

TWO VALUE MODELS FOR TEAM PROBLEM SOLVING



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Where emphasis is placed, accomplishments result."

Larry Miles

The father of Value Analysis and Engineering

ABSTRACT

Two value models representing diminishing returns and accelerating growth, are presented. Early use of the models provides direction needed for high value problem solving by individuals and teams. This education and training 1995 SAVE paper completes a trilogy. It is the sequel to the VE techniques 1992 SAVE paper, "Function Analysis for Team Problem Solving," and the behavior & creativity 1993 SAVE paper, "Value Assessment of Team Problem Solving."

INTRODUCTION

High value problem solving often appears deceptively simple while in reality it is more difficult than many realize. For example, over 1.3 trillion ways exist just to rank 15 items. "Why" and "How" we deal with people and things are a value challenge.

VA/VC/VE/VM uniquely address this challenge and are considered synonymous because they have value methodology as their nucleus. The methodology challenges overall function and total cost of products, processes and services. It increases value by eliminating and preventing unnecessary functions and by improving needed functions.

VE function analysis with a disciplined job plan

invariably produces excellent results. Paybacks of 5:1 with cost savings of 5-15% are common. Less often, but not infrequently, paybacks are produced greater than 5:1 with cost savings approaching 100%.

Because VE improves function, it should not be focused only on decreasing cost. For example, with cost increases of 0-100+% value outcomes sometimes are extraordinary with existing functions enhanced and new functions created for paybacks exceeding 10:1.

A common value technique is blast-create-refine. The technique produces a "blast" departure from the norm and sometimes is called challenge-create-refine to obviate technical or, more likely, emotional roadblocks.

When a departure is a relatively simple change of existing technology, technology transfer, the "challenge" portion of the technique is itself a refinement step. Refinement generally is a diminishing returns activity and produces excellent though often not extraordinary value.

When a departure is a fundamental breakthrough, technology creation, the "challenge" portion of the technique is a renewal step, a "blast," an innovative leap and a break with tradition. Renewal generally is an accelerating growth activity and often produces extraordinary high value results because technological innovation has few if any limits.

Achieving and maintaining world class excellence requires extraordinary Win-For-All high value team problem solving in everything we do and with everyone we know.

Extraordinary Problem Solving Essential



Figure 1

Teams and individuals not achieving an appropriate Win-For-All relationship of overall benefit, quality and performance, with total cost are themselves a root cause of less than satisfactory value. At issue is the activity scope of their high value problem solving. For example, getting a lot more for your money is not necessarily a Win-For-All high value activity. A focus on function and value only for cost cutting and cost reduction is less than satisfactory. Improving value sometimes requires more, not less, cost. Increasing cost to improve function can appropriately increase earnings and revenues to achieve needed Win-For-All high value results.

TWO VALUE MODELS

For brevity, our rapidly changing world is considered as a dynamic system represented by two value models, diminishing returns and accelerating growth. The diminishing returns model represents refinement with an improvement rate that is decreasing. The accelerating growth model represents renewal with an improvement rate that is increasing. By helping us to better understand past and present as well as to foresee the future, the two models are crystal ball windows for improving our challenge-create-refine comprehension of what we are doing and what we can and should be doing,

Two Value Models

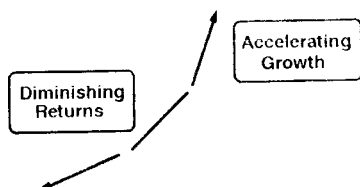


Figure 2

Diminishing Returns

Diminishing returns improvement has high value provided enough, *but not too much*, is conducted and implemented. An excellent example is the marginal analysis work conducted in the early 1900's by the economist Vilfredo Pareto. During the 1930's and 1940's, T.P. Wright and J.R. Crawford called the diminishing returns model the learning curve and applied it to aircraft production. The diminishing returns model is a power function:

$$Y \propto X^B$$

With each doubling of quantity (X units), cumulative average unit cost (Y cum avg \$/unit) decreases by a percentage. Similarly, with each doubling of quantity (X units), unit cost (Y \$/unit) decreases by a percentage. The learning curve is represented by a diminishing returns model 1) because each additional doubling of quantity requires ever larger absolute quantity increases and 2) because as base cost decreases, caused by quantity doubling, the same percentage cost decrease has ever smaller absolute cost decreases.

