Enhancing Value for the Guggenheim Abu Dhabi Museum

Via Function Inspired Change

Stephen J. Kirk, PhD, FAIA, CVS-Life, FSAVE, LEED AP[1]

ABSTRACT

This paper highlights the principals of value management applied to the planned Guggenheim Museum in Abu Dhabi. Core to success was the use of function analysis which is the unique element of the value methodology (VM). Both performance and life-cycle cost savings resulted from function inspired change. The techniques of VM as well and the resulting recommendations for value enhancement of the Guggenheim are described. The project is being managed by the Abu Dhabi Tourism Development & Investment Company (TDIC). The lead designer is Gehry Partners, LLP in Los Angeles, California. The schematic VM workshop focused on review of the site and building design efficiency, architectural and engineering systems effectiveness, sustainability and life cycle performance, and risks associated with the schedule and constructability. The VM team identified over 300 ideas for value enhancement.

KEYWORDS

buildings, construction, cost data, economic evaluation, function analysis, FAST, life-cycle costing, Miles Value Foundation, SAVE International, value engineering, value analysis, value management, value methodology

INTRODUCTION

According to SAVE International, the internationally recognized authority for value engineering/ value analysis (VE/VA), the value methodology (VM) is a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions [1]. In 1993, The Office of Management and Budget (OMB) prepared Presidential Directive A-131 [2] for guidance in application of VE for effectively "reducing costs, increasing productivity, and improving quality." In 1996, Public Law 104-450 was passed by the US Congress which requires each executive agency to establish and maintain a VE procedure for applying VE to their projects, products and processes [3].

Lawrence D. Miles, the originator of the VA/VE process states best value is determined by two considerations: performance and cost [4].

[1] Partner, CEO, Kirk Value Planners, Kirk Value Planners, LLC, Goodyear, AZ 85395 (e-mail: skirk@kirkvalueplanners.com)

Value is defined as a fair return or equivalent in goods, services, or money for something exchanged. Value is commonly represented by the relationship:
Value ≈ Function/Resources

where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, energy, life-cycle cost, etc. required to accomplish that function. A value methodology focuses on improving value by identifying alternate ways to reliably accomplish a function that meets the performance expectations of the customer [5].

Figure 1 illustrates the various ways value can be added to a project. For example the arrows in the lower right corner indicate an idea which maintains performance and reduces costs. The arrows in the center indicate an idea that raises performance and lowers cost. Ideas of all 5 types are typically identified in a VM workshop [6].

