Value Strategies for Improving Resiliency in Construction Planning

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Biography

Stephen J. Kirk, PhD, FAIA, FSAVE, CVS-Life, LEED® AP is Partner and Chief Executive Officer of Kirk Value Planners (A Member of Kirk Associates), which specializes in project planning, VE, sustainability, life cycle costing, and post occupancy evaluation services. He has over 35 years of experience in applying value based design decision-making techniques to corporate offices, educational buildings, museums, embassies, research facilities, hospitals, airports, national parks, and roads & highways. 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 is the author/co-author of nine books related to project planning, VE & LCC including his text, *Enhancing Value in Design Decisions*. Dr. Kirk received the prestigious Gold Award from the Engineering Society of Detroit in 2010 which recognizes the Michigan "Engineer of the Year." Steve served as President of SAVE International from 1998 to 1999. He is currently serving as Director and Vice President of Education for the Miles Value Foundation. Dr. Kirk is a Fellow of SAVE International and is the Dean of the College of Fellows. Steve is on the faculty of the School of Architecture at Arizona State University.

Stephen Garrett, CVS is Partner and Chief Operating Officer of Kirk Value Planners, which specializes in provide comprehensive facility economics, value planning, education, and value management services. Steve has over 25 years of professional experience including extensive skills in value based decision making, project criteria development, costing, scheduling, quality assurance / quality control (QA/QC), strategic planning, and program management for large, complex projects for national and international clients. As partner, he typically leads highly skilled, multi-discipline teams in generating strategies and recommendations for projects ranging from hundreds of thousands to billions on 5 continents. He is also skilled in life cycle costing with his experience including office, government, manufacturing, institutional, health care, education, and laboratory facilities. Steve received his Bachelor of Architecture degree from Lawrence Technological University. He is a guest instructor for Lawrence Technological University and the University of Michigan. He is a Certified Value Specialist (CVS), has been a member of SAVE International for over 10 years, teaches certified SAVE International courses, is the former President of the Greater Michigan Chapter and is currently serving as a member of the SAVE International Certification Board.

Abstract

The concept of resiliency or disaster mitigation has become more critical as both public and private organizations make significant investments near areas where natural disasters may occur. As the world's population increases, it creates added risk to large swaths of occupied areas as weather events grow in severity. The typical response is the add resiliency features for a premium that reduce the risk to life or property damage but these often do not meet the requirements for project budgets or can add significant lengths to the completion schedules. In some projects, the focus can be shifted away from sustaining a way of life and more on what it means to live in a resilient community.

This presentation will discuss a number of value strategies for improving resiliency. The focus will be on identifying hazards, assessing vulnerabilities, determining the probability of risk or hazards, establishing the stakeholder importance, creating performance targets, and determining a best value response. Two case studies will be used to illustrate how these strategies have improved resiliency to reduce risk. Use of strategies such as, the value methodology, FAST, needs analysis, project performance measures, risk analysis, collaborative workshop iteration for maximum creativity, and evaluation techniques, Life Cycle Costing will be also used to continuously explore, and improve, options for maximum project success.

Identify Hazards

The discussion about resiliency starts around the identification of potential hazards. The following **Figure 1** illustrates some of these hazards evaluated for a public project:

