VALUE BY DESIGN
INTEGRATION OF VALUE ENGINEERING & SUSTAINABILITY

with case studies of Hydro Electric Infrastructure Projects

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CALGARY
25 October 2012
Not part of my job…!

Value by Design has no *Value* if this was your project......
VALUE BY DESIGN
INTEGRATION OF VALUE ENGINEERING & SUSTAINABILITY

Presentation Outline

Value & Sustainability
Triple Bottom Line
Infrastructure project Footprint
Value by Design
Sustainable strategies
Value based Sustainable Design
Knowledge Transfer
Value Strategies

Case Studies of Large Power Projects
Process followed
Significant Proposals – Sustainable appraisal
Accomplishments
Sustainability Appraisals
Value by Design combines the concepts of INTEGRATED VALUE with CREATIVITY in a Group setting through facilitated brain steering

- Low / Optimum cost
- Sustainable Development
- Corporate Responsibility

Optimum Value by Design is achieved when the necessary performance of a system is defined and delivered at the lowest life cycle cost by balancing the three bottom lines (integrated value)

- Lowest Financial cost
- Lowest Environmental impact
- Greatest Social benefit
Creativity & Innovation

Team work

Persistence

VALUE BY DESIGN
Corporations are accountable to people to take care of the environment, meet community needs and deliver excellent financial results.

Commitment to sustainability means balancing, tracking and measuring the Corporate performance along environmental, social and economic bottom lines.
Sustainability - Balancing the Three Basic Aspects
Triple bottom Line

Value by Design is for a Holistic development
Sustainability is about satisfying the needs of the present without compromising the ability of our future generations to meet their own needs.

Sustainable development is about meeting the growing needs of natural resources, industrial products, energy, food, shelter and effective waste management while conserving and protecting environmental quality and natural resource base essential for future generations.
Value by Design is for a Holistic development achieved by:
Ensuring environmental integrity, social well-being and economic prosperity.
Sustainable Appraisal of a Project

Maximizing the Value in all 4 quadrants is Value by Design

SPeAR Riches, 2003
Construction produces 50% volume of garbage in the landfill!

Construction footprint!
The CO2 Numbers *(approximate)*

1 tonne clinker = 1 tonne CO2

8,000 Km

Forest sink
2,000 m2/a

Carbon footprint!
Sustainability Strategy applied to Construction Projects:

- Minimize Environmental Impact
- Minimize Social Impact
- Optimize Resource Utilization & Life Cycle Cost
- Use State of the art technology

EcoSmart™ Strategy:
To minimize GHG “signature” of concrete by optimizing replacement of Portland cement with SCM while improving or maintaining:

- Cost
- Performance
- Constructability
- Project Delivery

Value by Design
ENVIRONMENTAL IMPACT OF Concrete Construction

- Annual global: 5 billion cubic yards.
- Next only to Water in consumption!

Twice as much concrete is used in construction around the world than the total of all other building materials, including wood, steel, plastic and aluminum.

Making one tonne of cement:
- requires 2 tonnes of raw material (limestone and shale)
- consumes 4 GJ of energy in electricity, process heat, and transport (the energy equivalent to 131 cubic metres of natural gas)
- produces 3 kg of NOX, causing ground-level smog
- produces 0.4 kg of PM10 - particulate harmful to the respiratory tract
- produces 1 tonne of CO2 emission
SEYMOUR-CAPILANO CLEAR WELLS (METRO VANCOUVER)
HIGH VOLUME FLY ASH CONCRETE & GEOTHERMAL PIPING
Sustainable Value Accomplishments: actual project example

On time, under budget
didn’t use contingency fund
Met people’s needs
 alternate arrangements, facility to see construction partnership, partnering, business needs
Recycling of concrete - 10,000 cu.m
 on-site separation of steel ensuring recycling
Environmentally excellent- exceeding standards
 no pollution, including sound, well managed run off, etc. plant & animals,
High quality concrete construction with EcoSmart Concrete
 44% SCM on 28,000 cu.m. Reduction of CO2 footprint (4200 tonnes)
Transfer of knowledge to other projects
 Filtration plant used 55% fly ash replacement
 Invited talks, technical tours, case studies
Sustainable Appraisal of a Project / Product

Environmental Factors

Societal Factors

Natural Resources Earth

Economic Factors

SPeAR Riches, 2003
Are you practicing Value by Design?
Why integrate the best of Value Engineering And Sustainability ideas?

