INNOVATIVE APPLICATION OF THE VALUE METHODOLOGY (VM) FOR LARGE, COMPLEX FACILITIES

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BIOGRAPHY

Stephen J. Kirk is President of Kirk Associates, which specializes in value analysis, choosing by advantages, life cycle costing, sustainability, facility economics, and strategic value planning services. He has over 25 years experience in applying value based design decision-making techniques to large, complex facilities such as airports, offices, housing, courthouses, research facilities, and hospitals. He is an instructor at the Harvard Graduate School of Design. Dr. Kirk is a registered architect, a Fellow of the AIA, a CVS-Life, and is a "LEED Accredited Professional." Steve is a Senior Fulbright Scholar in architecture and received his doctorate degree at the University of Michigan. He served as president of SAVE International in 1998-99, is Director and Vice President of Education for the Miles Value Foundation, and is a Fellow of SAVE. Currently Dr. Kirk serves on the Industry Advisory Panel of the US State Dept. Overseas Building Office. He is the author/co-author of eight books related to value analysis.

Stephen E. Garrett is a Principal of Kirk Associates, which specializes in value analysis services. Steve has over 22 years of professional experience including extensive skills in value engineering, cost estimating, scheduling, quality assurance/ quality control (QA/QC), strategic planning, project criteria development, and program management for large, complex projects for national and international clients. As principal, he typically leads highly skilled, multi-discipline teams in generating strategies, developing project criteria, increasing value, directing planning efforts, and managing project completion efforts. He is also skilled in life cycle costing and frequently participates or runs workshops. His experience includes office, government, manufacturing,

institutional, health care, education, and laboratory facilities. Steve received his Bachelor of Architecture degree from Lawrence Technological University. He is a Certified Value Specialist (CVS) and has been a member of SAVE for 10 years.

ABSTRACT

Value based methods are ideal for managing large, complex projects throughout the world. This presentation will utilize a number of international projects as case studies to illustrate how value based design decision-making methods were used to maximize value. Key VM principles often forgotten in large, complex projects will be discussed. In addition, large projects offer VM strategies that are not possible with small projects. Likewise complex projects require strategies that are somewhat different than simple projects. The presenters have years of first hand experience in applying the techniques of FAST, quality modeling, risk modeling, creativity, choosing by advantages (CBA) and life cycle costing (LCC) to improve on some very prestigious large, complex international projects. The audience will become familiar with issues particular to each case study, such as security, maintainability, quality, sustainability, schedule, constructability, operational effectiveness, as well as the life cycle cost implications. Ten case studies will help illustrate key points. Texas is an ideal setting to discuss VM applied to large, complex projects.

LARGE, COMPLEX PROJECTS

Large facility construction projects may not be complex. These include warehouses, big box retail stores, parking decks, etc. The reverse is also true; complex projects may small. Examples include restaurants, clinics, banks, single family houses, etc. Kirk Associates has had an opportunity to work on a great variety of projects over the past 25 years. We have selected some representative samples of what we consider to be large, complex projects. These include multi-family housing, hospitals, airports, courthouses, office towers, K-12 Education, R&D laboratories, manufacturing, university campuses, and city planning.

10 Case Study Examples:

- **Residential Tower and Townhouses** (land reclamation; repetitive project items, material shortages, high inflation risk)
- **Medical Center**: New Veterans Administration Hospital (patient needs, metrics, schedule, component construction)
- **Airport:** New North Terminal Replacement, Detroit, Michigan (space planning efficiency, maintainability, material flow in restricted site)
- **Courthouse Standards**, Ministry of Justice (international law standards, quality calculator)
- **Office/ Bank Tower**, (security, schedule, façade technology, energy)

- **K-12 School for Cherokee** (quality, education, culture, LEED features)

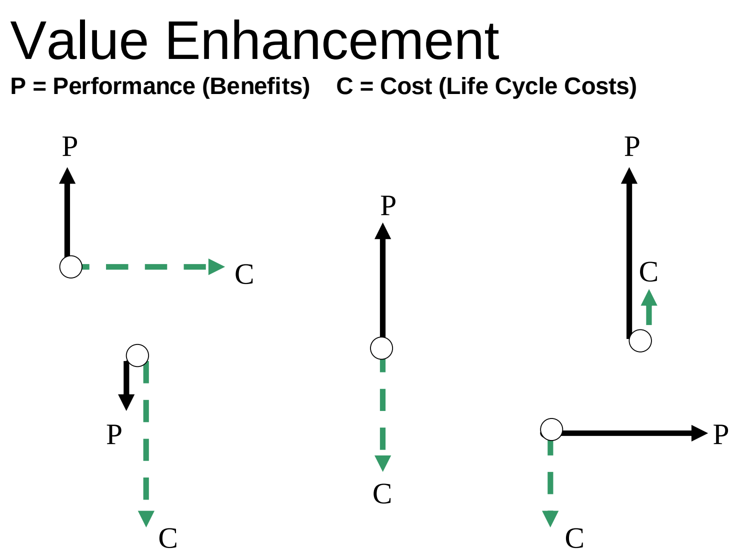
- **R & D Center,** Renovation & New, Fortune 50 (historic structure, new technology, new lab operation)

- **Manufacturing,** Assembly, Fortune 50 (just in time, lean manufacturing, BIM, point of use delivery, POE)
- **University Campus,** (learning environment, interaction, constructability)

- **City Planning** (distribution of city services, CBA, Metrics)

VALUE BASED DESIGN DECISION-MAKING

Done correctly, value based design decision-making is about value over the lifetime of the facility being analyzed. Value management is not simply about money, it is, as the name suggests, about value, which includes important issues such as operational effectiveness, flexibility, comfort, site & architectural image, cultural values, engineering performance, safety & security, environmental sustainability, construction schedule and initial and long term cost effectiveness.
Some claim VM is only for projects over budget. The experienced have found that VM should always be applied whether the project is within budget or not. For example, when a project is within budget the VM team focuses on adding even greater performance while finding cost savings to pay for the added features to stay within the budget. If over budget, the VM team first focuses on meeting the budget then looks for opportunities to add performance.



