

Value Engineering: A Systematic Team Approach for Strategic Planning

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Abstract. The Value Engineering (VE) Methodology is an effective tool for business or strategic planning. While there are many viable strategic planning processes, the “Balanced Scorecard” approach (formally developed by Robert Kaplan, PhD, and David Norton, PhD), is highlighted here using VE and function analysis to develop strategy maps and scorecards. As part of the VE Methodology, Functional Analysis System Technique (FAST) diagramming offers an integrated approach and structure to strategy map development by formulating a cause and effect relationship and establishing the “how” and “why” behind the strategy map. By holistically utilizing the VE Job Plan, one is able to move from strategic thinking all the way through to measurement and execution of a strategy.

Introduction

Value Engineering (VE) incorporates a systematic process (formal job plan), VE-trained facilitators/team leaders, and a multidisciplinary team to identify and evaluate solutions to complex problems in the life-cycle of an organization, project, process, or system. The VE process uses several industry standard problem solving/decision making techniques in an organized effort directed at independently analyzing the functions of programs, projects, organizations, processes, systems, equipment, facilities, services, and supplies. VE is not a cost reduction activity, but a function-oriented method to improve the value of a product. There is no limit to the field in which VE may be applied.

The Balanced Scorecard concept evolved from a one-year multi-company measurement research project that began in 1990 by Drs. Robert Kaplan and David Norton. Since then, Kaplan and Norton have written a number of books and offered extensive training on this topic. As a result, several hundred companies have implemented the Balanced Scorecard approach with a high degree of success. In their books, Kaplan and Norton site multiple case studies where the concept has been used to drastically improve performance of organizations through identification, alignment, integration, and execution of their strategies.

After receiving training in and applying the Balanced Scorecard approach, authors of this paper sought a systematic method for developing and implementing strategy maps and scorecards. Being certified and experienced in the value management discipline, they recognized the value in employing VE and FAST diagramming as a means to this end. As described below, the authors propose how VE can be utilized for strategic planning through development and implementation of strategy maps and scorecards.

Strategy Maps and Balanced Scorecard Overview

Many, if not most, organizations and institutions engage in some form of strategic planning. Multiple strategic planning definitions and approaches exist for identifying an organization's vision, understanding its mission, conducting a situation analysis, determining goals, and identifying strategies and tactics. Definitions for each of these terms can be found at the end of this document. However, research has shown that execution of strategies, not development, is where companies fail.

In 1990, Kaplan (the Baker Foundation Professor at Harvard University) and Norton (President of the Balanced Scorecard Collaborative/Palladium) began a research project on measurement which eventually led them to development of a balanced strategy mapping and measurement system. The term to describe the management tool that evolved is a "balanced scorecard." The "balanced scorecard" consists of a strategy map describing an organization's strategy and a scorecard for measuring and managing that strategy.

In Kaplan and Norton's book, "Strategy Maps" [2004], the premise is that "Successful execution of a strategy requires three components:

$$(Breakthrough\ results) = (Describe\ the\ strategy) + (Measure\ the\ strategy) + (Manage\ the\ strategy)$$

The philosophy of these three components is simple:

- You can't manage (third component) what you can't measure (second component)
- You can't measure what you can't describe (first component)."

To describe, measure, and manage the strategy, Kaplan and Norton developed what have been termed as strategy maps and balanced scorecards. At the highest conceptual level, maps and scorecards provide a framework that helps organizations translate strategy into operational objectives that drive both behavior and performance. This framework enables a balance between:

- Financial and non-financial factors
- Tangible and non-tangible assets
- Long-term and short-term priorities
- Strategic and operational decision-making
- Top-down articulation and bottom-up execution
- Staff/sponsors' interests
- Lead and lag indicators of performance [Durn, 2006].

A strategy map is a pictorial model (or visual representation) used to holistically describe an organization's strategy. A generic strategy map template is shown in Figure 1 and an example of a completed map is found in Figure 2.