- Value Engineering has saved the private industry and governmental agencies many $Billions since its inception in 1947.

- The VE approach promotes the philosophy of “Do the Right Thing Right the First Time.” (DTRT RTFT)

  - Sustainability Concepts look at the holistic development which can be ideally combined in the VE style work plan.

  - A shift in paradigm is required to include Sustainability aspects in the study.

  - VbD looks at Financial, Social and Environmental costs (i.e., Three bottom lines)

  - Integrated – Strategic - decision making for final selection of proposals

  - Good synergy when used with Value Methodology
WHAT IS VALUE?

Value = \frac{\text{Worth}}{\text{Cost}}

V.E. Objective is to make \frac{\text{W}}{\text{C}} \approx 1.00 or better

‘Low cost’ need not give you high value
Higher satisfaction at lower cost improves value

\begin{itemize}
  \item Tata Nano: $2500
  \item Jaguar: $50000
\end{itemize}

Both have optimized value
Both owned by the same company- TATA Motors, India
Value by Design  CSVA Calgary 2012

Understanding the Customer
True usage of Target Costing (~$2000)
No Gold plating or Strip Down
True Function–based product design
Operating cost (21 km/Ltr.)
Open Innovation in Design

TATA NANO
Jaguar & Land Rover ($50,000)
- also owned by TATA
Tata Airpod
Single seat. Compressed air fuel
Innovation, sustainability
**WHAT IS VALUE?**

Value = \( \frac{\text{Satisfaction of Needs}}{\text{Use of Resources}} \)

- Land usage
- Natural Resources
- Financial Resources
- Human Resources (positive & Negative)

VbD Optimization aims at maximizing the Integrated Value

*Best Value* is about improving the understanding of the business/project needs and delivering on it in a responsible manner.
The Amphibious Bicycle – Innovation from India
Ideal for flood prone areas! (Discovery & BBC reports)

Creativity and Innovation requires an open mind!

Invention by Mohammed Saidullah
Value by Design Objective:

Utilize a systematic approach, to identify the required functions and deliver the project at the lowest possible cost, keeping the design intent unchanged.

Expectations:
1. Reduction on construction costs,
2. Reduced use of Natural Resources
3. Reduced use of Land
4. Improved operational performance, Safety
5. Reduced maintenance costs (loss time, shutdown, etc.)
6. Identification of risks and mitigation strategies (Safety by design?)
7. Lower life cycle costs (Financial, social & environmental)
8. Integrated enhancement of Value (triple bottom line)
How is ‘Value by Design’ done?

Value Methodology uses a combination of creative and analytical techniques to identify alternative ways to achieve objectives. The use of Function Analysis differentiates Value Engineering from other problem solving approaches.

**Function Analysis** Systems Technique

FAST

- Charles Bytheway
  Father of ‘FAST’

SAVE Conference, Detroit, 2009
How do we Improve Value of a function?