For example, a typical 87% learning curve for manufacturing suppliers has an exponent (B) of approximately -0.2. With each doubling of quantity, cumulative average unit cost and unit cost decrease to about $1.00 - 0.87 = 13\%$ of their base costs.

Accelerating Growth

Accelerating growth improvement has high value provided enough, *but not too little*, is conducted and implemented. For example, in the late 1700's by underestimating the accelerating growth of ingenuity and technology, the Reverend Thomas Malthus dismally and incorrectly predicted that nearly all of us will live our lives at a minimum level of subsistence. The accelerating growth model is commonly called the growth curve and is an exponential function:

$$Y \propto e^{kX}$$

With each incremental increase (X), the population (Y) exponentially increases. Especially for information and information related products, accelerating growth has few if any limits. An

exponential growth curve is represented by the accelerating growth model 1) because for a fixed absolute increment (X), e.g., the completion of a year, the population (Y) increases by a percentage and 2) because, as base population increases, the same percentage population increase has ever larger absolute population increases.

For example, a 100% per annum growth curve -- an expansion by a growth factor of 2.0 per year that is typical for electronic and computer suppliers -- has a constant (k) of about +0.7. Within a decade, its base population increases more than 1,000 times. In two decades, it grows more than 1,000,000 times. That is, over a 20 year period, growth factors exceeding one million are common for information and information related products.

CAUTION

The two value models I have presented, diminishing returns and accelerating growth, are of course mathematical models. They do not represent reality 1:1 because they are an over-simplification of reality. A mechanistic application of the models, separately, together or with other models and structures, is not recommended. Careful common sense judgment by value practitioners and others is required.

As discussed at the beginning of this paper, Win-For-All high value team problem solving often appears deceptively simple while in reality it is more difficult than many realize. In particular, it requires a reasonable and realistic concern for both people and things to provide Win-For-All customer satisfaction that includes a Win-Win-Win for suppliers-contractors-customers as well as for you-me-others.

PAYBACK AND VALUE ADDED

This paper considers value added the same as a marginal rate of return, prevailing instantaneous payback (dY/dX). Because value added (dY/dX) seldom is constant, enough *but not too much or too little* high value problem solving is essential.

Payback

A cost ratio (Y/X) sometimes is quoted incorrectly as payback

. Similarly, paybacks claimed by some are an average payback ($\Delta Y/\Delta X$) and not a prevailing

instantaneous payback (dY/dX). Favorable cost ratios and average paybacks do not assure favorable prevailing instantaneous paybacks.

High value team problem solving requires favorable prevailing instantaneous paybacks. Previous effort accomplishment is not at issue. Culmination points, breakevens where *too little or too much* effort loses more than is gained, are a value added issue.

Value Added

Diminishing returns value added generally starts large and becomes ever smaller. Beyond a breakeven culmination point, too much team problem solving decreases cost savings and is increasingly counterproductive.

Accelerating growth value added generally starts small and becomes ever larger. For relatively large initial implementation costs, too little team problem solving might produce negative cost savings.

DISCUSSION

Several value approaches are needed for different situations to assure an appropriate Win-For-All high value relationship of overall benefit with total cost. THE WAY really is Many Ways. Moreover, both diminishing returns and accelerating growth might have less than satisfactory high value outcomes. That is, even the biggest bang for the buck (a very large effect for a relatively small low cost effort) might be lacking a Win-For-All relationship of overall benefit with total cost.

Win-For-All is a cardinal high value problem solving issue. Winner-Take-All increasingly is inappropriate because what is needed and wanted is Win-For-All, a Win-Win-Win for suppliers-contractors-customers as well as for you-me-others. Win-For-All high value team problem solving often requires more, not less, cost.

The end of the Cold War has accelerated a move from confrontation to cooperation. It has started a major transformation, a paradigm shift, from Win-Lose containment and self-sacrifice to Win-Win, to Win-Win-Win and eventually to Win-For-All enlargement and self-fulfillment. The changing world we live in now is changing as never before. It is changing from conformity to diversity.

In several ways, events are overtaking us. Our world is changing beyond what previously has been experienced. The agricultural revolution has come and gone. The industrial revolution also is becoming history as it is replaced by the information revolution. There is no doubt that the rate of change in today's world is accelerating. For example, less than 3% of working Americans are in agriculture and less than one in six have manufacturing jobs. Within a few more years, by the turn of the next century, service work quite likely will account for nearly all U.S. jobs. Today, service related work accounts for more than 80% of U.S. jobs.

