Title:
THE INTEGRATION OF THE VALUE METHODOLOGY – VM/VE (VALUE ENGINEERING / VALUE MANAGEMENT) INTO THE CAPITAL PROJECT EXECUTION PROCESS

Summary:
Through a series of value improving processes, developed to interact with capital projects execution processes, acceptable trade-off between cost and functionality is achieved.

The paper will explain the benefits of VE/VM when applied in the Project Business Case Development, Design to Capacity & Technology Selection, Process simplification, Customisation of Engineering Specifications & Standards, Constructability and Value Contracting.

Presenter:
Kurt J Huber  GDE (WITS), CVS Life
Swiss born, Director of VM Services (Pty) Ltd
Current Chairman, Standard Generating Group – Value Engineering (Part of the Engineering SGB – managed through the Engineering Council of South Africa – ECSA)
Kurt is certified as a Value Specialist by the Society of American Value Engineers.
He is also a Part-time lecturer (Value Engineering / Value Analysis) in post-graduate studies at the School of Mechanical Engineering at the University of the Witwatersrand.
THE INTEGRATION OF THE VALUE METHODOLOGY – VE/VM (VALUE ENGINEERING / VALUE MANAGEMENT) INTO THE CAPITAL PROJECT EXECUTION PROCESS

WHY VALUE ENGINEERING SHOULD BE APPLIED IN PROJECTS?

- To enhance cost effective decision making
- Reduce delays in projects
- Reduce cost without sacrificing requirements

WHERE IS VALUE ENGINEERING APPLIED DURING A PROJECT?

It can be applied from the Concept Stage to the Final Audit Stage.

Example of typical Project Management Models applied in two leading Companies in South Africa:

BUSINESS DEVELOPMENT & IMPLEMENTATION MODEL

<table>
<thead>
<tr>
<th>IDEA GENERATION</th>
<th>FRONTAL LOADING</th>
<th>IMPLEMENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDEA PACKAGING</td>
<td>PRE-FEASIBILITY</td>
<td>FEASIBILITY</td>
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<tr>
<td>BUSINESS</td>
<td>1. Opportunity</td>
<td>2. Feasibility</td>
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<td>SCANNING</td>
<td>2. Opportunity</td>
<td>3. Basic</td>
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<td>3. Business</td>
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<td>4. Contract</td>
<td>EXECUTION</td>
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<td>GOAL STRATEGIES</td>
<td>5. Contract</td>
<td>START-UP</td>
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<tr>
<td>MINISTRIES</td>
<td>6. Performance</td>
<td>EVALUATION/OPERATION</td>
</tr>
<tr>
<td>GOVERNANCE</td>
<td>7. Performance</td>
<td></td>
</tr>
</tbody>
</table>

VALUE ENGINEERING APPLIED

- **Initiation Phase:**
  - Business case
  - Management summary
  - Final tender
  - Space report
  - Detailed design

- **Development Phase:**
  - Procure
  - Construct
  - Commission

- **Execution Phase:**
  - Analyst

**Gate Criteria:**

- 30%
- 50%
- 70%
- 95%
- 100%

**Example Process:**

1. Right Business
   - Continue / Re-work
   - Principle Approval
   - Accept next Phase
2. Right Business
   - Continue / Re-work
   - Principle Approval
   - Accept next Phase
3. Right Business
   - Continue / Re-work
   - Principle Approval
   - Accept next Phase
4. Ready to Operate
   - Approve Start-up
5. Beneficial
   - Complete Process
   - Quality Product
7. All Decisions are made
   - Acceptance of Post Audit & Close-out report
VALUE ENGINEERING DEFINITION (AS PER PMBOK):

Value Engineering is a creative approach used to optimize life-cycle costs, save time, increased profits, improve quality, expand market share, solve problems, and/or use resources more effectively.

BASIC PRINCIPLES OF VALUE ENGINEERING:

Value as used in Value Engineering can be defined as: The lowest cost to reliably provide the required functions or service at the desired time and place and with the essential quality."

\[
\text{VALUE} = \frac{\text{FUNCTION}}{\text{COST}}
\]

The lower the cost for optimum function, the better the value.

BENEFITS OF VALUE ENGINEERING:

Cost Optimisation: Value Engineering (VE) or Value Management (VM) is measuring its results by measuring Value being the end result of doing something functionally correct for the least cost.

Alignment: VE / VM also incorporate the principles of aligning diverse opinions normally expressed in a real project management scenario.