The power of value based design decision-making is in the methodology. The six step problem-solving process focuses on increasing value by improving performance (quality) and lowering cost (life cycle cost). The steps of decision-making are:

- Information gathering and benchmarking, for example creating cost and quality models
- Function analysis, which is the exercise of stating the project purpose in a verb/noun form
- Creativity phase, which does not stop with the first workable idea
- Evaluation of ideas generated using life cycle cost analysis and using benefit cost comparisons
- Development of those ideas into a workable preferred alternative using “choosing by advantages”
- Recommendations to the decision-makers balancing benefits and costs

While this methodology has been used frequently in small, simple projects, it is particularly important for large, complex facilities. It fosters the consideration of true alternatives when making decisions about whether to retain, consolidate, build new assets and it will benefit any field of consultation, including architects, every kind of engineer, and business managers. Moreover, it is a service that can be provided even when another architect is doing the design and documentation phases. The value specialist works closely with the client and architect to develop a variety of options from which to choose. This role works best with repeat clients, where the trust and rapport are already established. An option for providing these services to a first-time client is to come into a project as part of the design or construction management team.

STRATEGY 1: FOLLOW THE METHODOLOGY

Application of the value methodology as an “entire decision-making system” is critical for success. Don’t try to shortcut the methodology.

Holistic Design Team Involvement

Part of the strength of value-based decision-making is the holistic approach to design that is achieved by involving all the stakeholders. Traditional multi-disciplined team includes participants from:

Owner
User,
Facility Manager,
Constructor, and
Design team (architect and engineers).

The owner, ultimately the decision-maker, must be involved from the beginning to assist in defining their value expectations for the project and in setting priorities. A value specialist is not a decision-maker; they can only facilitate sound decision-making.

In addition, the value team includes subject matter experts (SME’s) that include the traditional disciplines of:

Architect,
Structural Engineer,
Mechanical Engineer, and
Electrical Engineer

A slightly more expanded team might include:

Civil Engineer,
Landscape Architect,
Interior Designer, and
Sustainability Specialist

Large, complex projects offer the opportunity to include "special" team members that financially would not be feasible in smaller projects. For example:

Hospitals	Nurses, Physicians,
Airports	Maintenance Specialists,
Museum	Lighting Designers
Performing Arts	Acousticians
Historic Structures	Historic Architects, State Historic Preservation Officer
Courthouses	Court Planners, Operations Specialists, Attorneys, Judges
Housing	Housing Managers, Interior Designers, Sales
R & D	Lab Planners,
Schools	Teachers, School Board Members
Retail	Traffic flow, branding, theaming, Appeal
Manufacturing	Materials Handling, Lean Manufacturing Specialists
All	Technical consultants (curtainwall, vertical transportation, etc.)

Workshop Setting for Real Time Decision-Making

Real time decisions are reached using value based methods in a team "value enhancement workshop" setting. Many of these workshops have now evolved into a "value based design Charrette" to more fully explore a variety of ideas. Holding the workshops in a neutral location so all stakeholders feel comfortable is important. Paramount to the success is the skills of the value specialist to <u>facilitate</u> decision-making in these team-oriented sessions. Value methods used by the facilitator to help <u>communicate</u> to the team include: function analysis, quality modeling, LEED sustainability, group creativity/ innovation techniques, life cycle costing, design/cost simulation modeling, and Choosing by Advantages (CBA).

<u>Time</u>

Small, simple projects can usually be studied in workshops of 2 to 3 days in duration. For large, complex facilities more time is required. How much time? This is a function of the number of VM objectives to be achieved (cost, quality, schedule, etc.) since more time is required to model and generate ideas for each objective. Additional time is also required to develop the ideas into proposals. A **5 day workshop** is the norm for large, complex projects. Hospitals for example take time just to understand the complexity of layout, adjacencies, and flows of patients, staff, visitors, material handling, waste removal, etc. Identifying and analyzing alternative solutions is very time consuming and requires adequate time in the workshop to fully develop feasible alternatives for decision-maker consideration. This also allows for sub-team breakouts. For example exterior wall, maintainability, operations, constructability, etc.

