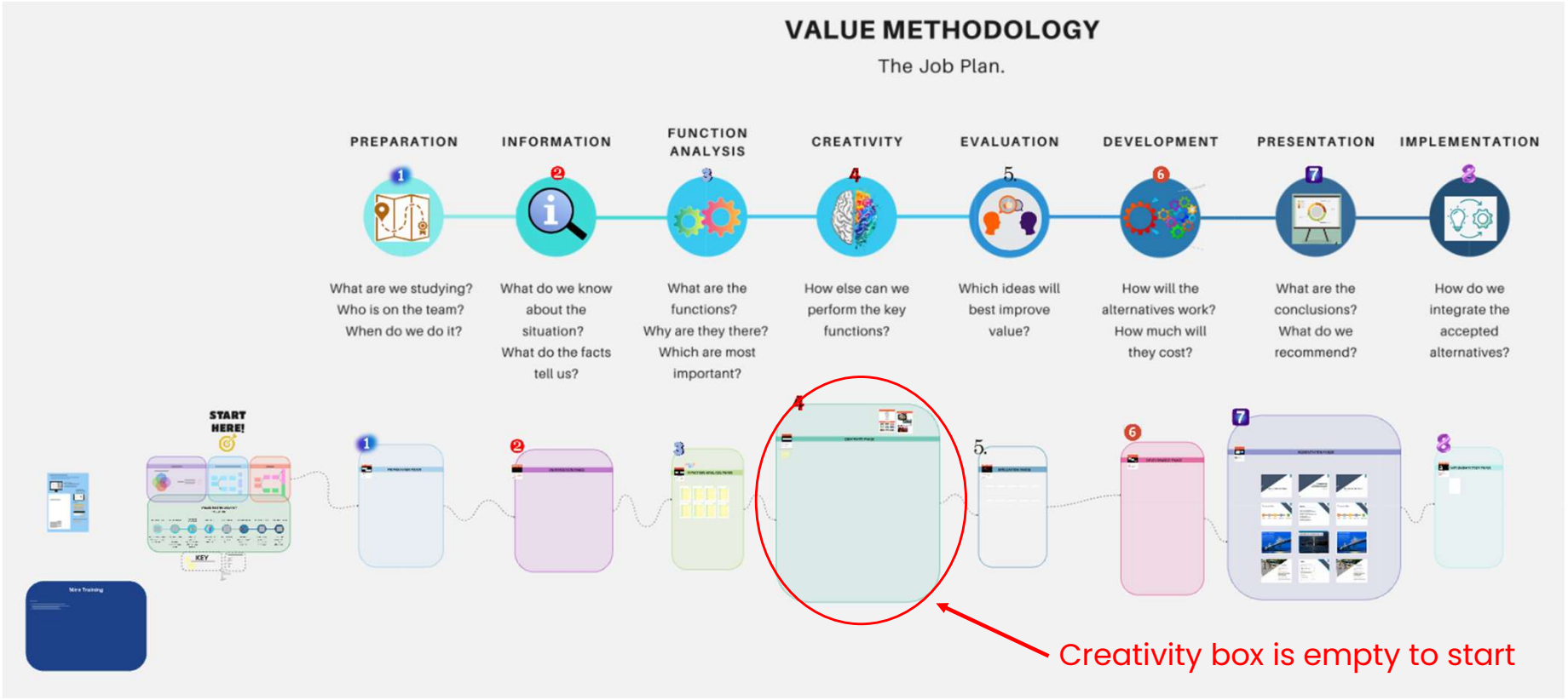
Virtual VE Studies

Benefits

- Virtual platforms are now commonplace
  - Teams, Webex, GoToMeeting, etc.
  - Miro, Mural
- Schedule flexibility
- Enables greater attendance
  - Larger pool of SMEs
  - Enables part-time participation
- Reduces or eliminates travel expenses
- Reduces reproduction cost