OUTPUTS OF VALUE ENGINEERING:

1. We get Correct and Cost Effective Solutions to the problems we encounter, as we ensure Functional Correctness before deciding on the solution to be implemented.

2. Through their participation in a VE study / workshop we obtain Buy-in and achieve Alignment of the people who have to implement and run with the solution.

VALUE ENGINEERING JOB PLAN:

- GATHER INFO.
- PURPOSE
- OBJECTIVE
- FUNCTION
- CREATIVITY
- EVALUATION
- IMPLEMENTATION

- WHY
- WHERE
- WHAT
- HOW
- WHO & WHEN
IMPACT ON LIFE CYCLE COST AND NPV

- Capital Expenditure (Minimise)   Big Impact
- Revenue (Maximise)    Limited Impact
- Operational Expenditure (Minimise)   Big Impact
- Cash Flow Profile    Limited Impact
- Delay Capital Expenditure   Big Impact
- Revenue (Accelerate Ramp-up)   Impact

NPV (Net Present Value) Total Cost of Ownership

DECISIONS DETERMINING LIFE CYCLE COSTS

SCOPE DEFINITION
TYPICAL EXAMPLE OF A VE STUDY ON CONSTRUCTABILITY

ESTABLISH A PURPOSE STATEMENT:
This refers to the purpose of the study e.g. to ensure optimised Constructability for the process.

SELECT PARTICIPANTS:
To ensure shared learning, alignment of all stakeholders and to obtain the correct technical input the correct selection of participants is required.

- Ideal group size is 8 to 16 people
- Multi Disciplined, Engineering, Operations, Marketing, Contractors, Suppliers etc.

SET OBJECTIVE:
Establish a measurable objective within a time frame.
Include “Results to Achieve”, “Results to Prevent”, Available Resources” and “Constraints”

01.) Outcome desired is presented in terms of being measurable and time bound.
02.) Environmental complexity of scope is referenced in terms of current risks and available support.

OBJECTIVE MATRIX

Objective : Maximise Constructability within budget, so as to produce a “Fit for Purpose” plant, ready for commissioning by the 22nd August 2004

RESULTS TO ACHIEVE

01.) Identify / manage interface
02.) Implement standardisation
03.) Optimise civil design
04.) Ensure maintainability / operability
05.) Ensure timely decision / approval process
06.) Optimise process design
07.) Clarify future expansion
08.) Adhere to SHERQ
09.) Finalise / freeze programme

RESULTS TO PREVENT

- Changing role players
- Lack of resources
- Lines of miscommunication
- Ignoring incremental weather
- IR issues
- Long equipment lead-times
- Working in isolation (islands)

AVAILABLE RESOURCES
- Suppliers
- Services (GG Laboratory)
- Electricity supply (construction / permanent)
- Highveld (architects)
- MAGNITEC
- ACME workshops (artisans) / stores
- Institutions (Mintek / CSIR)
- Coal plants (advise)
- Labour broker
- ACME facility in Richards Bay

CONSTRAINTS
- Programme / end date
- Electrical supply (132kv supply)
- Accessibility (plant – construction)
- Local labour (broker)
- XYZ
- Weather
- GG
- Equipment lead-time
- Transport contracts
- Type of truck
LIST AND EVALUATE FUNCTIONAL REQUIREMENTS:

List all the Functions that need to be addressed to optimise Constructability of the project.

Evaluate all functional requirements against each other to define priorities and the cause and effect scenario.

Utilise the Functional Numerical Evaluation Matrix

FUNCTIONS: (examples)

01.) OPTIMISE INTERFACE between plants – intra & inter – and suppliers
02.) STANDARDISE PLANT AND EQUIPMENT
03.) OPTIMISE DESIGN
04.) INTERFACE VENDOR PACKAGES
05.) STREAMLINE APPROVAL PROCESS
   Timely decision and approval process
06.) ENSURE QUALITY Materials Product variability (quality of material)
07.) DESIGN ENVELOPE for feed material
08.) EXECUTE SAMPLING Process Sampling (where, why, how) – facilities & philosophy

FUNCTIONAL ANALYSIS

Objective: Maximise constructability within budget, so as to produce a “Fit for Purpose” plant, ready for commissioning by the 22nd August 2002

<table>
<thead>
<tr>
<th>Functions</th>
<th>Scr</th>
<th>Rnk</th>
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</thead>
<tbody>
<tr>
<td>Implement Standardisation</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Identify / Manage Interface</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Optimise Civil Design</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Ensure Maintainibility / Operability</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ensure Timely Decision / Approval</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Optimise Process Design</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Clarify Future Expansion</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Adhere to SHERQ</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Finalise / Freeze Programme</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Basic Function(s): Identify / Manage Interface

