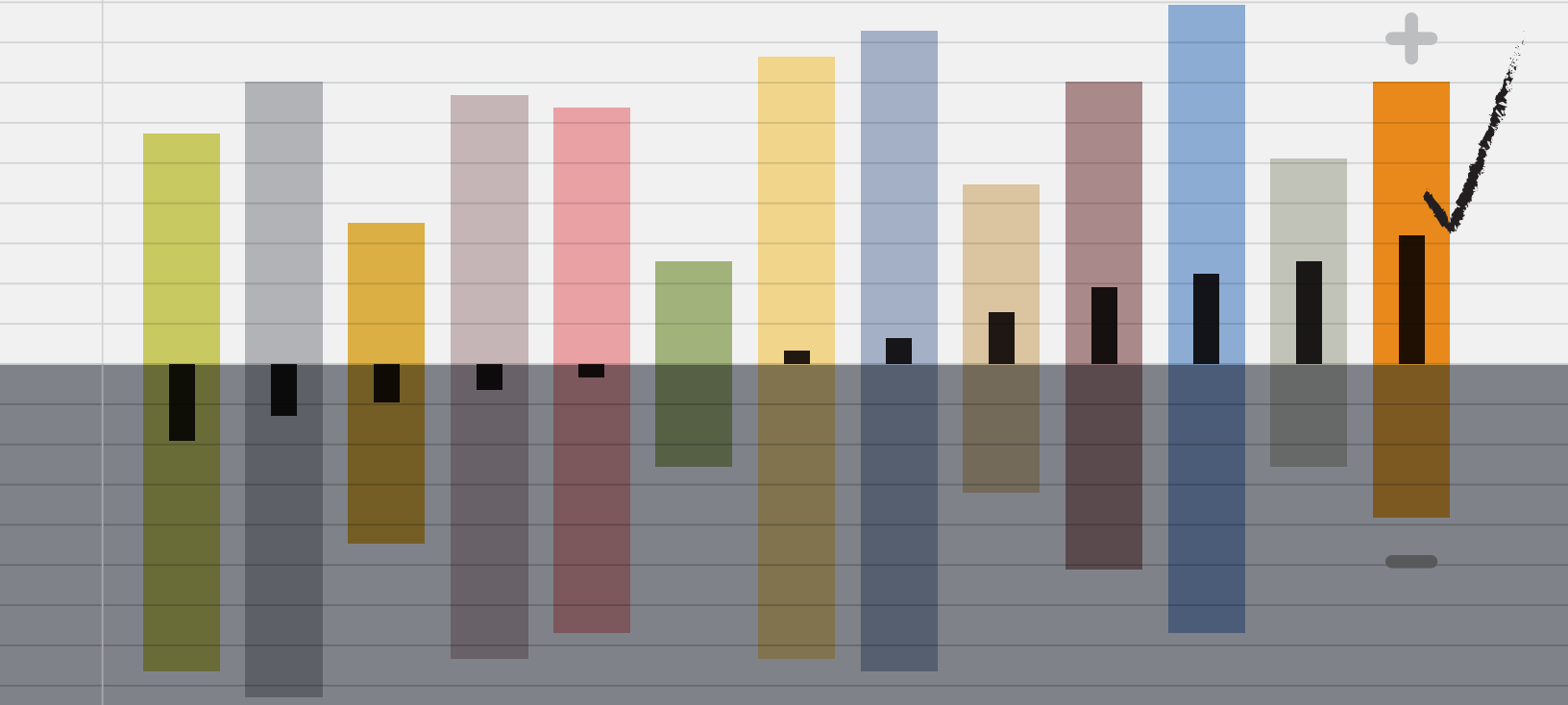
Adding Value. Enhancing Ideas.



VM Guide®

A Guide to the Value Methodology Body of Knowledge

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Preface

First shared with the public more than 70 years ago, the Value Methodology (VM) has been successfully applied, learned, shared, and improved upon by many professionals and institutions around the globe. Its evolution resulted in it being called different names and varying in the number of phases followed in its application. The use of a function logic map with many variations became standard practice, different certification levels emerged and changed, and many more interesting things happened during this function-oriented story that began with a man named Larry Miles.

Larry Miles invented a breakthrough in problem-solving that has been tested and validated for decades. Since he planted the VM seed in 1947, it has grown and branched significantly. As of today, many authors have written about and around Miles' function-based methodology, adding much knowledge to his original approach while the language around his legacy evolved to match the need to successfully apply VM to other applications such as the service industry, organizational development, and management procedures.

All these important changes, experiences, and improvements have forged a set of best practices around the Value Methodology, recorded separately in SAVE International Value Summit papers or in independently authored books. SAVE International's Executive Committee decided to gather, organize, and document all the most relevant experience and best practices into a new document, the Value Methodology Guide (VM Guide®). It represents the core knowledge that individuals aspiring to achieve certification as a Value Methodology Associate (VMA) or Certified Value Specialist® (CVS®) need to know to qualify. In addition, the VM Guide® is rich with guidance and examples that will serve as an excellent reference for new practitioners and as a resource for seasoned value practitioners to refresh their skills and/or maintain their continuing education requirements to recertify.

The development of the VM Guide® was also inspired by recent changes in the SAVE International® certification process, the associated development of core competencies required to become certified by SAVE International®, and the absence of a single source to which one may refer while preparing for professional certification. Multiple publications currently exist, like the Function Analysis Guide (SAVE, 2016) and the Value

Methodology Memory Jogger, Second Edition (GOAL/QPC, 2018). These publications will be revised to align with the VM Guide® that, going forward, represents the standard terminology and practice to be used when teaching and applying VM.

The VM Guide® is a SAVE International® publication, authored by members of SAVE, the Lawrence D. Miles Value Foundation, and related VM organizations representing Canada, Germany, Hungary, Japan, Mexico, and the United States. The primary authors are Certified Value Specialists® with decades of experience applying the Value Methodology to projects, products, processes, services, and organizations. The content of the VM Guide® was shared with the membership of SAVE International for their review and feedback before the publication was finalized through multiple VM Guide® Chapter Review Committees. Dozens of VM practitioners and program managers from around the world contributed to this book.

As previously stated, the VM Guide® is focused on identifying information covering the theory, guidance, process, and techniques that a SAVE International® Certified Value Specialist® (CVS®) should know. It is neither possible nor practical to attempt to include all the knowledge available around the Value Methodology. Therefore, the VM Guide® does not include all VM techniques available: it is important to honor the history of VM while respecting the need to evolve.

A key task of the VM Guide® development process was to ensure that the information included represents state-of-the-art practice and is inclusive of different areas of application. Techniques that are not covered in the VM Guide® are still valid; however, the SAVE International® professional certification process does not include them. Therefore, the VM Guide® includes references and links to additional sources for information discussed, and readers are encouraged to use outside sources to further hone their skills in specific areas of interest; e.g., creativity techniques, evaluation methods, facilitation skills, etc. Finally, a significant effort was made to present the information in a generic manner that is not industry-specific, so it can be easily applied to projects, products, processes, services, and organizations.

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1
Introduction

1.0 Overview and purpose of this Guide

The VM Guide® is intended to form a basis for the knowledge value practitioners need as they learn the Value Methodology (VM), prepare for a VM certification exam, and to serve as a minimum level protocol for CVS® practice throughout their career. The Guide has been organized to convey the WHO, WHAT, WHY, and WHEN of VM – and is presented in three major components:

- Core terms, concepts, processes, and activities of the methodology.
- Applications illustrating how the VM process (known as the VM Job Plan) and related techniques are executed relative to projects, products, processes, services, and organizations (collectively referred to as the "subject" of a VM study).
- Additional resources and templates to provide a basic foundation for applying core techniques in a standardized way. Note that these examples and forms are not intended to be "required" by practitioners in the performance of actual VM studies.

It is important for readers to appreciate that VM is a systematic process and not a "collection of standalone tools." Each phase of the VM Job Plan builds on the previous phases. As the VM Guide® presents the overall, decades-proven Value Methodology, this concept of "system" is organized in focused chapters threaded together to identify coherent professional practice. Each chapter includes specific terms and definitions applicable to the chapter content. In addition, a complete Glossary of Terms is included at the end of the VM Guide®.

1.1 Foundational concepts

The foundational concepts of VM date back to the 1940s, when Lawrence D. Miles, the "Father of Value Analysis" (as he originally called it), worked for the General Electric Company in Schenectady, New York. Tasked with providing increasingly difficult-to-find materials and parts required for the military during World War II, Miles began looking for ways to provide the function required, as opposed to the specific piece or part requested. Many of these "substitutes" performed as well as, if not better than, the originally requested items and, in some cases, for less cost. This was the birth of function analysis, as we know it today, and remains the single most important distinction of VM.

The VM Job Plan is defined in Miles' Techniques of Value Analysis and Engineering, (3rd Edition, 1989), as the "problem-solving system." Since the inception of the "value method," many people have written books, taught courses, delivered presentations, and facilitated teams through tens of thousands of VM studies and training courses. And through that time, the problem-solving system—the VM Job Plan—remained intact. It is a logical, sequential approach to analyze a subject, whether it be a project, product, process, service or organization.

1.1.1 Value

Since its creation in the late 1940s, the Value Methodology described in this Guide has received different names, like value engineering or value analysis. Nevertheless, the word "value" is always there. To really understand the power of this methodology, the VM practitioner must grasp the essence of value.

It is not uncommon to find analysts or decision-makers using the word "value" interchangeably with "price" or "cost"; this common misunderstanding may lead to the wrong decision being made, cutting corners, and cheapening the project. This misconception has also led many practitioners to refer to any cost reduction activity as "value engineering," a very risky mistake.

When Larry Miles stated his famous axiom "All cost is for function," he was stating that value is first established by the user's (or customer's) needs and wants. Chapter 2 describes in detail how the concept of value cares for both the customer's needs and the organization's interests in better using the available resources to satisfy these needs. Chapter 2 also focuses on the idea of a function as the means to describe the customer's needs and wants which will be detailed in a manner to broaden the understanding of the problem or opportunity in such a way that it drives the generation of creative alternatives.

1.1.2 Function

The thorough analysis of expected and achieved functions is the most important element that makes the Value Methodology unique among so many problem-solving methods. "Function" is the element of value that focuses on achieving the customer's needs while broadening the mind of the team performing the VM study. As explained later in this VM Guide®, VM defines a "function" as a non-specific abstraction, consisting of an action verb and a measurable noun, that describes what an element of a project, product, process, service, or organization does or should do. In other words, VM acknowledges that customers never buy things, but the function (or result) they receive from those things. Chapter 6 describes the process to perform a complete analysis of functions that will be used to later generate alternative solutions to the problem that could not easily be found with traditional, "object-oriented" (instead of function-oriented) approaches.

1.1.3 The Value Methodology

The Value Methodology (VM) is a systematic process used by a multidisciplinary team, led by a qualified VM Facilitator, to improve the value of a project, product, process, service, or organization through the analysis of functions. The formal VM process includes eight distinct phases referred to collectively as the VM Job Plan. Depending who uses this standardized approach, the same methodology has been called other names such as value engineering, value analysis, and value management, as stated in the SAVE International Value Methodology (VM) Standard (see Appendix C – VM Standard). All three of these terms represent the application of the Value Methodology in either different moments of the life cycle of the subject under study or in different application scenarios within an organization.

1.1.4 Divergent and convergent thinking

As previously described in 1.1.2, the fact that the team focuses on a generic description of what the customer needs (the function) requires the VM team to reframe the subject under study as a statement of purpose or intent. The Value Methodology improves the problem framing process, which is the process of describing and interpreting a problem to arrive at a problem statement. Problem framing is an important step in problem solving, as slight changes in framing a problem may lead to a vastly different problem-solving process and the resulting solutions.

This change in framing problems is essential to changing the way we think about possible solutions. Figure 1.1 describes the difference between traditional problem framing (which is object-oriented), and the Value Methodology problem framing (which is function-oriented). By using generic descriptions of the customer needs, using the function rules described in Chapter 6, the team approaches the problem with a very different and divergent mindset that leads to a more innovative set of solutions. Also, Chapter 3 describes how the standard VM Job Plan starts with divergent thinking until innovative ideas are generated, and later uses convergent thinking in the evaluation and development of those ideas into implementable proposals.

1.1.5 Teamwork

One of the foundational concepts of the Value Methodology states that a multidisciplinary team is responsible to improve the value of a project, product, process, service, or organization through the analysis of functions. Teams assembled for VM studies are normally shaped as a task force, which implies the formation of a requisite group of subject matter experts who bring together a specific set of skills and disciplines to accomplish a specific goal. Team members may come from different areas within the same organization or outside it, such as clients, designers, or any other stakeholders who will bring the required set of knowledge expected to achieve the desired results.

1.1.6 VM facilitator

In every VM study, team members are the experts providing the right set of skills and knowledge to the goal of the study. Although it is beneficial if they understand VM, they are not necessarily expected to be knowledgeable about the VM process; that is the role of the VM facilitator. The VM facilitator is the one who will guide the work of the group to accomplish its goals. The facilitator will plan, lead, and facilitate the VM study, and is expected to have the skills and experience described later in this guide. Chapter 12 provides the common VM guidelines and best practices for VM facilitators.

1.2 Application areas

The Value Methodology may be applied to anything that performs a function. Applications encompass construction, product design and manufacturing, supplies, transportation, health care, government, environmental engineering, business processes, and service industries. Organizations that use the

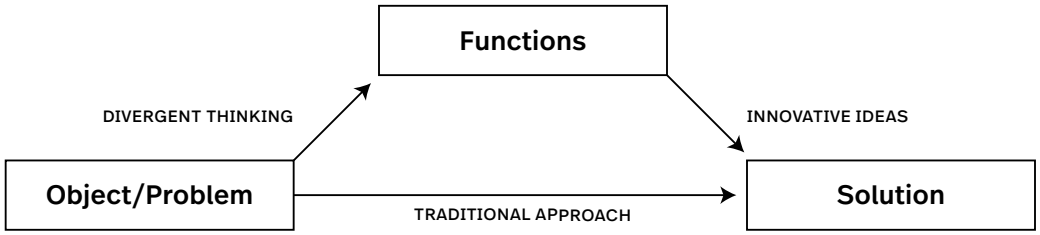

Figure 1.1 – How VM uses functions to generate divergent thinking, reframing the problem.

Value Methodology span both private and public sectors and include federal, state, and municipal agencies.

While the types of information and team structure vary, depending upon the VM study subject, the VM Job Plan is applied in the same sequential order in all cases.

VM helps to find solutions for all kinds of challenges. Because VM is, by design, a multidisciplinary, multicriteria method that looks at both value and costs, it can solve problems and produce solutions that can easily be implemented. By looking for the function, VM takes you away from a monodisciplinary approach and opens a fresh perspective on the challenge at hand. The language (verb and noun) and the method allow people with totally different backgrounds, disciplines, and interests to work together and find common ground and "out of the box" solutions.

1.3 History and evolution

As previously noted, the Value Methodology was developed during the World War II era, from 1939 to 1945, by Lawrence Delos Miles during his employment with General Electric Company. Miles was repeatedly tasked with securing materials, parts, and systems desperately needed for the military, and consistently succeeded – despite overextended suppliers – in supplying those needs by analyzing what functions they were required to perform.

In 1944, Miles transferred to Locke Insulator, a subsidiary of General Electric, in Baltimore, Maryland. As Manager of Purchasing there, he was responsible for delivery and cost of millions of dollars' worth of materials and products per year. He developed patterns of engineering, laboratory, and purchasing teamwork that limited costs and improved products. He learned both the productive and destructive force of human attitudes and practices, and their effects on appropriate designs and appropriate costs. His thinking increasingly turned to "What function am I buying?" rather than "What material am I buying?"

In 1947, Miles returned to GE in Schenectady to lead what was named the Purchasing Department Cost Reduction Section. He researched and developed workable techniques that would secure more cost-effective achievements by the decision-making employees in a plant or business. The new function-based approach was introduced to GE's Vice President of Engineering who said, "This is the best method I have seen to get competitive costs and retain quality. What are you going to call it? Proper quality at proper costs equals value. Why not call it value analysis?" From that point, Miles was tasked with training 1,000 people per year. He used people and products from different plants, applied the techniques, and showed them how they could increase earnings and maintain competitive positions. Training sometimes exceeded the annual target of 1,000 people, and during the four years from 1948 to 1952, $10 million in savings were reported. In 1950, GE gave Miles its highest award, the Coffin Award (named for and given in honor of their first president), with the citation:

> "In recognition of his outstanding accomplishment through the establishment, organization, and development of a Value Analysis Program, which has resulted in substantial cost reductions."

In 1954, the U.S. Navy Bureau of Ships implemented the first federal government VM program with assistance from Miles and his staff. It was there that the name "value engineering" took hold. Nine years later in 1963, the Department of Defense (DoD) established specific requirements for a formal program within the three military services. This included design and construction activities, as well as suppliers, and mandated incentive-sharing clauses in construction contracts. Contractors were permitted to propose value engineering changes (value engineering change proposals or VECP) and share in net savings. The high level of success achieved by the DoD led to great expansion over the next 15 years. This included agencies such as General Services Administration, Environmental Protection Agency, U.S. Forest Service, Veterans' Administration, Federal Highway Administration, and the Department of the Interior. Today, every federal agency with a significant construction or purchasing program employs VM in some form. Most state Departments of Transportation employ VM, as do many municipalities throughout the U.S. and Canada.

Today, the terms "value engineering," "value analysis," and "value management" are often used interchangeably. However, in some environments, they are distinguished differently. For example, the California Department of Transportation has a value analysis program, while the Federal Highway Administration has a value engineering program. The City of New York, Office of Management and Budget, having had a highly successful program since 1982, designates value engineering when the methodology is applied to construction projects, and value analysis for application to business process improvement studies. In the manufacturing sector, value engineering is performed on a project in development, whereas value analysis occurs after the product is designed and produced. When the General Services Administration started a program in the 1970s, they called it value management.

The term "value methodology" encompasses all these nuances as an umbrella term that represents that the true Value Methodology –– the Job Plan as we know it –– is employed, without regard for the setting in which it's used.

1.4 VM Organizations

1.4.1 SAVE International®

SAVE International® (SAVE) is the premier, international, professional association devoted to advancing and promoting the Value Methodology. The association provides its members education and training, publications, certification, promotional tools, networking, and recognition.

SAVE operates a certification program which is globally recognized as the industry standard for competence in the application of the Value Methodology. The annual Value Summit

is SAVE's major event and typically attended by delegates from every continent.

SAVE members are trained and certified in the practice of the VM in more than 35 countries. Originally founded in 1959 as the Society of American Value Engineers (SAVE), the society officially changed its name to SAVE International® in 1996. Find more information about SAVE online at www.value-eng.org. The name "SAVE International" became a registered trademark in 2012.

1.4.2 Miles Value Foundation

The Lawrence D. Miles Value Foundation (MVF) is a charitable foundation created, in 1977, to promote and fund the development of educational programs, new applications, and a research library for the study of the Value Methodology.

The MVF accomplishes its mission by:

1. Promoting public awareness of the Value Methodology through publications, multimedia programs, and technology transfer programs
2. Offering practical and innovative applications of VM in business and government
3. Developing and teaching courses in the value principles and methodology at the undergraduate, graduate, and postgraduate levels
4. Encouraging professionals and students to undertake research and development of value-related applications and programs through scholarships and grants programs.

Find more information on the MVF online at valuefoundation.org.

1.4.3 Other Value Methodology organizations

With the spread of the Value Methodology came the formation of VM organizations throughout the world. Several of those organizations are SAVE International affiliates and operate the SAVE Certification Program in their countries and in their native languages. Those include:

- Society of Japanese Value Engineering (SJVE) (www.sjve.org)
- Indian Value Engineering Society (INVEST) (www.invest-in.org)
- Society of Korean Value Methodology (SKVM)
- Society of Hungarian Value Analysts (SHVA) (www.shva.hu)
- Value Management Institute of Taiwan (VMIT) (www.vmit.org)

Additional professional organizations with which SAVE often collaborates include:

- Dutch Association of Cost Engineers (DACE), Netherlands (www.dace.nl)
- Hong Kong Institute of Value Management (HKIVM) (hkivm.org)
- Value Analysis Canada (VAC) (www.valueanalysis.ca)
- Value Engineering Society of China (VESC) (www.vesc.org.cn)

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2
The Value Concept

2.0 Introduction

The function of the Value Methodology is to improve value. This chapter explores the history, theory, elements, and approaches to measuring value.

2.1 Terms and definitions

2.1.1 Cost-benefit analysis (CBA)

A method used to ascertain the soundness of any investment opportunity and provide a basis for making comparisons with other such proposals. All the positives and negatives of the VM study subject are first quantified in monetary terms and then adjusted for their time-value to obtain correct estimates for conducting a CBA.

2.1.2 Cost, initial

The expenditure of all the resources needed to design, deliver, produce, or establish a project, product, process, service, or organization. Cost has different dimensions that can be measured by factors such as materials, labor, equipment, time, risk, etc. and be quantified in currency. Cost should not be confused with "price," which is the amount of money exchanged or set as consideration for the sale of something. Initial cost is also frequently referred to as "capital cost."

2.1.3 Cost, life-cycle (LCC)

The sum of all recurring and one-time (non-recurring) costs over the full lifespan or a specified period of a project, product, process, service, or organization. It includes the initial costs, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life, including salvage or decommissioning costs.

2.1.4 Customer

A person or an organization that purchases a product or service. The customer plays a critical role, if not the most important, in determining value. In some cases, the customer may also be a user.

2.1.5 Efficiency

The ratio of useful output to total input. Efficiency refers to very different inputs and outputs, depending on specific fields and industries.

2.1.6 Expected value

A quantitative measure of value expressed by multiplying an anticipated outcome by the probability of its occurrence.

2.1.7 Performance

The extent to which a project, product, process, service, or organization achieves its intended function(s). Performance can be measured quantitatively or qualitatively, the measurement of which answers the question of how well the function(s) is(are) being performed.

2.1.8 Productivity

The rate of output per unit of input; usually for a production process, however it is used also for construction activities.

2.1.9 Quality

A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1) the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2) a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use"; according to Philip Crosby, it means "conformance to requirements."

2.1.10 Resource

All inputs of cost, time, energy, space, materials, labor, etc. required to accomplish a function.

2.1.11 Risk

An uncertain event that could have an impact on the cost, schedule, or performance of a project, product, process, service, or organization. Risks can either be positive (opportunities) or negative (threats). The Value Methodology must consider the impact of risks to value.

2.1.12 Schedule

A procedural plan indicating the time, duration, and sequence of activities or operations. Schedule may be considered as an input (a resource) or an aspect of performance, depending upon the context of the project, product, process, service, or organization.

2.1.13 Stakeholder

An individual, group, or organization who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of the project (i.e., VM study).

2.1.14 Time

The measured or measurable period during which an action, process, or condition happens. Time, as an element of value, may be considered as an input (resources) as well as an output. For example, time may be considered as an input when considering the delivery of a project and as an output when experiencing a service such as a massage.

2.1.15 User

A person or entity that utilizes or receives the results of the project, product, process, or service, or is a member of an organization.

2.1.16 Utility

An economic concept that is used to quantify the usefulness of, or level of, satisfaction derived from a thing. Utility is closely related to the concepts of performance and quality.

2.1.17 Value

An expression of the relationship between the performance of functions relative to the resources required to realize them. This can be expressed as *Value = (Function Performance)/Resources*.

2.1.18 Voice of the customer

A process and/or method of eliciting the preferences and requirements of customers and users relative to value.

2.2 Development of the value concept

The history of the value concept is long. From the dawn of civilization, the idea of value has engaged scholars, philosophers, mathematicians, economists, and psychologists. This section is intended to provide some historical context to the thinking behind the value concept while illustrating the importance of concepts such as utility, cost, performance, time, uncertainty, and human perception in considering value. Refer to Appendix B for additional information on the historical and cultural perspectives on value.

In 1947, Lawrence D. Miles established the concept of value as a technical field of study. In 1961, he published Techniques of Value Analysis and Engineering, which presented the concept of function as an integral part of value.

Miles defined value in terms of the relationship between function and cost. This was eloquently stated in his axiom, "All cost is for function." Of equal importance, he stressed that value is established by the user's–or the customer's–needs and wants.

Miles stated that a product or service is considered to have good value only if it has appropriate performance and cost. He also made the following observations:

- Value is always increased by decreasing costs (while, of course, maintaining performance).
- Value is increased by increasing performance if the customer needs, wants, and is willing to pay for more performance.

It follows that there are other ways to improve value. One way is to increase performance while increasing costs, such that the improvement in performance is greater than the increase in cost. Another way is to decrease performance while decreasing costs, such that the decrease in cost is greater than the decrease in performance while still delivering the functions and minimal performance needed by the customer.

2.3 Who determines value?

As described above, value is frequently extrinsic and depends upon the individual's point of view. Seldom is value singular in nature and it usually involves many perspectives. To improve value, it is important to consider who determines value.

2.3.1 Customers

The customer ultimately makes buying decisions and is frequently also a user. The concept of customer value is based on the idea that people make rational buying decisions based upon the relationship between the total cost of ownership and performance. The primary principle in this decision is overall value; or, simply said, is the customer getting the most for their money?

It is important to remember that customers closely relate value directly to the function or functions that they are trying to acquire. Understanding what customers value is important because it can help us better understand how people choose among competing suppliers of goods and services. This approach, which ties into traditional marketing disciplines, can help lead organizations to search for the answers to several important customer value questions such as:

- What are the key buying factors that customers value when they choose between a business and its most closely related competitors?
- How do functions support customer "wants and needs"?
- How do customers correlate an organization's performance compared with its competitors for each key buying factor?
- What is the relative importance of each of these components of customer value?

Often the view from the marketplace differs from the organization's internally developed perception of customer values. It is important that those seeking to apply VM appreciate the importance of understanding the wants and needs of its cus-

tomers in improving value. Ultimately, the success of an organization depends on how well it satisfies the needs and wants of its customers.

The key criterion in measuring this is value. The Value Methodology, as described in the chapters that follow, will provide the reader with a means of creating and improving value for the projects, processes, products, services, or facilities an organization provides. There are numerous techniques that can be employed to capture and understand the customer preferences.

Voice of the customer (VOC) is a process used to capture the requirements/feedback from the customer and/or user (internal or external) to provide information regarding the level of performance and quality they desire. These are presented in Chapter 5, Information Phase.

An organization must strive to hear its intended customers or end users if it desires to succeed. Once the organization has accomplished this first step, it will be in a better position to:

- Understand what customers and users value from its projects, products, processes, services, and organizations.
- Measure value and communicate it to customers and users.
- Prioritize what a customer wants as value and deliver it.
- Retain existing customers (the cost of finding a new one is typically 5 to 10 times that of serving an existing customer).
- Convert unknown customers to known ones.
- Create a competitive advantage through the development of a customer-focused organization.
- Manage changes in customer expectations and optimize processes to keep delivering optimum value.

Measuring customer's value is dynamic throughout a project, process, product, service, or organization. Periodic reassessment of value should occur to account for changes over time.

2.3.2 Users

Users may or may not also be customers. For example, someone who purchases an automobile is a customer and will likely also be a user. The same person's family and friends who ride in the vehicle would be users. A lease company may purchase the automobile, but the individuals (its customers) that drive it are users.

Users must be considered as key stakeholders. Their experience with the project, product, process, service, or organization will influence the behavior of future customers and other users in determining its value. Sometimes, customers do not adequately consider the preferences and perceptions of users. This occurs when the customer is disconnected from the user. This disconnection is common for public projects where the user is "the public" and the customer is the agency sponsoring the project. Organizations should seek to solicit input from users whenever possible. Users should be considered for inclusion on VM study teams.

2.3.3 Stakeholders

Stakeholders represent those who have an interest in the project, product, process, service, or organization. For example, a salesperson or family member is a stakeholder in a customer buying an automobile. They have an interest in influencing the buying decision, but do not ultimately make the final decision.

Construction projects often have many stakeholders. For example, stakeholders having an interest in a highway project might include regulatory agencies, community groups, utility companies, property owners, and the public, in addition to the designers, consultants, contractors, subcontractors, etc.

Manufactured products stakeholders consist of designers, manufacturing engineers and operators, finance, sales and marketing personnel, and service people, etc.

It should be noted that stakeholders have three different views: those who support the activity, those who are neutral, and those who oppose the activity. Failing to identify all the stakeholders in the beginning can lead to serious implications for the project, product, process, service, or organization.

There are many tools and techniques related to identifying and managing stakeholders. VM Facilitators should seek to identify them and understand their interests, as they can significantly influence value decisions.

2.3.4 Design, project, product, development, or delivery team

Those involved in conceiving, designing, producing, or otherwise delivering a project, product, process, or service have significant influence on value. This group of people owns the responsibility to interpret the needs of customers, users, stakeholders, and decision makers and transform them into something of value that addresses those needs. In order to deliver value to customers and users, they must synthesize these external values with their own perceptions of them. Design teams that do not fully hear the voices of customers and stakeholders will likely fall short of fully delivering value.

2.3.5 Decision makers

Decision makers, as key stakeholders, play an active role in determining value and may, or may not, occupy any of the other roles described above. It is important to understand who has decision making authority relative to value judgments. Customers are natural decision makers when they purchase a product or service. CEOs may make decisions about what to produce or how to price their products. A spouse could influence the decision of what clothing is purchased for their partner. Understanding what motivates decision makers is important in considering value.

2.3.6 VM team

The VM study team should seek to solicit and understand the different value perspectives of the groups identified above, as each influences its own perception of value. This may be a challenging and time-consuming activity, but it is essential if the VM study team is to improve value.

2.4 Reasons for poor value

There are many reasons why optimal value is not always achieved. The Value Methodology is a proven approach to identify these problems and provide solutions that improve value. While there are countless possibilities, some of the most common reasons include:

- Lack of information
- Fixation with standard solutions
- Poor communication
- Misconceptions and wrong beliefs
- Rigid adherence to standards
- Habits and attitudes
- Indecision, and
- Fear of failure

2.4.1 Lack of information

A basic lack of information can lead to poor value. People are not all-knowing, and seldom is all relevant information available. Also, uncertainty arises from gaps in information. For example, a project in the planning phase is likely to hold a high degree of uncertainty due to the lack of scope definition and technical information available at such an early stage of development.

Making value judgments with imperfect information is an everyday fact of life. Examples where a lack of information could negatively impact value include:

- A bridge project has identified specific locations to locate the foundations; however, no geotechnical information is obtained characterizing the soils. This lack of subsurface information could potentially degrade the project value if poor soils are discovered during construction, which increases costs to mitigate and delays the project. This uncertainty; however, is reducible through additional geotechnical investigations.
- A consumer sees a pair of shoes on sale at a store. The customer purchases the shoes, ignorant of the fact that the same product is available at the store down the street at a 20 percent lower price. Had the customer engaged in market research, a better, higher value buying decision would have been made.
- A company's hiring process only searches for candidates in a specific locale. Limiting the geographic range reduces the pool of potential candidates by not considering potential applicants amenable to relocating to the company's location, missing out on highly qualified individuals.

Today's good information often becomes tomorrow's bad information. Conditions can change quickly and without our knowledge, as was the case in the preceding examples. In this respect, an accurate assessment of value is only as accurate as the information upon which it is based.

All projects generally begin with several basic assumptions. Too often as a project progresses, these assumptions become "criteria" or "requirements" if not challenged and either verified or changed. Value studies provide a structured way to question original assumptions, identify their cost and performance impacts, and replace or challenge them with facts. The greatest source of incomplete information or ignorance comes from not fully understanding the customer's needs.

2.4.2 Fixation with "standard" solutions

Humans have a natural tendency to resist change, especially in relation to longtime solutions that appear to be working just fine. We are all familiar with the mantra, "If it's not broken, don't fix it." While there is an undeniable common sense to this phrase, "we should not let it dull our creativity, nor our desire to find a better solution."

Noted American geologist Thomas C. Chamberlin (1843–1928) addressed this concept as it applies to the application of the scientific method. He observed that a strong tendency among scientists and researchers, in their desire to reach an interpretation or explanation, that commonly led them to a tentative interpretation based on an initial examination of a single example or case. He realized that this tentative explanation, as such, did not threaten objectivity; but, if it began to be trusted without further testing, it could blind us to other possibilities that were ignored at first glance. This premature explanation becomes a tentative theory and then a ruling theory, and, subsequently, our research becomes focused on proving the ruling theory. The result is a blindness to evidence that disproves the ruling theory or supports an alternate explanation. Only if the original, tentative hypothesis was by chance correct does our research lead to any meaningful contribution to knowledge.

Through these observations, Chamberlin developed the method of multiple working hypotheses, which involves the development, prior to research, of several hypotheses that might explain the phenomenon to be studied. Many of these hypotheses will be contradictory, so that some, if not all, will prove to be false. However, the development of multiple hypotheses prior to beginning research lets us avoid the trap of the ruling hypothesis and makes it more likely that our research will lead to meaningful results. Through this approach, all possible explanations of the phenomenon to be studied can be considered with open minds, including the possibility that none of the explanations or solutions is viable and the possibility that a new explanation may emerge. One tool to perform this analysis is a support/refute matrix.

As in the case of the first example, "If it's not broken, don't fix it," Chamberlin's observations are quite relevant. Generally, we have a fixation with the existing solution or standard way of doing things. This can inhibit the potential for value improvement.

The VM process helps to address this issue, as alternatives that challenge the status quo are free to be developed. The benefits and risks associated with the change are quantified for the decision-makers. Often the risk associated with not changing becomes the compelling rationale for action.

2.4.3 Poor communication

Most projects, especially those dealing with facilities and management processes, involve multiple stakeholders. Nowhere is this more evident than within public organizations where there are typically several regional and local government entities, regulatory agencies, special interests, and citizen groups involved in the project development process. These stakeholders often hold radically different views about the importance of a project's objectives. Typically, the dominant stakeholder (usually the project's "owner") places their objectives ahead of all others, which are often not aligned with the customer's or user's. This bias often leads to the development of a project scope that does not optimize value for all stakeholders.

Related to this phenomenon is the type of one-way communication structure still pervasive in most organizations. In a one-way communication structure, information primarily flows from the top down. This is especially true of most public and many corporate structures that are functional or departmental in nature.

Under this structure, most communication passes in one direction, from the upper echelons of management down through the established hierarchy. Just like in an army, where the one-way communication structure is common, this model makes it easier to maintain control over the organization in meeting objectives, especially in very large organizations. However, there are only limited opportunities for communication back up the chain and, as a result, there is a high probability that the information received by the lower tiers will be misunderstood or misinterpreted. Further, this model tends to stifle constructive criticism and feedback (i.e., it has a chilling effect), which are essential to innovation and improvement.

VM utilizes a cross-functional, team-based organizational structure. One of the primary strengths of this structure is that it utilizes a completely different communication model, which is multidirectional. In a multidirectional communication model, information flows freely among all participants. This is much more conducive to innovation and improvement.

For this structure to be effective, a skilled, objective VM facilitator must provide direction and structure while also encouraging the free flow of information.

The application of VM within the context of a VM study is an intense, focused effort in which members of the VM study team, project team, the project owner, and user representatives come together in the same room as a single team possessing a single goal: to improve project value. Additionally, the VM techniques applied at each step of the VM Job Plan gather, organize, and develop information regarding the project; draw meaningful conclusions from the project information through the application of function analysis; and, foster direct communication between team members through a consensus-driven approach.

2.4.4 Misconceptions and wrong beliefs

Misconceptions and honest, wrong beliefs that result from mental conditioning as does the ready acceptance of opinion, rumor, and speculation without justification or verification. They result from the longtime propagation of many of the other poor reasons for value cited here. There is a certain mythology that has arisen in modern society to which we all tend to subscribe. In his bestselling book Freakonomics (2005), author Steven Levitt identifies many underlying economic principles which he discusses at length. Two of them support the notion of honest, wrong beliefs. These are:

- **Conventional wisdom is often wrong.** It is a commonly held belief in the United States that money wins elections. One need only look at the 2008 presidential election to confirm this, right? The Obama campaign significantly outspent the McCain campaign, and guess who won? We often see correlations where we want to see them; however, it doesn't mean they are correct. Based on an analysis of data presented in Freakonomics, a winning candidate can cut their spending by 50 percent and lose only 1 percent of the vote, while a losing candidate who doubles their spending can similarly expect to pick up 1 percent more votes.

- **Experts use their informational advantage to serve their own agenda.** Here, Levitt shows how experts can easily exploit our trust and lead us to believe they are working for us rather than themselves. Real estate agents typically work for a commission of the total sale of a property. It stands to reason that their interests are in line with their clients–the higher an agent can sell a client's property, the more money they will both make. However, as Levitt shows, the data paints a very different picture. The average realtor makes 3 percent more on the sale of their own homes than they do for everyone else. That's $9,000 more on the sale of a $300,000 house! Why don't the rest of us get the same value from their services?

The application of VM facilitates challenging such beliefs with current facts and helps to dispel honest wrong beliefs by developing alternatives that would otherwise be dismissed without analysis and quantification of the benefits in the current environment. Through VM's focus on the user, misconceptions such as those identified above can be revealed and strategies developed to address them.

2.4.5 Rigid adherence to standards

In today's world, technological change is an accepted part of life. Despite this, organizations are still prone to maintaining outdated standards or relying on aging technology. Much of this resistance is rooted in a belief that new technologies are unproven and inherently flawed. With this line of thinking, individuals and organizations can quickly fall behind their competitors. One such example is provided below.

A VM study was performed on a project by a state department of transportation. During the Function Analysis Phase, the function "Improve Sightline" was identified as describing one of the major project elements involved regarding the current design concept. To achieve this function, the grade of an existing highway was going to be lowered to allow motorists to see over the crest of a gentle hill. The cost to do this was estimated in the tens of millions of dollars while creating significant disruptions to existing traffic and requiring extended detours.

During the Creative Phase of the VM Job Plan, one of the ideas the VM study team developed was to adopt a different design standard. In fact, such a standard had been recently adopted by the American Association of State Highway and Transportation Officials (AASHTO), which resulted in the elimination of this work. The state had not yet adopted this standard but was in the process of doing so. The change in question was driven by the manner in which driver sight lines were calculated. Due to the higher volumes of SUVs and light trucks taking to the streets, average driver sat significantly higher above the roadway than their counterparts from previous decades. This lag in the adoption of new standards nearly cost taxpayers millions of dollars and thousands of hours in traffic delays.

Value studies initiated by an organization are conducted under the premise that innovation is necessary in order to improve value. Considering this: VM provides an excellent vehicle for presenting the ideas and technologies of tomorrow, and challenging yesterday's standards, within an environment that is conducive to introspection and thoughtful consideration.

2.4.6 Habits and attitudes

Individuals develop habits and attitudes over a lifetime. This ingrained form of behavior can lead to an appalling degree of ignorance with respect to making decisions that lead to good value. We all possess many layers of habits and attitudes related to culture, religion, profession, and lifestyle. While many of our habits and attitudes are quite positive, they can also create blind spots with respect to our ability to make value decisions in the workplace. Companies often get into trouble when the motivation for profit, which is ingrained in corporate culture, takes control.

Habits and attitudes represent the greatest obstacle to achieving good value. Habitual thinking can be extremely difficult to overcome. If you repeatedly ask somebody, "Why do you do it that way?" usually by the third time, they will respond, "Because that's the way I've always done it." This type of response comes up even sooner if asked in the workplace. People perform tasks all the time without really thinking about them or knowing why they are doing them. If they stopped to ask things like "Why are we filing these reports?" or "Why do accounting and purchasing both need to approve this requisition?" they might find that the answer is "You don't need to." What follows are all good examples of habits and attitudes influencing behavior in the workplace:

- We did it that way on our last job.
- It deviates from standard procedures.
- We've never done that before.
- It will set a precedent.
- It's too risky.
- Management won't like it.
- It hasn't been tested.
- It doesn't agree with company policy.
- Headquarters will never approve it.

The responses identified above represent obstacles to change based upon habitual ways of doing things. It is important to recognize these for what they are and not to let them get in the way of innovation. Remember, habits are a necessary part of our life; however, their very nature is thoughtless. The best way to overcome habitual thinking is to make people aware of what they are saying and then get them to think critically about it. People are usually not even aware that their habitual responses are rooted so deeply. Once the roots are exposed for what they are, people are more apt to accept changes.

2.4.7 Indecision

Decision making isn't always easy, especially in the face of multiple variables and uncertainty. It is human nature to delay challenging decisions for a variety of reasons. These may include:

- **Accountability:** Perhaps the decision makers wish to avoid accountability for their decisions. This is a common phenomenon in politics that allows politicians to avoid the disfavor of constituents by not choosing a position.
- **Insecurity:** In some cases, decision makers may be unsure of what to do. They delay making decisions in order to avoid making a poor choice.
- **Perfection:** Sometimes people avoid making decisions because they are seeking the "perfect" solution. The reality is that perfection is seldom achievable, and the perfect choice today may be an imperfect one tomorrow.
- **Guilt:** All decisions have consequences, both positive and negative. The negative consequences of decisions often have emotional strings attached to them. One of these is guilt, which can be a powerful influence in delaying decisions that make us feel uncomfortable.

2.4.8 Fear of failure

The fear of failure is a significant factor in diminishing value. Fear of failure is closely related to fear of embarrassment, which may be an outcome of failure. It can cause us not to even try something.

Fear of failure is the intense worry that we experience when we imagine the bad things that might happen if we do not succeed. These negative feelings increase the odds of holding back or giving up.

Fear of failure is what causes people not to try; to push back on new ideas; and, to stay inside one's comfort zone. It is a very primal, and powerful phenomenon that must be managed. One of the best ways to deal with fear of failure is by providing evidence that an idea or approach can be successful. Fear is

rooted in uncertainty – of not knowing what will happen. Steps that can be taken to deal with fear of failure include:

- Thoroughly evaluate the advantages and disadvantages.
- Consider the probabilities and impacts of threats.
- Identify ways to manage the threats.
- Focus on good outcomes but do not become attached to them.
- Stay positive.
- Think of opportunities that lie out of the comfort zone.

VM should seek to identify and manage risks. Doing so will help reduce the chance that fear of failure will erode value.

2.5 Elements of value

There are several basic elements that provide a measure of value to the customer. These elements comprise performance, quality, perception, time, cost, and risk. They provide the basic building blocks from which all value emanates:

- **Performance.** Performance is defined as the capacity of a project, product, process, service or organization to fulfill its functional requirements. For example, a performance attribute for a sports car might be "speed" measured in kilometers per hour while for a hammer it might be "durability." Performance can be measured quantitatively or qualitatively. The level of desired performance should be determined by the customer or user.
- **Quality.** The American Society for Quality (ASQ) defines quality as "a subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1) the characteristics of a product or service that bear on its ability to satisfy a predetermined requirement or stated or implied needs; 2) a product or service free of deficiencies."In the first meaning, quality is synonymous with "performance" as described above. In the second meaning, quality is more about conformance to standards and/or specifications.
- **Perception.** Our perception of value can significantly influence our reality. Many psychological, cultural, and behavioral phenomena affect how we interpret value. For example, our perception of clothing fashions may change over time, based on cultural norms and the effects of advertising. The discipline of behavioral economics is concerned with identifying, studying, and quantifying the effect of cognitive bias on value judgments.
- **Time.** The customer requires acceptable delivery, usually at a specific place within a given period. The best projects, products, processes, or services are of no value if they cannot be provided to the customer in a timely fashion.
- **Cost.** Like the previous definition, costs include all the resources required to realize the subject. Cost includes the salaries/wages of the people and equipment that do the work, the materials they use, and all the other circumstances that require an expenditure of resources. Cost can consider initial as well as life-cycle costs.
- **Risk.** We can never be certain that things will go exactly according to plan. Therefore, the impact that uncertainty can have must be considered. Risks may be classified as either threats (negative risks) or as opportunities (positive risks). There can be many risks to a project, both known and unknown, that can affect one or all of the aforementioned elements. Risk often manifests itself as fear, whether it is fear of failure, embarrassment, or the unknown.

2.6 Value measurement

There are several different approaches to measuring value. The methods described below are all valid and have their uses. Some of these, such as Cost Benefit Analysis, are well established methods that are widely practiced and understood. It is not the intent of the VM Guide® to fully detail the nuances of these methods, but rather to point to them as recognized methods to measure value.

It is important when considering the measurement of value that the focus is on functions; in other words, what is the value of the desired functions?

Measurement makes value even more tangible and transparent. This can be unwanted in organizations driven by prestige or politics. On the other hand, it gives insights to where value can be improved.

2.6.1 Inputs and outputs

Several variations are used to measure value relative to the concept of inputs and outputs. These can be categorized under two basic approaches: efficiency and productivity.

Efficiency, as an expression of value, is one way to consider the relationship between inputs and outputs. For example, an efficiency ratio that considers expenses (E) relative to revenues (R) yields the following relationship:

$$Efficiency = \frac{Expenses}{Revenues}$$

For example, if expenses are $2,000 and revenue is $10,000, the efficiency ratio is 0.20 or 20% (20/100)–meaning that $0.20 is spent for every dollar earned in revenue. It should be acknowledged that this method is very cost-centric and may not adequately capture other dimensions of value. However, it is one possible way to consider value from the standpoint of efficiency. Caution should be used in applying this perspective, as it could lead an organization to efficiently produce products of poor value or even the wrong product.

Productivity is another expression of value that considers inputs and outputs. Labor productivity can be measured as a

ratio of the total output (goods or services) in dollars to the number of person-hours to produce the output. Labor productivity may also be measured as the ratio of total output to the number of workers used to produce the output.

$$Productivity = \frac{Outputs}{Inputs}$$

For example, assume a company generates $80,000 in goods in 1,500 hours. To calculate the labor productivity, 80,000 divided by 1,500 = $53 of revenue generated per hour of labor. Using the same example, if the labor was performed by 30 employees, then the net productivity per employee would be calculated by dividing 80,000 by 30, yielding a value of $2,666 in revenue per employee. This method considers outputs (measured in costs) relative to inputs (measured in terms of labor – either person hours or number of people).

Both methods are simplistic, but useful, in comparing the value of different options from the standpoint of inputs and outputs.

2.6.2 Costs and Benefits

One method of expressing value is to quantify the costs and benefits of a thing using a monetary unit for both (such as U.S. dollars or Japanese yen). This is typically expressed as a ratio. Using such a method, all the resources required to actualize the subject are compared to the benefits it delivers, which are expressed in currency equivalents to enable the calculation of the net cost or benefit. This method is popularly known as Cost-Benefit Analysis (CBA).

As a technique, CBA is used most often at the start of the development of a project, product, or process when different options or courses of action are being appraised and compared as options for choosing the best approach. It can also be used, however, to evaluate the overall impact of a program in quantifiable and monetized terms. Economists often use CBA to consider the value of social programs and major public investments. In these applications, it may be used to quantify value by assigning monetary equivalents to things such as mortality and carbon emissions. It must be acknowledged that while one may indeed assign monetary values to human life and climate change, the validity of such estimates is open to debate.

CBA adds up the total costs of a program or activity and compares it against its total benefits. The technique assumes that a monetary value can be placed on all the costs and benefits of the subject, including tangible and intangible returns to other people and organizations in addition to those immediately impacted. As such, a major advantage of CBA lies in forcing people to explicitly and systematically consider the various factors which should influence strategic choice.

$$Value = \frac{Benefits\ of\ Functions}{Costs}$$

Decisions are made through CBA by comparing the net present value (NPV) of the subject's costs with the net present value of its benefits. Decisions are based on whether there is a net benefit or cost to the approach; i.e., total benefits minus total costs. Costs and benefits that occur in the future may have less weight attached to them in a cost-benefit analysis. To account for this, it is necessary to "discount" or reduce the value of future costs or benefits to place them on par with costs and benefits incurred today. The "discount rate" will vary depending on the sector or industry, but public sector activity generally uses a discount rate of 5 – 6%. The sum of the discounted benefits of an option minus the sum of the discounted costs, all discounted to the same base date, is the "net present value" of the option. Many governmental agencies require CBA to be performed to justify the expenditure of taxpayer money on large public projects.

2.6.3 Performance and Resources

Another form of value measurement considers outputs in terms of a mixture of qualitative and quantitative factors (performance) relative to all inputs (resources). While like Cost-Benefit Analysis (CBA), it differs greatly in how it approaches the quantification of these factors. This more nuanced view of value allows for measurements that are not purely money- or time-based.

Performance describes the capacity of the subject to provide key customer or user functions. Resources describe the monetary costs, time required, labor, materials, etc. to produce the desired performance.

$$Value = \frac{Performance\ of\ Functions}{Resources}$$

Resources are quantitative by nature and can be readily measured in terms of monetary or time-based units. The measurement of performance can be more challenging and requires specialized methods, because performance can be expressed both qualitatively and quantitatively. Such methods, referred to collectively as Multi-Criteria Decision Analysis (MCDA) techniques, include, but are not limited to: The Analytic Hierarchy Process (AHP), the Analytic Network Process (ANP), and, the Hierarchical Decision Model (HDM). The application of these methods allows for decision makers to assign numeric values to performance criteria that reflect their preferences and priorities using mathematical algorithms to express total value. This approach eliminates the need to assign monetary values to qualitative criteria as is the case with CBA methods.

2.6.4 Expected value

Expected value seeks to incorporate the concept of uncertain-Expected value seeks to incorporate the concept of uncertainty and is defined as the predicted value of a variable, calculated as the sum of all possible values with each multiplied by the probability of its occurrence. In the practice of risk analysis, the expected cost value of a risk is calculated by multiplying the anticipated value of the outcome (also referred to as an

"impact"), expressed in monetary units, by the likelihood of occurrence, expressed as a percentage.

$$Expected\ Value = Outcome \times Probability$$

For example, if there is a 50 percent chance that a project will be $2,000 over budget, the expected value of the overage would be $1,000 = $2,000 x 0.5. It should be noted that the same formula applies to the expected value of time or schedule risk where units of time are used instead of money. There are more sophisticated articulations of expected value that consider multiple outcomes and include more complicated logic.

Expected value can be combined with some of the previously described methods for measuring value to consider risk and uncertainty.

2.7 References

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3
Value Methodology Job Plan

3.0 Introduction

The Value Methodology follows a sequence of phases, or steps, designed to lead a multidisciplinary team through a structured way of thinking. This process is referred to as the Value Methodology (VM) Job Plan. The VM Job Plan must be followed, from start to finish, to fully realize the benefits of value improvement.

The VM Job Plan includes the five original steps identified by Larry Miles in the same relative order, although some have been renamed to add clarity while other phases were added to expand its scope and enhance its effectiveness. The VM Job Plan now includes the following phases:

1. Preparation
2. Information
3. Function Analysis
4. Creativity
5. Evaluation
6. Development
7. Presentation
8. Implementation

The VM Guide® dedicates a section to each of the eight phases of the VM Job Plan, which provides additional information concerning the processes, activities, and basic techniques for each phase. A brief introduction to each phase, its primary objectives, and relevant considerations is provided in this chapter.

3.1 Terms and definitions

3.1.1 VM facilitator

One who is substantively neutral, has no significant decision-making authority, enables a group to improve how it defines and solves problems, and increases a group's effectiveness. In the context of VM, one who leads the group through the VM Job Plan.

3.1.2 VM Job Plan

A sequential approach for applying the Value Methodology, consisting of the following eight phases: 1) Preparation, 2) Information, 3) Function Analysis, 4) Creativity, 5) Evaluation, 6) Development, 7) Presentation, 8) Implementation.

3.1.3 VM proposal

A developed idea resulting from the application of the Value Methodology during a VM study to increase the value of a project, product, process, service, or organization. VM proposals may alternately be described as alternatives or recommendations.

3.1.4 VM study

A structured effort to improve the value of a project, product, process, service or organization through the application of the Value Methodology by a multidisciplinary team facilitated by one who is competent in VM techniques, ideally a Certified Value Specialist (CVS®).

3.1.5 VM study subject

The subject of the VM study can be anything for which there is a desire to explore opportunities for improvement. The Value Methodology is commonly applied to define new, or enhance existing, products, processes, projects, services, or organizations.

3.1.6 VM team

A multi-disciplined group of participants, led by a trained facilitator, that apply the value methodology to the subject of a VM study.

3.2 Evolution of the VM Job Plan

The VM Job Plan has evolved over time. To develop a better understanding of the VM approach, it is useful to first discuss the scientific method which is perhaps the most widely understood and applied approach to problem solving. The original development of the scientific method is largely attributed to Francis Bacon (1561–1626), a persuasive, seventeenth-century English statesman and philosopher, who argued that knowledge was gained only by gathering empirical data rigorously and logically refined into a single, essential conclusion. The scientific method consists of four distinct steps:

1. **Observation.** State the problem and research it. Observe a phenomenon or a group of phenomena and gather data.
2. **Hypothesis.** Formulate a hypothesis (or multiple working hypotheses) to explain the phenomena. In many fields of study, the hypothesis can often take the form of a causal mechanism or a mathematical relation, while in general problem-solving instances, a potential solution to the problem or a prediction of the expected outcome, is identified.
3. **Experimentation.** Perform experiments to test the predictions. In science, the use of numerous, independently reproduced experiments to verify and validate the original findings is generally required.
4. **Conclusion.** Draw conclusions from the experiments. Summarize the results of the experiments into meaningful conclusions relative to the original hypothesis.

The original VM Job Plan, as conceived by Miles, consisted of the following five steps:

1. **Information.** Develop an understanding of the subject. The key to this step is the process of asking questions of the customers and stakeholders.
2. **Analysis.** Develop an understanding of the subject's functions. This step represents the main point of departure of Value Methodology from other problem-solving approaches, including the scientific methvod. Miles created an entirely different way of thinking about problems and systems based on what the subject does rather than what it is.
3. **Creativity.** Identify alternative concepts to achieve the subject functions. Although creativity is a routine component of just about every problem-solving method, the creative process in VM focuses on functions rather than the things that perform them. This may at first appear to be a rather subtle difference; however, the implications are profound.
4. **Judgment.** Evaluate the alternative concepts based upon their merits. Miles regarded this as a rather straightforward step with the assumption that basic common sense would be used to select the best ideas for additional development.
5. **Development Planning.** Develop the alternative concepts into detailed recommendations. Also originally included within this step was the implementation of the alternative concepts into the project.

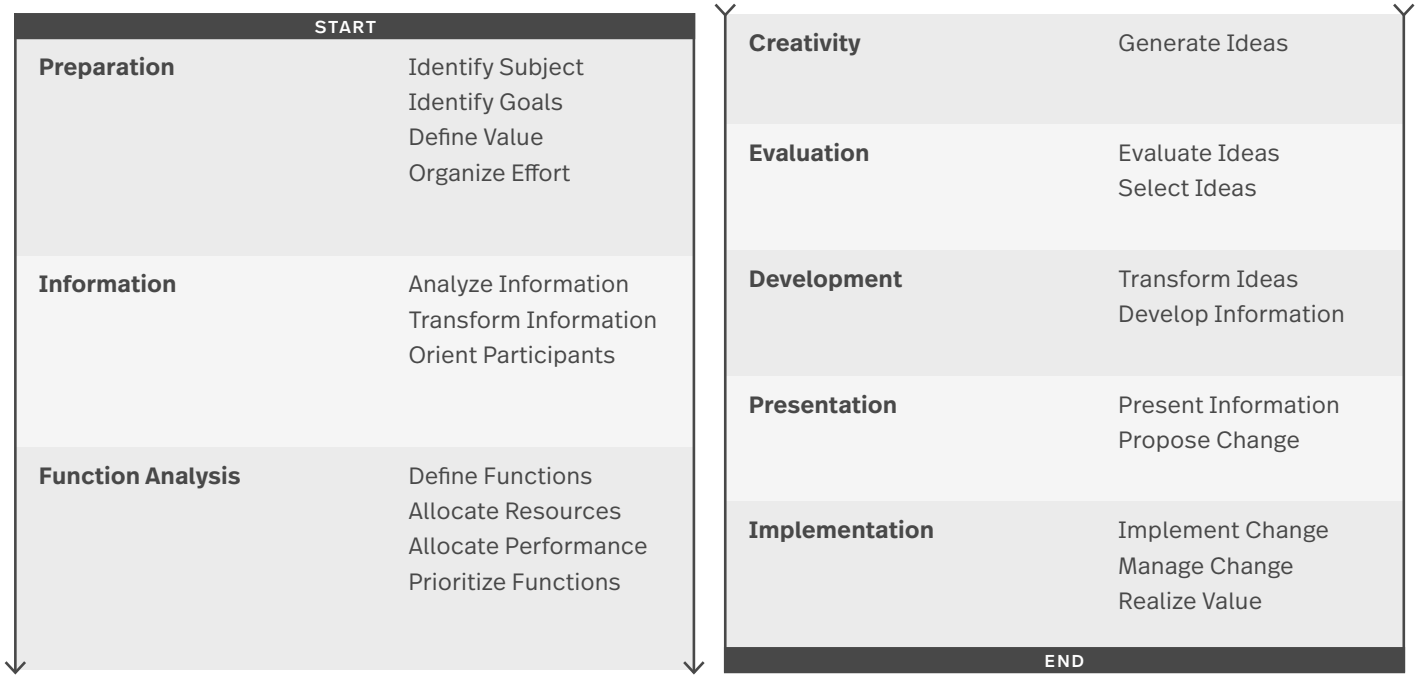


Figure 3.1 – Phases and functions of the VM Job Plan

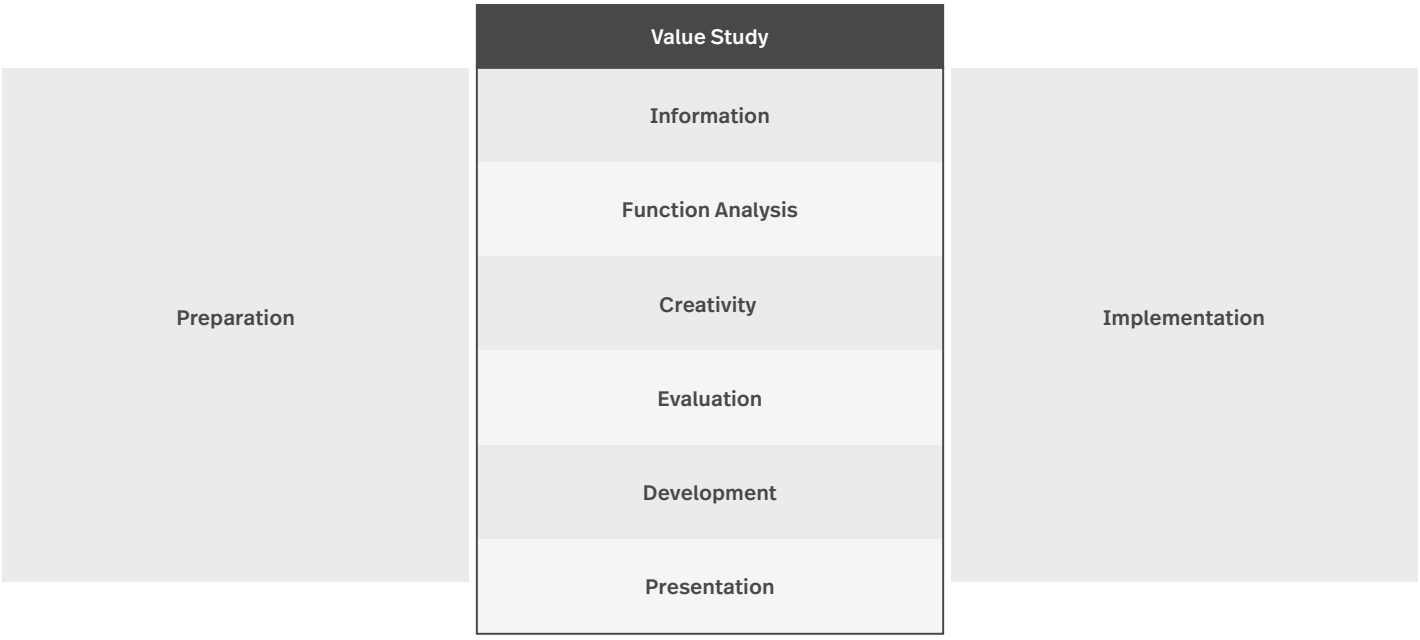


Figure 3.2 – Typical configuration where the Preparation and Implementation Phases occur outside of the Value Study

How does the VM approach to problem solving differ from that of the scientific method? There are several important differences that merit further discussion. These differences are best introduced by two quotes attributed to Albert Einstein [1879–1955], one of history's greatest thinkers and scientists.

> "The significant problems we have cannot be solved at the same level of thinking with which we created them."

The scientific method first states the problem and then gathers pertinent data. The VM Job Plan states the problem, gathers data, and then defines the underlying functions. This is an essential difference in understanding the problem. The process of breaking problems down into functions broadens the level of abstraction involved to understand and to solve the problem at the most appropriate level.

> "Imagination is more important than knowledge."

The scientific method develops a hypothesis (solution), or in some cases multiple working hypotheses. The VM Job Plan dedicates an entire step to the creation of ideas that will address the functions. There is a deliberate separation of creativity (imagination) and judgment (knowledge and experience). This separation is essential if our imagination is to be fully realized and applied to the problem.

Although many variations of the VM Job Plan emerged over the years, all of them included this same fundamental sequence of activities and thinking, even though the names of the phases may have differed or new phases were added.

3.3 The relationship of a VM study to the VM Job Plan

It is important to recognize the difference between a VM study and the VM Job Plan. While it is essential that all phases of the VM Job Plan be followed to fully actualize value improvement, the VM study (where the full, multidiscipline VM study team applies VM) is oftentimes a subset of these phases.

Traditionally, a VM study is most often identified as including the Information, Function Analysis, Creativity, Evaluation, Development, and Presentation Phases. This is usually the case where a third-party VM study team is brought in to perform an objective analysis of a project, product, process, service, or organization. In this situation, the sponsoring organization would likely handle both the VM study preparation as well as the ultimate implementation of the VM proposals resulting from the VM study (see **Figure 3.2**).

The sponsoring organization must adhere to the VM Job Plan to successfully reap the benefits of the effort. That said, the VM study could vary somewhat in terms of the participants at certain phases. For example, for some organizations, the VM study team members may be involved in the Preparation and Implementation Phases. In other organizations, it is possible that others might be involved in the Development Phase. Regardless, all phases must be followed in the proper order.

3.4 Communication dynamics and the VM Job Plan

Maintaining good communication is essential to the flow of the VM Job Plan. Figure 3.3 illustrates a model of group communication relative to the VM Job Plan. Although this model was originally developed to demonstrate group decision-making, it also applies to the communication dynamics of the VM Job Plan.

It is important to understand how the steps in the VM Job Plan relate to the dynamics of group communication. The participants of a VM study are first introduced to the subject's problems, issues, and objectives. The exchange of information begins and thinking becomes divergent, which results in divergent communication. The initial presentation of project information leads to questions, which in turn leads to more questions. Thinking continues to diverge through the process of Function Analysis, which frames problems in the abstract. This trend increases during the Creativity Phase. At about the midway point of the VM process, thinking begins to converge as the diverse ideas generated are evaluated critically. This convergence in thinking and communication continues through the development of alternative concepts, is summarized in the Presentation Phase through reports and presentations and culminates in deciding which alternatives to accept or reject.

Another way to think about the dynamics at play: the application of VM applies creative dismantling followed by critical reconstruction to improve project value. The VM facilitator must utilize all their facilitation and leadership skills to optimize the value of every step of the VM Job Plan. Ultimately, effective value leadership is directly linked to good communication.

