contents:

VM: The Cure for Hurry (Editorial)  
Roger B Sperling, CVS  

Six Degrees of Separation: 
Comparing Business-Improvement 
Practices  
Michael Cook, Ph.D., CVS  

Unlocking the Power 
Of Target Costing: 
A Platform for the 
Strategic Use of VM  
James A. Rains, Jr., CVS, 
and Mark Sullivan  

Beyond Value Management (VA-VE): 
Value Vistas for the 21st Century  
R.V. Gopalakrishnan  

Owner, Engineer, and 
Contractor Views of 
VE Incentive Clauses  
George F. Jereas, Ph.D., P.E., 
Vernon G. Cooke, I.S.P., 
and Francis Hartman, Ph.D., P.E.  

Annual Index  

inside this issue:  
Building Your Business 
Or Industry With 
The Value Methodology
I enjoy a good book, especially one that keeps me company on trips away from home. And it is a double pleasure when my recreational reading crosses over into my professional interests. When a writer of fiction or nonfiction writes words that evoke an aspect of value methodology, I find it rewarding. When I find a page of prose that gives new meaning to the value process, I am enriched and am glad to pass it on to others.

This happened recently while reading John Steinbeck’s novel *East of Eden*. The works of Steinbeck had never been on my reading list until I visited a new museum in the city of Salinas, California, that is dedicated to this locally bred author of mid-20th century America. Seeing interactive displays of his books and plays stimulated me to find out what he had to say. I found *East of Eden* a compelling read.

I also discovered the following paragraph:

In human affairs ... successful conclusion is sharply limited by hurry. So often men trip by being in a rush. If one were properly to perform a difficult and subtle act, he should first inspect the end to be achieved and then, once he had accepted the end as desirable, he should forget it completely and concentrate on the means. By this method he would not be moved to false action by anxiety or hurry or fear. Very few people learn this.

I read this passage again and again, because it seemed to me a good description of value methodology. Let me explain. Value methodology is applied to products, projects, and processes that, in many cases, were conceived in a hurry. As Steinbeck suggests in the first two sentences above, we trip by being in a rush. And, though it takes only a few days to complete the VM job plan, we accomplish a thorough review and report alternatives to the owner that may be more thoroughly considered than the original concept.

Next, the third sentence—we should inspect the end to be achieved—alludes to function analysis, which is an inspection of what is truly needed in the end. This must be done before we concentrate on the means, developing alternatives to accomplish the end. Finally, Steinbeck sums it up: this method (VM to value practitioners) avoids false action, a lesson very few people learn.

Though Steinbeck was writing of the affairs of men and women, value practitioners can take his words out of context to teach the lesson that VM is a process that develops alternative solutions to problems that may have been solved but are sharply limited by hurry. Furthermore, the process to overcome the false action requires first an understanding of the desirable end before seeking the answers.

I also enjoy reading *Value World* for some of the same reasons. I can learn new perspectives and new techniques from other VM practitioners. I commend the articles in this issue because of what they bring to you, the reader: new ways of seeing and applying value methodology as a cure for hurry.

Mike Cook starts out this “Corporations/Industry” issue with “Six Degrees of Separation,” a way of comparing and contrasting continuous-improvement methods. “Unlocking the Power of Target Costing,” by co-authors James Rains and Mark Sullivan, introduces the concept of target costing in conjunction with value methodology. R.V. Gopalakrishnan reveals how value methodology is applied in Indian organizations in “Beyond Value Management.” George Jergeas, Vernon Cooke, and Francis Hartman’s contribution, “Value Engineering Incentive Clauses,” contains research that gives real-life examples of how this tool is used—as well as how various arrangements motivate owners, engineers, and contractors to engage in value engineering.

I encourage you to avoid tripping by being in a rush as you read these articles. Peruse them at your leisure, savoring and rereading passages if they are meaningful to you. Save the issue for reference. Use these ideas as a springboard for new ways of doing things in your corporation or industry.
Six Degrees of Separation: Comparing Business-Improvement Practices

Michael Cook, Ph.D., CVS

Let’s see—there’s business resource planning, supply chain management, business process transformation, total quality management, reengineering, quality function deployment, continuous flow manufacturing, total productive maintenance, design to capacity, classes of facility quality, manufacturing systems analysis, process simplification, and value management. And the next issue of the Harvard Business Review will almost certainly highlight some other improvement methodology as the newest best practice. How are you supposed to understand each of these practices and be clear on their differences and similarities? Trying to keep track of these improvement practices is enough to drive any businessperson or consultant crazy.

As corporations and industry strive to survive and prosper, they must investigate and make use of every available best practice to be competitive and increase shareholder value. I’ve seen every one of the aforementioned practices—and even more—introduced in the company I work for in the last 10 years alone. DuPont has attempted to initiate, integrate, and institutionalize each one of these as they come along. The term program of the month is a reality for DuPont. I know that the same is true for other corporations and industries around the world.

If you think about it, any good continuous-improvement methodology should have some business value. The issue is identifying the value it offers. This can be accomplished by describing it according to some set of established parameters or dimensions. As I’ve learned about and dissected each of these practices, it has become clear to me that they are structurally similar. Indeed, each methodology can be distinguished or separated from another by characterizing six simple dimensions: focus, solutions, structure, timing, people, and tools. As such, I’ve labeled these dimensions the six degrees of separation.

When I come across a methodology that someone is touting as the latest and greatest practice for solving a business problem, the first thing I do is ask them to explain these six dimensions (see Figure 1).

**FOCUS**

First, where is the focus of this methodology? For example, is its arena of application focused on inventory control, services, product design, or project execution?

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**Figure 1**

Six Degrees of Separation of a Continuous Improvement Methodology

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2 Volume 22, Number 1, Spring 1999
SOLUTIONS
Second, why is the methodology conducted? That is, what
solutions are delivered? Is it to improve cycle time, reduce fixed
cost, minimize inventory turns, or improve customer satisfaction
levels (to name a few)?

STRUCTURE
Third, what is its structure? That is, what are the phases, steps,
tasks, and activities along with the sequencing of these elements?

TIMING
Fourth, when are these elements delivered? Specifically, what is
the timing placed on that structure? Does each element have a
duration on the order of hours, days, weeks, or months, and is
there an optimal time in the business or project cycle to apply the
methodology?

PEOPLE
Fifth, who is involved in the delivery process, and what are their
roles and responsibilities? Is there a consultant working solo to
conduct interviews, gather and analyze data, and report back with
recommendations and an implementation plan? Or is it a team
effort, with a consultant acting as a coach to lead a team to
discover the solution? Or are people involved in some other way?

The companies that will win in the
future are the ones that will effectively
analyze and synthesize the best of the best
methodologies and then use these, where
appropriate, to their utmost potential.

TOOLS
Sixth, how is the problem understood and solved? That is, what
tools and techniques are used to analyze the problems and create
solutions? For example, do the tools involve computer models,
metrics, quality analysis, functions, cost, interviews, or
storyboarding?

This is a very simple way to understand a methodology’s
distinctions. It provides a framework for learning about any
methodology. When you view other methodologies through this
characterization, you will often find only minor and distinctly
identifiable differences. Let’s demonstrate this for continuous flow
manufacturing, one of IBM’s favorite continuous-improvement
methodologies.

SIX DEGREES OF CFM
First (focus), continuous flow manufacturing focuses on all
physical aspects of manufacturing, from receipt of raw materials
through production to finished product inventory. It is applied to
processes that make continuous, batch, or discrete products.

Second (solutions), CFM’s primary goal is to reduce
manufacturing cycle time, although by conducting CFM you’ll
identify excess inventories, bottlenecks in operations, quality
problems, and other disruptions to synchronized production.

Third (structure), CFM’s structure consists of the following
seven sequenced phases: initiation (assessment, business commit­
ment, and team formation); analysis; opportunity identification;
evaluation; implementation planning; implementation; and auditing.

Fourth (timing), the initiation phase can last up to two or three
months; the analysis, opportunity identification, evaluation, and
implementation-planning phases—taken together—last about six
months. Implementation is dependent on the scope of the
opportunities to be implemented, and auditing is an ongoing activity.

Fifth (people), a CFM consultant coaches a cross-functional
and cross-level team of about eight people. They work together
eight hours a day, three to four days a week for the six months it
takes to complete the phases of analysis, opportunity
identification, evaluation, and implementation planning.

Sixth (tools), some of the techniques involve mapping out the
manufacturing process and flow of materials, focused
interviewing, brainstorming, storyboarding, and just-in-time
manufacturing principles.