Cost Cutting

Cost cutting (sacrificing function to reduce cost and improve value) generally is appropriate for deteriorating markets with declining revenue. Because functions no longer are needed, cost cutting is cannibalistic. To assure the biggest bang from declining bucks due to cost cutting, high value problem solving is essential.

A cost cutting example is the reduced U.S. defense budget due to the end of the Cold War. The budget now is less than half what it recently was. In the early 50's Norbert Weiner, the father of cybernetics, foresaw the cost cutting consequences of the Cold War's end -- an excess backlog world-wide of people and things -- a transitional period of economic confusion caused by a mechanistic limited focus on immediate paybacks and profits. He foresaw the uncertainty of receiving a long term benefit and knew we first must survive a difficult cost cutting transformation. Cost cutting seldom is Win-For-All in the near term and, if pathological, is not Win-For-All in the long term.

Cost Reduction

Cost reduction (refining function to reduce cost and improve value) usually has highest value during the first "challenge-create-refine" step immediately following a "blast" innovative renewal leap. The first refine step often has highest value because successive refine steps generally follow a diminishing returns learning curve that eventually is counterproductive.

In a mature, stagnant or fixed market, reducing unit cost decreases revenue. Somewhat similar to cost cutting, cost reduction is not a Win-For-All high value activity if unemployment increases and resources are under utilized. To take up the revenue

decrease slack caused by cost reduction, real market growth in the form of function innovation is needed to sustain, or preferably to continually increase, overall revenues and earnings.

For example, after production of about 15 million cars the Model T Ford had its price drop from \$850 in 1910 to \$290 in 1926. Adjusting for wholesale prices of metal products being 15% less in 1926 and considering that by 1910 over 10,000 cars already were produced, the Model T over its life cycle followed a learning curve of 88-90%. As impressive as the Model T's long term record of American manufacturing productivity achievement is, it was a diminishing returns achievement. Henry Ford's "You can have any color you want as long as it is black." focus on cost reduction, refining but not increasing function, eventually caused a stagnant and finally a declining market for the phenomenal Model T Ford.

Interestingly, the Wright Flyer also has an arrested development history. After flying their aircraft, the Wright Brothers' primary focus shifted from high value technological innovation to patent protection. Relatively quickly, others surpassed the Wright Brothers' remarkable achievement of man's first powered flight in a heavier than air machine.

For example, in the early 1800's at the beginning of the Industrial Revolution, Charles Babbage, pioneer of the computer, deplored the Luddites who opposed introduction of new machinery by smashing the English lace frames at Nottinghamshire. Luddite machinery destruction was (and still is) a futile gesture by people driven by desperation and questionable high value technological innovation. France and the United States have had similar experiences. Before the U.S. Civil War began, slaves were considered materially better off than seamstresses. Small wonder that in 1841, an enraged Paris mob of tailors and seamstresses destroyed inventor Barthelemy Thimonnier's stock of 80 wooden sewing machines. The sewing-machine industry became a boon only during the U.S. Civil War when the Union Army created both the need and the funds for many new uniforms. However, after the end of that war, the lower ranks of the industry settled back into the worse patterns of hand-sewing days.

Market Creation

The automatic age, the second industrial revolution where machinery -- especially automatic machinery -- is the economic equivalent of physical

and mental slave labor, was an outcome of World War II seminal work conducted by Norbert Weiner with others. Because it is capable of replacing both brain and brawn of human production, the information revolution, as we now know it, is a serious matter. Norbert Weiner considered the information revolution increasingly capable of producing only 'an uncertain benefit of limited duration to a relatively select and privileged few. He foresaw cost cutting, cost reduction and market creation applied mechanistically would ever more frequently produce less than satisfactory outcomes that are not Win-For-All high value.

Customer Satisfaction

CUSTOMER SATISFACTION

Customer satisfaction (improving function and cost to satisfy customers and improve value) requires Win-For-All high value problem solving. When an activity is locally high value but not globally high value, the activity frequently does not satisfy a reasonable and realistic expectation of Win-For-All customer satisfaction.

The way we conduct our lives is moving from a relatively restrictive containment approach to a more liberal vision of endless expansion with accelerating growth. However, the temporal wealth distribution of accelerating growth typically has the rich getting richer as the poor remain nearly the same. To achieve Win-For-All high value, both people and things need to be better addressed. This is a social obligation as well as a business and technical challenge.