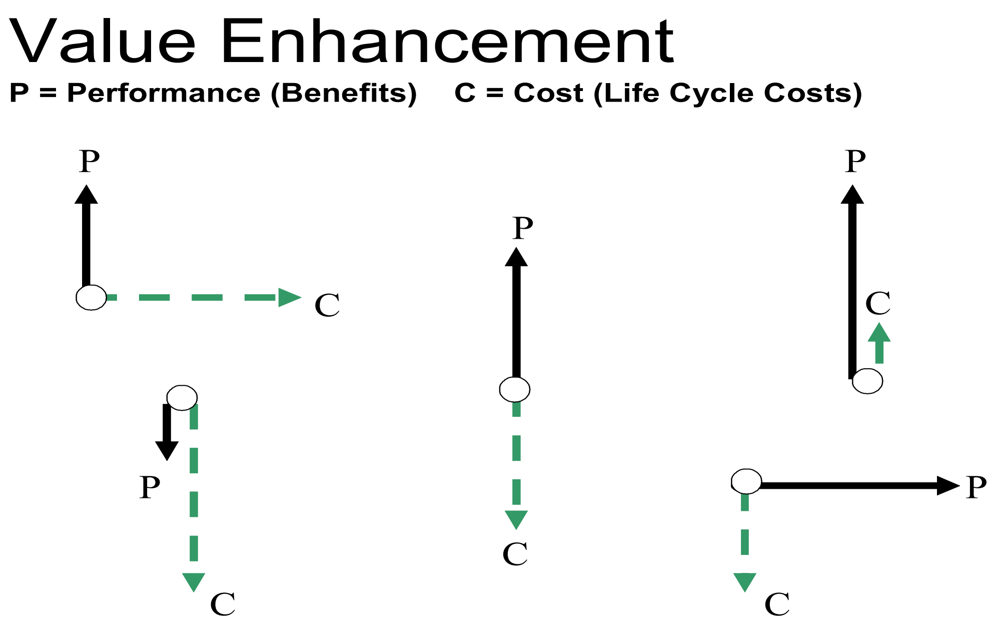

FIG. 1 Value Enhancement Options

STANDARD VE/VA PRACTICE

The standard practice of performing VE/VA for projects, products, and processes is defined in ASTM E1699-13 [7]. According to this document, VE/VA is typically applied during the schematic stage of a building construction project or about 15% design completion. A Certified Value Specialist (CVS) guides a value study. Experience has shown that project studies performed by a person or team with little or no VM leadership will tend to steer in the direction of a superficial review and concentrate on errors made by others. A VM study, on the other hand, focuses on both reducing the total cost of ownership and improving overall performance. Application of the VM methodology and coordination of the activities before and after the study also significantly increase the probability the recommendations will be implemented. The VM Job Plan Workshop Methodology [1] consists of the following six (6) steps:

1. Information Phase
2. Function Analysis Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase

Function Analysis is the foundation of a value methodology and is the key activity that differentiates this body of knowledge from other problem-solving or improvement practices. During the Function Analysis Phase of the Job Plan, functions are identified that describe the work being performed within the scope of the project under study. These functions are described using two word, active verb/measurable noun pairings, for example one function of a museum is to "enhance culture." The team reviews the project's functions to determine those that could be improved. These may be project functions that seem to be performed inefficiently or with more than expected cost. These functions become the focus of the value methodology team in their endeavor to improve the project.

Function Analysis Systems Technique (FAST) diagrams are helpful in organizing functions together in a how – why logic pattern [8]. This helps assure the team that all required functions have been identified. For the museum example, how can the function "enhance culture" be achieved? Answer, by "establishing world-class art galleries."

Life-Cycle Costing is an important tool during the development phase [9]. It is used to compare the original design with alternatives. Economic criteria such as the discount rate and study period are analyzed. Building costs evaluated in a life-cycle cost analysis include initial capital cost, replacement costs, and annual cost for maintenance, energy, water, etc. Present value (present worth) calculations convert the monies spent at various times to an equivalent cost as of today for comparison of alternatives [10].

PROJECT DESCRIPTION

The Guggenheim Museum Abu Dhabi Project consists of the design of a world-class facility for the exhibition of contemporary visual art located in the Cultural District of Saadiyat Island in the Emirates of Abu Dhabi, which is part of the United Arab Emirates. The main goal of the project is to bring contemporary visual art from all over the world to Abu Dhabi, in an extraordinary setting, at the tip of Saadiyat Island, as part of a series of cultural institutions such as the Louvre Museum, a Performing Arts Center, a Maritime Museum, and the Sheikh Zayed Museum.

The museum will contain exhibition spaces of various sizes and character, for permanent and temporary collections, as well as the support and administrative functions necessary to operate a facility of this size. The building will also contain public amenities such as an auditorium, a restaurant, a café and a bookstore. The total building is approximately 35,000 SM.

Schematic Design

The schematic design is configured to allow for visitors to experience the museum in a unique way-- blurring the lines of indoor and outdoor spaces. At the heart of the building is a centralized courtyard which serves as the primary orientation space for the museum visitor. The courtyard is imagined to be cooled through passive and active means providing a comfortable environment for patrons visiting the museum. The exhibition spaces, which are the primary means of circulation are accessed from the central courtyard, are comprised of the three main elements; gallery spaces for a Permanent Collection, Special Exhibitions, as well as a series of exhibition spaces creating a Center for Arab, Islamic and Middle-Eastern Culture.

The architectural language of the museum is a series of block forms delineating the interior gallery volumes. The cone shapes (see Fig. 2), which define the exterior covered spaces around the museum, serve the functions of creating a microclimate environment around the museum as well as providing transitions from indoor/outdoor experiences for visitors moving between temperature and humidity controlled gallery spaces and the potentially extreme environment of Abu Dhabi. See Fig. 2.