Based on this characterization of the six dimensions, you
should now have a quick understanding of CFM. And you now
have a way to standardize your understanding of any
methodology. Try it the next time you examine another
methodology, or—better yet—try it the next time you explain the
value methodology to someone.

CONCLUSION
The most interesting thing to me about these six degrees of
separation is not how it can be used to pass judgment on a
methodology, rather how the different—or perhaps best—aspects
of one methodology can be incorporated or integrated into another
methodology. For instance, CFM might be improved by using the
best elements of value methodology, or even vice-versa. This
integration strategy is of high value to corporations and industry as
they try to pick and choose from the best practices in front of
them. The companies that will win in the future are the ones that
will effectively analyze and synthesize the best of the best
methodologies and then use these, where appropriate, to their
utmost potential. The companies that will have difficulty winning
are those that will try to do every methodology that comes
down the pike or, worse yet, will try to use one and only
one methodology—without modification—as a magic bullet for
every business situation.

Michael Cook, Ph.D., CVS, is leader of process simplification and
value engineering for the DuPont Company. He has facilitated
more than 125 PSIVE studies for DuPont and other companies in
the chemical, petroleum, pulp/paper, and gas-production arenas.
Cook is co-creator of process simplification and is a founding
member of DuPont’s Integrated World Class Methodologies team.
Cook is SAVE International’s vice president education.
Unlocking the Power of Target Costing: A Platform for the Strategic Use of VM

James A. Rains, Jr., CVS, and Mark Sullivan

INTRODUCTION

Target costing, like many new concepts that Western companies have attempted to adopt over the past two decades, has been largely misunderstood by most firms. Target costing is an extremely powerful concept when properly utilized. Unfortunately, most companies that have seen the value of using target costing have failed to take the time to understand the basic philosophical drivers that underlie the concept. Instead they have tried to adopt the mechanics of target costing, as they understood them, within the context of traditional financial management processes. Not surprisingly, these firms have not received all the value target costing could provide, and the experience has been very frustrating for those in the trenches who were held responsible for making target costing work. In a very real sense, these firms have been attempting to do the financial equivalent of designing a supersonic plane while insisting on using the design requirements of a biplane.

TARGET COSTING

Target costing is not a project-based process for cost reduction. It is an integral part of an integrated companywide cost-management process—an integrated cost-management process that, in turn, is a major component of an integrated and holistic companywide strategic management process. In short, target costing is an integral part of an integrated approach to companywide profit planning.

Target costing is therefore a proactive approach to ensuring that a desired profit is achieved on a project. But it is used to achieve that desired profit in an integrated and companywide approach in which the entire company is making sure that each of the company’s endeavors are profitable, at planned levels. This concept is fundamentally different from traditional Western financial thinking, which has been focused on project-based cost reduction after costs have strayed beyond acceptable boundaries.

BACKGROUND

Before embarking on the journey to effectively using target costing, the company wishing to benefit from it must first understand the differences between traditional Western financial thinking and the thinking underlying target costing. First of all, target costing is very much about attaining value. It is not a cost-reduction tool. It is about achieving what the customer wants and needs at the least possible cost for doing it. Second, target costing is a proactive and integrated cost-management process. It is not a project-by-project tool, as so many consultants have tried to position it.

Target costing, if it is to work as intended, is very dependent on the systematic use of the systems-thinking construct that costs must be managed at the level of the company best able to deal with each level of cost. And, those costs need to be managed on an ongoing basis. To hold a project manager responsible for costs that the manager has no ability to affect is simply unreasonable and self-defeating. Yet that is exactly what many Western firms implementing target costing are doing, which brings us to the third fundamental difference between target costing and traditional Western thinking.

Target costing is a proactive cost-planning approach. Whereas traditional Western financial-management approaches have turned to cost-reduction efforts in a reactive fashion once project costs had exceeded project budget levels, often at the detriment of value, target costing provides a systematic way to ensure that desired costs are planned into the project at every step of the project. Rather than being a budget-driven process, as is true in traditional Western financial management, target costing is based on a holistic planning approach to the management of the company. Under that approach desired profitability for the company as a whole is determined, and cost requirements that are required to achieve that profit—at all levels of the company—are identified and planned.

The fifth major difference in thinking is that target cost is externally focused. It starts with what the market is willing to pay and drives costs to the levels required to achieve the desired level of profitability for the company as a whole. In order to achieve this level the company must plan profits and costs at a portfolio level, instead of project by project as is normally done in Western companies. This in turn means that costs must be managed cross-functionally and systematically across the entire company. If a project is to achieve its desired profitability, the company must do as much as possible to manage those costs outside of the control of the project manager and for the project manager to ensure that those costs that are controllable within the project are in fact planned. It is the dynamic interaction between all parts of the company to deliver planned-for costs that makes target costing the powerful construct that it is.

Operationally, target costing is nothing more than the proactive implementation of the DuPont formula. Taken at its essence, the DuPont formula states that a desired company level of profitability is a function of the management of value times asset utilization \((\text{profitability} = \text{value} \times \text{asset utilization})\). Managing asset utilization is the proactive and integrated management of lean engineering and lean manufacturing. These are largely the costs that Western financial thinking tends to refer to as fixed costs. Clearly, the lower the costs to maintain the asset base required to run the company the greater the opportunity for the firm to be...
profitable. Value is, of course, meeting the wants and needs of the customer at the least possible cost. The more the company can achieve value, the greater its ability to achieve desired margins. By planning to maximize value and asset utilization on an integrated, companywide basis, the opportunity to maximize profits is achieved.

PROFITABILITY
Desired profitability can therefore be achieved by systematically attacking the sources of cost on a companywide basis and by focusing on achieving value. Those costs that Western firms have traditionally thought of as fixed are managed primarily through the systematic use of "zero-look VE" through a discipline referred to as life-cycle costing, while variable project-level costs are managed using zero-look VE and first-look VE, using target costing. Notice that project managers are not held responsible for the fixed costs that are outside the project's ability to affect. Those costs are managed on a companywide basis and are assigned to the project.

In reality the project is, therefore, not required to achieve its target cost but rather its target cost less the costs assigned it to cover companywide costs. And because the overriding concept is achieving desired profitability, it is critical that costs are managed after project launch to ensure that promised profitability is achieved, regardless of what happens following launch. Post-launch costs are managed with second-look VE using the disciplines of "kaizen costing" and "maintenance costing"—widely known as continuous improvement. Costs are managed on an ongoing basis, so the traditional Western concept of fixed costs is eliminated. All costs are treated as variable and can be managed. And the primary tool for managing those costs is value methodology. The key, of course, is that costs are managed on a companywide basis and are managed continuously in a planned and integrated fashion.

If achieving a target-costing plan is so important, why do so many Western industries rarely do it? When an Arthur Andersen study was made public a few years ago, many Japanese firms said the data collected must be wrong. They felt that the key to making a profit is knowing the cost of a product through every step of its development cycle and how that cost compares to the required target cost. Survey results from many Western companies stated that detailed cost knowledge was not available during the design process.

Too many Western businesses still believe they can determine the price that someone will pay for their product. They believe that cost + profit = selling price. The strongest and most successful companies in the world have learned that the customer determines the selling price. These companies know that selling price – cost = profit.

Simply put, by doing customer clinics and surveys the company determines what the customer will pay for a product and the functions it will perform. Then the company develops a strategic plan based on the company's entire product portfolio, the level of competitiveness in the marketplace, the level of technology being offered, and the profit desires of the company. This strategic plan includes the target cost plan. Another way to look at this is to use the determined selling price and subtract the target profit to decide the allowable cost.

This up-front strategic and target-cost plan determines the requirements that create accountability at downstream milestones. Up to 90% of a product's final cost is determined as soon as the design is complete. Studies have shown that 60% of the final product cost is established at the time of concept finalization. Without cost targets and without constant reference to the cost of what is being designed, the likelihood of developing the most cost-effective product is low. Without the knowledge of design cost, the probability of a profitability problem and the opportunity to lose money or at least minimize the profit is great.

APPLYING VALUE METHODOLOGY
We will now turn to an explanation of how the mechanics of target costing are employed in an individual project to ensure that the project achieves its desired profitability.

Once the target cost (also called allowable cost) for a new product is established, the next steps include a breakdown of that cost. Such a breakdown includes cost allocation all the way down to the component level and on a per-function basis. There is far more potential to avoid costs and investments of a new product in the development stages than in production stages, due to the opportunities available to implement change without the expensive cost of change. Target costing makes cost an input to the design process, not an outcome (Cooper and Slagmulder 1997).