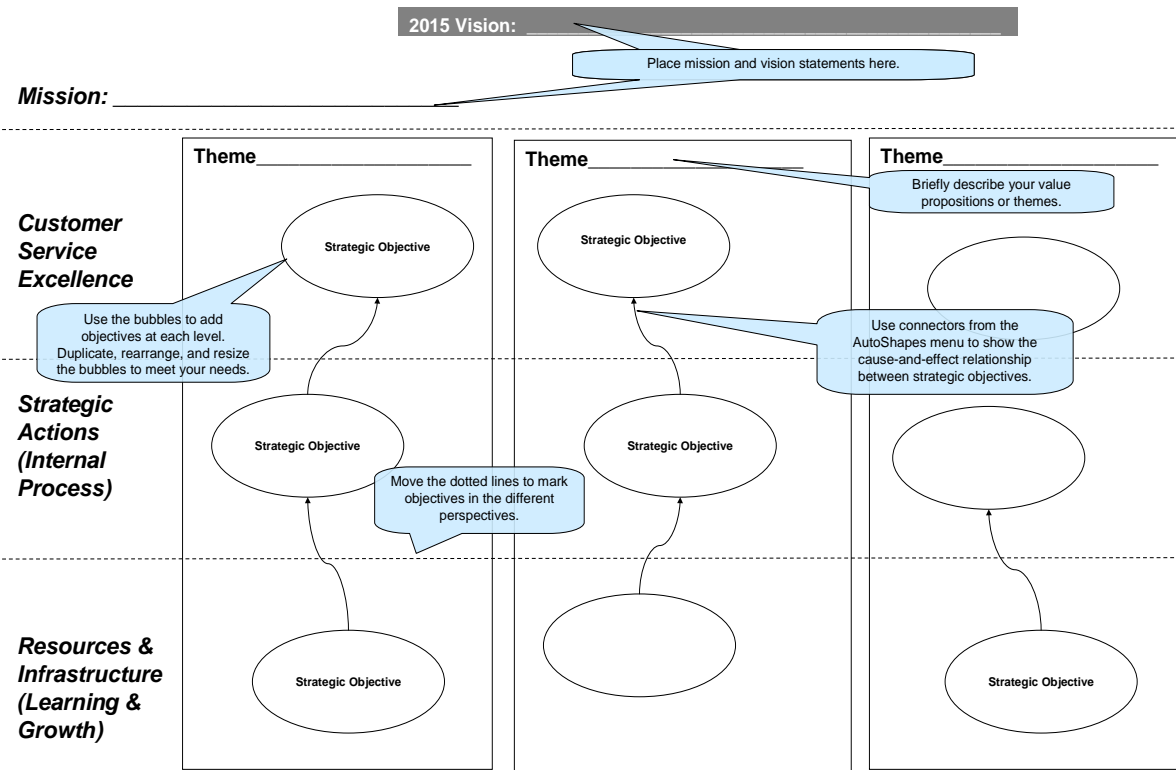


Figure 1. Generic strategy map template.