FIG. 2 Guggenheim Museum Abu Dhabi, UAE, Gehry Partners, LLP

VALUE MANAGEMENT STUDY

Value Management Workshop Objectives

The project Owner TDIC initiated a VM study at the schematic design phase. Kirk Value Planners lead the study. Following is a summary of the VM objectives:

- Improve site & building design efficiency
- Enhance architectural & engineering systems effectiveness
- Further sustainability & life cycle performance
- Identify project risks & mitigation strategies (constructability/ schedule)
- Explore ways to meet owner construction budget & schedule

VM Team

The VM team consisted of members from the:

- TDIC, owner;
- Guggenheim Foundation, user
- Gehry Partners, architect;
- Adamson, executive architect,
- Arup, engineering
- AECOM, project manager; and
- Kirk Value Planners, value specialists and facilitators.

More than 50 participated in this 3-Day VM Workshop.

Value Models

As part of the information phase of the VM workshop, a number of value models were prepared including cost benchmarks, a cost model, a risk model, a sustainability model, a constructability checklist, and a schedule (time) model. Each model helped the team identify ideas for value enhancement.

Cost Benchmarks

The VM team compared the cost per square meter of the Guggenheim Abu Dhabi Museum with other recent international museums. All project costs were adjusted to US Dollars, the current time, and the same location. **Figure 3** illustrates a comparison of the Guggenheim cost of over $13,000 per SM which is much higher than the average cost of the other museums at approximately $8,000 per SM.