Value methodology is best performed at each stage of the product development cycle—concept planning, basic product planning, design/prototype, and during preparation for production. These different stages are often called zero-look VE, first-look VE, second-look VE, etc. In some industries, such as the automobile industry, suppliers play a significant role in the total cost of the vehicle, perhaps approaching 70%. Thus it is extremely important for supplier involvement throughout this step of the process. According to Arthur Andersen & Co. (1993) Toyota has three key themes for working with suppliers, each of which relates to its VM activities:

• Design-in-cost (95% of cost reduction occurs prior to start of production)
• Improve quality
• Share engineering resources and people as the need arises

The VM approach follows the job plan in phases.

Information Phase
The strategic profit plan developed at the corporate level is broken down and assigned to the program manager for the area he or she can influence. Thus, each program manager has a specific profit plan that is based on the life cycle of the product, volume requirements, and the tolerated market selling price. Extensive marketing data must be collected to understand the exact functions and requirements for the product to be successful in the marketplace.

According to Fowler (1992), the project team must take the time to develop drawings and cost information for a VM effort to be successful. "Drawings may be file prints, marked up blueprints,
quadrille-pad sketches, or modified CAD drawings. Drafting-
room protocol does not constrain the effort. The objective is
simply to capture the essence of the part or assembly. Each
drawing is given a distinctive sketch number. An engineering parts
list is created to describe the hierarchical structure of the
sketches. Then these drawings and bill of materials are costed by
a task team of individuals. These people must have a broad range
of experience and background in the product and in cost
estimating. This costing activity needs to be performed on a
regular basis throughout the design development phases.

Function Phase
Function-requirement to function-cost comparisons are used to
identify opportunities and priorities for reducing cost through
value methodology. "Komatsu uses function-cost tables to
calculate the actual cost of components that perform needed
functions to the cost targets. [Komatsu is Japan's largest heavy
industrial manufacturer.] Based on the comparison, they determine
if they can meet the function, reliability, and cost targets" (Arthur
Andersen 1993). Obviously, functions that the customer feels are
important and necessary take precedence over functions the
manufacturer feels are important and necessary. This information
is used to determine where to focus creativity and is normally
assigned to different groups of designers.

The strongest and most successful companies
in the world have learned that the customer
determines the selling price. These companies
know that selling price = cost = profit.

Creativity
Design engineers now own the responsibility for meeting
customer-required functions and the strategic profit plan. This
often is not the case in Western cultures. Too often the designer is
only concerned with producing a product that will work, with little
or no concern for its cost. By using function-related thinking, the
opportunity to expand and develop ideas for product
improvements is vast. Function thinking takes the current product
or way of doing things out of the box, and allows for abstract
creativity on the part of the designers. Reverse engineering and
other comparisons with competitor products are used to identify
design differences and develop ideas for closing gaps between
target costs and estimated costs. Keep in mind that the objective
is not to minimize cost. The objective is to attain the target
cost and to reliably perform the required functions. Because
implementation costs often are not a factor, brainstorming
is not constrained.

Evaluation, Planning, and Implementation Phases
Traditional evaluation techniques should be used. The most
popular technique for comparing and evaluating competing ideas
is the idea selection matrix. This tool enables the participants to
list proposals and compare each to a set of criteria that the
team develops. Such criteria can include, but are not limited to,
ease of manufacturing, investment cost, producibility, reliability,
durability, and salability. The design team also establishes the
weight of importance for each criterion. The team then compares
each alternative and develops the relative importance of each
criterion to each proposal. A "value ratio" is developed and the
design team can objectively form a consensus on the best
alternatives to pursue. Obviously, each proposal goes through
extensive costing and the cost estimates are part of the value ratio.
Remember: The objective is to meet the target cost.

Because the product design is still in the development phase,
implementation of proposals is usually quite simple. The
selected proposals become part of the mainstream design before
investments in tooling, prototypes, and testing are made.

CONCLUSION
For a business to realize a profit on a newly developed product, it
must establish a target cost. To achieve this target costing plan is
the business' most important management task (Nagoya 1998).
There are six fundamental questions that companies need to
ask themselves before embarking on the target-costing VM
course. They are:
• Is profit management becoming more critical to the survival of
your firm?
• Is satisfying your customers becoming more critical to the
survival of the firm?
• Is product design becoming more critical to your firm's
survival?
• Are supplier relations becoming more critical to the survival of
your firm?
• Is cost management the right place to expend resources?
• Can you create the right organizational context to support
target costing and value engineering programs (Cooper and
Slagmulder 1997)?

Applying this process properly will most certainly require
a firm to rethink its entire strategic planning process and costing
philosophy. Despite the pains of change, the payoff is high.
Three decades of experience in Japan attest to target costing’s
ability to deliver planned profit and—in so doing—keep the
organization constantly focused on delivering value. The
companies in the West that can adopt target costing the soonest
and the fastest will find that they will have a very important
strategic and competitive edge that will take them far into the
next millennium.

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ACKNOWLEDGMENT

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James (Jim) A. Rains, Jr., CVS, is an industrial engineer for the General Motors Automotive Operations location in Warren, Michigan. He holds a bachelor's degree in industrial engineering from General Motors Institute and a master's degree in industrial management from Central Michigan University. Rains is active in SAVE International as its executive vice president. He is a member of the board of directors and serves as treasurer for the Lawrence D. Miles Value Foundation.

Mark Sullivan serves as the manager of strategic analysis at General Motors. He holds a master's degree in business administration from the Anderson Graduate School of Management at UCLA. Beyond his membership in SAVE International, Sullivan is active in the Society of Competitive Intelligence Professionals, World Future Society, American Marketing Association, International Benchmarking Clearinghouse, Society of Automotive Analysts, and Council for Continuous Improvement.

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Value analysis and value engineering are more than a half-century old. The concept evolved during the 1940s as a creative problem-solving system, implemented by the use of a specific set of techniques, a body of knowledge, and a group of learned skills.

The VA-VE team approach spread like wildfire and, by the 1970s, emerged as a systematic value management methodology, achieving larger and quicker value gains for many an organization across the world, including India. What is refreshing about it now is its lasting strategic value for sustained organizational renewal, in the fiercely competitive marketplace, as we step into the 21st century.

VA: THE ‘FUNCTION’ FETISH
It was Lawrence D. Miles of General Electric in the United States who developed the functional approach to purchasing. During and after World War II, material shortages were rampant; he found that he could search for and procure alternate materials to perform the same needed functions—and, in most instances, at less cost. Miles was hailed as the “father” of value analysis.

According to Miles all cost is for function, and value analysis is aimed at one specific need, e.g., accomplishing the functions that the customer needs and wants, reliably, at the lowest cost. Value analysis served as a searchlight to locate unnecessary costs; cost reduction resulted through removal of cost to perform the function, not of cost in making the part.

FIRST VA GAINS FOR INDIA
The earliest VA gains in India can be traced to the transportation sector—by road and by sea. During the 1940s, the best bus transportation system, run by TVS (T.V. Sundaram Iyengar & Sons, Madurai), could keep its fleet of buses running on the roads for about 96% of the time, as opposed to the then "world benchmark" usage factor of 97% in the United States and western Europe.

This was made possible by TVS’s quicker and more cost-effective approach to restoring the mobility of broken-down buses. TVS was the first to stock critical and essential assemblies of a bus in its depots. When a part of an assembly failed, the whole assembly was removed and a new one from the stock was fitted.

The bus was then made mobile within one or two hours, instead of the many hours—sometimes days—it took to repair and refit the same in the traditional method. Its VA cost-benefit analysis paid TVS good dividends over the decades. This approach has since become a standard industry practice to ensure availability of plants and equipment.

The largest VA gains for India—from transportation by sea—were first achieved by an Indian bureaucrat while in service in the United States in the early 1960s. M.S. Ram, who was the director general of India Supply Mission in Washington during 1957–62, effected more cost-effective shipments of wheat to India. The savings were nearly one-fourth, amounting to several millions of dollars—every year, throughout the 1960s—on transportation as well as foreign exchange.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Perceived Importance*</th>
<th>Largest Mismatches</th>
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<td>In-House vs. Customer</td>
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*Rating scale least important most important

Ram had learned about the VA efforts at GE and applied VA techniques to transport cargo. Traditionally, tankers from the U.S. Gulf were coming to the Persian Gulf “in-ballast” to pick up oil and return to America. If only a method could be found to utilize the tanker to carry grain, it could come loaded with grain from America to Bombay and return with oil from the Persian Gulf to America, thus getting cargo two ways.