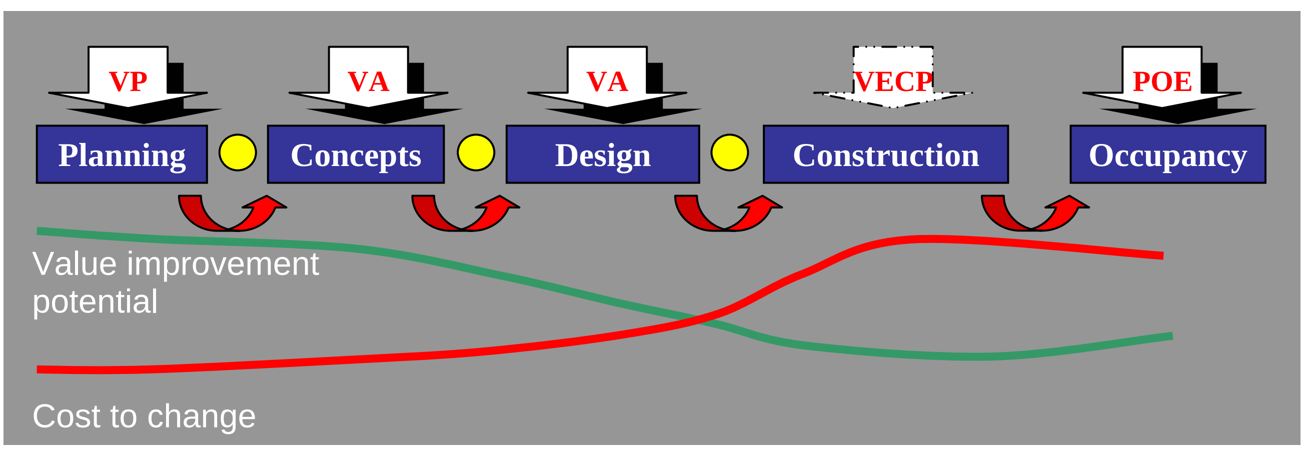
Apply VM Early in the Design Process

In its history, value analysis was once applied late in the design process, when all the construction documents were finished. More information was known, however it was too late to make design changes if new ideas were identified which would improve project performance or lower life cycle costs. VM has moved closer to the crucial formative stage of decisions, the point where design decisions are made for the facility layout, massing, circulation, project sitting, and major building systems. At its best, value analysis is a process of coordinating and integrating interdisciplinary preservation teams.

In the process of recommending ideas, the importance of starting early is a matter of how changes become more expensive as project development progresses. A great idea for adding value to a project is not so great when it requires the whole team to back up and start over again on some of the basic assumptions. So some great ideas never get used. The over-arching mindset of the value analysis process is the integration of the whole for the benefit of the project life cycle, regardless of where the value management team came into the project. Naturally, a large part of the value specialist's skill set is team building acumen and understanding of group dynamics in the facilitation of the team.

Large, complex projects offer the opportunity and the need to study the project multiple times during the design process. A simple project is usually only studied once, preferably at the conceptual stage.

Value Studies at different stages of application



Examples of multiple applications

Courthouse	**Planning** developing design standards for all courthouses **Programming** space needs **Concept Design** concept selection (CBA), circulation, layout, adjacencies
Airport	**Schematic design** layout & engineering systems **Design Development** maintainability & sustainability
Hospital	**Infrastructure,** energy plant, utilities, roads **Main Hospital,** clinics, admin., surgery, emergency, long term care

STRATEGY 2: USE THE METHODOLOGY

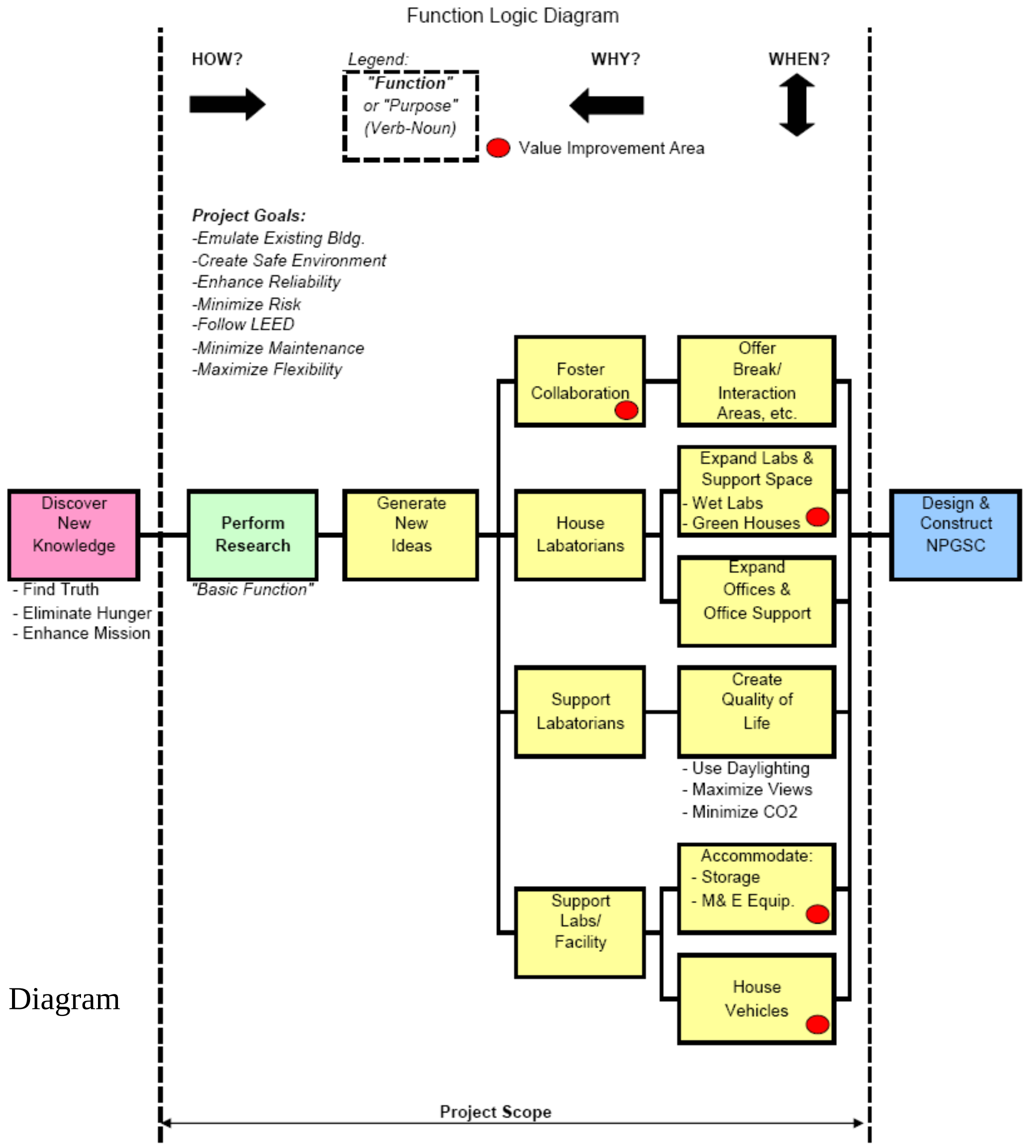
The techniques of VM have continued to evolve over the past 50 years. A single case study of an Research & Development (R&D) facility is used to offer examples of the methodology tools:

- Function Logic Diagrams (also called FAST, Function Analysis Systems Technique Diagrams)
- Value Models (Quality, Risk, Cost, LCC, Maintenance, etc.)
- Alternatives (constructability, schedule, materials, preparation)
- LEED Checklist / sustainability
- Lean Principles
- Choosing by Advantages (CBA)

Function Logic Diagram

Function analysis is core to any value study. For a R&D facility, the VM team prepared a function logic/ FAST diagram (Figure 1) to help understand the overall purposes of the new National Plant & Genetics Security Center (NPGSC). This diagram describes the essential functions of the project that will assist in discovering new knowledge by allowing scientists to “perform research” for the USDA.

Figure 1:

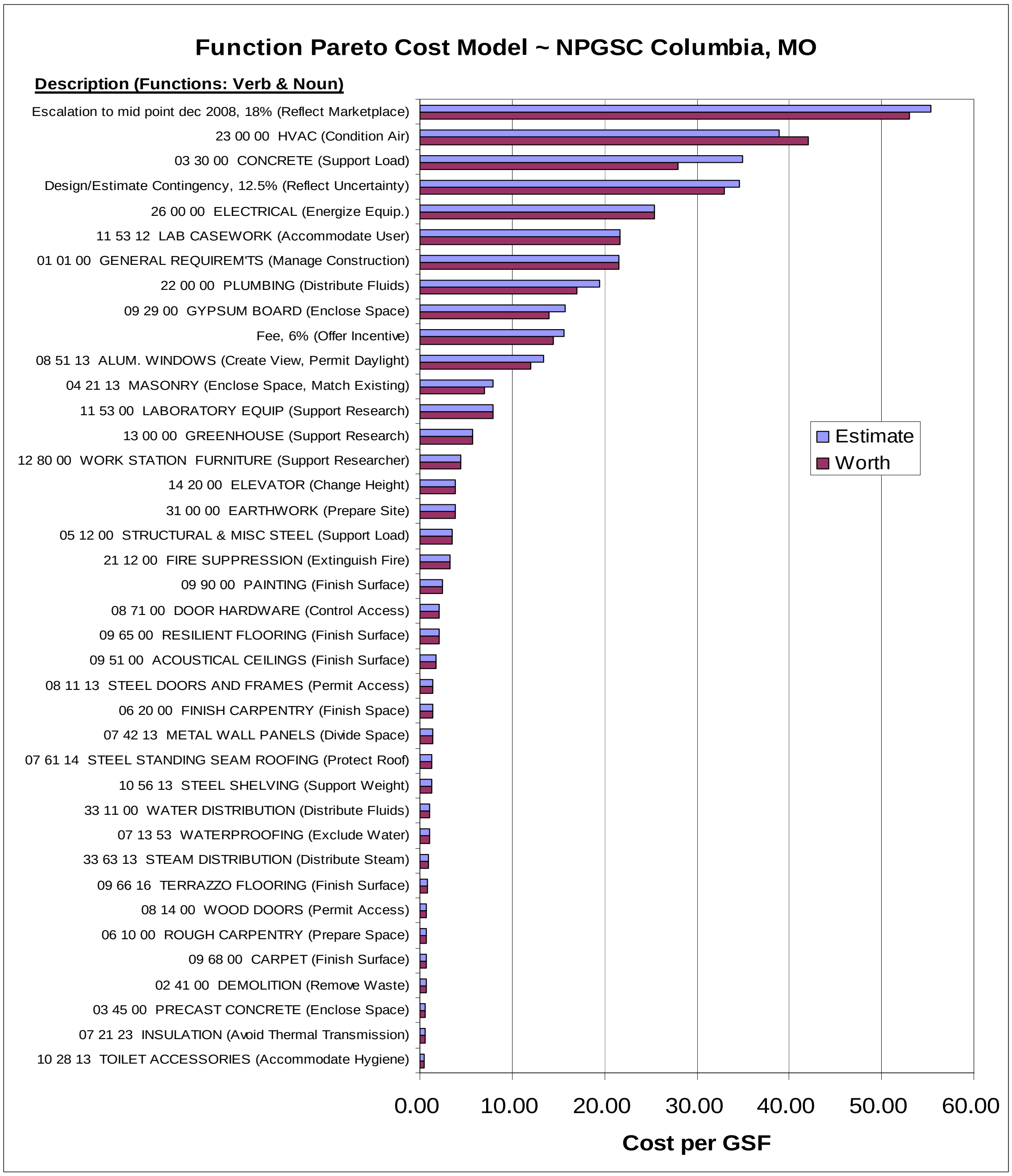


Function Logic Diagram

Function Pareto Cost Model

The VM team prepared a "Function Pareto Cost Model" to help understand the overall building systems and associated functions of the NPGSC. The chart describes the item, its function (in parenthesis), its associated cost (from the A/E submitted estimate), and VA target worth based on team discussions (Figure 2). This information is shown in a "Pareto" bar chart (high cost to low cost) to help the team focus on the most expensive functions and to target areas of potential savings.