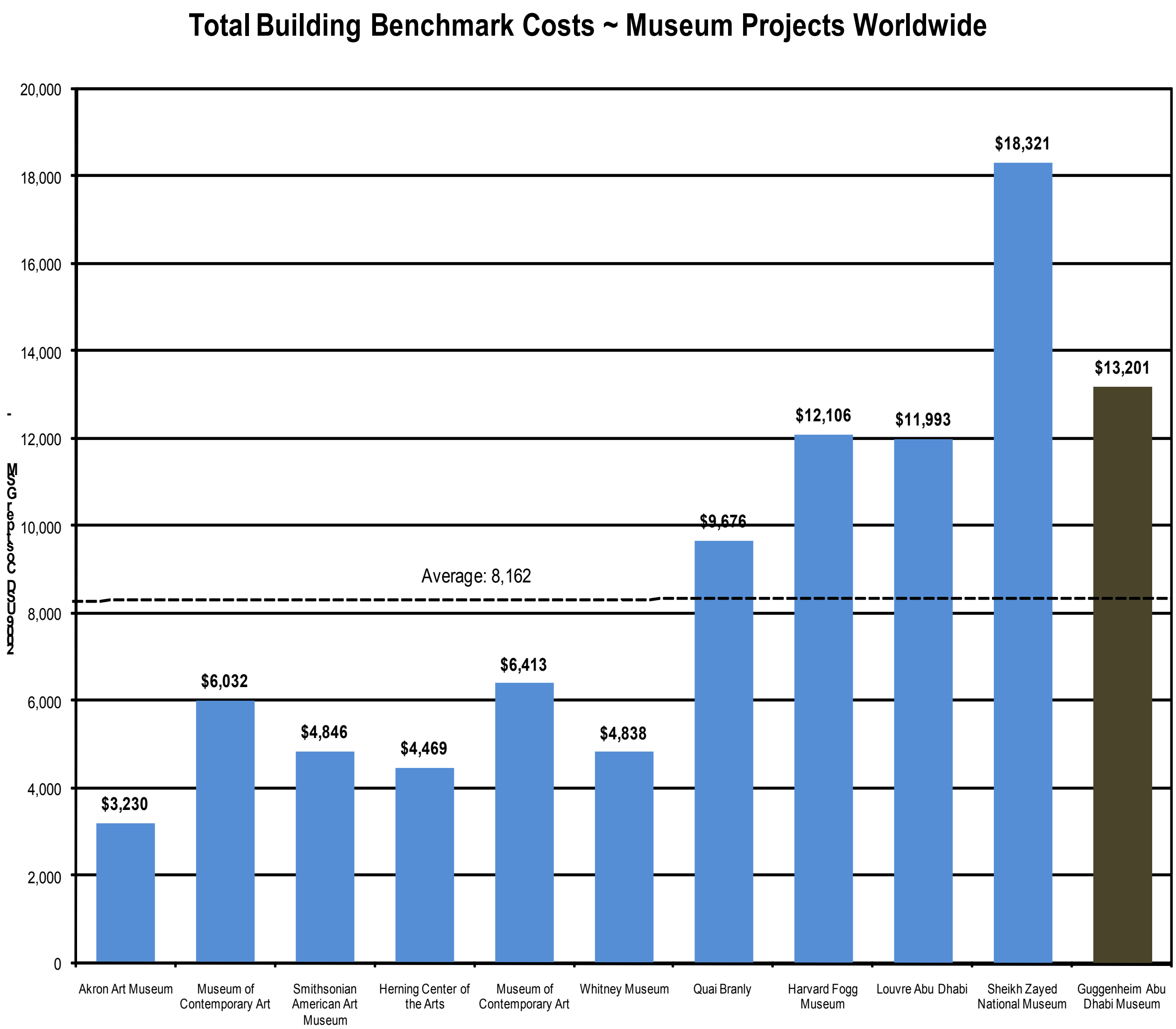

FIG. 3 Cost Benchmarks (Building USD Cost / GSM)

Cost Model

To understand the cost of construction for the project, a cost model was prepared prior to the workshop. Each of the cost components were then further broken down in a Pareto diagram (highest to lowest cost) and shown for the Museum in **Fig. 4**. The team focused on how to lower the costs of the highest components.