Figure 1: List of Potential Natural Hazards

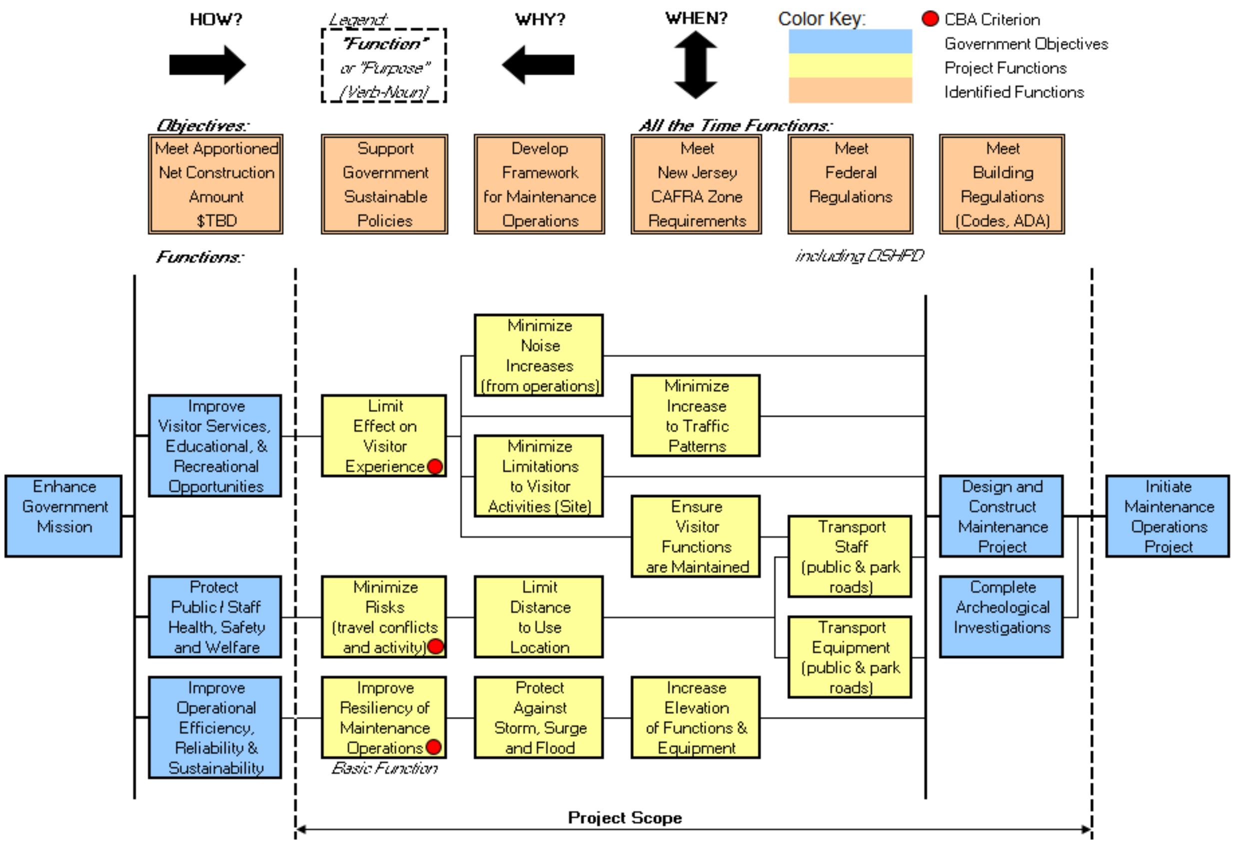
Natural Hazard	Potential? (Yes/No)
Earthquake	
Landslide / Avalanche	
Permafrost	
Cave/Karst Sinkholes	
Shrink/Swell Soils	
Coastal Storm Surge	
Tsunami	
Riverine Flood	
Flash Flood	
Hurricane	
Tornado	
Wildfire	
Volcanic Eruption	
Hydrothermal Activity	
Mudslide / Liquefaction	

Figure 2 which illustrates the process of using a FAST diagram to identify the key functions required of the project. Reading from right to left, the effort begins with initiating the design and construction of the project. Information is collected on how to "transport staff / equipment, ensure visitor functions are

maintained, and increasing elevation of functions and equipment." Next, project function requirements are defined using traditional function analysis techniques. This is done in a Value Planning Workshop. It is an iterative process of Exploring Options and Optimizing Value. During this stage it may be determined the projects basic function is to improve resiliency of the project. Through collaborative efforts with various stakeholders, exploration of additional options may result in a new solution that will meet the thresholds required for risk, budget, and schedule, thus allowing the project to continue into the next stage of design.

Figure 2: Function Logic Diagram

Relocation Maintenance Facilities



Assess Vulnerabilities

Traditional planning and design decisions already include a series of questions, such as: What is the project mission and operational goals? What facilities are necessary to support critical project operations? Superimposed over those essential questions are concerns about climate change and other natural hazards for your operation.   Many tools can be used to identify these vulnerabilities, including FAST diagramming. **Figure 3** lists the identified hazards for an example project.