3.5 Phases of the VM Job Plan

3.5.1 Preparation Phase

Thorough preparation is critical to the success of any VM study. The first part of this preparation is identifying what is to be studied (the VM study subject) and when it is to be studied. A variety of techniques may be employed to select the best subjects for study and identify the proper timing for the VM study.

Key activities involved in the Preparation Phase include:

- Defining and confirming the VM study goals and objectives;
- Identifying the key participants, customers or users, and stakeholders;
- Determining how value is defined;
- Identifying the study duration; and,
- Identifying the logistics required to support the VM study effort.

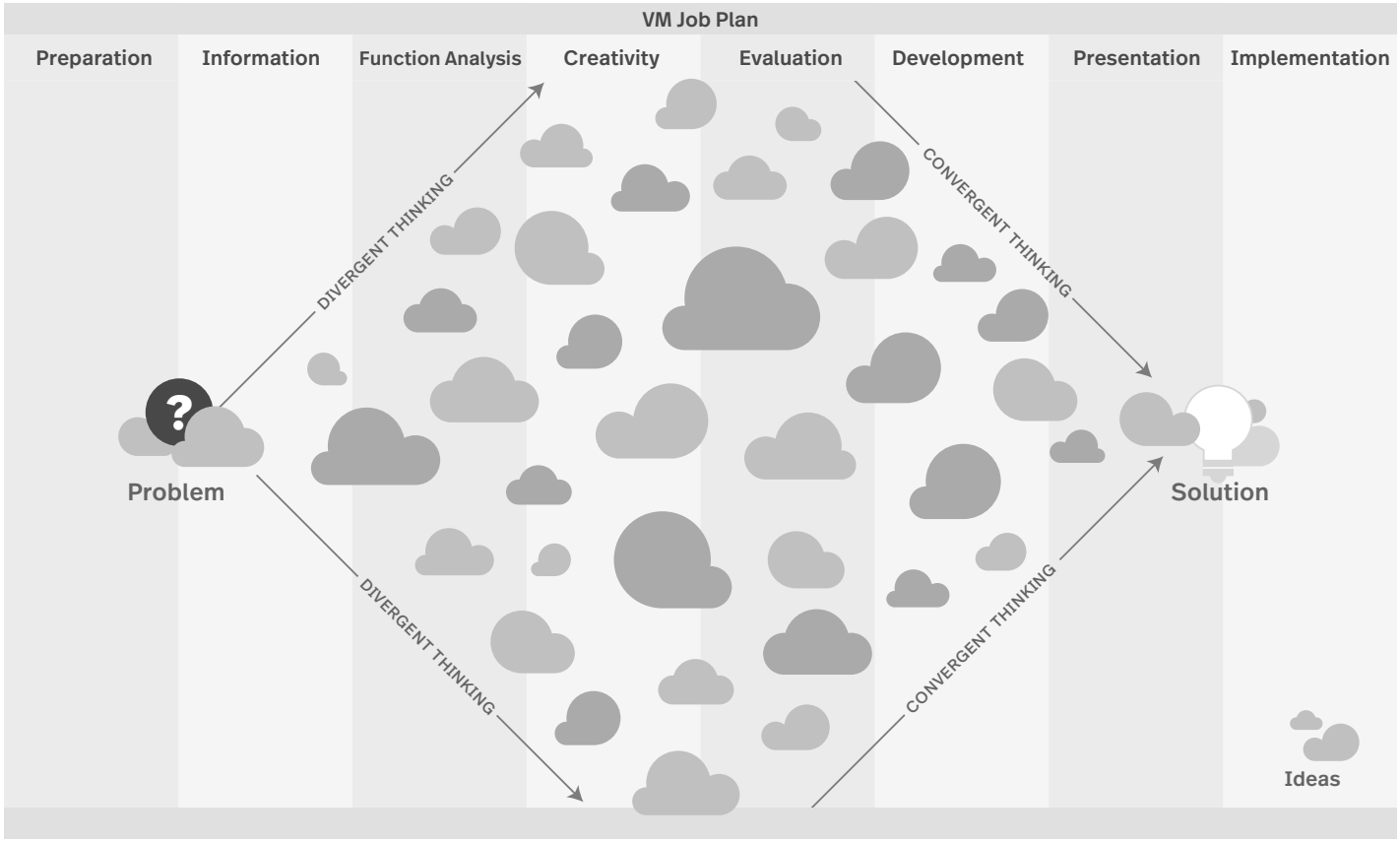


Figure 3.3 – Dynamics of Group Communication and the VM Job Plan

A basic level of understanding is provided by gathering and reviewing the appropriate information before starting a VM study. Depending upon the type of VM study, the information required will vary slightly. However, in all studies, information pertaining to the subject scope, performance or quality, time or schedule, cost, and risk should be identified, gathered, and organized for use in the Information Phase.

A pre-study meeting is usually conducted as a vehicle for planning and organizing a VM study. This meeting typically includes the value practitioner and key stakeholders and, in some cases the rest of the VM study team. This meeting helps ensure a well-defined VM study by aligning all participants and focusing their effort on value improvement relevant to the VM study sponsor's goals.

3.5.2 Information Phase

The primary objective of the Information Phase is to obtain a thorough understanding of the subject under study. The information gathered prior to and during the VM study is reviewed and discussed by the team. Typically, the stakeholders responsible for the study subject will present the current state of the things to the VM study team and answer their questions. Key considerations in this phase include:

- Human relations are very important to the success of any VM study. "People problems" are oftentimes more difficult to resolve than technical problems. The effectiveness of a value practitioner's efforts depends upon the amount of cooperation they can obtain from the various stakeholders involved with, or responsible for, the subject under study.

- All pertinent facts concerning the subject must be uncovered and drawn together, including but not limited to customers, stakeholders, the sponsor's objectives, the history of the subject and its development, cost, time and schedule, quality and performance requirements, implementation successes and failures, and potential risks.

- All aspects of the subject should be questioned, analyzed, and examined. It is often helpful if the subject can be observed in actual operation (if applicable). The main considerations are getting all the facts and getting them from the best available sources.

- The subject information must be thoroughly analyzed and meaningful conclusions drawn from it. One of the key activities of the Information Phase is to transform the "raw" information into a form that the VM study team can use to focus them on value improvement. This effort ultimately assists the team in identifying areas of opportunity and allocating the most pertinent information to functions in the subsequent phase.

3.5.3 Function Analysis Phase

Function analysis is the heart of the Value Methodology. The ultimate objective of the Function Analysis Phase is to identify functions that do not provide good value and those that are altogether unnecessary. There are three steps in the Function Analysis Phase:

1. **Define the subject's functions.** This includes the activities of identifying, classifying, and organizing functions.

2. **Allocate resources to functions.** Project information related to cost, performance, schedule, risk, and other information (such as size, weight, etc.) is associated with specific functions to identify an understanding of these relationships and enhance the team's understanding of value improvement opportunities.

3. **Prioritize functions for value improvement.** Ultimately, the objective of function analysis is to prioritize specific functions for value improvement. These will serve as the focus for the Creativity Phase and aid the team in thinking laterally about potential alternative solutions.

3.5.4 Creativity Phase

In the Creativity Phase of the VM Job Plan, a creativity session is conducted for each function targeted for improvement during the Function Analysis Phase. During these creativity sessions, any idea that can be associated with that function is recorded for later evaluation. Creativity techniques are typically employed to identify numerous ideas on each function requiring improvement. Generating a large quantity of ideas is the goal, rather than the quality of the ideas. A large quantity of ideas leads to a greater number of quality ideas. A key element of creativity is to avoid evaluating ideas generated during the creative process.

A variety of creative techniques can be employed to stimulate the VM study team's imagination. Team brainstorming is typically used to initiate the creative process. All members of the VM study team must be encouraged to participate, because a high level of participation motivates and energizes the creative process. The focus should first be on the development of ways to perform the function, and secondly on ways to improve the value of the function.

3.5.5 Evaluation Phase

The objective of the Evaluation Phase is to reduce the large quantity of ideas generated in the Creativity Phase to the best value improving ideas through the evaluation process. The VM study team will discuss and evaluate each idea relative to performance, quality, time, cost, and risk. This process identifies the major benefits and challenges of each idea and how it would impact value. Once this is done, the team agrees on a rating for the idea. Rating serves as a filter, with the better or higher rated ideas generally advancing to the next step and being developed further.

Frequently, several ideas or a combination of competing ideas remain. When this occurs, an evaluation matrix may be used that better quantifies the impact of competing ideas to identify which will best meet the VM study Subject's need, purpose, performance, and cost objectives. Key considerations include:

- Spending money as you would your own. This is an important rule when considering the cost of implementing an idea.
- Evaluating the ideas relative to performance and quality.
- Understanding how the ideas will impact time and risk. Will the idea take more time than the current approach? Will it reduce uncertainty by maximizing opportunities or minimizing threats?
- Identifying implementation factors, such as the time required and resources available to integrate the change. The challenges related to acceptance of the ideas and resistance to change should also be considered.
- Comparing the benefits and challenges of each idea relative to the current state of the subject.
- Refining ideas that might be otherwise rejected. Often additional creativity techniques can be used to develop a solution for a problem that arises during idea evaluation. It is useful to think of the Creativity and Evaluation Phases as an iteration process in nature. The surviving ideas are then refined, and more cost information is obtained. Detailed estimates are prepared only for the more promising alternatives.
- Selecting ideas for further development. Ideas with the greatest value improvement potential are normally chosen to be developed with further study, testing, refinement, and information gathering. If there is more than one outstanding idea addressing a specific function or the differences between two or more ideas are not clear enough to eliminate any of them, then all should be retained and carried over into the next phase.
- Selecting ideas for further development. Ideas with the greatest value improvement potential are normally chosen to be developed with further study, testing, refinement, and information gathering. If there is more than one idea addressing a specific function that is outstanding, or the differences between two or more ideas are not clear enough to eliminate any of them, then all should be retained and carried over into the next phase.

3.5.6 Development Phase

The objective of the Development Phase is to develop the best ideas identified during the Evaluation Phase into specific VM proposals, recommendations, or alternatives that have been technically validated. The impact of each VM proposal should also be quantified as much as possible. Key questions and considerations include:

- Does the proposal clearly explain the nature and rationale of the proposed change?
- Does the proposal consider all the impacts to resources (e.g., initial cost, life-cycle cost, schedule, etc.)?
- Does the proposal consider how the change will be implemented?

Ensure that each VM proposal has been fully documented and is presented in a format that will enable decision makers to clearly understand all relevant information.

3.5.7 Presentation Phase

A final report containing the VM study team's alternatives and a presentation to the VM study sponsors and/or stakeholders concludes the VM study. The objective is to inform the audience of the VM study team's findings. This initial presentation should not be advertised as a decision meeting–the decision-making process should occur in the final phase; Implementation. The VM study team typically provides the written report after the presentation. Key considerations in presenting results include:

- The presentation of the VM proposals, both written and oral, must gain the cooperation of the decision makers and their advisors. It is therefore important that VM proposals be developed and conveyed in as clear and concise a manner as possible. Avoid decision making meetings at VM study presentations.
- The VM study team can elaborate on those points that are not clear to the listeners, and questions regarding the VM proposals can be answered instantly.

3.5.8 Implementation Phase

The Implementation Phase is critical to the ultimate success of the VM Job Plan. During this phase, the sponsors and/or stakeholders involved in the decision-making process will review and assimilate the data given to them in the Presentation Phase. An implementation meeting should be conducted once sufficient time has passed to review the VM study team's findings. The purpose of this meeting is to decide the acceptability of each VM proposal. Ideally, the VM study team will be present to provide clarifications and assistance to the decision makers. Accepted proposals require the development of an implementation plan and schedule for integration into the VM Study Subject.

Tracking the implementation of VM proposals and auditing the results helps to measure the efficacy of the VM effort. The

subject should have some kind of mechanism put in place that will allow the changes to the subject's scope, performance, quality, schedule, cost, and risks to be managed.

3.6 References

- Miles, Lawrence D. Techniques of Value Analysis and Engineering, 2nd Edition, McGraw Hill, 1972.
- plato.stanford.edu/entries/scientific-method/
- Kaner, Sam. Facilitator's Guide to Participatory Decision-Making (Jossey-bass Business & Management Series), 3rd Edition, Jossey-Bass, 2014. (Note: Figure 3.3 is an adaptation of an original diagram found on page pg. 6.)

4
Preparation Phase

4.0 Introduction

The success of a VM study depends upon the quality of information used by the team during execution of the study. The organization, planning, and information required for the VM study must be defined and systematically collected in order to meet the study's goals and objectives.

All VM studies are unique. Therefore, the VM facilitator must understand the scope as well as the goals and objectives of the VM study in order to ensure that it is well planned and organized to obtain maximum benefit. If the scope, goals, or objectives are not clear or agreed upon, the Preparation Phase can be used to reach common ground while facilitating team building.

4.1 Terms and definitions

4.1.1 Constraints

The state of being checked, restricted, or compelled to avoid or to perform some action. For most VM studies, there are restrictions on some parameters of a solution (e.g., laws, standards, market demand, policies, resources, commitments made, etc.). These restrictions are called constraints and can be real or perceived. VM may be an effective tool for turning perceived constraints into opportunities for value improvement.

4.1.2 Subject matter expert (SME)

A person who is an authority in a particular area, discipline, or topic.

4.1.3 VM pre-study meeting

A formal exchange of information that identifies, clarifies, and communicates the conditions of a VM study, including its subject, objectives, participants, schedule, and logistics.

4.1.4 VM study sponsor

The person or organization responsible for defining the specific objectives of the VM study and the stakeholders' needs.

4.1.5 VM study decision maker

A person involved in determining the acceptance or rejection of VM proposals.

4.2 Process

4.2.1 Identifying VM study goals & objectives

Establishing the goals and objectives of a VM study is critical. The VM study sponsor will no doubt have identified a desired goal(s) which is the catalyst for the VM study. Goals broadly describe desired outcomes. These can be further articulated as objectives that identify specific results which may be described using key performance indicators (KPIs). Sometimes, the VM study sponsor will have identified both goals and objectives, but frequently they have only the goal in mind.

VM studies may have varying objectives, depending on what is being studied and the needs and wants of the sponsor, customers, users, and stakeholders. The VM facilitator (as well as the VM study team) should have a clear understanding of what the sponsor's goals and objectives are prior to commencing the VM study. The goals could vary dramatically, depending upon the state of the project and the reasons for performing the VM study.

For example, a VM study's goals and objectives could be:

Goal	Objective
Identify a means to reduce processing time	Reduce it by two weeks.
Build consensus among stakeholders as to what the project scope should be.	Identify a project scope that can be delivered within the annual budget.
Improve product market share.	Improve market share by 5 percent
Reduce project costs.	Get the project back within budget.
Reduce production costs.	Reduce them by 10 percent.
Reduce project risk.	Identify specific methods to reduce litigation risks.

As these goals and objectives indicate, the Value Methodology can be used in a number of different ways, all of which aim at improving value. They should always relate back to the VM Study Subject's scope, performance, quality, cost, schedule, and risks and can be general or specific in nature. Having a clear statement of the VM study's goals and objectives will help the VM study team stay focused and achieve the sponsor's expectations for the VM effort.

4.2.2 Inputs and outputs

4.2.2.1 Inputs

- VM study Subject
- VM study sponsor goals.

4.2.2.2 Outputs

- VM study objectives
- VM study subject information
- VM study participant list
- VM study agenda
- VM study site visit requirements
- VM study meeting location
- VM study environment and meals
- VM study information requests.

4.2.2.3 Activities

- Conduct VM pre-study meeting
- Identify VM study participants
- Identify VM study schedule
- Identify site visit requirements
- Identify VM study logistics
- Distribute and review VM study subject information

4.2.2.4 Process flowchart Figure 4.1

4.3 Activities

4.3.1 Conduct VM pre-study meeting

As with all studies, conducting a pre-study meeting(s) is essential to the planning and organization of the VM study. The purpose of this meeting is to ensure a well-defined VM study by aligning all participants and focusing the effort on achieving the goals and objectives of the study. The pre-study meeting(s) should ideally occur a minimum of two weeks in advance of the VM study to ensure that all required information is compiled and all required pre-study activities are completed. This also allows time for the VM team to review the information and request additional information prior to the study, as it may be difficult to obtain this information in a timely manner after the study begins.

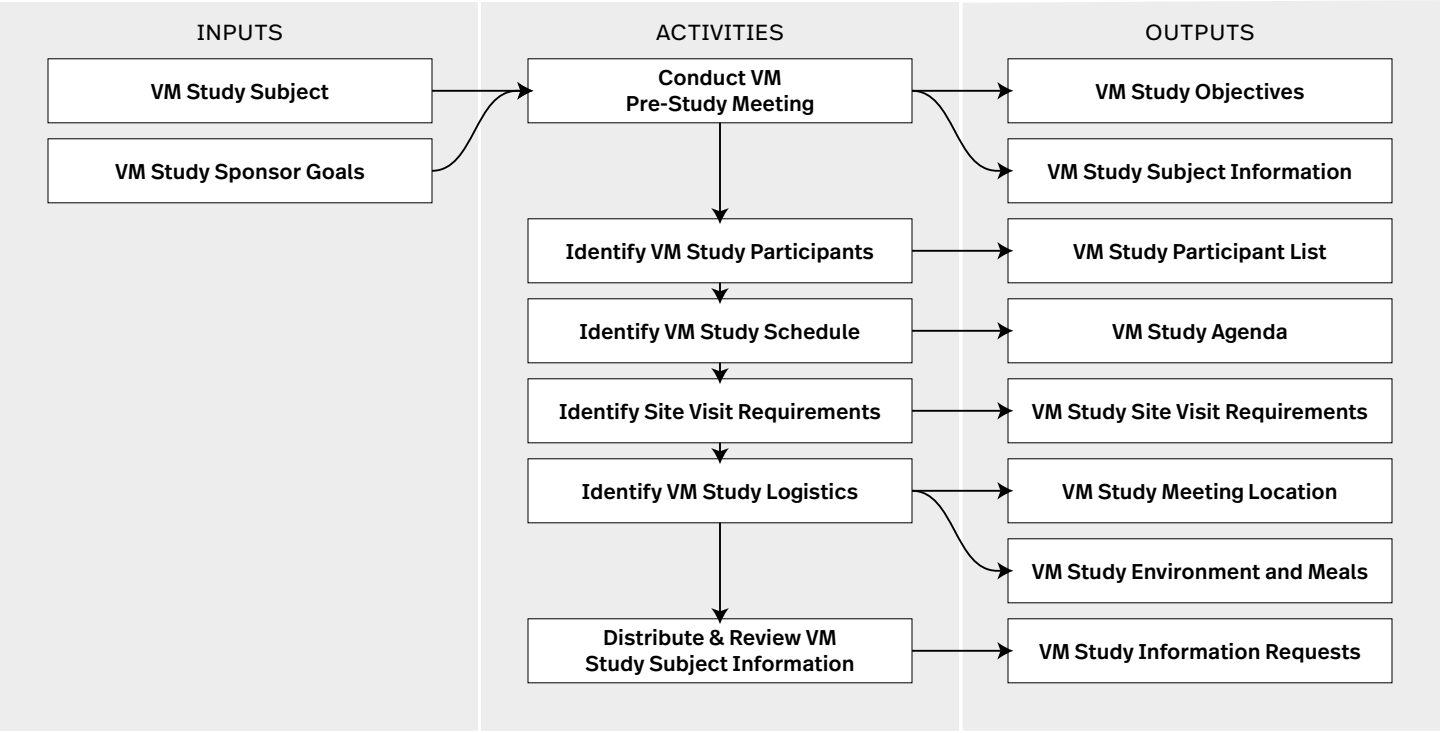


Figure 4.1 – Preparation Phase Flowchart

The participants attending the VM pre-study meeting may vary, depending on the VM study. This meeting typically includes the VM facilitator and key stakeholders, and in some cases the rest of the VM team. The VM facilitator should remember that, in some instances, this may be the client's and/or design team's first exposure to the Value Methodology. Therefore, the VM facilitator should be prepared to answer their questions and explain the Value Methodology process. During the pre-study meeting, the following should be discussed:

- An overview of the project, process, service, product, or organization that is the focus of the VM study
- Identification and clarification of the VM study goals and objectives
- What information is available, in what format, and how it will be provided to the VM facilitator
- Identification of the information needed to support any of the Information Phase techniques likely to be utilized (e.g., Pareto chart, Gantt chart, etc.)
- How the project, process, product, service, or organization information is to be distributed to the VM team and by whom
- Whether additional pre-study analysis is required (e.g., research on similar products, highway safety analysis, market research, etc.)
- The scope of work for the VM study (i.e., is the entire project, product, service, process, or organization the subject of the VM study or just a portion?)
- The schedule and end date for the VM study
- The disciplines required for the VM study
- VM study logistics (i.e., location, site visit requirements, agenda [including timing for the midpoint review and results presentation])
- What performance or quality criteria and requirements are to be considered
- VM study report format and submission dates, as well as Implementation Phase requirements.

4.3.1.1 Identify VM study participants

Once the VM facilitator understands the project, process, product, service, or organization, they can begin to discuss the size and disciplines required for the VM study with the VM study sponsor and/or the subject team. The VM team should be multidisciplinary, should mirror the disciplines involved in the original design/development of the study subject, and should incorporate the knowledge required to cover the issues and objectives of the VM study.

VM study teams of five to seven members excel; however, there is no limit to the number of team members and it is not uncommon to have larger VM study teams. The size of the VM study team should be based on the disciplines necessary to address the relevant aspects of the project and to achieve the VM study objectives. If large VM study teams are to be utilized, consideration should be given to having two or more VM facilitators. This allows for flexibility in the design of the VM study, such as breaking the VM study team into multiple teams. It also allows for the VM facilitators to consistently discuss how the VM study is proceeding and make any required adjustments in order to ensure the VM study goals and objectives are being met. In some scenarios, it can be helpful if a communication specialist and/or behavioral specialist works with the VM facilitator(s) in larger groups.

Once the required disciplines are established, the individuals to fill these roles should be discussed. The VM study team participants may be obtained from several sources:

- VM study sponsor's organization;
- Stakeholders;
- Subject matter experts within the design team organization who are independent from the design team;
- Members of the design team;
- Subject matter experts from an independent consulting firm with no involvement in the design team organization;
- Other agencies or organizations; and,
- Customers and/or users.

Regardless of the composition of the VM study team, the team selected should consist of individuals who are:

- Experienced in their field of practice;
- Creative, open to new ideas, and able to share their knowledge and expertise;
- Able to promote the ideas of other VM study team members;
- Able to respect the ideas generated by other VM study team members;
- Will fully participate in the VM study process and actively provide their knowledge and expertise; and,
- Able to fully commit to the time requirements of the VM study.

4.3.1.2 Identify VM study schedule and agenda

The VM facilitator must discuss and establish the overall VM study schedule during the pre-study meeting. This includes:

- Study duration and dates;
- Meetings that should include study sponsor, designer/developer, and stakeholders (e.g., kickoff meeting on the first day of the study, midpoint review meeting);
- Presentation of VM study results duration and dates (e.g., on the last day of the VM study, or after the VM study);
- Date for submission of the draft VM study report;
- Date for the implementation meeting; and,
- Date for submission of the final VM study report.

Determining the appropriate length for the team portion of the VM study should be the priority in determining the overall VM study schedule. For many years there was a widely perceived notion that a VM study should be five days long, or 40 hours. In fact, the duration of a VM study should be based on several different factors, which include:

- Size and complexity of the project;
- VM study goals and objectives;
- VM study scope;
- Size and expertise of the VM study team; and,
- Resources available to conduct the study.

For a typical 5-day VM study, the baseline includes time allotments as shown in **Figure 4.2**. The shaded area represents those phases of the VM Job Plan that occur as a team effort.

Some value practitioners require that a longer period of time be devoted to the VM study. Reasons a study may need to be longer include solving problems, creating new concepts or designs, planning strategies, or streamlining processes or procedures. This may vary from six or eight days to as long as twelve days or more. Longer studies typically require a split schedule and, depending upon the study target, may necessitate a variation in the time allotted to specific VM Job Plan activities.

In some cases, VM study sponsors may attempt to limit VM studies to three days or even shorter periods without regard for the scope of the VM study subject or the integrity of the VM Job Plan. Time limitations may result in more enthusiastic participation by the study sponsor's personnel, because they "lose" less time away from their normal work effort. At the same time, these time constraints require that some portion of the VM Job Plan be compromised. The VM Job Plan is often construed to apply only to the formal phases included in the team study: Information, Function, Creativity, Evaluation, Development, and Presentation. The Preparation and Implementation Phases, while not always considered formal steps of the VM Job Plan, are integral to the success of any value improvement effort and are addressed as such in this discussion.

Regardless of the study type, the study subject, or the length of the VM study, certain pre-study activities must always occur. In addition to project identification, definition of the VM study schedule, and team selection,

VM Job Plan Phase	Number of Hours per Study Value Type			
	Project	Product	Process	Procedure
Preparation	8–24	8–16	20–30	40–60
Information	4–6	2–6	2–6	2–6
Function Analysis	2–4	6–10	4–8	2–6
Creative	3–6	3–6	3–6	3–6
Evaluation	4–6	2–4	3–6	3–6
Development	16	4–8	12	8
Presentation–Oral	2–4	2–4	2–4	2–4
Presentation–Report	40	8–16	40	40
Implementation	Times will vary and depend on VM study sponsor.			

Figure 4.2 – Five-Day VM Study Model
(shaded area represents VM Phases that are part of the study)

extensive preparation work is required in the form of data collection, cost analysis and models, team information packages, and logistical arrangements. Once the team study is concluded, additional documentation may be required to complete or further refine the developed VM proposals. A complete report is prepared to document the study efforts and its results and to determine what implementation actions must occur.

None of the phases and activities associated with the Value Methodology Job Plan (as described in Chapter 3) may be eliminated by reducing the length of a team study: all must occur for every VM study, regardless of how long the team sessions last.

Using a construction project as an example, assume the study sponsor has requested a 3-day VM study. The compressed time is required to maintain the design schedule, the budget to conduct the VM study is limited, and the key team members are unable to commit to more than three days away from their regular responsibilities. **Figure 4.3** shows how the hours per phase would differ for a 3-day study compared to the 40-hour model previously illustrated. The shaded area represents those phases of the VM Job Plan that occur as a team effort.

There are both advantages and disadvantages associated with the 3-day VM study approach. While it reduces the VM study sponsor's cost for the study, the VM team and VM facilitator are put under tremendous pressure to accomplish a great deal in a short period of time. In order to maintain the integrity of the VM Job Plan and, at the same time, prevent the activity from being simply a cost reduction exercise, the VM facilitator's job of keeping the VM team focused and on track becomes even more critical than usual. As noted earlier, every phase of the VM Job Plan is impacted in some way. Of additional consideration, pre-study and post-study times must be increased as a result of the compressed team study schedule.

A 3-day VM study may limit results to mere validation of a project's functional concepts rather than lead to significant project improvements. VM proposals developed during a shortened study are likely to be more conceptual and less detailed than those produced in a longer study; and, as a result, they may prove more difficult to implement. Most importantly, the results may not be optimized due to the limited time the VM study team has had to exploit the techniques of the Value Methodology and gain the benefits of team communication and project understanding those techniques offer.

Even when constrained by a 3-day study, it is possible to have impressive results that dramatically demonstrate the power of the VM process. However, this scenario represents a double-edged sword, because impressive results only encourage ongoing use of the abbreviated VM study approach. Note that a successful VM study in a 3-day period depends highly upon an experienced VM facilitator and VM study team.

Many reasons exist as to why a VM study might require more than the typical five days. A high profile, controversial project, or multiple funding entities may create specific issues that require more attention by the VM study team. A more involved study may be required if the project is over budget, has problems associated with completion, or is very complex, having more elements on which to focus and requiring a larger team to perform the study.

Much can be gained by increasing the time available for a VM study. First and foremost, the VM study team can be more intimately involved in the pre-study planning

VM Job Plan Phase	Number of Hours	Effect of Reduced Time
Preparation	24-32	More pre-study time required by the VM Facilitator to prepare for the abbreviated VM study
Information	4	Site visit eliminated
Function Analysis	2-3	Less time for team interaction; increased VM Facilitator influence; reduced time for cost/performance/function analysis
Creative	2-3	Fewer ideas generated; potential loss of significant ideas
Evaluation	4	Reduced depth of team discussion and analysis of ideas
Development	8-10	Less detail, potentially less credibility related to VM proposals
Presentation–Oral	2	Fewer VM proposals to present.
Presentation–Report	64	More time required in report writing to complete development of value proposals.
Implementation	Times will vary and depend on VM study sponsor.	

Figure 4.3 – Three-Day Value Study Model for a Construction Project (shaded area represents VM Phases that are part of the study)

(Preparation Phase), resulting in increased and improved information gathering. Of equal importance, the VM study team may meet with project stakeholders and decision-makers at the midpoint of the study to validate the direction the team is taking with their VM proposal development. Additionally, when complex problems are considered, more time is available to spend on function analysis to address these problems.

Obviously, a study spanning more than five days requires a split schedule of some sort. There is a significant advantage to having a break of several days between team sessions, as it offers the opportunity for team members to do research and gather additional information needed for development of VM proposals. Avoid too much time between team meetings to reduce the potential for loss of the VM study team's momentum.

Assuming an 8-day VM study, the breakdown of time spent on each phase of the VM Job Plan might be as shown in **Figure 4.4**.

The true issue is not whether a VM study is conducted over three days or three months. The key is maintaining the integrity of the Value Methodology Job Plan and making the necessary adjustments in the time allotted for all elements of the process to maximize the results generated. The key is achieving a "fair return" for something exchanged–in this case, time.

4.3.1.3 Identify site visit requirements

During the pre-study meeting, whether a site visit will be undertaken must be discussed. A site visit can provide the VM study team with invaluable information on the existing conditions as well as any project constraints (e.g., proximity to another building, right-of-way restrictions, how a part is manufactured, how a business process occurs within an organization, etc.). Visiting the site and discussing what they have seen helps stimulate the VM study team's ideas in the Creativity Phase of the VM study.

If a site visit is to occur, the planning and coordination of the site visit needs to be discussed during the pre-study meeting to ensure that the time allotted for the site visit is used effectively. Following are some of the requirements for a site visit that should be discussed:

- Will the site visit occur during the Preparation Phase or during the Information Phase of the VM study?
  - Some clients require that the VM study team undertake the site visit prior to the study.
  - In a typical 5-day VM study, the site visit occurs during the Information Phase.
- Whether the site visit occurs during the Preparation Phase and/or Information Phase, the following questions should be discussed:
  - How long will it take to get to the site, tour the site, and return to the location of the study?
  - How is the VM study team to travel to and from the site?
  - How accessible is the site?
  - Does lunch need to be provided (e.g., bag lunch or stop to eat near the site)?

VM Job Plan Phase	Number of Hours	Effect of Reduced Time
Preparation	32	Includes pre-study meeting
Information	8	Enhanced site visit and discussions with stakeholders.
Function Analysis	8	Increased function analysis possible; multiple FAST diagrams can be constructed.
Creative	4-8	Additional time for creativity; different techniques may be employed.
Evaluation	12-16	Increased evaluation time allows more thoughtful consideration of ideas.
Development	24-28	More credible, well-developed VM proposals.
Presentation–Oral	4	Increased number of VM proposals to present.
Presentation–Report	72	More time required in report writing due to greater number of value proposals developed.
Implementation	Times will vary and depend on VM study sponsor.	

Figure 4.4 – Eight-Day Value Study Model for a Construction Project (shaded area represents VM Phases that are part of the study)

  - What safety equipment, if any, is required (e.g., hard hats, work boots, safety vests, safety vehicle (if stopping alongside a highway, an active construction site, a manufacturing assembly line)?
  - Who will lead the site visit (e.g., client and/or design team)? Remind them to focus on areas of potential risk, challenges, and constraints, as these are areas the VM study team will review during the study.
  - What documents will be required as reference during the site visit?

A site visit may not be possible due to time limitations of the VM study and/or the location of the site with respect to the meeting location (e.g., the site is in a remote location or it will take a significant amount of time to travel to and from). In this case, the site visit may consist of the VM study team reviewing the site via Google Earth, Google Maps, videos, and/or photos.

4.3.1.4 Identify VM study logistics

The location of the VM study is an essential component to its success and should be discussed during the pre-study meeting. Some factors that the VM facilitator should discuss with the client and/or design team with respect to the study location include:

- Size of the meeting room to comfortably accommodate the VM study team, as well as additional participants in the Information Phase and Presentation Phase. When a lot of people are on the team, extra meeting or breakout rooms are beneficial.
- Minimizing travel expenses for the VM study team.
- Minimizing distractions to the VM study team. For example, having the study in the office or facility where the majority of the VM study team works may result in team members being pulled out of the study to deal with issues and/or not return in a timely matter from breaks or lunch. Therefore, it may be beneficial to hold the study close to, but not at, said facility.
- Accessibility of the meeting location for the VM study team. This refers to potential restrictions on the VM study team, such as:
  - What hours is the meeting space accessible? For example, can the VM study team start at or before 8:00 a.m. and stay later than 5:00 p.m.? Can the VM study team leave for a few hours and then return later in the evening, if required?
  - What security requirements, if any, apply? Must VM study team members go through security each day and, if so, do they need to be escorted while in the facility? What documentation is required for security?
- Power supply availability. All VM study team members are required to bring their laptops. Therefore, it is essential that enough power supply is available.
- Accessibility of the meeting location to the site. The advantages of having the study near the site allows the VM study team to undertake a site visit, potentially access the site later in the study to assist in the development of an idea, and potentially allows them access to maintenance and operation personnel.
- Meal requirements. The VM facilitator must understand whether the facility has easily accessible locations for lunch, whether catering is required or permitted, whether the VM study team must bring their own lunch, and typical timing requirements with respect to lunch in order for them to develop the study agenda. For example, if the facility has a cafeteria where the VM study team can go for lunch, when is the best time for them to break for lunch to facilitate their timely return to the study?
- Internet access. The VM facilitator should confirm what type, if any, internet access is available. For example, at some government offices, internet access is available only for government personnel with special card access. If internet is not available, the VM study team should be informed that they should bring all the materials and documents required to undertake the VM study on their laptop computers. Alternatively, they could use their cell phones as a hotspot.
- Audio/visual. A telephone with teleconference capabilities should be available in the meeting room to allow those who are attending the Information and Presentation Phases via teleconference/web meeting to participate. This also allows the VM study team to call the client and/or design team as well as another subject matter expert during the VM study. Other appropriate audiovisual equipment, such as multimedia projectors, monitors, whiteboards, and flip charts should be available as necessary.

Regardless of where the VM study is to be held, the VM facilitator will be responsible for minimizing distractions, ensuring that the VM study team members have what is required to undertake the study, access to the facility, making travel arrangements, arranging meals, and whatever else is required to undertake the VM study.

STUDY MEETING ROOM ENVIRONMENT

The study environment is also important to the success of a VM study. Remember, the VM study team will be working for long hours for up to five consecutive days in the meeting room. When selecting a meeting room for undertaking the VM study, the following items should be considered:

- Availability. The meeting room should be available on a 24-hour basis for the duration of the study. This allows for the VM study team to leave their displays on walls, tables, easels, etc. in place. It also allows them to leave materials in the room, as well as work as long as they wish without having to lose momentum due to having to leave the room by a specified time.

- Size. The meeting room(s) must be large enough to accommodate not only the VM study team and all their materials, but also the design team and client as well as anyone else who will be attending the Information Phase and Presentation Phase. For the VM study team, the room must accommodate free movement around the table, being able to put displays on the walls and review them without disturbing another team member and provide a clear view for all participants to the projection screen and flip charts. It is ideal to have extra space available for tables for materials and/or products as well as any supplies the VM facilitator brings to the study (e.g., printer, scanner, etc.). For very large teams, consider one large room and several smaller rooms.

- Location. As previously discussed, the location of the meeting room relative to the site or manufacturing plant should also be considered in terms of allowing the VM study team to undertake a site visit, as well as revisit the site if required later during the VM study.

- Lighting. A room with natural lighting/windows should be provided. However, care should be taken as to the amount and size of the windows provided, as this could potentially impact the temperature of the room as well as the participants' ability to see the projector screen and/or computer screen due to the sun. Having a meeting room that does not have natural light/windows may have a negative impact on the productivity of the VM study team, which may result in more breaks being required.

- Temperature control. The ability to control the temperature of the meeting room will ensure a comfortable working environment for the VM study team.

It is the responsibility of the VM facilitator to ensure that the meeting room can accommodate the VM team for the duration of the VM study. There is no standard arrangement for the set-up of tables in the meeting room. The table setup depends on the type of study, table shapes and size, room shape, and the VM facilitator's preference. The important thing to remember is that the projector and/or flip charts must be visible to all VM study team members and visiting participants, and that the VM study team members are able to face each other. The VM facilitator will be responsible for setting up the meeting room to accommodate the VM study team and visitors.

MEALS AND BREAKS

It is important during the pre-study meeting to discuss meals and breaks during the study, as this may impact the study agenda. For instance, if meals can be provided (i.e., catered), then this allows for the flexibility of a working lunch, if needed. For example, providing the VM study team with lunch allows them more time during the Development Phase to work on their VE proposals. If lunch is to be provided, consider dietary restrictions. The VM facilitator should coordinate with the VM study team to address such needs. Keep in mind that sharing a meal can also have a team bonding effect.

It should also be noted that, due to a study being held at a remote project site, the VM study team may be required to bring lunch. This is important for the VM facilitator to know, as they will need to relay this to the VM study team. If lunch is not provided, then an understanding of where the VM study team can go out for lunch and the anticipated amount of time needed for them to go out for lunch, eat, and return is required. This amount of time needs to be included in the overall study agenda.

4.3.2 Identify, collect, distribute, and review information

4.3.2.1 Identification and collection of information

During the pre-study meeting, the project, product, service, process, or organization as well as the available information will be discussed. The information provided should identify the purpose and need, deliverables, cost, schedule, and details on the "base case" design. The VM facilitator needs to understand the project, service, product, process, or organization for which the VM study is to be undertaken in order to understand what level of details will be provided in the documentation. Information regarding the study subject should cover the basics, including:

- Scope,
- Performance and quality,
- Schedule,
- Cost, and
- Risk.

4.3.2.2 Distribution of information

Once the VM facilitator receives the project, product, process, service, or organization materials, they distribute that information to the VM study team. There is no standard format for providing information to the VM study team. However, some clients may have special requirements for the distribution of materials. For example, some clients may require that the development of a workbook with the relevant information be provided to the VM study team. Additionally, some clients require that the materials be provided to the VM study team prior to the study (e.g., one-week prior). Therefore, it is essential that the VM facilitator discuss with the client or owner their requirements for distribution of the materials as well as timing during the pre-study meeting. Often, some or all the information is confidential. It might be necessary to make the team members aware, or even have them sign a confidentiality agreement.

4.3.2.3 Review of information

All the VM study team members are required to review the materials provided prior to the VM study. The VM study team will be asked by the VM facilitator to submit any requests for additional information. Such requests should be compiled by the VM facilitator and sent to the VM study sponsor and/or design team prior to the study. Additional guidance relative to the review and analysis of VM study information is covered in Chapter 5, Information Phase.

4.4 References

- Adams, Ginger R. and Hays, Terry R. "The Value of Time," SAVE International Conference Proceedings, 1994 The content of this section is condensed and revised from this reference.
- Resource on team size retrieved from: **knowledge.wharton.upenn.edu/article/is-your-team-too-big-too-small-whats-the-right-number-2/**

5
Information Phase

5.0 Introduction

The Information Phase concerns the processes of gathering, organizing, reviewing, and transforming information about the subject under study and orienting the study participants to the subject, to each other, and to the VM study process. In this phase of the VM Job Plan, the goal of the VM facilitator, as well as the other VM study team members, is to develop a thorough understanding of the subject.

The Information Phase includes the following activities:

- Gathering and organizing subject information;
- Reviewing and transforming subject scope information;
- Reviewing and transforming subject performance and quality information;
- Reviewing and transforming subject time information;
- Reviewing and transforming subject cost information;
- Reviewing and transforming subject risk information;
- Conducting a VM study kick-off meeting; and,
- Conducting a site visit (if applicable).

In the Preparation Phase, consideration was given to collection of the subject information. The Information Phase focuses on the review and transformation of that information by the VM study team. It is important to remember that the Information Phase is not a one-way street. In other words, developing a thorough understanding of the subject is best achieved through the establishment of an active dialogue between the subject team, customers, users, owners, stakeholders, and the VM study team.

5.1 Terms and definitions

5.1.1 Balanced scorecard

A technique used to document and communicate the objectives, related key performance indicators and targets, and anticipated outcomes of an organization (and/or its projects, products, processes, and services).

5.1.2 Cost model

A resource model used to graphically depict the relationship of elements relative to their cost. For example, a cost model of a building might show the relative cost of each of the major systems (foundation, superstructure, exterior enclosure, etc.), sorted from high to low, on a bar chart. Cost models are often augmented with a Pareto distribution (see Pareto model below).

5.1.3 Gantt Chart

A Gantt chart is a type of bar chart that illustrates the relationship of activities to a schedule. Articulations of Gantt charts may show interdependencies of activities and define the "critical path" (the longest series of required sequential activities) of a project or process.

5.1.4 Pareto model

A further articulation of any resource model that graphically illustrates the cumulative distribution of values. For example, a Pareto distribution curve overlay a bar chart that shows the cumulative contribution of each element of cost. The basis of the Pareto model is the so-called 80/20 rule, which means that 80 percent of the total cost of a system can be linked to 20 percent of its elements. Pareto analysis is used to select important elements, to prioritize problems, and to highlight important issues. It also helps to see the small number of important issues as well as their relative importance to each other.

5.1.5 Process flowchart

Process flowcharts are tools for visualizing manufacturing, business, administration, etc. processes. Process flowcharts usually have two sides, and the processes are placed hori-

zontally on it. All the processes in the organization are placed between customer expectations (left side, input) and customer satisfaction (right side, output). Organizational processes include management processes, value-creating processes, and supporting processes. There are many international standards for displaying process maps, such as UML (Unified Modeling Language), Event-driven Process Chain (EPC), Business Process Modeling Notation (BPMN) (ISO/IEC 19763-5: 2015), and VSM (Value Stream Map).

5.1.6 Project management plan

A project management plan is a tool for planning and managing a project. The document continuously evolves with the project and is always updated with the latest relevant information. The project management plan should be accessible to all project members, as it is one of the most important documents of communication.

5.1.7 Quality management plan

A document defining the acceptable level of quality, which is typically defined by the customer and describes how the project, product, process, or service will ensure the specified level of quality. Quality control activities monitor and verify that deliverables meet defined quality standards. Quality assurance activities monitor and verify that the processes used to manage and create the deliverables are followed and are effective.

5.1.8 Quality model

A model that illustrates the relationship between customer satisfaction and the degree of quality provided by a project, product, process, or service. One such example is Quality Function Deployment (QFD) which is a method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts and, ultimately, to specific elements of the manufacturing process.

5.1.9 RACI matrix

RACI is an acronym for "responsible, accountable, consulted, and informed." A RACI matrix is typically used to cross reference activities and deliverables with stakeholders to define the level of involvement. For example, a public agency might be identified as "consulted" for the review of a project document. The information on a RACI matrix is used in supporting communication and managing stakeholders.

5.1.10 Resource model

A graphic and/or numerical representation (such as a spreadsheet, pie chart, cost model, Gantt chart, etc.) indicating resources such as cost, space, time, and energy and associated performance or risk allocated to each component of a project, product, process, service, or organization.

5.1.11 Risk model

A resource model that represents the probabilities and impacts of threats and opportunities. Risk models can be qualitative or quantitative in nature. They include tornado charts (a graphic form of risk rankings), HEAT maps, histograms, and probability density curves.

5.1.12 Risk register

A matrix used to record information concerning subject risks. Risk registers usually include a description of the risk, type of risk (threat or opportunity), probabilities, impacts, triggers, and possible response strategies.

5.1.13 Scope

The defined parameters of the subject under study. The subject scope is often supported by various forms of information that include narratives (or a scope statement), specifications, drawings, schedules, plans, estimates, and other supporting analysis.

5.1.14 Specifications

A specification often refers to a set of documented requirements to be satisfied by a material, design, product, or service. The characteristics of quality and performance are usually defined by specifications for projects, products, processes, and services. Different types of specifications have different meanings. Examples include functional, technical (i.e., design and engineering), operations, and maintenance specifications.

5.1.15 Work breakdown structure

A tool that splits a project into components. It identifies all the project's tasks and deliverables and breaks them down into many small, meaningful, manageable parts (work packages). A WBS helps to show the scope of the project, regulate progress, set accurate costs and timetables, and shape project teams. Once a WBS has been created, it may be transformed into a schedule.

5.2 Process

5.2.1 Gathering and Organizing Information

The initial process of the Information Phase is to gather and organize relevant subject information. Having the right information at the right time is a critical ingredient for the success of any VM study. This process begins in the Preparation Phase and continues in the Information Phase as additional information is developed and gaps are identified, requiring supplementary information.

For example, assume that a VM study is to be conducted on a public infrastructure project. If the success of the project is directly related to the quality and timeliness of the information on which it is based, then this is especially true for VM studies. Most projects, especially during the latter phases of their development, generate volumes of information. The project team, which has been responsible for generating, collecting, and organizing the data, possesses a level of familiarity with it that the VM study team cannot match. Furthermore, few, if any, members of the project team will have a full appreciation and understanding of all aspects of the information used to develop the project.

With respect to subject information, the VM study team may be in an unusual position. While team members begin the

study from a relatively uninformed standpoint, assuming they have not been previously involved with the subject, this lack of knowledge frees them from the assumptions and conclusions held by those currently involved with the subject.

Information sources should have been initially identified during the Preparation Phase. Typically, the sponsoring organization, supported by other stakeholders, either has in their possession or has identified the sources of the information needed to support the VM study effort. The VM facilitator should coordinate receipt of this information and ensure that it is organized and complete before distributing it to the VM team.

Ideally, the primary information sources were identified in the Preparation Phase. In thinking about information, it is useful to classify it as either primary or secondary sources. A primary source is an original report, study, document, object, or eyewitness account. In other words, this is the source where any given information first appeared. For example, a VM study focused on the design and construction of a hospital would consider plans, specifications, the basis of design, schedules, and cost estimates as examples of primary sources of information.

A secondary source is a document that is written about the primary source. These include documents that report, analyze, discuss, or interpret primary sources. Examples of secondary sources of information relevant to a VM study for a hospital might include:

- A newspaper article that covers the local politics related to the funding of the hospital project;
- A report related to a third-party analysis of the process used by the hospital authority to determine the programmatic needs of the hospital; or,
- A Wikipedia article entry about hospitals.

Secondary sources can provide additional insight that supplement primary sources; however, it must be recognized that primary sources are essential to the performance, and must form the basis, of a VM study. Indeed, primary information sources form the foundation for any comparative analysis of value emanating from a VM study.

The VM facilitator should work with the study sponsor and stakeholders to identify both primary and secondary information sources. Oftentimes, there is more information available than there will be time for the VM study team to process. In such cases, judgment must be exercised to determine what information is given priority. The study sponsor and other key stakeholders should be consulted in making this determination.

Once the information has been gathered and organized, it should be reviewed for completeness. It is possible that the information provided is incomplete, incorrect, or missing key elements. In such cases, clarifications and/or requests for additional information can be made prior to the VM study.

5.2.2 Reviewing and transforming Information

Many of the activities in the Information Phase concern transforming information in its "raw" form into meaningful insights that will help guide the VM study team in achieving the study's objectives. In reviewing the available information, it may be determined that adequate information does not exist, at which point a decision must be made as to whether the VM study can proceed without that information. Alternatively, the VM study team may be tasked with helping to create this information.

Ideally, the following information should be reviewed and analyzed for the subject under study.

- Scope information;
- Performance and quality information;
- Time and schedule information;
- Cost and financial information; and,
- Risk information.

Frequently, existing information requires additional analysis for it to be readily usable during a VM study. For example, a product study may include a detailed bill of materials (BOM); however, that may be lengthy and difficult to read. The VM study team would benefit if the cost information were transformed into a cost model that showed which product sub-assemblies or components make the greatest contributions to total cost. Further, time or schedule information may not exist at a sufficient level of detail to provide the VM study team with a meaningful understanding of how the various manufacturing activities are contributing to overall production time. In this example, the VM study team would benefit from having a Gantt chart available which details the duration and relationship of the various activities in the work breakdown structure of the manufacturing process. Transforming both the cost and time information into informative resource models will aid the VM team in drawing meaningful conclusions about the impact of the product's various components relative to total value. Further, this transformed information will prove invaluable during the subsequent phases of the VM Job Plan.

As was mentioned, frequently some of the key information necessary to fully consider value improvement may be missing or unavailable. In such cases, the VM study team may need to take the initiative to create this information, ideally with the participation of key stakeholders, either before or during the VM study. For example, assume a VM study is to be performed on an existing process that is poorly documented and perhaps evolved out of necessity rather than by design. As a result, no existing process flowchart exists. It is determined prior to the VM study that the VM study team should help develop a process flowchart with the stakeholders. Members of the VM study team then interview current users and stakeholders to identify activities, durations, and sequences to develop a process flowchart that will serve to define the current state of the process during the VM study.

The techniques identified in Section 5.4 will aid the VM Team in transforming raw information to forms that are more readily usable throughout the course of the VM effort.

5.2.3 Orienting participants

The other key process of the Information Phase is orienting the VM study participants. This includes:

- Orienting the participants to each other. This includes introducing the VM study team, sponsor, delivery team, and other stakeholders.
- Orienting the participants to the VM study subject information, including any analysis of that information.
- Orienting the participants to the VM study process. This includes introducing and reviewing the VM study agenda, VM study scope and objectives, and discussing key VM study deliverables and milestones.
- Orienting the participants to the subject site and environment. This includes conducting a site visit to a project site, observing that manufacture and/or assembly of a product, and observing the execution of a service or process.

5.2.4 Inputs and outputs

5.2.4.1 Inputs

- Scope information (may vary by subject and industry)
  - Scope statements
  - VM study's goals and objectives
  - Project management plan
  - Supply and/or value chain information
  - Work breakdown structure (WBS)
  - Process flowcharts
  - Time and motion studies
  - Drawings
  - Part or component lists
  - Technical reports
  - Stakeholder information
- Performance and quality information (may vary by subject and industry)
  - Specifications and/or requirements
  - Quality management plan
  - Warranty and/or defect information
  - Voice of the customer information
  - Surveys and/or interviews
  - Marketing data
  - Value stream map
- Time information (may vary by subject and industry)
  - Major milestones
  - Schedules
  - Project's critical path
  - Process throughput
  - Gantt charts
- Cost information (may vary by subject and industry)
  - Initial cost estimates, bill of materials, labor costs, etc.
  - Operations costs
  - Maintenance costs
  - Salvage costs
  - Disposal, demolition or reuse costs
  - Economic data (i.e., inflation, escalation, financing, cost indices, etc.)
  - Applicable discount rates
  - Sales and marketing data
- Risk information (may vary by subject and industry)
  - Risk management plan
  - Risk register

5.2.4.2 Outputs

- Voice of the customer feedback (e.g., interviews, surveys, focus panels, etc.)
- RACI matrix
- Process flowcharts
- SWOT analysis
- Balanced scorecard
- Schedules or other time models
- Cost models
- Life-cycle cost analysis and/or models
- Risk models

5.2.4.3 Activities

- Review and transform scope information
- Review and transform performance/quality information
- Review and transform time information
- Review and transform cost information
- Review and transform risk information
- Conduct VM study kick-off meeting
- Conduct site visit

5.2.5 Process flowchart Figure 5.1

5.3 Activities

The VM study team should have enough time to review all relevant subject information prior to commencement of the VM study. It is recommended that at least one week, and preferably longer, be allotted for VM study team members to review the subject information. Additional time may be warranted, based on the quantity and complexity of available information.

Invariably, there will be pieces of information that will either not have yet been developed or that are not organized in a format immediately usable by the VM study team. Ideally, these "information gaps" will have been identified during the Preparation Phase, and the owners of the information will be working to develop it so that it can be made available during the VM study. Sometimes the information will simply not be available in time. When this situation occurs, it will be necessary to identify the assumptions to be used in place of the information. The VM facilitator should work with the study sponsor to identify these assumptions and document them for inclusion in the report that will summarize the VM study team's findings.

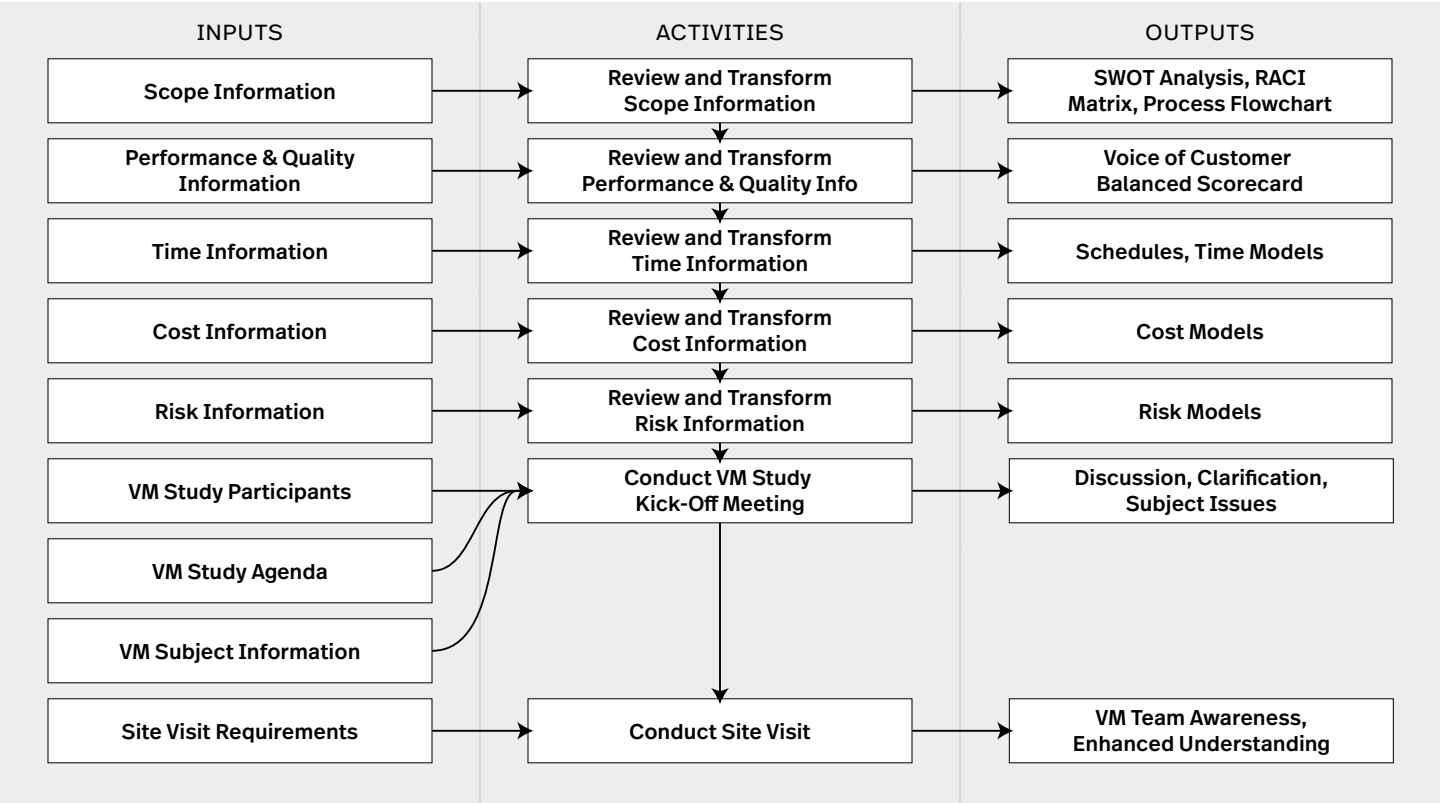


Figure 5.1 – Information Phase flowchart

5.3.1 Reviewing and transforming subject scope information

Scope information describes and defines what the subject "is." Examples of scope information include project charters, product descriptions, basis-of-design reports, space planning documents, drawings and plans.

The types of information related to a subject's scope may include, but are not limited to, the inputs identified in Section 5.2 above. Most of these information types are either self-explanatory or defined in the Terms and Definitions section of this chapter.

While it is important to understand the information that defines what the subject is, additional information stating what it "is not" is also helpful. This type of information is often referred to as constraints or limitations and can help clarify for the VM study team how the subject scope is defined.

It is essential that the VM study team have a clear understanding of who the customers, users and stakeholders are and what their interest is in the subject and their influence on scope. Stakeholder analysis is an important activity, and there are numerous techniques that can be employed to perform this.

Process flowcharts are particularly useful for VM studies where the subject is a process or service (detailed in Section 5.4.4). Experience shows that most processes, in practice, occur differently than how they are documented – if they are documented at all. Development of a process flowchart as part of a VM study can help validate existing processes as well as establish a baseline for poorly documented ones. The creation of a process flowchart, by virtue of listing all activities, also generates a work breakdown structure. Adequate scope information is the foundation from which all cost, schedule, and risk information emanates. A good WBS provides the building blocks on which to build this information for many subject types, especially for processes and services.

5.3.2 Reviewing and transforming subject performance and quality information

It is of vital importance that the VM study team have quality information and a clear understanding of the subject's performance. Depending upon the nature of the subject under study, this information can be obtained through a variety of techniques, including interviews, surveys, and focus panels as well as through documentation such as specifications, requirements, quality management plans, and terms of reference.

Performance and quality information is vital in understanding "how well" the subject must deliver its functions. This information can be either qualitative or quantitative in nature. Examples of performance information for an elementary school project might include:

- Compatibility of the interior spaces to the educational program;
- Flexibility of classrooms for accommodating small or large class sizes;
- Energy efficiency of the building envelope;
- Safety and convenience of vehicular circulation for bus and parental pick-up areas;
- Number of parking spaces and proximity to the building; and,
- Degree of site illumination for safety and to support nighttime activities on playing fields.

This information may be readily available, or it may require the application of some of the basic techniques identified in Section 5.4 to identify and define.

A key concept related to performance is identifying the degree and customer preference for performance. Performance scales can be developed that identify minimum acceptable and ideal levels of performance. There are a variety of prioritization techniques that can also be used to help determine the relative priorities of different performance attributes using more sophisticated multi-criteria decision analysis (MCDA) techniques. Regardless, the goal of this activity is to ensure that the VM study team has a thorough appreciation of how customers and stakeholders perceive and understand performance.

Quality, as discussed in Section 2.5, can be viewed as synonymous with "performance," or it can be considered as how well something conforms to its specifications. With respect to the latter, quality information may be useful for identifying where quality is deficient, revealing opportunities for value improvement. For example, a consumer product will likely have information related to manufacturing defects and/or warranty issues. It is important to understand this information and transform it into meaningful insights

5.3.3 Reviewing and transforming subject time information

A thorough review of a project's time, or schedule, information is an important step in the Information Phase. Hopefully, the project will have a well-developed work breakdown structure (Refer to 5.1.15.). The VM facilitator should be aware that a WBS may exist at several different levels within the project. For instance, one WBS may define the delivery of the design of a facility, while another WBS may define its construction. Depending on the timing and scope of the VM study, one or both work breakdown structures may be relevant.

A project schedule is generally derived from the WBS. Numerous project scheduling tools and techniques for project managers exist. Some of the more prevalent software programs on the market today include Microsoft Project® and Primavera P6®. Programs such as these allow detailed schedules to be de-

veloped from a WBS. In addition, these programs allow project resources to be linked to activities occurring within the WBS.

There are several different ways in which a project schedule can be graphically represented, all of which can be accomplished using project management software. These include bar charts (also known as Gantt charts) and network diagrams (also known as PERT–program evaluation and review technique–charts). Gantt charts are useful for showing the relationship of activity start and end dates. These are easy to read and are the standard schedule representation used for most applications.

If a Gantt chart is used, it can be further articulated by identifying the critical path of the schedule, which represents a series of key activities that drive the total duration of the schedule. Identifying the critical path can help the VM study team spot opportunities for adding value to the subject by focusing on innovative ways to modify, reduce, or eliminate critical path activities.

5.3.4 Reviewing and transforming subject cost information

As mentioned in the previous section, the potential for achieving major savings in any project is greatest during the early phases of the project life cycle. It becomes increasingly expensive and time-consuming to make changes, regardless of benefits, as the project progresses toward completion. Finally, a point is reached where the cost to make a change exceeds any potential benefit; it is then simply "too late." Therefore, application of the Value Methodology at an early phase is important.

As one writer has put it, "Cost is the principle dimension in value analysis. Without cost for comparison, the analysis of value must necessarily be subjective–and consequently fall short of the full potential."1 It is desirable to develop a cost estimate for each VM proposal, which can then be compared to the subject's baseline. Yet in the early phases of a project, when the potential for savings is at a high point, many areas that are to be estimated are not yet clearly defined. Only after the project is well advanced and everything has been fully developed can the task of estimating project costs be made relatively easy and straightforward. Unfortunately, by this time it may be too late to change, and the cost to redesign will be too high and many VM proposals must be dropped by the wayside. It is essential, therefore, to look at methods by which the VM facilitator can gain an appreciation of costs very early in the project cycle.

Cost is one of the most misunderstood items in business today. The cost of a product under study may vary greatly, depending upon whom you ask and the level of cost with which they are familiar. Is the cost fully burdened? Does it include profit? Is it just material cost? Construction costs, for which detailed parametric information and historical data is often available, are heavily influenced by the availability of skilled labor and vary widely from region to region. Finally, the true cost of procedures and processes within organizations is often unknown.

While a primary goal of many VM studies is cost reduction, some organizations set up their costing systems to determine whether cost and/or profit targets will be met, without necessarily answering the question of how much it costs to produce the product. As mentioned earlier, the cost of management procedures, policies, and processes may be unknown. In either case, the use of cost visibility techniques is essential in developing an understanding of project costs.

Life-cycle costs are another important aspect that must be considered. Life-cycle costs reflect the total cost of ownership of the VM study subject. Techniques to analyze life-cycle costs are presented in Chapter 9.

Cost visibility techniques establish costing ground rules to determine what is included in the project cost. This helps the VM study team organize the cost and understand the current cost situation, including the cost-driving elements.

First, determine the appropriate level of cost for the subject, depending on the stage of its life cycle. For example, a VM study focusing on the construction of a new hospital early in the design process would probably use area costing (i.e., cost per square meter). A study focusing on an existing product would utilize detailed unit production costs (i.e., bill of materials). Once a level of costing has been decided on, it is important to maintain whatever level was chosen throughout the VM study in order to maintain consistency and avoid confusion in communicating the cost of alternative concepts.

The following are several important items to consider as cost data is analyzed:

- Determine total cost. Based on the costing ground rules, determine the total cost for the subject. For goods, a product that retails to the customer for $18.29 may have a total production cost (material, labor, and some portion of overhead) of $12.79 for the purposes of the study. For construction projects, the total cost would include all design costs, contractor overhead and profit, design and estimating contingencies, real estate, and mitigation costs. For processes or services, the total cost would include direct and indirect labor costs, as well as any support costs (materials, transportation, office space, etc.).