Secondary Functions:
- Implement Standardisation
- Optimise Process Design
- Adhere to SHERQ
- Optimise Civil Design
CAUSE / EFFECT GRAPH FROM THE NUMERICAL EVALUATION

RECOMMENDATIONS

The following actions recommendations and/or investigations reflect the requirement to achieve the objective:

(Rating: ***** excellent, **** very good, *** good, ** poor, * bad)

**Functional Requirement:** OBTAIN MATERIALS

**Action:** Order Materials:  
**Rating:**  
**When:**  
**Who:**

01.) Reduce lead-time of high cost materials:  
   - Cables  
   - Switches  
   - Electronics  
   *****  
14/09  
JP

02.) Change Supplier of XXX product to secure better quality  
***

03.) Change to local manufacturing of XYX materials ($ versus Rand)  
*****  
13/09  
UF

LIST RECOMMENDATIONS, ALTERNATIVES:

Choose the highest rated functional requirement first and brainstorm for better solutions, recommendations and alternatives.

EVALUATE SOLUTIONS, RECOMMENDATIONS AND ALTERNATIVES:

01.) Apply a “Star rating” to each recommendation  
02.) Alternatively the “Perspective Modeling Matrix can be applied)  
03.) Establish an action plan for all high rated recommendations for implementation, feasibility studies etc... (Who and when)

RECOMMENDATIONS
POTENTIAL RISK:
Assumptions and constraints need to be documented, representing the risk associated with the decision.

TYPICAL PROCESS QUESTIONS:
- Is the proposed alternative correct in relationship of functionality and cost?
- Are there associated issues?
- What is the time window to complete the project (Window of Opportunity)?
- What are external issues (constraints beyond our control)?
- Has Marketing confirmed the demand on which the project is based on?
- Will there be a fluctuation in foreign exchange related cost?

PREVENTIVE & CONTINGENT ANSWERS:
Provide for each risk some recommended solutions if risk can be managed. (Reflect extra cost if applicable)

RECOMMENDATION & CONCLUSION:
Compile & finalise recommendation for Management. Provide an Executive Summary and separately a detailed document containing all the information secured through the Constructability Evaluation process.

DOCUMENT INDEX:
- Title (i.e VE Project - Constructability
- Purpose
- Description of Project
- Purpose Statement
- Participants
- Objective Matrix
- Numerical Evaluation Matrix
- List of Recommendations and Evaluation process
- Potential Risk
- Recommendation & Conclusion
ADDITIONAL VE TECHNIQUES & APPLICATIONS

**Effluent Treatment**

- **Is not meeting Legislative Requirements**

**Current Practice**
- Dispose Effluent (Drain)

**Input**
- Effluent Generation

**Output**
- Water Reclamation
- Effluent Treatment

- **Delete Sludge**
  - (Anaerobic Sludge)
  - (Activated Sludge)

- **Reduce Organic Load**
  - (Secondary)
  - (Primary)

- **Balance ph Balanced Effluent**

- **Transfer Effluent**

- **Store Reclaimed Water (Low Quality)**

- **Polish Reclaimed Water (Preliminary)**

- **Store Reclaimed Water (Final)**

- **Transfer Reclaimed Water**

- **Dispose to Drain / Sewer (RO Reject, Water to Drain)**

**Current Practice**
- Dispose Effluent (Drain)

**Untreated & Treated Effluent Disposal**
- C = Chemical
- O = Oxygen
- D = Demand

**FLOW DIAGRAM - Effluent Treatment**

- **01. Suspended Solids**
- **02. ph**
- **03. COD's**
## DESIGN TO CAPACITY & TECHNOLOGY SELECTION - FUNCTION / COST ANALYSIS