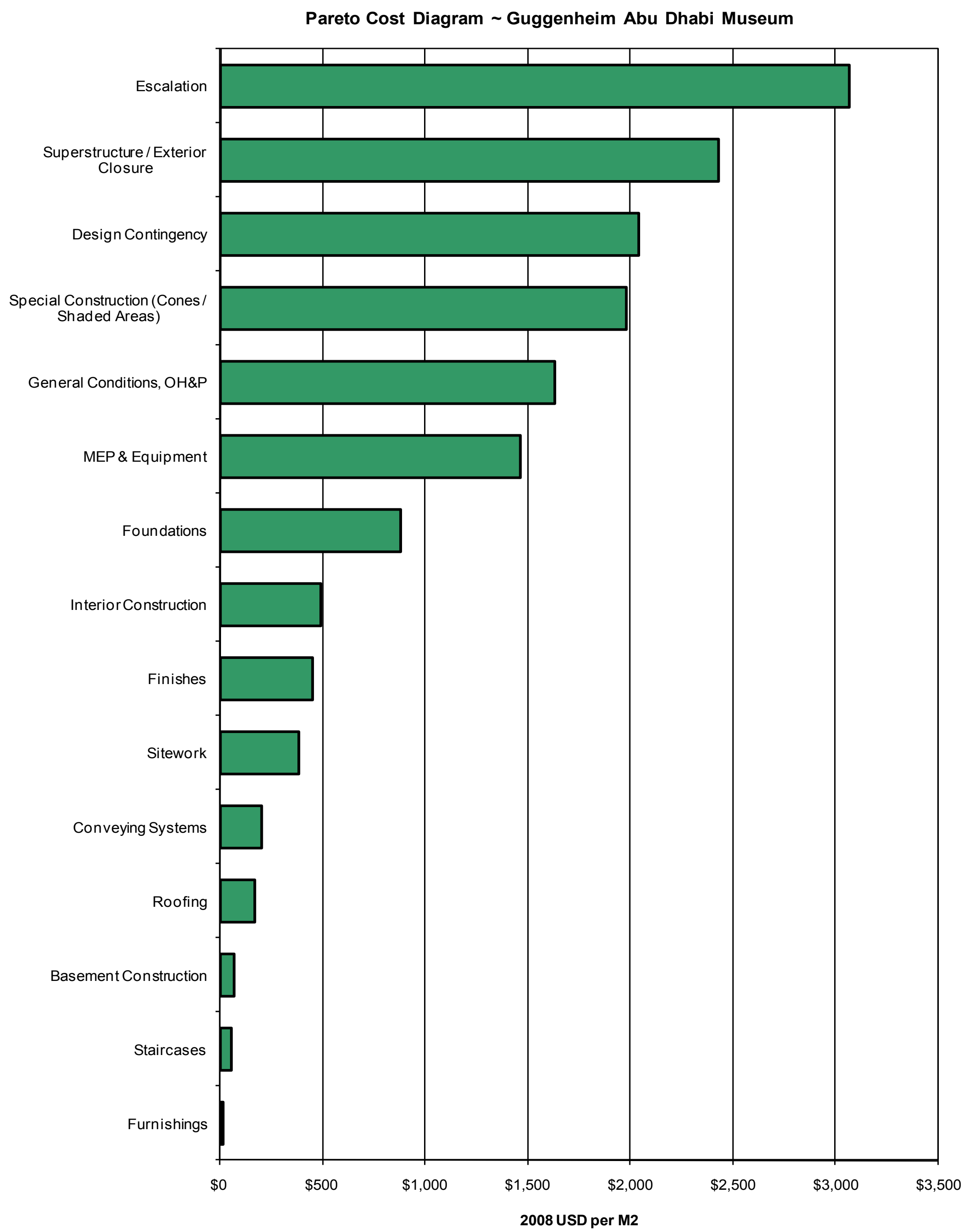

FIG. 4: Cost Model (Pareto of Museum Construction Cost)

Risk Model
A risk model was introduced to help the VM team identify specific risk areas currently observed within the project. Risks were captured in 5 major categories:

1. Management, Financial, and Administrative risks;
2. Environmental, Geotechnical risks;
3. Technical risks;
4. Security risks; and
5. Implementation risks.

Major risks included the schedule, budget limitations, inflation, inclement weather, new unproven systems like the cones and shards, design approvals and changes, availability of qualified contractors, change orders, field changes, defects or rejected material submittals, and estimating. The VM team reviewed the risk areas and generated contingency plans to minimize “medium and high” risks items associated with the project.

Sustainability Model
The LEED USGBC [11] (Leadership in Energy and Environmental Design) model was prepared by the VM team during the workshop. It helped the VM team identify opportunities to make the project more sustainable. Enough points were identified to achieve “silver” certification.
A second LEED model, the Estidama Pearls version [12], was also prepared by the VM team. Suggestions to maximize the sustainability opportunities for this project were captured by the VM team.

Constructability Checklist
In an effort to more fully understand the challenges this project will produce during the construction phase, a constructability checklist was developed by the VM team during the workshop. It involves identifying the challenges anticipated in several key areas as follows:

- Staging and Mobilization;
- Maintenance Considerations;
- Site work;
- Structure;
- Exterior Closure;
- Roofing; and
- Finishes

Schedule (Time) Model
The design team prepared a design and construction schedule for the VM team review. It was used to review potential opportunities in minimizing or reducing possible risks of meeting the current project schedule.

FAST Diagram

The VM team prepared a function logic diagram to help understand the overall purposes of the new museum. This diagram describes the primary functions of the project that will "**enhance Abu Dhabi culture**", by "**attracting international attention**" (with world class architecture), and by "**enlightening the public**" (with world class art and galleries for viewing and educating visitors) which are considered the basic functions of the project. A portion of the function-logic diagram is shown as **Fig. 5**. Later the team identified alternative ideas for meeting the functions shown on the diagram. The function analysis served a tool to creatively inspire change in the current design.