The India Supply Mission in Washington was the first to boldly experiment transportation of grain in tankers, seizing quickly on two developments:
- A chemical injected into the tankers immediately after discharge of oil that could completely eliminate the oil and smell, and make the tanker fit for grain, and an Evacuator (by vacuum/suction) to speed up the grain discharge
- Instead of paying $25 per ton for dry cargo ships, the rates paid to the tankers were only $19 per ton. The gains were indeed significant on over 1 million tons of wheat transported every year.

With the India Supply Mission succeeding in transporting grains in...
tankers, the other 20 countries who were moving wheat from the United States in that period followed suit.

**FROM VA THROUGH VE TO VM**
Value analysis swiftly moved on to cost prevention and avoidance, at the "upstream" stage of product design and development. Value engineering was first adopted in 1954 by the U.S. Navy Bureau of Ships to analyze engineering drawings before ships were built. Design to cost and cost assurance were the later versions of value engineering.

Value management, the umbrella term denoting cost effectiveness, came into being in 1974 to encompass value analysis/value engineering at any stage and in any endeavor: construction, projects, programs, processes, services. More importantly, value management for world-class companies now aims at delivering superior quality at lower cost—both as perceived by the customer.

**BETTER VALUE FROM PRODUCT DESIGN**
Value analysis/value engineering recognizes that all designs have unnecessary costs and it is not possible to get the best balance among cost, performance, and reliability without a VE study. It is not a reflection on the designer’s ability, but rather a management problem to be addressed.

While traditional value analysis/value engineering tends to overlook small parts in an assembly, which may constitute a larger percentage in parts count, design for manufacturability and assembly is deployed with value engineering to reduce the number of components and enhance design efficiency, quality, and reliability.

DFMA specifically analyzes the need for a part to be a separate one and explicitly seeks possibly eliminating and combining parts of low functional importance with others. VE + DFMA workshops conducted by the author during the 1990s have shown an average potential reduction of 25% in the number of components of product assemblies, across organizations.

**FROM TQM TO CUSTOMER VALUE MANAGEMENT**
Total quality management initiatives progress through three stages:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Focus</th>
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<tbody>
<tr>
<td>1</td>
<td>Conformance quality</td>
</tr>
<tr>
<td>2</td>
<td>Customer satisfaction</td>
</tr>
<tr>
<td>3</td>
<td>Market-perceived quality and value, relative to competitors</td>
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</table>

In stage 1, ISO-9000 quality systems certify that products conform to the requirements of the customer. Quality function deployment is an effective methodology for translating customer requirements to part, product, and process characteristics and specifications. In stage 2, many enterprises develop their own "quality trees" delineating the various quality attributes, along with their weightages deemed to reflect the voice of the customer.

Traditionally, TQM/VM teams take an in-house view of rating characteristics considered important to the customer. Knowing directly from the customers can be a great learning experience for teams, as evidenced by the example of a flow meter shown in Table 1. If they were unaware of the mismatches, the VE team could well be working toward a costly meter with great accuracy and reading difficulty, while the customer needed a cheaper version—less accurate but easily readable.

**GAINS FROM CUSTOMER VALUE ANALYSIS**
Modi Xerox and many other TQM-practicing organizations that seek to fulfill international quality award and certification criteria go on to stage 3—for example, from customer focus to market orientation. They can gain more from using customer VA techniques such as:
- Market-perceived quality profile;
- Relative price profile;
- Customer value mapping;
- Orders won-lost analysis;
- Head-to-head customer value charting.

It is expected that customer value analysis will geometrically multiply the opportunities to use traditional value analysis/value engineering/value management, along with quality function deployment, design for manufacturability and assembly, and such others in the winning organizations of the 21st century.

Staying close to the total served market should induce organizations to do their own customer value mapping (see Figure 1). This can be a powerful tool to assess where a company’s product stands against the competition on the relative quality-relative price
matrix. Efforts made to operate below and to the right of the fair value line (the line on which quality is balanced against price) should help to beat competition and result in increased market share.

**VALUE MIGRATION ANALYSIS: THE EMERGING VALUE INITIATIVE PRIORITY**

Market value is increasingly perceived as an important barometer of a company’s progress. It is a measure of the power of business design to create and capture value; it is defined as the market capitalization at any given time (shares outstanding x stock price + long-term debt).

A business design is the totality of how a company selects its customers, defines and differentiates its offerings, defines the tasks it will perform itself and those it will outsource, arranges its resources, goes to market, creates utility for customers, and captures profit. Business designs also have a well-defined cycle of value growth, stability, and obsolescence; they represent the third of three important cycles: the product life cycle, the customer-priorities life cycle, and the business-design life cycle. Value migration is inevitable from outmoded business designs to new ones that are better able to satisfy customers’ most important priorities.

Recent studies reveal that neither market value nor revenue offers long-term profitability and value protection. Share of market value does it; the ratio of market value divided by revenue (MV/R) is the indicator of profitability and value. The ratio indicates the positioning of the organization’s business design along the three stages of its cycle: value growth, value stability, and value outflow. On assessing the status for the recent period and mapping the trend of value migration over time, ongoing efforts can quickly be made to capture, sustain, or protect value, as needed.

A high MV/R ratio (of 2 or more) typically indicates the value growth stage (spirit of conquest zone). A ratio of between 0.8 and 2.0 indicates the value stability stage (comfort zone), and a ratio of less than 0.8 to 1 indicates the value outflow stage (vulnerability zone).

The imperative top management priority is for organizations to do ongoing value migration analysis, anticipate value migration, protect existing value, and capture new value by modifying business design and offering new utilities to customers, as needed. It should enable managers to confront the obsolescence of their business designs hands-on to halt value erosion in quick time and create value gain progressively.

**VALUE VISTAS FOR THE 21ST CENTURY**

It should now become obvious that practicing traditional value analysis/value engineering/value management to manage customer value will not suffice in the coming decades. Many organizations that practice TQM, value management, and other methodologies have not thrived; many more have not survived in the fiercely competitive market of the 1990s. Baldrige Quality Award winners have closed shutters; INVI-ST Golden Key Award winners—the best VE/VM practicing Indian organizations—have hit a low or changed hands.

It is therefore imperative to go beyond present VM efforts to strategically align an organization and its business design with the evolving customer priorities to capture profit and value growth. Figure 2 gives the emerging “10 commandments” for managing value in the 21st century. Some insights on the emerging value vistas are highlighted below.

**Figure 2**

The ‘New Commandments’ for Managing Value: Value Vistas for the 21st Century

1. Demystify VA/VE/VM across the organization; let each employee feel excited to add value.
2. Actively listen to the voice of the customer; involve customers in the design of products and services.
3. Develop target costing for each new product; let individuals and teams put in VE efforts to ensure cost.
4. Synergize VE with DFMA; reduce number of components and greatly improve reliability.
5. Generate better value from procurement and outsourcing; partner with suppliers and develop co-destiny.
6. Conduct process value analysis; streamline flow by eliminating non-value-adding activities.
7. Use customer value analysis and gain market share by operating below and to the right of the fair value line.
8. Go beyond TQM to customer value management; deploy strategic initiatives in comprehensive alignment with the evolving market.
9. Value does migrate. Capture, sustain, or protect value by modifying business design to meet the priority needs of present and future customers.
10. Use a holistic and integrated ongoing approach to outperform by managing to provide ever-superior value; lead visibly with constancy of purpose.

1. **Involving All Employees in Value Work**

Outperforming organizations will increasingly seek total employee involvement as a way of life for continuous improvement of customer satisfaction. They will provide diverse stimuli—such as empowerment, small group activity, training, etc.—and will offer a wide “basket of values” to make all employees want to add value and abhor waste.

Enterprises have been experiencing large gains out of sporadic employee-improvement efforts. For example, Bharat Heavy Plates & Vessels had several value circles which helped its VM teams in reducing cycle times of its key processes. At Bharat Electronics Ltd., quality control circles initially had resistance problems; well-nurtured, they grew in large numbers. Some of them could solve chronic problems such as rejections and delays. BEL has now emerged as the best VM practicing organization, as adjudged by the Society of Indian Value Management.
In the coming years, the challenge to organizations will be in learning how to unleash employee creativity—intellectual capital, as it is increasingly perceived—in full. They can learn a lot from champions like Toyota's Taiichi Ohno, the “JIT evolutionary,” and GE’s Jack Welch, the most successful change master of this decade. They can share the strong belief of M.S. Ram: “VA-VE/VM will act as a catalyst in kindling the creative instincts of employees, who often work in a routine way and perform routine functions. It will add a new dimension to their personality and will lead to the value growth of their organization.”

2. Acting on Customer’s Voice
Winning companies will increasingly capitalize on customer complaints. In the past, many a top executive had traveled widely to personally listen to dealers’ or customers’ dissatisfaction. Illustratively, such “hard wiring” with customers by the managing director of the Madras Rubber Factory and the deputy managing director of Mahindra & Mahindra seeded their focused organizational efforts to emerge as market leaders in tires and tractors, respectively.