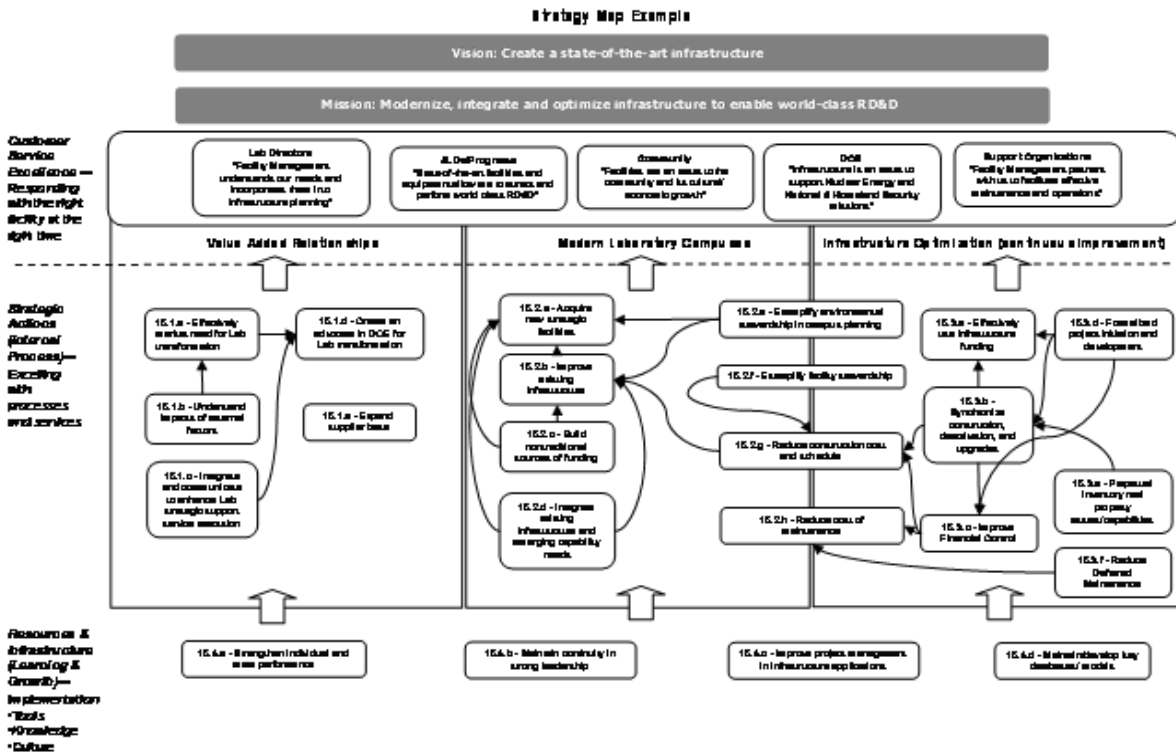


Figure 2. Example of a strategy map.

The model shows the cause and effect relationship of the strategic objectives hypothesized to create value for the customer. In order to remain “balanced,” strategy maps take into account different perspectives, including:

- Financial performance (note: public and non-profit organizations usually have a primary focus on mission versus financial performance)
- Customer objectives which define the customer's value proposition
- Internal processes needed to create and deliver the value proposition
- Learning and growth objectives describing the organization's intangible assets and their role in strategy. Intangible assets include human capital, information capital and organization capital.

As a guideline, each strategic objective should be [Durn and Englund, 2007]:

- A short (3-8 word) statement that describes a strategy, something that an organization wants to be able to do well
- An action statement that clarifies what strategy will be implemented
- A linked set of priorities that deliver the overall strategy
- Enduring, and relevant for 3-5 years.

Each strategic objective should also have one or two performance measures.

A scorecard is built around strategic objectives and contains measures, targets, and initiatives surmised to drive the organization towards accomplishing its strategic objectives and in turn, its mission and vision. The information contained in the scorecard can and should be cascaded to individual performance goals to assure each and every person in an organization is working toward accomplishment of the strategy.

In addition to the scorecard elements suggested by Kaplan and Norton, the generic scorecard shown in Figure 3 contains a column for consideration of risks in achieving the strategic objectives.

Scorecard

Objectives	Risks	Measures	Targets	Initiatives

Figure 3. Example of a Generic Scorecard.

Value Engineering Overview

The Value Engineering (VE) process uses a six-step job plan, which is part of a decision process that has been optimized over the last 50 years by many people and application experiences. The use of a function and logic approach inspires people to ask key questions, which reduce the potential that a need or issue is missed. It is important to understand the functions that the customer values and then use function analysis to provide the inputs to their strategic direction. The use of a value-based decision-making approach helps ensure that

resources (e.g. time, money, and expertise) are directed toward the solutions that have the highest potential for meeting the customer needs [Value Methodology, 2008].

The VE Job Plan applied at the Idaho National Laboratory (INL) includes the following phases:

- Phase 0: Preparation / Planning
- Phase 1: Information Gathering
- Phase 2: Function Analysis
- Phase 3: Creativity
- Phase 4: Evaluation
- Phase 5: Development
- Phase 6: Presentation / Implementation.

The unique aspects of VE can greatly enhance the outcome of a strategic planning effort. These aspects include:

- Utilizing facilitators trained/certified in the VE process
- Generating formal documentation of the results and team recommendations
- Engaging an interdisciplinary team of those involved or affected by the recommendations
- Performing function analysis that introduces a different perspective of the project or organization
- Following a formal job plan.

This paper will demonstrate the considerable benefit that can be realized in utilizing VE to strategically plan the future of an organization with strategies that can be planned through execution and visually represented on strategy maps and scorecards. This proposed approach is described below.