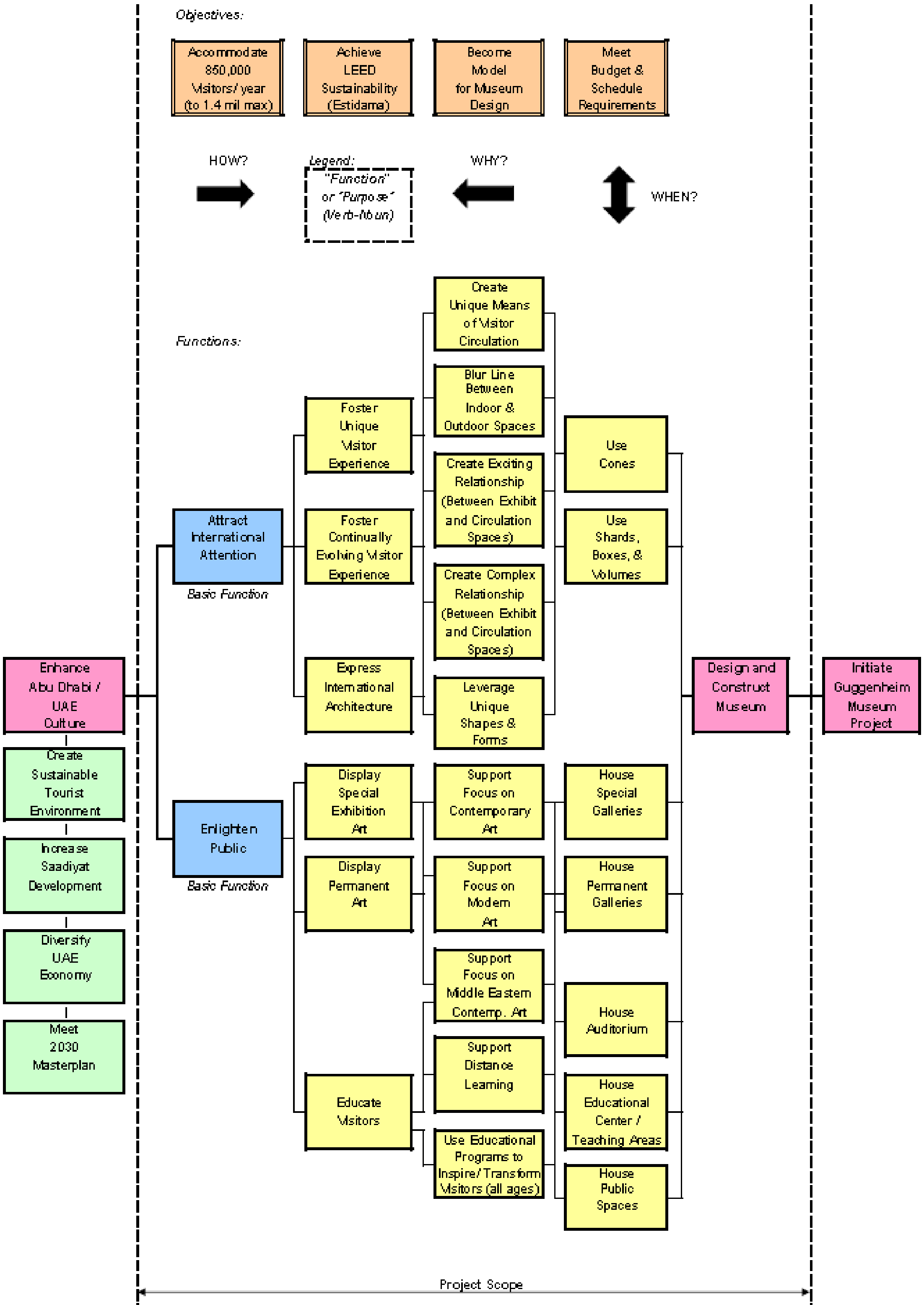

FIG. 5 FAST Diagram of the Museum

Team Organization & Creativity

With the large number of participants it was important to organize the teams to maximize their participation and creativity. Two sessions of creativity were organized as illustrated in **Fig. 6**. Session 1 focused on landscape, architectural, and structural in Track I, and mechanical and electrical systems in Track II. The second session focused on sustainability in Track III, and risk and constructability in Track IV. The team members were re-mixed to optimize their subject matter expertise from session 1 to session 2.