“Prosumers”— producers involving consumers in the design of their products—will increase. Becoming more sensitive to evolving customer priority needs will quickly modify producers’ business design to capture value and profit.

Hindustan Lever’s New Surf with Excel Power detergent powder, Jenson & Nicholson’s Instacolor paints, Mafatlal’s Dial-a-Trouser ready-made garments, and many others aim to go beyond customer satisfaction to customer delight, enthusiasm, and excitement.

Customer-satisfaction surveys will be conducted more frequently to assess a product’s standing against the competition and how to improve on it. New product- or service-development teams will involve their customers more to work toward their “first time right” designs.

3. Assuring New Product Cost
Target costing will be widely used to ensure profitability of new products. Because it equals market price minus target return, targeting cost is synonymous with profit planning.

Japanese firms pioneered its use through their cost-reduction strategies and VE activities. The goal of their VE teams (also called cost assurance teams) is to use the expertise and ingenuity of people in the company to develop innovative ideas to bring a new product’s cost into line with allowed cost.

In India, we habitually have been doing more of value management after a product is out. We need to develop target costing and put in focused VE efforts upstream in order to thrive.

4. Enhancing Product Reliability
For world-class companies, VM practice will become a way of life, since they strive for ever-increasing customer satisfaction (value) and inventory turns (waste elimination). VE/VM efforts will intensify on assemblies—particularly on new products and imported designs.

They will benefit enormously from the application of design for manufacturability and assembly, as well. The number of parts will reduce and reliability will be greatly enhanced. Multiplier gains will include reduction of assembly efforts, time, and cost. DFMA questions the need for a part to be separate based on three most essential criteria: relative motion, different material or characteristic, and necessary assembly or disassembly.

DFMA is being used in India in small doses. In the several “Synergy From VE + DFMA” workshops conducted by the author, one of the assemblies of imported design showed the largest parts-reduction potential of 47%. Spoon-size gains from value engineering and DFMA should become shovel-size in the years to come.

5. Creating Better Value From Procurement
Thriving companies will increasingly resort to outsourcing, limiting their in-house efforts to their core competencies. The trend will be toward fewer suppliers, technically sophisticated and willing to “co-destine” themselves with customers.

Fewer suppliers will be called to make preassembled modules and deliver on the line just-in-time, many times a day. General Motors, for example, visualized only 15 subassemblies for its 15,000-part car. On the Indian scene, TQM practitioners like Godrej-General Electric Appliances are developing greater numbers of on-the-line-delivery vendors.

Value-seeking companies will involve their suppliers more in their VM efforts to improve customer value. For example, Honda in the United States got suggestions from every supplier on its design for the 1998 Accord; it resulted in shaving 21.3% of the cost of producing the car.

In India, the purchasing and procurement function has traditionally been a suspected cost center with too many unreliable suppliers and too many personnel chasing timely high-quality supplies. We need to elevate it fast to transform it to a value center, generating more value and profit in the long run. Companies doing it increasingly and swiftly will thrive in the 21st century.

Process view is customer orientation, because customers perceive the company only through processes they interact with, such as order receiving and fulfillment, billing, and servicing. It is said that business is people in relationships; performing processes and customer satisfaction is its result. “Manage the process to get the result” is the emerging new mantra.

Business process improvement, redesign, and reengineering will be often be deployed because it is seen as the breakthrough operational strategy for total quality and competitiveness. TQM practitioners such as Hindustan Motors and Mahindra & Mahindra are already deploying BPR with impressive gains. TQM begot many other new “religions” in the last decade: total cost management, total improvement management, and total innovation management.

Process value analysis is an explicit step in total cost management. Through process mapping, it assesses the cycle efficiency in terms of value adding time as percentage of total time, and seeks to identify and eliminate the large non-value-
adding time consumed by unnecessary delay, inspection, storage, and transport activities. Should be process can reduce cycle time greatly through the use of information technology, for example. In India, we have been gainfully extending VM application to processes because is vs. should be is built into its evaluation-by-comparison technique. Fast cycle time will be effected more, in future years, through process value analysis; quicker response will be the result.

7. Gaining From Comparative Value Mapping
Outperforming companies will increasingly use customer VA techniques such as market-perceived quality and relative price profiles, orders won-lost analysis, and customer value mapping to understand their product’s standing against the competition. Independent agencies will be increasingly deployed to do the comparative studies and surveys.

Recent advertisements on the Indian scene already proclaim the superior quality features of a product and its lower price in relation to competitors’, e.g., cars, color TVs, computer printers, and home appliances, where competition is getting more fierce. Customer value analysis will greatly help in understanding and serving the market better.

8. Making All the Difference by Going Beyond TQM
The operational focus of winning companies will go beyond TQM to customer value management, because it will help them continuously align their operational strategies with evolving market needs. They will increasingly become market driven to achieve value growth.

How customer value management differs from “traditional” management and TQM is captured in Table 2.

Illustratively, companies like Hero Honda and TVS-Suzuki are already introducing new “super” models of two-wheelers, Daewoo and Tata Engineering & Locomotive Co. are on to develop their new small cars, and Kirloskar and Larsen & Toubro are diversifying into new businesses such as multipurpose passenger vehicles and tractors. Thriving organizations will more frequently reassess their strengths and core competencies and align themselves comprehensively with their changing markets.

9. Profiting From Sensitivity to Value Migration
Companies will seek an increased share of market value through a better understanding of the value-migration trends due to their current business designs. Value migration analysis will help them introspect and modify their business designs quickly to capture, sustain, and protect value and profits as needed.

Research has shown that the success of a business design in creating value is independent of company size. It gets reflected through positioning among the three value-migration stages: value inflow, stability, and outflow.

Hindustan Lever, for example, improved its market value/revenue ratio in 1996–97, compared with 1995–96, on their own and through the merger of Brooke Bond Lipton. Its value inflow will get much larger with the proposed merger of Ponds. Interestingly, Nirma has also leapt into the value inflow stage and is well set to achieve larger value growth.

Bajaj Auto, though it remains in the value inflow stage, has slipped downward on the MV/R ratio. Similarly L&T, continuing in the value stability stage, has a reduced ratio. Ashok Leyland has further lowered its ratio while remaining in the value outflow stage.

Managing transition of value migration from one stage to the other is challenging. For example, Hero Honda and Western India Products are on the move into the value growth stage from stability; on the other hand, Tata Iron & Steel Co. will now slip down from the value stability stage into the outflow stage (as Telco did), unless its value erosion is quickly arrested and reversed.

10. Making All Value Initiatives ‘Hum in Sync’
More multidimensional strategies will be deployed by organizations seeking to provide superior customer value. They will be more innovatively and seamlessly “marrying” their people with their emerging technologies, processes, products, and

![Table 2](image)

<table>
<thead>
<tr>
<th>Traditional Management</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Customer VM</th>
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<tbody>
<tr>
<td>Product out</td>
<td>Customer dissatisfaction</td>
<td>Close to customer</td>
<td>Close to market</td>
<td>Market aligned</td>
</tr>
<tr>
<td>Customer in</td>
<td>Conform to requirements</td>
<td>Customer satisfaction</td>
<td>Market standing</td>
<td>Value growth</td>
</tr>
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</table>
services. Not only the harp with so many strings should stay in tune, but the whole orchestra should continuously play in sync to the ever-changing tunes of the market, thereby exciting the customers to "pour in" value.

Top management will be constantly called upon to visibly demonstrate its commitment to, and constancy of purpose of, value strategies and initiatives. Thriving companies in the 21st century cannot do without their inspiring transformational contact leadership as well as the conducive teamwork among all people within and outside the organization.

Prospecting for Prosperity
The 21st century beckons enterprises to become global world-class players—winning all the way by providing superior customer value. They will be required to move quickly beyond the value management “wave” to be able to create value and grow.

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R.V. Gopalakrishnan is a management process consultant in Bangalore, India. He is an ex-faculty member of the Indian Institute of Management, Bangalore, and past chair of the Indian Value Engineering Society, Karnataka Chapter. Gopalakrishnan has received the Outstanding Contribution to Value Management award from the Society of Indian Value Management.

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Owner, Engineer, and Contractor Views of VE Incentive Clauses

George F. Jergeas, Ph.D., P.E., Vernon G. Cooke, I.S.P., and Francis Hartman, Ph.D., P.E.