Using the VE Job Plan to Do Strategic Planning

Phase 0: Preparation / Planning

During the Preparation / Planning Phase, the personnel that will devise the strategy are identified. The composition of the team varies according to the organization or program under study. Staff personnel and management are the primary team members of a strategic planning team. Subject matter experts for potentially related technologies and integrated disciplines, customers, supporting organizations, and key stakeholder are recruited or called upon to participate in the Value Engineering (VE) study to answer questions, identify customer needs and expectations, and fill in information gaps as needed.

Once the VE team is assembled, they can begin to work together to collect the data necessary to build and formulate a more solid mission, vision, and end state.

Potential outcomes of the Preparation / Planning Phase are the identification of the **Members of the Strategy Planning Team, Names of Potential Experts** that could be called upon as needed, and an **understanding of the Issues** the team needs to address.

Phase 1: Information Gathering

During the Information Gathering Phase of the Job Plan, pertinent facts and information are gathered to begin to bring all team members up to same level of understanding of the organization or program.

When using VE to develop a strategy map and balanced scorecard, the information gathering phase can be utilized to collect the pertinent data which will help to:

- Understand and describe an organization's current situation
- Understand customer needs and expectations
- Identify strengths and weaknesses
- Acquire knowledge of current technology states (i.e., experimental, developmental, demonstrated, deployable, fully operational, etc.)
- Define where it wants to be in the future
- Determine how to fill the gap between where it is today and where it aspires to be.

A couple of techniques that can be used in gathering this type of information include interviews of key customers and stakeholders, and SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis [Thompson and Strickland, 1999].

Interviewing. As part of the information gathering phase, team members can be assigned to interview managers/staff as well as stakeholders/customers of the organization. If interviews are conducted, a standard set of questions should be designed in advance to gather information on customer needs, mission, and vision; strengths, weaknesses, opportunities and threats; key strategic issues, and the end state (what the organization will look like if the vision is achieved). This data can then be compiled prior to the VE workshop into a draft vision, mission, and desired end state as a place to start the strategic thinking.

SWOT Analysis. A SWOT Analysis is used to understand the strengths, weaknesses, opportunities, and threats related to the organization or program under study. The analysis can begin to define the current situation of the organization or program, which in turn will begin to reveal the areas that need to be built up or grown. Once key issues are identified, they can be fed into the organizational strategy.

Securing as much of the information as possible can be one of the most difficult efforts to accomplish but one that may provide the greatest value to the strategic planning study if completed thoroughly. The team will begin to grow into a cohesive working team through a shared understanding of the customer expectations and possible future of the organization or program.

Potential outcomes of the Information Gathering Phase are **Draft Vision and Mission Statements, Desired End State, Customer Needs and Expectations, and Situation Analysis.**

Phase 2: Function Analysis

The Function Analysis Phase of the Job Plan sets the Value Engineering Systematic Approach apart from all other systematic approaches. Within the Function Analysis Phase, the functions of the organization or program are defined in two words, one action verb and one measurable noun, and the relationships of these functions are evaluated. Through this evaluation, basic, secondary, and dependent or "when" functions are identified.

Many techniques are used to identify the functional relationships: Functional Flow Block Diagramming (FFBD), Functional Analysis System Technique (FAST), etc. This paper will demonstrate the application of FAST in the development of a strategic map and score card.

Figure 4 illustrates the critical path functions identified by the team for the deactivation of a building. The functions on the critical path have been numbered for tracking purposes. At this point, the team could take each function on the critical path and break it down further or define supporting functions, as needed.