<table>
<thead>
<tr>
<th>Function performance</th>
<th>Cost of function?</th>
<th>Resulting Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needed performance</td>
<td>Financial</td>
<td>Enhanced Value</td>
</tr>
<tr>
<td></td>
<td>Environmental</td>
<td>Enhanced Value</td>
</tr>
<tr>
<td></td>
<td>Social</td>
<td>Enhanced Value</td>
</tr>
</tbody>
</table>

Ideal-Enhanced Value
Value by Design is not

- What a good Project Manager “does already”.
- A task that can be fully outsourced to a consultant
- An effort to trade off essential functions to cut costs.
- Merely a review to eliminate “Gold Plating”.
- A method for reducing costs through degrading performance and reliability.
- In any way intended as a reflection on the competence of the designer.
- An effort to cheapen the design.
- Only done at end of design or start of construction to return project to budget
- An effort to show off Environmental stewardship
- An effort to keep the paper work intact
**HOW IS VbD DIFFERENT FROM CONVENTIONAL METHODS?**

**Conventional Approach**
- Item oriented
- Analytical, based on habits
- Cost visibility by components (material, labor etc.)
- Individually oriented (cost engineer peer reviewer?)
- Financial Cost is the main (and only) concern

**Value by Design Approach**
- Function oriented
- Creative and Innovative not based on habits
- Cost visibility by function (primary, secondary, etc.)
- Team oriented (brain storming/steering)
- All 3 bottom lines are considered Financial Environmental Social
- Integrated Assessment model
IS THERE A GOOD TIME TO DO VbD?

<table>
<thead>
<tr>
<th>Conceptual Design</th>
<th>Preliminary Design</th>
<th>Detailed Design</th>
<th>Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Savings</td>
<td>Cost Reduction</td>
<td>Break even point</td>
<td>Cost Additions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constructive Intervention</td>
<td>Destructive Intervention</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Time scale

‘Value by Design’ Study

Follow-up & Review

Timing for Value by Design Study in Project life cycle
Value by Design – Schematic Process Model
## Value by Design - Responsibility Matrix.

<table>
<thead>
<tr>
<th>Task</th>
<th>Project Sponsor</th>
<th>Project Manager</th>
<th>Project Engineer</th>
<th>Task Manager</th>
<th>Engineering Managers</th>
<th>Principal Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Value by Design Study (Overall)</td>
<td>I</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>2 Sourcing a Certified Value Specialist</td>
<td>I</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>3 Sourcing workshop participants</td>
<td>C</td>
<td>A</td>
<td>R</td>
<td>C</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>4 Ensuring participation of RESC</td>
<td>I</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>I</td>
<td></td>
</tr>
<tr>
<td>5 Conducting Value Workshop</td>
<td>I</td>
<td>C</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>6 Value by Design Report</td>
<td>I</td>
<td>C</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>7 Presenting Recommendations</td>
<td>I</td>
<td>C</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>8 Review &amp; Sign-off on Recommendations</td>
<td>I</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>9 Follow-up Review &amp; Reporting for Gates 3 &amp; 4</td>
<td>I</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>10 Summary &amp; Lessons learned</td>
<td>I</td>
<td>C</td>
<td>A</td>
<td>R</td>
<td>I</td>
<td>I</td>
</tr>
</tbody>
</table>

A - Accountable; R- Responsible; C: Consulted; I: Informed
Value based Sustainable Design

Corporate Sustainability Priorities and Goals

1. Specific priorities, e.g. community development, climate change, water conservation, etc.
2. Use of LEEDTM, SPiRiT, WSS Protocol, CHPS, Built Green, or other evaluation approaches.
3. Organization’s sustainable design guidelines, e.g. use of integrated design, LCA/LCC, others.

Decision / Selection Criteria
Establish the decision criteria to be considered in evaluating and selecting design solutions: e.g.,
1. Corporate values.
2. Design principles.
3. Financial parameters/pro forma.
4. Life cycle cost analysis.
5. Environmental life cycle analysis.
6. Social Commitments

(Steven Page- Olympic Associates)
Critical Success Factors for VbD

**Methodology / Standard SAVE process; use a CVS**
Value job plan must be followed systematically

**Attitude of Participants**
Right attitude, appropriate stakeholders, awareness of process

**Project Charter - Partnering**
Create a project charter to clearly show the ‘vision’ subject to Corporate policies

**Executive support**
VbD workshops, sponsorship, implementation of results

**Management of Process**
Clear objectives, timelines, review and feedback (who?, what?, when?)

**Professional Workshop Facilitation**
Probing with right questions, using appropriate tools, managing the process, maintaining momentum of team, etc. etc.
Project Charter/Partnering Agreement