INTRODUCTION

VE incentive clauses are not widely used in engineering contracts. Owners expect engineers to provide cost-effective solutions as part of their standard service and contractors to provide the materials and services described in the contract documents for the price indicated. Engineers believe they provide economical designs for their services and treat value engineering as a separate, reimbursable activity not tied to any savings it might produce. Contractors also expect to provide their most competitive response to the tender in order to win the business by providing a cost analysis similar to the value engineering of construction options during the pre-tender phase in their capacity as construction managers. This paper presents an examination of the VE practice of incentive compensation. The research purpose was to determine how well currently structured incentive arrangements motivate owners, engineers, and contractors to engage in value engineering. Currently used VE incentive arrangements and the motivations that drive various types of owner, engineer, and contractor engineering firms in their contracting practices were reviewed. Organizations’ views of one another, conflict areas, and VE obstacles were examined. Results were drawn together to produce a VE incentive clause presenting win-win opportunities for all parties while addressing individual concerns uncovered by the research.

METHODOLOGY

Following a detailed literature search and discussion with industry practitioners, researchers developed and tested a survey form. The survey form was used to collect empirical data and practitioner responses to case situations. Ten surveys were conducted with representatives from owner, engineer, and contractor organizations. An effort was made to balance the survey so that organizations with only experience as an owner, engineer, or contractor were included as well as organizations with experience in multiple domains, such as an owner and contractor firm and an engineer and contractor firm.

The individual industry practitioners surveyed were senior executives in their respective firms, typically at the director, vice-president, or president level. They were chosen because their backgrounds included both the real-life project experience required to understand project issues and the management expertise required to understand the business motivations and impact of VE incentive decisions.

Once complete, the literature research and survey material were consolidated and supplemented by material used in delivering University of Calgary project-management lectures. Analysis of these data should help identify barriers and benefits to the implementation of VE incentive clauses.

LITERATURE SEARCH

The logical starting point for this research was the structure of contracts, because all work performed between parties is the result of some form of contractual arrangement. Two parties typically hold a contract: an owner, who requires work performed and makes an offer, and a contractor, who accepts an owner’s offer and performs work for a fee. The term contractor also applies to engineers because both exchange their design and management services for compensation from owners. Although other variations of contracts are possible—such as multiple parties acting as owner or contractor—the underlying principle of the contract being an agreement remains the same (Goodfellow 1995).

It appears that the business environment has changed over time, influencing attitudes toward VE incentives.

Many contracts are awarded based on a tendering process. This process involves the owner precisely specifying performance guidelines, then accepting bids from contractors willing to satisfy those guidelines. In these cases, the owner would have performed any design work for the project prior to submitting it for contractor bids, ensuring the owner that bids received may be treated equally (Slater 1996; Lockwood 1996; Goodfellow 1995).

A variation to this rigid specification approach occurs where the owner will accept alternate solutions. This opens up the possibility for the contractor to undertake a VE exercise to provide a design that is fit-for-purpose, such as a concrete bridge instead of a steel bridge being able to carry traffic. The tender documents must make allowances for considering these alternates; the owner is obliged only to evaluate contractor-submitted bids that fully comply with tender documents (Goodfellow 1995; City of Calgary 1995).

Once parties have made a contract, they must perform according to the contract’s terms. This means that any changes to the work specified in the contract must be made through a contractually defined change-order process. Changes related to value engineering typically follow the change-order process defined in the contract, with a few additional steps to account for the fact that they originate...
from the contractor (Heller 1971, 143–144).

Value engineering modifications are handled contractually by Value Engineering Change Proposals. A VECP is a structured method of bringing about changes to the contracted work by specifying, in the contract, the obligations of each contract party for dealing with proposals that may result in VE-induced changes.

The VE incentive clauses studied (Fisk 1992, 372–373; O’Brien 1976, 232–233) accommodated increases in the project’s value regardless of whether the increase was due to a reduction or increase in the price of the project contract. In the case of a contract price reduction, the resultant savings were shared according to the defined sharing formula. Contract price increases were handled according to a change-order mechanism. These clauses generally contained a number of sections, as summarized in Figure 1.

The ability of contractors to include their VECP-development costs as part of the implementation costs of the proposed change varied according to their reimbursement arrangements. Those contractors who received direct compensation for VECP-development activities were not allowed to include these costs, while those who weren’t compensated were allowed to include them.

Savings after the execution phase that occur over the project’s lifetime, also known as collateral savings, were compensated to the contractor in varying degrees. Some contracts provided for a portion of one year’s savings (O’Brien 1976, 233); others provided for a portion of one year’s savings, plus a follow-on royalty based on a defined quantity of future savings (Heller 1971, 160–161).

ANALYSIS OF LITERATURE SEARCH

Contracts exist to document the agreements made between parties on a project. Each party is expected to perform to its obligations under its respective contract.

A form of contract exists during the tender phase of the contracting process, when the owner is obliged to consider contractor-submitted bids that are in full compliance with its tender only. Therefore, the owner must incorporate any alternative design requests as part of its tender to be able to enter into subsequent contracts that deal specifically with a contractor-submitted alternative.

Some contracts include clauses that define how to apportion contractor-identified VECP savings. The purpose of these clauses is to prompt contractors to identify potential savings in project areas not normally within their scope of control, with both the owner and contractor sharing in the resulting project-cost reductions.

The clauses provide for direct compensation of costs incurred for VECP preparation, either through owner-sponsored reimbursement or as part of the eventual savings realized. The former approach places the risk of developing the VECP with the owner because the owner must determine, up front, if the potential for savings outweighs the proposal costs. The latter approach encourages the contractor to seek VECP opportunities that will sufficiently cover its cost of development, placing the risk of incurring the VECP development costs with the contractor.

**Figure 1: Typical VECP Document Outline**

- **An application** section defines how the clause is to be invoked. Any limitations on what is not considered value engineering would be defined here.
- **A documentation** section defines the information required to back up a VECP claim. The contractor would be required to provide cost estimates and schedules as part of its proposal.
- The **logistics** of the submission defines how the VECP will be processed. This would include the quantity of VECP documents, whom they are to be submitted to, and the owner’s obligations to the contractor.
- The **owner acceptance** section describes the process for accepting and executing the VECP. Any processes for initiating change orders, allocating costs, and calculating the VECP savings are included here.
- In the **subcontracts** section, any VECP-related modifications to subcontracts are defined. This section would be present in those contracts where the owner wanted to pass on the benefits of VE incentives to subcontractors.
- **A confidentiality** section restricts the distribution of information contained in a VECP.

On the issue of collateral savings, the clauses placed a heavy emphasis on execution-phase savings while de-emphasizing collateral savings. This would encourage contractors to concentrate on immediate cost-reduction opportunities at the expense of lifetime cost-of-ownership savings, unless the subsequent savings were large enough to warrant the VECP’s development costs.

**INDUSTRY SURVEY**

This section examined the perspectives toward value engineering for each of owner, engineer, and contractor organizations. A common format for investigating each of these organizations was used.

- **Viewpoints:** An understanding of the beliefs and expectations held by owners, engineers, and contractors toward the other project parties set the context for the views expressed.
- **Lifetime:** The cost component of an item was defined to include the lifetime cost of that item, warranting an investigation on each party’s definition of project lifetime.
- **Conflict:** VE issues may arise and set one or more project parties in positions of conflict with each other, preventing the effective implementation of value engineering.
- **Obstacles:** Practices or procedures within the control of a project party may exist and hinder the implementation of value engineering.

Understanding the various positions the project parties have toward value engineering, as well as the problem areas value engineering faces, is required to develop an effective VE incentive mechanism. Knowing the obstacles that parties face allows appropriate measures to be taken to address those obstacles.
OWNERS PERSPECTIVES

The owner firms whose perspectives are presented in this section were primarily engaged in long-term ownership strategies of large capital projects such as hospitals and petrochemical facilities. Their views were balanced to some extent by engineer, procure, and construct firms, also engaged in large capital projects, who brought an owner’s understanding of engineering and contractor perspectives to the survey. This section is based on the views of seven such firms.

Contracts are essentially created by owners. Their contracts define the terms and conditions under which both engineers and contractors will provide materials or services to the owner. This gives the owner considerable flexibility in defining how those other parties are to be engaged. For example, VE incentive clauses may be either included or excluded, depending on the owner’s expectations for the project.

Owners rarely include VE incentive clauses in their contracts with engineers and contractors. Owners expect engineers to provide value-engineered designs as part of the normal course of business. They also expect contractors to perform their work according to the contract specifications and handle any contractor-initiated VE recommendations through negotiations (Revay and Jergeas 1996; Lockwood 1996; Lawson 1996; Fisher 1996; Lester 1996; Magnusson 1996). Table 1 summarizes the owner views on engineers, contractors, project lifetime, conflict areas, and obstacles to value engineering.