- Determine cost elements. Break down the elements of total cost into major areas such as material, labor, and overhead. For construction studies, costs can be broken down using a standard estimating format such as Uniformat and MasterFormat.

- Determine incremental unit costs. This step identifies where costs are being created on a unit basis by component or by elements of a process. This translates into cost per hour, cost per cubic meter, or cost per subassembly.

- Determine annualized costs. To establish a base for determining cost improvements, calculate the annualized cost of the study item by multiplying the unit cost by the number of units produced per year. For product studies, annualized costs will be used at the end of the study to determine annualized savings.

- Determine life-cycle costs. Many VM study sponsors will want to consider the long-term costs associated with the maintenance and operation of products, facilities, and processes. These are costs with which the customer and/or owner will be very concerned. Life-cycle costs will be discussed in greater detail later in this chapter.

Once the subject cost data has been gathered and reviewed, the next step is to transform this "raw" cost information by modeling it. There are numerous ways in which cost models can be developed, and Section 5.4 identifies several useful methods which include initial cost models and life-cycle cost analysis. The application of such techniques is essential in helping the VM study team identify opportunities for cost improvement.

5.3.5 Reviewing and transforming subject risk information

Value Methodology can play a significant role in the management of risk by minimizing threats and maximizing opportunities. The first step in addressing project risk is to gather and review the project risk information. This includes the project's risk management plan, risk register, any qualitative or quantitative risk analysis, and the risk response plan.

As the discipline of project management becomes more sophisticated, the management of risk has drawn increasing attention. The tools, techniques, and training available to project managers and team members have grown rapidly in recent years, and it is likely that some level of risk information will be available to the VM study team. Figure 5.2 below outlines the steps involved in risk management.

The following is a brief description of the activities associated with each step of the risk management process:

- Risk management planning. This level focuses on determining the general approach, or strategy, for dealing with project risk. It addresses who will be involved, what activities will be performed, and how risk will be handled in relation to other project development activities.
- Risk identification. This level identifies potential project risks and formally organizes them into a risk register. Risk identification includes the following steps:
    - Identify risk categories appropriate for the project.
    - Brainstorm potential risks associated with each strategy.
    - Organize, prioritize, and define key project risks.
    - Set up the risk register.
- Risk analysis. This level expands upon the risk register by further analyzing potential risks. Risks are categorized according to their probabilities and impacts.
    - Identify the most critical risks by analyzing the risk register to permit appropriate focus on the top 10 – 20 risks.
    - Identify the risk event description.
    - Develop a detailed description concerning the potential impact of the risk event.
    - Identify best case, worst case, and most likely scenarios.
    - Define the probability that the risk event (regardless of its degree of impact) will occur.
    - Define the impact of the risk. At its basic level, risk impacts can be described qualitatively using terms like high, medium, and low. If the analysis is more sophisticated, it will include actual quantities such as money and time.
- Risk response planning. This level concerns the identification and development of strategies and action plans to deal with risks by reducing threats and enhancing opportunities.
- Risk monitoring and control. This level is where risk is actively measured and managed. Identified risks are tracked, old risks are retired, new risks are added, response plans are executed, and the effectiveness of the risk management plan is monitored.

The project's risk management plan will provide an overview of how the project is addressing risk. The level of detail and complexity with which this is done varies from project to project. Ideally, the project will at least have a risk register available for the VM study team to review. A risk register will provide information on specific risks to the project and should include at least some qualitative analysis on them, including their probability and impacts.

If no qualitative analysis has been performed, the VM facilitator should consider adding this activity to the VM study agenda, either as part of the VM study or as a separate activity performed prior to it. If the project team has not performed any form or risk management, then it is likely that they are unaware of what risks exist and how they could impact the project. If the risks are known and have at least passed through some degree of previous analysis, then the VM study team will be in a better position to consider threat mitigation and opportunity enhancement strategies.

Figure 5.2 – Information Phase Flowchart

5.3.6 Conducting a VM study kick-off meeting

The team portion of the VM study should always begin with a kick-off meeting. The kick-off meeting orients the participants to the VM study process and the subject information. The kick-off meeting should focus on the following activities:

- Introduce the VM study process, objectives, and agenda;
- Provide an overview of the subject of the VM study;
- Identify constraints and stakeholder issues related to the subject; and,
- Perform any additional information gathering as appropriate.

The VM study kick-off meeting should be attended by the VM study team, design/engineering team (if applicable), owner and/or study sponsor, customer representative(s), and any other stakeholder(s), as prudent, who have a vested interest in the project.

It is likely that the majority of those present at the kick-off meeting will be unfamiliar with the Value Methodology and may not understand the importance of conducting a VM study. The VM facilitator must always keep in mind that the performance of a VM study involves a significant allocation of time, money, and resources. Some individuals will question the need for conducting the VM study in light of the cost, which is why it is important that the VM facilitator carefully and effectively communicate to participants the VM study process, objectives, and agenda. Copies of the VM study agenda should be distributed to all participants, and an attendance sheet should be distributed to the group so that names and contact information can be documented.

After all participants have been properly introduced, the VM facilitator should begin by clearly stating the objectives for the VM study, which should have been identified in the pre-study meeting. Following this, the VM facilitator should refer everyone to the VM study schedule and provide a brief overview of each major activity. It is important to stress that the VM study will consider all aspects of value, not just cost. As cost cutting carries with it many negative connotations, it is best to emphasize the value improvement aspects of VM to maintain a positive and collaborative VM study environment.

Often the VM study's sponsor, who may be the "owner" of the subject, will want to make a few statements regarding the study objectives and the current state of things. The importance of demonstrating the visible involvement of the study sponsor at this early stage of the process cannot be understated. The VM facilitator should always encourage this, as it sends a strong message to the participants. Management involvement is much better than management support.

An informational overview of the subject should be presented by the appropriate stakeholders. Following this introduction, a more detailed presentation of the subject should be made by the appropriate stakeholders representing expertise in the various disciplines necessary to develop key project areas. This briefing should focus on discussing major elements rather than finite technical details. A project overview focusing on a new hospital should, for example, include input from the following project team members concerning the following project elements:

- Project manager: scope statement, project history, objectives, and budget.
- Medical facilities planner: medical facility specifications, user requirements.
- Architect: functional requirements, building layout, exterior and interior finishes.
- Structural engineer: building structure.
- Civil engineer: site work, vehicular circulation, site utilities.
- Mechanical engineer: HVAC systems, plumbing, fire protection.
- Electrical engineer: electrical distribution, lighting, data and communication systems.

The point here is to acquaint the VM study team with the "big picture." Hopefully, each member of the team will have had time to conduct a more detailed review of the technical documents.

Following this presentation, the VM study team should be afforded the opportunity to ask questions and receive additional clarification concerning the information. The VM facilitator should ensure that the VM study team members utilize good interpersonal communication practices during this dialogue and that the questions are not phrased in a critical manner. The project team will be the VM study team's best source of information, making it critical that a high level of professionalism be maintained in order to foster trust and openness during the VM process.

While all the key participants are present, the VM facilitator should take the opportunity to ask the project team to identify constraints related to the project. Project constraints typically relate to issues beyond the control of the project team and may include political considerations, funding or revenue issues, regulatory requirements, and legal challenges. The VM study team must have a basic understanding of these constraints, as they will have an impact on the types of proposals the VM study team will generate later in the VM study process.

In addition to project constraints, there may be other concerns that external stakeholders will want the VM study team to consider. These may include issues related to indirect project impacts to the public. Issues of this nature are common for construction projects where there may be citizens and businesses directly or indirectly affected by the project. This information should be solicited from the stakeholders and documented. It is recommended that the VM study team record this information for all to see, so the meeting participants can be involved in the documentation of these constraints and issues.

5.3.7 Conducting a site visit

VM studies may include a site visit as part of the Information Phase. The function of a site visit, simply stated, is to allow the VM study team to observe the subject. A site visit provides

VM study teams with an excellent opportunity to gain valuable information about the subject that may not otherwise be obtained through other means. A site visit, depending on the nature of the subject of the VM study, might include:

- Project. A VM study focused on a new highway interchange might involve a visit to the location where construction will occur. The VM study team may walk the site; observe the operation of existing traffic; consider potential traffic detours; identify construction access opportunities; identify potential utility conflicts; and, identify adjacent property impacts.
- Product. A VM study focused on the improvement of a forklift might involve a visit to a warehouse where multiple competitor forklifts have been staged. VM study team members could operate and observe the different forklifts and compare their function and performance. Similarly, certain sub-assemblies of the vehicles could be disassembled and inspected.
- Process. A VM study focusing on a facility inspection process might involve having the VM study team accompany an inspector to observe how that person performs the work. This would allow the VM study team to ask questions of the inspector; record how long it takes to perform certain activities; and, observe the inspection methods and techniques employed.
- Service. A VM study focused on a fast-food restaurant customer experience could be observed whereby members of the VM study team act as customers. During this experience, they could interact directly with the restaurant staff and gauge the quality of their work; inspect the quality of the food; and, survey the restaurant environment relative to its impact on their own customer experience.
- Organization. A VM study focused on developing a strategic plan for a public agency might conduct interviews with groups of employees to ask them about their experiences and share their insights about working in the organization. A SWOT analysis format might be employed to help identify what works well within the organization and not as well as to target potential threats and opportunities.

Sometimes, it may be advisable to schedule a site visit a week or more prior to the VM study. This allows for adequate time to visit the site which may be in a different physical location than the study. Scheduling the site visit in advance also allows time for additional analysis of the information that is gathered, thereby making it more useful during the performance of the VM study.

5.4 Basic techniques

5.4.1 Voice of the customer

One of the simplest and most effective techniques for gathering information on scope, performance, and quality is to gather it directly from customers, users, and other stakeholders through interviews, surveys, and focus panels. This group of techniques can be used to gather and analyze information on a number of important questions, including (but not limited to):

1. What are the customer and/or stakeholder problems or needs?
2. What are the customers and/or stakeholder priorities?
3. What are the strengths and weaknesses of the study subject?
4. How well is the current approach meeting the customer's needs?
5. What are the stakeholder issues?
6. How does the customer define value?

The answers to these questions are essential for the VM study team to understand if they are to improve customer value.

Techniques for capturing the voice of the customer include, but are not limited to:

- Interviews
- Focus panels
- Surveys
- Questionnaires
- Product or service reviews
- Technical support feedback
- Warranty feedback
- Experts opinions
- Tracking of customers' behavior
- Customer satisfaction assessment
- Online product reviews
- Quality function deployment (QFD)
- Field reports
- Market demands
- Complaints log.

Interviews involve scheduling a time and place to interact directly with customers and stakeholders. This can be accomplished through phone calls, videoconferencing, or in face-to-face meetings. Interviews should be designed in advance with input from the VM study sponsor and their representatives. A script should be developed that includes key questions. Questions should be open-ended in nature to lead to rich discussion and dialog, rather than simple yes or no responses. Interviews have the advantage of allowing the interviewer to ask follow-up questions based on initial feedback. Generally, this method is recommended when there are individuals who have critical input and/or limited time. A 10 – 30-minute interview can obtain a significant amount of important information.

A focus panel (or focus group) is a interview variation that involves selecting a cross section of customers who typically provide feedback on a specific product or service. Focus panels can be used to:

1. Obtain feedback on customer satisfaction.
2. Identify marketing issues on product acceptance, features, ideas for future products and services, and other related issues.
3. Understand how well customers' expectations are being met in the area of customer service.
4. Obtain leverage to identify value improving opportunities.

One of the key ideas behind focus panels is that they should involve multiple customers at the same time. The purpose is to create a group conversation around the VM study subject and to have customers share their experiences.

Surveys provide a less direct means of asking questions like those that might be asked in an interview. Surveys are useful when trying to elicit feedback from many respondents. They have the advantage of potentially being anonymous and more candid, but often do not gather as much useful information as interviews or focus panels. Nowadays, there are many ways to conduct surveys easily and efficiently through the internet using e-mail or specially designed software as a service platform. Survey questions should be thoughtfully designed to ensure that responses are useful and meaningful. They should be developed in conjunction with the VM study sponsor and their representatives.

All these techniques can be structured, if desired, in the form of a SWOT analysis which will be further detailed in Section 5.4.2. In all cases, the VM facilitator should ensure that all feedback is recorded so that it can be referred to later in the VM study process. Oftentimes, the raw feedback is organized, categorized, and summarized into a report, presentation, or through the use of charts and graphs.

5.4.2 SWOT analysis

SWOT is an acronym that stands for strengths, weaknesses, opportunities, and threats. SWOT analysis involves organizing a group of stakeholders and leading them through a discussion focused on those four topics. SWOT is best performed by framing these topics in the form of questions:

- Strengths: "What is currently working well?"
- Weaknesses: "What is not working well or needs improvement?"
- Opportunities: "What positive things could occur in the future that could add value?"
- Threats: "What negative things could occur in the future that could degrade value?"

Alternatively, SWOT can be reframed slightly to think of strengths and weaknesses as being internal attributes (easier to control or change) and opportunities and threats emanating from the external environment (more difficult to manage or control). The facilitator should lead the conversation and elicit feedback from the stakeholders. Oftentimes a flipchart or whiteboard can be used, and the information captured in a simple 2x2 matrix (**Figure 5.3**).

	Helpful To achieving the objective	**Harmful** To achieving the objective
Internal	Strengths	Weaknesses
External	Opportunities	Threats

Figure 5.3 – Example SWOT analysis matrix

SWOT analysis can be combined with other information gathering techniques, such as by leveraging it in interviews, focus panels, and surveys. For example, a survey could be designed using a SWOT structure. The feedback from this could be summarized and shared with a group of stakeholders and then used to elicit additional feedback in the form of an interview or focus panel.

5.4.3 RACI matrix

RACI is an acronym that stands for responsible, accountable, consulted and informed. A RACI matrix is used to identify the level of stakeholder involvement for various activities or elements. For example, the activities of a WBS could be cross-indexed with stakeholders to identify their roles.

The four terms are defined as follows and are illustrated in Figure 5.4 :

- *Responsible:* A stakeholder who is identified as "responsible" means that they are tasked with performing the activity or completing the task.
- *Accountable:* A stakeholder who bears the responsibility of ensuring that an activity or milestone is achieved. Oftentimes, this involves managing or overseeing the work that is performed by those that are "responsible."
- *Consulted:* A stakeholder whose input or feedback is explicitly required for a given activity or milestone.
- *Informed:* A stakeholder who is kept apprised of the status of an activity or progress toward achieving a milestone.

RACI matrices are particularly useful for understanding processes and services. They can help identify communication gaps and potential communication risks.

5.4.4 Process flowcharts

A process flowchart is a way to illustrate the sequence and interrelationships between the activities of a process or service. The VM study team may be either the recipient of a process flowchart developed by others or they may need to construct a flowchart where none exists.

Nowadays, there are several commercially available software programs facilitate the construction of flowcharts, such as Microsoft Visio® which allow flowcharts to be easily developed. Flowcharts use a common symbol language comprised of different shapes, lines, and arrows. The standard ANSI and ISO symbols are identified in Figure 5.5 .

Flowcharts can be created horizontally and/or vertically. They provide a simple but powerful way to describe a process and, using the symbol language identified above, can convey a significant amount of information that is easy to understand and follow. "Yes" and "no" statements, or probabilities, or other conditional information can be added to the connecting lines of a flowchart to identify the underlying process logic. Figure 5.6 provides an example of a simple flowchart.

A common technique in developing flowcharts is to leverage interviews or focus panels to elicit process flow information which is then used to develop a flowchart. This excellent approach allows for the interviewees to provide feedback on the sequence and logic of the flowchart as it is developed.

	Buyer	Seller	Agent	Lender	Escrow
Identify Property	**A**	**I**	**R**	**I**	**I**
Negotiate Price	**A**	**A**	**R**	**C**	**I**
Open Escrow	**I**	**I**	**C**	**C**	**A**
Obtain Financing	**A**	**I**	**I**	**R**	**I**
Close Purchase	**A**	**A**	**I**	**I**	**R**

Figure 5.4 – Example RACI Matrix

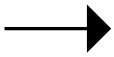
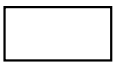
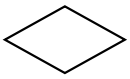
Standard Shape	Name	Description
	Flowline (Arrowhead)	Shows the process' order of operation. A line extends from one symbol and points to another. Arrowheads are added if the flow is not the standard top-to-bottom, left-to-right.
	Terminal	Indicates the beginning and ending of a program or sub-process. Represented as an oval or rounded (fillet) rectangle. They usually contain the word "Start" or "End" or another phrase signaling the start or end of a process, such as "submit inquiry" or "receive product."
	Process	Represents a set of operations that changes value, form, or location of data. Represented as a rectangle.
	Decision	Shows a conditional operation that determines which one of the two paths the program will take. The operation is commonly a yes/no question or true/false test. Represented as a diamond.
	Input/Output	Indicates the process of inputting and outputting data, as in entering data or displaying results. Represented as a parallelogram.
	Document	Indicating a specific document, form, or other formal modality for recording information.
	Predefined Process	Shows named process which is defined elsewhere. Represented as a rectangle with double-struck vertical edges.
	On-page Connector	Pairs of labeled connectors replace long or confusing lines on a flowchart page. Represented by a small circle with a letter inside

Figure 5.5 – Flowchart symbols and their meaning

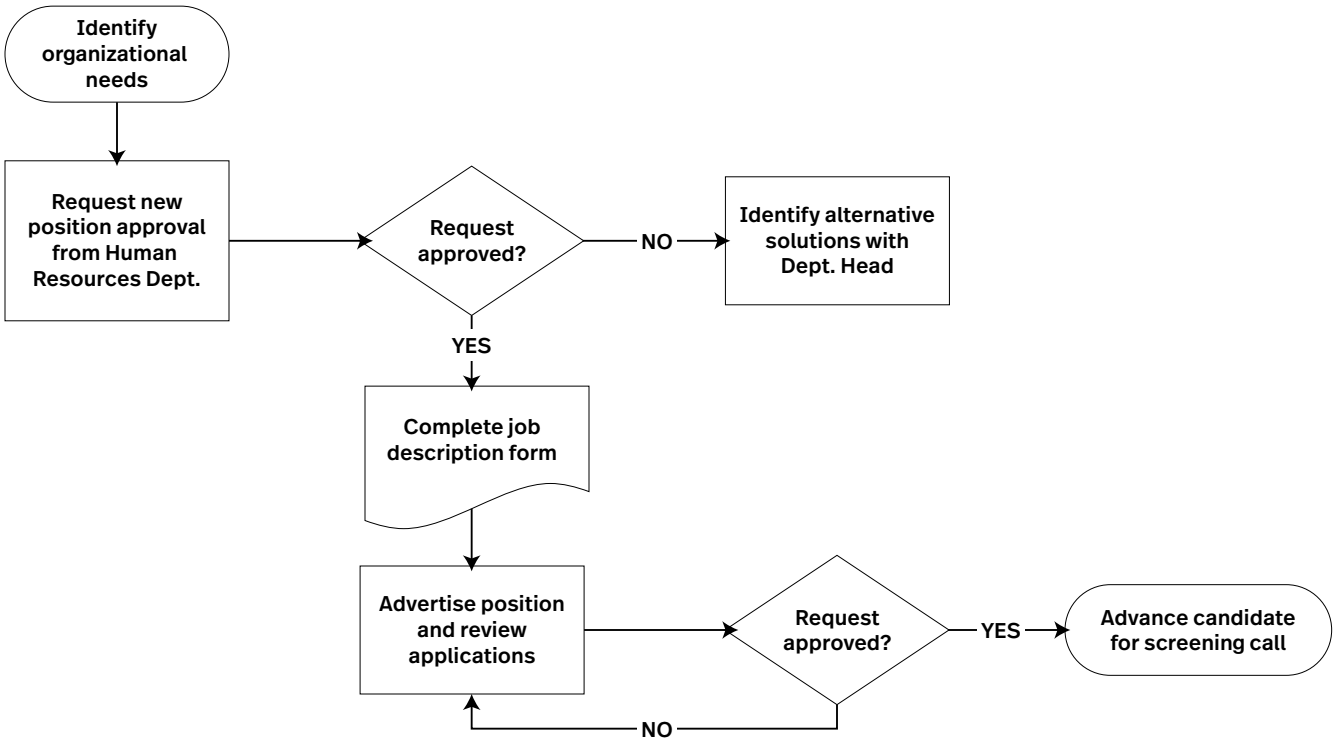


Figure 5.6 – Example process flowchart for a staff recruiting process

5.4.5 Balanced scorecard

The balanced scorecard is a method that was originally developed as a strategic management tool and introduced to the business world in the 1990s. As a strategic management tool, it is used to consolidate the objectives, key performance indicators (KPIs) and targets, and initiatives relative to four "perspectives." These included:

- Financial. What are the financial (cost) objectives? KPIs might include: initial cost, life-cycle cost, cash flow, sales growth, operating income, return on equity, etc.
- Customer. What is important to the customers and stakeholders? KPIs might include: performance specifications, quality standards, customer satisfaction, repeat customers, etc.
- Internal business processes. How do we deliver our products and services? KPIs might include: cycle time, unit cost, yield, new product introductions, etc.
- Learning and innovation. How can we continue to improve, create value, and innovate? KPIs might include: time to develop a new generation of products, life cycle to product maturity, time to market versus competition, etc.

RESTAURANTS – BALANCED SCORE CARD							
	STRATEGIC OBJECTIVES	KEY PERFORMANCE INDICATORS	TARGETS			INITIATIVES	
			CURRENT	INTERVAL	NEXT	PROGRAMS	BUDGET
COST / FINANCIAL	Increase company profitability	% Net profit margin	7%	Q	12%	N/A	N/A
		$ Net cash flow	22.101	M	24		
	Optimize revenue and expenses	$ Sales to date	30.564	Q	35.05		
		$ Cost per call	0.24	M	0.12		
CUSTOMER / QUALITY / PERFORMANCE	Maintain high levels of customer satisfaction	% Survey excellent score	32%	Q	50%	Begin customer rewards project Project to train employees on new customer rewards	$5,000.00 initiative 0.5 hour per employee
		% Call abandon rate	16%	M	10%		
	Increase customer profitability	$ Revenue per client	300	M	350		
		$ Average new customer acquisition cost	12	M	5		
	Build and improve the customer network	# New customers	315	M	350		
		% Market share	6%	Q	10%		
TIME / SCHEDULE	Increase call-handling expertise	Average call handling time	315	M	350	Training for call handlers Review the service delivery process	0.25 hour per call handler 5 hours manager
		% Scheduling adherence	6%	Q	10%		
	Improve service delivery	% Processes optimized	9	M	7		
		% Active projects running on time	75%	M	85%		
		and on budget	50%	M	55%		
			50%	M	50%		
LEARNING / THREATS / OPPORTUNITIES	Build a culture that encourages innovation	# Employee engagement index	27	Q	40	Ask for and reward employee ideas that improve processes Write up employee innovations in the company newsletter Determine bonus structure for successive years of service Group to decide rewards for completed training programs	$25/idea, $5,000/ successful idea Groups 5 hours manager 1 hour manager
		# Ideas received for new/ improved service from employees	25	M	25		
	Nurture high-performing employees	% Employee satisfaction	75%	Q	85%		
		% Employee turnover	9%	M	5%		
	Continuously improve skills and competence	# Training hours per full-time employee	15	M	18		
		% Employees meeting professional development requirements	72%	Q	85%		

Figure 5.7 – Example of a balanced scorecard used for a VM study.

Many variations can be made on the balanced scorecard concept. For example, a "value scorecard" might consider similar questions framed from the standpoint of the elements of value: performance/quality, cost, time, and risk (Figure 5.7).

The balanced scorecard technique can be used to summarize key subject information in a way that the VM study team can easily digest and understand. Further, this technique can be combined with the various voice of the customer methods to develop a better understanding of the subject's performance objectives.

5.4.6 Gantt chart

The Gantt chart, named after its inventor, Henry Gantt (1861-1919), is the most common technique used for communicating time information. It is a graphical way of communicating the duration, interrelationship, and sequence of activities involved in the execution of a project or process. Gantt charts are usually presented as a horizontal bar chart. Gantt charts are constructed by listing the activities and/or milestones of a project or process along the vertical axis and the start and end dates along the horizontal axis. Most scheduling software available allows a WBS to be entered, with the start and finish dates (which indicate the total duration) added, automatically creating a Gantt chart (Figure 5.8).

This Gantt chart shows 10 activities that are associated with the staff hiring process. Activities that have a duration associated with them are shown as bars, and milestones (which have no duration and represent key accomplishments) are typically shown as diamonds. Lines with arrows connecting the activity bars and milestones indicate dependencies. For example, Task 6 (Submit form to HR Dept.) can only occur after completing Task 5 (Complete position request form). This example was created using Microsoft Project®, however other software tools such as Microsoft Excel® and Microsoft Visio® can be used to create Gantt charts.

Gantt charts can be further articulated to show the "critical path" of the project or process. This is usually achieved by color coding all the tasks involved in determining the total duration of the project. Color coding is especially helpful in large, complex projects and processes having hundreds of tasks. Tasks on the critical path should be of interest in a VM study, as they offer the greatest opportunity for schedule improvement. It should be noted, however, that other tasks not on the critical path could become part of it should their durations or dependencies change.

The subject of a VM study may not have a Gantt chart prepared. If this is the case, the development of some form of time or schedule model should be considered. Gantt charts are recommended, as they provide a clear, understandable model of the element of time for the subject under study.

5.4.7 Cost models

Cost models provide a means to organize and communicate cost information for the purpose of improving cost visibility. Any type of cost information can be modeled, including initial costs and life-cycle costs. The first step in preparation of a cost model is to validate the available cost information. The reason for verifying cost information is to ensure that cost information aligns with the scope and schedule information. Sometimes, there is a disconnect with this information, which means that the costs may not be accurately captured. If there are discrepancies in the costs, these should be identified early to avoid confusion or misunderstanding during the later phases of the VM study.

To construct a cost model, the VM facilitator, or cost SME, organizes cost by specific categories such as component, assembly, process, construction trade, system, or another logical breakdown. This helps the VM study team at the beginning of the VM study to know where the major costs are to be found. Typically, this information is communicated using a bar chart.

Oftentimes, cost models include a Pareto distribution, or curve, which augment the cost model. Italian economist Vilfre-

ID	Task Name	Duration
1	**Staff Hiring Process**	**33 days**
2	Identify organizational needs	**0 days**
3	Conduct monthly HR planning meeting	**1 day**
4	Define staff position needed	**5 days**
5	Complete position request form	**1 day**
6	Submit form to HR Dept.	**0 days**
7	HR Dept. reviews request	**10 days**
8	Complete position description form	**5 days**
9	Create job posting	**1 day**
10	Review candidate applications	**10 days**
11	Schedule candidate phone screening calls	**0 days**

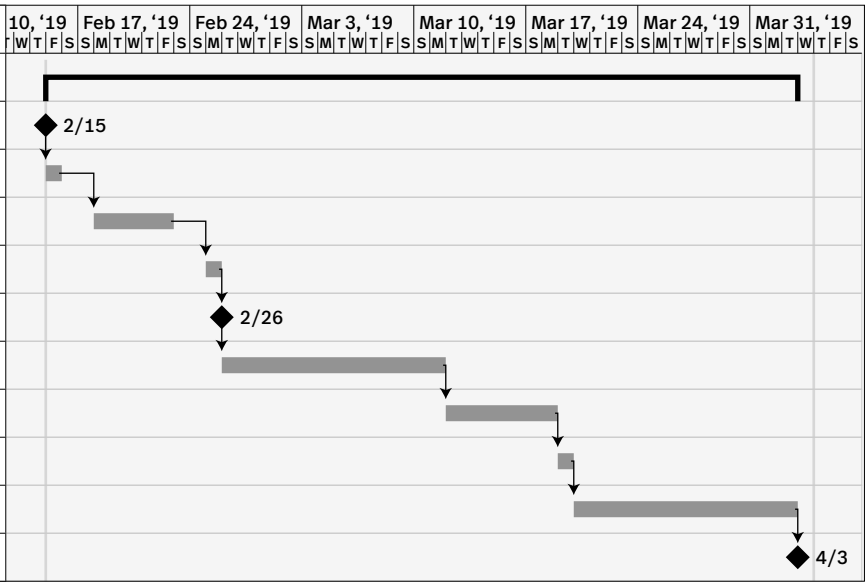


Figure 5.8 – Gantt chart of a hiring process

do Pareto (1848–1923) developed the curve known as Pareto's law of distribution. This cumulative distribution function can be applied to any system in which a significant number of elements are involved. It points out that, in any area, a small number of elements (20 percent) command the greater percentage of total cost (80 percent). A Pareto cost model is constructed by first creating a bar chart where the cost items are sorted from high to low (moving left to right), while a cumulative distribution (Pareto curve) is overlaid. A Pareto cost model is a simple but effective technique for focusing attention on those cost items that have the greatest contribution to total cost and can point to opportunities to improve value (**Figure 5.9**). It should be emphasized that Pareto distributions can be applied to other elements as well, such as time, performance and risk – whatever is important to the customer or user.

5.4.8 Risk registers and scoring

Understanding risk information is important to improving value. A core risk management technique that all VM practitioners should be familiar with is the development of a risk register. A risk register includes the following information as illustrated in **Figure 5.10** .

- Risk ID: A number or code assigned to each risk.
- Risk category: It is common practice to group risks into specific categories. For example, risks for a construction project might label the groups as environmental, real estate, design, construction, utilities, and geotechnical.
- Risk type: Is the risk a threat (negative) or an opportunity (positive)?
- Risk description: A detailed description concerning the nature of the risk, its trigger, and whether it may be a recurring event. Use the acronym SMART, which stands for "Specific, Measurable, Attainable, Relevant, and Timebound," to develop the risk event description.
    - Specific. A good event description should answer the following questions:
        - Who. Who is involved? Who is responsible?
        - What. What will happen?
        - Where. Where will it happen?
        - When. When might it happen? Could it happen more than once?
        - Why. Why will it happen? What causes it to happen?
    - Measurable. Establish concrete criteria for how you will know when the risk occurs.
    - Attainable. Think of "attainable" as "manageable." Can the risk be managed or controlled in the first place? This was discussed earlier in the chapter, but consider it in greater detail. Sometimes risks that initially appear to be manageable turn out to be quite unruly.
    - Realistic. To be realistic, the risk must be something that has some probability of occurrence. For example, something like "Godzilla rises from the sea and destroys the job site" probably isn't very realistic. At least, let's hope not!
    - Timely. A risk should be grounded within a time frame. Without assigning a duration of time to a risk, no sense of urgency is communicated. When in the project's life cycle might the event occur`? During design? During environmental review? During construction?
- Probability: Define the probability that the risk event (regardless of its degree of impact) will occur.
- Impact: Identify the degree of impact to the subject.

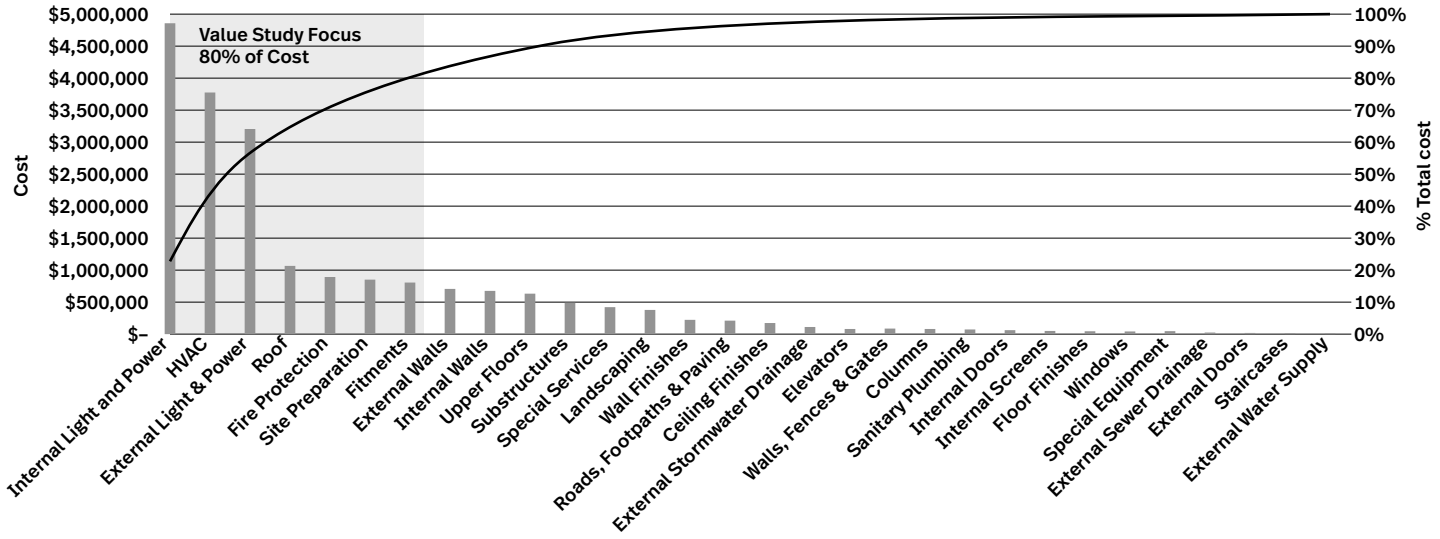


Figure 5.9 – Pareto Cost Model.

ID	Category	Type	Title	Description	Probability	Impact
1	Environmental	Threat	Wetlands Mitigation	Lack of land availability for wetlands or habitat restoration. The environmental review has not yet been completed and it is possible that the extent and quality of the impacted wetlands has been underestimated. This could affect the mitigation ratios.	Medium	High
2	Geotechnical	Threat	Poor Soils	Lack of good soils data could result in incorrect assumptions about the foundation systems required for the building. This could affect the design, cost and schedule of the foundation system.	High	Medium

Figure 5.10 – Example risk register for a construction project.

The basic information included in a risk register is an excellent way of organizing risk information. A risk model may be developed using information from a risk register. The probability and impact of each risk requires some level of analysis. At its simplest form, qualitative risk analysis seeks to characterize the overall criticality of the risk using descriptive terms such as high, medium, and low. The two values for probability and impact are often represented using a simple matrix or risk heat map.

Probability		Threat / Opportunity				
Very High 95%	5	5	10	15	20	25
High 75%	4	4	8	12	16	20
Medium 50%	3	3	6	9	12	15
Low 25%	2	2	4	6	8	10
Very Low 5%	1	1	2	3	4	5
Impact		1	2	3	4	5
		Very Low	**Low**	**Medium**	**High**	**Very High**

Figure 5.11 – Example of a risk heat map.

The example risk heat map in **Figure 5.11** assigns numerical values to the impacts and probabilities. These can be multiplied to produce a risk score. For example, a risk with a medium probability and a high impact would be scored a 12. It is recommended that some thought be given to establishing the meaning of these qualitative terms. For example, a “medium” probability means a 50 percent chance of the risk occurring, while a “high” cost risk might have a range of $100,000 to $200,000. This will help the participants involved in the risk analysis develop a clearer idea of what these qualitative terms mean and improve the analysis. This resulting risk score can then be used to rank and prioritize the risks. A VM study can provide an excellent vehicle for improving value by minimizing risk.

5.4.9 Work breakdown structure

A method of defining all the work involved in delivering a project, product, or process using a hierarchical structure. The Project Management Body of Knowledge® defines a WBS as "a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables." A good WBS focuses on the final outcome which appears at the top. Deliverables are organized into work packages which usually focus on major achievements or milestones. The process for building a WBS is as follows:

1. Identify the major deliverables.
2. Identify the major supporting activities and minor deliverables.
3. Organize and structure the deliverables into work packages.
4. Assign responsibility for deliverables.
5. Verify the WBS is correct

It is important that the VM facilitator understands work breakdown structures and how to read them. Work breakdown structures are commonly used in many applications and often form the basis of schedules (see Gantt charts above). They are sometimes used to structure cost estimates and bills of materials. A WBS follows a standard coding system as illustrated in **Figure 5.12** .

1. New Product
    - 1.1. Market Research
        - 1.1.1. Focus Groups
        - 1.1.2. Surveys
        - 1.1.3. Research
        - 1.1.4. Market Research Findings
    - 1.2. Product Design
        - 1.2.1. Design
            - 1.2.1.1. Research Evaluation
            - 1.2.1.2. Design Document
        - 1.2.2. Concept Models
        - 1.2.3. Design Selection
    - 1.3. Product Development
        - 1.3.1. Bill of Materials
        - 1.3.2. Initial Prototype
        - 1.3.3. Prototype Testing
        - 1.3.4. Production Development Sign-Off
    - 1.4. Production Planning
        - 1.4.1. Production Design
        - 1.4.2. Production Testing
        - 1.4.3. Production QA Design
        - 1.4.4. Production Plan Sign-Off
    - 1.5. Marketing
        - 1.5.1. Marketing Strategy
        - 1.5.2. Marketing Plan
        - 1.5.3. Marketing Collateral
            - 1.5.3.1. Brochures
            - 1.5.3.2. Advertising
            - 1.5.3.3. Commercials
    - 1.6. Project Management

Figure 5.12 – Example of a work breakdown structure (WBS) describing a new product development process

In the example above, it is easy to see how the WBS could be easily converted into a schedule by assigning durations for each work package.

5.5 Informative References

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6
Function Analysis Phase

6.0 Introduction

Function analysis embodies a group of techniques within the Value Methodology that sets it apart from traditional cost reduction and problem-solving efforts. A function is the specific purpose or intended use for any product, process, service, organization, or project that makes it work or sell. In short, it is the reason why the owner, customer, or user needs a thing.

The Function Analysis Phase encompasses the following activities:

1. Define Functions. This activity is focused on identifying, classifying, and organizing functions. The following three supporting activities may be performed together or in sequence, based upon the various techniques used.
    - Identify functions. The most used technique is random function identification. Random function identification is just that, randomly listing functions of the overall subject being studied.
    - Classify functions. The key techniques of classification are the same as the first step. Each function identified is classified as basic and secondary.
    - Organize functions. To ensure that all functions have been identified, FAST diagrams are commonly used and highly recommended.
2. Allocate resources and performance. This activity correlates resources (i.e., time, money, etc.) to functions. The most common technique used is the development of a function-resource matrix. Project resources may then be distributed among the functions appearing on a FAST diagram.
3. Prioritize functions. The outcome of completing the above activities is identification of the functions presenting the best opportunity to improve value..

These activities are tied together into a process known as function analysis **Figure 6.1** . This process is perhaps the single most important and useful technique in Value Methodology; however, it is the most difficult to explain and the most difficult to grasp and put into practice. For further reference, readers are encouraged to consult the Function Analysis Guide prepared by SAVE International® and the Miles Value Foundation. This excellent resource is dedicated solely to the practice and application of function analysis.

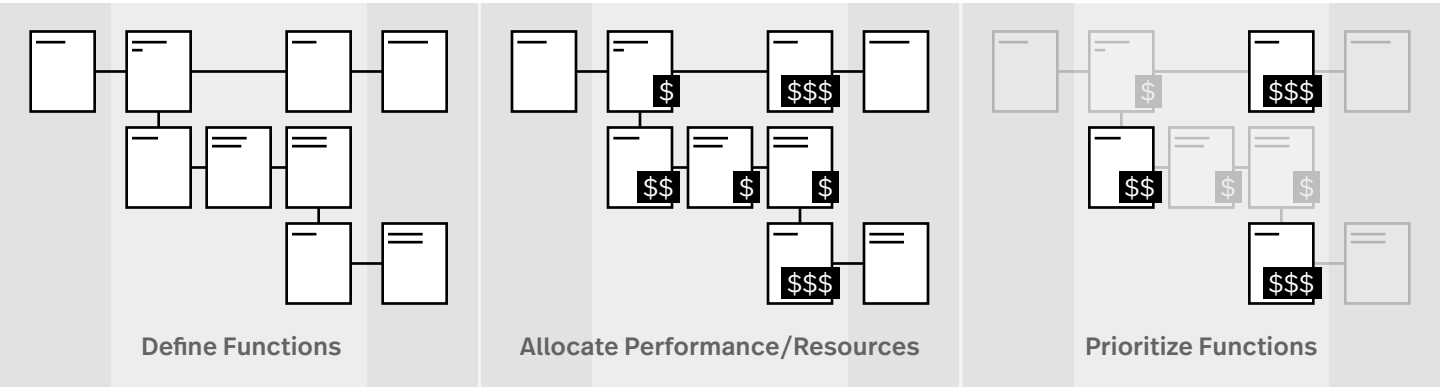

Figure 6.1 – Steps of Function Analysis

6.1 Terms and definitions

6.1.1 Activity

A specific task, action, or operation that describes how a function is performed. For example, the activity "pour coffee" describes how the function "dispense liquid" is performed. Activities are the means leading to the attainment of a function.

6.1.2 FAST

The Function Analysis System Technique (FAST) is a group process that creates a diagrammatic representation of the HOW-WHY logic of functions, and their interrelationships, of a project, product, process, service, or organization under study.

6.1.3 Function

A non-specific, two-word abstraction, consisting of a verb and noun, that describes what an element of a project, product, process, service, or organization does.

6.1.4 Function, all-the-time

Functions that happen continuously or occur on a repetitive, ongoing basis, relative to the project, product, process, service, or organization.

6.1.5 Function analysis

A detailed examination of a project, process, product, service, or organization to identify, classify, and organize its functions; allocate performance and resources; and prioritize functions for value improvement.

6.1.6 Function, basic

The essential function(s) that fulfill the purpose or intent for which a project, product, process, service, or organization exists and answers the question, "What must it do?" There can be more than one basic function.

6.1.7 Function, higher-order

The specific goals or needs that the basic function(s) fulfills and beyond the scope of the VM study subject.

6.1.8 Function logic path

All functions on a FAST diagram that are connected to each other in the HOW-WHY logic direction.

6.1.9 Function, lower-order

Functions that are not part of the scope of the VM study and are inputs for a project, product, process, service, or organization.

6.1.10 Function, one-time

A function that occurs only once relative to the project, product, process, service, or organization.

6.1.11 Function performance specification (FPS) matrix

A technique whereby the quality or performance criteria related to the subject functions are correlated along with related specification units of measure, parameters, targets, and flexibility.

6.1.12 Function resource matrix

A technique whereby the functions of a project, product, process, service, or organization are correlated to its attributes, such as space, weight, cost, time, performance, risk, etc. The purpose of a function resource matrix is to develop insight into how functions contribute to value and to aid in prioritizing which functions offer the greatest potential for value improvement.

6.1.13 Function, secondary

A function that supports the basic function(s) and results from the approach to achieve the purpose or intent of a project, product, process, service, or organization.

6.1.14 Function, unwanted

A function identified by the customer, user or stakeholder as undesirable that is caused by the approach used to achieve the purpose or intent of a project, product, process, service, or organization.

6.1.15 Random function identification

A technique that lists the elements, components, or parts of a project, product, process, service, or organization and then identifies the various functions related to them. Once the functions have been identified using this technique, they may be classified and organized for subsequent analysis.

6.1.16 Subject objectives

Functions that express specific, compulsory requirements, or articulate broader goals, of the subject, whether it is a project, product, process, service, or organization.

6.2 Process and key concepts

6.2.1 The function concept

Larry Miles' great insight was that people were not interested so much in things, but rather, what things do, which he described as "functions." Once he understood what the functions of a thing were, he realized he could usually find a different way to perform them. This is a very liberating way of thinking, as it releases the mind from the limitations of objects and allows the mind to open itself up to alternative ways of satisfying the functions.

Within the context of the Value Methodology, functions are defined using two words: a verb and a noun.

Consider the following function:

Enclose Space

The verb "enclose" answers the question, "What does it do?" This question focuses attention on the function rather than the object and leads straight to the heart of the functional approach. This is a radical departure from typical problem-solving efforts for which the first question is, "What is it?"

The noun "space" answers the question, "What does it do this to?" This simple phrasing convention is known as the "two-word abridgment." Describing a function using only two words forces us to focus our thinking in a very concise way. At the same time, the two-word abridgement is abstract. Limiting oneself to only a single verb and noun results in a very imprecise statement. The function "enclose space" could be delivered through a variety of objects and/or actions in the absence of any additional context. One way to "enclose space" could be to use a cardboard box. Another could be a glass jar. Yet another way could be to simply cup one's hands Figure 6.2 .

Figure 6.2 – Examples of things that could deliver the function "enclose space"

We can also think about functions from a different perspective by first starting with an object and then identifying its functions. For example, if we were to consider the function of a teacup, we might say "contain liquid." This describes the essential function that a cup must provide if it is to fulfill its intended purpose. It would also be equally valid to state that the function is "hold fluid." Because there are often many words that have similar meanings, there may also be many ways in which a function could be defined.

Figure 6.3 – The function of a teacup could be defined in more than one way. For example, "contain liquid" or "hold fluid" would both be valid

Another important aspect in thinking about functions is to make a distinction between two-word abridgements that define functions and activities. For example, another two-word abridgment for a teacup could be "contain tea." While the phrase "contain tea" is articulated as a verb and a noun, this statement is not a function, but rather, an activity.

An activity describes how a function is performed. Activities typically are more specific in nature, whereas functions are non-specific. The way to tell the difference is to consider the word choice for the noun component of the two-word abridgment. The noun "liquid" (as well as the noun "fluid") is non-specific in that it could be a reference to any liquid (e.g., coffee, tea, water, soda, acid, alcohol, etc.). Conversely, the noun "tea" is very specific. The statement "contain tea" will likely trigger a specific image in the mind's eye, most likely the object "teacup" or possibly "teapot." The function "contain liquid" is more ambiguous and may cause one to think of a swimming pool, a bowl, or a bucket just as likely as it would a teacup. Section 7, Creative Phase elaborates further upon this subtle, but important, difference. The proper definition of functions will be further explored in Section 6.4.1, Define Functions.

Figure 6.4 illustrates the degree of abstraction based on the conceptualization of a plastic water bottle. Beginning with objective reality, the process begins with a physical object. Emanating from this, the physical object is represented in progressively more abstract constructs ranging from symbolic to metaphysical representations. The intent of function framing is to define reality in a way that describes what things do and, in the case of higher-order functions, why they do them. This allows the maximum potential for divergent, or creative, thinking about possible solutions while still maintaining an understanding of what function must be satisfied. In this sense, it does not fixate on existing solutions, but the underlying premise upon which the current solution is founded.

6.2.2 Why function analysis?

Function analysis is a unique way of thinking and solving problems. If applied correctly, Function analysis can aid a VM study team to:

- Identify opportunities.
- Create understanding.
- Expand knowledge.
- Stimulate communication.
- Change viewpoint.

Identify opportunities is one of the primary reasons to perform function analysis. Per SAVE International®, the objective of the Function Analysis Phase is to identify the functions of the project that offer the best opportunity for the improvement of value. Remember that value improvement can be a combination of improving performance and/or reducing cost. Performance can increase at a greater rate than the increase in cost to create a value improvement.

Create understanding. After participating in function analysis, even experienced team members who have worked on the same project for years may discover a new understanding of the project for which they are responsible. The wonderful aspect of this "new" understanding is that it is a common understanding among all team members. When a team works together to develop a random function list and a FAST diagram, they create something as a team. Thus, no matter the technical background of the participants, each person can describe the product in function terms. The use of generic, non-technical functions creates a level playing field. In addition, because the entire team participated in creating the FAST diagram, there is buy-in or agreement from all team members regarding what the project under study performs.

Expand knowledge is a critical component of function analysis, as it is in other phases of the VM Job Plan. The VM study team gains new knowledge of the project under study through the presentation materials, team discussions, and the application of the function analysis process. In most cases, the majority of team members are unfamiliar with function-focused thinking. Just becoming familiar with functional thinking is a significant learning opportunity which can produce advances in the project, both technical and non-technical. Finally, this new knowledge leaves participants with tools that they can leverage to benefit both their professional and personal lives.

Stimulate communication. It is wonderful to see a team grow together with every team member involved in the function analysis phase. No matter one's background and experience, each person has a role to play during this process. The most interesting team communication or interaction occurs at the beginning of the team's effort to create the

Construct		Information	Mode	Form
Greater Abstraction ↓	Physical Object		Objective reality	Physical object
			Physical, 3-D model of object	Model, prototype
	Symbolic Image		Image capturing physical reality	Photograph
			2- or 3-D representation	Drawing, map, digital rendering
			Analogous, representative image	Pictogram
	Metaphysical Language	*"A plastic bottle approximately 8 inches tall and 3 inches in diameter that holds 12 ounces of liquid."*	Expansive description of reality	Specification, manual, code, book
		"Hold Drinking Water" or "Water Bottle"	Activity or object	A concise description of what it is
		"Contain Liquid"	Basic function	A concise description of what it does
		"Maintain Hydration"	Higher-order function	A concise description of why it does it
		"The sun sets An oblong vessel glistens Floating in endless seas"	Artistic, poetical, philosophical, or abstract representation	Abstract interpretation of reality

Figure 6.4 – Level of abstraction relative to function thinking.

FAST diagram. For example, as a facilitator, direct the team members to get out of their chairs and start to place the Post-It® Notes to create a FAST diagram. This interaction continues through the remainder of the function analysis phase and helps create a collaborative team environment. When this natural team bonding occurs, superior results in the remaining phases of the VM Job Plan also occur. This is, by far, the greatest intangible benefit of using VM.

Change viewpoint. A primary role of the VM study facilitator is to encourage change. If radical change is to occur, then changes in behavior, attitude, and mental thinking must also happen. Otherwise, no lasting change will occur. The team must alter their customary thought patterns to move into a new direction. We all know that our thought patterns have developed over a very long time; in fact, some patterns formed before we were born. As we continue to grow and learn, we become creatures of habit and tend to follow along the same paths, right or wrong. Thus, to say that we need to change a person's viewpoint, we mean that we are trying to alter the way a person thinks and behaves. Function analysis helps bring about such change, because it depersonalizes the conversation. This is very difficult; but for successful VM results, it must occur in the minds of the participants.

VM study facilitators must allow ample time in the agenda to perform function analysis. When a team skips function analysis or takes shortcuts, the study outcome will suffer. Even if the time needed exceeds the time allotted on the agenda, it is still necessary to complete all the steps of function analysis.

6.2.3 Process inputs and outputs

6.2.3.1 Inputs

- Subject scope information (e.g., drawings, sample parts, basis of design, specifications, etc.)
- Voice of the customer information
- The project's resource model(s) (e.g., cost model, costed bill of materials, schedule, etc.)
- All the other information and inputs gathered during the Preparation and Information Phases

6.2.3.2 Activities

- Define functions
- Identify functions
- Classify functions
- Organize functions
- Allocate performance and resources
- Prioritize functions

6.2.3.3 Outputs

- List of classified functions
- Understanding of function logic
- Understanding of function-resource relationships
- List of functions targeted for value improvement.

6.2.3.4 Process flowchart Figure 6.5

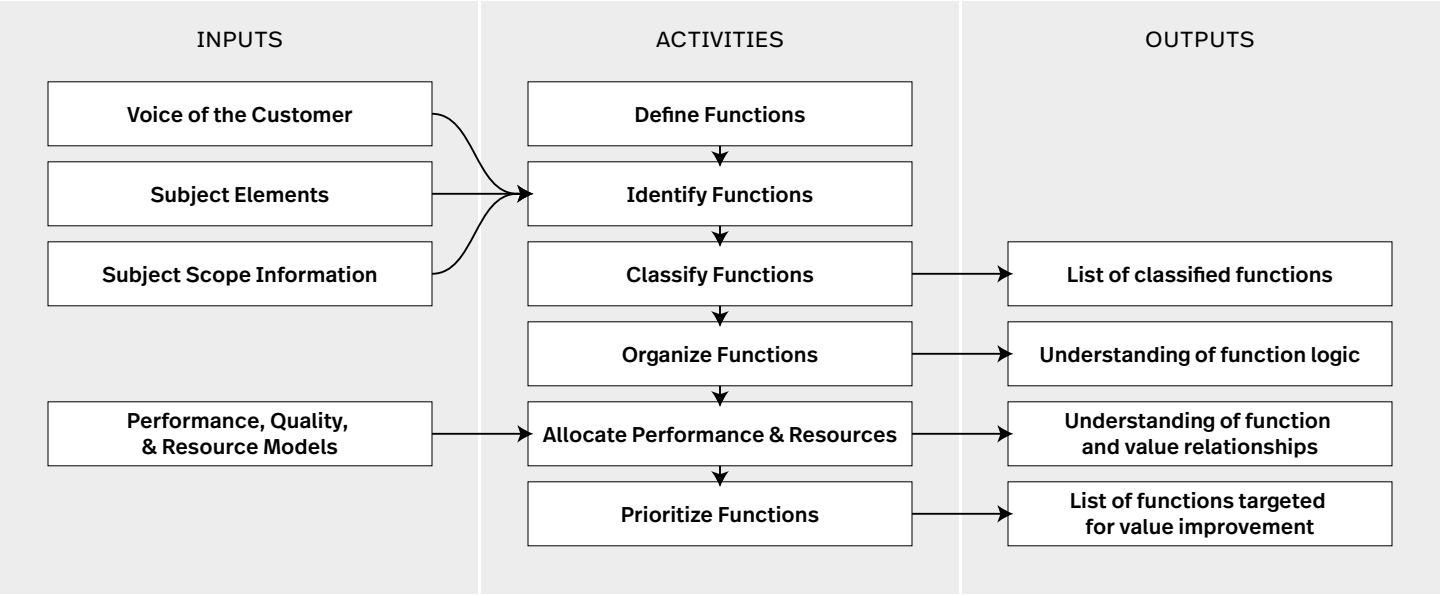

Figure 6.5 – Function analysis phase flowchart.

6.3 Activities

6.3.1 Define functions

Preliminary attempts to define the function(s) of the VM study subject will usually result in it being broken down into many concepts and described in multiple sentences. While this method could conceivably describe an individual function satisfactorily, it is neither concise nor workable enough for the function approach. The Value Methodology determines function by considering the user's actual need. The traits or performance characteristics that justify a product's existence with respect to a particular owner, client, or user, are determined.

As stated earlier in this chapter, the first principle in defining a function is that it be accomplished by using only two words: a verb and a noun.

The verb portion of this should answer the question, "What does it do?" This question focuses attention on the function, rather than the product or its design, and leads straight to the heart of the function approach. This is a radical departure from typical cost reduction efforts where the first question is, "What is it?" followed by "How do we make it cheaper?" The traditional emphasis on making the same things less expensive gives little thought to vital considerations such as the functions of the project's components or the user's need and purpose Figure 6.6 .

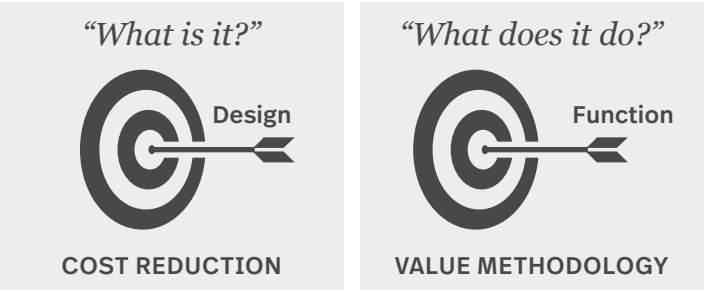

Figure 6.6 – Focus of cost reduction versus Value Methodology.

After answering the question–"What does it do?"–with a verb that defines the item's required action (it may, for instance, generate, control, pump, enclose, protect, or transmit), the second question–"What does it do this to?"–must be answered with a noun that tells what it acts upon (electricity, temperature, liquids, light, surfaces, space, sound, and so on). If possible, it is always preferable to define functions first using a measurable (i.e., quantitative) noun together with an active verb (e.g., insulate heat, support load, transfer force, and so on).

The following are examples of work functions for several types of VM studies:

- In product design studies, electric motors "produce torque," light bulbs "emit light," fuel tanks "contain liquid," and heating elements "produce heat."
- In design and construction studies, structural columns "transfer load," interior walls "separate space," doors "control access," clerestory windows "admit light," and ceiling tiles "attenuate sound."
- In manufacturing process studies, a machining or casting process is designed to "shape material," while a material handling procedure is designed to "deliver material," and a QA/QC process is to "verify quality."
- In business process studies, a payroll system is designed to "distribute money," an inspection report procedure is designed to "identify condition," and a change order approval procedure is designed to "authorize change."

Simple statements such as these ensure clarity of thought and communicate the work function without confusion.

It must be recognized that it is not always possible to use measurable or quantitative nouns. This is perfectly acceptable and, in fact, necessary when considering functions that are subjective or intangible in nature. In such cases, qualitative or non-measurable nouns can be used instead. Figure 6.7 pro-

Active Verbs		Quantitative Nouns		Qualitative Nouns	
Actuate	Impede	Acceleration	Liquid	Aesthetics	Happiness
Amplify	Interrupt	Air	Load	Acceptance	Identity
Apply	Limit	Contamination	Object	Appearance	Pleasure
Change	Locate	Current	Particles	Approval	Prestige
Collect	Modulate	Data	Polarity	Beauty	Satisfaction
Conduct	Move	Density	Protection	Color	Sound
Contain	Prevent	Energy	Radiation	Comfort	Status
Control	Protect	Flow	Solids	Convenience	Style
Emit	Reduce	Fluid	Sound	Effect	Symmetry
Enclose	Rotate	Force	Space	Features	Taste
Fasten	Secure	Friction	Speed	Emotions	Texture
Filter	Store	Insulation	Torque	Form	Touch
Ignite	Transfer	Light	Voltage	Gratitude	Worth

Figure 6.7 – Verbs and Nouns for Functions

vides a sample list of active verbs and nouns (both quantitative and qualitative) for functions.

It is important for the VM study team to concentrate their efforts on precisely what it is they are trying to articulate with the function statement. Care must be exercised to provide the correct level of function definition. For example: The function of a water service line to a building could be defined as "provide service." In this example, "provide" does not give us any useful information on the manner in which water is being provided, and "service" is not readily measurable and does not enable us to intelligently seek alternatives. On the other hand, if we define the function of the water line as "convey fluid," the noun in the definition is measurable, and acceptable alternatives, dependent upon the quantity of water being transported, can be more easily determined. When the noun used is a measurable noun (i.e., the water volume in terms of "Q" factor in the fluid flow equation), we are a step closer to being able to establish a cost-to-function relationship.

Let us expand on this point further. As the reader will see in the chapters that follow, function statements serve as the focus for the Creativity Phase. If one is handed the statement "provide service" on a scrap of paper and asked to brainstorm as many different ways to provide service as possible, without knowing what the words referred, the ideas generated would differ radically from the ideas a similar scrap of paper with the statement "convey fluid" written on it, might inspire. It is therefore important to consider words very carefully when defining functions.

The system of defining functions in two words, a verb and a noun, is known as a two-word abridgement. Advantages of this system include:

- It forces conciseness by defining a function in two words. If, with two words, the functional component is still too large to be defined or understood by the team, this is a sign to drill deeper and develop a more detailed two-word definition.
- It avoids combining functions and defining more than one simple function at a time. By using only two words, the VM study team is forced to break the problem into its simple elements.
- It aids in achieving the broadest level of dissociation from specifics. When only two words are used, the possibility of faulty communication and misunderstandings is minimized.

6.3.1.1 Identify functions

Identifying functions is the first and most important step of the function analysis phase. There are essentially two techniques that can be used to do this: random function identification and Function Analysis System Technique (FAST). These are described in greater detail later in this chapter.

In this step, the team determines all possible verb-noun combinations that describe the functions of the subject under study. Performing this step incorrectly or incompletely biases the rest of the VM Job Plan on incorrect or poorly articulated functions, which leads to misguided thinking and inferior results.

Some people argue that any verb-noun combination is a function; however, this sentiment is incorrect. Many verb-noun combinations are simply actions or activities, rather than functions. The difference is that an action or activity is not generic and, thus, does nothing to change the viewpoint of a team member. For example, think about "charge battery." Is this an activity or a function? It is an activity. Hearing the words "charge battery," one might immediately think about hooking up a battery to a charging machine or using battery cables and nothing else. Thus, those two words did nothing to change a person's viewpoint to divert their mind away from an action performed by a person.

In his book, FAST Creativity & Innovation, Charles Bytheway states, "Active verbs motivate, stimulate, and energize your thinking; and at the same time arouse within you your creative and inventive abilities" (p. 12). For example, active verbs to use instead of "charge" might include "deliver," "store," "transfer," or "transmit." Similarly, the name of an element or component, such as "battery," is not a measurable noun, and places the focus on the part instead of the function. Focusing on specific elements or components leads to a cost-cutting approach rather than value improvement through function-oriented thinking. Appropriate nouns to describe the battery include "energy" and "power." From the list of verbs and nouns, the team selects the best combination, such as "store energy." When the team brainstorms the function "store energy," it broadens the perspective and leads to significantly more ideas than using the action "charge battery."

Another example is "cook food." Is this an activity or a function? It is an activity. Hearing the words "cook food," one might immediately think about a stove or microwave and not much else. Those two words do not change a person's viewpoint to divert their mind away from the performance of the activity. In fact, one could argue that a stove does not cook food. What does it do? Generic functions that more aptly describe the functions of a stove include "generate heat," "distribute heat," "control heat," and "conduct electricity" (or gas).

6.3.1.2 Classify functions

Once the functions have been identified, they can be classified. Functions are classified into the following types:

- Basic functions
- Secondary functions
- Unwanted functions
- Higher-order functions, and
- Lower-order functions

In addition, there are three additional types of functions that must be considered when using FAST diagrams. These are listed below and will be discussed further in section 6.4.2 of this chapter.

- Subject objectives,
- One-time functions, and
- All the time functions.

BASIC FUNCTIONS

Basic functions define the specific purpose for which a subject exists. The basic function answers the question, "What must it do?" Basic functions deliver essential value. A subject may possess more than one basic function, which is determined by considering the customer's needs. A non-load-bearing exterior wall might be initially defined as "enclose space." However, further analysis could determine that, for this wall, the two basic functions "secure area" and "restrict view" are more definitive than the function above; and, both answer the question, "What must it do?"

Four rules govern the selection of basic functions:

1. The basic function describes the primary purpose and intent of the subject.
2. If a function can be eliminated with the subject continuing to achieve its primary purpose, then the function in question is not a basic function.
3. Losing a basic function will cause a loss in value.
4. The customer must be willing to pay for it.

SECONDARY FUNCTIONS

Secondary functions answer the question, "What else does it do?" and usually result from the design, configuration, or approach selected to perform the basic function(s). Generally, secondary functions contribute greatly to cost and may or may not be essential to the performance of the basic function. Secondary functions that lead to esteem value (convenience, user satisfaction, and appearance) are permissible only insofar as they are necessary to permit the item to be bought or sold. Therefore, while secondary functions may have zero "use" value, they may sometimes play an important part in the marketing and acceptance of a design or product. In fact, this could be said of many high-end designer products where the esteem or "badge" value is of far greater importance than its use value. Value Methodology attempts to separate the costs required for basic function performance from those incurred for nonessential secondary functions. Once identified, it becomes easier to reduce the cost of secondary functions, while still providing the appeal necessary to permit the design to sell or otherwise appeal to customers or users. By concentrating on only what is essential to the subject's need and purpose, Value Methodology can successfully eliminate many unnecessary secondary functions.

UNWANTED FUNCTIONS

Unwanted functions occur as a byproduct, or unintended consequence, of the way another function(s) is performed. Unwanted secondary functions often degrade performance and increase costs to mitigate them. For example, extended use of a carpentry hammer often leads to fatigue, and possibly injury, due to the unwanted secondary function defined as "transmit vibration." The presence of this unwanted secondary function is partially mitigated by the material selected for the handle; for example, hickory wood, which is a very hard, stiff, dense, and shock resistant material. Note that hickory is also more expensive.