(Steven Page- Olympic Associates)
VbD Workshops

Multi-disciplined team approach
  • Include all professionals
    (arch., struct., civil, mech., envi., and elec., etc.)
  • Involve the Owner, Consultants and Construction Manager.
  • Involve major stake holders
  • Create a project charter (partnering?)
  • Sustainability strategy and business guideline
  • Strategic decision making guidelines
  • Internal champion is a must
  • Must be coordinated by a trained facilitator, CVS

Similar to VE Workshop,
but add specific Sustainability considerations/ resources
Capturing organizational learning is key to continuous improvement.
<table>
<thead>
<tr>
<th>VbD Phase</th>
<th>Agenda</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Phase</strong></td>
<td>• Conceptual presentation on <strong>Value Methodology</strong></td>
</tr>
<tr>
<td></td>
<td>• Conceptual presentation on <strong>Sustainability</strong></td>
</tr>
<tr>
<td></td>
<td>• Detailed Project Presentations</td>
</tr>
<tr>
<td></td>
<td>• Defining Problem/Opportunities</td>
</tr>
<tr>
<td></td>
<td>• Corporate guidelines / policies</td>
</tr>
<tr>
<td><strong>Function Analysis</strong></td>
<td>• Identifying Project Functions/FAST</td>
</tr>
<tr>
<td><strong>Creativity</strong></td>
<td>• Defining Targets</td>
</tr>
<tr>
<td></td>
<td>• Creative Brainstorming / <strong>Brain steering</strong></td>
</tr>
<tr>
<td><strong>Evaluation</strong></td>
<td>• Screening of Ideas to be Championed</td>
</tr>
<tr>
<td></td>
<td>• Detailed Evaluation</td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>• Mid-Workshop Review Meeting with Owner/Agency</td>
</tr>
<tr>
<td></td>
<td>• Technical Write-ups of VE Proposals</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>• Team Presentation of VE Proposal</td>
</tr>
</tbody>
</table>
RECENT CASE STUDIES -

BC HYDRO

• RUSKIN UPGRADE PROJECT – DAM & POWERHOUSE
  • Detailed case study of the Dam

• XXXXX PROJECT UPGRADING OF PENSTOCKS
  • Project is under development – Detailed case study
**VbD* Study**

**Summary**

- Value Ideas:
  - 176 ‘raw’ Ideas Generated
  - 60 Ideas Shortlisted
  - 26 Ideas Developed in to VE Proposals

* Originally done as a VE Study
# Summary of Proposals & Recommendations:

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rejected VE Proposals due to increased costs &amp; not commensurate with benefits</td>
<td>2</td>
</tr>
<tr>
<td>VE Proposals considered for Design improvements (9 accepted)</td>
<td>12</td>
</tr>
<tr>
<td>Rejected VE Proposals after general considerations</td>
<td>7</td>
</tr>
<tr>
<td>Accepted VE Proposals for further consideration*</td>
<td>2</td>
</tr>
<tr>
<td>Accepted VE Proposals at the Preliminary Design*</td>
<td>3</td>
</tr>
</tbody>
</table>
Proposals with the highest impact

Design change Proposal adopted and are currently being constructed.
Install a plastic concrete cut off wall instead of jet grouting the right abutment slab

Financial
- savings of $8.00 million – adopted

Environmental benefits.
- Less water pollution
- Fish flow maintenance
- Tree planting
- Taking care of species – animals and plants

Social benefits –
- First Nations sensitive areas avoided
- Sensitive areas enhanced with consultations
- Provided jobs to local native business owners

Reduced use of land
Project Site

Concrete Dam & Radial gates

Right Abutment

Upstream
Existing inclined concrete slab cutoff
Original design with jet grout columns

Concrete dam

Seepage cutoff walls
New innovative design
CUTOFF WALL AND EXCAVATION

Original design: Jet grouting below slab

New Design: Slurry Panel Cutoff Wall

A plastic concrete cut off wall instead of jet grouting
VE Proposal savings of $8.00 million – adopted
additional environmental benefits not quantified in $$. 
Accomplishments - Ruskin Value Study.