Practitioners of quality, performance, cost and value sometimes forget that people are not things. People are human and should be treated humanely. As we more rapidly transform our world, less shock and more therapy are essential. Win-For-All high value outcomes are an obligation and a challenge. For example, accelerating growth increases differences between people as well as between things. Because it increases disparity and inequality, a better understanding and greater acceptance of the increasing diversity caused by accelerating growth is needed. Diversity, not uniformity, is a fundamental characteristic of accelerating growth.

Attract and satisfy high value technological innovation focuses on customer satisfaction that includes: dependability, convenience, enhancements and expectations. In this respect, because its primary focus is on people, rather than things, it is the inverse

or reverse of conforming to a performance culture that focuses on the four "M's" of productivity: methods, machinery, manpower and material. The roots of proactively attracting and satisfying customer compliments, rather than reactively addressing and resolving production complaints, were pioneered by psychologist Hugo Münsterberg, who was the director of the Harvard experimental psychology laboratory at the turn of century. The dramatic Hawthorn Experiments are a qualitative extension of Münsterberg's approach.

Mechanistic refinement, e.g., W. Edwards Deming's quality is free approach with the approaches of Walter Shewhart's statistical quality control and Frederick Taylor's so called "scientific management," no longer is adequate. Attempts to reduce variation by establishing uniform order and control, frequently applied with a micro-management focus to repetitive minutia, still might be necessary but now are insufficient. To achieve Win-For-All customer satisfaction, high value technological innovation of today and tomorrow requires moving from a reactive approach of reducing manufacturing complaints to a proactive approach of increasing customer compliments,

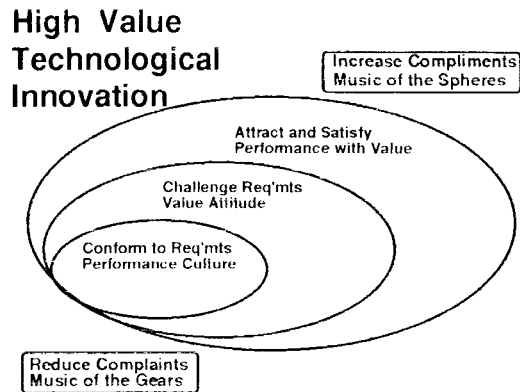


Figure 3

Original VE techniques and applications focused on manufacturing with the objective of training people to reduce existing hardware cost. To significantly improve value while globally meeting Win-For-All customer requirements and expectations, modern high value VE techniques and applications of today and tomorrow must perform ever better and faster. They need to continually expand existing markets as well as create new markets for hardware and software, products and processes, services and practices.

Value Engineering

Original VE Existing Products	Modern VE New Products
<ul style="list-style-type: none"> • Reduce hardware cost • Train employees and suppliers 	<ul style="list-style-type: none"> • Improve product value • Meet customer needs and wants

Figure 4

CONCLUSION & RECOMMENDATIONS

High value cost cutting, cost reduction and market creation need to be better orchestrated for improved customer satisfaction. An issue is the distribution of high value outcomes -- the color of money -- who gets what, when and where. To counterbalance diminishing returns, the sustained and ever higher value outcomes of accelerating growth often are necessary for reasonable and realistic Win-For-All results.

More accelerating growth renewal is needed because Win-For-All high value improvement requires increasing revenues and earnings by appropriately increasing overall function as well as total cost. The two value models, diminishing returns and accelerating growth, should be better understood and used for problem solving. Sustained Win-For-All high value problem solving requires diminishing returns refinement and accelerating growth renewal.

Greater acceptance of increasing diversity for more humanistic Win-For-All outcomes of extraordinary world class value is recommended. Manufacturing cost reduction was an early VE focus that over the 2nd half of this century has expanded to include construction, service, information and information related industries. Now for the 1990's and the 21st century, VE is positioned to takeoff as its focus continues to expand beyond the diminishing returns of cost cutting and cost reduction to the accelerating growth of continual market creation and customer satisfaction.

ACKNOWLEDGMENTS

The interest and assistance of Louis K. Bragaw,

Jr., Hartford Graduate Center, John Calaci, LORAL Vought Systems, Ted Fowler, CVS, Fowler & Whitestone, Joe Lambert, CVS, Lockheed Martin, and Dave Mitchell, SAE, are gratefully acknowledged. The encouragement and cooperation of associates and organizations within industry, government and academia also are helpful and are appreciated.

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