HIGHER-ORDER FUNCTIONS

Higher-order functions represent the specific need(s) or overarching goal(s) that the basic function(s) exists to satisfy and are beyond the scope of the study. Higher-order functions represent the customer's big-picture need and describe the output of the basic function(s). Recall that the basic function must answer the question, "What does it do?" which, in the case of a carpentry hammer, is "deliver force." The higher-order function(s), on the other hand, answers the question "Why do we 'deliver force?'" The answer would be to "connect materials" or "separate materials."

LOWER-ORDER FUNCTIONS

Lower-order functions describe functions that lie beyond the scope of the study. They are generally not part of the function analysis process unless the level of abstraction changes the scope of the problem. For example, a carpentry hammer is designed based on the assumption that there will be a user with a hand to wield it. The user will apply force to the hammer. The function "apply force" is a lower-order function and lies outside the scope of the product. Another way to think about lower-order functions is that they are required inputs. This chapter will discuss levels of abstraction will be discussed in greater detail later.

Examples of basic and secondary functions include:

- Multimedia projector. Its basic function is to "project image." In addition, the projector has many secondary functions, such as "convert energy," "generate light," "focus image," "enlarge image," "receive current," "transmit current," "support weight," and so on. Unwanted functions such as "generate heat" and "generate noise" also exist.
- Shopping center. Its basic function is to "attract customers." In addition, the shopping center has many secondary functions such as "enhance convenience," "enclose space," "maintain environment," "control access," "store vehicles," and so on.
- HVAC system. The basic function of the HVAC system is to "condition air." The other functions such as "heat air," "cool air," "move air," "control humidity," "distribute air," and so on, are secondary functions. Unwanted functions such as "generate noise" also exist.
- Manufacturing process. Its basic function is to "assemble product." In addition, the manufacturing process has many secondary functions, such as "form shape," "move material," "attach components," "inspect product," and so on. "Generate waste" is an unwanted function that plagues most manufacturing processes.
- Hiring procedure. Its basic function is to "fill position." In addition, the hiring procedure has many secondary functions, such as "define responsibilities," "identify benefits," "review qualifications," "communicate responsibilities," "evaluate qualifications," and so on.

LEVELS OF ABSTRACTION

Determining the basic function(s) is not always an easy process. For instance, the two-word abridgement most often volunteered by people who are asked to describe the basic function of a hammer is "drive nails." This definition, however, immediately stumbles over the obvious question: "What about the other uses of a hammer?" Can't hammers be used for purposes other than driving nails, such as those suggested in **Figure 6.8**?

Figure 6.8 – Uses of a hammer.

The hammer doesn't actually drive the nail, but rather transmits force from a person's hand and arm, through the hammer, to the head of the nail. It doesn't matter to the hammer whether it strikes a chisel or a cobbler's tack. "Deliver Force" is simply a more accurate definition of a carpentry hammer's basic function, especially because force can be quantified. But wait! Aren't there still other common uses for hammers, as suggested in **Figure 6.9**?

Figure 6.9 – More uses of a hammer.

The function of a judge's gavel could be to "convey authority." The function of a croquet player's mallet could be described as "move ball." The function of a doctor's hammer might be to "test reflexes." Aren't these also basic functions? A simple way to check is by asking the question "If the hammer were unable to deliver force, would it still fulfill its purpose or reason for being?" For each of the six uses of a hammer displayed in Figures 6.8 and 6.9, all must deliver force to fulfill the associated higher-order functions. Here are the answers to the questions posed above for each use of the hammer:

- A carpenter's hammer must "deliver force" to drive a nail into a board.
- A sculptor's hammer must "deliver force" to strike the chisel which chips the stone.
- A cobbler's hammer must "deliver force" to drive the tack into the sole of the shoe.
- A judge's gavel must "deliver force" to create noise and convey their authority to the courtroom.
- A croquet player's mallet must "deliver force" to move the ball through the wickets.
- A doctor's hammer must "deliver force" to the patient's knee to test their reflexes.

It appears that "deliver force" is indeed the correct basic function, and in each case the desired effect is quantifiable. The hammer, depending upon its application, may have a radically different higher-order function associated with it, but its basic function is the same. This process of forcing thinking to higher or lower levels of abstraction helps to develop a multiplicity of two-word abridgements from which the primary function to be studied can be determined. This technique is referred to as the ladder of abstraction and is very useful during the Function Analysis Phase.

6.3.1.3 Organize functions

The next step in defining functions is the process of organizing functions. Once the functions have been identified, and perhaps classified, it is usually necessary to review, organize, and edit them. If random function identification is used, then it is highly probable that the VM study team will have stated functions in a number of different ways that have approximately the same meaning. In the carpentry hammer example (Table 9), the following functions were stated as potential candidates for the basic function:

- Deliver force,
- Transfer force,
- Transmit force.

The VM study team should discuss all the functions and arrive at a consensus about which functions to carry forward, which are redundant, and which should be eliminated. In the example above, "deliver force" is ultimately selected as the basic function, because the verb "deliver" conveys two concepts:

1. The hammer delivers force from the hand through the hammer to the nail.
2. The hammer delivers the force in a specific manner.

Next, the VM study team considers the secondary function, "transfer force." The VM study team agrees that "transfer force" is a secondary function and that it supports the hammer's basic function, "deliver force." Next, the VM study team discusses the function "transmit force." The VM study team decides that this function has approximately the same meaning as "transfer force," but decides this two-word abridgement doesn't articulate the concept as clearly as "transfer force." Based on this, the VM study team decides to remove "transmit force" from further consideration and instead retain "transfer force" and "deliver force." This process is an example of organizing functions.

Another key concept that often causes confusion when defining functions is understanding the difference between an activity and a function, as discussed in Section 6.2.1. An activity is a description of a real-world observation. For example, "drive nails" is an observation of a carpentry hammer performing its purpose. This statement seems to conform to the rules of defining a function:

- It is two words, a verb and a noun.
- The verb is active.
- The noun is seemingly measurable (you can count the number of nails).

Yet, the statement "drive nails" is not a function. To determine the function, we must get to the core concept, or function, that lies behind the activity description "drive nails." We do this by asking the questions WHY and HOW Why does a hammer drive nails? The answer might be to connect materials. We drive nails to connect two pieces of wood together, an activity description that can be defined by the function "connect materials." That answers the WHY But now we must answer HOW How do we drive nails? This question leads to a different answer – "deliver force." Both "connect materials" and "deliver force" are function statements. Now, let's replace the function statements with activity statements (disguised as functions using verbs and nouns): Why do we drive nails? To build a wall. How do we drive nails? The laborer swings their arm. Let's compare these verb-noun abridgements in a table Figure 6.10 .

Activity	Function
Swing Arm	Apply Force
Drive Nail	Deliver Force
Build Wall	Connect Materials

Figure 6.10 – Comparing Activities and Functions

Note that the choice of noun is very important. We must strive to select nouns that are not specific and that will anchor us to current solutions. One of the most powerful aspects of function analysis is that it forces us to think laterally by virtue of the abstraction involved. For example, different ways to deliver force could include those identified in Figure 6.11 .

Ways to Deliver Force	
Hydraulics	Pound with a rock
Pneumatics	Screwdriver
Particle accelerator	Stapler
Gravity	Drill
Brute strength	Auger
Knife	Magnetism
Thumbtack	Gunpowder
Pushpin	Pistol
Brass knuckles	Throw stones
Use a board	Pendulum

Figure 6.11 – Ways to Deliver Force

> If the same exercise was performed using the activity statement "drive nails," the focus would have likely been on solutions fixated on the use of nails. Alternatively, the higher-order function of "connect materials" could have been considered, which would lead to different solutions that might include ideas like glue, dovetail joints, screws, and cast-in-place concrete to name just a few – none of which involve nails.

6.3.2 Allocate resources

This step allocates resources to functions. Resources may be cost, life-cycle cost, time, energy, space, failure points, risk, etc. Common techniques of allocating resources to functions include: 1) the random function identification method; 2) function-resource matrix; and, 3) FAST diagrams. These techniques are presented in Section 6.5.

The term "resources" speaks to a wide array of information related to the subject of the VM study and could include inputs (e.g., cost and time), outputs (e.g., performance, quality), risk, or physical characteristics (e.g., area, weight, volume, etc.). The purpose of allocating resources to functions is to develop a better understanding of where the opportunities exist for value improvement. For example:

- In a VM study focusing on reducing the mass of an aircraft to improve its fuel efficiency, the VM study team would want to identify the weight of each component and associate it to the related functions. The result of this analysis would help the VM study team identify which functions contribute most to the aircraft's total weight.

- In a VM study focusing on reducing the risk related to a medical procedure, the VM study team could take the risks identified related to the various activities involved in the procedure during the Information Phase and then link these to the related functions. Those functions having the greatest degree of risk would be prime candidates for focusing the VM study team's efforts during the Creativity Phase.

- In a VM study seeking a primary objective to identify cost reduction opportunities in order to bring a project back within budget, the VM study team would want to develop a better appreciation of which functions contribute the most to cost. They would therefore evaluate the project's cost estimate and allocate costs to the various project functions. This effort would reveal which functions offer the greatest opportunity for cost improvement.

It is important to note that multiple resources could be incorporated into this step, as many are likely to be important to customers and stakeholders. For example, most customers who purchase a consumer product typically consider both cost and performance in their buying decisions, and the VM study team would likely gain valuable insight by considering both during this step.

6.3.3 fPrioritize functions

The purpose of this step is to select the functions that have the greatest opportunity for value improvement. Assuming the VM study team has allocated whatever relevant resources to the functions in the previous step, the opportunities for value improvement should become clear. The VM study team should consider those functions that have the greatest correlation to critical resources that are consistent with the objectives of the VM study and identify those that merit focus during the Creativity Phase.

As discussed in Section 6.4.2 above, there may be numerous resources that have been allocated to the functions using one of the applicable techniques. It is possible that many functions could be attractive candidates for value improvement. The VM study team must consider how much time is available in the VM study for the Creativity Phase. This may force the team to limit the functions they select to a smaller number based on the constraints of the VM study schedule. The customer/client may have concerns or problems with certain functions and may request the team to prioritize those functions for further study. Finally, the VM study team may have a "hunch" that certain functions offer a good opportunity for value improvement.

6.4 Basic Techniques

6.4.1 Random function identification

The basic technique for identifying functions is called random function identification. It is recommended to begin by starting with the project's purpose and need, and then working toward identifying the primary project elements, and next toward specific details as necessary. After preparing a reasonable list of functions, the next step is to begin considering function classification. A basic example is provided in Figure 6.12 which examines the functions of a hammer. This approach to function classification was the one originally developed by Miles, which he referred to as random function identification. The steps of the process are outlined as follows:

1. Review information, such as a bill of materials, construction cost estimate, or work breakdown structure. This information should serve as a starting point for detailing the individual elements of a product, project, service, organization, or process.

2. Create a simple matrix or table that includes columns for elements or components and functions (i.e., verbs and nouns).

3. List the elements or components from the appropriate document identified in Step 1 on the matrix.

4. The team should next identify the basic function(s). Start by asking the question, "What does it do?"

5. As a team, brainstorm all the possible functions for each element or component by asking the same question, "What does it do?" There could potentially be numerous functions for each.

This process can be performed by using flipcharts or a whiteboard as well.

6.4.2 FAST Diagrams

The Function Analysis System Technique, commonly referred to by the acronym FAST, is one of the most effective techniques for classifying and organizing functions. FAST is a powerful diagramming technique for analyzing the relationship of functions. FAST diagrams have the following uses:

- Show the specific relationships of all functions with respect to one another.
- Test the validity of the functions under study.
- Help identify missing functions.
- Broaden the knowledge of all team members with respect to the project.

FAST was developed by Charles W. Bytheway of the Sperry Rand Corporation and was first introduced in a paper presented at the 1965 National Conference of SAVE International® (then known as the Society of American Value Engineers). Subsequently, FAST has been widely used by governmental agencies, private firms, and value consultants.

Nº	Component	Verb	Noun	Function Type
1	Head (machined, steel casting)	Connect	Materials	Higher-order
		Separate	Materials	Higher-order
		Transfer	Force	Secondary
		Transmit	Force	Secondary
		Deliver	Force	Basic
		Apply	Force	Lower-order
		Locate	Components	Secondary
		Precipitate	Oxidation	Unwanted
		Increase	Force	Secondary
		Increase	Mass	Secondary
		Increase	Leverage	Secondary
		Improve	Durability	Secondary
		Focus	Force	Secondary
		Deflect	Force	Unwanted
		Enhance	Appearance	Secondary
		Reduce	Deflection	Secondary
1	Handle (hickory)	Transfer	Force	Basic
		Increase	Leverage	Secondary
		Increase	Friction	Secondary
		Transmit	Vibration	Unwanted
		Reduce	Vibration	Secondary
		Reduce	Fatigue	Secondary
2	Wedge (hickory)	Connect	Components	Secondary
		Increase	Friction	Secondary
1	Wedge (steel)	Connect	Components	Secondary
		Increase	Friction	Secondary
		Improve	Durability	Secondary
1	Sealant (epoxy)	Connect	Components	Secondary
		Ensure	Durability	Secondary
1	Label (paper, adhesive)	Identify	Brand	Secondary
1	Assembly (labor)	Connect	Components	Secondary
		Improve	Durability	Secondary
1	Shellac (spray applied)	Resist	Oxidation	Secondary
		Enhance	Appearance	Secondary

Figure 6.12 – Random function identification.

FAST builds on the verb-noun rules described earlier in this chapter. It is an excellent communication technique in that it allows VM study team members to contribute equally and communicate with one another while addressing the problem objectively and without bias or preconceived conclusions. FAST has also proven to be a useful tool for project planning and a good way to present complex concepts to decision makers.

FAST distinguishes between the four main groups of functions covered earlier, making it a natural choice for classifying functions. It accomplishes this by illustrating the intuitive logic used to determine and test function dependencies through the development of a diagram that, at first glance, appears to resemble a flowchart or network diagram.

The major difference between the random function identification process first described by Miles and the FAST process invented by Bytheway is FAST's ability to analyze entire systems rather than simply individual parts within a system. It is evident when studying systems that functions do not operate in a random fashion. A system exists because functions form dependencies with other functions, just as individual parts form dependency links with other parts to ensure the system works.

It is important to understand that there is no "correct" FAST diagram. In other words, there is no perfect FAST diagram against which all others can be measured. There is, however, a "valid" FAST model that serves as a guide to follow when building FAST diagrams. The degree of validity of a FAST diagram depends directly upon the capability of the VM study team members building it and upon the team's adherence to the rules of function-logic as defined in the remainder of this chapter. The FAST diagram must be constructed using team consensus, because the discussion involved in creating a FAST diagram is just as important the diagram itself. A FAST diagram is "complete" only when its creators reach a point of consensus.

6.4.2.1 "How" and "Why" logic

In a previous section dealing with levels of abstraction, the concept of HOW and WHY logic was introduced. It happens that this intuitive logic is foundational when constructing FAST diagrams. The directional references of the "How" and "Why" questions remain the same. "How' is read from left to right and "Why" is read from right to left. Using the examples below, if the function were addressed and the question asked, "How do we deliver force?" the answer, in the form of a function could be "transfer force" (see Figure 6.13).

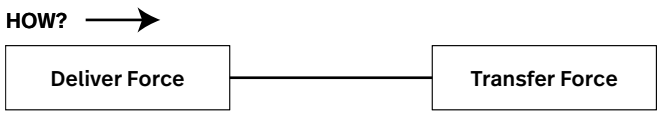

Figure 6.13 – HOW logic.

Continuing in the HOW direction, the question is asked, "How do we transfer force?" The answer could be "receive force." (Figure 6.14)

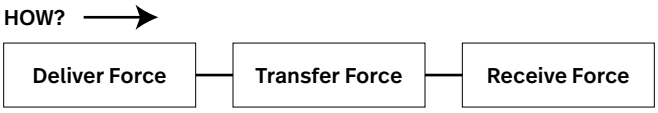

Figure 6.14 – HOW logic continued.

To test the logic of the example above, the functions can read in the reverse WHY direction: "Why do we transfer force?" "To deliver force." Why do we deliver force?" "To connect materials." If the team agrees with the answers, they can continue to expand the FAST model, either in the WHY or HOW direction. In the WHY direction the question is asked, "Why does the hammer connect materials?" This is answered by "to create structure." Switching to the HOW question in the opposite direction, the question is asked, "How do we create structure?" It's answered by "connect materials." Examining the function inputs thus far, the FAST model would look as follows Figure 6.15 .

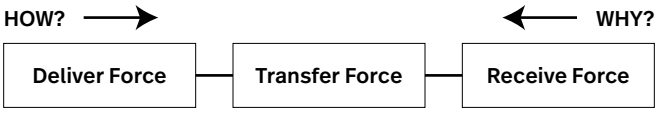

Figure 6.15 – How-why logic.

The example was constructed with the intent of describing the function relationships of a carpentry hammer; however, the same function model could have been applied to any other aspect of a building or construction process. This shouldn't be too surprising, because all these things perform the functions described in the same dependency order. Differences occur when additional secondary functions are added and when the model is dimensioned in terms of time, performance, or other measurements that reflect the problem under study.

Many people, when first introduced to FAST diagrams, find it counterintuitive, especially those accustomed to flowcharts and network diagrams. They appear to be backwards! This is one of the most important aspects of FAST and it is what forces those involved in constructing FAST diagrams to think about a project differently. Unlike more common diagramming techniques, FAST appears to read from finish to start if viewed from left to right. There are a number of reasons for this difference:

- The FAST diagram begins with the goal or objective, which focuses our attention where it should be. When beginning any endeavor, we usually know what we want to achieve, so why not begin there? By addressing functions on the FAST diagram with the question WHY the function to its left expresses the goal of that function. The question HOW is answered by the function on the right, and describes the approach being utilized to perform the function to the left.
- Changing a function on the HOW-WHY path affects all the functions to the right of that function. This is a domino effect that only goes one way, from left to right. Starting with any place on the FAST diagram, if a function is changed the goals are still valid (functions to the left), but the method to accomplish that function, and all other functions on the right, are affected. Functions to the right of another function are called "dependent functions," because the way that a function performs depends on the function to its left.
- Reading from the goal, on the left side of the diagram, to the beginning, on the right end (in the HOW direction), goes against our system paradigm. Because it seems strange, building the model in the HOW direction, or via function justification, will focus the team's attention on each function element of the model. On the other hand, reversing the FAST model and building it in its system orientation would cause the team to leap over individual functions and focus on the system, leaving function "gaps" in the system.

Another way of thinking about building FAST diagrams is that they are built in the HOW direction and the logic is tested in the WHY direction.

6.4.2.2 "When" logic

The "When" direction is not part of the intuitive logic process, but it supplements intuitive thinking. In terms of FAST logic, "When" is not necessarily time related, but indicates cause and effect. Referring to **Figure 6.16**, "When you deliver force, you focus force." "Focus force" is a secondary function that supports the function "deliver force." As a secondary function, it can be expanded in the how-why directions to create a minor logic path and build a subsystem FAST diagram. Since the independent function is not on the major logic path, changing the function would not significantly affect the basic function. Another helpful way to think of a "When" function is to add the qualifying statement "caused by." For example, "focus force" is also caused by the need to "deliver force." In other words, there would be no need to "focus force" if the hammer did not "deliver force."

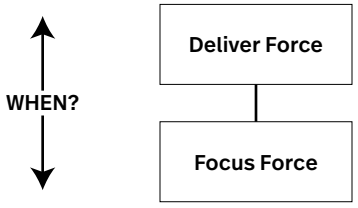

Figure 6.16 – WHEN logic.

6.4.2.3 Structure of the FAST diagram

The FAST diagram is built upon the left-right logic of HOW and WHY and the up-down logic of WHEN." Ideally, construction of the diagram should begin with the basic function and work towards the right in the HOW direction. There are several additional elements that are necessary to further communicate the functional relationships. The basic elements of the FAST diagram are illustrated in **Figure 6.17**.

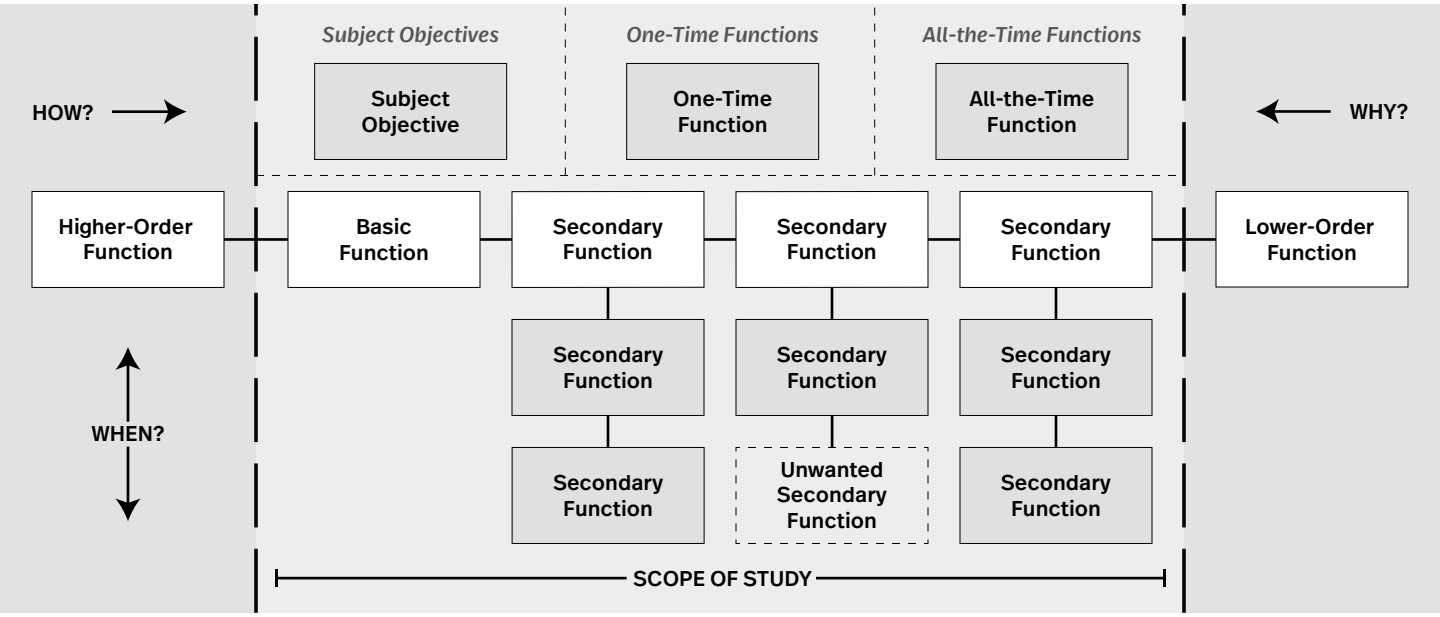

Figure 6.17 – Structure of a FAST diagram.

SCOPE LINES

Scope lines represent the limits of the VM study and are shown as the two dashed vertical lines on a FAST diagram. The scope lines demarcate the "scope of the study," or the subject with which the VM study team is concerned. The basic function(s) will always be the first function to the immediate right of the left scope line. The function to the immediate left of the left scope line is the higher-order function, or output. The right scope line identifies the beginning of the subject, and separates the lower-order function, or input, from the scope of the study.

HIGHER-ORDER FUNCTION(S)

The higher-order function(s) represent the need(s) of the project and is located to the left of the basic function(s) and outside of the left scope line. Any function to the left of another function is a higher-order function relative to that function. However, when considering higher-order functions, the reference is generally directed to the reasons for why the project exists.

LOWER-ORDER FUNCTION(S)

The function(s) to the right and outside of the right scope line represents the input side that initiate the subject under study and are known as lower-order functions. Functions that lie to the right of the rightmost scope line are also sometimes referred to as "assumed" functions. This is because these functions are generally left up to the customer or user to determine, so an assumption is made as to what those are.

It is important to note that the terms "higher" or "lower" order functions should not be interpreted as meaning relative importance, but rather as the input and output side of the process. As an example, if we were analyzing a purchase order processing procedure, the function "receive order" could be the lowest order function, with the function "receive product" being the highest order function. How to accomplish the highest order function, "receive product," describes the need for the procedure and helps prioritize our thinking to address the purpose of the procedure, or basic function, such as "ship product."

BASIC FUNCTION(S)

Basic functions, which represent the purpose of the project under study, are located to the immediate right of the leftmost scope line and are directly connected via the function logic path to the higher-order function. Once determined, the basic function(s) will not change. If the basic function(s) is not performed, then the project loses its value.

SECONDARY FUNCTIONS

All functions to the right of the basic function portray the conceptual approach (i.e., design) selected to satisfy the basic function(s). The concept describes the method being considered, or elected, to achieve the basic function(s). The concept can represent either the current conditions (as is) or proposed approach (to be). Which approach to use (current or proposed) in creating the FAST model is determined by the VM study team and the definition of the subject under study. Conceptually, all functions to the right of the basic function(s) are treated as secondary functions and are subject to change. Unwanted secondary functions can optionally be highlighted by using a dashed line around the box.

VM studies focused on improving a design or concept that is currently in progress should first begin by constructing a FAST diagram based on this initial concept. Doing so will reveal potential problems or areas for study. Constructing a FAST diagram based on a design in progress will also be useful for the next step in the functional approach, which involves correlating cost and performance to the identified functions. Once this is accomplished, it may be useful, time permitting, to construct a FAST diagram based upon how the VM study team believes the solution should look. If the VM study is focused on a project that has not begun design or formal planning, then the FAST diagram should be constructed based on what the solution could or should be.

SUBJECT OBJECTIVE

Subject objectives are functions that express specific, compulsory requirements or articulate broader goals of the subject, whether it is a project, product, process, service, or organization. For example, one of the objectives for a hammer (a product) might be to "improve durability." Such a statement is global in nature and could apply to all the functions that appear on the diagram. The term "subject" can be replaced by one of the terms that speaks to the nature of the subject: project, product, process, service, or organization. So, if the subject of the study were a project, one could refer to the subject objectives as "project" objectives.

ONE-TIME FUNCTIONS

One-time functions are those secondary functions that only happen once. For example, the carpentry hammer is manufactured once, thus the function "assemble components" is considered to be a one-time function.

ALL-THE-TIME FUNCTIONS

All-the-time functions are secondary functions that happen continuously. For example, the carpentry hammer has many different parts that have the function "connect components." While it might be possible to try and locate this function on the diagram somewhere, it would likely be both challenging and confusing to do so. That is why placing such functions above the diagram and labeling them as "all-the-time" functions solves this problem, while making the diagram cleaner and easier to understand.

FUNCTION LOGIC PATH

Any function on the HOW or WHY logic path between the higher-order and lower-order functions is considered to be a critical logic path function. Changing a function on the critical logic path will fundamentally alter the way the basic function is performed.

6.4.2.4 AND/OR logic

It's often helpful to differentiate how functions are connected. One way to do this is through AND/OR logic. The AND connection is represented by showing a split or fork between functions (see **Figure 6.18**) and indicates that both paths must be followed. The AND lines can also indicate that the connecting functions are of equal or lesser importance, depending on how they are drawn.

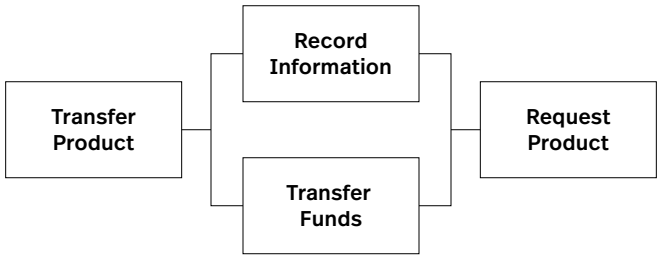

Figure 6.18 – AND logic.

The OR connection is represented by lines emanating from the root function at different locations (see **Figure 6.19**) and indicate a choice in the function path. The OR lines may also indicate function paths of equal or lesser importance, similar to AND lines. The AND/OR lines may also be drawn in the vertical, or WHEN direction.

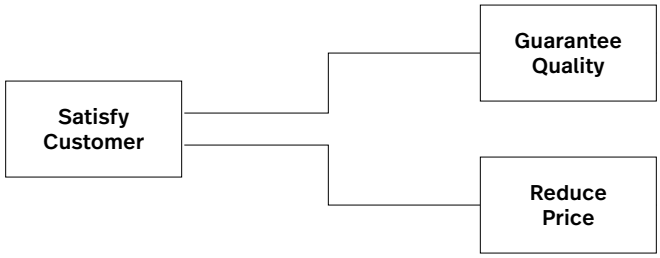

Figure 6.19 – Or logic.

Following is a completed example of a FAST diagram of a carpentry hammer (**Figure 6.20**). To create a FAST diagram, start with a whiteboard or tape several flip charts to the wall. Use Post-It® notes of different colors for the functions. Draw the left scope line and add the HOW, WHY and WHEN arrows for clarity. As stated previously, after completing random function identification, the VM study team should begin construction of the FAST diagram by selecting the basic function and then begin to build the critical function logic path in the HOW direction. Identify the higher-order function(s) by asking WHY while focusing on the basic function(s). Once the critical function logic path is defined, the VM study team should then begin adding secondary functions that support the functions on the path. Once complete, identify the lower-order function(s) and draw the right scope line. Finally, consider the functions above the diagram (project objectives, one-time, and all-the-time functions).

The use of Post-It® notes allows the VM study team to move the functions around as they test the logic. It is normal for FAST diagrams to go through many transformations before the logic checks out in all directions. It is important to be patient and invite the full participation of the team throughout the process. Once the team is satisfied that the FAST diagram adequately describes the scope of the study, the team can move on to the next step in the function analysis process, which is to allocate resources to the functions.

6.4.2.5 FAST diagrams versus flowcharts

Some believe that VM studies of processes and procedures do not require the application of FAST diagramming because a process flowchart essentially represents the same thing. The fact is, however, that there are several critical differences between FAST diagrams and flowcharts (or network diagrams).

The functions of a process or procedure represent intended objectives, whereas the activities of a process or procedure are the physical means of achieving those objectives. A FAST diagram arranges functions in a logical manner to answer the questions HOW and WHY with the aim of defining the purposes for which the process or procedure exists. A process flowchart, on the other hand, specifies what actions occur by people and/or equipment to accomplish the intended functions. It is simply the graphical representation of a sequence of activities.

Another way to think about these two graphic techniques is that a FAST diagram describes the intent of the system, and a flowchart describes the actual activities involved in implementing the system. FAST is also a good method for identifying flaws in a system, because it enables the team to determine where unneeded or unwanted functions are included and/or where needed or wanted functions are missing.

Charles Bytheway used the system to stimulate creativity. He emphasized the use of what he called "thought-provoking questions" as opposed to focusing on completing the FAST diagram, believing that success was defined by developing creative alternatives (solutions) based on the functions derived from answering the leading questions. This approach highlights a very big difference between a FAST diagram and a flowchart: although it is not imperative for the FAST diagram to be complete, a flowchart must be completed to represent the entire process being defined.

FAST diagramming is arguably the most powerful technique used in the Value Methodology; and, it is effective for getting a multidisciplinary team to reach consensus on the scope of the subject being analyzed. At the same time, a FAST diagram must not be misinterpreted to represent activities on a flowchart. FAST reflects the divergent opinions and perspectives of people. It is a subjective, albeit collective, representation of a project's scope. A flowchart, on the other hand, is the objective representation of what actually happens to accomplish the required functions.

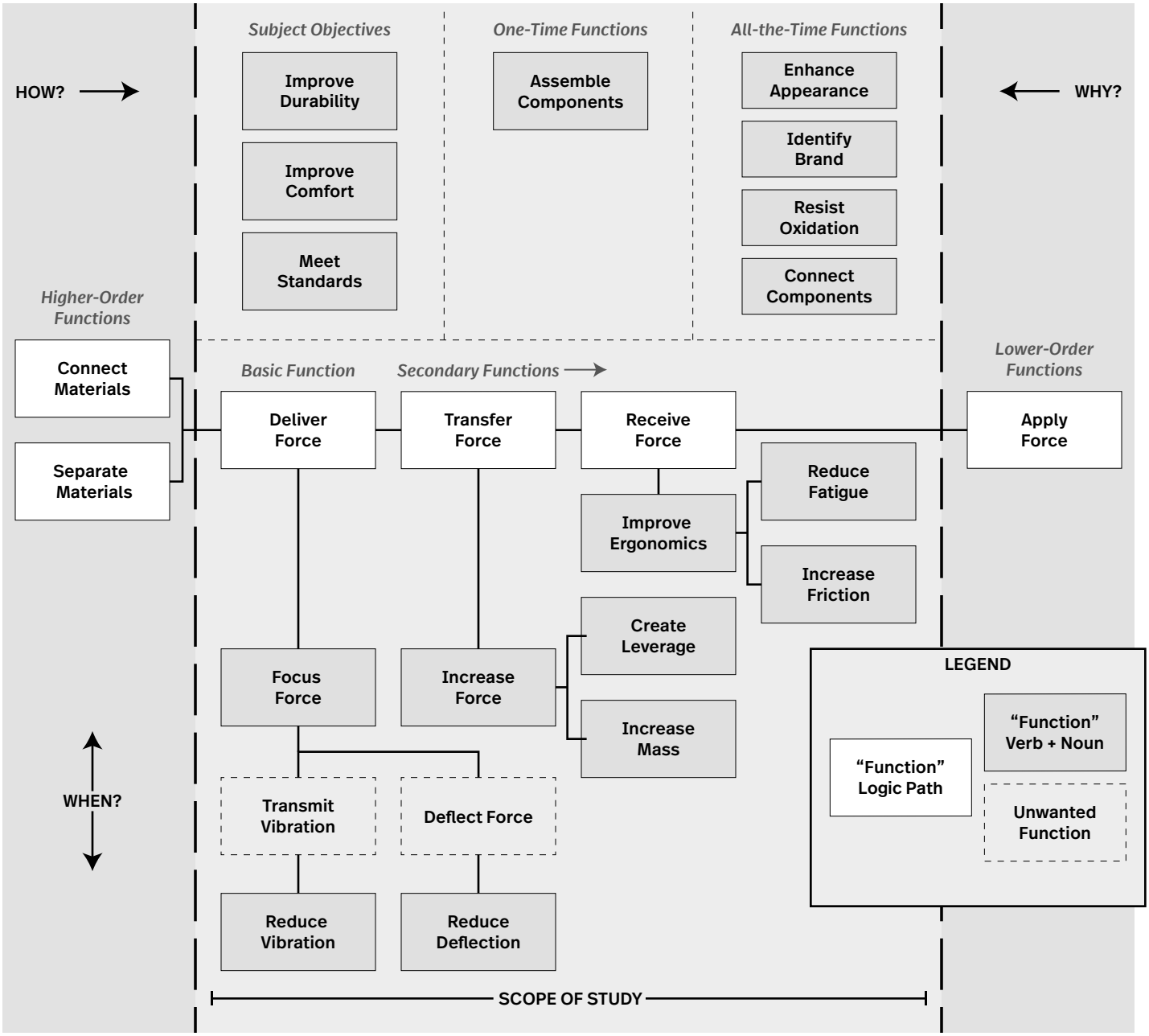

Figure 6.20 – FAST diagram of a carpentry hammer.

6.4.3 Function resource allocation (matrix)

The next step of function analysis is to allocate project resources to the functions so that the VM study team can identify opportunities for value improvement. Any project characteristic can be correlated with functions. Common ones include:

- Performance/quality;
- Cost;
- Time;
- Risk;`
- Space (area);
- Volume or weight; or,
- Personnel (such as full-time employees (FTE)).

A technique commonly used is called the function resource matrix. The functions within scope are listed across the top of the matrix. Then, for example, major cost groups are listed down the left-hand side of the form with the associated incremental costs placed in the total cost column. The VM study team will need to use their best judgment in splitting up the cost of a single element or component among multiple functions. Costs should be extracted from existing project data,

where available, such as a construction cost estimate, bills of material, or labor/time estimates. Next, the function impacted by each project element is identified. Once this is done, the team must estimate how much of the cost of each element belongs to each function. This need not be a precise estimate. Finally, all columns are added vertically to determine how much cost is allocated to each function. For the hammer example, please refer to **Figure 6.21** .

In either method, the cost of each function is recorded above and to the right of it on the FAST diagram. Costs for the supporting secondary functions can be rolled up to the level of basic functions or to secondary functions that constitute major project elements or assemblies.

COMPONENT	QTY	U/M	UNIT COST	COST	FUNCTION – Active Verb/Measurable Noun											
					Deliver Force	Transfer Force	Receive Force	Create Leverage	Improve Durability	Improve Comfort	Reduce Deflection	Increase Friction	Recude Vibration	Reduce Fatigue	Connect Components	Identity Brand	Resist Oxidation	Enhance Appearance
Head (machined, steel casting)	1	ea	$4.730	$4.730	50%	15%		15%	10%		5%							5%
Handle (hickory)	1	ea	$2.470	$2.470		25%	25%	20%				10%	10%	10%				
Wedge (hickory)	1	ea	$0.060	$0.060											100%			
Wedge (hickory)	2	ea	$0.120	$0.120					50%						50%			
Sealant (epoxy)	1	ea	$0.220	$0.220					80%						20%			
Label (paper, adhesive)	1	ea	$0.050	$0.050												100%		
Assembly (labor)	1	ls	$2.350	$2.350						20%					80%			
Shellac (spray applied)	1	ea	$0.040	$0.040													50%	50%
TOTALS				$10.040	$2.37	$1.33	$0.62	$1.20	$0.71	$0.47	$0.24	$0.25	$0.25	$0.25	$2.04	$0.05	%0.02	$0.26
Direct Costs EXCLUDE all Fixed burden & Overhead, S, G, & A, Margin																		
FUNCTION – PERCENTAGE				100%	23.56%	13.22%	6.15%	11.99%	7.06%	4.68%	2.36%	2.46%	2.46%	2.46%	20.36%	0.50%	0.20%	2.55%

Figure 6.21 – Function resource matrix for the costs of a carpentry hammer.

6.4.4 Function performance specification matrix

A variation of the resource-function allocation matrix is known as function performance specification (FPS) which is a method for associating functions with their performance and/or quality-based criteria and parameters. FPS associates functions with performance or quality criteria (what is being measured), the unit of measurement, and the parameters such as minimum/maximum/target values and relative flexibility.

FPS is useful for communicating customer and/or stakeholder performance wants and needs in a non-technical environment, as well as for specifying requirements in an engineering environment. It helps participants to discover hidden assumptions and develop better information. The Min/Max/Flex help to define the freedom the designer has for alternatives and stimulate creativity.

In Figure 6.23, the performance criteria and parameters for the performance of the functions of a hammer are shown using an FPS matrix:

Note that the term "flexibility" refers to the flexibility of the requirement. A simple convention is used in FPS to denote this:

- 0 = The specification is an absolute requirement and is not flexible.
- 1 = The specification is somewhat flexible.
- 2 = The specification is flexible.
- 3 = The specification is very flexible.

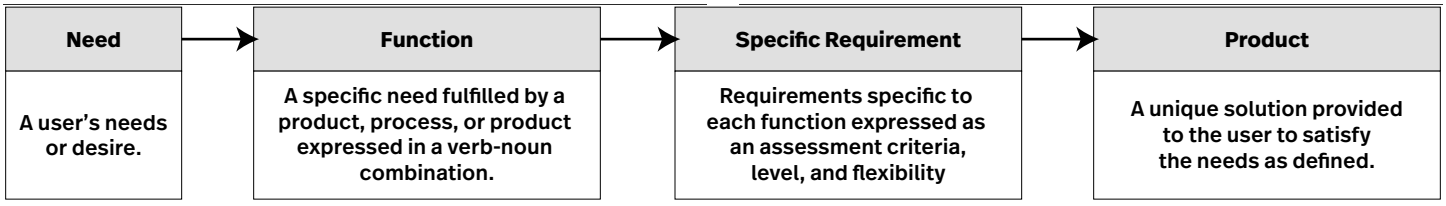

Figure 6.22 – Process flow for function performance specification.

Function	Performance Criteria	Units	Min	Max	Target	Flexibility
Deliver Force	Momentum	kg*m/s	0.05	0.25	0.10	F2
Increase Mass	Weight of hammer head	kg	0.2	1.0	0.3	F1
Deliver Force	Opening of claw	mm	2	6	3 to 5	F1
Identify brand	Readable label on handle or head	mm	20x10	40x30	20x10	F3
Enhance Appearance	Appearance of wooden handle	Panel judgement	Poor	Very nice	Nice	F2

Figure 6.23 – Example FPS matrix for a hammer

6.4.5 FAST dimensioning

An alternative technique, which is less rigorous but faster, can be used if a FAST diagram has been prepared. In this method, first write the data directly in or above the function boxes, as was done in Figure 6.24 which includes information relative to cost and percent of total cost. This is a simple and effective approach. When dimensioning cost data for construction or product studies, it is fairly easy to use the project cost estimate to begin allocating costs to the functions on the FAST diagram from right to left. The functions on the right-hand side of the diagram are typically far more specific and finite in nature than those on the left (a feature of the previously discussed ladder of abstraction).

Other information can be added to a FAST diagram from a function resource matrix or from a function performance specification matrix. Further, information related to RACI matrices, work breakdown structures, etc. can also be considered. The purpose of adding this information is to help the VM study team prioritize which functions have the greatest opportunity for value improvement.

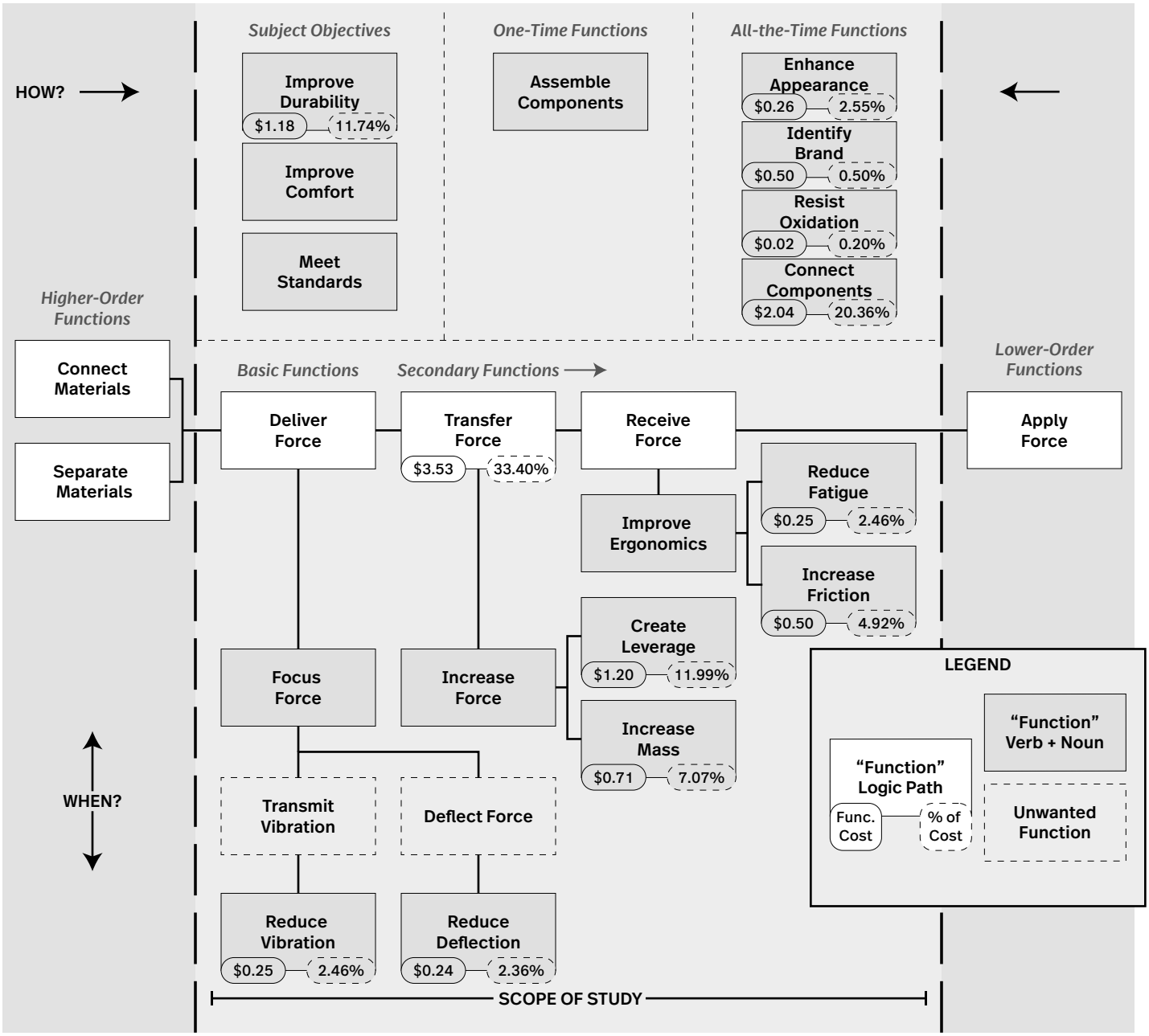

Figure 6.24 – FAST diagram of carpentry hammer dimensioned with cost.

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7
Creativity Phase

7.0 Introduction

The purpose of the Creativity Phase is to generate a large quantity of ideas that can perform the functions prioritized for value improvement during the Function Analysis Phase. The following questions are answered during this phase:

- What other ways will perform the function?
- What else will do the job?
- Does the job need to be done at all?

Therefore, the VM study team is required to use their creativity in order to generate ideas (as referred to as alternatives). The use of a multidisciplinary VM-team enhances the Creativity Phase. This is the phase where the VM study team unleashes the power of their collected technical knowledge and practical experience to generate ideas or alternatives to meet the functional requirements of the project, product, process, service, or organization.

It is essential that the VM study facilitator creates an atmosphere in which the VM study team members are able to think creatively and reframe the problem by using function-focused thinking. The Creativity Phase should encourage a free flow of ideas, a session where no idea is a bad idea, and only enough of an explanation for the VM study team members to understand the idea is required. During this phase, the VM study team looks for quantity and association of ideas that would improve the value of the project, product, process, service, or organization. The more ideas or alternatives they generate, the more likely that a “breakthrough” idea will be identified.

7.1 Terms and definitions

7.1.1 Convergent thinking

A mental process that focuses on coming up with the single, well-established answer to a problem. It is synonymous with the term “critical” thinking.

7.1.2 Creativity

A phenomenon whereby something new and somehow valuable is formed. It is the ability to produce original and unique ideas or to make something new or imaginative. Creativity can be supported and enhanced by the utilization of creativity methods and techniques. Creativity in VM leverages divergent thinking with a focus on functions.

7.1.3 Creativity techniques

Methods that promote creativity and the generation of new ideas for developing visions or to solve problems.

7.1.4 Divergent thinking

A process or method used to generate ideas by exploring many possible solutions. Divergent thinking typically occurs in a spontaneous, freely flowing, "non-linear" manner, such that many ideas are generated in an emergent, cognitive fashion. Divergent thinking requires a judgment-free environment and aims to elicit ideas that may be unconventional.

7.1.5 Freewheeling

A state of unrestrained, divergent thinking not bound by formal rules, procedures, or guidelines.

7.1.6 Hitchhiking

The process of taking one idea and building on it to create a different idea.

7.2 Process and key Concepts

7.2.1 The importance of functions in the creative process

Creative problem-solving lies at the heart of the Value Methodology. The VM Job Plan provides a structured sequence of phases designed to leverage both divergent and convergent thinking. From the first phase, where the problem(s) is defined, through the last phase, where the solution is implemented, the VM Job Plan draws upon both types of thinking – both convergent and divergent – while shifting the dominance of each as the VM study team move through the process.

During the Function Analysis Phase, the VM study team will have spent a significant amount of time defining and analyzing functions, allocating resources to them, and selecting those functions that have the greatest opportunity for value improvement. The basis for the Value Methodology is that these functions are required to be carried forward into the Creativity Phase to serve as the primary focal point for creative techniques. There are two key concepts related to the use of functions that support this requirement: framing and ambiguity.

7.2.1.1 Framing problems using functions

In the social sciences, framing comprises a set of concepts and theoretical perspectives on how individuals, groups, and societies organize, perceive, and communicate reality. Problem framing is the process of describing and interpreting a problem to arrive at a problem statement. It is considered an important step in problem solving, as slight changes in framing may lead to a vastly different problem-solving process and resulting solutions.

The word "hammer," or witnessing someone use a hammer to drive a nail, are examples of real-world observations. The phrase "invent a better mousetrap" could be used as a problem statement in that it implies that there is an element of inadequacy (or problem) in the current approach. This phrasing forces us to think about the object and current operations.

Within the context of Function Analysis, framing is the process whereby we transform the problem statement from the familiar perspective of the directly observable world to that of the ontological (i.e., the examination of what is meant by a word like "hammer" and all it entails).

The use of function statements changes the problem context, called framing, and creates ambiguity through its use of word structures.

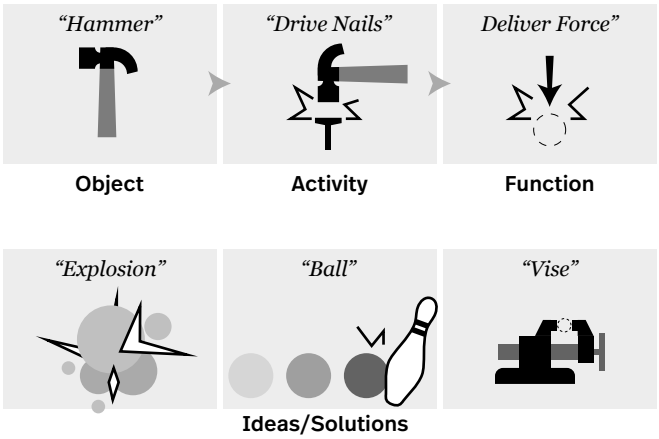

Figure 7.1 – Comparison of objects, activities, functions, and ideas.

In the example above, reframing the context of the object "hammer" as a function "Deliver Force" yields ideas and solutions that we would likely not have considered had we focused exclusively on the object. Obviously, many of these ideas will appear "useless" at face value, but they are not useless in the sense that they provide a vehicle for our minds to associate different concepts in unexpected ways that may indeed lead us to a breakthrough.

The book Stimulating Innovation in Products and Services (Kaufman & Woodhead, 2006) has an excellent discussion on defining problem statements they refer to as the "Fuzzy Problem Technique." The authors walk the reader through a series of questions that center on the concept of problem framing using function logic. The questions provide a natural progression that ultimately refocus the problem statement using different levels of abstraction. Q: If we want to design a better mousetrap, why do we want to trap mice? A: To eliminate mice. Q: Why do we want to eliminate mice? A: To prevent disease.

Using this technique, we make the problem progressively fuzzier and identify three problem solving frames: "Trap Animals"; "Eliminate Animals"; and "Prevent Disease." Note that by shifting the noun 'mice' to 'animals,' we have further altered the frame of the problem statement. One could take it a step further and replace "animals" with "creatures" or "entities" and make the problem even fuzzier. Fuzziness will get us more ideas, which is the goal of creative thinking, because it broadens the net we cast if we think of ideas as fish. We can begin to see how framing and ambiguity (fuzziness) are interrelated in function analysis.

Function analysis requires us to reframe the object as a statement of purpose or intent. It is not the hammer that interests us, but what the hammer does and, perhaps, why it does it. This change in framing problems is essential in changing the way in which we think about possible solutions.

7.2.1.2 Leveraging the ambiguity of functions

Ambiguity is alternatively defined as: 1) doubtfulness or uncertainty of meaning or intention: to speak with ambiguity; an ambiguity of manner; or 2) an unclear, indefinite, or equivocal word, expression, meaning, etc. Note that the concept of ambiguity has many applications beyond language and is a meaningful construct in the fields of visual arts, music, computer science, computational linguistics, and mathematics. However, this section concerns the concept of ambiguity relative to language.

Clearly, functions, as defined in Chapter 6, reframe objects and activities according to what they do rather than what they are. This transformation results in ambiguity, partly because it forces us to articulate function statements concisely and excludes the use of qualifying words such as adjectives, partly because words have different meanings and partly because objects and activities can have multiple functions. But most of all, Function Analysis creates ambiguity because it reframes context.

The ambiguous nature of function statements inherently contributes to divergent thinking. It opens our minds to alternative possibilities beyond current, known solutions.

7.2.2 Creative process

Creativity, being a key part of the Value Methodology, is very important; yet, many adults tend to believe that they are not creative in the traditional sense. Creativity, however, is about producing an idea or alternative that is new, useful, and/or surprising.

- A new idea or alternative may not be new within an industry, but may be new to the client, organization, and/or VM study team. For example, having VM study team members from different states and/or countries allows them to bring their knowledge and experience of how things are done in their locales that may not have been considered for the subject under study.
- A useful idea is an idea or alternative that is implementable and has value.
- A surprising idea is an idea or alternative that is unexpected in terms of its elegance, simplicity, cleverness, and/or usefulness in meeting the functional requirements of the project, product, process, service, or organization

During the Creativity Phase, there are several ground rules (see also Chapter 12) that must be established by the VM study facilitator to ensure that all VM study team members feel comfortable participating in the Creativity Phase.

- Establish an atmosphere conducive to creativity that allows for all VM study team members to openly provide ideas or alternatives.
- Record all ideas or alternatives. Any idea may spark new ideas or alternatives, be combined with another idea or alternative, or benefit from incubation in the mind of a VM study team member. The emphasis during the creativity phase is on the quantity of ideas rather than the quality.
- Do not allow judgment, not even a snicker, of any idea or alternative. This is referred to as the "principal of deferred judgement." Encourage a wide variety of ideas from many angles and/or points of view.
- Establish an ambitious (stretch or reach) goal for the number of ideas or alternatives to be generated. For example, if the VM study team generates 24 ideas or alternatives, encourage them to generate 40 ideas.
- Encourage the VM study team to watch for opportunities to combine or improve ideas or alternatives as they are generated (e.g., "free-wheeling").
- Encourage the VM study team to focus on the prioritized functions they identified VM study team during the Function Analysis Phase. Following the Pareto Principle, this often results in focusing on a smaller number of functions that are most attractive for value improvement.

7.2.3 Process inputs and outputs

7.2.3.1 Inputs

- Functions selected for value improvement,
- Open minded participants,
- An environment conducive to creativity.

7.2.3.2 Activities

- Generate ideas.
- Record all ideas.

7.2.3.3 Outputs

- A list of ideas organized by function.

7.2.3.4 Process flowchart Figure 7.2

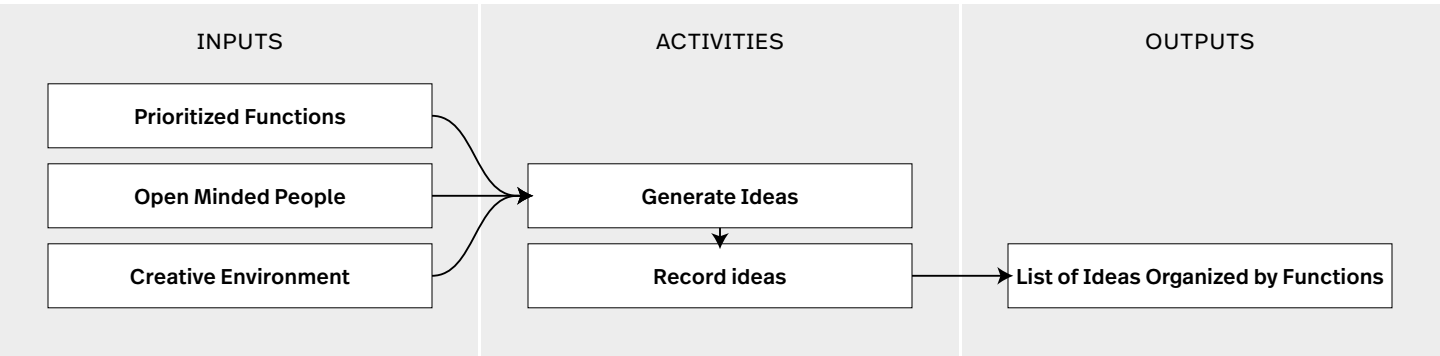

Figure 7.2 – Function analysis phase flowchart.

7.3 Activities

7.3.1 Generate ideas

The basic function of the Creativity Phase is to generate ideas. The emphasis should be placed on quantity, and the success of this phase will hinge on the participation of the VM study team, strong facilitation from the VM facilitator, and thorough leveraging of creativity techniques. Refer to Chapter 12 for additional guidance on facilitation techniques.

The VM facilitator can use numerous creativity techniques during the Creativity Phase. Regardless of the techniques used, the Creativity Phase should always first focus on generating ideas based on the functions prioritized at the end of the Function Analysis Phase. This ensures that the VM study team focuses on the functions that will meet the goals and objectives of the VM Study and provide the best return for their efforts.

Creativity techniques can be divided into intuitive and discursive methods (or use a combination of both).

- **Intuitive creativity methods:** The approach of the intuitive creativity method is based on consideration of the overall problem. Brainstorming by function is a prime example of an intuitive creativity method.
- **Discursive creativity methods:** A discursive method develops a solution path through a deliberate and structured procedure, step by step. A problem is often decomposed into sub-problems, which are solved in individual solution steps separately and finally matched. Overall, this results in fewer, more focused, and rational solutions. Techniques such as cause-and-effect diagrams, mind-mapping, and morphological analysis are examples of discursive methods.

Other approaches to creativity are similar to intuitive and discursive methods. An example is intuitive, and data driven. Either an intuitive and visionary approach (working towards an ideal result) or a data-driven and experimental approach (improving and testing the present solution) is chosen for the identified function.

Once the VM study team has exhausted ideas for one function, they should move onto the next, repeating the creative techniques as appropriate.

7.3.2 Record ideas

The VM facilitator should follow the guidelines below for capturing ideas from the participants involved in the creativity session:

- Write down what the participants says – try not to edit or paraphrase their words.
- If the facilitator or team does not understand the idea, probative questions may be asked, but avoid the temptation to get into great detail.
- Don't be dismissive of wild or unconventional ideas. Write everything down!
- Make sure all the ideas are visible.

There are many ways in which to record the ideas or alternatives generated by the VM study team, such as a flipchart, whiteboard, and/or via a laptop using a multimedia projector or monitor. The key is to record all the ideas or alternatives generated.

7.4 Creativity techniques

Creativity techniques are methods that promote creativity and the generation of new ideas for developing visions or to solve problems. While using creativity techniques, it must be known that creativity is a complex interaction of talent, knowledge, motivation, and individual characteristics. According to research published by William C. Miller (Innovation Styles, 2007), the two dimensions that govern creative thought are:

- Approach: This dimension responds to what stimulates and inspires innovation, which could be facts (details and analysis) or intuition (insights and images).
- Procedure: This dimension responds to the approaching style of the innovation process, which can be focused (well-planned and outcome oriented) or broad (perceptive and learning oriented).

Understanding these ensures the right mix of innovation traits in the team. The four main approaches are:

- Envisioning by imagining the ideal future by focusing on long-term goals for maximizing future potential.
- Exploring by discovering new possibilities using ideas from other areas and disciplines.
- Experimenting by combining and testing new combinations.
- Modifying by refining and optimizing what currently exists to build on proven ideas.

Awareness and understanding of these two dimensions will help the team to propose and appreciate ideas in the Creativity Phase. Also, it helps the team to deploy the right creativity tools according to the problem at hand and the target given.

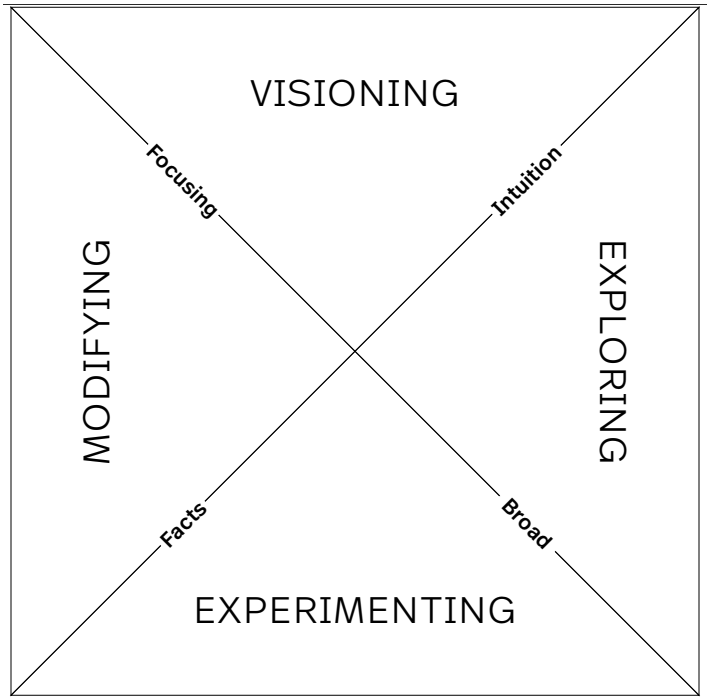

Figure 7.3 – Innovation styles model (adapted from Miller, 2007).

Examples of creativity tools for each creativity type include:

- Visioning – Visualization[9], reverse brainstorming.
- Modifying – The technique of "hitchhiking" is a classic example of this type of creativity. Mind mapping, and fishbone diagrams are other examples of this modality.
- Exploring – Incorporating functions into brainstorming sessions is an example of this type of creativity which stimulates free association. Another example is a technique called "Brutethink," whereby a random word is selected and then participants seek to create new ideas to solve a problem using that word in the solution.
- Experimenting – Examples of this type of creativity include techniques such as morphological analysis and TRIZ.

The two basic creativity techniques that all VM facilitators must know are brainstorming and brainwriting. The VM facilitator should be aware of other creativity techniques and is encouraged to try them when appropriate.

7.4.1 Brainstorming

The most used creative technique in the Creativity Phase is brainstorming. Steps for brainstorming include:

1. Determine and which function(s) and/or element(s) of the project, product, process, service, or organization to be brainstormed and present them on a flip chart, white board, or other visual medium so that the entire VM study team can observe the process.
2. Review the rules of brainstorming, which include but are not limited to:
    a. All VM study team members are required to participate in brainstorming.
    b. Defer all judgment of ideas or alternatives to the Evaluation Phase.
    c. Seek quantity of ideas or alternatives rather than quality. The more ideas or alternatives the team generates, the greater potential for a "breakthrough" idea that will result in significant benefits for the project, product, process, service, or organization.
    d. Encourage freewheeling, combining, or hitchhiking on ideas. Allow for the free flow of ideas
    e. Avoid any discussion of the ideas or alternatives generated, as it interrupts the flow of ideas or alternatives. If VM study team members do not understand an idea or alternative, allow the team member who generated the idea to briefly explain or, if necessary, provide a sketch of the idea or alternative.

7.4.2 Brainwriting

Brainwriting (also called trigger sessions) is a useful way to get numerous ideas from untrained or reluctant participants. Here's how it works:

- Identify the function under focus.
- Each member of the group writes down their ideas using brief statements (short periods only; e.g., five minutes).
- One member reads out their list; others cross out the ideas duplicated on their own lists and write down new "hitchhiked" ideas.
- A second member reads out their list of ideas not already covered, and the process is repeated until everyone has shared their list.
- The last member reads out their original list and "hitchhiked" list, and the procedure repeats in reverse.