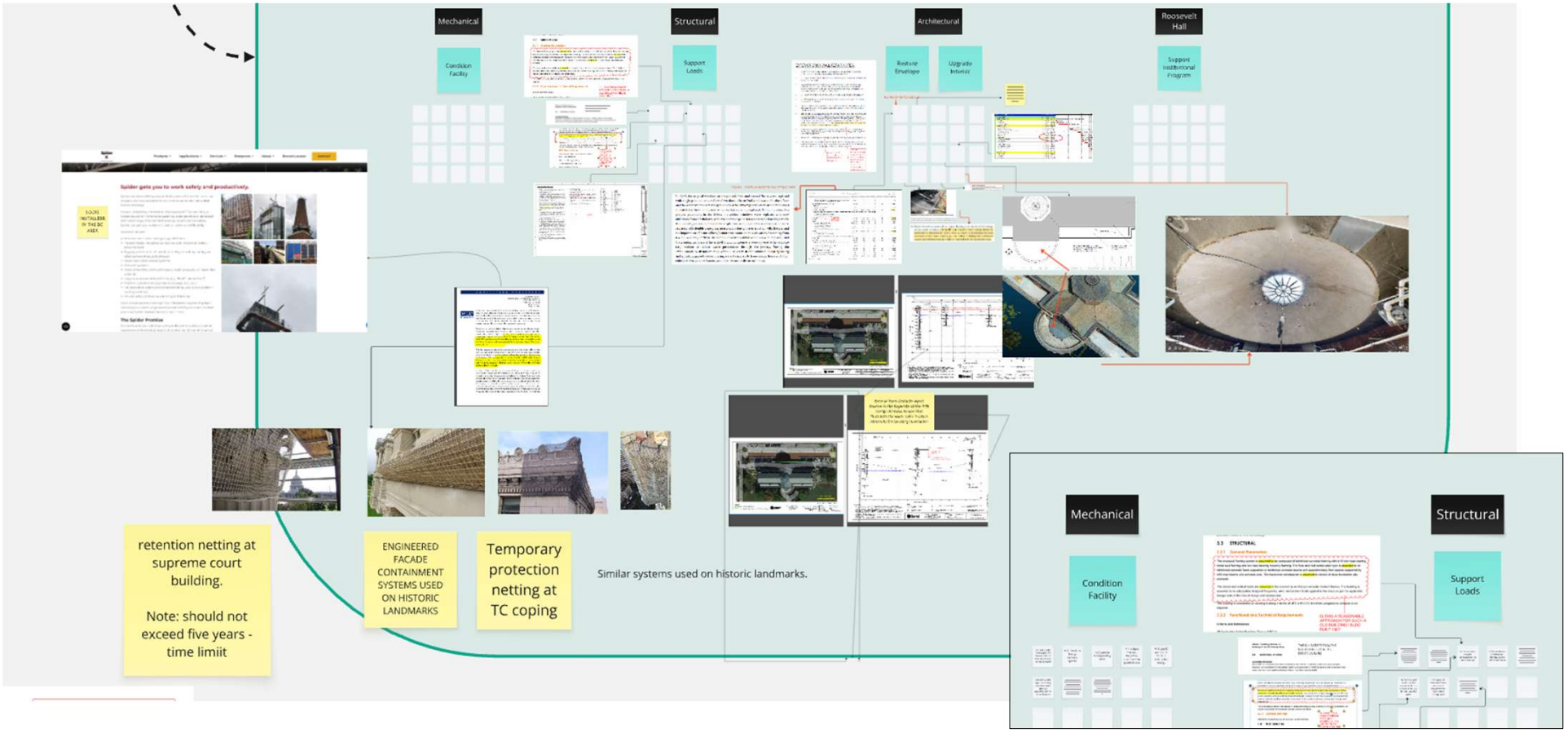
Virtual VE Studies

Generic Miro Board Template



Virtual VE Studies

Project VE Study Miro Board Sample



SAVE International

https://www.value-eng.org/

2026 Value Summit

June 8–10, 2026
Milwaukee, WI

- 200+ Attendees
- 10+ Countries Represented

https://www.value-eng.org/page/2026ValueSummit

Contact Information

Contact me at:

John.Corcoran@vms-inc.com

John Corcoran, PE, CVS®, PMP

Senior Value Manager at Value Management Strategies, Inc.

Questions?