ANALYSIS OF OWNER PERSPECTIVES

In summary, owners appear to be interested in obtaining a project that performs some specified function—at the lowest price possible. When first awarding a contract, owners view themselves as willing to pay the contract amount to receive the contract-specified function. This is most often achieved through a competitive tendering process. Owners are receptive to contractor-initiated value engineering when the project’s function is maintained and the cost to the owner is reduced. In these cases, owners are less interested in the cost of the contractor’s materials and labor as they are about the price they pay the contractor, meaning that owners were more concerned with receiving a good price from the contractor than attempting to manage the contractor’s costs. Instead, owners feel that their contractors would be more competitive in their pricing knowing that their VECPs would be treated on a price or value-for-the-dollar basis. This leaves the contractor free to give the owner value-based pricing, with the owner evaluating the contractor’s price against the value of the proposed change, entering into pricing negotiations as needed.

Owners are less receptive to engineer-initiated VE activities outside the scope of the basic design agreement. This is due to the owner’s perception that the engineer must provide an economical design as part of its professional duties; owners are not receptive to paying an additional amount for specific VE activities.

Every party must work toward a common set of project

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<td><strong>Owner Views</strong></td>
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<td>Owner views on engineers</td>
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<td>Engaged for bulk of engineering</td>
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<td>Used to evaluate VECPs</td>
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<tr>
<td>VE improvements included in fee; no fee owing</td>
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<tr>
<td>Owner views on contractors</td>
</tr>
<tr>
<td>Little opportunity to make discoveries</td>
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<tr>
<td>Discrepancy between owner expectations and contractor rewards</td>
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<tr>
<td>Life-cycle costs not shaved, only capital costs</td>
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<tr>
<td>Owner views on project lifetime</td>
</tr>
<tr>
<td>Seek to minimize lifetime ownership cost</td>
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<tr>
<td>Seek to align project lifetime definitions among project team member</td>
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<tr>
<td>Apply VE to achieve cost-effective designs</td>
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<tr>
<td>Owner views on conflict areas</td>
</tr>
<tr>
<td>Engineers and contractors seek to maximize their margins with VECPs</td>
</tr>
<tr>
<td>VECPs seen as failure by engineer</td>
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<tr>
<td>Contractors can overuse or ignore VECPs</td>
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<tr>
<td>Owner views on obstacles to VE</td>
</tr>
<tr>
<td>Not a major concern unless changes limited by government agency</td>
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<tr>
<td>Poor communications hinder adoption of contractor VECPs</td>
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<td>Project schedule may not accommodate a VECP</td>
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16 Volume 22, Number 1, Spring 1999
objectives that are defined by the owner. One area where project objectives must match is in the definition of project lifetime. Everyone must contribute according to the owner’s lifetime definition in order to achieve a fit-for-owner-purpose project. At times, owners see other project parties matching the lifetime definition to their involvement, not the owner’s.

Conflicts between the project parties could develop. This most often occurs when there is confusion about the responsibilities each party is to have or the obligations that may be owed to other parties. One example is contractors and owners not appreciating the liability concerns that engineering firms have regarding design modifications; the engineering firm remains liable for the design, not the contractor or owner.

Effective communication practices play a part in helping the project participants understand each other’s positions and thereby reducing the potential for conflict, along with the goals they should be working toward to meet the owner’s expectations.

ENGINEER PERSPECTIVES

The engineering firms whose perspectives are presented in this section were primarily engaged in the design of large capital projects. A mixture of purely engineering firms and engineer, procure, and construct firms were surveyed to obtain an engineering viewpoint. This section is based on the views of eight such firms.

Engineering firms are engaged by owners to provide design services. In some instances the engineering firms supplement the owner’s in-house engineering staff, and others have complete control over the project’s design.

Engineering firms tend to view themselves as providing a complete, professional service for their fee. This professional attitude extends to their views on VE incentive clauses; most of the engineering firms surveyed did not currently make use of VE incentive clauses, nor did they desire to make use of them. Instead they viewed their incentive for developing an economical design, using VE techniques as appropriate, as being repeat business from the owner (Revay and Jerges 1996; McTague 1996; Hunka 1996; Annable 1996; Lester 1996).

Some engineers see a trend toward incentive-based contracting in place of VE incentives. For example, an engineering firm would achieve some predetermined project criteria, such as time frames or overall cost, and receive an incentive or penalty for its efforts. As a result, the engineering firm shares in the overall success or failure associated with defined objectives (Annable 1996; Magnusson 1996). One engineering firm did make use of VE incentive clauses, though the clauses tended to form part of a larger incentive-based contract. (Mapp 1996).

A common theme was the engineering firm’s desire to create economical designs for the owner. For example, some engineers have reorganized themselves to take maximum advantage of the technology currently available. Though the savings generated from such measures are not incentive clauses, they lower the...

| Table 2  
| Engineer Views |
| Engineer views on owners | Not receptive to VECP clauses  
Reluctant to deviate from specifications  
Contract documents ill-defined, making VECPs difficult to quantify |
| Engineer views on contractors | Request changes to signed contracts with no savings to owner  
May attempt to provide items below industry standard |
| Engineer views on project lifetime | Owner defines project lifetime.  
Challenge is to maximize owner’s return on investment during owner’s involvement.  
Life-cycle costing through decommissioning becoming common. |
| Engineer views on conflict areas | Contractor and engineer responsibilities are unclearly defined.  
Engineer could challenge contractor VECP because it reflects negatively on engineer.  
VE reduces engineer’s margin in fixed-fee contracts. |
| Engineer views on obstacles to VE | Engineer may hire less-experienced design staff unfamiliar with VE.  
Owner needs proficient staff to process VECPs.  
Owner may not have tolerance for innovative VECPs.  
Fit-for-purpose projects make VECPs hard to quantify. |
overall cost and time to complete the project. As a result these firms are able to lower their fees to win business, which benefits the owner through lower engineering costs (McTague 1996; Hunka 1996; Annable 1996). One engineering firm related the following example of economical design work. Although this is not a traditional VE-based apportionment of savings, it does illustrate how both owner and engineer benefit from VE savings (McTague 1996).

Engineering services are charged at about $50 per hour, and it may take about 4,000 hours to engineer a $2 million project. If the owner is willing to invest an additional 500 hours of engineering with the engineering firm, the engineering firm believes it may reduce the total project cost to $1.5 million. This savings of $500,000 translates into a savings of 10,000 engineering hours. Therefore, by the owner investing a total of 4,500 hours in engineering and receiving a 10,000-hour reduction in engineering equivalent, the owner ended up receiving an instant return of more than twice its investment in engineering. Table 2 summarizes the engineer views on owners, contractors, project lifetime, conflict areas, and obstacles to value engineering.

ANALYSIS OF ENGINEER PERSPECTIVES

Engineers believe that they provide economical designs as part of their fee for service. Because value engineering represents services over and above what would be considered basic design services, engineers offer these services on a separate fee basis. This also affords them the opportunity to explain to the owner the value offered by a VE exercise and why the firm must be remunerated in addition to its base fee.

Instead of engaging in VE incentive arrangements, engineers prefer to form relationships with the owner. The engineering firm’s incentive then becomes producing economical, fit-for-purpose designs to obtain the owner’s business. Designs that continually show the owner more value than competing designs will result in the engineering firm’s services being reused by the owner; the engineering firm’s VE incentive is repeat business. In cases where VE incentive arrangements are used, they tended to form part of an overall incentive-based contract.

Owners are receptive to contractor-initiated value engineering when the project’s function is maintained and the cost to the owner is reduced.

The owner’s project objectives generally become the objectives the engineering firm attempts to meet. This would involve the engineering firm aligning its vision with the owner’s in areas where the objective might be different. In areas where the owner did not make any specific statements, the engineering firm would use its professional judgment to set certain design goals.

Conflicts develop when project authority and lines of communication are not well defined. This opens up the possibility for the engineer to unknowingly accept responsibility as the engineer of record for design modifications performed by others. With effective communication procedures in place, the engineer would be able to accept responsibility for project changes because the engineer would become an integral part of the change-order process.

CONTRACTOR PERSPECTIVES

The contractor firms whose perspectives are presented in this section were primarily engaged in the execution of large capital projects such as buildings, civil works, and petrochemical facilities. A mixture of purely contracting firms was balanced by engineer and owner firms that also engaged in project execution activities. Like the previous sections, such an approach provides contractor viewpoints tempered by the understanding of motivations behind other project parties. This section is based on the views of five such firms.