A good group of participants can manage at least a half dozen passes. Everyone's paper is then collected and combined into

a single list of ideas–all duplicates should have been crossed out during the process. The VM facilitator may want to write down the "surviving" ideas on a flipchart or whiteboard as the brainwriting session evolves.

In a variation on this technique, everyone writes down their ideas on Post-It® notes or small index cards and places them in the center of the table. Everyone is then free to pull out one or more of those ideas for inspiration. Team members can create new ideas, variations, or piggyback on existing ideas.

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- Visualization is visioning the ideal result and then focusing towards practically achieving it. Example can be of Josephine Cochran who invented Washing machine. She wanted to create a machine which would not break dishes when washed. Retrieve from **www.uspto.gov/about-us/news-updates/woman-invented-dishwasher**
- Flip method is also called as reverse brainstorming. Refer to **www.mindtools.com/pages/article/newCT_96.htm**.
- Online functions databases:
    - **www.productioninspiration.com**
    - **wbam2244.dns-systems.net/EDB/index.php**

8
Evaluation Phase

8.0 Introduction

The purpose of the Evaluation Phase is to systematically reduce the large number of ideas generated during the Creativity Phase to those that best enhance the value of the subject under study and appear the most promising for development. The evaluation processes used in this phase generally involve two stages. For example, an evaluation process to choose a meeting room shown among competing options is illustrated in Figure 8.1 . The first stage of the process concerns structuring the evaluation, while the second stage concerns making judgments relative to the options.

Evaluations are used to prepare decisions within the context of solving selected problems. Therefore, evaluations are only needed and can only be carried out if alternatives are available. In this sense, doing nothing is also an alternative.

8.1 Terms and definitions

8.1.1 Criteria

Standards for evaluation upon which a decision or a judgment is based.

8.1.2 Evaluation

To determine the significance, value, or condition through careful appraisal and study.

8.1.3 Grading

To classify ideas on a scale, such as by quality, size, color, etc.

8.1.4 Ranking

To arrange ideas by priority or importance relative to other ideas being considered.

8.1.5 Weighting

To give something (here, especially, the criteria) a specific meaning. Therefore, different criteria can be differentiated, and the importance will becomes obvious.

STAGE 1	STAGE 1
ordering defining structuring setting priorities	• Define criteria: number of seats, equipment, accessibility, costs ... • Define criteria weighting • Define the property: number of participants, is a projector available? (yes/no), distance to airport, is parking available? (yes/no)
STAGE 2	**STAGE 2**
make distinctions make choice	• Make a choice (evaluation result: a value, spider chart)

Figure 8.1 – Two evaluation stages using the selection of a meeting room.

8.2 Process and key concepts

Evaluation is based on a comparison of options (in this case, ideas that address a function) on the basis of a measure of value. The measure of value can be monetary. It can be quantitative or qualitative. Evaluations should be made using a systematic approach.

Evaluations should seek to be objective and the underlying facts must be documented to permit traceability. Objectivity is enhanced by involving the whole VM study team, and in some cases stakeholders, representing various areas of responsibility in the evaluation process. The criteria on which an evaluation is based and their importance describe the point of view from which the evaluation has been carried out. In order to gain an objective view of the results, it is advisable that the entire VM study team perform evaluations together.

Effective evaluations require a clear definition of all relevant criteria. Any evaluation criterion identified should support achieving the VM study objectives and consider value holistically and relative to the context of the VM Study subject. This ensures that all team members involved in the evaluation process make judgments based on the same clearly defined criteria with accurately described characteristics, thus creating a common understanding. Adhering to a methodical approach is crucial to ensure the VM study team's evaluation can be understood even by persons not involved in the process.

Another important concept in this phase is the number and type of "filters" used to discriminate ideas relative to the time available in the VM study for evaluation and the quantity of ideas. **Figure 8.2** illustrates this concept. Imagine that you had 200 ideas, but only four hours to evaluate them. How would you select the best ones? By applying three levels of filters, it would be possible to begin with a "coarse" idea filtering technique (such as evaluating by a simple yes/no rating) to quickly eliminate ideas that are clearly impractical), and by then moving to a "medium" filter (such as by applying nominal group technique), and then taking only the handful of best ideas and subject them to a "fine" filter (such as by applying an evaluation matrix). Each level of filtering produces progressively higher levels of fidelity while also taking more time. This chapter will further explore these essential concepts.

The expertise of the VM facilitator carrying out the evaluation and their competence in applying appropriate techniques, as well as the quality of the data on which the evaluation is based, determine the rigor of the evaluation. Increasing the level of filter applied during the Evaluation Phase also increases the level of information considered.

8.2.1 Process inputs and outputs

8.2.1.1 Inputs

- Value study goals,
- Subject context,
- List of creative ideas.

8.2.1.2 Activities

- Establish framework.
- Establish criteria.
- Evaluate ideas.
- Select ideas.

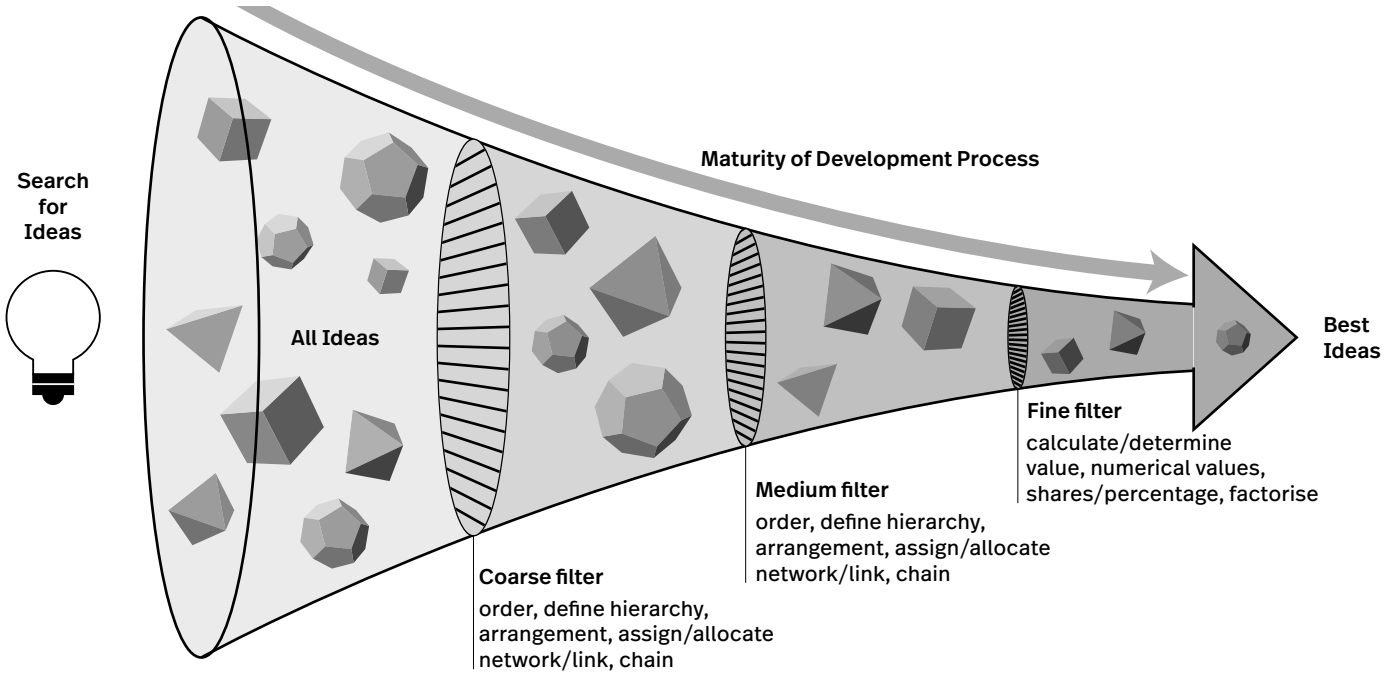

Figure 8.2 – Evaluation process flowchart.

8.2.1.3 Outputs

- Evaluation criteria,
- Evaluation results/rationales,
- List of prioritized ideas selected for development.

8.2.1.4 Process flowchart Figure 8.3

8.3 Activities

8.3.1 Establish evaluation framework

In VM, evaluation can be performed by applying the idea filter concept described previously:

- Coarse, or simple, evaluation techniques applied according to a basic grading system relative to all of the evaluation criteria.
- Medium, or intermediate, evaluation techniques applied with via comparison of evaluation criteria compared to each other or baseline conditions (e.g., status quo, current design, existing product, etc.).
- Fine, or detailed, evaluation techniques which discretely grade or score the evaluation criteria relative to a range or scale. This may include a variety of different weighting, rating, or numerically scored ideas in a systematic way.

Following the application of these techniques, additional operations may be performed to further make sense of the evaluation results. These include:

- Organizing ideas,
- Excluding redundant ideas,
- Summarizing similar ideas,
- Rough sketches or visualizations, and,
- Possible use of forms or templates.

The decision as to what level of, and how many, filters are applied during the evaluation process largely depends on the time available, the number and expertise of the participants, and the number of ideas. The VM facilitator will need to apply their judgment in making these decisions. For example, if there were 100 ideas to evaluate and only two hours to do it, then perhaps there would only be time to perform a coarse evaluation. With an additional hour, it might be possible to add a medium filter. And with perhaps another hour, the very best ideas could be further scrutinized under a fine filter.

Whatever techniques are applied, based on the degree of filtering selected, should also involve capturing key discussions, judgments, ratings, and rating information. This is of critical importance. It is essential to have this recorded information available in order to conduct the final activity in the Evaluation Phase, which is to prioritize and select the ideas after completing the evaluation. This is especially true as the number of ideas increases. The VM study team will quickly forget key discussions and rationales as the evaluation progresses, unless they are dutifully captured and documented.

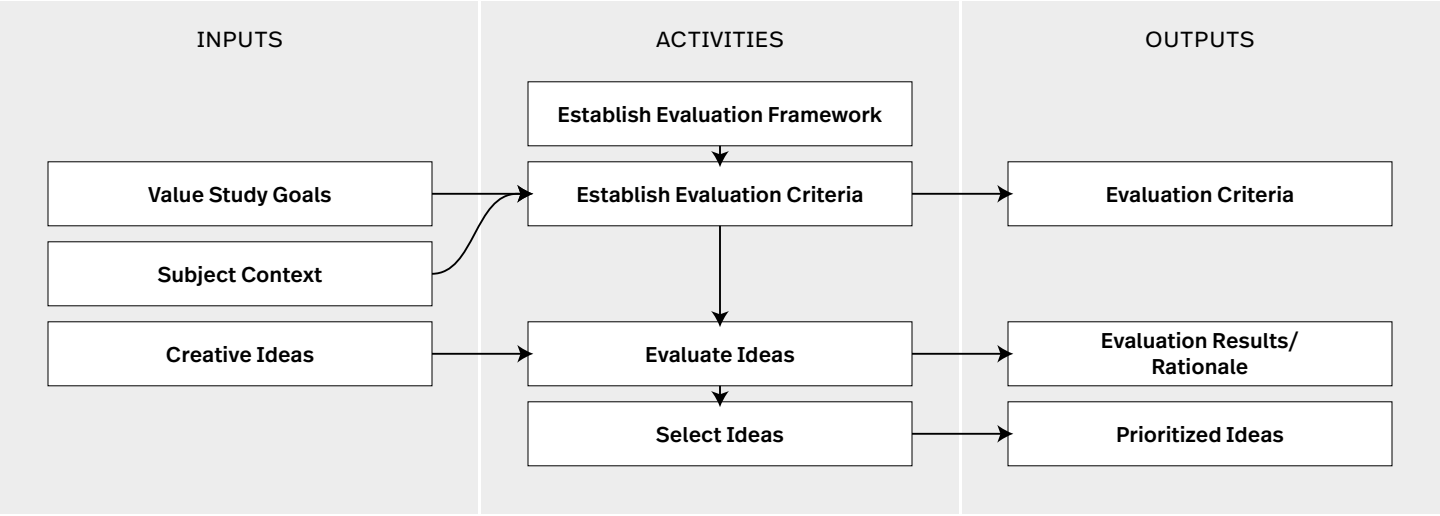

Figure 8.3 – Evaluation process flowchart.

8.3.2 Establishing evaluation criteria

8.3.2.1 Understanding the current state

Identifying appropriate criteria is an essential element of the evaluation process. The fact that different customers, users, and stakeholders can have different demands regarding a subject must be taken into consideration. Accordingly, the VM study team must be sufficiently familiar with the stakeholders and their requirements in order to carry out an evaluation that takes them into account.

Evaluation criteria can be specified by the VM study sponsor or key stakeholders, VM study team, or some combination. The criteria and their relative importance (e.g., weighting and/or ranking) must be discussed and agreed upon by the team in order to create a common understanding and, therefore, achieve acceptance.

8.3.2.2 Guide for establishing evaluation criteria

Evaluations may be carried out holistically or with a specific focus, such as technical, economic, social, and/or market-related requirements. The evaluation criteria should be defined in accordance with the field being examined. The general process for establishing evaluation criteria is illustrated in **Figure 8.4** .

Figure 8.4 – Steps in establishing evaluation criteria.

It is essential to include the whole spectrum of categories from the object's environment in the evaluation criteria:

- Step 1. Consider the context of the subject under evaluation. Either a more generic evaluation or one that focuses on more specific spheres of influence can be considered. Relative to the context of VM, which is focused holistically on improving value, the elements of performance/quality, cost, time, and risk provide the broadest set of potential evaluation criteria. Another approach is to consider relative spheres of influence. For example, an evaluation involved in identifying new product development opportunities might consider the suitability of ideas relative to technical, economic, social and/or market-related domains.
- Step 2. Define the criteria based on the subject's environment. For instance, the following criteria for the construction of a new hospital might consider:
  - Program compatibility: the capacity of the facility to meet the number and type of medical needs of patients.
  - Future flexibility: the capacity of the facility to be expanded or modified to meet future demands.
  - OPEX: the cost to maintain and operate the facility (e.g., life-cycle cost).
  - CAPEX: the cost to design and construct the facility.
  - Schedule: the time from inception to beneficial use of the facility.
  - Project risk: the potential for the project to run over budget or encounter delays.

  The number of evaluation criteria selected for each category may emphasize the dominant aspects of the evaluation. If, for example, three technical criteria are defined as opposed to only one criterion from each of the other fields, the technical aspect will dominate the result, unless, of course, weighting the criteria influences that ratio.
- Step 3. Transform the criteria for evaluation by identifying the range of acceptability for the criteria. This means identifying what is acceptable or unacceptable. Further, consideration must be given as to whether a criterion is quantitative or qualitative. Doing so provides the individuals involved in the evaluation some means of gauging how well an idea or potential solution will satisfy the evaluation criteria. This could be a numeric score (e.g., 1 to 10), a letter grade (e.g., A to F), or descriptive (e.g., excellent to poor). Once a range is established, it is important to associate either a quantitative measure or a qualitative description to help those making the evaluation do so in a consistent manner. Evaluation criteria are supposed to model the extent to which requirements/demands are met. Accordingly, they must be described in a precisely defined manner in order to create a common understanding of the measure and scale. It is important to include the initial conditions in the evaluation. Particular attention is to be paid when defining non-monetary criteria or a criterion which, at first glance, cannot be represented by numerical values, in order to make it measurable. In this case, it is important to find as comprehensive a description as possible, which can be set in relation to something that is familiar or comparable.

- Step 4. Consider the relative importance, or priority, of each criterion. This step must look at the total set of criteria under consideration and determine their priority. Are all the criteria equally important? Is one more dominant than the others? These questions must be answered to ensure that those involved in the evaluation process share a similar understanding of the importance of the criteria. There are different techniques for weighting and prioritizing.

Defining and representing evaluation criteria as accurately as possible is the essential basis for efficient and correct evaluation: efficient, since discussions concerning matters of understanding can be reduced to a minimum; and, correct, since everyone involved in the evaluation gains a clear understanding and clear representation of the criteria measurements. A common understanding can only be achieved if the evaluation criteria grading is discussed and defined by the entire team.

8.3.2.3 Examples of evaluation criteria

Depending upon the subject of the study, the evaluation criteria may vary greatly. The sponsor of the VM study may have criteria that differ from those of customers or end-users. Additional stakeholders may also come to the table with widely differing demands.

Evaluation criteria should always originate in the VM study subject's environment and relate to the goals of the VM study. Figure 8.5 provides a small sample of possible evaluation criteria for different applications.

Looking at the "generic" evaluation criteria related to the elements of value (performance, cost, time, and risk), these could be further expanded upon for nearly any situation to better respond to the subject's context and goals of the VM study. Figure 8.6 provides an example of this, focusing on a manufactured product.

Generic	Project	Product	Process
• Performance • Cost • Time • Risk	• Reliability • Maintainability • Program Compatibility • Environmental Impact	• Customer Satisfaction • Market Suitability • Strategic Alignment • Technological	• Efficiency • Quality • Cycle Time • Scalability

Figure 8.5 – Examples of evaluation criteria.

Performance	Cost	Time	Risk
• reliability • durability • maintainability • efficiency • effectiveness • attractiveness • build quality • user acceptance	• cost of tools • cost of molds • cost of appliances • cost of machines • cost of equipment • cost of labor • cost of facilities • cost of defects	• time to design • time to manufacture • time to assemble • time to test • time to approve or certify • time to deliver • time to market	• risk of technical feasibility • risk of unexpected implementation costs • risk of supply chain disruptions • risk of material cost variability • risk of difficult or impossible commissioning

Figure 8.6 – Examples of evaluation criteria for products.

8.3.3 Evaluating ideas

8.3.3.1 Evaluation in the context of human behavior

The VM study team bears the primary responsibility for evaluating ideas. If required, additional experts or stakeholders may augment the team (e.g., individuals representing the subject team, customers, key external stakeholders, etc.) during the evaluation process to ensure that the required expertise is introduced.

The VM study team can only be successful if the team not only has the necessary expertise and experience but is also familiar with the methods and tools. The VM facilitator should be familiar with evaluation techniques to be applied. The required environmental factors also must be in place, as well as a corresponding management style which takes the team members' behavior into consideration as well. This means meetings must be chaired and managed. The dynamics resulting from individual behavior within a group is an important factor for the successful organization of a VM study.

In VM, evaluation must also take the interpersonal relationships involved in working together as a team into consideration. Special consideration should be given to the following points.

- Encouragement of cooperation within interdisciplinary teams in order to find solutions that find a consensus;
- Praise and recognition of the team's achievements;
- Improvement of interpersonal communications to promote common understanding;
- Maintaining a skeptical view of the status quo in order to drive beneficial changes;
- Support for decision-making in the team; and,
- Responsibility for decision-making to lie with the team which developed the solutions.

Newly generated ideas might be rejected too quickly because too little is known about them, which risks losing good ideas. In this context, it is important to ensure that an idea is always evaluated favorably, not unfavorably. Particular attention must be paid to this aspect, especially during the rough evaluation phase.

Experience, too, can have both positive and negative effects on an evaluation. Creation of something new always involves departing from established patterns and allowing the formation of new relationships. The positive effect of experience is that very experienced persons can resort to a large pool of possible relationships and, therefore, have a lot of options for determining new combinations. The negative effect is that some people may have great difficulty departing from rigidly established thought patterns. In this sense, evaluations can provide an opportunity to achieve objectivity. In order to reap the benefits of different levels of experience, special attention must be paid to the formulation and grading of the evaluation criteria.

An evaluation can never be completely objective. Systematic procedures, joint evaluations made as a team on the basis of clearly defined and agreed criteria, as well as tenacity in the pursuit of ideas will increase objectivity and, in practice, lead to extremely good results.

8.3.3.2 Establishing the scope of evaluation

Since VM is an application-neutral method, the ideas evaluated may cover a broad variety of topics relevant to the context of the subject. Some of these ideas could lay outside of the scope of the evaluation. Careful consideration should be given to identify critical constraints beforehand to better manage the scope of evaluation. For example, ideas focusing on a project could lead to challenging external processes that lay outside the initial VM study scope. Depending on the context and critical constraints, it is possible that such ideas could be either inside or outside the scope of the evaluation. Establishing such parameters can quickly discount or dismiss large numbers of ideas. This can be a benefit by avoiding wasting the VM study team's time on evaluating ideas that have no opportunity of success; or, conversely, it could result in lost opportunities for value improvement if the evaluation scope is not fully understood. When in doubt, the VM study sponsor should be consulted to ensure the scope of the evaluation is clearly defined and to avoid wasting effort unnecessarily.

8.3.4 Selecting ideas

After the VM study team has evaluated the ideas, decisions must be made relative to which ideas will be selected and advanced into the Development Phase. Regardless of the techniques employed to evaluate the ideas, the evaluation process should have narrowed down the list of ideas considerably. The remaining ideas identified by the team for further investigation in the Development Phase should be listed by priority, based upon the outcome of the evaluation.

In some cases, further evaluation may be necessary, especially if it appears that the list of surviving ideas appears to be larger than what the VM study team can adequately develop in the time allotted. In cases such as this, it may be advisable to attempt to make a quick estimate of costs in order to develop a better understanding of the magnitude of savings (or cost increase) involved. Alternatively, the nominal group technique can be employed to help rank the remaining alternatives in order of importance.

Once the ideas have been listed according to their priority, they will need to be assigned to the VM study team members for development. It is important to emphasize that the entire team may be involved in the development of an idea into an alternative; however, it is best to assign one individual on the team the responsibility to ensure the idea is fully developed and does not fall through the cracks.

8.4 Techniques

8.4.1 Coarse filter – simple evaluation techniques

A relatively quick way to evaluate ideas, which is commonly used by VM practitioners, is to identify a set of evaluation criteria, discuss the merits of the idea relative to the evaluation criteria, and then assign the idea a rating based on how well it addresses the evaluation criteria. If time is limited and/or there are many ideas to evaluate, care should be given to selecting a smaller set of criteria to consider.

Each idea should then be discussed relative to the evaluation criteria. An overall rating can then be assigned using any numeric scale preferred (1 to 3, 1 to 5, and 1 to 10 are most common). Even a simple binary evaluation can be applied (e.g., yes or no; thumbs up or thumbs down; develop or dismiss). Numeric scales, if used, should reflect overall acceptability of the idea. Each number on the scale should be defined:,. for example, a 1 to 3 scale might consist of numbers with corresponding values such as:

1. Unacceptable. This idea should be dropped from further consideration.
2. Shows potential. This idea should be considered only after all the ideas rated “3” have been developed.
3. Acceptable. The idea should be developed into a value alternative.

The example in Figure 8.7 shows a simple evaluation of several ideas for the forklift project’s hydraulic system, described by the function statement “transfer energy.” In this case, the ideas were organized by function and discussed by the VM study team relative to the evaluation criteria. In order to conserve time, the ideas are just given a simple rating.

Function: TRANSFER ENERGY		
Idea #	Idea	Rating
TE-1	Hand-operated reciprocating pump	1
TE-2	Radial piston pump	2
TE-3	Gerotor (generated rotor) pump	3
TE-4	Use a gear pump from a different manufacturer	3
TE-5	Eliminate hydraulic system completely and use an electric motor	2
TE-6	Rotary vane pump	1
TE-7	Axial piston pump	2

Figure 8.7 – Example of an evaluation by simple rating.

Increasing the size of the rating scales or categories used increases the granularity or fidelity of the analysis, allowing for a higher level of discernment between ideas. Idea codes can be used to help identify and track ideas by function (e.g., Transfer Energy = TE-1) as they move through the evaluation and development process. This method is fast but tends not to be as thorough as the other techniques described below for intermediate and detailed evaluations. In the example above, the rationale for the rating isn't recorded. That may handicap the team later as the reasons for the rating given may be forgotten or become unclear; however, it may have been the only reasonable way to evaluate the ideas given time constraints. The preference is to always record the highlights of key discussions in order to help the team recall the rationale behind the ratings.

8.4.2 Medium filter – intermediate evaluation techniques

This approach builds upon the previous technique and compares the advantages and disadvantages of an idea relative to the subject's baseline state. The VM facilitator should facilitate the discussion of each idea and record the benefits and challenges (or advantages and disadvantages) based on the evaluation criteria. From this discussion, the VM study team should be able to make conclusions as to which ideas merit further exploration in the Development Phase, and which ideas should be eliminated from further consideration (see **Figure 8.8**). The ideas can be rated based on a rating scale as described previously. This approach provides better documentation on the team's reasoning; however, it also requires more time.

Another technique that falls within this category is the nominal group technique originally developed as an organizational planning method by Delbecq, Van de Ven, and Gustafson in 1971. This technique, with a few minor modifications, provides an effective means of prioritizing ideas through group consensus. This process includes the following steps:

1. After the ideas have been captured following a creativity session, the VM facilitator asks each participant to read and elaborate on their ideas to ensure everyone understands the concept. Duplicate ideas can be crossed out and the remaining ideas are numbered or assigned an idea code.

2. The VM facilitator asks each person to write down, within a few minutes, the idea numbers or codes that seem especially important. Some people may feel only a few items are important; others may feel all items are important. The VM facilitator then goes down the list and records the number of people who consider each item a priority.

3. Session participants are then asked to choose up to 10 ideas that they feel are the most important and rank them according to their relative importance. The idea each feels is most important should get at "1" down to their least important which would get a "10." These rankings are collected from all participants and aggregated (see **Figure 8.9**). The lower the score, the higher the idea is ranked. Time permitting, participants should be asked why they ranked ideas the way they did.

Function: CONTROL SPEED				
Idea #	Idea	Benefits	Challenges	Rating
CS-1	Electronic shift control	• Allows for "on the fly" shifting • Improves fuel efficiency	• Increases costs	10
CS-2	Hydrostatic hand paddles	• Allows greater sensitivity in controlling speed • Allows for visual feedback	• Increases costs • Adds complexity • Concept not intuitive for most operators	7
CS-4	Joystick control	• Provides a unique solution • May lend itself to a new marketing approach • Could provide for increased control if combined with an electronic shift control	• Increases costs • Concept may not be intuitive for most operators	8
CS-5	Manual shift with clutch	• Reduces costs • Allows more operator control	• Requires clutch maintenance • Less convenient	3

Figure 8.8 – Evaluation by comparison.

Sometimes, these results are given back to the participants in order to stimulate further discussion or to allow for the readjustment in the overall rankings assigned to the various responses. This is done only when group consensus regarding the prioritization of issues is important to the overall research or planning project. As its name suggests, the nominal group technique is composed of values provided on an individual basis but grouped together to form a single ranking.

Another variation of this approach works particularly well if ideas have been recorded on flip chart paper and posted on the walls. It involves handing out a set number of colored stickers (or using colored markers to write stars) to the participants and then asking them to place stickers next to the ideas that they feel are the best. This forces participants to engage with the ideas and makes them accountable for identifying their preferences. Once the participants identify their preferred ideas, the total number of stickers or marks can be added up and the highest scoring ideas circled. These ideas can then be further discussed or advanced into a fine filter stage of evaluation. This approach can be further augmented by passing out a different colored sticker, or marker, to indicate ideas to which they object. Doing both can lead to robust discussions concerning why people support or oppose ideas. Ideally, the highlights of these discussions are recorded to document the evaluation process.

8.4.3 Fine filter – detailed evaluation techniques

The use of a more detailed evaluation matrix offers a way to more finely filter and consider ideas. This approach seeks to consider discrete evaluation criteria and score them individually. During the ensuing discussions, the rationale for each idea relative to the evaluation criteria is documented. This documentation can prove very valuable to project stakeholders, even for those ideas ultimately rejected, as it provides a concise, but thorough, discussion of key issues. Many times, stakeholders want to know why an idea was not further developed into a proposal. This conscientious approach should satisfy that inquiry.

Unfortunately, many promising ideas are discarded based on unfounded statements with respect to only one evaluation criterion. The process described above forces participants to articulate their criticism in an organized way that addresses all the key evaluation criteria, not just those that immediately come to mind. Additional in-depth discussion is often required before potential benefits are revealed.

Use of an evaluation matrix should consider performance, cost, schedule, and risk. When these criteria have been considered, a final rating is assigned to the idea. This can be handled using several methods.

The simplest approach is to identify if the idea results in an improvement or degradation relative to each of the evaluation criteria. This can be indicated with a symbol (e.g., plus or minus symbol, or an up or down arrow). Once the criteria have been evaluated in this manner, and the rationale for the rating recorded, the idea can then receive a final score. This could be a 1 to 10, 1 to 7, 1 to 100, or whatever scale is preferred. It is always helpful to include some kind of qualitative description to the scale. For example, a 1 to 7 scale might be described as follows.

1. Major value degradation
2. Moderate value degradation
3. Design consideration (No cost data developed)
4. Possible value improvement
5. Minor value improvement
6. Moderate value improvement
7. Major value improvement.

Function: GENERATE TORQUE							
Idea Code	Bill	John	Fred	Sally	Jamal	Total Votes	Ranking
GT-1	7	8	10	10	8	43	9
GT-5	8	5	4	6	3	26	5
GT-11	1	2	1	3	2	9	1
GT-16	6	9	8	7	10	40	8
GT-18	10	10	7	9	9	45	10
GT-23	2	3	3	2	1	11	2
GT-26	5	6	9	8	6	34	6
GT-29	3	1	2	1	4	11	2
GT-32	9	7	6	5	7	34	6
GT-34	4	4	5	4	5	22	4

Figure 8.9 – Example of an evaluation using the nominal group technique.

More sophisticated variations of the evaluation matrix seek to first assign weights (relative importance) to the evaluation criteria. There are many ways to do this that range from simple to complex. Basic methods include:

- Direct weighting. Distribute 100 points between the evaluation criteria based on group discussion. The more important a criterion is relative to its peers, the higher the score.
- Scaled pairwise comparisons. This method compares all criteria against each other in pairs, and then assigns a weight of 1 to 9 to the dominant criterion. Scores are then added together and normalized with resulting scores assigned to the criteria.
- AHP pairwise comparison. This method, developed by Thomas Saaty (1926-2017), is a more sophisticated version of scaled pairwise comparisons. It uses a scaled eigenmatrix to assign relative ratio measures to evaluation criteria.

Using this quantitative method, each idea can be assigned a numeric rating (such as a 1 to 10) for each criterion that is then multiplied by the importance, or weight, of the criterion, to derive an adjusted score. The scores for each criterion can then be added together to calculate a total score. This method can be time consuming, but it provides additional rigor to the evaluation process.

			Performance Attributes				Legend					
							+ = Improved 0 = No Change - = Degraded	7 = Major Value Improvement 6 = Moderate Value Improvement 5 = Minor Value Improvement 4 = Possible Value Improvement 3 = Design Consideration (No cost data developed) 2 = Moderate Value Degradation 1 = Major Value Degradation				
Function	**Idea #**	**Idea**	Traffic Operation	Maintainability	Operational Reliability	Environmental Impacts	Advantages	Disadvantages	Cost	Schedule	Risk	Rating
Maintain Conveyance	1	Enlarge channel to increase conveyance under the bridge, dredge the river	0	0	-	-	Less Bridge and more less expensive earth work. Improves hydraulic flow.	Will likely require supplemental EIR/EIS and additional permits. Increase risk of obtaining permits and public outcry. Might require O&M funds to maintain channel.	+	+	-	3
Maintain Conveyance	2	Construct box culverts under roadway in lieu of bridge structure	0	0	-	-	Reduces cost and time	Greater impacts to floodway and habitat. This alternative would require improvements to the channel that would make it not feasible	+	+	-	2
Maintain Conveyance	3	Develop a letter of map revision to submit to FEMA to modify the floodplain	0	0	0	0	This action will have to be considered with any alternative (including the baseline design) that modifies the floodway.		0	0	0	4
Maintain Conveyance	4	Have farmers remove their unpermitted fills to open up the floodplain again	0	0	+	-	Improves hydraulic flow and would allow bridge to be shortened in length	Requires political action that will be difficult to enforce and likely result in litigation	+	+	-	3
Maintain Conveyance	5	Identify acceptable annual closure risk	0	0	0	0	This needs to be done in order to get all stakeholders in alignment and avoid confusion		0	0	0	5

Figure 8.10 – Example of a simple evaluation matrix for a construction project.

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9
Development Phase

9.0 Introduction

The Function Analysis, Creativity, and Evaluation Phases of the VM Job Plan comprise the core of a VM study. Upon completion of the Evaluation Phase, the VM study team will have identified numerous ideas that to be developed into VM proposals.

The VM study team members are responsible for preparing the VM proposals, which are often based upon a comparison to the VM study subject's baseline or status quo. All VM proposals are ultimately documented with written descriptions, narratives providing justification, sketches, performance and risk assessments, calculations, and cost comparisons (both initial costs and life-cycle costs, if needed).

There are three activities in the Development Phase:

- Assign ideas to the VM study team members.
- Develop VM proposals.
- Review and revise VM proposals.

9.1 Terms and definitions

9.1.1 Annuity

A series of payments made at equal intervals. Examples of annuities used in the Development Phase and relative to life-cycle cost analysis include yearly insurance premiums, monthly mortgage payments, annual energy costs, insurance, licenses, etc.

9.1.2 Break-even point

The sales amount–in either unit (quantity) or revenue (sales) terms–required to cover total costs, consisting of both fixed and variable costs to the organization.

9.1.3 Escalation

Changes in the cost or price of specific goods or services in a given economy over a period. This is similar to the concept of inflation, except that escalation is specific to an item or class of items (not as general in nature). Changes in the money supply do not usually drive changes in cost, and escalation tends to be less sustained. Note that escalation is different than inflation (see 9.1.5).

9.1.4 Future value

The value of a current asset at a specified date in the future based on an assumed rate of growth. Examples of factors that are often expressed as a future value (FV) in a life-cycle cost analysis include major periodic maintenance, equipment or building system replacements, salvage or demolition costs, etc.

9.1.5 Inflation

A quantitative measure of the rate at which the average price level of an array of selected goods and services in an economy increases over a period of time. Inflation is often expressed as a percentage and indicates a decrease in the purchasing power of a nation's currency.

9.1.6 Interest rate

The amount of money charged, expressed as a percentage of principal, by a lender to a borrower for the use of assets. In terms of borrowed money, the interest rate is typically applied to the principal, which is the amount of money loaned. The interest rate is the cost of debt for the borrower and the rate of return for the lender. It should be noted that the term "discount rate" refers to the interest rate that Federal Reserve Banks charge commercial lenders, and that is frequently used by public sector agencies in LCC analysis. The VM study sponsor may define a preferred discount rate to be applied to their specific cash flow analysis.

9.1.7 Life-cycle cost (LCC) analysis

The sum of all recurring and one-time (non-recurring) costs over the full life span or a specified period of a project, product, process, service, or organization. It includes the initial costs, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life. The VM study sponsor should ultimately provide direction on the appropriate methods and factors they wish to be applied.

9.1.8 Life-cycle period

The length of time considered in a life-cycle cost analysis. For example, a life-cycle cost analysis performed for the useful life of a highway bridge might assume a life-cycle period of 75 years, which is a typical period used to define the "useful life" of the structure.

9.1.9 Present value

The current value of an asset. In life-cycle cost analysis, present value (PV) is the current value of a future sum of money or stream of cash flows (an annuity) given a specified rate of return.

9.1.10 Return on investment (ROI)

A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. ROI tries to directly measure the amount of return on a particular investment, relative to the investment's cost. To calculate ROI, the benefit (or return) of an investment is divided by the cost of the investment. The result is expressed as a percentage or a ratio.

9.1.11 Simple payback

In capital budgeting, the period of time required to recoup the purchasing power of the funds expended in an investment or to reach the break-even point. For example, a $1,000 investment made at the start of Year 1 which returned $500 at the end of Year 1 and Year 2, respectively, would have a 2-year payback period. This method does not recognize the time value of money.

9.1.12 Time value of money

The time value of money is the concept that money available at the present time is worth more than the identical sum in the future, due to its potential earning capacity. This core principle of finance holds that, provided money can earn interest, any amount of money is worth more the sooner it is received.

9.2 Process

Chapter 3 described how the process followed within the VM Job Plan starts with a focus on divergent thinking. The use of non-specific language in the Function Analysis Phase empowers this divergent thinking, and the Creativity Phase takes advantage of it. Nevertheless, implementing change in any organization implies planning for specific, non-generic tasks. The Evaluation Phase started focusing the team members' minds back into convergent thinking, and now is the time to prepare specific descriptions.

9.2.1 The development process

Even though every project is different in nature, the process of developing VM proposals in this phase should be almost identical in every VM study, although the type of information and assumptions used in this process may vary from industry to industry. In the end, all can be simply classified as technical, social, and economical, common to all organizations' interests. With this in mind, all VM studies will follow the same three simple steps in the Development Phase: 1) assign ideas to VM study team members; 2) develop VM proposals; and, 3) review VM proposals. Only the nature of inputs and outputs used in this phase (described in 9.2.2) may be industry specific.

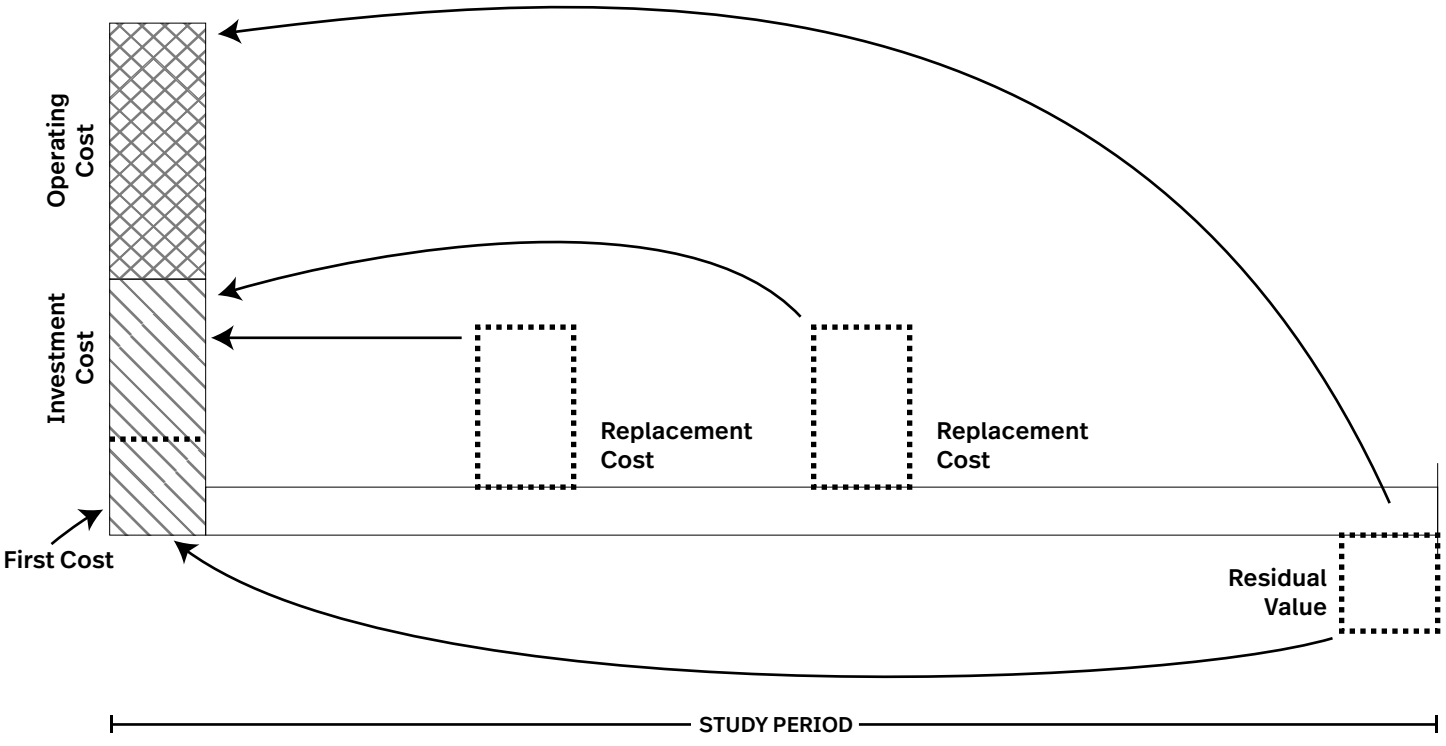

Figure 9.1 – Examples of a future sum of money or stream of cash flows converted to present value.

9.2.2 Inputs and outputs

9.2.2.1 Inputs

- Selection of evaluated and prioritized ideas
- Scope information (may vary by industry)
  - Scope statements
  - VM study's goals or objectives
  - Project management plan
  - Supply and/or value chain information
  - Work breakdown structure (WBS)
  - Process diagrams
  - Time and motion studies
  - Drawings
  - Part or component lists
  - Technical reports
  - Stakeholder information
- Performance and quality information (may vary by industry)
  - Specifications and/or requirements
  - Quality management plan
  - Warranty and/or defect information
  - Voice of the customer information
  - Surveys and/or interviews
  - Marketing data
  - Balanced scorecard
- Time information (may vary by industry)
  - Major milestones
  - Schedules
  - Project's critical path
  - Process throughput
  - Gantt charts
- Cost information (may vary by industry)
  - Initial cost estimates, bill of materials, labor costs, etc.
  - Operations costs
  - Maintenance costs
  - Salvage costs
  - Disposal, demolition, or reuse costs
  - Economic data (e.g., inflation, escalation, financing, cost indices, etc.)
  - Applicable discount rates
  - Sales and marketing data
- Risk information
  - Risk management plan
  - Risk register.

9.2.2.2 Outputs

- VM proposals
  - Proposal narratives, of existing (baseline) condition and proposed change(s) thereto
  - Sketches
  - Calculation sheets (technical and costs)
  - Advantages and disadvantages
  - Discussion and/or justification as to why the VM proposal idea should be implemented
  - Initial and life-cycle cost estimates
  - Performance and/or quality assessments, if applicable
  - Risk assessment, if applicable
  - Recommended implementation action plan.

9.2.2.3 Activities

- Assign Ideas to the VM team
- Develop VM proposals
- Review and revise VM proposals.

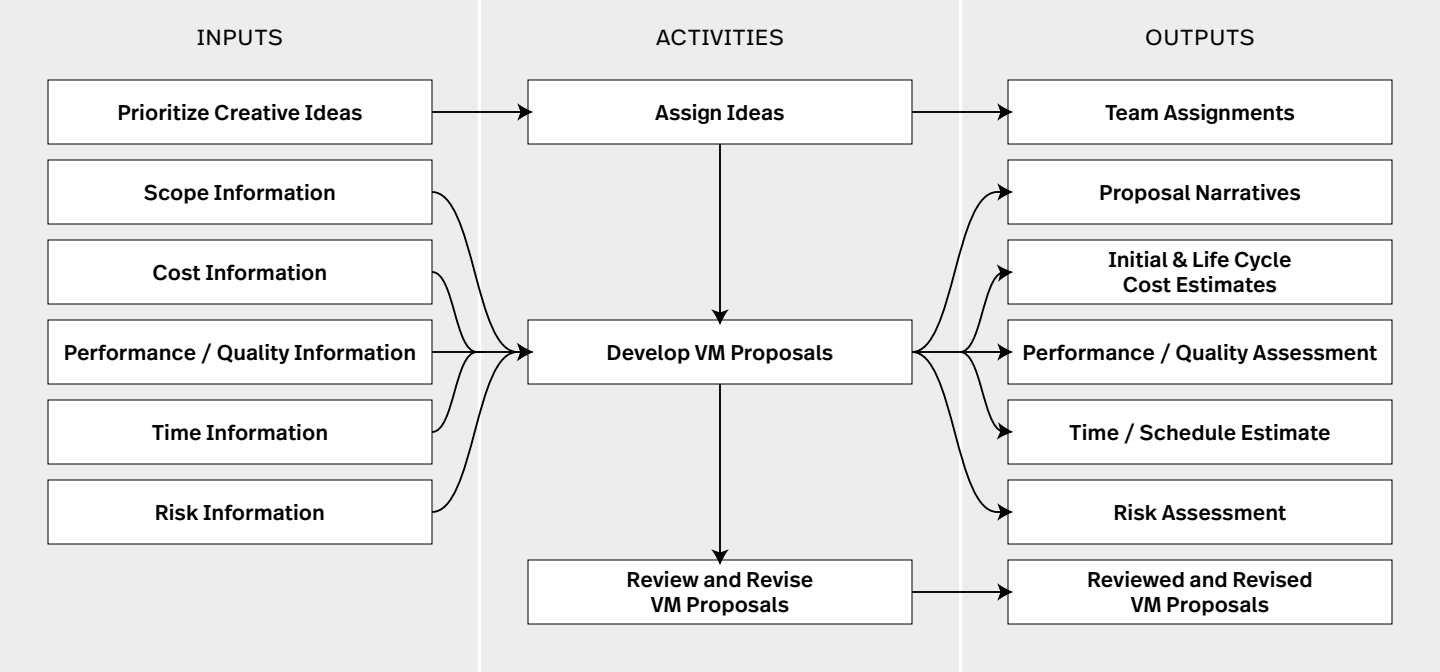

Figure 9.2 – Development Phase flowchart.

9.2.2.4 Process flowchart Figure 9.2

9.3 Activities

9.3.1 Assigning ideas to the VM team

Responsibility for the development of each idea should be related to the VM team members' knowledge and skills and the time available. The VM proposals can be developed by one VM study team member or a group. However, one VM study team member must be responsible to ensure that the VM proposals are developed. The VM study team should use the entire team as a resource, as well as any other resource (e.g., internet, previous projects, discussions with colleagues, etc.) in the development of the VM proposals. The VM proposals are developed as far as time and resources allow during the workshop. The VM study team allow for time to gather and review all their developed VM proposals before preparing the VM study results presentation in order to allow all team members to review and comment on the VM proposals.

9.3.2 Develop VM proposals

The development of the VM proposals is the essential activity of the Development Phase. The following sequence of related tasks are included in this activity:

- Ensure technical viability.
- Determine costs.
- Assess time or schedule impacts.
- Assess performance and quality impacts.
- Assess risk.
- Develop narratives.
- Develop proposal titles.

It must be emphasized that there are many different ways to organize and present information for VM proposals. If the procedures identified here are followed, the VM study team should be successful in developing VM proposals that thoroughly communicate the concepts to the project team and to the decision makers. This information should be presented clearly and concisely by the VM study team to make the decision-making process an easy one.

9.3.2.1 Ensure technical viability

Assuming that all the short-listed ideas were assigned at the end of the Evaluation Phase, the VM study team members will be ready to begin documenting the information to be developed for each VM proposal. The first step in this process is to ensure the technical viability of the VM proposal. In other words, will it work?

Depending on the nature of the concept, technical viability may or may not be obvious. If not, the VM study team must consider this first, before expending any additional time on the concept.

It is important to note that the VM study team need only develop the concept to the level of the baseline concept. In some cases, especially for projects involving facilities, it may only be necessary to develop the concept at a preliminary level to ensure that it is fundamentally sound. In other words, it is not necessary to develop the design of a new forklift component in AutoCAD, as this is an activity that may take far more time than available to the VM study team. Both the VM study team and project team must keep in mind that the project team will have to integrate any VM proposal ultimately accepted VM proposal.

As the VM study team verifies the alternative's technical feasibility, any calculations or assumptions should be documented. Include these, along with any sketches, diagrams, or other graphical information, as part of VM proposal's documentation. Should the concept not be technically viable, then the reason(s) why should be documented and the concept dropped from further consideration.

9.3.2.2 Determine costs

Once the VM study team feels confident that the concept will work, they assess its financial impacts. This baseline cost data provided to the VM study team should be used as a basis for developing the costs for the VM proposals. In some cases, the concept behind a VM proposal may be so radically different from the subject's baseline or status quo that it will be necessary to develop a completely new cost estimate from scratch. In such cases, the VM study team must be careful to document where they obtain the cost information supporting the VM proposal. Any assumptions should be well documented and justified.

If life-cycle costs will be affected by the VM proposal, a life-cycle cost analysis should be included as part of the VM proposal documentation. Information pertaining to life-cycle periods and discount rates should be obtained from the project team or project sponsor.

In developing cost estimates, it is always advisable to make a side-by-side comparison of baseline and alternative costs to show which areas differ in cost. In developing the costs of the alternative concept, it is not always necessary to provide an estimate of the complete project. Usually, it's only necessary to include the project costs that will change as a result of implementation of the VM proposal.

In manufacturing or product-oriented studies, the investment required to implement any change may be significant. An example could be redesigning a plastic component for which implementing the idea will require a new tool. The cost of that tool may offset the idea's benefits and make the proposal economically unfeasible. Many other non-manufacturing proposals may have the following implementation costs, normally classified as follows:

- Capital expenses (the cost to acquire new equipment, building, construction, etc.);
- Tooling expenses (the cost to retool existing equipment); or,
- Engineering expenses (testing costs, validation costs, etc.).

9.3.2.3 Assess time or schedule impacts

The VM study team should assess the impact of the VM proposal to time or schedule. Will the proposal reduce or increase time? Will the critical path of the subject schedule be affected? These important questions must be considered, as they influence total value.

The VM study team may wish to develop a Gantt or swimlane chart if the VM proposal will have a significant impact on the sequence and/or duration of activities involved in actualizing the subject, be it a product or process. In some cases, it may be appropriate to limit the discussion on time relative to how it impacts key milestones. The interrelationship between schedule and cost should be considered, as time savings usually have cost implications associated with them. For example, a VM proposal that results in a construction schedule savings of six months will also enjoy a reduction in project costs relative to time-related overhead and construction cost escalation.

9.3.2.4 Assess performance and quality impacts

Once the technical feasibility and costs have been determined, the VM study team should have a fairly good idea whether the VM proposals will provide an improvement in value. The next step is to assess the anticipated impacts that the VM proposal will have on project performance and/or quality.

The VM study team should consider the basic and secondary functions for the project and the related performance measures. For example, if a structural column is being changed–let us assume the function is "transfer load"–the related performance measures should be considered. In this example, will the VM proposal increase or decrease the amount of dead load the column can effectively transfer? What about seismic resistance? The VM study team should consider key aspects of

performance that the alternative will impact and clearly state them in the development of the VM proposals.

Similarly, consideration should be given to the potential impact on quality. Will the change have a positive or negative impact on the quality of the VM study subject? Will there be a potential increase or decrease in defects? The VM proposal should capture and communicate the rationale for any anticipated impact to quality VM proposal.

9.3.2.5 Assess risk

Consideration should be given concerning the uncertainty of the VM proposal and/or its effect on uncertainty inherent in the project. For each VM proposal, risk can be considered either qualitatively or quantitatively, depending upon the level of information and time available to the VM study team.

Key considerations concerning risk may include:

- Risks associated with implementing the VM proposal. The VM study team should give some thought to the uncertainties facing the implementation of the VM proposals. For example, if a VM proposal incorporates a new technical innovation that has never been tested, there may be a risk that the concept will not work. This could result in a loss of time and/or money and would negatively affect the product. In this case, the VM study team would be wise to articulate their opinion on the probability of success and the related impacts for both success and failure. If decision makers are unaware of the risks involved with a VM proposal, they may be more prone to making poor decisions.

- The probability that the VM proposal will be implemented. In some cases, the decisions related to accepting or rejecting a VM proposal may involve several participants. The VM study team may want to consider articulating their opinion of the probability of a VM proposal's acceptance, given the process and environment in which the decision will be made. Often, the probability of acceptance decreases inversely to the number of parties involved in the decision process. Therefore, a proposal that involves only one "gatekeeper" may be less risky than one with three. This is useful information to provide along with the proposal and may also help the VM study team develop strategies to improve the chances of acceptance.

- The impact to existing risks. A VM proposal might either increase or decrease the probability or impact of existing risks. In fact, some proposals may be developed specifically to minimize threats or maximize opportunities. The VM study team should discuss what effect a VM proposal will have on these risks as part of the narrative.

VM proposals may serve as risk response strategies, intentionally or unintentionally, by design or as a by-product. It is worth considering what kind of response strategy a VM proposal falls into. Generally speaking, there are four types of strategies that apply to threats (negative risks) and three that apply to opportunities (positive risks). Thought should be given on how the VM proposal can be employed along these lines.

The actions available to address risks are based on the following risk response strategies to deal with threats:

- Avoid. The surest way to deal with a risk is to avoid it completely. There are several different ways to do this. One is to modify the project scope.

  For example, assume that a retaining wall possesses a cost risk related to unknown geological conditions. If the retaining wall were eliminated, then the risk could be avoided completely. However, project costs may need to be increased to acquire additional real estate in order to replace the wall with an embankment. The question then is: "Will the cost to avoid this risk be less than its expected impact?" If the answer is yes, then this may be a good strategy to adopt. Many risks identified early on in a project's life cycle can be avoided once additional information is developed.

- Transfer. Transferring a risk is a euphemism for "passing the buck." In other words, a risk can be passed on to another party, perhaps one that is more adept at dealing with a specific risk. This usually incurs a price to be paid to do this. It is common to pass on some risks to a third party, such as a contractor or consultant. The success of this strategy largely depends on the third party's ability to assume and reduce the risk.

  For example, an agency charged with the construction of a subway project determines it will supply to the contractor the heavy machinery needed to construct the tunnels. The VM study team felt that there was a great deal of risk associated with this approach, as the contractor could blame any productivity problems on the owner-supplied equipment and file a lawsuit. One strategy to deal with this risk was to transfer it to the contractor by requiring him to furnish his own tunneling machinery. Of course, this risk transference came at a price, but the VM study team's analysis indicated that the cost to do so was less than the expected impact of not doing so.

- Mitigate. Risk mitigation is a strategy that does not prevent a risk, but rather reduces its probability and the severity of its impact. The appropriateness of risk mitigation is often related to the time in the project's lifespan when it is considered. Often it is easier to mitigate for risks early on and more costly to do so later in the project's life cycle.

  For instance, assume that a highway project will require an extended period of heavy construction within 10 feet of several residences. If nothing is done to deal with this risk, it is likely that the affected residents will file a lawsuit, increase project costs, and, more significantly, delay construction indefinitely. A mitigation response strategy for this risk would be to begin negotiations with the residents to temporarily relocate them for a period, thereby eliminating the chance for lengthy and expensive project delays. This mitigation strategy would increase project costs; however, it allows for the risk by reducing its severity, especially in terms of schedule impacts.

- Accept. The last strategy is to simply accept the risk. This viable strategy is appropriate for small risks that are very unlikely or very difficult to respond to in using one of the previously mentioned strategies. Examples of risks where acceptance might be a good option include inclement weather and other naturally occurring incidents such as earthquakes and floods.

The following is a list of risk response strategies that apply to opportunities:

- Exploit. Opportunities possessing very strong potential benefits should be actively exploited. This is done by enhancing the probability that the opportunity will happen, or better yet, ensuring that it will happen. Often, adopting this strategy requires some investment of project time and money to achieve; but if the return on investment is there, it will probably be worth it.

  For example, assume that an office building project can receive additional funding if it meets certain energy efficiency requirements. This opportunity can be exploited by making improvements to the building's heating, ventilation, and air conditioning (HVAC) and insulation systems. The VM study team should analyze the costs required to meet the requirements versus the additional funding it can receive. If the return on investment is there, the chances of getting the funding can be enhanced by spending the additional funds on the improvements.

  It is also very common that an opportunity found to improve a manufactured component may be also applied to more components or products not included in the VM study, but which are within the same organization. This increases the likelihood of the proposal being implemented, while significantly reducing the idea's simple payback. For example, a car manufacturer has developed a new welding procedure for a radiator. Even though the idea was developed for a specific car, this new welding method can be applied to all other radiator models manufactured by the company. This will increase the chances of investing in the new technology.

- Share. Sometimes an opportunity can be capitalized on if the benefits are shared with others, creating a "win-win" situation. Most projects have many stakeholders with different objectives in mind. Often a little collaboration goes a long way to maximize opportunities.

  One way to employ the "share" strategy is through a VECP. (Refer to 13.1.1 and 13.4.2.4 for more information on VECP.) Basically, this contract clause establishes a profit-sharing mechanism between an owner and a contractor, whereby the contractor is encouraged to develop cost saving modifications to the design. Cost savings are typically split, sometimes with the owner receiving the smaller share. The U.S. Department of Defense has used this strategy for decades, resulting in hundreds of millions of dollars in cost savings.

- Enhance. This strategy seeks to increase the probability of an opportunity occurring and/or the degree of the resulting benefits. Enhancement is not always a sure thing, but often proves to be a worthwhile approach.

  For instance, assume the VM study identifies an opportunity that indicates that a chance that the type of environmental document required for a major infrastructure project can be changed. If the type of review can be reduced from an environmental assessment (EA) to a negative declaration (ND), then the schedule can be accelerated by three months. This opportunity can be enhanced if the impacts to a certain area on the project are avoided. This may require a modification to the project scope or perhaps additional analysis. Regardless, the chances of this opportunity occurring can be enhanced if specific actions are taken to do so.

It is worth evaluating multiple response strategies in dealing with risks, especially those risks that have a high expected impact. Often, the appropriate response is fairly self-evident. For larger projects, it is worth conducting a more comprehensive approach to developing risk response strategies by holding a VM study. The combination of risk analysis and VM provides an effective means of reducing

project risk. Creative solutions exist for dealing with many risks; however, time must be devoted to finding them.
If qualitative risk analysis techniques have been applied on the project, then it may be worthwhile to consider extending those same techniques to the development of the VM proposals. For example, if a probability and impact matrix has been utilized for the project as the primary risk analysis technique, then the VM study team should consider applying the same techniques to the VM proposals. Providing a commensurate level of analysis in line with the rest of the project adds validity to the VM proposals and provides the project team with a greater level of confidence in considering their acceptance.

In any event, risk should be considered at some level during the Development Phase. The level of detail depends on the nature of the VM study subject, information available, time available during the VM study, and the stage of the subject's development.

9.3.2.6 Develop narratives

The last step in finalizing the documentation for a VM proposal is preparing the narratives and any additional graphical information, such as sketches or diagrams. Having developed the technical concept, identified costs, and assessed performance, the VM study team members should now have a thorough understanding of the alternative concept. This information should now be summarized by developing a thorough narrative of the VM proposal, which should include:

- A brief description of the subject baseline or existing condition;
- A brief description of the alternative or proposed concept;
- A list of benefits and challenges of the alternative concept as compared to the baseline concept;
- A discussion of the alternative, including a thorough description of the technical details and any further language that will provide the rationale for why the change is justified; and,
- A summary of the alternative's financial impacts.

This information should be documented on a series of forms that allow the project team and the decision makers to review it in an organized manner.

The writing should be prepared to allow management personnel, who may be of a nontechnical background, to understand the basic concepts involved in the VM proposal. Detailed technical information should be included to supplement this discussion so the project team can review and verify the technical details of the VM proposal.

A final consideration is the title of the VM proposal. Ideally, the title should be concise, but descriptive enough to convey the general nature of the proposed change. Framing the title properly may help sell the underlying concept and avoid misunderstandings. As each VM proposal is finalized, the VM study team should discuss the title and consider the following:

- Craft the title with the audience in mind.
- Use simple, concise language and avoid jargon.
- Be specific when possible, especially if there are competing VM proposals that offer differing, mutually exclusive solutions.
- Avoid superlatives.

9.3.3 Review and revise VM proposals

The VM facilitator and all VM study team members should review the completed VM proposals. This important internal review allows each team member to check for errors, ensure narratives are complete, and confirm performance has been assessed properly, especially with respect to their respective disciplines.

The VM study team should identify any errors and/or note any suggested revisions based on their review. These edits should be incorporated into the written report when the VM proposals are submitted for review.

It is also advisable to have key stakeholders (such as members of the project team or other designated technical reviewers) to review the VM proposals midway through the Development Phase. This opens the opportunity for a "reality check" to ensure the VM study team's assumptions are correct and that there are no fatal flaws based on a cursory review.

Providing the opportunity for this midpoint review helps provide stakeholder "buy-in" prior to the exit briefing typically held on the final day of the VM study. It also reduces the potential of developing VM proposal technically flawed or otherwise unacceptable VM proposals, thereby minimizing wasted effort and maximizing the VM study team's credibility.

The VM practitioner must be careful to avoid the temptation to throw out valid proposals simply because they may be unpopular. At this stage of the process, the reviewers must present a credible reason to the VM study team for excluding a VM proposal, as the team will usually be pressed for time. This review should be more of a "reality check" review rather than a formal meeting.

If reviewers are present, their comments should be documented and included as part of the VM proposal in the written report. This valuable feedback helps with the future implementation of the concept, should it be accepted during the Implementation Phase.

Also during the review process, the VM study team should consider a number of additional strategies to facilitate the acceptance of proposed changes within an organization:

- Develop an implementation overview plan to identify key individuals or groups involved in the implementation effort.
- Review specific proposals with key managers of affected departments and solicit their support.
- Seek input regarding implementation tasks and estimated timetables.
- Highlight the overall advantages of the proposed changes to various levels of supervision before the final recommendations are presented to the executive group.
- Identify risks and concerns so that they may be included in the final presentation to the executive group.

Above all, be patient and thorough in such discussions. Remember to consider that the proposed changes sometimes require additional effort to achieve implementation.

9.4 Basic techniques

9.4.1 VM proposal development forms

The VM proposals should be organized using a standardized format. VM programs and practitioners utilize a wide variety of formats for VM proposals based upon the type of information decision makers of an organization require to determine its acceptability. The VM facilitator should, therefore, ensure that whatever format will be used contains all the information needed by the VM study sponsor and/or decision makers and adjust the format of the VM proposals accordingly.

Regardless of the VM study subject, there are certain pieces of information that any decision maker must have.

A complete set of forms containing this basic information (Figure 9.2) should include:

- Descriptions of baseline and alternative concepts;
- Benefits and challenges of the proposed change compared to the base case;
- Discussion and justification of the alternative concept;
- Financial information (initial cost and life-cycle costs, as applicable);
- Performance and/or quality assessments;
- Time and schedule information;
- Risk information (related risks, probabilities, impacts, and contingencies); and,
- Graphical information (flowcharts, diagrams, sketches, etc.).

In addition to this basic information, several additional pieces of information may be considered for inclusion:

- Management considerations,
- Redesign and/or implementation costs,
- Technical reviewer or stakeholder comments, and/or
- VM study team member review comments.

Figure 9.3 presents a suggested format of content to be included in the VM proposals, as well as the organization of that information. This format is intended to capture the information developed for the VM proposals through the following steps in the development process:

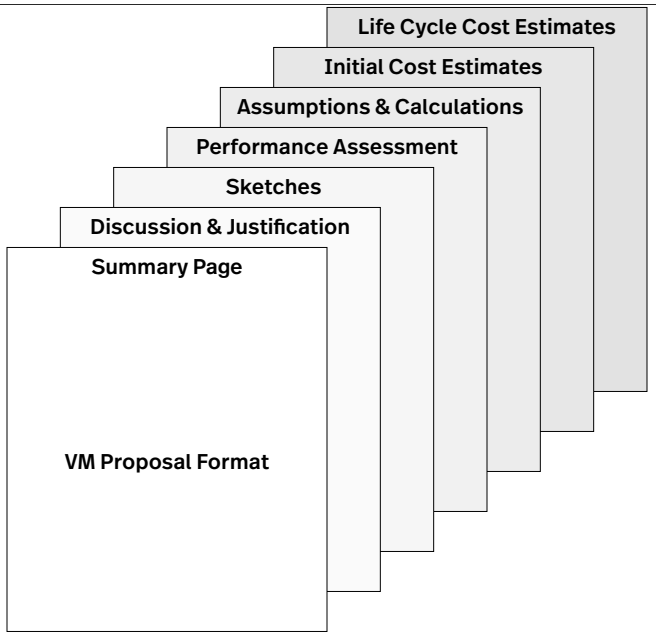

Figure 9.3 – VM proposal forms.