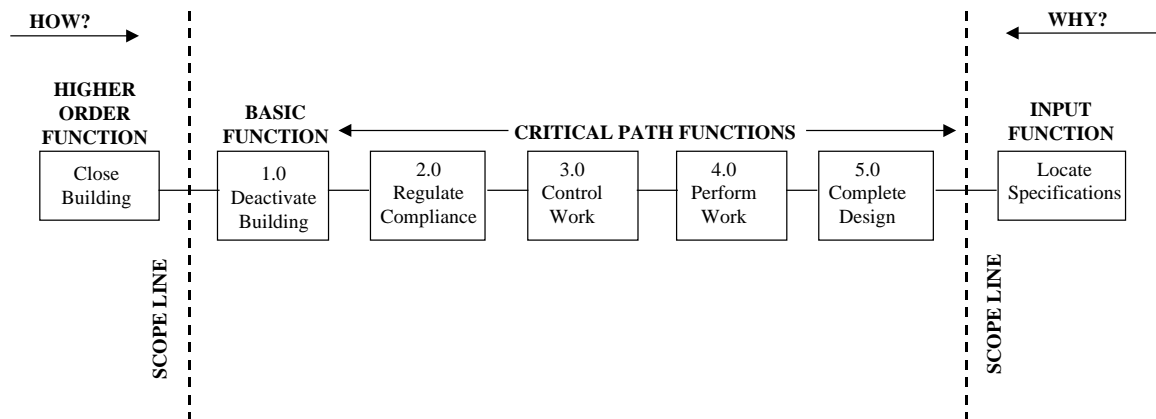


Figure 4. Example of a FAST Diagram on the deactivation of a building.

Functions to Strategy. Through the illustration above, you can begin to see the outline of a strategy map. The Basic Function, or the primary reason for existence, (1.0 Deactivate Building), can now be developed into the mission statement of the organization or program. The higher order function, or future outcome on the FAST Diagram (Close Building), can be built upon to define the Vision Statement. The critical path functions are similar in definition and logic to strategic objective on a strategy map, and the supporting functions or “when” functions may equate to the learning and growth objectives that need to be developed in order to accomplish the strategic objectives.

Functions and FAST are the crux of developing a strategy map and balanced scorecard. The FAST diagram can be used to validate the mission of the organization and further develop the how and why logic necessary to define the strategic objectives.

To demonstrate the application of FAST to the development of a strategy map, the FAST diagram in Figure 5 was built to define the functions and test the “How” / “Why” logic of the Nuclear Science and Technology Directorate at the Idaho National Laboratory [Idaho, 2008].

Example
**FAST Diagram for Idaho National Laboratory
 Nuclear Science and Technology**

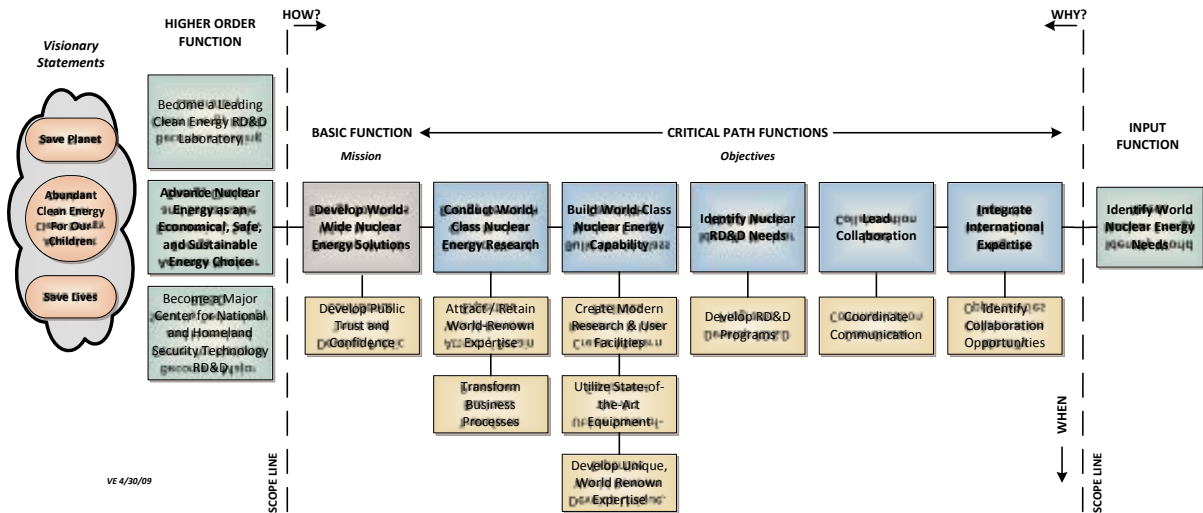


Figure 5. Example of a FAST Diagram for the INL NS&T Directorate.