1. VE proposals resulted in significant design decisions with impact on cost estimate. Cost savings of a minimum of $8 million achieved with a potential for additional savings. $150,000 was spent for the study.

2. Several VE proposals adopted in design with no significant impact on cost, but improved the quality of design.

3. VE study resulted in confirming that most of the design decisions thus far have been appropriate and thereby validating them.

4. Established the VE study as a tool for the management to ascertain that almost all possible design options have been studied before making major design decisions.

5. Created enhanced trust and reliance on the classic VE study which will potentially be applied to all major projects in BC Hydro. This will hopefully result in a shift in culture of project delivery within the organization.
Sustainable Appraisal of the Ruskin Proposal*

* For demonstration only

SPeAR Riches, 2003
Ruskin Dam VE Study

Winner of Outstanding Accomplishment

2009 SAVE Annual Conference – Detroit 29 June to 2 July 2009

BC Hydro
NCE- VE Consultants
RFP – Requirements of VbD Study

**Review and evaluate** the methods and approaches specified in the feasibility design documents developed to-date.

**Study the effectiveness** of the proposed design solutions, including scheduling and phasing

**Develop and/or refine concepts** or components to improve performance and/or reduce cost, while maintaining design standards and codes, safety and reliability.

**Integrate ideas of Sustainability** in the study
Social and environmental values to be considered along with life cycle financial impact

**Integrate Safety by Design** concepts in the study
Consider enhancement of Safety aspects for the project in the study
Case study-2. XXXXX PROJECT -
  • UPGRAADING OF PENSTOCKS
  • Project is under development –
Value by Design

Strengths
• Optimization of Quality / Performance
• Overall Cost Optimization
• Appropriate, Sustainable Technology
• Sustainable (Reduce, Reuse and Recycle) Approach
• Enhanced Reliability & Safety
• Socially Responsible solutions
• Risk Mitigation (bad news upfront)

Limitations/Hurdles
• Value team should be involved right from the beginning
  • Company policy must be clear upfront
• Reliance on creativity and lateral thinking
  • Team work is a must
• Change in culture may be needed
  • Can result in many intangible changes
• Initial cost (time and effort) may be a deterrent
• Management may not see the importance
Value by Design & Sustainable development

Potential Value Strategies include:

- Partnership
- Partnering approach
- Input from public and stakeholders:
- Impact mitigation program for all affected parties
- Minimize public disruption
- Maximize Recycling
- Use of ‘Green construction’
- Minimize green house gas emissions
- Environmental and noise monitoring during construction
- Tree protection and replanting /replacement program
- Optimized cost, minimize land use
- State of the art technology (long term planning)
- Integration of enhanced public safety, reliability
- The development to achieve triple bottom line balance.
VALUE BY DESIGN!

- SYSTEMATIC APPROACH (VALUE METHODOLOGY)
- SUSTAINABILITY CONSIDERATIONS (NOT JUST $$)
- FULL USE OF CREATIVITY & TEAM WORK
- LIFE CYCLE - COST, MAINTENANCE, SUSTAINABILITY
  - Triple bottom line approach
- KNOWLEDGE TRANSFER AND ORGANIZATIONAL LEARNING
- GOOD SYNERGY WITH SAFETY BY DESIGN
In Summary….

Project - Infrastructure Renewal
Mission - Sustainable Development
Strategy - Value by Design
Partners - Public, Stakeholders
Project Team - Stewards
Result - A Sustainable Facility