9.4.2 Calculate a return on investment

Return on investment (ROI) is a concept used to measure the efficiency of an investment. Within a VM context, ROI is often used to express the benefit of performing a VM study. The ROI of a VM study is calculated as follows:

- Value Study Cost Savings ÷ Cost of VM Effort = ROI
- $1,000,000 Cost Savings ÷ $50,000 VM Study Cost = 20:1

In other words, the above example shows that for every dollar spent on VM, it yielded a return of $20.00 in cost benefit. Many public VM programs use ROI as a way of communicating its performance.

Another way to articulate ROI is to consider both the net present benefits and net present costs expressed as a percentage.

- (Net Present Benefits - Life-Cycle Cost) ÷ Life-Cycle Cost

ROI may also be used to express the relationship between the cost benefits yielded by a VM proposal relative to the cost of implementing it. For example, assume that a VM proposal requires a $100,000 implementation cost but will result in a $15 million cost benefit. The ROI would be calculated as:

- $15,000,000 Cost Benefit ÷ $100,000 Implementation Cost = 150:1.

It is important to ensure that the implementation cost is not included in the value identified as part of the benefit as this would not accurately communicate the ROI .

9.4.3 Calculate a simple payback

Simple payback is the amount of time needed to recover the investment made in the project. This technique does not consider the time value of money. Simple payback is calculated by dividing the cost of the investment by its periodic cost benefit.

For example, a manufacturing company is considering the purchase of a piece of cutting equipment that costs $50,000 and which will generate $10,000 per year of net cash flow. The payback period for this capital investment is calculated as $50,000 cost ÷ $10,000 cost benefit per year = 5-year payback period.

Assume the same company is also considering the purchase of a conveyor system for $36,000, which will reduce transport costs by $12,000 per year. The payback period for this capital investment is calculated as $36,000 ÷ $12,000 = 3-year payback period.

If the company could only afford to purchase the cutting equipment or the conveyor system, which would be the wiser investment? Based on the simple payback calculations, the conveyor system would be the more prudent investment due to the shorter payback period and higher cost benefit.

9.4.4 Life-cycle cost analysis

As was established in Chapter 2, The Value Concept, value ultimately must be considered from the perspective of the customer or user. To do this, the VM study team must consider the total cost of ownership from this same perspective. Another way to think about the total cost of ownership is using the term “life-cycle cost.” While it is important to consider the total cost of ownership, it must be recognized that not all VM efforts calculate life-cycle costs for a variety of reasons.

Life-cycle cost (LCC) describes the total cost of producing, operating, and maintaining a thing. There are many definitions of life-cycle costing in use. The U.S. General Services Administration (which manages office buildings and other facilities) defines “life-cycle costing” as follows:

Life-cycle costing is the development of all the significant costs of acquiring, owning, and using an item, system or service over a specified length of time.

Life-cycle cost is the total economic cost of owning and operating a facility, manufactured process, or a product. A life-cycle cost analysis reflects present and future costs of the subject over the useful life of the subject. It allows an assessment of a given solution and is a tool for making comparisons. Life-cycle cost serves as a universal tool to express the multifaceted elements of cost and time in a uniform criterion of equivalent monetary units.

The life-cycle cost technique has a broad range of applications. In the analysis of facilities, it may be applied during the conceptual, planning, design, construction, and operating stages. Its application as a tool for analyzing economical alternatives to purchases at home and in the marketplace, has benefited everyone. Given the rise in the interest rates and inflation, the use of life-cycle cost has been expanded. The impacts are astounding, as will be seen later in this chapter. Before explaining the applications of life-cycle costing, facts about its application must first be addressed.

Most investors or owners want to know what the total ownership and/or operating costs will be for a given asset. Both the public and private sectors are observing an increasing interest in knowing, to the greatest extent possible, what a project will cost throughout its entire lifetime. This involves both an estimate of construction or production costs and a forecast of the probable costs of energy, maintenance, taxes, and borrowed money.

If, for example, we consider a typical office building in the United States, operating expenses (i.e., electricity, water, maintenance, etc.) make up the largest cost of owning a building. First costs typically account for less than 10 percent of the money that must be spent on a facility over its life; as much as 85 percent of the building’s real cost is related to operating the facility. Other costs include land acquisition, conceptual planning, renewal or revitalization, and disposal. An LCC analysis performed for a typical building would normally consider all these factors, as they represent the owner’s total costs.

The costs to the end user, however, are usually not considered. Personnel costs (i.e., salaries and benefits) make up 78 percent of the total business expenses for tenants, according to a study conducted for the General Services Administration, while costs associated with the building itself account for only 9 percent (see Figure 9.4).

Costs to the end user is a very important consideration to keep in mind and difficult, if not impossible, to put a dollar value on. These hidden life-cycle costs have a major impact on the user that we may not be able to effectively measure. While an owner of a rented commercial building may or may not be interested in the costs incurred by their tenants, owners of public buildings (i.e., taxpayers) should be. Individuals and organizations are becoming increasingly aware of sustainable design, and even landlords are beginning to think along these lines to ensure that their properties remain marketable and attractive to future prospective tenants.

Figure 9.5 depicts a generalized curve that shows when decisions have the greatest impact on the total cost of ownership. If the area under each segment of the curve represents an impact on cost, it is evident that those involved in planning have, by

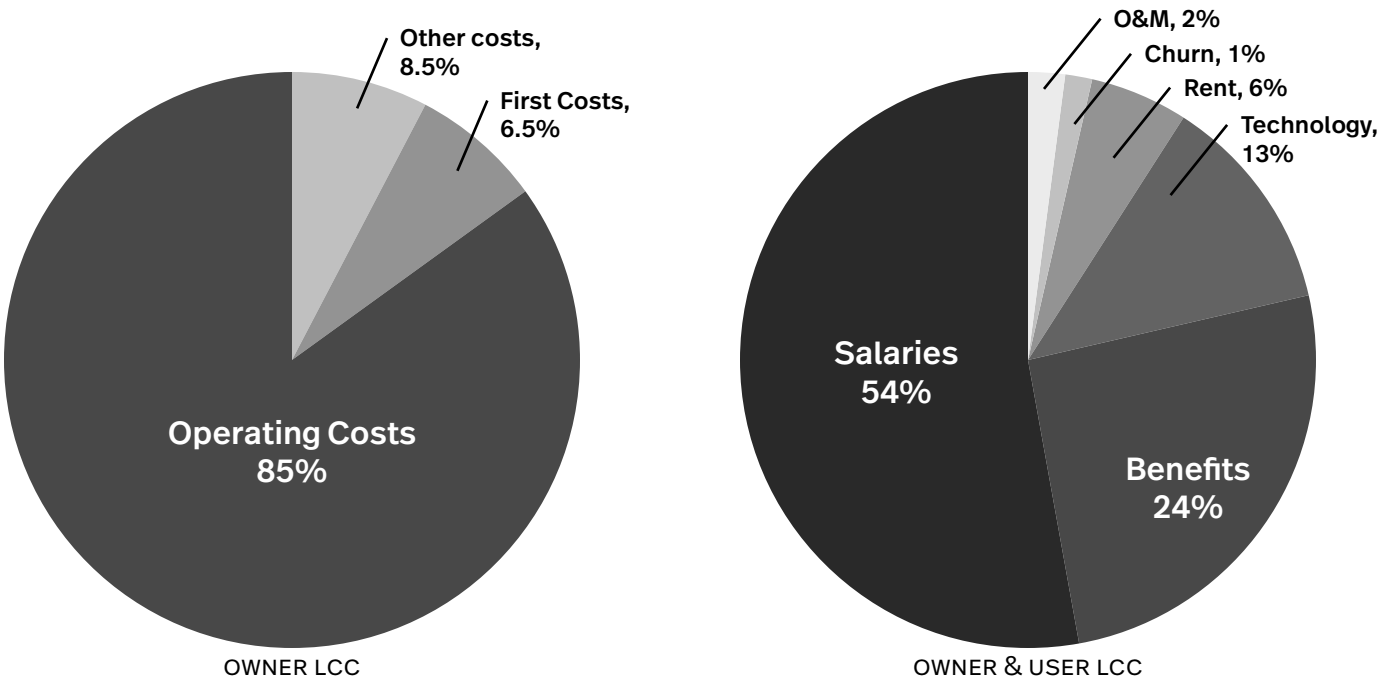

Figure 9.4 – Example of the total life-cycle costs of an office building.

far, the greatest role to play. Those executing the subject (i.e., contractor or manufacturer) can only perform within the carefully defined limits of the subject's scope and specifications. Once the design is completed, there is little opportunity to affect total costs. Those involved in the operation of the subject have even less influence, although the total cost of operating and maintaining the subject are far greater than money spent during planning and design. This figure illustrates that the best place to save money is during the planning and design phase. In short, good planning and project management is worth every cent it costs.

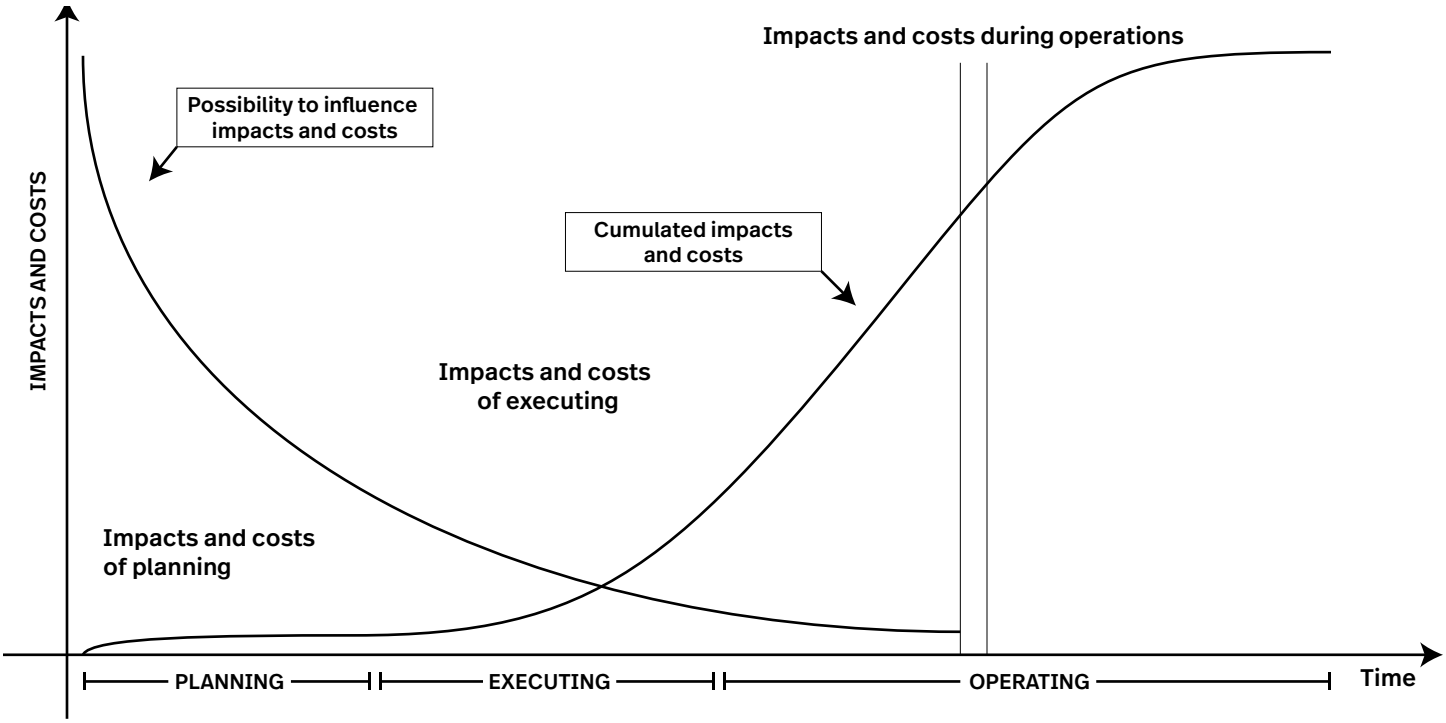

Figure 9.5 – Impact of major decision makers on life-cycle cost.

Life-cycle analyses are not limited to use only during the planning stage; they can be used at any time during the useful life of the facility. As an example, owners of processing plants that manufacture competitive products must know every element of cost, from obtaining and processing raw materials to marketing, sales, and distribution of the final products. A corporate owner of a sports complex uses life-cycle cost analysis to account for building amortization, operating and advertising costs, and other expenses so that it is easier to determine the amount the facility must earn to break even. The use of life-cycle cost analysis affects all facets of our economic livelihood.

Final analysis should account for non-economic criteria that have intrinsic benefits which do not lend themselves to finite cost evaluations. Factors such as safety, reliability, operability, and environmental factors may be more important than monetary savings.

While LCC analysis provides an excellent tool for decision making, its application should be well understood to avoid possible pitfalls in its use. Fiscal managers especially should appreciate that LCC dollars may not be the same as budget dollars. One problem is that cost estimates may not be applicable as budget estimates, because they are expressed in constant dollars (excluding inflation); and, all cash-flow dollars are converted to equivalent moneys at a common point in time. LCC estimates do not necessarily equate the obligated amounts for each funding year.

With this in mind for most VM studies, development of the economical assessment of a VM proposal must include its life-cycle cost analysis to help decision makers face a more realistic estimation of the future expenditures and benefits if the proposal is implemented.

The total cost of ownership requires the application of engineering economics to understand the relationship of time, interest and money. The primary technique used to achieve this is life-cycle cost analysis.

Cost categories used in LCC analysis vary widely. Funds for a project may be spent over a long timeframe, from the years leading up to its completion to the time when the facility, product, or process has outlived its usefulness. The following types of costs might factor into a total project's life. This does not mean that these are all the costs involved; but, rather, they serve as a reminder of the major cost factors to look for when performing life-cycle comparisons. LCC considerations may include:

- Investment costs. The amount of money expended for the assessment of market potential, the time and expenses involved in analyzing site alternatives, and the expenses incurred for development of a financial plan. Investment costs may also include expenses for obtaining a line of credit and other financing alternatives. The preparation of stock and bond sales may be another type of investment cost.
- Land acquisition costs. Costs for real estate fees, title searches, legal fees, deed filing fees, insurance, cost of land, and the interest on borrowed money for the purchase or leasing of land for use for a facility. In addition, the cost of environmental mitigation may need to be considered, depending upon regulatory requirements.
    - Property costs.
    - Real estate fees.
    - Environmental mitigation costs.
- Project development costs. Costs associated with the planning, design, bidding, construction, inspection, and initial start-up of a facility, product, or process. Any anticipated future costs for design modifications should also be included.
- Project management.
- Planning.
- Design and engineering.
- Project support (i.e., purchasing, marketing, accounting, etc.).
- Redesign costs.
- Construction and manufacturing costs. The cost of constructing, manufacturing, or implementing a facility, product, or service.
- Replacement costs. The future costs to modify or replace a portion of the project. Usually, specific pieces of equipment or parts are the major source of replacement costs. Based on the expected life of the components, several replacements may occur during the total project life.

- Salvage costs. The value of the project or product at some future time. Usually salvage value is the amount received from the sale at the end of the life-cycle period. Conversely, it could reflect the costs for demolition and/or environmental remediation.
- Operating costs. The costs required to operate the facility, product, or process. These costs include the day-to-day costs of staffing; energy costs to create and maintain a working environment and to operate equipment; costs of outside services such as waste disposal, water and sewage costs; chemicals and other resources needed to manufacture or to process a product; and, the costs of transportation from the raw material source to the final delivery point. These costs are often periodic costs falling at scheduled intervals.
- Maintenance costs. Factors included in maintenance costs are labor, cost of parts, materials, cleaning materials and equipment, and preventive maintenance as well as normal maintenance and repair of equipment, painting, and so on.
- Durability of products.
- Taxes.
- Insurance.
- Depreciation.
- Inflation.
- Time value of money. Time has a high price tag when evaluating alternatives. The longevity of a project and the lifespan of individual components must be considered in the decision-making process. The cost of money is the interest that is charged on borrowed money for the project.

Elements of cost in a life-cycle cost analysis pertain to the total life of the product. Some costs are one-time expenditures that occur before the project is completed. Others are single expenditures amortized for periods up to and beyond its useful life.

9.4.4.1 The time value of money

As money can produce earnings at a certain rate of interest through investment over a period of time, it is important to know that one unit of money received at some future date does not produce as much earnings as the same unit of money received in the present. This relationship between interest and time forms the basis for the concept known as the "time value of money."

Money also has a time value, as the buying power of any currency varies with time. For convenience, this manual defaults to dollars. The relationships between $1 in hand, $1 promised in the future, or a series of payments at specified times in the future are difficult concepts for many of us to grasp.

During periods of inflation, the quantity of goods and services that can be bought with a certain amount of money decreases as the purchase date moves into the future. Although this change in the buying power of money is important, the concept of the time value of money is even more so, in that it has earning power. It is necessary to know the different methods for computing interest in order to calculate the actual effect of the time value of money in the comparison of alternative solutions.

The following considerations must be kept in mind for application in calculations of investment alternatives:

- Present value (P) is produced at the beginning of a time period, expressed in today's value.
- Future value (F) occurs at the end of a future point in time (for example, 20 years from today).
- Annuity amount (A) is a single payment within a series of equal payments made at the end of each period under consideration. This is akin to a monthly mortgage payment.
- Interest rate (i) is the cost of money established by the organization or lending institution. The federal government's Office of Management and Budget frequently updates interest rates per OMB Circular A-94.6. The interest rate is also referred to as a discount rate.
- Life-cycle period (n) is the total number of periods, usually expressed in years.

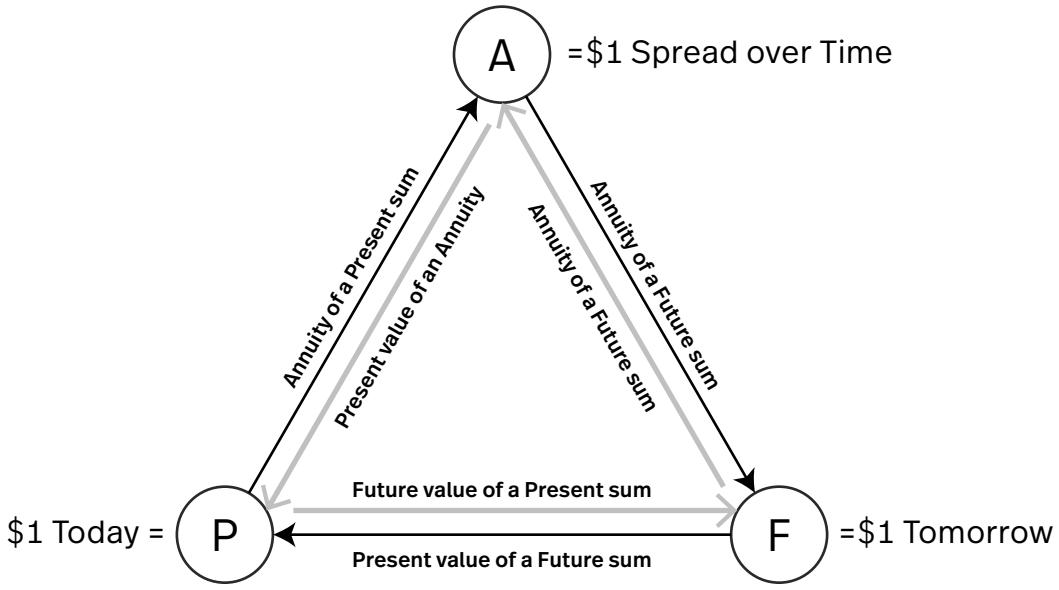

Figure 9.6 – Time value of money.

It is useful to think of the relationship of money at different points in time as a triangle where P equals a single present amount of money; F equals a future single sum of money; and A is an annuity which is a series of equal amounts (like the monthly mortgage payments). Figure 9.6 illustrates this interrelationship and includes the names of the financial equations involved in calculating the time value of money. These financial equations are provided in Figure 9.7.

9.4.4.2 Inflation and escalation

The terms "inflation" and "escalation" are often confused. Inflation refers to the persistent and appreciable rise in the general level or average of prices. Deflation has the exact opposite effect, or "negative inflation." Inflation reduces the purchasing power of money over time. Differential escalation refers to the annual change in the price of a specific commodity or service in addition to the general inflation rate. Perhaps the best examples of this phenomenon are the prices of oil and steel, which tend to follow independent price fluctuations and cycles apart from the macroeconomic forces of more general inflation or deflation.

Since it is very difficult, if not impossible, to accurately predict inflation rates very far into the future, it is generally

Find	Given	Formula
Future value (F)	Present Value (P)	$F = P \cdot (1 + i)^n$
Present Value (P)	Future value (F)	$P = F \cdot (1 + i)^{-n}$
Repeating Payment (A)	Future value (F)	$A = F \cdot \frac{i}{(1 + i)^n - 1}$
Repeating Payment (A)	Present Value (P)	$A = P \cdot \frac{i\,(1 + i)^n}{(1 + i)^n - 1}$
Future value (F)	Repeating Payment (A)	$F = A \cdot \frac{(1 + i)^n - 1}{i}$
Present Value (P)	Repeating Payment (A)	$P = A \cdot \frac{(1 + i)^n - 1}{i\,(1 + i)^n}$

Figure 9.7 – Time value of money, financial formulae.

best not to consider the effect of future inflation when performing life-cycle calculations unless the VM study sponsor requests it. Similarly, it is not recommended that differential annual escalation be considered unless there are very good reasons to do so.

Inflation can be calculated by amending the preceding financial formulae where "j" equals the general rate of inflation. For example, calculate a future single sum "F" using the single payment compound amount factor as follows:

$$F = P \cdot (1 + i)^n \cdot (1 + j)^n$$

This is the measure of the currency amount in the future. This equation can be expanded by considering differential annual escalation where "e" equals the differential rate of inflation:

$$F = P \cdot (1 + i)^n \cdot (1 + j)^n \cdot (1 + ej)^n$$

If constant dollars are used (i.e., inflation is not considered), then (1+j)n would be eliminated if we were to consider only the effect of differential escalation.

9.4.4.3 Life-cycle cost methods

Using life-cycle cost aids the decision-making process and increases the sensitivity to cost for operating and maintaining facilities, products, and processes. Life-cycle cost is derived from a series of computations applying economic factors to monetary expenditures as identified in the previous section. The validity of the comparison, like all estimates, depends on the quality of the cost estimates used in the analysis. There is no good substitute for sound cost figures. Therefore, before proceeding with a life-cycle cost analysis, be certain of the quality and the validity of cost parameters to ensure accurate results. The following steps outline the process for developing an LCC analysis:

- State the problem. Given that LCC analysis can be used as a decision-making tool, its first step involves identifying the problem to be solved. A problem statement enables direct focus upon the basis of the comparison. A description of the physical facilities and the alternatives to be compared should be defined thoroughly. Before going further into the analysis, check to see if the objectives will be met by the comparisons and the cost parameters in the analysis.
- Establish the alternatives. Next, the alternative concepts to be analyzed are documented by listing background information about the physical components of alternatives and their corresponding differences. It is essential to determine the basic cost and budgeting data of the owner's program at this time, as the data will form the criteria for life-cycle cost inputs and the guidelines for analyzing the results.
- Establish the parameters. Time, cost, and the cost of money impact life-cycle cost analyses. Time factors include the project planning life, sometimes called the useful life of the project; equipment life; the owner's planning schedule; foreseeable major expansions; and deletions or changes to the total program. Project life estimates, especially for equipment replacement, are hard to predict, as the life of the equipment depends on the quality of the equipment and the maintenance performed to keep it in operating condition. The useful life is the time that the facility will be used. Often a facility will have several major renovations during its useful life. Costs for additional renovation expenditures are planned by the owner and are usually included in life-cycle comparisons. Cost parameters have been outlined previously. Owners feel major impacts from escalating energy, labor, and maintenance costs above normal inflation rates. The use of escalation rates accounts for these fluctuations. Setting interest, inflation, and escalation rates accounts for the cost of money. Monetary loans for financing and tax benefits are part of the analysis.

The easiest way to model life-cycle costs is to convert all costs to a present worth amount. The present worth method can be set up using spreadsheet software like Microsoft® Excel, most of which include macros for the financial equations identified in Figure 9.9 (p. 111).

The present worth method requires that all costs for the life-cycle cost analysis–present, annual, and future expenditures–be brought back to today's baseline costs. Initial costs are already expressed in present worth amounts. Operations and maintenance costs usually estimate annual costs based on stated conditions of use. The interest rate and life-cycle period (useful life) should be established by the owner and/or user.

The following is a step-by-step walkthrough of the present worth method. This example compares two possible options for the purchase of a new automobile.

STATE THE PROBLEM:

You are an environmentally conscious consumer interested in purchasing a new automobile. You have narrowed your potential choices down to two prospective vehicles. Your final buying decision will be based upon which of the two vehicles has the lowest total cost of ownership.

ESTABLISH THE ALTERNATIVES:

	 Hybrid Car	 Subcompact Car
Purchase Price	$24,069	$17,154
Taxes & Fees	$1,748	$1,342
Transmission	Automatic	Automatic
Mileage (City/Highway)	54 mpg / 50 mpg	31 mpg / 39 mpg
Fuel Costs	$2.91 (reg. gas)	$2.91 (reg. gas)
Cost for Oil Change	$35	$35
20,000-mile Service (yr. 2)	$430	$576
40,000-mile Service (yr. 3)	$388	$449
60,000-mile Service (yr. 4)	$863	$858
75,000-mile Service (yr. 5)	$1,607	$1,327
Monthly Insurance	$126	$115
Trade-In Value	$11,694	$7,140

Figure 9.8 – Alternatives and related information considered for an automobile purchase.

ESTABLISH THE PARAMETERS:

The following assumptions apply:

- You will drive an average of 15,000 miles per year. Fifty percent of this mileage will be "city" driving, while the remaining 50 percent will be "highway" driving.
- Oil changes will occur every 5,000 miles.
- You typically own your vehicles for about six years.
- You are paying cash for your new vehicle, which includes the trade-in value of your existing automobile.
- The interest rate will be 5 percent, which is the return you would make if you invested your money in a high-yield bond.
- Present worth factor (PWF): 6 years at 5% interest = 5.075. Use this factor to convert annual costs (e.g., O&M costs) to present worth costs.
- Present worth factor (PWF) at 5% interest = Use table below. Use these factors to convert future single costs (i.e., replacement costs and salvage costs) into present worth costs.

Year	Factor
1	0.9524
2	0.9070
3	0.8638
4	0.8227
5	0.7835
6	0.7462

CALCULATE THE LIFE-CYCLE COSTS:

1. Input the life-cycle period (i.e., total length of time in years) and discount rate (i.e., cost of money). In this example, five years was the period established by the owner at an interest rate of 5 percent.

2. Input the initial capital costs to purchase the vehicles. This would include the purchase price plus taxes and fees.

3. Input the annually recurring costs. In this case, we must consider the annual maintenance costs (i.e., fuel costs and oil changes) to run the vehicle, plus additional monthly costs such as car insurance. These costs are expressed in present worth dollars and do not consider inflation. Note that to determine the annual costs for fuel, one must consider the fuel efficiency for city and highway driving and factor in the total miles estimated for each vehicle. These annual costs (A) must be converted to present worth costs (P) by applying the appropriate equation.

$$P = A \cdot \frac{(1+i)^n - 1}{i\,(1+i)^n}$$

4. Input the single future costs. In this example, both vehicles will need periodic maintenance identified by the manufacturer. The cost to do this (which is based on the cost to do so in today's dollars) is identified for both the alternatives. Note that these periodic maintenance costs are for different amounts and occur at different periods. The appropriate equation is used to convert these future single amounts (F) to present worth costs (P).

$$P = F \cdot (1+i)^{-n}$$

5. Input the salvage costs. Salvage costs represent the residual value of the system at the end of the life-cycle period (which, in this example, is year 5). In this case, the salvage costs are the trade-in (residual) value of the vehicles depreciated over time. However, since they typically represent money back to the

LIFE-CYCLE COST ANALYSIS								
Life-Cycle Period	6	Years	Real Discount Rate	5.00%		HYBRID		SUBCOMPACT
A. INITIAL COST						$ 25,817		$ 18,496
Service Life – Baseline	20	Years	**INITIAL COST SAVINGS:**					**$ 7,321**
Service Life – Alternative	20	Years						
B. SUBSEQUENT ANNUAL COSTS								
1. Maintenance						$ 105		$ 105
2. Insurance						$ 1,512		$ 1,380
3. Fuel						$ 841		$ 1,264
				Total Subsequent Annual Costs:		$ 2,458		$ 2,749
				Present Value Factor (P/A):		$ 5.076		$ 5.076
				PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):		**$ 12,474**		**$ 13,951**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**			**Present Value**		**Present Value**
Periodic Maintenance	2	$430	0.90703			$ 390		
Periodic Maintenance	2	$576	0.90703					$ 522
Periodic Maintenance	3	$388	0.86384			$ 335		
Periodic Maintenance	3	$449	0.86384					$ 388
Periodic Maintenance	4	$863	0.82270			$ 710		
Periodic Maintenance	4	$858	0.82270					$ 706
Periodic Maintenance	5	$1,607	0.78353			$ 1,259		
Periodic Maintenance	5	$1,327	0.78353					$ 1,040
Trade-in Value	6	–$11,694	0.74622			$ (8,726)		
Trade-in Value	6	–$7,140	0.74622					$ (5,328)
				PRESENT VALUE OFSUBSEQUENT SINGLE COSTS (Rounded):		**$ (6,032)**		**$ (2,672)**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)						**$ 6,442**		**$ 11,279**
E.				**TOTAL SUBSEQUENT COSTS SAVINGS:**				**$ (4,837)**
F. TOTAL PRESENT VALUE COST (A+D)						**$ 32,259**		**$ 29,775**
							TOTAL LIFE-CYCLE SAVINGS	**$ 2,484**

Figure 9.9 – Life-cycle cost analysis using the present worth method.

owner, they are expressed as a negative number (in other words, a negative cost). Since salvage costs are also a single future sum, and we want to find their present worth, we apply the same equation as identified in Step 4.

6. Calculate the present worth value of all costs. This step simply adds all the present, future, and annual costs that have been converted into present worth dollars and expresses them as a single total. The total alternative costs are subtracted from the total original costs to give us the total life-cycle cost savings.

The conventional subcompact, though more expensive to operate on an annual basis, ended up being the most economical option for the owner when considering the total cost of ownership over the life of the equipment. The VM facilitator must always consider life-cycle costs in the search for improved value.

9.5 References

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10
Presentation Phase

10.0 Introduction

The purpose of every VM study is to generate proposals that will increase the value of a given project, product, process, organization, or service. When the Development Phase has been completed, the VM proposals developed should now be richer in information regarding their power to improve the value of the subject under study. It is now time to introduce those VM proposals to stakeholders and decision makers who were not part of the VM study.

The Presentation Phase is the last step of the six workshop phases within the VM study, but it is not the end of the VM Job Plan for either the team members or the project stakeholders. This phase includes not only the presentation, but also any report deliverables. So far, valuable ideas have been developed into VM proposals, which is all they are now: proposals. In the next steps, part of the Implementation Phase's activities will deepen the analysis of those VM proposals the team recommends for implementation. That may require a more thorough analysis, validation, market and technical testing, a formal quotation from suppliers, a program or a formal action plan to implement each proposal, etc. With this in mind, it is important for the team to understand that the expected outcome of the Presentation Phase is not for stakeholders to make immediate implementation decisions, but for them to understand each of the presented VM proposals, their advantages and disadvantages, and the potential obstacles to implementation.

The purpose of this phase is, in simple words, to sell the team's ideas to stakeholders. Therefore, like all phases of the VM Job Plan, using the right communication skills and tools is paramount.

Presentations are normally given at the conclusion of the workshop and can vary in format and duration. The function of the presentation is to convince the stakeholders to consider and further investigate the proposals. Typically, the stakeholders are not asked to make decisions on the determination of each proposal. Not all proposals are necessarily presented, but all are included in the report.

Another key output of the Presentation Phase is often a written VM study report. The scope and breadth of such reports vary by organization; however, they are an important consideration in documenting the VM study effort.

10.1 Terms and definitions

10.1.1 Handout

A document that summarizing the key information needed by both the VM study team and the stakeholders attending the presentation. It is not intended to include specifics about the Job Plan phases nor all details of each VM proposal, but to share some basic information to make the presentation run easily. In most cases, these documents will be two to five pages in length. In some cases, a PDF copy of the slideshow used by the team is distributed. Handouts generally become obsolete after the presentation ends, since the VM study team, facilitators, and other stakeholders will focus their efforts on the formal report.

10.1.2 Visual presentation

For the sake of clarity among the diverse VM community members, we are differentiating "presentation" and "visual presentation." In this text, we define the presentation as the overall effort to compile and communicate the VM study results to stakeholders, including preparation and the meeting held to communicate those results and data. Visual presentations, as used herein, refer to a specific type of common presentation tool used by many practitioners. They are often created in Microsoft® PowerPoint and other similar software packages and are displayed on projection screens, large monitors, or in print-outs.

10.1.3 VM study report

A document containing all the information developed at the time of the study, needed for stakeholders to make informed decisions about which VM proposals to implement. It is recommended that the executive summary be developed in such a way that it could be a standalone document for broader circulation. Reports should include the background and description of the project under study; a complete listing of VM proposals; complete VM proposals containing all relevant data; complete analysis conducted by the team; a comprehensive listing of all ideas generated and evaluated, along with their evaluation rationale; a brief description of the VM process; agendas; and, a listing of all participants with their contact information. Audiovisual materials may be added to VM study report when prudent.

10.2 Process

The use of visual and oral presentations is so common nowadays that we often overlook the importance of preparing for them. Remember that "the presentation" and "the visual presentation" are two different things. Sometimes, we spend excessive time working on a very impressive slideshow, but not enough on the actual content that effectively communicates and sells the ideas contained in them. Below is a listing of the most common inputs, outputs, and activities required for a successful presentation. Figure 10.1 shows the Presentation Phase flowchart.

10.2.1 Inputs and outputs

10.2.1.1 Inputs

- A list of invited guests to the presentation and their roles.
- The VM presentation's date, time, agenda, and location (including internet and/or teleconference information for remote participants).
- VM Proposals including descriptions, sketches, initial and life-cycle cost estimates, Return on Investment, and other exhibits, etc.
- VM study subject information such as a description of the current situation, goals, objectives, scope, schedule, cost, risk, and performance information.
- VM study process information such as Function Analysis, ideas, evaluation, etc.
- Audio / visual equipment and materials

10.2.1.2 Outputs

- A list of all VM proposals. It is recommended to sort these in an intuitive sequence that maximizes clarity and impact on the stakeholders.
- A document used to assist the team to better describe their VM proposals to the stakeholders (usually a slideshow, handout, or both). This may include a summary of all the VM proposals presented, showing their impact to improve the value of the subject under study.
- A visual presentation of the VM study results.
- A written VM study report documenting the proceedings, findings, and recommendations.

10.2.2 Activities

- Schedule VM presentation.
- Select VM proposals to present.
- Prepare visual presentation and handouts.
- Deliver the VM presentation.
- Develop VM study report.

10.2.3 Process flowchart Figure 10.1

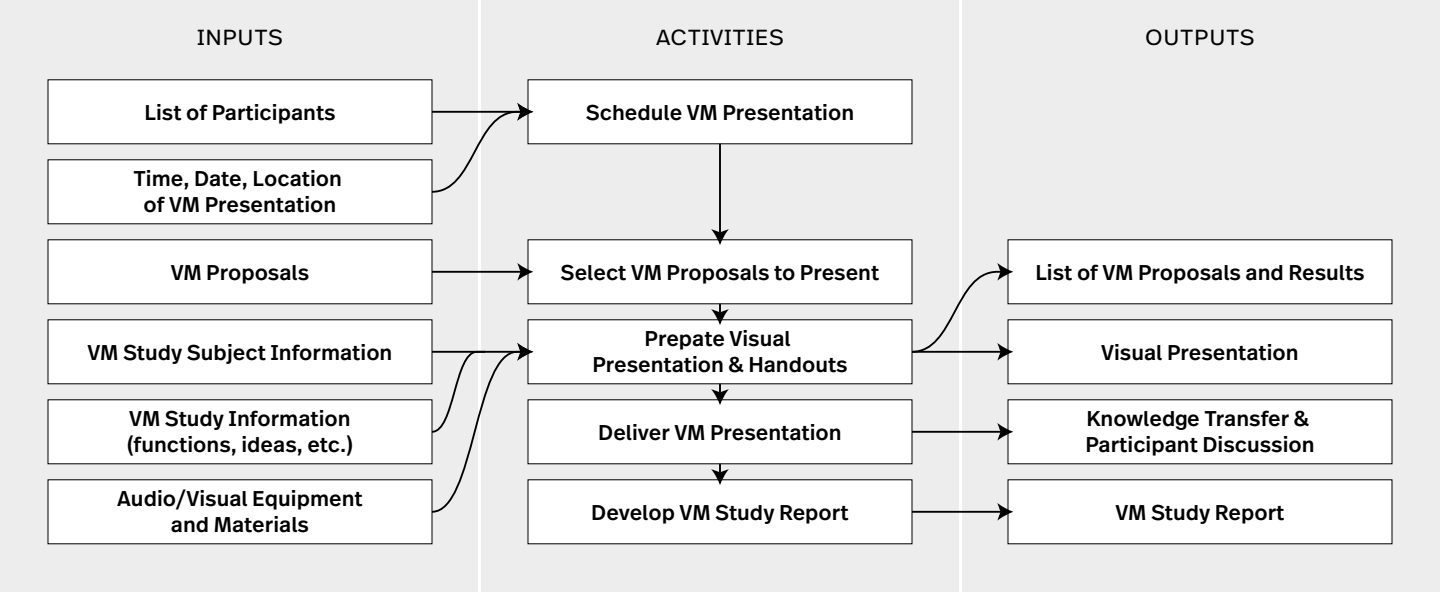

Figure 10.1 – Function analysis phase flowchart.

10.3 Activities

As noted above, the primary purpose of the Presentation Phase is to sell ideas. To that end, it's important to tailor the presentation to the audience. Work to ensure the right people are available to participate: align the schedule with their availability and organize the information appropriately based on their needs. For instance, executive level briefings tend to be significantly shorter than presentations to technical reviewers.

10.3.1 Schedule the VM presentation

Part of the Preparation Phase activities is to plan for a formal presentation at the end of the workshop stage of the study. This seemingly obvious phase of the VM Job Plan may be overlooked by team members, stakeholders, or even the facilitator. The VM study has several stakeholders who made the study happen in the first place, so they will be interested in learning the outcome of such an enterprise.

Time is one of the most critical resources in every institution. Managers, clients, and stakeholders in general have very tight agendas. They may not be available for the team if the presentation is not formally scheduled in advance. Ultimately, the way the presentation is developed is depends on the context.

10.3.2 Select the VM proposals to present

There are numerous ways to select and sort the VM proposals for the presentation. Not all proposals should necessarily be included in the VM presentation; however, all written proposals should be included in the report. When deciding on which proposals to include in the presentation, consider those ideas with greater risk or controversy for which presenting could enhance the potential acceptance. Some teams may dictate that VM proposals fall in a certain sequence, while others receive greater freedom. Ultimately, the sequence should be intuitive and logical, based on both the audience and the study's goals.

10.3.3 Prepare the visual presentation and handouts

Preparing your presentation using visual media or a handout compels you think it out in advance and ensures you cover all the material needed to generate interest about the team's VM proposals and, finally, selling them. Time permitting, it may be desirable to distribute presentation materials before the presentation to afford participants an opportunity to review content.

The eight elements listed within the typical presentation outline described in this chapter's introduction could be misleading if the team forgets the purpose of the Presentation Phase: selling ideas. Avoid spending a significant part of the presentation describing the Value Methodology or its elements to the stakeholders. The presentation is not about VM, but about the ideas it triggered. Unfortunately, it is not uncommon to find teams spending almost half the time of the presentation explaining function analysis or the VM Job Plan to their audience.

10.3.4 Starting the presentation

Every presenter has different styles to open their presentation; nevertheless, most VM study teams follow some standard best practices. First, the VM facilitator welcomes all attendees and introduces the team. In this introduction, it is always important to publicly acknowledge and thank all team members for their work during the workshop. Second, introduce the presentation outline and content. Although every institution is different, it is always a good idea is to ask all guests to hold their questions until the end of the presentation in order to better control the meeting time.

There is no hard and fast rule about who should be the presenter, but it is customary that the VM facilitator be the one who introduces the Value Methodology followed by the team. Then every team member presents those VM proposals they developed. This is the most important moment of truth for the audience, when VM proposals are either sold or not. Therefore, care must be taken regarding body language, voice, effective use of the visual presentation, etc. Some pitfalls and best practices are listed at the end of this chapter.

A typical outline of a VM presentation is as follows:

1. Identify the VM team
    - Introduce the team
    - Acknowledge stakeholders, owners, and other contributors
2. Identify the subject
    - Review the VM study subject and/or problem statement
    - Outline the scope of the study
    - Review VM study goals, objectives, and/or success criteria as agreed on in the contract
3. Identify functions studied
    - Use an abbreviated FAST diagram
    - Identify the basic functions
4. Present costs of functions
    - Indicate the cost of the item
    - Relate cost to function
5. Explain the methodology used
    - Relate how many ideas were generated/considered
    - Explain weight evaluation attributes
    - Relate the performance criteria required
    - Give specific recommendations
    - Recommend specific changes

6. Discuss the expected benefits
    - Review life-cycle costs
    - Review break-even analysis
    - Review return on investment
    - Explain intangible benefits
7. Discuss specific implementation plan
    - Propose a plan to implement
    - Indicate implementation cost and timing
    - Indicate the consequences of delay
    - Identify implementation risks
8. Ask for action
    - Be prepared to answer questions

Time is important, but other people's time should be considered even more important when the team delivers the presentation. Finish the presentation on time. Managers may have other meetings, guests or team members may have flights to catch later that day, and many more possible reasons exist for the team not to make the presentation longer than planned. Take care to leave enough time for attendees to ask questions.

10.3.5 Develop VM study Report

Following the presentation and the conclusion of the formal VM study, the VM study facilitator prepares a written VM study report for submission to the project's decision makers and stakeholders. The VM study facilitator is primarily responsible for gathering the documentation generated during the study and compiling it systematically into a report.

Some agencies and organizations have their own requirements for VM study reports. Typically, the VM study report should be organized in sections, preceded by a cover, a distribution list, and a table of contents. The VM study report typically includes:

- Executive summary. A brief and concise overview of the VM study subject, goals and objectives, process, participants, findings, and recommendations.
- VM proposals. Documentation of the individual VM proposals as discussed in Chapter 9, Development Phase.
- Subject analysis. Summary of the analysis performed as part of the VM study, such as function analysis, FAST diagram, resource models, and other information developed using VM techniques.
- Subject description. A narrative of the subject's baseline scope, schedule, cost, and risk that formed the basis for the VM study.
- Idea evaluation. List of all the ideas generated by the VM study team during the Creative Phase and annotated with information concerning their evaluation.
- Value Methodology process. Summary of the VM Job Plan, study agenda, and participants.

Preparing a thorough VM study report is essential to clearly communicate the results of the VM study to the project team and decision makers as the first step in the implementation of the VM proposals. The report must focus upon the audience, typically stakeholders and project managers. The report should be a standalone document prepared with the understanding that its readers and users did not necessarily attend the workshop. Report users may not be experts in the focus of the study and, therefore, common language should be used in lieu of jargon.

In some cases, it may be desirable to have two iterations of the written report–a draft and a final version. In this case, the draft version need only include the executive summary and VM proposals sections. Following the implementation meeting, a final report is prepared that includes the remaining sections of the overall report, plus an implementation section that documents the final status of the VM proposals and outlines the implementation plan, schedule, and responsibilities for each.

10.4 Basic techniques

The best ideas in the world remain unrealized unless they can be communicated clearly and convincingly to those in a position to act on them. Those with experience in marketing, sales, and advertising no doubt understand the importance of selling new ideas and concepts. Those employed in technical positions, or even those in project management, may not understand the value of selling change.

Many people avoid change for a multitude of reasons. The VM facilitator will probably need to help some members of the VM study team to sell change. The following techniques and strategies may be employed to sell change.

10.4.1 Share the credit

Often the project team has vested an enormous amount of effort in developing the project's baseline concept. Recognize that not only has time and effort been invested, but pride has, too. Pride may be a major obstacle in overcoming change. If the VM study team has developed a concept that is particularly strong, it may be wise to demonstrate how the stakeholders and/or project team members have contributed to the development of the VM proposal. If others outside the VM study team can feel some pride in ownership of a new concept, they will be less apt to resist it.

10.4.2 Find champions of change

The sponsoring organization most likely has members who will be advocates of change. Ideally, the VM facilitator will have identified these individuals early in the process. The VM study team must seek to include these individuals in group meetings and

seek their input, especially in the exit briefing, as they can provide valuable leverage in motivating change within an organization.

10.4.3 Sell the concept of change early

The earlier people can get involved with the VM process, the more time there will be to prepare them for change. The VM facilitator should work with the study sponsor and project team to prepare for change. Everyone involved in the process must understand that the VM study team is simply an extension of the project team. The VM study team exists to help develop a better project, not to embarrass or criticize anyone, especially since they will have the advantage of hindsight that the project team did not have. The decision makers should be made to view the process as a collaborative effort.

10.4.4 Use language to communicate ideas with enthusiasm

The VM study team should consider brainstorming ways of selling their most important, and potentially most valuable, concepts. Developing key catch phrases and sound bites can really help sell big ideas by creating links between words and concepts. The objective of selling an idea is to persuade others to think it's a good idea and worthy of further attention. The presentation should reflect both benefits and any risks or challenges. The proposal should address ways to mitigate the challenges, reflecting a well-thought-out, thoughtful idea. The use of a few choice words can help make ideas stick in the minds of decision makers and will encourage them to explore the VM proposals developed by the VM study team.

10.4.5 Sell value improvement

Keep in mind that the objective of the Value Methodology is to improve total project value, not just reduce costs. This means communicating to the project team and decision makers that the VM study team focused on all aspects of the value equation, which include performance, time, risk, and cost. Assuming performance metrics were utilized as part of the VM process, the VM study team will be able to show in detail how project performance will be affected by the VM proposals they developed. Selling value improvement will be much easier than merely selling cost reductions. In some cases, increasing the cost for portions of the VM study subject will increase overall value.

10.4.6 Be prepared

All of the blood, sweat, and tears that went into developing the technical aspects of the VM proposals will pay off when the VM study team is hit with tough-minded technical questions from the project team. One of the best ways to sell ideas to technical reviewers is to have developed all the facts. If a question arises concerning an issue that the VM study team has not addressed during the Development Phase, let everyone know that the VM study team will research the question and find the answer. In the zeal to sell ideas, avoid the temptation to gloss over disadvantages or potential problems. The project team and decision makers will appreciate the forthrightness and honesty, which will in turn foster trust and respect.

10.4.7 Create excitement

Visible enthusiasm on the part of the VM study team will in and of itself help sell their ideas. If the VM study team is obviously indifferent about their work, then you can bet everyone else will be as well. An enthusiastic attitude is infectious and will be difficult to resist if it is genuine.

10.4.8 Overcome visual bias

Another important consideration in presenting graphics, especially sketches of design concepts, is to present the baseline and alternative concepts in a manner that is balanced. Usually, the level of graphic development for an alternative will be significantly less sophisticated (e.g., a hand-drawn sketch) than for the baseline concept (which may be presented in a detailed technical format such as AutoCAD). Presenting graphic data together using these two formats is a surefire way to bias the audience toward the concept that has been presented in a more detailed fashion (e.g., the baseline concept). People assume that the more detailed technical graphic has been more thoroughly vetted and tend to gravitate toward certainty over uncertainty.

One way to overcome this bias is to present all concepts at the level of the lowest graphic level. For example, if the baseline has been computer-drafted and an alternative has been hand-sketched, then a hand-drawn representation of the baseline concept should be prepared and both sketches presented together. This has been found to be an extremely effective strategy based on the experience of hundreds of technical presentations. The key consideration here is to present information in a way that will not create bias against the new concept.

10.4.9 Be wary of PowerPoint

Microsoft® PowerPoint is the dominant presentation development software in the world today. Originally developed in 1987, it has been responsible for the design and delivery of billions of presentations. One might argue that the vast majority of these presentations have been awful. A growing body of evidence supports the theory that the very nature of PowerPoint is counterproductive to both presenters and the recipients of presentations. In his landmark book on the presentation of visual data, Beautiful Evidence, Edward R. Tufte devotes an entire chapter to the discussion and analyzes the cognitive structure and style of PowerPoint presentations. Tufte provides a number of compelling examples that explain how the delivery of technical information through PowerPoint actually undermines the presentation of data. Further, the use of the "AutoContent Wizard," "chartjunk," and overuse of bullet structures often serves to confuse the message that the data tries to make. Another noted author, Seth Godin, takes a slightly different approach to the shortcomings of PowerPoint presentations from a marketing perspective.

The lesson to be learned from these authors is that the structure of PowerPoint should never dictate the presentation–the content should. Use PowerPoint to sell the ideas (as recommended by Seth Godin) and use informational handouts as "leave-behinds" to present data (as recommended by Ed-

ward Tufte). The handout could be a 1- to 4-page summary of important data, or it could be a full written repo

Think outside the AutoContent Wizard and pre-generated templates and focus on the most effective way to deliver the content.

Ultimately, when considering presentation format, evaluate the audience and the message of the presentation. Sometimes, simpler is better and better reflects the level of development of the proposals and project.

10.4.10 Recognize others for their efforts

Recognition may be more important than pay for many. The VM facilitator should take time to recognize and thank the project team and other contributors for their efforts. The exit briefing offers an excellent opportunity to do this directly. A gracious expression of appreciation demonstrates respect for the hard work of others and will not go unnoticed.

10.4.11 Communicate concisely

Time is a valuable commodity, especially for executive level management. Avoid getting into minutiae when presenting value alternatives during the exit briefing. Focus on the facts and present the concepts as concisely as possible.

10.4.12 Effective Q&A

It is always a good idea to ask the audience to hold their questions until the end of the presentation. The team focuses their presentation on the most innovative ideas which usually raise the most interest which elicits questions from both the technical and business audience in the meeting. Engaging in discussions for every idea puts the presentation's agenda in danger, achieving deep discussion about the ideas listed first, and overlooking the ideas at the end of the presentation. Introduce this guideline when the presentation begins, before any question is raised.

10.4.13 Use of graphics, sketches, and charts instead of words

As the saying goes, a picture is worth a thousand words. For succinct communication, use the least amount of text necessary and maximize the use of graphics and visuals in slideshows. Use the notes section of presentation software or a set of printed notes if needed but take care not to read every word presented. Perhaps use "7x7" rule (seven lines of text, each with seven words) to minimize clutter. It is also recommended to include baseline concept and VM concept graphics to depict the "before" and "after." When doing so, eliminate potential bias by ensuring both images use the same style of depiction (i.e., use hand drawings for both versus a CAD image for one and hand drawing of the other).

10.4.14 Have a presentation moderator

While presenting, the presenter should focus on actively selling ideas. This makes most presenters overlook the time spent delivering their message; therefore, preparation of a timed agenda and a team member monitoring the flow of the presentation keeps the schedule on track.

10.4.15 Remote presentations

Nowadays, it is extremely common to have some audience members attend the presentation remotely by phone, web conferencing platforms, or social media tools. Prepare in advance for remote participation. Have a steady, high-speed internet connection and a good speaker on the telephone or the right software installed on the computer that shares the slideshow. Some organizations may have restricted access to cloud-based files or the use of USB drives to share files. Some countries or institutions restrict access to products such as Google and all its related tools. Some platforms work with specific web browsers and fail with others when sharing a screen. The team may take access and compatibility for granted and then be surprised when trying to start the presentation. This information should be discussed during the Preparation Phase.

Observe some important good practices while delivering a presentation to remote attendees. First, take care not to rely too much on body language, laser pointers, or any tool that remote attendees cannot see. In a best-case scenario, they can see the same computer screen as the local attendees, but not the presenter. It is also common for remote participants to connect to the presentation using only a telephone line and not be able to see the screen. The team should also consider leveraging technology as appropriate. For example, using virtual and/or augmented reality technology can enhance the way we sell an idea and merge remote meeting rooms to the VM presentation room. The team should always validate what each remote participant can see or hear when the meeting starts and adjust their language and description of VM proposals accordingly. Since it is common that more than one team member presents, it is always a good idea for team members to introduce themselves to the remote audience, so the audience knows who is presenting each idea.

10.5 References

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11
Implementation Phase

11.0 Introduction

The Implementation Phase focuses on determining the disposition of the VM proposals and validating their effect on the value of the subject. Once the decision makers have had a chance to review the VM study report and may have provided their preliminary feedback toward each VM proposal to the VM program manager and/or VM facilitator, an implementation meeting should be scheduled to agree upon the disposition of each VM proposal. The Implementation Phase features the following steps:

- Review VM proposals,
- Resolve VM proposals,
- Develop implementation plan, and
- Document, track and audit results.

It is important to note that in most cases, the Implementation Phase activities occur outside of the actual VM study.

11.1 Terms and definitions

11.1.1 Change management

A collective term for all approaches to prepare and support individuals, teams, and organizations in implementing change. The most common change drivers include technological evolution, process reviews, crises, and changes in consumer habits, pressure from new business entrants, acquisitions, mergers, and organizational restructuring. It includes methods that redirect or redefine the use of resources, business processes, budget allocations, or other modes of operation that significantly alter a company or organization.

11.1.2 Implementation meeting

A key activity of the Implementation Phase, also called a resolution meeting. The purpose of this meeting is to resolve the disposition (usually acceptance or rejection) of the VM proposals developed and presented in the previous two phases of the VM Job Plan.

11.1.3 Implementation plan

An overall schedule for all activities necessary to implement the results of the VM study. It typically contains detailed action plans including schedules, milestones, tasks, resources and level of effort required, and identification of the parties responsible for completion of the implementation actions. Schedules (e.g. Gantt charts) and other project management applications usually support the implementation plan.

11.1.4 Resistance to change

Action taken by individuals and groups to hinder change related activities when they perceive a change as a threat to them. Keywords here are “perceived” and “threat.” The threat need not be real for resistance to occur. The usual description refers to change within organizations, although it is found elsewhere. Resistance is the equivalent of objections in sales and disagreement in general discussions. Resistance may take many forms, including active or passive, overt or covert, individual or organized, aggressive or timid.

11.1.5 Status reports

A status report is a document describing the situation of something, such as a project at a specific point in time during the Implementation Phase or at the end of the phase. It may utilize a variety of presentation techniques, whether in writing or verbally supported by graphics, charts, diagrams, tables, or any other forms of visualization.

11.2 Process

The Implementation Phase concentrates on driving change throughout the subject under study. Once the VM proposals have been accepted by the decision makers, those responsible for the subject under study need to integrate the associated changes into the existing current state. This typically requires systemic and/or hierarchical changes within the organization to achieve success. The key to dealing with the changes that occur as a result of a VM study, big or small, is to competently manage them. This requires developing a basic understanding of the nature of change itself and of the people responsible for the implementation of the change.

11.2.1 Managing change

The capacity of individuals and organizations to cope with change varies dramatically, depending on the size and nature of the change as well as an awareness of the risks associated with not accepting the change. This section discusses the basic mechanics and psychological principles involved in how people process and respond to change. Depending on the nature of an organization's approach to implementation, the VM facilitator and/or VM program manager may need to assist others in adjusting to the changes resulting from VM proposals. There are essentially four stages of change (**Figure 11.1**):

Figure 11.1 – Stages of change.

Stage 1: Shock. Many people interpret impending change as a threat. Much like physiological shock, the tendency is to shut down thinking, and as many other systems as possible, in order to cope with the attendant fear. Just as people need warmth and rest when in physical shock in order to initiate recovery, they need emotional support, information, and an opportunity to gather with others in order to begin recovering from the shock of change.

Coping strategy: The shock and stress of change can be minimized by building a support network in the form of a detailed implementation plan and by providing as much information as possible with respect to the change. Upper management should provide support and, more importantly, maintain a visible level of involvement in seeing the changes through. Clear communication of organizational expectations and proper allocation of time and resources to implement the change provide a sense of safety.

Stage 2: Defensive retreat. Many times, those are most directly affected by a change will attempt to cling to or maintain old, familiar ways. Individuals and organizations can get stuck here or suffer from shock (return to Stage 1) as each element of the change is introduced.

Coping strategy: Render assistance by identifying what those individuals resisting change are holding on to; provide insight on how to modify old behaviors in the context of the new situation; or, simply shed the old ways altogether if they are now inappropriate or obsolete. Identify areas of stability (i.e., things that are not changing). Provide information continually and consistently. Ask, "What is risky?" and provide safety in response to the discomfort felt with risk taking. In some cases, acceptance of the change may be compulsory based on management decisions or external factors.

Stage 3: Acknowledgment. This stage may include a sense of grief and sadness over what has been lost. This aspect of change may be pronounced in those that have had a major hand in the creative and/or technical development of the project's baseline concept. For these individuals, it is important to start accepting the change, so they can see the value of what is coming, and to look for ways to make the changes successful. The project team must begin taking risks again in order to implement the change. This process requires additional creativity and a sense of discovery that can lead to positive team energy if well managed.

Coping strategy: Involve people by working with them to explore options and by planning through the use of an implementation plan and schedule. The VM facilitator or project manager should encourage and support risk taking at this stage by pointing out how the organization will support them. Emphasize that everyone is facing the same learning curve.

Stage 4: Adaptation and change. At this stage, the transformation is in full motion. Individuals are now prepared to establish new procedures and to help others. Risk taking comes into fruition at this stage, relative to changing methods, products, or whatever is called for by the change.

Coping strategy: Stick to the implementation plan. Encourage and support risk taking using the process and structures developed in Stage 3. Establish feedback loops so that information travels in all directions, new learning occurs, and mid-course corrections can be made if and when necessary.

11.2.2 The forces of change

The next step in managing change is developing an understanding of the positive and negative forces involved in individual and organizational change. Positive and negative forces work toward cross-purposes.

Positive forces (catalysts of change)

- Changes in an organization's environment, such as the introduction of new policies, procedures, standards, or regulations, rapidly increasing competition, or unpredictable changes in the economy may affect personnel.

- The development of new products or services or product selection resulting from improvements in technology, changes to the competition or the industry, or unusual requirements of a new client may impact the organization.
- Changes in the workplace to employee demographics, organizational structure, management style, or employee demographics related to acquisitions or mergers, may call for new forms of communication and chains of decision making.
- Changes in productivity, product quality, customer satisfaction, commitment, or an increase in employee turnover or absenteeism may call for changes in internal relations (i.e., the relationship between different departments within an organization).

Negative forces (resistance to change)

- Resistance to change occurs when a change ignores the needs, attitudes, or beliefs of the members of an organization.
- Individuals resist change when they lack specific information about it. This ignorance hinders them from developing an understanding of when, how, or why the change is occurring.
- Individuals may not perceive a need for change; they may feel that their organization or project is currently operating effectively and/or profitably. In such a case, change may not be voluntary or requested by organizational members.
- Members of an organization may suffer from an "us versus them" mentality that causes them to view the change agent as their enemy.
- Members of an organization may view the change as a threat to the prestige and security of their manager. They may perceive the change in procedures or policies as an indication that their manager's performance is inadequate.
- Members of an organization may perceive the change as threats to their ego, expertise, status, or security.

For controlled, managed, and effective change to occur, the VM facilitator and/or project manager must confront each of these negative forces and strive to overcome them.

11.2.3 Implementing change

The successful implementation of the changes related to VM proposals requires that the strategies outlined in the implementation plan succeed. Although careful preparation for change, including the proper documentation of the VM proposals and a sound implementation plan, increases the chances of success, it does not guarantee success. Implementation requires an ongoing assessment of the reactions of the project team to the change. Strategies for the successful implementation of change include:

- The appointment of a steering or oversight committee to monitor the change, provide leadership, and resolve conflicts.
- Contingency plans to overcome unanticipated costs, delays, risks, or unforeseen resistance to change. The dynamic nature of organizational systems requires this level of flexibility in implementation plans.
- A strong commitment to the implementation plan on the part of the top management to buffer the effort from internal and external challenges and to ensure that needed resources are made available to see the change through to completion.
- Encouragement of those on the receiving end of the VM study to participate early and often. Ensuring that key stakeholders are involved throughout provides opportunities for them to contribute to the process, improve ideas, and offer their insights on improving the value of the VM study subject. Providing avenues for stakeholders to build-on the VM study team's ideas is one of the best times to do this. Having a "midpoint" review meeting after the Evaluation Phase is a good time to facilitate this input. Preparing the stakeholders for change is very important to maximize the chances for VM proposals to be implemented. With this in mind, Japanese practitioners widely use a good practice called "nemawashi." Nemawashi is an informal activity in Japanese culture that offers preparatory opportunities by leaking information in advance to people or organizations that are expected to have a significant impact on change.

11.2.4 Inputs and outputs

11.2.4.1 Inputs

- VM study report
- VM study presentation

11.2.4.2 Outputs

- Feedback on VM proposals
- VM Proposal disposition
- Implementation plan
- Status reports
- Value improvement

11.2.4.3 Activities

- Review and assess VM proposals
- Resolve VM proposals
- Conduct implementation meeting
- Develop implementation plan
- Track and audit results
- Take corrective actions (if necessary).

11.2.4.4 Process flowchart Figure 11.2

11.3 Activities

11.3.1 Review and assess VM proposals

The project team and decision makers face the task of reviewing and assessing the VM proposals once the VM study report has been submitted. This assessment provides project stakeholders and the VM study team with the assurance that the alternatives contain accurate information and that the assessments are based on their merits with the current information. During the assessment of alternatives, the project manager, key project team members, technical reviewers, and external project stakeholders review the VM study report and document their comments and recommendations on all VM proposals. It is not uncommon for the various reviewers of the VM study report to have different positions regarding the acceptability of the VM proposals. For this reason, these comments should be collected and submitted to the VM facilitator, so that proper preparation for the implementation meeting can be accomplished.

The structure of this form is self-explanatory. It is an expedient way to capture comments on many alternatives and highlight issues that will affect their implementation.

Once all reviewer feedback has been received, it should be reviewed by the VM facilitator, VM program manager, and/or the possibly the VM study team. It may be desirable for the VM study team to meet as a group to perform this review. Alternatives that appear to have deficiencies or are found to be unacceptable for one reason or another should be discussed. It may be possible for the VM study team to develop workarounds or enhancements to overcome the deficiencies.

11.3.2 Resolve VM proposals

An implementation meeting should be scheduled to develop consensus and resolve the implementation dispositions of the VM proposals. The meeting includes pertinent VM study team members and the individuals with the authority to determine the alternatives' implementation decisions, such as the subject manager, key subject team members, relevant technical reviewers, and any appropriate external project stakeholders.