Mission and Vision. From this FAST, the vision and mission statements can be crafted from the higher order and basic functions, respectively. The vision statement on the strategy map was created from a combination of the higher order function and the visionary statement, “Ensure future clean energy for our children.” Using the higher order function alone may not create the emotional aspect of a vision statement. The vision should create excitement and provide a future picture of what is different as a result of the mission. It may be productive to develop draft mission and vision statements prior to the VE Study and enhance them utilizing information gleaned during development of the FAST diagram and strategy map.

Perspectives and Strategic Objectives. The VE team can begin to identify the strategic objectives from the customer perspective, using the functions on the critical path. For each function, ask “For whom? Why? And what do they need?” This will produce an initial list of customers that can be prioritized for the strategy map. Strategic objectives from an internal organization perspective are typically the critical path functions. The strategic objectives from a learning and growth perspectives come from the “When” functions and/or by asking, “What resources (high level) are needed to accomplish the function?” The resulting list can be categorized and then formulated into representative learning and growth objectives.

The following illustrates the thought process used to create the customer perspectives: “Conduct world class nuclear energy research” for whom and why or what do they need?

- The US Citizen needs the Idaho National Laboratory (INL) to do innovative nuclear energy research development & demonstration (RD&D) for the nation’s benefit (energy security, clean environment, etc.)
- Nuclear industry and utilities need the INL to provide solutions to complex nuclear industry problems (fuels and materials issues).
- DOE, Nuclear Programs, and International Partners need the INL to lead and coordinate nuclear RD&D efforts.

- The world needs the INL to analyze economic and stable nuclear energy solutions.

Figure 6 illustrates how the team can go from a FAST diagram to a strategy map to begin formally defining the future end state and vision for the organization or program.