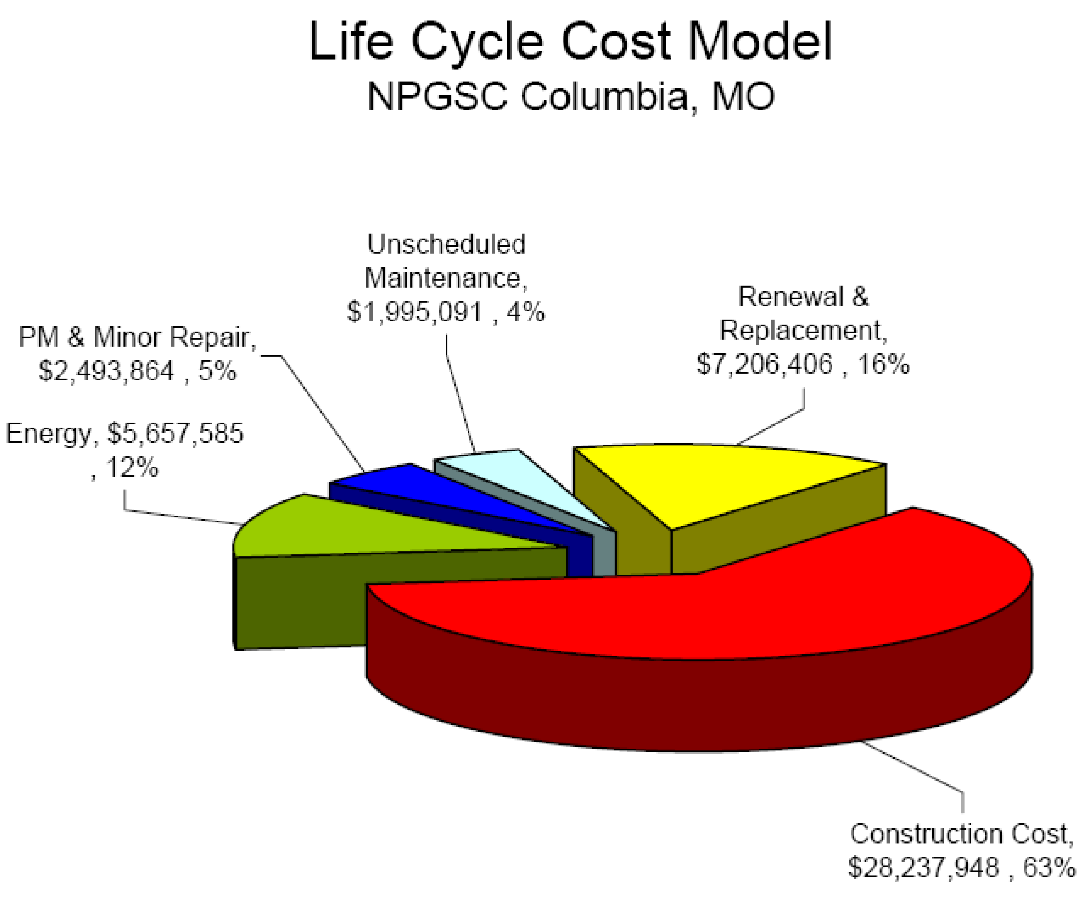
Figure 2: Function Pareto Cost Model



Life Cycle Cost Model

At times the overall project life cycle costs are not available for the project under study. For the NPGSC, the VM team relied on historical costs of similar laboratory projects and from Whitestone Building Maintenance and Repair Data 2005-06. The following life cycle cost model (Figure 3) is based on this information but adjusted for the NPGSC project. This graphical “pie” diagram helped the team focus on high energy, preventative maintenance & minor repair, and renewal & replacement cost items to identify areas of savings. Largest costs include energy, renewal, and replacement costs. This analysis was based on a 25 year life cycle and a 3% discount rate. The costs are shown in present worth.

Figure 3: Life Cycle Cost Model



Risk Model

The risk model (Figure 4) helped the VM team identify high project risks. The model was prepared during the value analysis workshop by the client and A/E team. It was used by the team to help identify ways to mitigate the risks identified earlier. Most significant risks to this project included: project schedule, changing government regulations, budget limitations, inadequate subgrade testing, security concerning visual surveillance of site and building, architectural integration with the existing building, limited site laydown areas, traffic congestion on site, interference with other work on site, and utility relocations.