The meeting should be an informal working meeting to encourage the positive exchange of opinions, supporting data, and discussion. The implementation disposition for each proposal is discussed with the project manager, relevant project team members, and other project stakeholder representatives. The meeting should result in the resolution of the dispositions for every proposal, categorized by one of the following: "accepted," "conditionally or partially accepted," or "rejected." If a modification could facilitate acceptance of a reject proposal and overcome its deficiencies, then the VM study team should accept the challenge to modify it.

Any proposals noted as "conditionally accepted" should include the action required, responsibilities, and timing of the final decision. The VM facilitator, project manager, or value program manager (if one exists within the organization) will review the resolution of the conditionally accepted proposals at a later date to complete the report on the VM study.

The VM facilitator documents all relevant comments and dispositions during this activity and includes that documentation in the final VM study report if it is included as one of the VM study

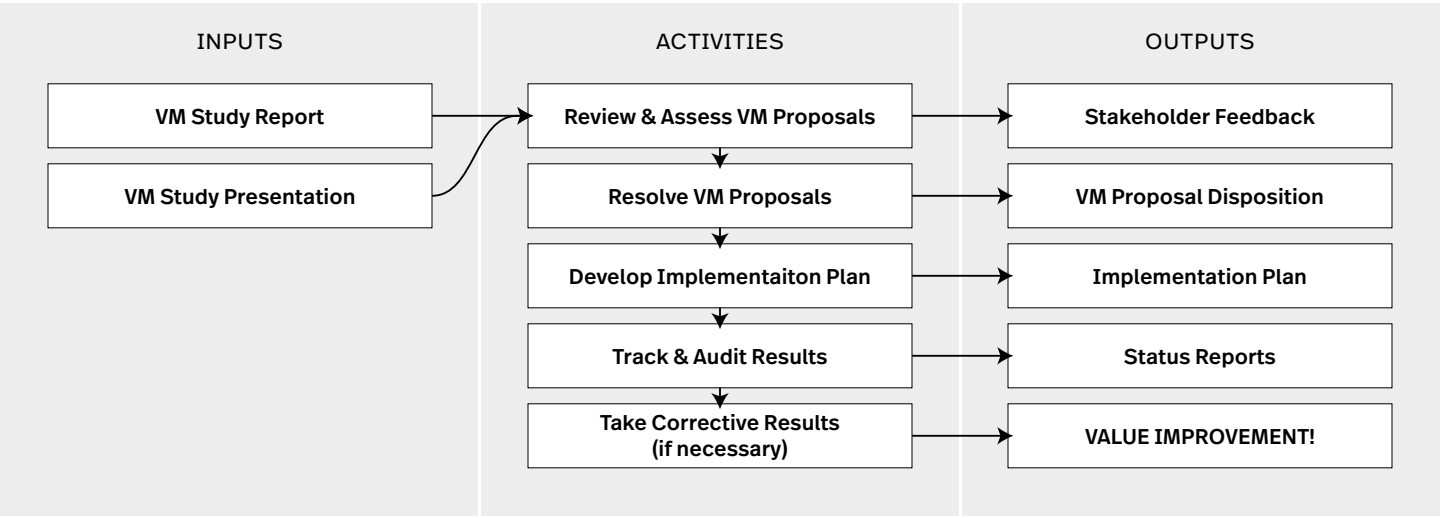

Figure 11.2 – Evaluation process flowchart.

deliverables in the VM study scope established in the Preparation Phase. A "master" implementation action form should be prepared that summarizes the comments from the reviewers.

In an ideal scenario, the VM facilitator and VM study team participate in the implementation meeting to: address questions regarding the VM proposals and the technical feasibility of the proposals; to validate the cost impact; and/or, validate the level of effort required to implement the VM proposals within the subject or organization. However, if the VM facilitator and VM study team are not present, the clarity of the material generated during the Development and Presentation Phases (i.e., the VM study proposals and VM report) becomes critically important. When participation of the VM study team representatives is not possible, considerations to increase the rate of implementation of the VM proposals include: concise yet specific titles for each alternative which describe the proposed change (i.e., updating the title generated during the Creativity Phase to accurately represent the alternative); the documentation of assumptions made during the Development Phase; detailed cost impacts developed for each alternative (i.e., avoid using lump sum figures where appropriate); and illustrations (i.e., sketches) which are clearly understood by project stakeholders.

11.3.3 Develop the implementation plan

The VM proposals selected for implementation require a plan to ensure proper integration of the changes. An implementation plan should be developed for each VM proposal identified as "accepted." The implementation plan needs to identify implementation responsibilities, action dates, modifications to the project schedule, and any additional project development activities that may be required.

The team, or individual, responsible for managing the VM study subject must take the lead in developing the implementation plan, assisted by the VM facilitator and/or VM program manager as necessary. Modifications to the work breakdown structure and/or development schedule for the VM study subject should be developed and circulated to the stakeholders in a timely fashion.

Some organizations, especially those with established value programs administered by a value program manager, will have already established procedures for developing implementation plans. In such cases, the subject manager's efforts are greatly reduced.

Implementation plans vary widely and depend upon the unique nature of the changes themselves, as well as the organization involved in implementing the changes. There are, however, common elements that usually need to be considered in implementing the change. These considerations include:

- Responsibility
    - Who will be responsible for managing the changes called for in the VM proposal?
    - What authority do they have?
    - Whom will they report to?
    - What resources will be assigned to them to assist in implementing the change?
- Design/system integration
    - How will the changes be integrated into the project?
    - What approvals, clearances, or testing will be necessary to implement the change?
    - Will the changes necessitate modifications to other aspects of the system or design?
- Schedule
- How will the project schedule be impacted by implementing the change?
    - What other projects or processes will be affected by any anticipated delays?
    - Will critical budgeting or funding milestones be affected?
- Implementation costs
    - What will it cost the project to implement the changes?
    - Will there be redesign or testing costs?
    - Will there be impacts to existing suppliers or other contracts already in place?

11.3.4 Track and audit results

It is generally the project manager's or value program manager's responsibility to track and audit the results of the VM proposals. In some cases, the VM proposal runs into problems during the implementation process. Perhaps unanticipated technical problems arise, or maybe an external stakeholder refuses to approve the change. Regardless, problems will be encountered and need to be addressed. It is incumbent upon those monitoring the implementation process to respond proactively to resolve these issues.

In many cases, numerous alternatives will have been selected for implementation. In such a situation, develop a database that identifies the alternatives' information, responsible parties, latest status, and action dates. Depending upon the company's or agency's organizational structure, the database may be an essential tool in ensuring that implementation is carried successfully through to completion.

11.4 Basic techniques

11.4.1 Implementation forms

Organizations conducting VM studies are advised to develop a standardized approach, or form, for documenting implementation actions. The form should be tailored to meet the needs of

the organization. It is recommended that the following information be considered:

- Title. The title of the alternative as shown on the VM proposal form.
- Proposal number. Proposal number as shown on the VM proposal form.
- Responses. A summary of the final disposition of the alternative prepared by the project manager, value program manager, or VM facilitator.
- Prepared by. Identity of the person preparing the response and date.
- Rationale for disposition. A discussion justifying the grounds for acceptance or rejection and a brief statement of technical feasibility.
- Implementation disposition. Choose one of the following dispositions:
    - Accept. Acceptance of the proposal denotes the intent to implement in the given project development phase.
    - Reject. Proposal is not acceptable as presented and will be dropped from further consideration.
    - Conditionally Accept. Proposal is desired but requires added technical analysis and/or stakeholder agreement before final disposition can be made. Another way to state this is "Further Study Required."
- Performance impacts. A discussion of the proposal's performance impacts. Elaborate on any deviations in the performance assessment from that presented by the VM study team.
- Cost impacts. A discussion of the proposal's cost impacts. Identify any changes or differences from the VM study team's concept that affect cost.
- Cost change. Validation of initial cost savings (or increase) in dollars.
- Schedule/delivery impacts. A discussion of how the proposal will affect the schedule (re: project delivery, production time, process time, etc.).
- Schedule change. Identification of any change in project schedule.
- Risk impacts. A discussion of how the proposal impacts risk. This may include the risks related to implementation, the effect of the proposal on existing project risks, or both.
- Other comments. Comments on other issues relating to the alternative. Note any concerns or controversial items. Identify suspense dates or action items here.

Implementation forms should be modified to meet the specific needs of the VM study subject and those of the organization. Figure 11.3 shows an example of an implementation form.

11.4.2 Implementation status reports

Status reports formally document and track the implementation status of a VM proposal. Each VM proposal likely requires one. This is an important means for VM program managers to follow implementation progress. Status reports related to the tracking of changes emanating from VM proposals generally include the following information:

- Tracking identification number. A code used to track the change within the organization.
- Report number. A serial number for the status reports issued for the VM proposal under implementation.
- Title. The title of the change.
- Date of update. Current date.
- Person responsible. The individual responsible for implementing the change within the organization.
- Implementation status. A description of the current state of the change, including any issues or actions required. Identify any corrective action required for the implementation plan or the manner in which it is being implemented.
- Next update. The date of the next implementation status update.

The VM program manager should work with the individuals responsible to implement the changes and work within the organization to support these efforts and advocate for change.

11.5 References

- Scire, P. Applying Grief Stages to Organizational Change, 2007.
- Kubler-Ross, E. On Death and Dying, Routledge, 1973.

VALUE PROPOSAL IMPLEMENTATION ACTION VM PROPOSAL № 8.3

Lower grade of highway and retain existing overcrossing

Response prepared by: Ashraf Malek, PM Date: September 24, 2019

Disposition:	Conditionally Accept
Validated Initial Cost Savings:	$17,060,000
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	12-month decrease
Validated Change in Performance	No change

Technical Feasibility: This proposal is technically feasible and will be studied further. The existing drainage system is low enough to handle the reduction in grade, however, a more extensive drainage survey is required to validate this assumption. It is believed that replacement of the pavement can occur through a series of four 55-hour closures (two-per-side) if either long-life HMA or pre-cast slabs are installed.

Validated Performance: This proposal would retain the existing overcrossing structure which is in good condition. This proposal would provide equivalent performance to the current design concept.

Implementable Portions: the project team believes that this proposal can be fully implemented as proposed pending the additional analysis.

Project Development Delivery Impacts: Check back with PM in December 2019 for the final disposition. The potential cost benefit will be validated at this time.

Figure 11.3 – Example of a VM implementation form for a project.

12
VM Facilitation and Team Dynamics

12.0 Introduction

Facilitation is one of the nine core competencies in which an individual must be proficient to achieve and maintain certification as a Certified Value Specialist®. In the context of the Value Methodology, successful execution of a VM study requires good facilitation skills.

The International Association of Facilitators (IAF), a participatory organization with members in more than 65 countries, sets internationally accepted industry standards, provides accreditation, supports a community of practice, advocates and educates on the power of facilitation, and embraces the diversity of facilitators. Much of the content in this chapter is based on the core competencies required for certification as a professional facilitator, and how those competencies relate specifically to facilitating the VM Job Plan.

For example, one of the IAF competencies is to "plan appropriate group processes." In the context of a VM study, the process is the VM Job Plan. The VM facilitator's role is to enable the team to complete all the steps in the VM Job Plan, within the allotted time, using the structure and time management techniques to generate useful outcomes.

Some general rules for facilitation include:

- Observe body language and respond appropriately.
- Play "traffic cop." Use hand signals, physical position, verbal interruptions to prevent or stop disruptive behaviors.
- Recognize that disruptive behavior usually comes with a cause of which you are not likely aware–it's not personal.
- Bring the following to the event you're facilitating:
    - Knowledge – working familiarity with concepts and methods of facilitation;
    - Skills – practiced ability to act on and carry out the appropriate actions;
    - Self – beliefs, values, life experiences all help determine our ability to use our knowledge and skills.
- Maintain a base of knowledge in management, organizational systems and development, group development, psychology, and conflict resolution.
- Understand the dynamics of change.
- Know a range of facilitation methods:
    - Understand problem solving and decision-making models;
    - Understand a variety of group methods and techniques;
    - Know consequences of misuse of group methods;
    - Distinguish process from task and content;
    - Learn new processes, methods, and models in support of clients' changing/emerging needs.

As the VM facilitator, with whom rests the eventual result of the facilitated session, remember to demonstrate a belief in the group and its possibilities.

12.1 Terms and definitions

12.1.1 Consultant

One who gives professional advice or services.

12.1.2 Facilitator

One who is substantively neutral, has no significant decision-making authority, enables a group to improve how it identifies and solves problems, and increases the group's effectiveness. In the context of VM, one who leads the group through the VM Job Plan.

12.1.3 Neutral

Not engaged on either side.

12.2 General facilitation skills

Facilitation is an interesting word that is often misunderstood. Facilitation means "to make easier." Therefore, facilitators make things easier for people to do or to understand. In the context of a VM study, VM facilitators make communication, change, and the various techniques involved easier. Facilitation is generally more passive than leadership and not as participatory in nature.

The following is an excellent definition of a facilitator (Kaner 2014):

> "A facilitator is an individual who enables groups and organizations to work more effectively, to collaborate and achieve synergy. She or he is a "content-neutral" party who by both taking sides or expressing or advocating a point of view during the meeting, can advocate fair, open and inclusive procedures to accomplish the group's work. A facilitator can also be a learning or dialogue guide to assist a group in thinking deeply about its assumptions, beliefs, and values about its systemic processes and context."

The VM facilitator wears the hat of facilitator on many of the activities during a VM study. This important role has many facets which include:

- Using the power of objectivity and credibility to help groups address issues.
- Surfacing difficult issues and help others to do so.
- Clarifying communication and the exchange of information between participants.
- Supporting and counselling others.
- Instilling a sense of calm during times of discord and conflict.
- Mobilizing a group's energy and keeping it on task.
- Conveying empathy to all participants to help build an environment of trust and mutual understanding.
- Helping participants cope with uncertainty.

To accomplish these objectives, a VM facilitator must apply and develop the following basic skills.

12.2.1 Active listening

This may at first appear obvious; however, our listening skills are often less than stellar. Active listening differs from passive listening: it requires us to be engaged with the speaker. As one author has said, "Hearing is with the ears. Listening is with the mind." There are 10 essential rules for active listening:

1. Stop talking. Obvious, but not always easy for some.
2. Put the speaker at ease. Create a permissive, supportive climate in which the speaker feels free to express himself or herself.
3. Show a desire to listen. Act interested and mean it.
4. Remove distractions. External preoccupation is less likely if nothing external is present to preoccupy you.
5. Empathize. Try to experience, to some degree, the feelings which the speaker experiences.
6. Be patient. Give the speaker time to finish; don't interrupt.
7. Hold your temper. Don't let your emotions obstruct your thoughts.
8. Go easy on argument and criticism. Suspend judgment.
9. Ask questions. If things are still unclear when a speaker has finished, ask questions that serve to clarify the intended meanings.
10. Stop talking.

12.2.2 Questioning

The enormously important skill of questioning is central to the process of eliciting information from others. The form of questioning best suited to the techniques presented in this book is the Socratic method, attributed to the famous Greek philosopher Socrates. Socrates originally used this approach as a means of examining ambiguous and/or abstract concepts such as morals and virtues. The Socratic method is a negative method of hypotheses elimination in that steadily identifying and eliminating those hypotheses that lead to contradictions develops better hypotheses. Although the Socratic method is difficult and time consuming to apply directly, the general theme of using questioning to elicit information and to examine assumptions remains valid. One form of the Socratic method is known as Socratic questioning.

Socratic questioning is a systematic and disciplined approach to questioning that focuses on core issues and concepts. The purpose of Socratic questioning is to delve into the heart of an issue and uncover deeper meaning by encouraging rational discourse. It encourages participants to thoroughly articulate their thoughts in a manner that forces a deeper analysis of issues and fosters a shared understanding.

In their excellent book *A Thinker's Guide to the Art of Socratic Questioning*, Paul and Elder (2006) provide a list of questions that are based on this approach. Below is an adapted list from that publication.

- Clarity
  - Could you elaborate further?
  - Could you give me an example?
  - Could you illustrate what you mean?
- Accuracy
  - How could we check on that?
  - How could we find out if that is true?
  - How could we verify or test that?
- Precision
  - Could you be more specific?
  - Could you give more details?
  - Could you be more exact?
- Relevance
  - How does that relate to the problem?
  - How does that bear on the question?
  - How does that help us with the issue?
- Depth
  - What factors make this a difficult problem?
  - What are some of the complexities of this question?
  - What are some of the difficulties we need to deal with?
- Breadth
  - How would other perspectives look at this?
  - What are other points of view?
  - What are other ways to look at this?
- Logic
  - Does all this make sense together?
  - Does your first paragraph fit in with your last?
  - Does what you say follow from evidence?
- Significance
  - Is this the most important problem to consider?
  - Is this the central idea to focus on?
  - Which of these facts is most important?
- Fairness
  - Do I have any vested interest in this issue?
  - Am I sympathetically representing the viewpoints of others?

The application of this method of questioning is extremely effective within the context of VM studies. It frames group interaction in a rational, professional manner that forces people to think critically rather than emotionally. This excellent approach separates facts from bias and uncovers any hidden agendas or meaning.

12.2.3 Using feedback

The VM facilitator should use feedback throughout the VM study to make course corrections and maintain efficiency. He or she should frequently ask participants for feedback by asking questions like:

- How are we doing?
- Are we on track?
- Do you have any concerns about the process?
- What can we do better?
- Are we thoroughly addressing the issues?

The VM facilitator and the team both should evaluate the information received in response to these questions and incorporate it in an appropriate manner.

12.2.4 Handling conflict

Inevitably, conflicts arise during VM studies, just as they do anywhere else. The VM facilitator must do their best to address conflicts as they arise and deal with them appropriately.

It is best to avoid conflicts before they occur. Considerations that can be applied during a VM study toward preventing or avoiding conflict include:

- Identify points of agreement.
- Reformulate contributions to highlight common ideas.
- Encourage people to build on others' ideas.
- Test for false consensus.
- Test consensus for relevance/motivation.

The VM facilitator should try to maintain objectivity and remain neutral in the face of conflict. The best role to assume is generally that of a referee.

12.2.5 Consulting or facilitating?

It may be unclear as which role the VM facilitator should play during a VM study, because many different activities and interactions take place throughout the VM Job Plan. When should the VM facilitator lead and when should they facilitate? This question has no definitive answer, as the context of the situation influences which role is appropriate. Following are some general guidelines worth considering.

Facilitation – Impartial or neutral, VM facilitators guide a team through the VM Job Plan and ask provocative questions to stimulate rich discussion and brainstorming. They do not typically impose their own ideas, but instead rely on the subject matter expert team members for idea generation.

Consulting – Typically, consultants are subject matter experts who bring their specific expertise to a workshop to evaluate the project under study and make recommendations on how to improve its value through different alternatives. They are not neutral parties.

It's worth noting that it is acceptable to have a consultant subject matter expert fulfill the role of VM facilitator, when appropriate; however, the VM facilitator need not also be a consultant subject matter expert.

Figure 12.1 provides a facilitation gauge for VM facilitator. The horizontal axis represents the VM facilitator's relative contribution to content. The vertical axis indicates the suggested level of interaction with the group. The various types of activities in which the VM facilitator is likely to engage are arrayed along the sweep of the dial. For example, the act of eliciting information during a paired comparison of performance attributes would involve a high level of interaction (mainly in the form of Socratic questioning) and a moderate contribution to content (by demonstrating how the technique works and guiding participants through the process). Another example might be during the presentation of the results of the VM study. In this case, the level of interaction would be low (as communication is primarily one-way) and the contribution to content would be very high (as the content emanates solely from the VM facilitator).

Virtually everything the VM facilitator does involves aspects of leadership and facilitation; it is more a question of degree. Passive groups require a higher level of leadership and direction, while active and motivated groups require a greater degree of facilitation. The VM facilitator must gauge the personality of the group and tailor their interaction with them in a manner that will best accomplish the objectives of the VM study.

12.3 Group dynamics

Substantial literature examining group and team dynamics exists. For the purposes of brevity, this section discusses several theories and their implications for practice which directly apply to VM and temporary teams, as are often formed for the purposes of completing a VM study.

12.3.1 Tuckman's group development model

Bruce Tuckman first published his article "Developmental Sequence in Small Groups" in Psychological Bulletin in 1965, based on analysis of 50 small group studies. Tuckman's focus was to identify a "developmental sequence that would fit the findings of a majority of the studies" (2001, p 67). In doing so, he identified

> "four stages going from (1) orientation/testing/dependence, to (2) conflict, to (3) group cohesion, to (4) functional role-relatedness. For these [the author] coined the terms: forming, storming, norming, and performing – terms that would come to be used to describe developing groups for the next 20 [plus] years and which probably account for the paper's popularity" (2001, p 67).

He collaborated with Mary Ann Jensen in 1977, publishing a paper titled "Stages of Small-Group Development Revisited."

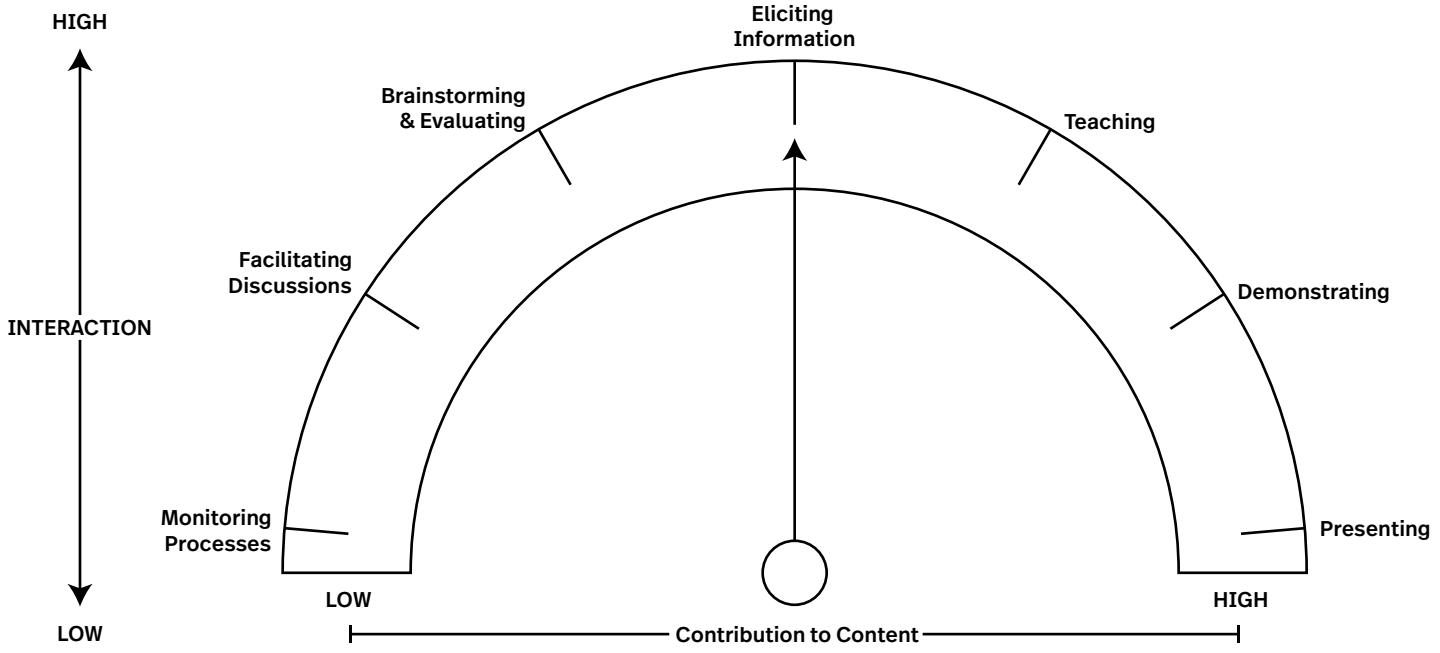

Figure 12.1 – Facilitation gauge for a VM facilitator.

In it, they refined and further developed the model to include a fifth stage–aptly labeled adjourning–based on research that positively indicated that it was a distinctly separate phase in the development process. The model's basis in research of small groups and its self-defined fluidity make it an appealing target for drawing parallels to VM study team building and the overall VM Job Plan.

Stage 1. Forming: This begins with the commencement of a group process. Considered an "ice-breaking" stage, group members gain an understanding of where they fit and discover group norms.

Stage 2. Storming: After group members better understand the group norms, the non-confrontational information gathering from Stage 1 transitions into a less comfortable stage marked with confrontation, direct or passive aggression, and discord.

Stage 3. Norming: Norming happens when the group achieves some agreement, tacit or otherwise, of the group norms and each group member's role. Group tasks and scope are defined and accepted. Cohesion of the group begins in this stage as respect builds among its members.

Stage 4. Performing: This stage is realized when trust builds among the group members, and they believe that the tasks at hand cannot be completed without each group member's effort. Members see each other as interdependent. Conflicts that may arise are addressed quickly in a collaborative and constructive manner. The group matures into a team and creates the much sought-after synergy during this stage.

Stage 5. Adjourning: Twelve years after the original model was proposed, Tuckman and Jensen added this stage based on numerous studies that documented teams having progressed through Stage 4 frequently demonstrated a sense of loss when the team completed their tasks and was disbanded.

Tuckman does not identify how long each of the five stages lasts; conversely, the length of each stage depends greatly on the group's type, purpose, and goals. Not all groups progress through all stages; many stall in Stages 2 and 3, storming and norming. Group development can also regress and undergo de-forming, de-storming, and de-norming phases if the group structure changes, goals are modified or not fully understood, group members leave or join, conflicts arise that cannot be resolved, etc. Understanding that VM studies follow a prescribed path of steps to create a valuable product, the group development model can be compared to the VM Job Plan to show in what stage a group would exist for each of the phases in the VM Job Plan (Figure 12.2).

12.3.2 Other group dynamics

12.3.2.1 Groupthink

Kreitner and Kinicki (2007) note "highly cohesive groups victimized by groupthink make the poorest decisions, despite high confidence in those decisions" (p 328). Throughout every VM facilitator's career, there will invariably be a team or two that develops a dynamic that creates blind trust and confidence in all their ideas. In these cases, it's important for the VM facilitator to recognize what's happening and introduce healthy and productive testing and evaluation of brainstormed ideas. One method of doing this is to have different people play the role of "devil's advocate." This can be done in a respectful, good-natured way to maintain team cohesion while introducing a more balanced perspective. Ultimately, the most productive teams test their assumptions and create more robust solutions.

12.3.2.2 Small versus large groups

Smaller groups tend to be more comfortable, and members are more likely to share their opinions in a "safe" environment. Larger groups can be less comfortable, or even anxiety-provoking for some, resulting in hesitation or refusal to share opinions in front of everyone. This dynamic means that the VM facilitator must work to create a safe environment to generate the richest discussion and soundest decision making. Numerous techniques ensure all participants are engaged and include breaking

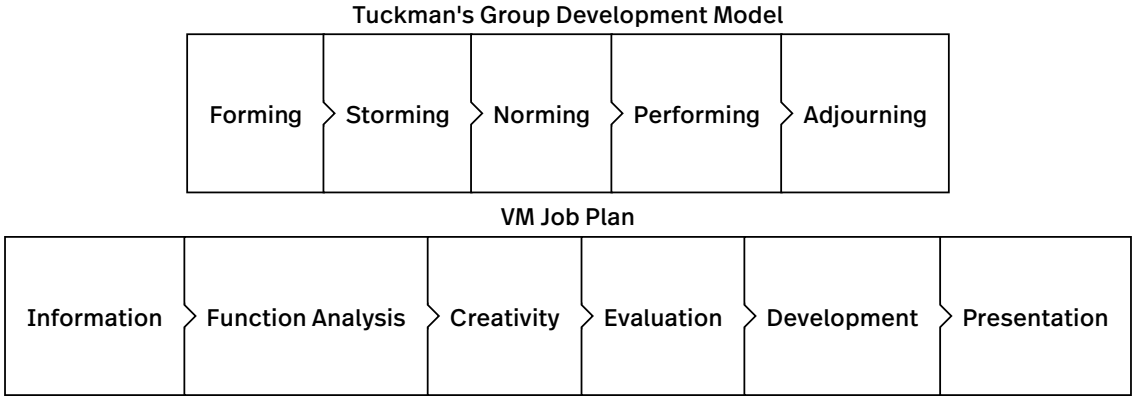

Figure 12.2 – Tuckman's group development model compared to the VM Job Plan.

larger groups into smaller "breakout" groups to discuss certain topics and with one member from each group reporting their findings to the larger team. Another is nominal group technique in which all participants answer a question on paper and the VM facilitator calls on each one in succession to ensure all voices are heard. If the participants are reluctant to read their written ideas aloud, the VM facilitator could collect them all and, during a short break, add them to the list in a random order.

12.3.2.3 Social loafing

This dynamic describes the behavior in which some group members "coast" or contribute less, relying on others to perform the majority of work. This is often more prevalent as group sizes grow for the reasons noted above. Methods to alleviate this issue are identical to the ones noted above.

12.3.2.4 The fallacy of silence meaning concurrence

As discussed below in Jo Nelson's "Working Assumptions," it is essential that all team members can contribute. In most Western cultures, it is often assumed that if someone has an issue, that person will speak up. Not all cultures make that same assumption. Whether it's a cultural difference or whether an individual does not feel comfortable for another reason, it is not safe to assume silence equates to concurrence. Doing quick check-ins with team members, voting with raised hands, etc. can ensure each person's opinion is considered. Not checking for true concurrence may result in team members going rogue, VM documentation not representing team discussion, or any other form of overt or covert resistance.

12.3.2.5 Heuristics

Loosely defined, heuristics are "mental shortcuts," and they often result in faulty analysis and lead to poor decision making. The official definition (www.merriam-webster.com/dictionary/heuristic) states "of or relating to exploratory problem-solving techniques that utilize self-educating techniques (such as the evaluation of feedback) to improve performance." For example:

- Anchoring. This shortcut describes the tendency for an initial idea or concept to bias subsequent ideas. In practice, when presented with an initial estimate, the team or client could "anchor" to that number even if it was unsubstantiated. Therefore, VM facilitators should be cautious about what numbers are printed or presented.
- Availability. This shortcut accesses information and events that are highly memorable and places undue value or probability on them. The result is the belief that things that quickly come to mind are more common or probable than data supports. A common example is a fear of shark attacks versus vehicle collisions.
- Confirmation. Confirmation bias describes the tendency for people to seek evidence that supports rather than challenges their current beliefs. It occurs when people selectively notice or focus upon evidence that tends to support the things they already believe or want to be true, while ignoring that evidence that would disprove those beliefs or ideas. Confirmation bias plays a stronger role when it comes to beliefs based upon prejudice, faith, or tradition rather than on empirical evidence. For example, if we already believe or want to believe that someone can tell us what are pets our thinking, then we will notice when they say things that are accurate or pleasant and tend to forget things said that are simply incorrect. Another good example would be how people notice when they get a phone call from a person they were just thinking about, but don't remember how often they didn't get such a call when thinking about that person.
- Representativeness. The representativeness heuristic often occurs when we estimate the likelihood of an event by comparing it to a situation that already exists in our minds. When we make decisions based on representativeness, we may be likely to make more errors by overestimating the likelihood that something will occur. Just because an event or object is representative does not mean its occurrence is more probable. For example, if two salespeople from a large company both displayed aggressive behavior, the assumption may be that the company has established a policy of aggressive selling, and that most other salespeople from that firm will also engage in aggressive techniques. Another example of this heuristic is the belief in runs of good and bad luck in games of chance. This particular incarnation is also known as the gambler's fallacy.

12.4 Forming teams

There are three major teaming models used for VM. This section explores various approaches, along with their advantages and disadvantages. Note, the below summaries are generalizations. There will always be exceptions. Each VM facilitator must review the options and select the best method to achieve the project's goals. Regardless of the approach taken, it is best to select team members who are naturally curious, strong communicators, proactive, collaborative, and respectful.

12.4.1 Team composition approaches

12.4.1.1 100% Independent

Purely independent teams, who have no stake in the project and who are not involved with the design, tend to approach a study with the greatest amount of curiosity and openness. Independent team members who bring

specific subject matter expertise are then able to look at the project with fresh eyes and are less likely to be biased. However, independent team members, by definition, have less project knowledge, may not appreciate the complexity of past decisions, and usually need more pre-study time to review documents to familiarize themselves with the project under study.

12.4.1.2 100% Design team and stakeholder

VM study teams composed of design team members and stakeholders typically have an intimate knowledge of the project, are familiar with how and why past decisions were made and understand the complexities of the project and its evolution to the concept under study. Typically, the ideas developed and presented have a significantly higher likelihood of implementation as the team often also includes decision makers. However, as with any strength, overuse can become a weakness. In this case, some (but not all) design team members and stakeholders may be biased against changes and, by their very definition, have a "stake" in the project, which could negatively influence the creative ideas generated, evaluated, etc., thus limiting the total number of options explored and possibly missing opportunities to improve value.

12.4.1.3 Hybrid – Blend of independent and subject team/stakeholder

Hybrid approaches to team composition capitalize on the deep project knowledge of design team members and/or stakeholders and the "fresh eyes" of independent team members. When the right balance is struck, these teams often engage in rich discussion and highly creative problem solving. It is important to ensure all team members approach the project with an inclusive, respectful mindset to reduce potential defensiveness of design team members and generally avoid an "us versus them" mentality.

12.4.2 Team size

In addition to composition, group size contributes to successful VM studies. It is crucial that resources are available to ensure the team members represent the expertise needed to analyze the project. Because budget limitations sometimes hinder that representation of skills and knowledge, identify team members who can contribute outside their own fields of expertise or who have a wide spectrum of experience. If the budget cannot accommodate the appropriate personnel, discuss options with the client to solicit the participation needed. Conversely, considerable research shows "as group size increases, group members' liking for the group decreases, and group members' performance decreases" (Mullen and Copper, 1994). Mullen and Copper's research findings pose a strong argument for not overloading the group with excess members simply because the budget allows it. If a large group is warranted, consider facilitation techniques that utilize small sub-groups for different activities to create a more comfortable environment, engage each participant, and prevent social loafing.

Occasionally, VM studies involve very large groups. Whether it's an idea-generating think tank or a large party of stakeholders, VM facilitator needs to keep the full group engaged and productive. Such situations make structure and clear direction imperative. For ideas on facilitating very large groups, see Sam Kaner's Facilitator's Guide to Participatory Decision-Making, Barbara Bunker and Billie Alban's Large Group Interventions: Engaging the Whole System for Rapid Change, and www.liberatingstructures.com.

To learn more about team size, please refer to Chapter 4 – Preparation Phase, section 4.3.2.

12.5 Facilitation of Preparation Phase techniques

The success of a VM study depends upon the quality of information used by the VM study team during execution of the study. The primary goals of the Preparation Phase are to gather an abundance of credible information and to obtain a clear definition of the client's goals and expected outcomes of the VM study. Refer to Chapter 4, Preparation Phase, for more specific information about activities included.

Facilitating the Preparation Phase requires interaction and collaboration with multiple stakeholders: the VM study sponsors, the project owner, project designer/manufacturer, operations and maintenance groups, interested third parties who may be affected by the outcome(s) of the VM study, the workshop host, and the subject matter experts (VM study team).

Preparation Phase initiates the process of thinking forward to implementation. Understanding the customer's needs, wants, and priorities can help the VM facilitator structure the workshop in such a way that it gets the VM study team thinking from the beginning about implementation factors. Creating a collaborative client relationship helps to:

- Clarify mutual commitment;
- Develop consensus on tasks, deliverables, roles, and responsibilities;
- Analyze organizational involvement;
- Diagnose client need, and create appropriate Job Plan elements to achieve intended outcomes; and,
- Predefine a quality product and outcomes with the client.

The importance of preparation cannot be overemphasized. Some specific tasks include:

- Define the study objectives and goals.
- Prepare a compilation of information gathered for the Information Phase for distribution to participants in advance of the workshop.
- Develop a high-level agenda to review with the client and obtain their approval.
- Develop a detailed facilitator's agenda to include specific activities and timing.
- Check your agenda and approach with a colleague.
- Learn the client's terminology.
- Try to ascertain whether there are hidden agendas or special personalities who will be involved.
- Ask lots of questions.
- Pay attention to the room layout and logistics; consider providing the study host with a diagram of preferred room layout and a list of equipment needs.

Remember the five Ps of Preparation (Wilkinson: The Secrets of Facilitation):

- Purpose. Why are we holding this session? What are the key objectives?
- Participants. Who needs to be involved, and what are their perspectives?
- Product. What do we want to have produced once we are done? How will we know whether we have been successful?
- Process. What steps should we take during the meeting to achieve the purpose, given the product desired, the participants, and the probable issues we will face?
- Probable issues. What are the concerns that will likely arise? What are the "gotchas" that could prevent us from creating the product and achieving the purpose?

Once the project materials are in hand, the VM facilitator should set about the task of creating and sustaining a participatory environment. Distribute relevant materials to all VM study team members. Schedule a meeting, in-person or virtual (telephone and/or computer), with the VM study team, client, and stakeholders, to discuss project documents, VM study goals, and what is expected of each team member during the workshop. Confirm the agenda and workshop logistics and clarify any open questions with the VM study team and stakeholders.

12.6 Facilitation of information phase techniques

The Preparation Phase overlaps the Information Phase (described more fully in Chapter 5), because part of the Preparation Phase includes gathering information relevant to the VM study subject for everyone to review prior to the workshop. The Information Phase formally continues the first day of the workshop, and it's the VM facilitator's role to keep the discussion focused to accomplish the necessary tasks in a timely manner. Continue the participatory environment that started during Preparation Phase by incorporating some or all of the following tips and tools:

- Describe the process to be followed; for example, relate the agenda to the VM Job Plan.
- Obtain group buy-in of goals and objectives.
- Foster open participation with respect for client culture, norms, and participant diversity.
- Manage group conflict by helping individuals identify and review underlying assumptions, providing a safe environment for conflict to surface, and recognizing its role within group learning/maturity.
- Manage disruptive behavior by controlling sidebar conversations and making sure whoever has the floor at the moment is allowed to be heard, uninterrupted
- Draw out all participants.

One keys to effective communication, especially during the Information Phase, is making sure everyone in the room has the opportunity to hear what each and every participant has to say. The participants in the room are at the table for varying reasons: intimate knowledge of the study subject, awareness of outside influences that could affect the VM study, specific technical expertise. They represent a part of a team. What one team member contributes all team members should hear. That's how participation and collaboration begin.

Some facilitators establish "ground rules" with the group at the beginning of a workshop. An alternative approach, developed for ICA Associates, Inc. by Jo Nelson, Certified Professional Facilitator and ICA Certified ToP™ Facilitator, is "working assumptions" (used with permission):

- Everyone has wisdom. (This doesn't mean everything that everyone says is wise. It means that behind what they say is wisdom, and we will listen for it.)
- We need everyone's wisdom for the wisest result. (In the same way that a diamond is more valuable when it is cut with more facets, what we come up with will be more valuable when we have illuminated more facets of what we are working with.)

- There are no wrong answers. (See number 1–behind what may seem on the surface as a wrong answer – and I have heard some that were positively evil on the surface–there is wisdom, and that is what we will listen for. The corollary, of course, is that there are no right answers, only the best we can come up with given our limitations.)

- The whole is greater than the sum of its parts. (Trite, yes, but points to consensus as creating a larger answer that is not identical to any one view but includes the wisdom of many. Diamond image again. I think of compromise as smaller than the sum of its parts, consensus as larger. Like a puzzle picture, which is the sum of the puzzle pieces and their relationships. All puzzle pieces are included, or there is a hole.)

- Everyone will hear others and be heard. (This doesn't mean that everyone has to talk all the time–then nobody would be heard. It means listening to others as well as making sure your wisdom is on the table.)

If the Information Phase includes a visit to a project site or an office or manufacturing floor where the process under study is performed, keep the group together so everyone can hear what the host/guide explains, and everyone can hear questions and answers. It is important to manage time wisely during the site visit, which can be challenging when subject matter experts wander off in search of areas or conversations specific to their discipline.

Finally, explain to the group that the Information Phase never truly stops during a VM study. The formal part of it concludes on the first day of the workshop. As you continue facilitating the VM Job Plan, the team will continue to uncover additional information, whether that comes from identifying functions, questioning creative ideas, or delving into the details of a VM proposal.

12.7 Facilitation of Function Analysis Phase techniques

Function analysis is the very heart of the Value Methodology. It is the unique tool that differentiates the Value Methodology from all other improvement processes. It is the very thought process that inspired the development of the VM Job Plan. And, it is the most challenging part of the VM process for practitioners to learn and master. Once mastered, it opens a whole new world of opportunity for more open creativity, less opinionated/more objective judgment, and, above all, clearer communication.

Chapter 6 goes into detail about how to perform function analysis and FAST diagramming. That chapter focuses on how to facilitate those activities. So … you've learned how to perform function analysis. And you've constructed a few Function Analysis System Technique (FAST) diagrams. You might even be a Certified Value Specialist or on your way to achieving that goal. Now, you're about to lead a VM study with a team of subject matter experts who've never had any VM training or experience. How do you facilitate them through the function analysis portion of the VM Job Plan?

12.7.1 Working with people unfamiliar with function analysis

Some of the biggest challenges to getting "novices" to understand the function analysis process include:

- Getting them to think abstractly; i.e., overcoming their specialized, "technical" familiarity with the product, project, process, service, or organization under study.

- Helping them to understand how to express "active verbs" and "measurable nouns."

- Distinguishing clearly the difference between functions and activities.

Multiple methods can help a team identify the functions of whatever project, product, process, service, or organization is under study. The first challenge is helping them to understand how to express functions. You can provide them with a list of examples of active verbs, measurable nouns, and non-measurable nouns.

You can show them a FAST diagram from a prior project and talk through the logic to demonstrate how the functions interrelate. If you choose to do this, use a FAST diagram from a project completely different type than what you're working on to minimize any temptation to "adopt" functions from the example diagram.

You can ask questions about the function(s) of different things around the meeting room (a chair, a projector) or completely unrelated objects (a tire jack, for example) to get the conversation moving to a function-based dialogue.

Next, you want the team to generate functions applicable to the project at hand. Begin by having the team randomly identify functions (similar to a brainstorming session), writing each on a Post-It® note, put them on a flip chart in no particular order, and kept for later use. You may also list the functions into a form (displayed electronically or, perhaps, drawn on a flip chart) for later use in classifying the functions; but, the functions should still be put on Post-It® notes at the same time.

A team should identify functions, classify them, then–if time permits–develop a FAST diagram. Having the team arrange the random functions into a FAST diagram helps to accomplish and/or refine the "classify" activity. As they work through and reach consensus on the function logic, the classification of functions naturally occurs.

12.7.2 Facilitating development of a FAST diagram

Developing a Function Analysis System Technique (FAST) diagram can be challenging for the most experienced of VM facilitators. The subtle nuances of a particular project, the client's terminology, and the potential language barriers among participants in a VM study all combine to make the logic flow of a FAST diagram somewhat difficult to define.

One approach to coaching a novice team through developing a FAST diagram is:

1. Put a flip chart page (or two together) on the wall.
2. Draw the HOW, WHY, and WHEN descriptors and the left scope line.
3. Label the spaces where the higher-order and basic functions are placed.
4. Label the space where subject objectives, all-the-time functions, and one-time functions are to be placed.
5. Place the flip chart containing the randomly generated functions (on Post-It® notes) next to the blank pages on the wall.
6. If you did not previously show an example of a FAST diagram, do so now and walk the team through the logic of the diagram to help them understand its construction.
7. Have all members of the team stand next to the flip chart pages and Post-It® notes with functions written on them and coach them––don't do it for them!––through developing their FAST diagram.
    a. Have them start with identifying the basic function(s) first, then working their way to the right asking the HOW questions.
    b. Once they have some portion of the diagram working logically to answer HOW, have them work from right to left by asking the WHY questions to test and verify their logic.
    c. Remind the team that the further to the right they progress, the lower the level of abstraction the functions become. They may even be moving into activities and/or design details (i.e., "getting into the weeds"). The function diagram is intended to represent a high level of abstraction, metaphorically speaking, a "30,000-foot-level" representation of the project scope.
    d. Listen carefully for words like "before" and "after" and "next," and constantly remind the team this is not a flowchart; there is no "before" and "after," only "how" and "why." Similarly, be sure team members do not confuse function logic with project delivery logic, particularly for capital or manufacturing projects. Ultimately the FAST answers "what must it do" and "how does it do it." The HOW question may lead participants down the path of discussing the sequence of steps to build the project instead of how the project meets the higher-order functions.
    e. Watch for placement of functions that belong in the category of "same time as" or "caused by"––this tricky area takes coaching for novices to understand.
    f. Watch for "and/or" connection possibilities––another, sometimes confusing area for new folks.
    g. Make sure all team members are engaged and participating.
    h. Emphasize that not all the functions that were randomly generated will necessarily be used in the function diagram. (There may be redundant functions, for example, where only one should be used. There are functions that are actually activities as opposed to functions). Note: Teams will attempt to force fit all their randomly generated functions. This wastes time, and you, the VM facilitator, should step in and coach.
    i. When the logic quits working, remind the team that a function may be missing, or one or more functions are in use that shouldn't be (either don't apply or are in the wrong place).
    j. Have the team test the logic of their completed FAST diagram in both the HOW and WHY directions.
8. Once the team is satisfied with the FAST diagram, draw the connector lines.

If the team gets stuck––debating placement of functions or meanings of functions (words mean different things to different people)––step in and help them clarify their intent by asking questions. Try rearranging the functions and talking team members through the logic to get to the bottom of their issue and remove the roadblock.

Facilitate–don't manipulate! It's especially important that the FAST diagram represent the VM team's consensus, not the VM facilitator's or the client's perspective or opinion. The team needs to feel ownership of the product they created.

Once function analysis is complete, whether or not a FAST diagram is constructed, the team should allocate resources (cost, time, space, as applicable) to the functions to better determine where value opportunities exist. Refer to Chapter 6.

12.8 Facilitation of Creative Phase techniques

During the Creative Phase (see Chapter 7), it is important to continue with and build on the participatory environment you created. Various techniques can draw out creative ideas and reaping the benefit of all the participants in the room is crucial. This is when some participants may be reluctant to speak out, because they're shy by nature, they fear being criticized, or they don't want to potentially contradict a boss, colleague, or client representative. Sometimes cultural reasons explain

why individuals won't contribute, for example, reticence out of deference to someone else in the room. It is the VM facilitator's role to evoke the group's creativity, and there are multiple ways to do so:

- Encourage creative thinking, perhaps by giving the participants an example of a truly creative idea that came out of a VM study on past project.
- Accept all ideas, bearing in mind that even if an idea is obviously not possible, it may trigger a really good idea in someone else's mind (piggy-back effect).
- Suggest visualization to stimulate ideas: "Imagine the last time you ..." followed by "What did you wish could have happened or been done differently?"
- Leverage past successes and challenges: "What lessons learned inform how we might approach this?"
- Open up possibilities. Ask the group, "If you, individually, could do anything at all to this project, without constraints, what would that be?"

Take care to record every idea, whether on flip charts or electronically, exactly as it stated by the participant. If the thought isn't clear, obtain clarification before writing it down. Do not assume you know what the participant means or intends.

Make sure each idea is one complete, coherent thought, remembering that people who were not in the room will read this list later and must be able to understand the concept as a standalone idea.

Reading body language during the Creative Phase becomes somewhat challenging if you're writing on a flip chart, which puts your back to the room, or typing into a computer, which takes your eyes off the room. Make sure you don't lose the connection you've worked hard to establish with the participants, because it will help them be more comfortable about offering ideas and will keep you more comfortable about interacting with each one of them.

12.9 Facilitation of Evaluation Phase techniques

One of the IAF's core competencies is "guide the group to appropriate and useful outcomes." While this competency might be interpreted to mean "use the VM Job Plan to guide the group," it seems to have a more specific application to the facilitation of the Evaluation Phase. The goal of the Evaluation Phase (described in detail in Chapter 8) is to pare down the list of creative ideas and select those concepts that appear feasible for development into specific VM proposals.

Following are some tips for how to keep the conversations focused on evaluation of ideas:

- Establish clear context for the session. Describe the process(es) to be used, the time allotted, and the ultimate outcomes expected.
- Consider applying different evaluation techniques, depending on the number of ideas generated in the Creative Phase, the nature of the VM study subject, and the VM study team's dynamics
- Actively listen, question, and summarize to elicit the sense of the group. Don't accept only one person's evaluation of an idea.
- Recognize tangents (e.g., discussion of development details) and redirect to the task.
- Vary the pace of activities according to the needs of the group. Recognize that different ideas require more or less time.
- Identify information the group needs and draw out data and insight from the group. This may include questions directed to the client, designer, user, or other stakeholder(s) that must be answered before a true judgment may be made.
- Help the group synthesize patterns, trends, root causes, and frameworks for action.
- Use a variety of approaches to achieve consensus.
- Adapt processes to changing situations and needs of the group.
- Assess and communicate group progress.
- Foster task completion.

Before proceeding to the Development Phase, the VM facilitator should have a "short list" of concepts to be developed into VM proposals, and the participants should be comfortable with the concepts on that list.

12.10 Facilitation of Development Phase techniques

Once again, begin by establishing clear context for the session. Describe the process(es) to be used, the time allotted, and the ultimate outcomes expected. As the team works through

developing their value improving proposals, make yourself available to:

- Answer questions.
- Perform research on their behalf.
- Review and guide how they complete their forms, watching for consistency in how information is presented and for clarity of concept.

As the facilitator, it is not your role to write up the VM proposals. You are responsible for coaching and guiding the team members. Make sure to gauge how the team is progressing, reminding them as appropriate of targeted completion times.

Once the Development Phase (see Chapter 9) is complete, work with the group to either:

- Have them review and comment on each other's work, or
- Project each VM proposal on screen and conduct a group review and editing process.

Remember, the developed VM proposals should represent team consensus.

12.11 Facilitation of Presentation Phase techniques

More specific guidance related to the Presentation Phase is contained in Chapter 10. A VM study typically concludes with a presentation of the VM study results, or highlights thereof, to the study sponsor(s), client(s), and stakeholders. The presentation may take a variety of forms. Facilitation of this phase requires:

- Identification of information to be presented.
- Assignment(s) to various individuals as to who will present what.
- Clear definition of expectations, such as:
    - Purpose of the meeting,
    - How long everyone has to speak,
    - What will happen if audience discussion digresses to the topic of implementation issues, and
    - How long the overall meeting will last.

Limiting team members' presentations to their allotted times sometimes poses a challenge, even though that was discussed during preparation. Be prepared to signal and/or gently interrupt the presentation or associated discussion to keep the meeting on track.

Always be ready to deal with surprises, especially now that the team, sponsor/client, and stakeholders have some familiarity with one another. Clarify misunderstandings of process and raise participants' comfort level. Modify terminology, if needed; for example, "alternative" may not be appropriate in some environments, so consider using "proposal" or "VM concept."

Keep the presentation focused on the informational aspect of its nature; i.e., remind participants that this is not a meeting during which to make decisions. Consider framing the presentation as a "preview" of what will follow in the VM study report.

12.12 Facilitation of Implementation Phase techniques

More specific guidance related to the Implementation Phase is contained in Chapter 11. In many cases, the VM study team and facilitator are not involved in implementation activities. When they are, it is usually in the form of facilitating a meeting for the purpose of documenting decisions (accept, partially accept, accept modified, reject, or further study) related to the VM proposals that were generated by the VM study team. This meeting may occur in person with only a few of the VM study team members. Select participants from the VM study based on the major proposals put forth by the VM study team and/or the feedback received from the client and decision makers. In other cases, the meeting may happen via telephone or web conference. Regardless, it helps if the VM facilitator includes a description of what's expected from the owner(s), stakeholder(s), study sponsor(s), etc.––the decision makers––in a letter accompanying the VM study report. Detailed descriptions as to what kinds of responses the decision makers are supposed to deliver go a long way toward improving the flow and outcome of the Implementation Meeting and bringing closure to the VM study.

Because some of those on the decision-making side may not have read the details of all the VM proposals and may attempt to make their decisions based solely on proposal titles, the presence of the VM study team members' presence serves a purpose. It is up to the VM facilitator and appropriate team members to re-educate the owners/designers/stakeholders about the ideas. This may include a facilitated discussion among various stakeholders to help them come to consensus.

The VM facilitator documents decisions, he or she does not participate in the execution thereof. Including details of how implementation may occur is helpful as well. For example, in a manufacturing scenario or an in-house business process improvement study, a clear implementation plan with assigned tasks and schedules might be completed at the implementation meeting.

Finally, based on client/customer preferences, a modified VM study report (or an addendum to the original report) may be produced to reflect the outcomes of the implementation meeting.

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13
VM Programs

13.0 Introduction

Within an organization, a Value Methodology (VM) program involves the establishment and maintenance of processes and procedures; planning and execution of VM studies and related VM activities; records management; education and training; advocacy; continuous improvement; and reporting. The VM program also monitors and tracks the "lessons learned" of each VM study, each VM proposal, and each VM study team. The VM program manager drafts, implements, and maintains the policies, procedures, and standards for the value program. This chapter provides an overview and recommended elements to maintain an effective VM program.

13.1 Terms and definitions

13.1.1 Value engineering change proposal (VECP)

A change submitted by a contractor, pursuant to a contract provision, to improve the value of the project or product under contract. VECPs are a vehicle to incentivize contractor innovation and are commonly used in public sector contracts.

13.1.2 VM program

A program within an organization that manages, implements, tracks, educates, trains, and advocates for the Value Methodology within the organization.

13.1.3 VM program manager

The individual responsible for directing, leading, and managing an organization's VM program.

13.2 VM program elements

The components to a VM program. These are described and defined in this section. The most successful VM programs use most, if not all, these aspects. However, even programs that only use a few aspects can be effective and advantageous to the organization. This section outlines the major program elements that must be considered.

13.2.1 VM program manager

VM programs normally have at least one person designated as the VM program manager. Sometimes this is a dedicated position, but it can also be accomplished as part of another role. For example, a quality manager, cost manager, plant manager, product manager, etc., might all be VM program managers as part of their described roles and responsibilities. The VM program manager is responsible for ensuring that all VM studies are properly performed, tracked, evaluated, implemented, and monitored. The VM program manager creates and implements organizational policy, standard operating procedures, and processes related to the VM program. This person answers the following questions:

- What type of project, product, system, or process is required to have a VM study?
- What type of VM study team is required? (In-house or consultant? Types of team members? Full week, or other duration?)
- What materials are required for the VM study? Where are the materials?
- Where will the VM study take place?
- When will the VM study take place?
- Who in the project, process, product, etc., management team will attend the VM study, and when will they be required?
- How will the results of the VM study be reviewed/implemented?
- What are the VM study results and how well did the study meet organizational goals?
- What are the results of the VM program as a whole – is it successful, does it meet the organizational goals? Where are the issues related to the VM program, and who can help resolve these issues?

Key attributes required for the VM program manager are:

- An ability to foster and encourage innovative thinking.
- Respect within the organization as being fair, technically competent, and a strong team player, and leader.
- A strong ability to influence and communicate effectively.
- The ability to see the organizational big picture without getting lost in the weeds of an issue or specific subject details.
- Knowledge of where to go in the organization to find information or answers to questions.

The VM program manager faces many challenges, which include:

- Reluctant managers who see the VM study as an impediment to doing their jobs.
- Fear among the "owners" of the subject of the VM study, who believe that the VM study team and/or VM process is designed to make them look bad or as not performing their jobs correctly.
- Management who do not understand how the VM program can assist or improve a study subject.
- Lack of organizational support for the program.
- Resistance to change, on many if not all levels within the organization.
- "Competition" with VM from other value improving programs, methods, and techniques (e.g., Lean, 6-Sigma, TRIZ, etc.).

Regardless of sector, some key strategies, if implemented, can make a VM program manager extremely successful. These strategies include:

- A strong VM program champion or sponsor at the highest levels of the organization. Sometimes, this must be "grown" by educating a likely champion on what the program can be and what can be accomplished. Some successful VM program managers use an invitation to speak about the value program at a conference or seminar to educate senior level manages about the program.
- Using every opportunity (including, staff meetings, internal company newsletters, correspondence with senior and subordinate peers, awards, etc.) to promote the value program and highlight the benefits and great results.
- Communicating the benefits of the VM program and articulating how they achieve the goals and objectives of the organization.
- Incorporating the use and results of a VM program as an expectation to achieve the organization's key performance indicators (KPIs).
- Using the VM program to complement other processes, like continuous improvement, Lean, product and process development, etc.

13.2.2 Policies, standards, and procedures

Every VM program should have some formally written mission, goals, standard operating procedures, guidelines, or description of what and how the VM program will be performed in the organization. Organizational policies can be as simple as a single sentence directing VM to be used as part of its standard operating procedures to detailed and extensive sets of standards and procedures. The VM program manager should be review and update them a periodic basis.

The VM policy should identify:

- Rationale for initiating the VM program;
- Goals and objectives of the VM program;
- Organizational position and funding sources for the VM program;
- Authority and reporting structure related to the VM program; and,
- VM program manager and contact information.

Professional VM standards should be clearly established. SAVE International® strongly recommends that this VM Guide® be identified as the standard for all organizations. This sets the bar for accepted standards of practice and identifies effective practices and techniques. Standard operating procedures should be identified for the VM program and consider:

- A process for identifying subjects for VM studies (see Section 13.4.1).
- A process for identifying appropriate timing for VM studies (see Section 13.4.2).
- VM study coordination procedures.
- VM study subject information requirements and collection procedures.
- VM study communications procedures.
- VM study performance procedures.
- VM study reporting procedures.
- VM proposal implementation procedures.
- VM study auditing and performance reporting procedures.
- VM program continuous improvement efforts.

13.2.3 VM program champion

The VM program champion is a senior level manager near the top of the organizational hierarchy who supports, sponsors, and actively engages with the VM program manager and ensures that there is organizational support for the VM program. The champion may support the VM program through one or more of the following actions:

- Encouraging value-focused innovation and the use of VM in problem-solving.
- Actively engaging in the VM program (e.g., attends presentations related to VM studies).
- Making the VM program a priority and insisting that it is used.
- Arbitrating and generally supporting the VM program manager if there are any in-house disagreements over the need for the VM program or a study.
- Providing and/or advocating for the resources needed for the VM program.
- Assisting in marketing the need for the VM program.
- Promoting the benefits of VM in achieving the organization's goals and supporting KPIs.
- Recognizing the VM study team's accomplishments and that of the VM program.

13.2.4 VM program information tracking and key performance indicators

Every VM study should be tracked to determine the effectiveness (or lack thereof) of the VM study. Key performance indicators (KPIs) measure the benefits of the VM program and aid in showing why the VM program is beneficial for the organization.

KPIs can track the performance of VM study facilitators, VM study teams, and contractors or in-house performers of the VM studies. This helps the VM program manager determine if any changes to the program are needed. For example, if one particular VM study team or facilitator fails to achieve acceptable results in their studies, then the VM program manager can see this via the metrics and determine if the team should be used in future studies or if maybe there are internal issues that need to be resolved before any future studies.

The list below includes some of the information and KPIs that can be tracked to help achieve a successful VM program. This is not a complete list. Each VM program manager should add to or subtract from this list to reflect the critical metrics of their organization and the items contained in their specific VM program studies.

- Summary information for each VM study performed vby the organization
  - Identifiers of VM study subject:
    - Subject identifier number
    - Location of the subject
    - Title of subject
  - General identification for future sorting information on the subject
    - Name of the manager in charge of the subject
    - Subject type: project, product, process, service, or organization
    - Names and contact information of key personnel related to the subject
    - Identification of delivery or contracting methods (if applicable)
  - Information on the cost of the subject
    - Budget
    - Estimated costs (broken down as appropriate to the subject)
  - Information on when the VM study is performed
    - The stage of the subject within its life cycle
    - Other schedule information (previous or subsequent activities or milestones)
  - Information on the VM study
    - Facilitation of VM study (in-house or external)
    - VM study team (in-house or external)
    - VM study team participants
    - VM study budget
    - Duration of VM study
    - Name and contact information of VM study facilitator
    - Anticipated VM study costs
    - Anticipated internal organization support costs
    - Total VM study costs
    - Date of VM study
  - Results of the VM study
    - Number of creative ideas
    - Number of VM proposals
    - Proposed VM proposal KPIs (could be any or all of these)
- Proposed initial cost savings
- Proposed life-cycle cost savings
- Total proposed savings
- Proposed time/schedule savings
- Proposed performance or quality benefits
- Proposed risk reduction
  - VM proposal implementation information
    - Names and contact information of individuals responsible for the implementation of accepted VM proposals
    - Number of accepted VM proposals
    - Accepted VM proposal KPIs (same as proposed)
    - Rationale for rejection of VM proposals
    - Implementation schedule
    - Implementation status
    - Implementation costs
    - Final validation of KPIs.

13.2.5 Qualified VM facilitator and team members

One of the most critical aspects of managing a successful VM program is determining who should be on the VM study team and who will lead the team. A Certified Value Specialist® can lead any VM study and get good results. That said, it is up to the VM program manager to make the study successful by selecting the right VM facilitator (i.e., CVS) along with the right team.

If team members or the organization's senior managers perceive the selected VM facilitator to not have the appropriate background or to not have a clear, basic understanding of the subject being studied, then the facilitator will have an extremely difficult time convincing them that the results of the study are worth listening to or considering. Diversity or a variety of opinions is critical to the success of the VM study.

A key question to ask when considering the participants on a VM study is: Should in-house resources be used? Should outside subject matter experts be hired to conduct the VM study? Would a mix of in-house and outside resources be a better option? Regardless of who participates in the VM study, it is important to avoid potential conflicts of interest.

Using in-house resources is critical, particularly in manufacturing or production applications–especially since the organization will not want to lose a competitive advantage. Also when a VM study is used to find a different (innovative) solution, in-house resources can be especially effective in creating support in public organizations. In these cases, the VM program manager should determine if the existing internal product team can work through the VM study, or if an internal team not assigned to the product should perform the study. This is not an all-or-nothing scenario: many effective VM studies are performed by a mix of internal team members with a few outside the product team experts to "challenge" the status quo.

13.3 VM program development

13.3.1 Location within the organization

The placement of the VM program within an organization requires careful consideration. VM, by its nature, precipitates change. The cultures of all organizations, to some degree, resist change. Therefore, if a VM program is to be successful in its goal of improving value, then it must be positioned within the organization in such a manner that it succeeds in ensuring effective implementation of the necessary changes.

Locating a VM program within an organization requires consideration of the following factors:

- Avoid "departmentalization." The VM program should not be pigeon-holed as being "owned" by any function or department. For example, if a VM program is located within a manufacturing company's "engineering" department, then other departments will likely view it as an engineering endeavor. Because value is holistic, care must be taken to avoid creating the perception of VM as the tool or service of a specific entity within the organization. That undesired perception engenders mistrust by other facets of the organization and creates internal roadblocks to implementation.
- Establish clear lines of accountability and authority. As a catalyst for change, care must be given to establishing lines of authority between the VM program and upper management. Recommended changes that emanate from a VM program will require direct support from upper management who have the authority to make decisions related to implementation and the expenditure of organizational resources to see them through. Decision makers should be held accountable for decisions to accept or reject recommendations. This transparency is important in building trust within the organization.
- Seek a location that supports customers and stakeholder interests. VM programs are better positioned for success when they align with customer and stakeholder interests. After all, VM should be focused on the voice of the customer; therefore, isolation is dangerous.