Figure 3: List of Some Potential Natural Hazards

Natural Hazard	Potential? (Yes/No)
Shrink/Swell Soils	Yes – the delta was recently formed by riparian sediment deposits and the continued settling of those deposits as well as the weight of the deposits on the continental shelf create a general condition of subsidence in the region

Coastal Storm Surge	Yes – the project area is within the recently certified 100 year flood protection system constructed by the Army Corps of Engineers, but that doesn't guarantee that the 101 year event from occurring
Riverine Flood	Yes - the project area is within the recently certified 100 year flood protection system constructed by the Army Corps of Engineers, but that doesn't guarantee that the 101 year event from occurring
Hurricane	Yes – strong hurricane force winds will definitely affect the project
Tornado	Yes – the "tornado belt" is typically north of the project area; however, the tails of recent, strong fronts present a definite potential for extreme winds from other than hurricane phenomenon

Determine the Probability of the Risk / Hazard

The next step is to conduct additional research in the information phase to confirm the probability of the natural hazards occurring. This combined with the risk of occurrence is compared to a predetermined scale to create a risk / probability score used to identify those hazards that need the most attention in the workshop. **Figure 4** reflects an example of this effort.

Figure 4: Risk and Probability of Potential Natural Hazards

Natural Hazard	Source of Information	Frequency of Potential Hazard	Risk	Probability	Score
Coastal Storm Surge	- FEMA Cap Service Center - Staff Technical Support / On Site Recordings	Last major event occurred July, 2004	Normal Event - High 100 year Event - Moderate	Normal Event - 65% 100 year Event - 15%	332.5
Tsunami	- State Tsunami Inundation Mapping - Tsunami Clearinghouse - National Tsunami Watch Center - Staff Technical Support / On Site Observations	Last major event occurred December, 1986	Normal Event - Low 100 year Event - Low	Normal Event - 10% 100 year Event - 10%	30

Establish Stakeholder Importance, Create Performance Targets

Project stakeholders, planning and design teams must weigh the importance of the operational need versus the risk posed by natural hazards in designing and locating facilities to meet that need. Historic structures located in areas of susceptible to natural hazards must be evaluated to determine their future disposition, weighing their historic significance and potential use against identified and evaluated risks. In the planning arena, decisions about adapting to natural hazards will relate to zones or developed areas. Design and construction decisions will focus on the specifics of facilities.

If the project is relative to security needs, an assessment what levels of additional risk are acceptable for resiliency would need to be completed and documented. In a workshop setting, the team reviews the potential hazards and identifies those which the stakeholders are most concerned about. A list of potential questions below identifies key aspects of the asset/function being considered regardless of a specific hazard:

- Is the function/asset significant in its own right or under protection of federal law (such as eligibility for listing on the National Register of Historic Places)?
- Is the function/asset included in the government's enabling legislation or key to the government's legislated significance?
- Is the function/asset identified as significant in government planning?
- What is the asset's API (Asset Priority Index)?
- What priority does this asset have in the Asset Management Plan (AMP) as reflected in its optimizer band?
- What is the current replacement value (CRV) for the existing, or planned, asset?

- How important, operationally, is this function? – must it survive intact after all natural hazard events? For example, some functions must be fully operational immediately after an event, such as those necessary to safeguard life/health/safety, while others can be rebuilt/restored over time without significant risk.
- Does this asset include critical infrastructure - i.e., assets and/or systems, without which the operation cannot operate or operate safely. Such systems include electric service to building(s) essential to operations (headquarters, command post, etc.), sewage systems serving public or staff restrooms, potable water systems, fire sprinkler systems for buildings essential to operations, etc. Critical infrastructure also includes systems that are essential to the protection of natural or cultural resources. Examples include security systems, fire protection systems, aspects of a Heating, Ventilating and Air Conditioning (HVAC) system that are designed to protect a nationally significant historic building, collections, or irreplaceable records from deterioration, etc.
- Where is the asset located? (Latitude and longitude, elevation, etc.)
- What are the future costs related to natural hazard risk associated with acquired land with existing assets?
- What other planning efforts have been done previously on this asset/zone?

Answers to these and other questions will allow the team to further focus on the stakeholder importance of the asset in question and determine a reasonable performance target for the project.

Create Value Based Response on How to Modify Actions to Create Desired Outcome

Done correctly, value based design decision-making is about value over the lifetime of the facility being analyzed. The value methodology (VM) 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.