Contractors obtain the majority of their business through the tendering process. This process typically places well-defined work out for lump-sum bids from competing contractors, providing little opportunity for them to provide a value-engineered solution as part of their bid response. However, in some instances, the tender allows for alternatives, meaning that there is an opportunity for the contractor to submit a more economical solution to the owner (Slater 1996, City of Calgary 1995).

One contractor provided the following example of how it would use such alternate bid opportunities to its advantage. The contractor first develops its base bid response to ensure compliance with the minimum terms of the tender. Parallel to the base bid response, the contractor develops any probable alternative solutions, using VE techniques as required. Once completed, the contractor evaluates the probability of the owner approving its alternate proposal and uses the results of that analysis to reduce its base bid amount. The objective of this exercise is to win the business on the lowest base bid amount, leveraging the base bid by the acceptance probability of the alternate solution (Lockwood 1996, City of Calgary 1995).

From a contractor’s perspective, the incentive in providing the owner with an economical solution is to win the business (Slater 1996). Table 3 summarizes the contractor views on owners, project lifetime, conflict areas, and obstacles to VE.

ANALYSIS OF CONTRACTOR PERSPECTIVES

Contractors have the potential to add value to the project in its early stages by becoming involved as construction managers. This affords them the opportunity to provide constructability analysis, which helps solicit bids that are focused on the project’s overall objectives. The contractor’s incentive for performing this duty is twofold. First, the contractor helps the owner set an accurate baseline capital budget. The owner will be able to use this information to make go or no-go decisions early on, before contractors spend nonreimbursable effort to prepare a bid.

Second, the contractor is able to build an ancillary line of business—that of construction manager. The construction manager’s role allows the contractor to show the owner the value...
of the manager’s construction knowledge. As a result, the contractor’s incentive becomes forming a relationship with the owner that it can leverage for future business.

A common alignment on project goals is achieved when the owner communicates those goals to the contractor. Contractors will adjust their views on the project objectives to match the owner’s, even in cases in which the contractor believes a different objective may be better. For example, the owner’s short-term capital decisions affect the potential resale value of the project.

Although the contractors interviewed for this paper did not have any experience with VE incentive clauses, they did believe that, if they did encounter one, they would like it to be well-defined, especially in the area of savings calculations. Their objective would be to obtain a full understanding of the clause to avoid disputes over future misinterpretations (Slater 1996).

**CONCLUSIONS**

Value engineering incentive clauses are not widely used. Owners tended to view these clauses as not meaningful to their relationships with engineers, because they expected engineers to provide cost-effective solutions as part of their standard service offerings. Likewise, engineers viewed themselves as providing economical designs for their services. This would include using VE techniques where necessary, but more often than not engineers preferred to treat value engineering as a separate, reimbursable activity; they did not see themselves being influenced by the potential to share in the savings generated by value engineering.

As for contractors, owners expect them to provide the materials and services described in the contract documents for the indicated prices. Contractors are typically chosen by competitive tender, so the owner feels assured of obtaining those services at the lowest cost. Similarly, contractors expect to provide their most competitive response to the tender to win the business. If possible, they would like to be engaged prior to the tender stage as a construction manager, at which time they would provide VE-like cost analyses of construction options to better help the owner meet project objectives.

Engineers and contractors are very competitive in their desire to win business. This competitiveness was evident in the methods engineers used to provide economical designs, and the desire by contractors to provide pre-execution construction management services. Both types of firms felt their biggest incentive was winning future business through relationship building by demonstrating the value of their service offering on the project. The development of a relationship with the owner was viewed as more important than the immediate benefits offered by a structured VE incentive clause.

> Because value engineering represents services over and above what would be considered basic design services, engineers offer these services on a separate fee basis.

Although VE incentive clauses were not provided for in the contract documents, owners would not object to reviewing VE proposals made by contractors. These proposals would be implemented if they were beneficial, with both owner and contractor negotiating the compensation arrangements.

All parties—the owners, engineers, and contractors—believed that a common project vision was essential for the successful completion of the project. Effectively communicating

| Table 3 |
| Contractor Views |

| Contractor views on owners | Commercial owners focus on lowest capital cost. Institutional owners focus on lowest life-cycle cost. Participation in design with owner clarifies project requirements and costs. |
| Contractor views on project lifetime | Owner defines project lifetime. Good communication with owner ensures a common goal. |
| Contractor views on conflict areas | Engineer may not accept VECPs. Owner becomes highest project authority to resolve conflicts. Reduction of capital cost affects compensation due to other project parties. |
| Contractor views on obstacles to VE | Risk of expending time on VECPs that are not accepted Risk of VECP running past project completion, making costs unrecoverable VE becomes cost-reduction activity for owner with limited budget. |
the project’s objectives helps ensure that everyone understands the vision and is working toward common objectives.

Good communication also helps the parties express their concerns to each other, reducing the potential for conflicts to develop. For example, engineers have a vested interest in any design activities that may take place on the project due to the professional liabilities associated with being the engineer of record. This means that owners and contractors should involve the engineer in any design modifications they are contemplating to ensure continued engineer acceptance of the project’s design.

RECOMMENDATIONS

Any compensation methodologies relating to value engineering must be accommodated by the various contracts that exist on the project, because the project parties are bound to interact with each other under the terms of their specific contractual agreement. It was found that, in practice, formal VE incentive clauses were not incorporated into these contracts. Instead, the parties preferred to handle the subject of VE compensation through negotiations.

This points out a discrepancy between the incentive clauses described in the literature and their use in practice. The literature described VE incentive clauses in great detail, including each party’s responsibilities and the division of resulting savings. In practice they were not used, even though they provide a win-win situation for both owner and contractor. It appears that the business environment has changed over time, influencing attitudes toward VE incentives. To paraphrase one of the research sources (Magnusson 1996):

As time passes, economic conditions may affect the behavior of people toward incentives. For example, during the 1960s and 1970s, periods of high growth, relationship building was less important since new projects from new customers were continually available. The object was to obtain as much margin from each project as possible, hence the use of incentive clauses. In the nineties business has entered a survival mode. There are fewer projects available, making the preservation of the customer base a key business success factor. Relationships, which are used to develop and maintain the customer base, have replaced incentive clauses as a tool to maximize an organization’s margin.

Given that negotiations have replaced contract-specified terms and conditions, and that any activity occurring between the project parties must still be accommodated by their contract, a revision to the formal VE incentive clause is due. The goal of such a revised clause would be to:

• Formalize the fact that VE activities are permitted to occur on the project.
• Define a mechanism for processing and approving VE proposals, including the criteria that will be used to judge each proposal.
• Ensure that the vested interests of all affected project parties are addressed.
• Leave the apportionment of VE savings open for negotiation.

The intention of the proposed contract clause framework in Figure 2 is to formalize the currently practiced negotiations within the context of a contract.

The authors believe that this VE incentive clause framework in Figure 2 addresses the concerns raised by owner, engineer, and contractor firms, as indicated by our research. We would like to encourage readers to take this framework and incorporate it into your future contracts, modifying it as needed to suit your needs. Our objective in making this request is for you and the other project parties to benefit from the practice of value engineering.

Figure 2
Recommended VECP Contract Framework

1. The contractor will make all reasonable efforts to identify areas of the project in which modified materials or designs may result in an increase in the project’s life-cycle value.
2. The owner will supply life cycle-cost calculations and criteria for the contractor’s examination for any project work item.
3. The VE proposal’s costs of development and evaluation will be negotiated by the owner and contractor prior to the contractor proceeding to develop the proposal.
4. The contractor’s VE proposals must be fully priced, including reengineering costs; approved by any stakeholders in the change, including the project’s engineer; and accompanied by life cycle-cost calculations using the owner’s formulae and criteria for the affected work items.
5. Any additional contractor remuneration over and above the contractor’s fully priced value engineering proposal, such as an apportionment of the lifetime cost savings, will be determined through contractor and owner negotiations.
6. Any value engineering proposals must be executed by way of a change order.
7. The owner, if agreeable to the proposal, will issue a value engineering change order.
8. In the event the owner disagrees with the contractor’s life cycle-cost calculations or impact on the item’s life-cycle worth, the owner will not issue any change order substantially complying with the contractor’s submission outside of the VECP process.
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George F. Jergeas, Ph.D., P.E., is associate professor of project management in the Department of Civil Engineering at the University of Calgary in Calgary, Alberta, Canada.

Vernon G. Cook, I.S.P., is solutions architect for Compaq Canada in Calgary, Alberta, Canada.

Francis Hartman, Ph.D., P.E., is director and chair of project management in the Department of Civil Engineering at the University of Calgary in Calgary, Alberta, Canada.

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