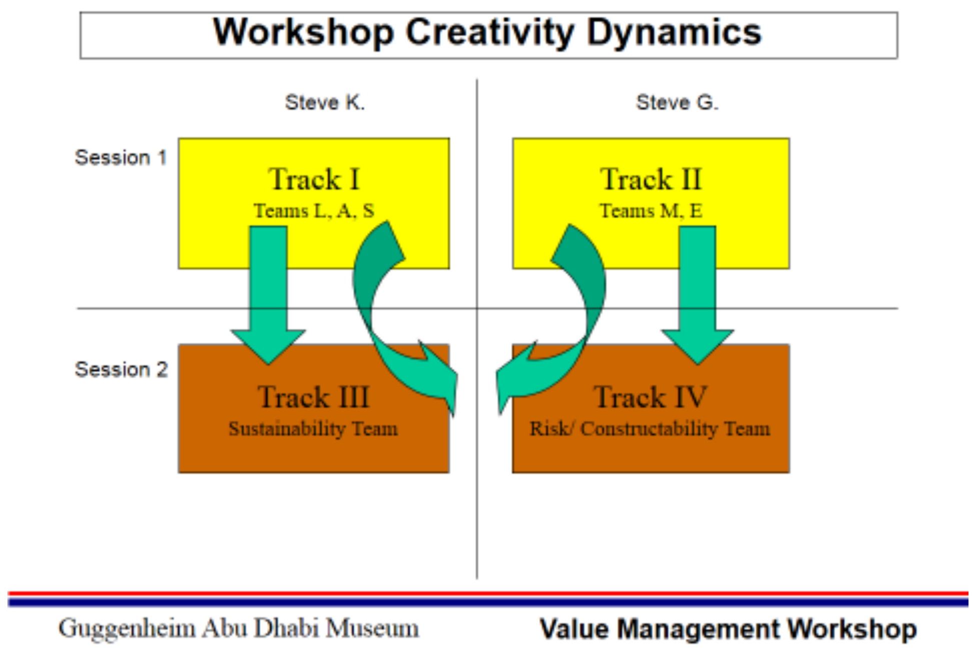

FIG. 6: Two Creativity Sessions

VM Idea Evaluation & Proposal Development

Each team did a preliminary evaluation of their own ideas. The most promising were presented to the complete group for their input. Based on these discussions, the most significant ideas were then developed into VM proposals by the small groups. Development included preparing life-cycle cost analysis, engineering calculations, sketches, further research on viability, and ultimately a recommendation listing the advantages of the proposed alternative.

VM RESULTS

Value Management Recommendations

The value management team identified 300 ideas for value enhancement. Of these, 81 ideas were selected for development into recommendations for improving the performance and / or lowering the initial and life cycle cost of the project. "Big" ideas included the following (number refers to the proposal number in the VM report [13]):

- Coordinate park into Master Plan as shared resource (L-13)
- Alternatives to address site flows, security and screening (L-57 & L-68)
- Support original program efficiency (A-5, A-10, A-31, A-85, A-292)
- Simplification / reduction of space in basement (A-61, A-293A)
- Create multiple phases for project (A-10, A-62)
- Accelerate seismic investigation (S-23)
- Enclosing the main atrium space (M-51A)
- Changes to sprinkler strategy (M-150 A-C)
- Air handling air curtain and redundancy changes (M-158, M-162, M-265)
- Leveraging desiccant dehumidification with solar regeneration (G-235)
- Lighting strategy changes (G-102, G-112, G-273)
- Improving Museum synergies (R-8)
- Advance the design to pre-purchase long lead items (R-244)

Performance Improvement

Figure 7 reflects the percentage of VM proposals focused on performance improvements by category:

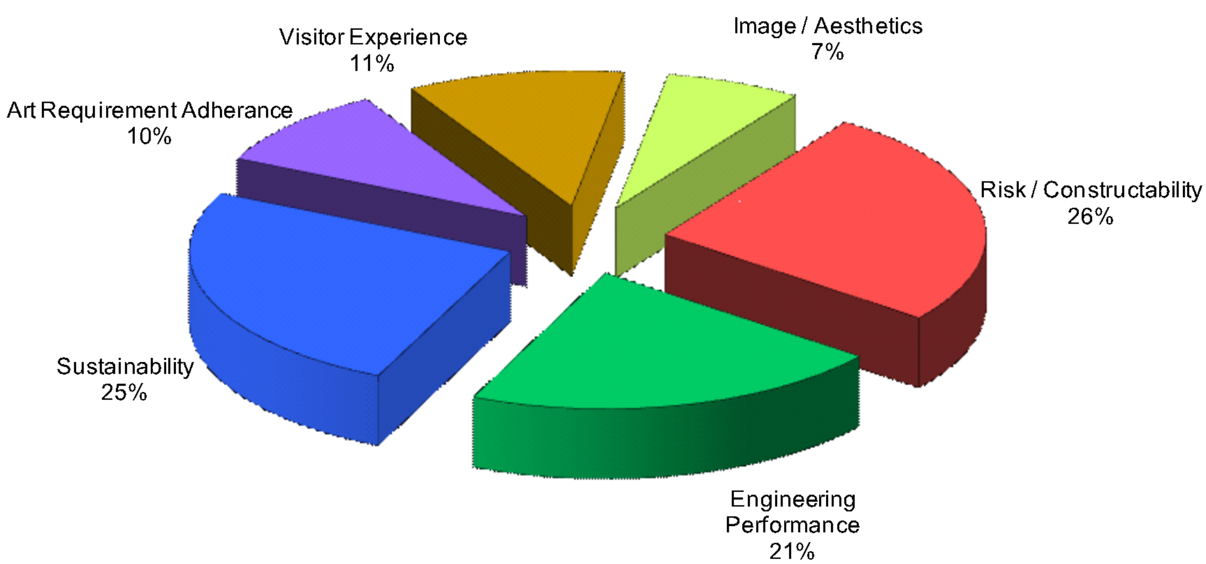

FIG. 7 Potential Performance Improvements by Category

Other benefits included: reduces risks, improves energy performance, leverages new technology, reduces circulation conflicts, simplifies construction, reduces exterior closure, improves egress flows, increased museum flexibility, lightens structure, reduces construction schedule, reduces risks associated with fuel, satisfaction of Estidama or LEED requirement, maintainability, energy, initial cost savings and life cycle cost savings.

Cost Savings

Some recommendations will generate significant savings for the project while others will add costs. Cost savings identified by the VM team is illustrated in **Fig. 8**. The life-cycle costs were also reduced by a similar percentage. These included energy, maintenance, and replacement costs.

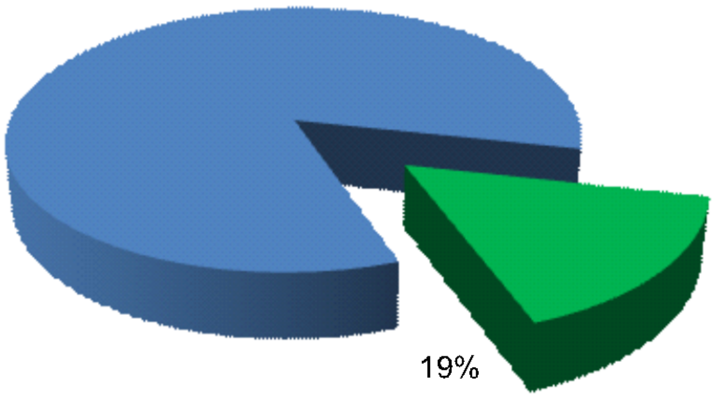

FIG. 8: Potential Cost Savings

CONCLUSION

This VM study, performed at the schematic design stage, was a success in part due to the use of function analysis which helped inspire change. Both performance and life-cycle cost savings resulted in this study which followed the SAVE Value Methodology and ASTM Standards E1699 and E2013. This building example, designed by world renowned architect Frank Gehry, demonstrates how the value methodology and a team of subject matter experts lead by a CVS produces performance improvements even to the most sensitive architectural designs. It also illustrates how much can be achieved in a 3-day VM workshop. At the conclusion of the VM workshop, the design team congratulated all the participants for their thought provoking ideas and recommendations.

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