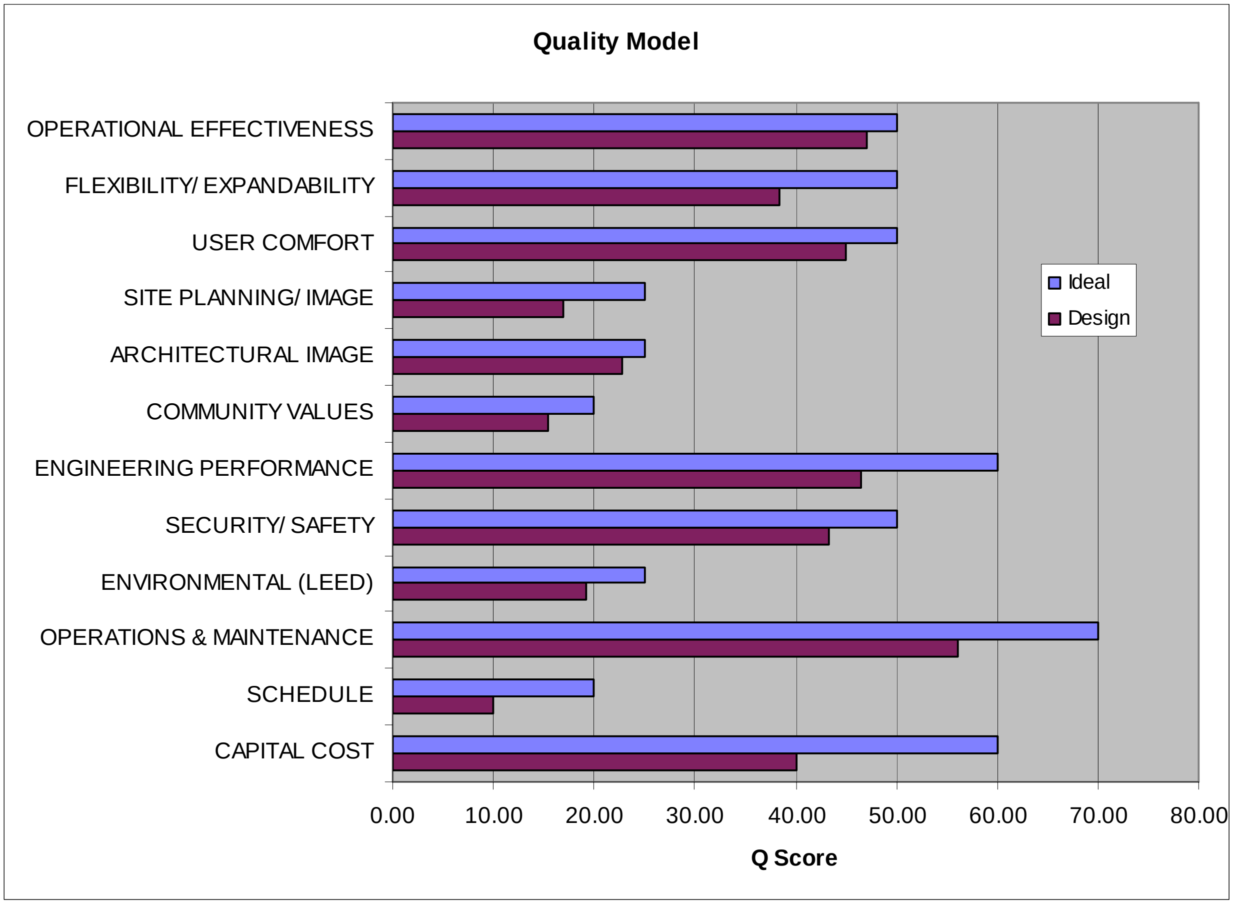
Figure 4: Risk Model (selected portion only)

ELEMENTS	RISK AREAS	N/A	LOW	MEDIUM	HIGH
A. MANAGEMENT, FINANCIAL & ADMINISTRATIVE RISKS					
	Schedule (Design, Bidding, Construction, Startup)				
	Changing government regulations				
	Public and political perspectives				
	Budget limitations, approvals process, & other constraints				
	Site acquisition - Adjacent site elements				
	Permitting delays				
	Agency jurisdictions and conflicts				
	Project mgt., organ., decision-making processes, info. flow				
	Labor issues				
	Other:				
B. ENVIRONMENTAL, GEOTECHNICAL RISKS					
	Inclement weather, storms, floods				
	Hazardous waste disposals, site remediation				
	Environ. restrictions (air quality, noise, toxic mat., etc.)				
	Contaminated soils remediation				
	Groundwater remediation				
	Uncharted underground testing				
	Inadequate subgrade testing				
	Unanticipated archaeological or historical findings				
	Other:				
C. TECHNICAL RISKS					
	Systems, processes, and material				
	New, unproven systems, processes and materials				
	Other: Dependence on university utilities				

Quality Model

The quality model (Figure 5) helped the VM team identify the elements of quality most important to the success to the project. The model also indicates the client's evaluation of how successfully the quality model elements were satisfied. The differences between the ideal and the current design were identified as "gaps" for later value improvement. The most significant gaps include: flexibility/expandability, site planning/image, community values (cultural response), engineering performance, security/safety, operation & maintenance, schedule, and capital cost.

Figure 5: Quality Model



Following is a description of the quality model elements:

OPERATIONS

Operational Effectiveness	The degree to which the building is able to respond to the work process and flow of people, equipment, and materials.
Flexibility/Expandability	The degree to which the building plan can be rearranged to conform to revised work processes and personnel changes. The ability of the building to grow to meet projected changes in the work process without disturbing existing building functions.
User Comfort	How the building provides a physically and psychologically comfortable place for people to work and live.