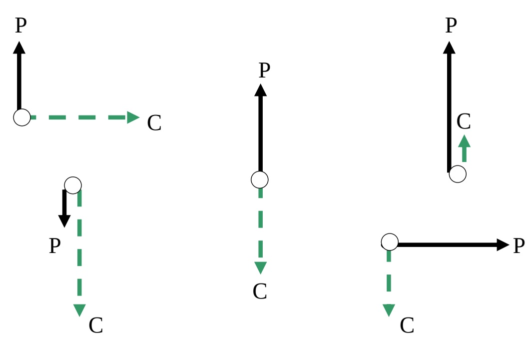
The power of value based design decision-making is in the methodology. The six step problem-solving process focuses on increasing value by improving performance (quality) and lowering cost (life cycle cost). The steps of decision-making are:

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

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. An example of the value enhancement opportunities is included in the follow page.

Value Enhancement

P = Performance (Benefits) C = Cost (Life Cycle Costs)



All project delivery methods can take advantage of the use of VM techniques such as:

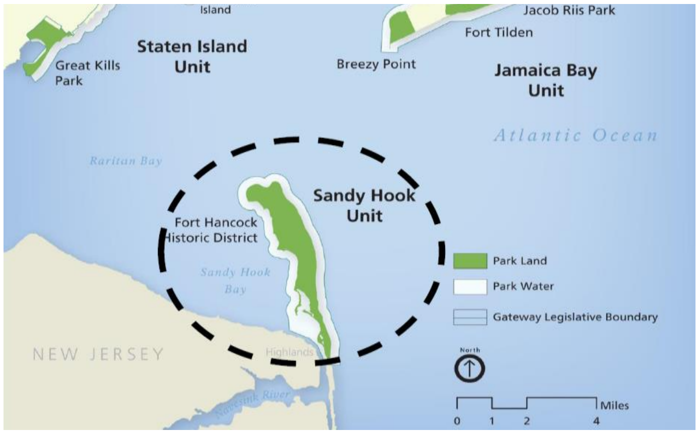
- Function Analysis, to properly understand the project requirements
- Creativity, to expand the number of alternatives considered
- Life Cycle Costing, to understand the long term impacts of alternatives
- Value Process, for improved problem solving and decision-making
- VM Workshop Setting, for consensus building
- Post Occupancy Evaluation, for feedback on decisions reached

Value Planning Workshop

Once the respective resiliency models are prepared, a value planning workshop is held to review all criteria for adequacy and completeness. In most cases, the resiliency and schedule expectations exceed the available amounts (cost and time). The value workshop study team includes participants from the owner, user, designer, constructor and facility manager. They explore a variety of options to get the project in balance. The workshop itself is structured following SAVE International Value Methodology. This methodology consists of the following phases: information, function, creativity, evaluation, development, and presentation.

Case Studies that Changed Value Dramatically

Example 1: Public Project ~ Facilities Damaged from Hurricane Sandy at Sandy Hook



The purpose of the project is to make the Sandy Hook Unit maintenance facilities resilient to coastal storm surges and flooding through relocation to more sustainable locations out of the 100-year floodplain and repurposing and/or reusing some existing facilities to improve the efficiency of park maintenance and recovery operations. VA Workshop #1 (completed December 2013) narrowed the search to a few select potential sites for further consideration of the primary maintenance operation at Sandy Hook. This workshop focused on determining the final site.

Project Justifications: Current pre-storm maintenance facilities at the Sandy Hook sustained severe flood damage and loss of major equipment. Moving the facilities to higher elevations and away from the potential path of coastal storms will help mitigate the risk of storm damage issues involving the park's assets.

Damage resulting from Hurricane Sandy

- Heavy wind / flying debris and damage
- Heavy rains / flash floods
- Coastal surge