13.3.2 Integration with other programs

Consideration should be given relative to how a VM program should interface with other value enhancing methods and related programs. VM shares many characteristics of other value enhancing methods and can work quite well with such programs. For example:

- Some organizations locate their VM program at a higher, executive level in conjunction with other strategic management activities.
- Public agencies that deliver capital projects often locate VM with related activities such as risk analysis, constructability review, and project controls. These activities and programs are generally concerned with managing quality, schedule, cost, and risk; and, all tie nicely into the VM concept. Many organizations use VM as a project control activity and embed these types of activities into VM studies.
- Private sector organizations sometimes co-locate VM with internal entities that perform other improvement processes, such as Lean, Six-Sigma, and quality practices.

13.3.3 Authority and reporting structures

Levels of authority relative to the VM program need to be clearly established to reduce the potential for internal resistance to change. Typically, the following levels of authority should be defined:

- VM study planning authority. Define how VM studies are planned and programmed within the organization for the fiscal year. This should include how the VM studies will be funded by the organization.
- VM study initiation authority. Define who within the organization can initiate a VM study. The decision to conduct a study requires the expenditure of staff time

and resources. Consider how personnel are assigned to studies and how their time is accounted for.

- VM proposal decision authority. Define who has the decision-making authority to approve or reject VM proposals emanating from VM study efforts. Consider how the costs to implement changes are accounted for and how they are funded.
- In addition to determining levels of authority, the VM program should also clearly define how VM study efforts are reported and to what level. The level of documentation required is important, and the VM program should coordinate with the various internal stakeholders on what information is needed to support the decision-making process. This includes documentation of Preparation Phase activities; VM study reports; VM proposal implementation activities; and tracking and monitoring VM proposal implementation.

13.3.4 Organizational awareness and training

Building organizational awareness relative to a VM program requires effort and is essential to its long-term success. The presence and purpose of a VM program should be clearly communicated throughout the organization. The organization's decision to make an investment in VM provides a significant opportunity for the entire organization to both participate in and benefit from it. Several activities are recommended along these lines:

- Upper management should champion the creation and continued advocacy of the program and communicate it throughout the organization. The organization should understand the purpose and objectives of the program, an overview of how it functions, and what it means for its employees and customers.
- VM program activities and performance should be regularly communicated. This can be through newsletters, emails, blogs, or other internal and external communications.
- Share applications and experiences by supporting related communities of practice to advocate the use of VM.
- Awards and recognition should be considered to acknowledge outstanding efforts and achievements made through the VM program to encourage continued success.
- Innovation emanating from a VM program should be communicated to customers and stakeholders. This is an excellent opportunity to market value being added through VM.

Training and education are another key consideration. The following information outlines the level of training and education that should be considered for people within the organization.

- All personnel. Consideration should be given to developing a brief overview of the VM program, including information on the process, goals and objectives, key personnel, and anticipated levels of employee participation. This general training could be delivered in a variety of formats, including presentations, videos, webinars, or other such methods. Consideration should be given to introducing new employees to innovative practices and thinking through VM training.
- VM study subject sponsor. Those who intend to serve as the champions of the VM program should be provided with an executive overview of VM, the structure of the VM program, organizational roles and responsibilities, and their roles in communicating the importance of the VM program. Further, upper management should be asked to commit to time for key activities, specifically related to establishing policy and removing organizational roadblocks.
- VM study team members. Individuals within the organization who may be involved as team members on a VM study should receive some basic training relative to the VM Job plan and major supporting techniques. This training could be in the form of a Value Methodology Fundamentals course accredited by SAVE International®.
- VM study subject managers (management). Those responsible for managing the projects, products, processes, organizations, or services that will be subjected to a VM study should be provided specialized training to help them better understand the Value Methodology and their roles and responsibilities, and to communicate the potential benefits that can be derived from VM studies. Education helps reduce the potential for resistance to change and remove uncertainty and fear related to the changes emanating from VM.
- VM program managers. Those involved in managing the VM program should complete both Value Methodology Fundamentals courses and supplement them with active participation in professional value societies such as SAVE International®. One of the best forms of education is networking with VM program managers in other organizations to discuss issues, challenges, and effective management strategies with their colleagues.

13.4 VM program management

13.4.1 Selecting subjects for VM studies

Identifying the right subject or parts of a subject (if it is of substantial size, cost, or complexity) is the first challenge in preparing for a VM study. In most cases, the need for a VM study on a specific project will be obvious.

In large organizations where there are either limited funds to conduct VM studies or simply too many potential projects

to choose from, it may be necessary to select projects that will offer the greatest return on investment.

In the situations described above, a program to stimulate the generation of items for VM studies is essential, particularly during the early stages of a VM program. As personnel become more familiar with VM and its benefits, generation of good study areas becomes automatic, making formal methods of generation less essential.

The following techniques may be used:

- Thresholds. Many organizations adopt a simple threshold, usually based on cost, to determine which subjects are selected for VM studies. This is particularly common within public agencies. For example, an agency could state that any project over $10 million in estimated costs requires a VM study be performed on it.

- Cost models. Cost data is an excellent source of information available to most organizations. This can take the form of historical or parametric cost data on past construction projects, bills of materials for product lines, or resource reports for business processes. Summaries of such cost data are frequently available and often continuously updated, based on information obtained on an organization-wide reporting system. Cost data gleaned from this information can be organized in the form of cost models. When applied to a meaningful population of comparative costs, a cost model can enable management to identify the high cost areas within a project. These areas may be earmarked for VM study.

- Publicizing the need. The VM program manager should explain to the organization what types of studies are wanted and the criteria used for selection. An invitation to all personnel to submit suggested projects and items to the VM program manager usually provides strong results.

- Quotas and project generation teams. Periodically issuing instructions to internal departments or divisions within the organization to submit a given number of projects for study by a specific date can result in a healthy number of items. Appointing a team of roughly four people to brainstorm an assigned design for high VM study potential usually results in numerous worthwhile projects for study.

- Standing VM committee. A committee of top personnel who meets periodically to select items or areas for study is likely to produce a good list of candidate studies. Studies originating from these sources have a better than average chance of implementation because they will have been selected by the individuals who are also the decision makers.

- Design-to-cost targeting. A cost model that establishes cost targets for each element of a project readily shows which elements exceed the budget. This information can be determined at any stage of design and serve as a warning to the VM program manager to concentrate effort on those elements.

- Pareto analysis. As described earlier in this Guide, Pareto analysis can be applied to an organization's portfolio. Projects, programs and other initiatives that possess 80 percent of the total portfolio value may be attractive subjects for VM studies.

- Spatial cost analysis. This method assumes that area or volumetric costs (e.g., square feet, cubic meters) are a direct index of design efficiency. This method is particularly useful in construction applications. A design having a high cost per square foot is assumed to be less efficient than one with a lower unit cost. The assumption is not necessarily true. For example, a poorly designed building with an excessive amount of wasted space may spread the cost of expensive items (e.g, plumbing fixtures, kitchens, mechanical, and electrical spaces) over a larger area, thereby lowering the per-square-foot cost. On the other hand, in an efficiently planned building with a minimum of wasted space, the cost per square foot will be higher, although the overall cost of the building will be less. Similarly, the enclosure method of estimating compares the cost per square foot of the original design with unit costs of alternatives based on total surfaces enclosed. "Enclosure," as used here, means any surfaces such as floors, walls, partitions, roof systems, columns, piers, stairs, railings, and similar items. Thus, the cost of the alternative design, which has, let us say, 25 percent less surface area in the form of fewer partitions and so on, would be assumed to cost 25 percent less. This method can be used to quickly determine the probable cost of alternatives early in the VM process.

- FAST diagrams. As discussed earlier in this Guide, FAST diagrams provide a graphic portrayal of the interrelationship of the functions of any project. On massively scaled projects, such as a mass transit system or a complex manufactured item such as a vehicle, FAST diagrams are useful for revealing key functional areas on which VM studies can focus. They permit the analyst to see where simplifications can be achieved. The process for using FAST diagrams to aid in identifying candidates for value analysis is covered in detail in Chapter 6 – Function Analysis Phase.

- Some U.S. federal and state regulatory agencies require VM regardless of project cost.

Each system and subsystem must be examined to identify high-cost elements which then become prime candidates for study. For each such item, the following questions provide further guidance:

- Is the item expensive?
- Is it complex?
- Is it a high-volume item? Can a simple change in one item produce large savings within the total project?
- Does it use critical materials?
- Is it a long-lead item?
- Is it difficult to construct or does it require specialized skills to create?
- Does it have high maintenance and/or operations costs?
- Does it use obsolete materials and methods?
- Are costs simply "out of line?"
- Was the design rushed?
- Is there a high degree of risk or uncertainty related to performance, cost, or time?
- Would the consequences of failure be catastrophic?
- Does it suffer from performance problems?
- Is it a state-of-the-art component with a low level of proven acceptance?
- Are life-cycle costs unacceptable?
- Does it contain redundant features?
- Does it create an unwanted function of high future cost?
- Does it use traditional design?
- Is the competition producing the item at a lower cost?
- Does top management want improvement?

13.4.2 Timing of VM studies

It is often the responsibility of the VM program manager to ensure that VM studies are performed at the right times. This requires awareness of the benefits that can be achieved through the VM process and the necessity to incorporate them at optimal times. For example, oftentimes projects are too far along in their development when a VM study is performed. A VM study performed for a project that is 95 percent designed, and nearly ready for construction will not fully realize the benefits of VM had the VM study been performed at the 10 – 15% design level. This failure results when organizations do not have a VM program manager or face one-off projects. It is the VM program manager's responsibility to ensure that all projects are considered for a share of the available VM effort.

When should VM be applied to a project? Theoretically, VM can be applied at any time during a subject's life cycle, from conception to completion and eventual replacement. More practically, VM should be applied at specific phases of a subject's development in order to achieve maximum results. The discussion below applies broadly to projects, products, processes, services, and organizations; however, it is most relevant for projects.

Some VM studies are intended to help the organization in a different way. Sometimes, a VM study does not have the objective to change the design or reduce cost, but may be used to explain or validate the design to a new team of stakeholders that has not yet been involved in the project or development of the subject. In this case, the Creativity Phase may be used to find small improvements but not big changes in design. If the main purpose of a study is to have people engaged and connected to the subject, timing is important, too: too early and people can't yet fully work on the project; too late and complaints about the design are so many that the VM study turns into a negative atmosphere of endeavor.

13.4.2.1 Planning phase

The first application of the VM effort should be made during the subject's planning or inception phase. This is the point in the subject's life cycle where maximum flexibility exists to make changes without incurring undue expenses for redesign. For projects, as development progresses, the cost to make changes increases until a point-of-no-return is reached and the cost of redesigning, reordering, and rescheduling overwhelm the potential benefits. This is shown in Figure 13.1. Early in the concept phase, a budgetary estimate is produced, which defines goals, requirements, and applicable criteria. The project's owner establishes most of this input and makes it available to the project development team. The project team, in turn, establishes broad objectives and a cost framework, which become the budgetary estimate.

Studies show that the project team has, by far, the largest impact on the total life-cycle cost of a project. The owner, too, has a significant impact on costs by establishing requirements which become the basis for the project development team's efforts. Between them, the owner and the project team establish roughly 70 percent of the total life-cycle cost of the project by the end of the project planning stage. The automotive industry uses the picture in Figure 13.2 to describe how traditional costing accounts for design effort at about 5 percent of the total cost, but the impact of design accounts for about 70 percent or more of the product cost. That is, typically, 70 percent of costs are committed by the time the design is "frozen." So, the earlier in the design cycle VM is used, the greater the opportunity to reduce or avoid costs. Thus, it is apparent that a VM analysis made during the planning stage has a tremendous potential for improving value.

At this stage, the VM effort can help the owner establish their true requirements. This requires a complete understanding of the basic function to be performed by the project. Dialogue between the VM facilitator, the VM study sponsor, the financer, main organization, and the subject team must be systematic and thorough. When applying VM, take nothing for granted, question everything, and insist on the justification of all requirements. The project team should welcome this process, as it helps them understand the owner's and user's true requirements and minimizes ambiguity.

13.4.2.2 Design phases

As subject development advances from the planning stages to the final development stages, the VM effort should keep pace. Preferably, the VM facilitator should accompany each project milestone in order to provide continuous guidance to the project team and ensure

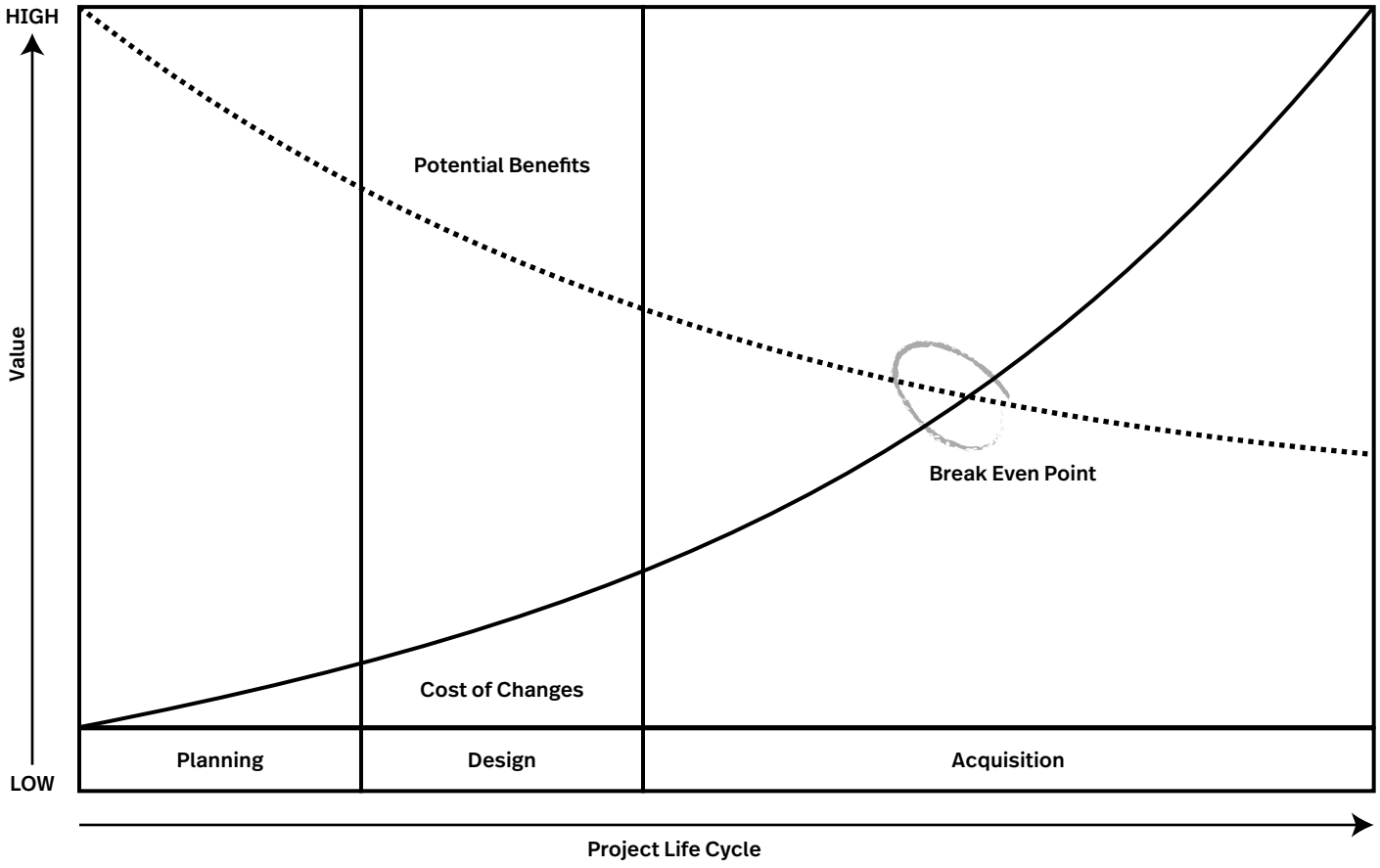

Figure 13.1 – Potential for cost savings over project life cycle.

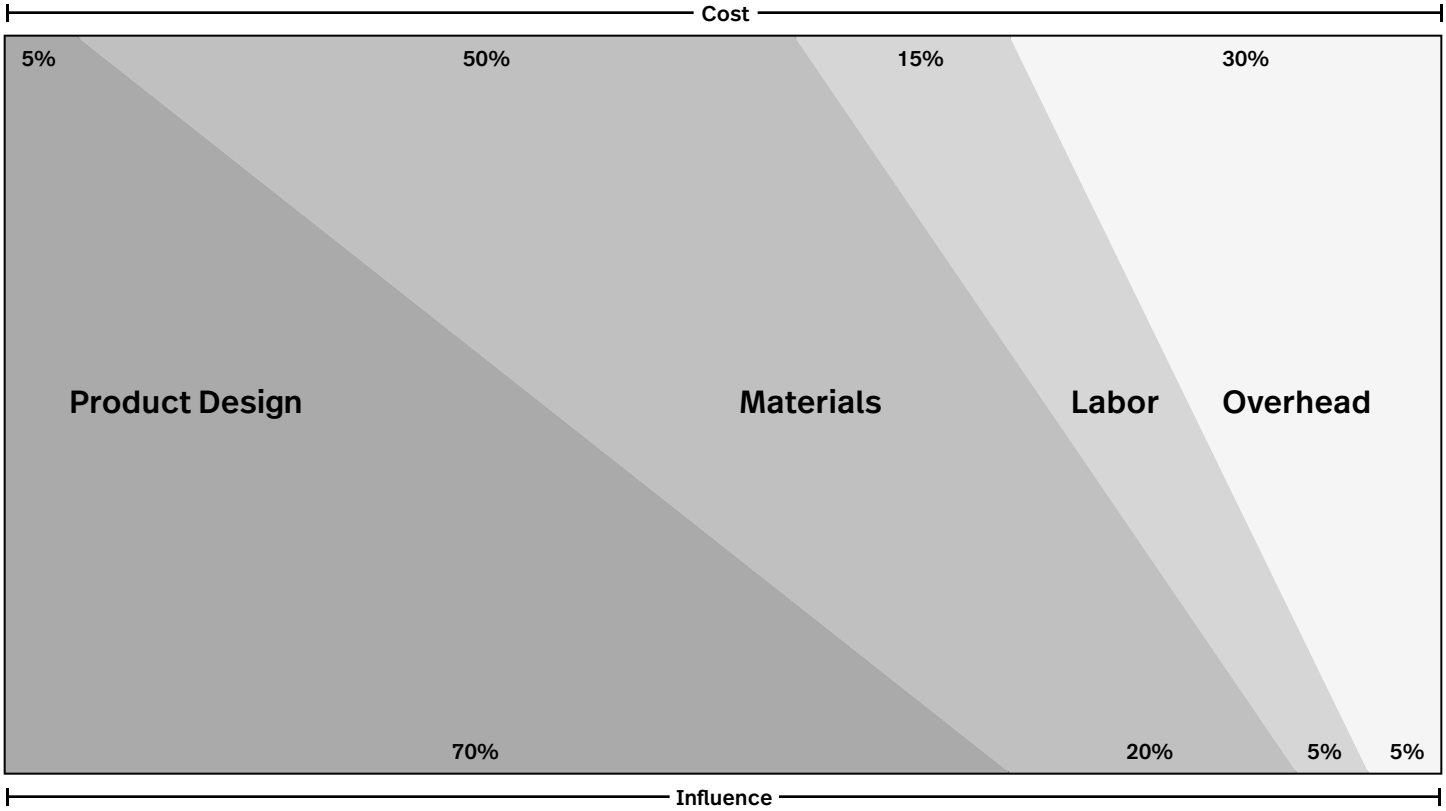

Figure 13.2 – Comparing the design team's influence versus traditional accounting

that value judgments are brought to the attention of the owner for decision. At a minimum, VM studies should be performed early in the design stages and accompany the preliminary milestones. At this point, development decisions have been made that permit a reasonable degree of exactitude in determining initial costs. Additional VM studies can profitably be performed as late as the final development phase, although the elements that can be changed without inordinate delays and costly redesign expenses are limited.

13.4.2.3 Acquisition phase

The VM effort can also be applied during the acquisition phase (production, construction, or implementation) of the subject. This arises from two possible situations: when an item has been identified by an earlier VM study and needs further investigation before a decision can be made; and, when the contractor, manufacturer, or vendor identifies areas that they believe can be improved. The first situation may arise when, for example, an item has been identified for improvement by the VM effort during the preliminary project development phase, but the item requires testing or research before a decision can be made. Even afterward, due to the delays inherent in such a process, it may be profitable to pursue a VM effort when the potential savings and performance improvements are of significant magnitude. Value incentive and program requirement clauses provide a means for sharing cost savings between contractors and owners.

The application of VM during the construction of new facilities is standard practice among major public agencies, such as the U.S. Army Corps of Engineers. Contractors receive incentives to identify and develop proposals to reduce costs and/or improve performance after the construction contract has been awarded. This can also be used in manufacturing applications where components of an assembly are subcontracted for production. In this case, vendors and subcontractors receive a cash incentive to develop innovations that reduce cost and/or increase performance.

A great many variations of VM contract provisions are in current use, but there are only two basic types. They are commonly known as the value engineering incentive clause and the value program requirements clause.

13.4.2.4 Value engineering incentive clause

The method normally used for soliciting contractor or vendor input is the value engineering incentive clause. This general provision to construction and production contracts solicits the contractor's or vendor's proposals for change through an instrument known as a value engineering change proposal (VECP). It calls for the owner and contractor to share the savings that result from any approved and implemented VECP. The usual savings sharing rate is 50:50; however, this may be varied in the

contract provisions as desired. An acceptable VECP must meet two tests: it must require a change in some contract provision, and it must reduce the contract price. A complete VECP should contain information similar to a VM proposal, as discussed in Chapter 9 – Development Phase.

13.4.2.5 VM program requirements clause

A VM program requirement clause requires the contractor to perform VM studies to a specified level, paid by the owner as a separate item of work under the contract. Clauses with program requirement provisions may also permit incentive sharing for individual proposals, but the contractor's proportion of the savings is considerably smaller than under an incentive provision.

The principal reason for the program requirement approach is to ensure continuous consideration of potential innovations, beginning with the initial project development stages. Construction contracts do not use this type of clause to any significant degree. It is more appropriate for research and development and supply contracts, and it has been very successful in these applications. In a comparatively recent construction-related innovation; however, agencies such as the U.S. Army Corps of Engineers, the Environmental Protection Agency, and the General Services Administration have established modified value program requirements for architect-engineer and construction manager contracts for major facilities.

13.4.3 Sustaining a VM program

One of the key components of a successful VM program is the need for a strong implementation process that is both transparent and assigns accountability. Many programs succeed in the performance of VM studies and identification of good potential alternatives, but they fail to successfully implement the recommended changes.

Several key features cause VM programs to fail. Some of these have been discussed previously:

- Failure to adhere to the VM Job Plan;
- Failure to apply VM techniques properly, especially function analysis;
- Failure to locate the VM program in the right place within the organization;
- Failure to assign a VM program manager and provide support;
- Lack of a strong implementation and change management process;
- Lack of a strong reporting process;
- Failure of the organization to communicate the benefits of VM and educate the appropriate people and ensure that it is aligned with the organization's KPIs.;
- Failure to ensure that the designer and consulting community maintain the proper VM training, certification, and professional standards;
- Failure to understand that implementing potential alternatives into design will generally require additional funding;
- Lack of emphasis on total value or overemphasis on cost reduction;
- Failure to account for life-cycle costs and total cost of ownership;
- Failure to integrate risk as a key component of value management;
- Internal resistance to change; and,
- Lack of executive management support and involvement.

The long-term success of any VM program depends upon effective succession planning, internal training and retention, and appropriate transfer of institutional knowledge.

Appendix

A
Glossary of Terms

Activity – A specific task, action, or operation that describes how a function is performed. For example, the activity "pour coffee" describes how the function "dispense liquid" is performed. Activities are the means leading to the attainment of a function.

Annuity – A series of payments made at equal intervals. Examples of annuities used in the Development Phase and relative to life-cycle cost analysis include yearly insurance premiums, monthly mortgage payments, annual energy costs, insurance, licenses, etc.

Balanced scorecard – A technique used to document and communicate the objectives, related key performance indicators and targets, and anticipated outcomes of an organization (and/or its projects, products, and services).

Break-even point – The sales amount–in either unit (quantity) or revenue (sales) terms–that is required to cover total costs, consisting of both fixed and variable costs to the organization.

Change management – A collective term for all approaches to prepare and support individuals, teams, and organizations in implementing change. The most common change drivers include: technological evolution, process reviews, crises, changes in consumer habits, pressure from new business entrants, acquisitions, mergers, and organizational restructuring. It includes methods that redirect or redefine the use of resources, business processes, budget allocations, or other modes of operation that significantly change a company or organization.

Constraints – The state of being checked, restricted, or compelled to avoid or to perform some action. For most VM studies, there are restrictions on some parameters of a solution (e.g., laws, standards, market demand, policies, resources, commitments made, etc.). These restrictions are called constraints and can be real or perceived. VM may be an effective tool for turning perceived constraints into opportunities for value improvement.

Consultant – One who gives professional advice or services.

Convergent thinking – A mental process that focuses on coming up with the single, well-established answer to a problem. It is synonymous with the term "critical" thinking.

Cost-benefit analysis (CBA) – A method used to ascertain the soundness of any investment opportunity and provide a basis for making comparisons with other such proposals. All the positives and negatives of the VM study subject are first quantified in monetary terms and then adjusted for their time-value to obtain correct estimates for conducting a CBA.

Cost, initial – The expenditure of all the resources needed to design, deliver, produce, or establish a project, product, process, service, or organization. Cost has different dimensions that can be measured by factors such as materials, labor, equipment, time, risk, etc. and be quantified in currency. Cost should not be confused with "price," which is the amount of money exchanged or set as consideration for the sale of something. Initial cost is also frequently referred to as "capital cost."

Cost, life-cycle (LCC) – The sum of all recurring and one-time (non-recurring) costs over the full lifespan or a specified period of a project, product, process, service, or organization. It includes the initial costs, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life, including salvage or decommissioning costs.

Cost model – A resource model used to graphically depict the relationship of elements relative to their cost. For example, a cost model of a building might show the relative cost of each of the major systems (foundation, superstructure, exterior enclosure, etc.), sorted from high to low, on a bar chart. Cost models are often augmented with a Pareto distribution (see Pareto model below).

Creativity – A phenomenon whereby something new and somehow valuable is formed. It is the ability to produce original and unique ideas or to make something new or imaginative. Creativity can be supported and enhanced by the utilization of creativity methods and techniques. Creativity in VM leverages divergent thinking with a focus on functions.

Creativity techniques – Methods that promote creativity and the generation of new ideas for developing visions or to solve problems.

Criteria – Standards for evaluation upon which a decision or a judgment is based.

Customer – A person or an organization that purchases a product or service. The customer plays a critical role, if not the most important in determining value. In some cases, the customer may also be a user.

Divergent thinking – A process or method used to generate ideas by exploring many possible solutions. Divergent thinking typically occurs in a spontaneous, freely flowing, "non-linear" manner, such that many ideas are generated in an emergent, cognitive fashion. Divergent thinking requires a judgment-free environment and aims to elicit ideas that may be unconventional.

Efficiency – The ratio of useful output to total input. Efficiency refers to very different inputs and outputs depending on specific fields and industries.

Escalation – Changes in the cost or price of specific goods or services in a given economy over a period. This is similar to the concept of inflation, except that escalation is specific to an item or class of items (not as general in nature). Changes in the money supply do not usually drive changes in cost, and escalation tends to be less sustained. Note that escalation is different than inflation (see 9.1.5).

Evaluation – To determine the significance, value, or condition through careful appraisal and study.

Expected value – A quantitative measure of value expressed by multiplying an anticipated outcome by the probability of its occurrence.

Facilitator – One who is substantively neutral, has no significant decision-making authority, enables a group to improve how it identifies and solves problems, and increases the group's effectiveness. In the context of VM, one who leads the group through the VM Job Plan.

FAST – The Function Analysis System Technique (FAST) is a group process that creates a diagrammatic representation of the HOW-WHY logic of functions, and their interrelationships, of a project, product, process, service, or organization under study.

Freewheeling – A state of unrestrained, divergent thinking not bound by formal rules, procedures, or guidelines.

Function – A non-specific, two-word abstraction, consisting of a verb and noun, that describes what an element of a project, product, process, service, or organization does.

Function, all-the-time – Functions that happen continuously or occur on a repetitive, ongoing basis, relative to the project, product, process, service, or organization.

Function analysis – A detailed examination of a project, process, product, service, or organization to identify, classify, and organize its functions; allocate performance and resources; and prioritize functions for value improvement.

Function, basic – The essential function(s) that fulfill the purpose or intent for which a project, product, process, service, or organization exists and answers the question, "What must it do?" There can be more than one basic function.

Function, higher-order – The specific goals or needs that the basic function(s) fulfills and are beyond the scope of the VM study subject.

Function logic path – All functions on a FAST diagram that are connected to each other in the HOW-WHY logic direction.

Function, lower-order – Functions that are not part of the scope of the VM study and are inputs for a project, product, process, service, or organization.

Function, one-time – A function that occurs only once relative to the project, product, process, service, or organization.

Function performance specification (FPS) matrix – A technique whereby the quality or performance criteria related to the subject functions are correlated along with related specification units of measure, parameters, targets, and flexibility.

Function resource matrix – A technique whereby the functions of a project, product, process, service, or organization are correlated to its attributes, such as space, weight, cost, time, performance, risk, etc. The purpose of a function resource matrix is to develop insight into how functions contribute to value and to aid in prioritizing which functions offer the greatest potential for value improvement.

Function, secondary – A function that supports the basic function(s) and results from the approach to achieve the purpose or intent of a project, product, process, service, or organization.

Function, unwanted – A function identified by the customer, user, or stakeholder as undesirable that is caused by the approach used to achieve the purpose or intent of a project, product, process, service, or organization.

Future value – The value of a current asset at a specified date in the future based on an assumed rate of growth. Examples of factors that are often expressed as a future value (FV) in a life-cycle cost analysis include major periodic maintenance, equipment or building system replacements, salvage or demolition costs, etc.

Gantt chart – A Gantt chart is a type of bar chart that illustrates the relationship of activities to a schedule. Articulations of Gantt charts may show interdependencies of activities and define the "critical path" (the longest series of required sequential activities) of a project or process.

Grading – To classify ideas on a scale, such as by quality, size, color, etc.

Handout – A document summarizing the key information needed by both the VM study team and the stakeholders attending the presentation. It is not intended to include specifics about the Job Plan phases nor all details of each VM proposal, but to share some basic information to make the presentation run easily. In most cases, these documents will be two to five pages in length. In some cases, a PDF copy of the slideshow used by the team is distributed. Handouts generally become obsolete after the presentation ends, since the VM study team, facilitators, and other stakeholders will focus their efforts on the formal report.

Hitchhiking – The process of taking one idea and building on it to create a different idea.

Implementation meeting – A key activity of the Implementation Phase, also called a resolution meeting. The purpose of this meeting is to resolve the disposition (usually acceptance or rejection) of the VM proposals developed and presented in the previous two phases of the VM Job Plan.

Implementation plan – An overall schedule for all activities necessary to implement the results of the VM study. It typically contains detailed action plans including schedules, milestones, tasks, resources and level of effort required, and identification of the parties responsible for completion of the implementation actions. Schedules (e.g. Gantt charts) and other project management applications usually support the implementation plan.

Inflation – A quantitative measure of the rate at which the average price level of an array of selected goods and services in an economy increases over a period of time. Inflation is often expressed as a percentage and indicates a decrease in the purchasing power of a nation's currency.

Interest rate – The amount of money charged, expressed as a percentage of principal, by a lender to a borrower for the use of assets. In terms of borrowed money, the interest rate is typically applied to the principal, which is the amount of money loaned. The interest rate is the cost of debt for the borrower and the rate of return for the lender. It should be noted that the term "discount rate" refers to the interest rate that Federal Reserve Banks charge commercial lenders, and that is frequently used by public sector agencies in LCC analysis. The VM study sponsor may define a preferred discount rate to be applied to their specific cash flow analysis.

Life-cycle cost (LCC) analysis – The sum of all recurring and one-time (non-recurring) costs over the full life span or a specified period of a project, product, process, service, or organization. It includes the initial costs, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life. The VM study sponsor should ultimately provide direction on the appropriate methods and factors they wish to be applied.

Life-cycle period – The length of time considered in a life-cycle cost analysis. For example, a life-cycle cost analysis performed for the useful life of a highway bridge might assume a life-cycle period of 75 years, which is a typical period used to define the "useful life" of the structure.

Neutral – Not engaged on either side.

Present value – The current value of an asset. In life-cycle cost analysis, present value (PV) is the current value of a future sum of money or stream of cash flows (an annuity) given a specified rate of return.

Pareto model – A further articulation of any resource model that graphically illustrates the cumulative distribution of values. For example, a Pareto distribution curve overlay a bar chart that shows the cumulative contribution of each element of cost. The basis of the Pareto model is the so-called 80/20 rule, which means that 80 percent of the total cost of a system can be linked to 20 percent of its elements. Pareto analysis is used to select important elements, to prioritize problems, and to highlight important issues. It also helps to see the small number of important issues as well as their relative importance to each other.

Performance – The extent to which a project, product, process, service, or organization achieves its intended function(s). Performance can be measured quantitatively or qualitatively, the measurement of which answers the question of how well the function(s) is(are) being performed.

Productivity – The rate of output per unit of input; usually for a production process, however it is used also for construction activities.

Process flowchart – Process flowcharts are tools for visualizing manufacturing, business, administration, etc. processes. Process flowcharts usually have two sides, and the processes are placed horizontally on it. All the processes in the organization are placed between customer expectations (left side, input) and customer satisfaction (right side, output). Organizational processes include management processes, value-creating processes, and supporting processes. There are many international standards for displaying process maps, such as UML (Unified Modeling Language), Event-driven Process Chain (EPC), Business Process Modeling Notation (BPMN) (ISO/IEC 19763-5: 2015), and VSM (Value Stream Map).

Project management plan – A project management plan is a tool for planning and managing a project. The document continuously evolves with the project and is always updated with the latest relevant information. The project management plan should be accessible to all project members, as it is one of the most important documents of communication.

Quality – A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1) the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2) a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use"; according to Philip Crosby, it means "conformance to requirements."

Quality management plan – A document defining the acceptable level of quality, which is typically defined by the customer, and describes how the project, product, or process will ensure the specified level of quality. Quality control activities monitor and verify that deliverables meet defined quality standards. Quality assurance activities monitor and verify that the processes used to manage and create the deliverables are followed and are effective.

Quality model – A model that illustrates the relationship between customer satisfaction and the degree of quality provided by a project, product, process or service. One such example is quality function deployment (QFD) which is a method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts and, ultimately, to specific elements of the manufacturing process.

RACI matrix – RACI is an acronym for "responsible, accountable, consulted and informed." A RACI matrix is typically used to cross reference activities and deliverables with stakeholders to define the level of involvement. For example, a public agency might be identified as "consulted" for the review of a project document. The information on a RACI matrix is used in supporting communication and managing stakeholders.

Random function identification – A technique that lists the elements, components, or parts of a project, product, process, service, or organization and then identifies the various functions related to them. Once the functions have been identified using this technique, they may be classified and organized for subsequent analysis.

Ranking – To arrange ideas by priority or importance relative to other ideas being considered.

Resistance to change – Action taken by individuals and groups to hinder change related activities when they perceive a change as a threat to them. Keywords here are "perceived" and "threat." The threat need not be real for resistance to occur. The usual description refers to change within organizations, although it is found elsewhere. Resistance is the equivalent of objections in sales and disagreement in general discussions. Resistance may take many forms, including active or passive, overt or covert, individual or organized, aggressive or timid.

Resource model – A graphic and/or numerical representation (such as a spreadsheet, pie chart, cost model, Gantt chart, etc.) indicating resources such as cost, space, time, and energy and associated performance or risk allocated to each component of a project, product, process, service, or organization.

Resource – All inputs of cost, time, energy, space, materials, labor, etc. required to accomplish a function.

Return on investment (ROI) – A performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. ROI tries to directly measure the amount of return on a particular investment, relative to the investment's cost. To calculate ROI, the benefit (or return) of an investment is divided by the cost of the investment. The result is expressed as a percentage or a ratio.

Risk – An uncertain event that could have an impact on the cost, schedule, or performance of a project, product, process, service, or organization. Risks can either be positive (opportunities) or negative (threats). The Value Methodology must consider the impact of risks to value.

Risk model – A resource model that represents the probabilities and impacts of threats and opportunities. Risk models can be qualitative or quantitative in nature. They include tornado charts (a graphic form of risk rankings), HEAT maps, histograms, and probability density curves.

Risk register – A matrix used to record information concerning subject risks. Risk registers usually include a description of the risk, type of risk (threat or opportunity), probabilities, impacts, triggers, and possible response strategies.

Schedule – A procedural plan indicating the time, duration and sequence of activities or operations. Schedule may be considered as an input (a resource) or an aspect of performance, depending upon the context of the project, product, process, service, or organization.

Scope – The defined parameters of the subject under study. The subject scope is often supported by various forms of information that include narratives (or a scope statement), specifications, drawings, schedules, plans, estimates, and other supporting analysis.

Simple payback – In capital budgeting, the period of time required to recoup the purchasing power of the funds expended in an investment or to reach the break-even point. For example, a $1,000 investment made at the start of Year 1 which returned $500 at the end of Year 1 and Year 2, respectively, would have a 2-year payback period. This method does not recognize the time value of money.

Specifications – A specification often refers to a set of documented requirements to be satisfied by a material, design, product, or service. The characteristics of quality and performance are usually defined by specifications for projects, products, processes, and services. Different types of specifications have different meanings. Examples include functional, technical (i.e., design and engineering), operations, and maintenance specifications.

Stakeholder – An individual, group, or organization who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of the project (i.e. VM study)."

Status reports – A status report is a document describing the situation of something, such as a project at a specific point in time during the Implementation Phase or at the end of the phase. It may utilize a variety of presentation techniques, whether in writing or verbally supported by graphics, charts, diagrams, tables, or any other forms of visualization.

Subject matter expert (SME) – A person who is an authority in a particular area, discipline, or topic.

Subject objectives – Functions that express specific, compulsory requirements, or articulate broader goals, of the subject, whether it is a project, product, process, service or organization.

Time – The measured or measurable period during which an action, process, or condition happens. Time, as an element of value, may be considered as an input (resources) as well as an output. For example, time may be considered as an input when considering the delivery of a project and as an output when experiencing a service such as a massage.

Time value of money – The time value of money is the concept that money available at the present time is worth more than the identical sum in the future, due to its potential earning capacity. This core principle of finance holds that, provided money can earn interest, any amount of money is worth more the sooner it is received.

User – An individual, group, or organization who may affect, be affected by, or perceive itself to be affected by a decision, activity, or outcome of the project (i.e., VM study).

Utility – An economic concept that is used to quantify the usefulness of, or level of, satisfaction derived from a thing. Utility is closely related to the concepts of performance and quality.

Value – An expression of the relationship between the performance of functions relative to the resources required to realize them. -This can be expressed as Value = (Function Performance)/Resources.

Value engineering change proposal (VECP) – A change submitted by a contractor, pursuant to a contract provision, to improve the value of the project or product under contract. VECPs are a vehicle to incentivize contractor innovation and are commonly used in public sector contracts.

Value Methodology – A systematic process used by a multidisciplinary team, led by a qualified VM facilitator, to improve the value of a project, product, process, service or organization through the analysis of functions.

Visual presentation – For the sake of clarity among the diverse VM community members, we differentiate "presentation" and "visual presentation." In this text, we define the presentation as the overall effort to compile and communicate the VM study results to stakeholders, including preparation and the meeting held to communicate those results and data. Visual presentations, as used herein, refer to a specific type of common presentation tool used by many practitioners. They are often created in Microsoft PowerPoint and other similar software packages and are displayed on projection screens, large monitors, or in print-outs.

VM facilitator – One who is substantively neutral, has no significant decision-making authority, enables a group to improve how it defines and solves problems, and increases a group's effectiveness. In the context of VM, one who leads the group through the VM Job Plan.

VM Job Plan – A sequential approach for applying the Value Methodology, consisting of the following eight phases: 1) Preparation, 2) Information, 3) Function Analysis, 4) Creativity, 5) Evaluation, 6) Development, 7) Presentation, 8) Implementation.

VM pre-study meeting – A formal exchange of information that identifies, clarifies, and communicates the conditions of a VM study, including its subject, objectives, participants, schedule, and logistics.

VM program – A program within an organization that manages, implements, tracks, educates, trains, and advocates for the Value Methodology within the organization.

VM program elements – The components to a VM program. These are described and defined in this section. The most successful VM programs use most, if not all, these aspects. However, even programs that only use a few aspects can be effective and advantageous to the organization. This section outlines the major program elements that must be considered.

VM program manager – The individual responsible for directing, leading, and managing an organization's VM program.

VM proposal – A developed idea resulting from the application of the Value Methodology during a VM study to increase the value of a project, product, process, service, or organization. VM proposals may alternately be described as alternatives or recommendations.

VM study – A structured effort to improve the value of a project, product, process, service, or organization through the application of the Value Methodology by a multidisciplinary team facilitated by one who is competent in VM techniques, ideally a Certified Value Specialist® (CVS®).

VM study decision maker – A person involved in determining the acceptance or rejection of VM proposals.

VM study report – A document containing all the information developed at the time of the study, needed for stakeholders to make informed decisions about which VM proposals to implement. It is recommended that the executive summary be developed in such a way that it could be a standalone document for broader circulation. Reports should include the background and description of the project under study; a complete listing of VM proposals; complete VM proposals containing all relevant data; complete analysis conducted by the team; a comprehensive listing of all ideas generated and evaluated, along with their evaluation rationale; a brief description of the VM process; agendas; and, a listing of all participants with their contact information. Audiovisual materials may be added to VM study report when prudent.

VM study sponsor – The person, or organization, responsible for defining the specific objectives of the VM study and the stakeholders' needs.

VM study subject – The subject of the VM study can be anything for which there is a desire to explore opportunities for improvement. The Value Methodology is commonly applied to define new, or enhance existing, products, processes, projects, services, or organizations.

VM team – A multi-disciplined group of participants, led by a trained facilitator, who apply the Value Methodology to the subject of a VM study.

Voice of the customer – A process and/or method of eliciting the preferences and requirements of customers and users relative to value.

Weighting – To give something (here, especially, the criteria) a specific meaning. Therefore, different criteria can be differentiated, and the importance becomes obvious.

Work breakdown structure (WBS) – A tool that splits a project into components. It identifies all the project's tasks and deliverables and breaks them down into many small, meaningful, manageable parts (work packages). A WBS helps to show the scope of the project, regulate progress, set accurate costs and timetables, and shape project teams. Once a WBS has been created, it may be transformed into a schedule.

Appendix

B
Historical and Cultural Perspectives on Value

The value concept's long history begins in the Classical period. Through the ages, the idea of value has engaged scholars, philosophers, mathematicians, economists, and psychologists. This section is intended to provide some historical context to the thinking behind the value concept, while illustrating the importance of concepts such as utility, cost, performance, time, uncertainty, and human perception in considering value. Included are historical perspectives representing different philosophical and cultural perspectives.

Historical evolution of the value concept

A Western perspective

In his dialogue Protagoras, Plato (428–347 B.C.E.) explored the dichotomy of pain and pleasure, concluding that pleasure is intrinsically good and pain intrinsically bad. The idea of intrinsic, or inherent, value formed the philosophical basis for subsequent philosophers. Indeed, "intrinsic value" forms the foundation of moral and ethical philosophy based on the idea that a thing may be inherently good or bad. Love, truth, beauty, and knowledge are commonly cited as examples of intrinsic value.

It is generally accepted that Aristotle (384–322 B.C.E.) first wrote about the concept of "extrinsic value." Extrinsic value is derivative in nature, meaning that an individual may ascribe value to a thing. Aristotle argued that value was based on an external need. The concept of "need" is closely related to the concept of "function" which is explored in Chapter 6. Aristotle made a distinction between "use" and "exchange" value, which is made evident by his observation "Of everything which we possess, there are two uses; For example, a shoe is used for wear and it is used for exchange." The notion of intrinsic and extrinsic value is a fundamental concept, and it is important to remember that most things possess both, whether it is an object, person, or even an idea. Further, Aristotle originally identified seven types of value: political, social, economic, religious, ethical, aesthetic and judicial.

The concept of "utility" was introduced during the Middle Ages. In its earliest form, utility was regarded as a subjective assessment of value. Utility, along with scarcity, were widely held to be the primary considerations in determining value during this time, and economics was not regarded as an independent discipline, but merely as an integral part of ethical and moral philosophy.

At the end of the seventeenth century, the discipline of economics began to take shape and introduced the idea of the cost of production. Early economists, such as William Petty (1623–1687), abandoned the subjective theory of value and instead focused on the importance of land and labor in determining value.

The publication of Adam Smith's (1723–1790) Wealth of Nations, in 1776, heralded the rise of the classical school of economics which championed the labor theory of value. The labor theory of value holds that the value of a good or service is determined by the labor required to produce it, rather than by the use or pleasure the owner gets from it (demand) and its scarcity value (supply). Smith also popularized the "paradox of value," known as the diamond–water paradox which describes the contradiction that diamonds have a higher market value, even though water is more useful and necessary for human survival. Smith did not have an adequate solution to this problem.

Swiss mathematician Daniel Bernoulli (1700–1782) contributed to the study of uncertainty on economic value. He observed that in addition to the concept of a utility function, there is also an expected utility function (which articulates how uncertainty influences perceived, or "expected," utility). He was one of the first to write about the notion of diminishing marginal utility (that utility is an increasing function of money, but at a diminishing rate). He famously wrote: "The determination of the value of an item must not be based on the price, but rather on the utility it yields.... There is no doubt that a gain of one thousand ducats is more significant to the pauper than to a rich man, though both gain the same amount."

Carl Menger's (1840–1921) Principles of Economics further developed the concept of marginal utility, in 1871, as a means of understanding value. Marginal utility is the change in the utility of a good or service that occurs with an increase in the consumption of that good or service. Marginal utility theory postulates that value depends entirely on utility. Neoclassical economists such as Menger believed that the consumer deter-

mines the value of a good or service based on the utility they expect to receive, regardless of the cost to produce it.

Menger used this line of thinking to explain the diamond–water paradox: the value of diamonds was greater than that of water because marginal utility, not total utility, determines consumer choice and, hence, value. It follows then that the cost of production determines supply, supply determines the final degree of utility, and the final degree of utility determines value.

Mathematician John Von Neumann (1903–1957) and economist Oskar Morgenstern (1902–1977) published the Theory of Games and Economic Behavior in 1944. In this book, they laid out a mathematical approach to modeling economic decisions in uncertainty by expanding on the expected utility hypothesis. One of the key assumptions of this work was that decision makers are rational regarding value judgments.

Behavioral psychologists Daniel Kahneman (1934–present) and Amos Tversky (1937–1996) observed that people frequently behave in irrational ways with respect to economic decision making. Through empirical research, they identified several phenomena that distort the way people perceive value. These phenomena, referred to as cognitive bias and heuristics, provide evidence and explain why people behave irrationally under certain decision-making conditions. One such bias, known as prospect theory, published in 1979, explains how value judgments are influenced by the way a prospect (the likelihood of an uncertain event occurring) is framed as either a gain (positive) or a loss (negative). In 2002, the two men were awarded the Nobel Prize in economics.

A Japanese perspective

The concept of value in Japan is classified into the following three categories:

- Spiritual value,
- Social value, and
- Economic value.

Each has a historical context and has evolved to present.

Spiritual value has been cultivated by merging Japanese philosophy with Oriental philosophy. The representative of Japanese philosophy is “Shinto,” which has been established since the seventh century BC. A Japanese faith inherited by the imperial family and the emperor system up to the present, Shinto recognizes nature and god as one. It has no scripture or specific teaching and no founder. And it is one of animistic and spiritual worship, folk beliefs based on myths, Yaoyorozu no kami (8 million gods), nature, and natural phenomena. In Shinto has no concept of owning things or dominating people: everything is grace and given. Shinto practitioners see all blessings as arigatai, meaning thankful, or “itadaku,” meaning acceptance of something gratefully. Value is assigned to accepting the situation, not to the value of things.

Social value has merged with the concepts of Western and Japanese philosophy based on the concept of bushidō in Japan. Bushidō is a Japanese original spirit that spread around the sixteenth century. It is the source of loyalty and morality that characterizes the Japanese, and the attitude or values, pursuing them. It produced the precision and quality of Japanese manufacturing and created a heart, wa, that respected the other party. It is expressed in the words gi, yu, jin, rei, makoto, meiyo, and chugi, meaning righteousness, courage, benevolence, politeness, truthfulness, honor, and loyalty. Value is assigned to offering their allegiance to others and helping others, rather than to the value of things.

Economic value has merged with Western behavioral philosophy, based on Japanese behavioral philosophy: “Merchant Culture.” Omi Shonin” represents Japanese merchant culture, and its famous philosophy is called Sanpou Yoshi. It is said that three targets–seller, buyer, and social–all should gain value at the same time: “seller good,” “buyer good,” and “social good.” It is a behavioral philosophy of co-existence and co-prosperity to not only do business for the benefit of sellers. Buyers must also be satisfied, and the transaction must contribute to the development and welfare of society. In Japan, based on the fusion with Western behavioral philosophy, and economic value has evolved to value concepts such as use value, exchange value, labor value theory, and value paradox.

An Indian perspective

Centuries ago, during the Vedic period (1500 - 500 B.C.E.), Indian philosophy outlined in epics and ancient literature, a philosophy to live life in alignment with the following four values:

- Dharma (righteousness, the right way of living, perform intended duties),
- Artha (economic value, wealth and power, means for living),
- Kama (desire for pleasure, intimacy, passion, emotion, love), and
- Moksha (state of liberation, salvation).

These are also known as puruṣārthas, the inherent values of the universe. These values were taught and inculcated in families through education systems and social systems. Besides these, spiritual (which relates to Moksha), psychological, and moral values were highly recognized, taught, and respected. The foundation of all these values still holds true today and is prevalent throughout Indian culture.

Today, India’s fast-growing economy spans diverse religions, castes, sub-castes, and languages. The current period of economic growth has come with an increasing consumerism fueled by the influence of mass media and social media, supported by low-cost internet service. All these factors influence the personal and social behavior of individuals and and their

buying decisions. The seven Indian values at the root of all these could be listed as shown below:

- Religious value,
- Caste/sub-caste value,
- Family value,
- Cultural value,
- Social value,
- Political value, and
- National value.

Of the seven values listed above, three of these (religious, social and political) were specified by Aristotle, but are not generally considered within the context of the Value Methodology. In the present Indian context, all seven of these values are important, because many behavioral and purchasing decisions are associated with or influenced by one or more of them.

Purchasing decisions may be related to family events, like marriage, or cultural and religious events. Both religious and family events may further be influenced by caste or sub-castes. Cultural events include the celebration of Diwali (festival of lights and lamps), Pongal in southern India, or Baisakhi in northern India, to name a few. National events are generally the Independence Day and Republic Day celebrations. Political value strongly influences society and the nation at large and is self-explanatory. All these values are important when considering value within the Indian context.

The origin and development of Value Methodology

The genesis of the Value Methodology occurred during World War II, from 1938 to 1945. Lawrence Delos Miles (Figure 1), regarded as the "Father of the Value Methodology," was an engineer for General Electric Company. During this time, every facility was at full capacity. Steel of all types was entirely scheduled. All vital products and materials, including copper, bronze, tin, nickel, ball bearings, roller bearings, electrical resistors, and capacitors, were heavily controlled. Miles was assigned the task of "finding, negotiating for, and getting" a number of these vital materials, such as materials to expand production of turbo-superchargers from 50 per week to 1,000 per week for B-24 Liberator aircraft, capacitors and resistors for skyrocketing military electronic needs, armament parts for expanding production of B-29 Superfortress aircraft, and so forth. In this environment, it was not possible to stop short of achieving the essential results.

Frequently, suppliers, already overextended, said no to increased schedules or new, necessary products. In this desperate situation, Miles was forced to basics. "If I can't get the product, I've got to get the function. How can you provide the function by using some machine or labor or material that you can get?" Time and again, there was a way to do it. Engineering tests and approvals were rushed, and schedules met. Thus "function" grew in vitality and was to later mature into the development of the VM techniques.

To assure materials for these and other vital programs, Miles usually worked two days in the vendors' plants, one to two days in GE plants, one day in the Pentagon keeping priorities suitable, and Saturdays and Sundays in his own office. One particular incident illustrates how an emphasis on function pressed itself upon him.

A production manager gave Miles a schedule calling for thousands of a few dozen types of resistors and capacitors to be delivered weekly starting in one week. Manufacturing schedules at the time were nine months out, with six months firm. He was told it was an absolute requirement. Miles asked, "Who agrees with you that this must be secured regardless?" The manager replied, "Tom Garahan, overall production manager of GE." Miles asked, "Does Harry Erlicher (vice president of purchasing) agree?" The manager said yes.

The resistors and capacitors were secured for Oak Ridge, Tennessee. Much later, it was learned they were for atomic bomb research and development. Their priority overrode everything; still, the others were vital, too. Miles went to vendors and made schedule changes, but told each he would find some way to provide the essential functions of resistance and capacitance through a different shape or type or material or equipment, which would keep other vital electronic equipment on schedule for the military. The function approach proved so effective that he would never abandon it.

Critical years passed. In 1944, Erlicher asked Miles to become the purchasing agent of a GE plant. Miles continued to experience benefits from the functional approach in buying.

In March 1944, he was transferred to Locke Insulator in Baltimore, Maryland, a subsidiary of GE, as manager of purchasing. He took line responsibility for the delivery and cost of millions of dollars of materials and products per year. During the next four years, he developed patterns of engineering, laboratory, and purchasing teamwork that controlled costs and improved products. He learned firsthand both the productive and the destructive force of human attitudes and practices, and their effect on appropriate designs and appropriate costs. His thinking became increasingly focused on "What function am I buying?" rather than "What material am I buying?"

In 1947, Miles wrote a letter to Erlicher saying that he believed that much good could come to GE if he were relieved of line operation responsibilities and assigned full-time to cost reduction work in the central purchasing office. Erlicher bought the idea and moved him back to Schenectady, New

York in late 1947, where his activity was named the Purchasing Department Cost Reduction Section (PDCRS).

In late 1947, back on Erlicher's staff, his schedule was cleared so that he could research and develop workable techniques which would secure more cost-effective results by the decision-making employees in a plant or business.

Larry Miles described the early technique:

> "To an exceptional degree it focuses on what is important, develops knowledge about it, and then causes great creativity in that area. You select from the creative approaches, answers that may not have come in years with other thinking methods. When the system was put to work the first time, it resulted in replacing a bronze clip holding a cover on a refrigerator control (that could flex millions of times without breaking) with a lower cost brass clip (that would flex thousands of times). Quality was not sacrificed because the clip would be flexed only about six times in the lifetime of the refrigerator. The $7,000 per year savings may seem like nothing, but when the same technique was applied to everything in the control box, the yearly savings jumped to $1.25 million."

The new functional approach was introduced to Mr. Winne, vice president of engineering. Mr. Winne listened, understood, and said, "This is the best method I have seen to get competitive costs and retain quality. What are you going to call it? Proper quality at proper costs equals value. Why not call it value analysis?"

Thus, the new method received its original name.

Then he said, "The vice president of manufacturing, Mr. DuChemin, will be most interested in this." Mr. DuChemin set up a 20-minute appointment with Miles. After two hours of listening and learning, he said "Train one thousand people per year." With the support of these people, Miles set up training programs made available to GE's plants. He accepted people and products from different plants, applied the techniques, and showed other employees how they could increase earnings and maintain competitive positions. Miles learned that great benefits were derived when technical people used what would eventually grow to become VM, and geared training to them.

For the next three years, Larry continued training personnel and doing work for the plants. He did this using a revolving team of six to eight people. Training was moved to plant locations with a goal of training 1,000 people per year. Later, GE often exceeded that number. Larry and his training team learned that the greatest benefits came when customers and vendors also knew and used his functional and methodical thinking approaches. On his advice, GE agreed to provide value analysis training to other industries as well. From 1948 to 1952, GE reported $10 million in benefits arising from value analysis.

In 1950, GE gave Larry Miles its highest accolade: The Coffin Award. This was given in honor of their first president for benefits to the company resulting from the creation and use of the value analysis system.

This highest GE award, at that time, went to fewer than one in 10,000 employees. Larry Miles was the first and only purchasing person to ever receive it. The citation was:

> "In recognition of his outstanding accomplishment through the establishment, organization, and development of a Value Analysis Program, which has resulted in substantial cost reductions."

In 1954, the U.S. Navy Bureau of Ships implemented the first federal government program with the assistance of Miles and his staff. There followed a period of gradual growth in federal agencies until 1963, when the Department of Defense established specific requirements for a formal program within the three military services. This involved the design and construction activities, as well as suppliers, and mandated incentive-sharing clauses in construction contracts. Contractors were permitted to propose "value engineering" changes and share in net savings. It also introduced full-time "value engineers" within agency staffs to promote and administer the program. The high level of success achieved by the Department of Defense led to further recognition in civil agencies. Great expansion followed in the next 15 years.

Today, every federal agency with a significant construction or purchasing program employs VM in some form: the Department of Defense, the General Services Administration, the Environmental Protection Agency, the U.S. Forest Service, the U.S. State Department's Overseas Building Operations, the Veteran's Administration, the Federal Highway Administration, and the Department of the Interior. Use of VM further expanded during the 1980s, by order of the executive branch with the support of Congress, to include requirements for the application of "value engineering" to all agencies within the federal government. In addition, many state and city governments have directed, through legislative action, that some form of Value Methodology be applied to all capital expenditures. Thus, the Value Methodology, born of necessity in a single company, has become a widely used, technical method for effective utilization of resources throughout the public and private sectors.

Concept of worth

Carlos Fallon (1909-1989) was another early contemporary of Miles who contributed greatly to the development of the Value Methodology. In his book Value Analysis to Improve Productivity (1971), Fallon wrote extensively about the concept of worth.

> "WORTH. An appraisal of the properties rendering a product useful or esteemed in the eyes of a person; a measure of such usefulness or esteem; the monetary equivalent of utility. From the West Germanic 'werte' through the Anglo-Saxon worth, this very English word reflects the direct approach to economic goods of Anglo-Saxon warriors, hunters, and farmers. By extension it has come to mean an appraisal of the effectiveness with which a product performs its function or a system accomplishes its mission. Either appraisal can yield a monetary figure that represents the customer's

regard for the capability of a product to satisfy his wants. Closely related terms are merit and system effectiveness. The monetary connotation of the term worth makes it possible to quantify utility in the same units as cost."

Fallon goes on to discuss the importance of the uniquely English concept of worth:

> "THE MERIT OF WORTH. As noted earlier, in English worth can be used to measure the supposedly unmeasurable utility. The objection to measuring utility is that it is subjective on the part of the customer. You cannot even estimate utility unless the customer is before you; yet, that's exactly where you want him or her, before you, in front of your cash register. All the economics of product value hinges on this confrontation. That is what market research and market analysis are all about, finding out what a product is worth to a particular set of customers. In English, worth is not value. If it is worth to me less than it costs it is not a good value. Worth more than it costs? A good value. We owe this extraordinarily useful word to the melding of English and Norman French where both value and worth endured, each in its own sense. Alas! in the Germanic languages, the only word for value is 'werte' or 'varde'. In French, Italian and Spanish the word is 'valoir', 'valore' and 'valor'. No worth!"

The semantics of the concept of worth, as described by Fallon, speak to the subjective nature of utility. Everyone may possess a different view of the worth of a handful of diamonds or a bucket of water. Unfortunately, since the time of Fallon's use of the word "worth" within the practice of the Value Methodology, the original meaning has essentially been lost. A technique of early value analysis, referred to as "function worth," focused on identifying the "least cost way to deliver a function" as part of a VM study. This method (called the value index), while being useful in having value as a way of stimulating the opportunity for cost improvement, tended to overlook the essential concept of understanding the customer's perspective of what they value, and it is no longer recommended.

The fundamental challenge with the concept of worth is that, aside from not existing in most other languages, it is used interchangeably with the word "value." The Merriam-Webster Dictionary defines value as "the monetary worth of something" and worth as "monetary value." It is not hard to understand why the use of these terms has led to confusion. Therefore, the word "value" is the preferred term. When referring to worth, the term "customer value" or "user value" adequately conveys the same concept.

References

- O'Brien, James J. Lawrence D. Miles Recollections, Miles Value Foundation–Excerpts Relating to the Historical Development of Value Analysis, 1987, included by permission of the Miles Value Foundation.

Appendix

C
VM Standard Reference

The Value Methodology (VM) Standard Reference is intended to provide the basic guidance required for applying VM as recognized by SAVE International®. VM can be applied to a wide variety of subjects, including industrial or consumer products, construction projects, manufacturing processes, business procedures, services, and organizations. VM is commonly referred to by the terms value analysis, value engineering, and value management. These terms may be used interchangeably with Value Methodology throughout this standard.

The VM Standard Reference will assist managers, value program managers, practitioners, and trainers in applying VM in their organizations in a consistent, standard manner. It may also assist those who procure VM services to develop proposal requests that ensure they receive good results conducted in a professional manner. Key terms include:

Value – An expression of the relationship between the performance of functions relative to the resources required to realize them. This can be expressed as

$$Value = \frac{Function\ Performance}{Resources}.$$

Value Methodology (VM) – A systematic process used by a multidisciplinary team, led by a qualified VM facilitator, to improve the value of a project, product, process, service or organization through the analysis of functions.

VM Job Plan – A sequential approach for applying the Value Methodology, consisting of the following eight phases:

Preparation Phase – A pre-study meeting is held to identify the VM study subject, goals and objectives, participants, schedule, information, and logistics.

Information Phase – The VM study team reviews the study subject's scope, schedule, cost, performance, quality, and risk. Various modeling techniques are applied to develop an understanding of this information.

Function Analysis Phase – The VM study team defines the project functions using a two-word abridgement. The VM study team reviews and analyzes these functions, using recognized techniques such as random function identification, FAST diagrams, function resource allocation, and function performance specification to define functions, allocate performance and resources, and select functions for value improvement.

Creativity Phase – The VM study team employs creativity techniques to generate ideas to perform the subject's function(s).

Evaluation Phase – The VM study team follows a structured evaluation process to select those ideas that offer the greatest potential for value improvement while delivering the project's function(s) considering performance, quality, schedule, cost, and risk.

Development Phase – The VM study team develops the selected ideas into VM proposals with enough documentation to allow decision makers to determine if they should be implemented.

Presentation Phase – The VM facilitator develops a report and/or presentation that documents and conveys the conclusions and results of the VM study.

Implementation Phase – The sponsoring organization reviews the results of the VM study and decides which VM proposals to implement. An implementation plan is developed and executed in order to actualize the value improvements.

VM study – A structured effort to improve the value of a project, product, process, service, or organization through the application of the Value Methodology by a multidisciplinary team facilitated by one who is competent in VM techniques, ideally a Certified Value Specialist® (CVS®).

The VM Standard Reference has not been prepared as a legal document. If the user intends to use the VM Standard for procurement purposes, the user should consult expertise familiar with contract language, including seeking legal guidance.

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