<table>
<thead>
<tr>
<th>Primary Function</th>
<th>Secondary Functions</th>
<th>Capacity</th>
<th>CAPEX Implication</th>
<th>CAPEX Allocated to:</th>
<th>Recommendations</th>
<th>Who</th>
<th>When</th>
<th>Estimated CAPEX Savings</th>
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</thead>
<tbody>
<tr>
<td>A Re-claim Topsoil</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>$16 million</td>
<td>Re-claim Sand</td>
<td>RB/AD</td>
<td>Mid Sept.</td>
<td>$9 million</td>
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<tr>
<td><strong>B Mine Sand</strong></td>
<td>Datenschutz</td>
<td>1. Reclaim Sand&lt;br&gt;2. Apply Movement&lt;br&gt;3. Control Rate</td>
<td>400 tons per shift with proposed design. Actual minimum requirement is 350 tons per shift</td>
<td>$16 million</td>
<td>1. Bucket / Excavator / FEL / Scraper Wheel / Hydraulics / Water canon / Continuous Miners&lt;br&gt;2. Conveyors / Trucks / Pipeline / Scrapers / Gravity&lt;br&gt;3. Flow-meter / Belt-weigher / &quot;Owner&quot; operated - Staff</td>
<td>N/A</td>
<td>RB/AD</td>
<td>Mid Sept.</td>
</tr>
<tr>
<td><strong>C Slurry Sand</strong></td>
<td>Datenschutz</td>
<td>01.) Stockpile Volume&lt;br&gt;02.) Re-claim Stockpile&lt;br&gt;03.) Blend Sand&lt;br&gt;04.) Screen / remove Contaminates</td>
<td>Stockpile Volume 150 tons&lt;br&gt;Conveyor can carry 1200 tons per shift</td>
<td>$22.5 million</td>
<td>1. Conveyors / Concrete base&lt;br&gt;2. Canons / High Pressure Pumps / Land based dredge&lt;br&gt;3. N/A&lt;br&gt;4. Concrete Sump / Stationary screen / disposable conveyor / FEL ramp</td>
<td>N/A</td>
<td>AD/GB</td>
<td>End Oct.</td>
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### COST / FUNCTION ANALYSIS

**VE THEME SHEET**

<table>
<thead>
<tr>
<th>Functions Performed</th>
<th>Basic / Secondary Function (BS)</th>
<th>Revision No: or Date:</th>
<th>% of Cost</th>
<th>Cost</th>
<th>Statutory</th>
<th>Client Specified</th>
<th>OEM Specified</th>
<th>Ergonomics</th>
<th>Increased LCC for Owner</th>
<th>Improved Performance (User)</th>
<th>Non Value Adding</th>
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<tbody>
<tr>
<td>Current Design:</td>
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<td>Facilitate Storage</td>
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<td>384.00</td>
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</table>

**Part / Assy Description:** R 2,400.00

Low Body Ladder Rack Assembly
## FUNCTION / COST ANALYSIS SUMMARY

### PRODUCT X

<table>
<thead>
<tr>
<th>Functional Definition</th>
<th>Roof / Side Panel Assembly</th>
<th>Floor Assembly</th>
<th>Roller Door Assembly</th>
<th>Sub-frame (Skeleton) &amp; Mounting Kit</th>
<th>Light Box Assembly</th>
<th>Ratchet Assembly</th>
<th>Ladder Rack Assembly</th>
<th>Total Cost per Function</th>
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<td>106.00</td>
<td>21.00</td>
<td>96.00</td>
<td>8817.00</td>
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</table>

### TYPICAL APPLICATIONS (TECHNICAL AND STRATEGIC)

- **SA Breweries**: Optimise CAPEX / OPEX of the Effluent Treatment Plant (ETP)
- **Placer Dome Western Areas**: Commissioning of the Twin Shaft integrating all disciplines (Engineering & Operation)
- **BFA**: IHM Slag Plant Project
- **Tiomin Inc. (Canada)**: Kwale Titanum Mineral Project (with LTA Process Engineering)
- **Murray & Roberts**: Joint Venture Project Management Activity
- **ADMA-OPCO (Abu Dhabi)**: Transportation of Gas and Injection (ZK) - Enhancing Oil Recovery
- **PPC Lime**: Secure the Business Opportunity to supply an additional 120 000 tons/ annum to...
TYPICAL APPLICATIONS (TECHNICAL AND STRATEGIC) – continued

Placer Dome Western Areas  Safety Management - Leading Practices Workshop

■ BHP - Billiton / SASOL Carbon Tar - Exploit synergies between
  the businesses in order to maximise XXX
  PRODUCT in Southern Africa

■ SASOL Synthetic Fuel  Assimilate Reliability into Secunda Complex

■ BMW SA  Optimisation of the Sanding Process in the Paint
  Shop

■ Rand Water -  Protective Services Strategic Plan for the future
direction of Rand Water's Protective Services.

“Tell him we haven’t got time for any of his bright ideas – we’ve got a battle on our hands”