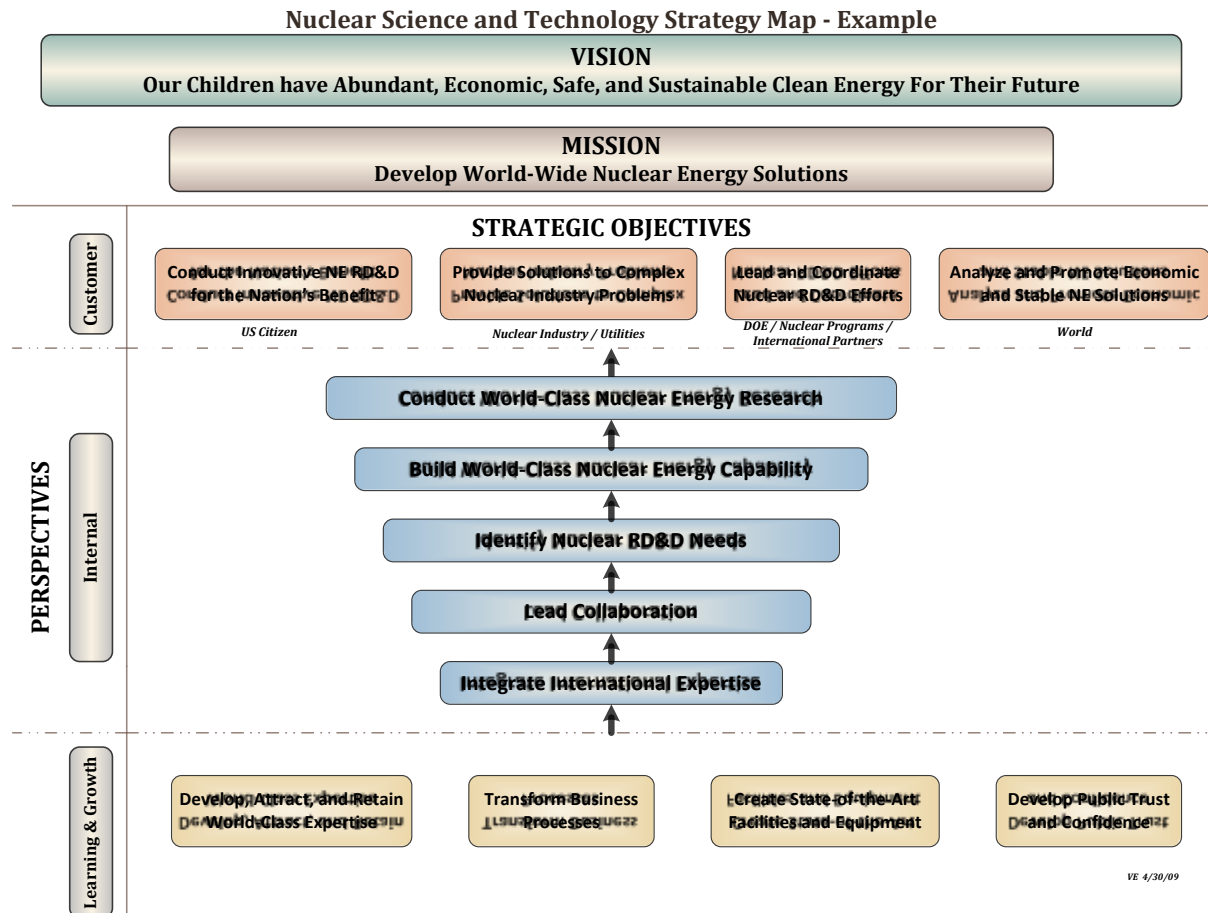


Figure 6. Example of a Strategy Map for the INL NS&T Directorate.

The FAST provides an effective way to promote team involvement and understanding about the strategic direction of an organization or company. It provides a method to ensure the necessary functions were considered systematically and are not unintentionally omitted from the strategic thinking through the validation of the cause and effect relationship.

As illustrated here, the FAST diagram is a means to develop the strategy map but not necessarily the end – it provides a way to understand the cause and effect relationship and may not be an identical match to the strategy map.

The outcomes of the Functional Analysis Phase will be a **FAST Diagram** and a **Strategy Map** describing the organization's high level strategy.

Phase 3: Creativity

During the Creativity Phase, the team should brainstorm ways of accomplishing the strategic objectives (stated as functions) of the organization. Brainstorming how to accomplish each of the functions will lead to potential initiatives for each of the strategic objectives. In addition, the team should brainstorm potential measures for each of the strategic objectives/functions.

In the evaluation phase, these measures will then be down selected to a smaller number of metrics (1 or 2 per strategic objective/function).

When brainstorming measures, the team should consider two types of strategic measures: “lead” and “lag” measures. While lag measures assess performance results at the end of a time period or activity, lead measures assess intermediate processes, activities and behaviors. For example, if a strategic objective is to grow customer confidence, “hours spent with customers” would be a lead measure while “customer retention” would be a lag measure [Durn and Englund, 2007]. Both types of measures are important. Lag measures provide outcome information and lead measures can drive desired behavior and activities.

The outcomes of the Creativity Phase will be brainstormed lists of potential **Strategic Initiatives and Measures**.

Phase 4: Evaluation

The Evaluation Phase is the time when the lists of strategic initiatives are evaluated to determine their value and potential impact for meeting the strategic objectives. Using typical VE evaluation tools and techniques, the strategic initiatives are defined down to a manageable set and then measures necessary to monitor and gauge the performance of those objectives are evaluated. A “good” strategic initiative should have the following items [Durn and Englund, 2007]:

- An Owner – accountability at the Leadership Team level
- Clearly defined start and stop dates and progress milestones
- Clearly defined deliverables
- A budget and committed resource allocation.

When evaluating measures, the following guidance should be considered:

- Each strategic objective should have one to two measures
- Both lead and lag measures should be used, as appropriate
- Lead measures are usually assigned to the Internal and Learning and Growth perspectives; occasionally to the Customer perspective
- Each strategic objective should have at least one lag measure.

The outcomes of the Evaluation Phase will be a **Preferred Set of Initiatives and Measures for each Strategic Objective**.

Phase 5: Development

Key milestones or tactics that support the accomplishment of the strategic objectives are defined in the Development Phase. During the Development Phase, the balanced scorecard will be defined and populated with the tactics and targets. An example of a balanced scorecard that could support the INL Nuclear Science & Technology (NS&T) Directorate is shown in Figure 7.

The outcome of the Development Phase will be a **Balanced Scorecard**.