RESOURCES

Capital Cost Effectiveness	The economic consequences of the building in terms of initial capital investment including construction cost, design fees, land costs, etc.
Operations & Maintenance	The degree to which the building is able to conserve energy resources through construction, site orientation, and solar design. Other considerations include maintenance, operations, and replacement costs.
Schedule	The amount of time required to complete the various tasks including programming, design, construction and start-up/move-in.

TECHNOLOGY

Environmental	The degree to which the facility is sensitive to environmental concerns such as hazardous waste, air & water pollution, use of sustainable materials, recycling, etc.
Security/Safety	The degree to which the building can segregate sensitive functions from one another and prevent the entry of people to restricted areas.
Engineering Performance	How the building operates in terms of mechanical systems, electrical systems, and laboratories.

IMAGE

Site Planning/Image	The degree to which the site responds to the needs of the project in terms of parking, vehicular & pedestrian traffic, outdoor amenities, and the visual impact to employees and visitors.
Architectural Image	The visual concept of the building and the way in which the building attracts attention to itself. The form of the building and the degree to which it acts as a symbol for the government & partnerships.
Community Values	How the building and its site project a "good neighbor" identity in terms of safety, security, and privacy. How the building responds to the culture of the community.

LEED Sustainability Checklist Model

The LEED (Leadership in Energy and Environmental Design) sustainability model (Figure 6) was prepared by the design team prior to the workshop. It helped the VM team identify opportunities to make the project more sustainable. Enough points were identified to achieve "silver" certification.

LEED™ Scorecard 2.2

SUMMARY OF LEED GREEN BUILDING RATING SYSTEM
PROJECT: Cherokee Central School, K - 12 Education Center

Figure 6

Y	?	N	$k			
35	14	20	$0.0	**Total Project Score**		Possible Points **69**
			$k	Certified 26 to 32 points; Silver 33 to 38 points; Gold 39 to 51 points; Platinum 52 or more points		

Y	?	N	$k			
5	4	5	$0.0	**Sustainable Sites**		Possible Points **14**
Y				Prereq 1	**Construction Activity Pollution Prevention**	0
		1		Credit 1	**Site Selection**	1
		1		Credit 2	**Development Density & Community Connectivity**	1
		1		Credit 3	**Brownfield Redevelopment**	1
	1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1				Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		1		Credit 4.3	**Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles	1
	1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
1				Credit 5.1	**Site Development**, Protect or Restore Habitat	1
	1			Credit 5.2	**Site Development**, Maximize Open Space	1
1				Credit 6.1	**Stormwater Design** Quantity Control	1
	1			Credit 6.2	**Stormwater Design** Quality Control	1
1				Credit 7.1	**Heat Island Effect**, Non-Roof	1
		1		Credit 7.2	**Heat Island Effect**, Roof	1
1				Credit 8	**Light Pollution Reduction**	1

Y	?	N	$k			
5	0	0	$0.0	**Water Efficiency**		Possible Points **5**
1				Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1				Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
1				Credit 2	**Innovative Wastewater Technologies**	1
1				Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1				Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Y	?	N	$k			
7	2	8	$0.0	**Energy & Atmosphere**		Possible Points **17**
Y				Prereq 1	**Fundamental Commissioning of the Bldg. Energy Systems**	0
Y				Prereq 2	**Minimum Energy Performance**	0
Y				Prereq 3	**Fundamental Refrigerant Management**	0
6		4		Credit 1,1	**Optimize Energy Performance**, Option 1: Whole Bldg Energy Simulation	1-10
				Credit 1.2	**Optimize Energy Performance**, Option 2: Prescriptive Compliance Path	4
				Credit 1.3	**Optimize Energy Performance**, Option 3: Prescriptive Compliance Path	1
		1		Credit 2.1	**On-Site Renewable Energy**, 5%	1
		1		Credit 2.2	**On-Site Renewable Energy**, 10%	1
		1		Credit 2.3	**On-Site Renewable Energy**, 20%	1
		1		Credit 3	**Enhanced Commissioning**	1
1				Credit 4	**Enhanced Refrigerant Management**	1
	1			Credit 5	**Measurement & Verification**	1
	1			Credit 6	**Green Power**	1

Y	?	N	$k			
5	3	5	$0.0	**Materials & Resources**		Possible Points **13**
Y				Prereq 1	**Storage & Collection of Recyclables**	0
		1		Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
		1		Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors, Roof	1
		1		Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
1				Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
	1			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
		1		Credit 3.1	**Materials Reuse**, Specify 5%	1
		1		Credit 3.2	**Materials Reuse**, Specify 10%	1
1				Credit 4.1	**Recycled Content**, 10% (post-consumer. + 1/2 pre-consumer)	1
	1			Credit 4.2	**Recycled Content**, 20% (post-consumer. + 1/2 pre-consumer)	1
1				Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manuf. Regionally	1
	1			Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manuf. Regionally	1
1				Credit 6	**Rapidly Renewable Materials**	1
1				Credit 7	**Certified Wood**	1

Y	?	N	$k			
11	4	0	$0.0	**Indoor Environmental Quality**		Possible Points **15**
Y				Prereq 1	**Minimum IAQ Performance**	0
Y				Prereq 2	**Environmental Tobacco Smoke** (ETS) Control	0
1				Credit 1	**Outdoor Air Delivery Monitoring**	1
1				Credit 2	**Increase Ventilation**	1
1				Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
	1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
	1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1				Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1				Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1				Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1				Credit 5	**Indoor Chemical & Pollutant Source Control**	1
	1			Credit 6.1	**Controllability of Systems**, Lighting	1
1				Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1				Credit 7.1	**Thermal Comfort**, Design	1
1				Credit 7.2	**Thermal Comfort**, Verification	1
1				Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
	1			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Y	?	N	$k			
2	1	2	$0.0	**Innovation & Design Process**		Possible Points **5**
1				Credit 1.1	**Innovation in Design**: Specific Title:	1
	1			Credit 1.2	**Innovation in Design**: Specific Title:	1
		1		Credit 1.3	**Innovation in Design**: Specific Title:	1
		1		Credit 1.4	**Innovation in Design**: Specific Title	1
1				Credit 2	**LEED™ Accredited Professional**	1