Responses to priority vulnerabilities

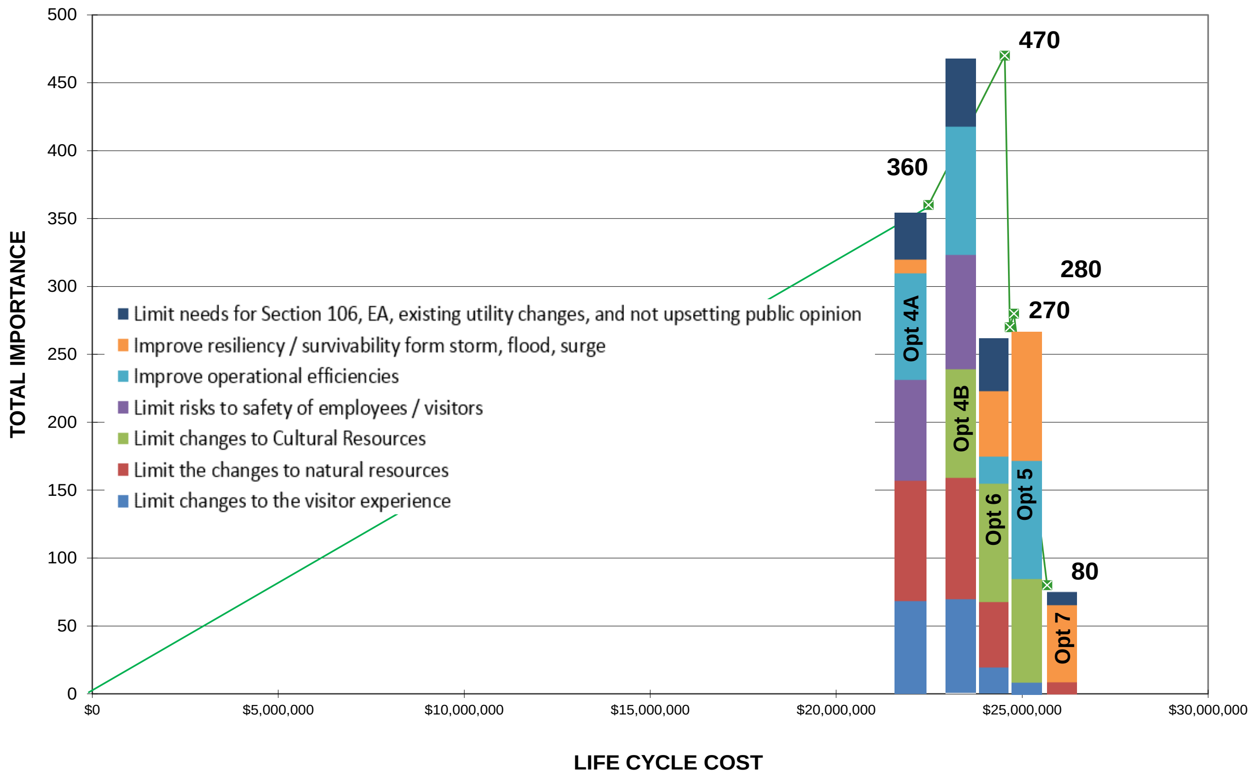
- Building, key system, raised key systems above 100 year flood plain
- Raised site to max available without destroying cultural landscape, relocation key portable equipment

- Modify buildings for high wind conditions and additional resistance to future hurricanes
- Site response, don't use materials large material or non-sustainable materials that get blown away (asphalt will need massive clean-up, seashell walkways are natural).

Following is the Importance to Life Cycle Cost Graph comparing all 5 alternatives.

CBA Importance to Life Cycle Cost Graph:
Gateway National Recreation Area -
Relocation Maintenance Facilities - Sandy Hook Unit

Figure 4G



Example 2: Public Project ~ Facilities Damaged from Tsunami in Hawaii

The purpose of the project is to make the Pu'uhonua Maintenance Facility resilient to coastal storm surges and tsunami flooding through relocation to more sustainable locations out of the 100-year floodplain. This will include improving the efficiency of park maintenance and recovery operations.

Project Justifications: Current pre-storm maintenance facilities at the park sustained severe damage and loss of major functions.

Damage resulting from Hurricane Sandy

- Tsunami
- Earthquake
- Coastal surge

Responses to priority vulnerabilities

- Building, key system, raised key systems above 100 year flood plain
- Building planned to be relocated to new location to provide safe working conditions
- Shortly after project was completed Tsunami occurred and wiped out facility planned to be moved.

Summary and Conclusion about Improving Resiliency

If the sustainability movement of the last 45 years taught all of us to reduce/reuse/recycle—to tighten our belts, as it were—then resilience calls for a belt-and-suspenders approach. In our effort to be more resilient as individuals, families, businesses, and communities, architects will need to carefully plan buildings, select products, and design systems that are easily adaptable to changing needs, holistic in acknowledging adjacencies and regional impacts, and finally see the environment as their client inasmuch as they see their paying patron as their client.

This paper has identified a more comprehensive approach using VM and associated tools that can greatly enhance the performance of a project for public and private clients. The approach goes beyond the most common practices in identifying other key indicators like stakeholder importance, cost of replacement, performance indicator, and probability of risk to focus on a the right hazard to identify the best value response.

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