Force Field Analysis

This technique is used to identify both positive aspects of the project and areas to be improved if possible. A list was prepared of the best and weakest features as identified by the workshop attendees. The VM team then listed 111 creative ideas during the "brainstorming" portion of the workshop. Ideas were listed to improve on weak features, reduce risk, improve quality, lower initial and life cycle cost. All ideas were to achieve the functions of the project. As many ideas as possible were listed without judging them.

Evaluation of Ideas

Once ideas are listed, the VM team evaluated them to select the most promising for development. This task included having the team develop criteria which would be used to evaluate each idea. The following is the criteria or factors used to evaluate the list of ideas:

- Performance Improvements
    - Flexibility
    - Space Efficiency
    - Dependability
    - Redundancy
    - Durability
    - Sustainability
    - Quality
- Cost Savings (all part of Life Cycle Costing)
    - Capital cost
    - Energy
    - Maintenance
    - Major Replacements
- Ease of Implementation
    - Time to modify
    - Cost to change

Development & Recommendation

The VM team then developed the most promising ideas by preparing sketches, performing engineering calculations, estimating the initial and life cycle costs, and listing the non-monetary advantages and disadvantages. Each value analysis proposal is documented for the report including a one page summary followed by a complete description of each proposal, sketches where necessary and cost estimates used as a basis for initial and life cycle costs. Some recommendations will generate significant savings for the project. Other ideas may add costs but would improve performance or generate life cycle cost savings. Due to time constraints, some ideas were not developed into proposals, but may still warrant additional consideration by the client.

STRATEGY 3: DON'T BE AFRAID OF THE BIG IDEAS

Hospital	**Idea:** Break up into components **Benefits:** schedule, constructability, cost, labor
Airport	**Idea:** Use double loaded terminal layout **Benefits:** Reduced walking distance, operational efficiency
	Idea: 100 ideas to reduce maintenance & improve durability **Benefits:** Didn't add first cost

Housing	**Idea:** Small changes make a big difference **Benefits:** Improved housing quality, improved constructability
Courthouse	**Idea:** Increase size of corridors and reduce size of courtroom since 95% of all cases settled in corridors **Benefits:** Improved basic function of settling cases
Office Tower	**Idea:** Single component ilo multiple components for 3-D exterior skin **Benefits:** Improved constructability, supported signature design
Schools K-12	**Idea:** Use Cherokee images & symbols, integrate LEED & Indian culture **Benefit:** Improved cultural expression and aesthetics
R & D	**Idea:** Create "unique" work environment **Benefits:** Improved research interaction
Manufacturing	**Idea:** Use "lean" principles to simplify flows, just in time delivery **Benefits:** Eliminate waste (time, materials, etc.)
University	**Idea:** Improve space use efficiency **Benefits:** Create more usable space for teaching
City Planning	**Idea:** Explore options for distribution of services **Benefits:** Improve public services and reduced city taxes

VM PRINCIPLES OFTEN FORGOTTEN IN LARGE, COMPLEX PROJECTS

Following is a summary listing of the observations identified by this research on large, complex projects:

- Missed "basic function" of project (project goals & objectives)
- Project so large & complex skip function analysis to start brainstorming
- Forgot about "time" (project delivery schedule)
- No focus on scarcity of resources – materials & skilled labor
- Too much focus on LEED sustainability ilo "economic sustainability"
- Lost opportunity to build on VM "Big Idea"
- Lack of use of multi-disciplined VM team extended to unique specialists
- Too little development of proposals due to too many proposals (quantity vs. quality)
- 24/7 projects lack of focus on maintainability
- No discussion on cost / life cycle considerations because don't have estimate

Following is a summary of the key strategies to address those observations for large, complex projects:

- Select VM team to include "specialists" for complex project issues (critical need to select experienced, knowledgeable team)
- Follow VM methodology and conduct workshop in a neutral site to limit distractions
- Use Function Logic Diagrams to identify Basic Functions (validation of goals & objectives of project)
- Give you and your team enough time to cover key issues (use time wisely)
- Brainstorm ideas on schedule, scarcity of resources, economic sustainability, and maintainability in addition to those based on function
- Lean on the appropriate tools (discovered in pre-workshop or workshop)
- Select ideas for development that reinforce VM team "Big Idea" discovery
- Develop VM ideas into thorough, well thought out proposals
- Follow through to discover those ideas implemented

SUMMARY

Value based methods are ideal for managing large, complex projects throughout the world. A number of international projects were used as case studies to illustrate how value based design decision-making methods can maximize value. Key VM principles often forgotten in large, complex projects can make a big difference in the success of the study. In addition, large projects offer VM strategies that are not possible with small projects. Likewise complex projects require strategies that are somewhat different than simple projects. Applying the techniques of function analysis, quality modeling, risk modeling, creativity, choosing by advantages (CBA) and life cycle costing (LCC) are important to improve the value of large, complex international projects.

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