Strategy at a Glance

Strategy Map		INL Specific	Balanced Scorecard		Action Plan	
Perspective	Objectives	Risks	Measurement	Target	Initiative	Budget (\$000)
Customer	Provide Solutions to Complex Nuclear Industry Problems	<ul style="list-style-type: none"> Industry won't collaborate. DOE won't fund. 	<ul style="list-style-type: none"> # of contracts 	FY-09: 1 FY-10: 3 FY-11: 5	<ul style="list-style-type: none"> Identify testing and analysis needs. Submit proposals. 	\$ 200
Internal	Build World-Class Nuclear Energy Capability	<ul style="list-style-type: none"> Congress changes the mission of the lab. Funding for facility upgrades, new equipment, or new facilities is not available. 	<ul style="list-style-type: none"> # of meetings with Industry participation 	FY-09: 4 FY-10: 6 FY-11: 10	<ul style="list-style-type: none"> Organize collaboration meetings. Invite Industry to RD&D Planning meetings. 	\$500
Learning and Growth	Develop, Attract, and Retain World-Class Expertise	<ul style="list-style-type: none"> Congress changes the mission of the lab. Funding for facility upgrades, new equipment, or new facilities is not available. 	<ul style="list-style-type: none"> # of new equipment procured 	FY-09: 2 FY-10: 3 FY-11: 5	<ul style="list-style-type: none"> Develop PEP to identify testing equipment and facility upgrades. Identify funding. Initiate procurement. Design facility upgrades. 	\$600
			<ul style="list-style-type: none"> # of new equipment installed 	FY-09: 1 FY-10: 2 FY-11: 3	<ul style="list-style-type: none"> Develop installation plan. Identify funding. Install equipment. 	\$1,200
			<ul style="list-style-type: none"> # of post-graduate new hires 	FY-09: 5 FY-10: 10 FY-11: 20	<ul style="list-style-type: none"> Work with HR to interview recent university graduates. Arrange on-site university visits. 	\$100
			<ul style="list-style-type: none"> # of current employees trained on new capability 	FY-09: 2 FY-10: 3 FY-11: 5	<ul style="list-style-type: none"> Assess training needs. Provide on-site training. Arrange off-site training. 	\$500
						\$3,100.00

Figure 7. Example of a Balanced Scorecard for the INL NS&T Directorate.

Phase 6: Presentation / Implementation

The Presentation Phase is utilized to ensure the new strategy is presented to senior management by the VE Team to obtain their immediate (although verbal) feedback and approval. In addition, follow-on activities could include development of pictures/posters to use to communicate to staff and management the newly defined strategy and balanced scorecard. These items are necessary to maintain communication and reinforce the shared vision for the organization or program.

The Implementation Phase is typically long-term with little VE Study Team direct responsibility. Potential outcomes could include a Project Execution Plan (PEP), a resource loaded schedule, individual performance goals, work packages, etc. This is a crucial phase for the success of the organization. If the Strategic Plan and Scorecard are integrated, communicated, and used as the basis for planning, the goals and strategies of the organization may not be completed. Also, members of the VE Study Team may be less interested in participating in future strategic development activities if their efforts do not appear valued.

Kaplan and Norton suggest that the most successful strategic implementation occurs when the senior management team uses a “new” system to manage strategy, with the following dimensions:

1. Strategy should be the central organizational agenda. The balanced scorecard allows organizations to describe and communicate their strategy in a way that could be understood and acted on.
2. Create incredible focus; every resource and activity in the organization was aligned to the strategy.
3. The organization structure should mobilize all employees to act in fundamentally different ways. The balance scorecard provides the logic and architecture to establish new organization linkages across business lines and employees.

When a new strategy is being launched, all employees must understand the strategy so they can find new ways to conduct their daily activities. Organizations need top-down communication, not top-down direction. One study showed that 67% of employees in well-performing organizations have a good understanding of overall organizational goals and 26% of the senior managers are highly effective communicators. Compare this with 33% of employees in poor performing organizations and 0% of senior managers [Kaplan and Norton, 2001].

The outcome of the Presentation / Implementation Phase will be a fully **Functioning and Executable Strategy**.

Conclusion

The Value Engineering (VE) Methodology is an effective strategic planning tool for organizations, projects, companies, etc. After half a century, function analysis remains a key piece of design; whether it is a building, a computer system, a car or a plane. This simple concept, to focus on “what” needs to be done, remains the basis for requirements development, problem solving, gap analysis, etc. When using the VE methodology to develop strategy maps and scorecards, function analysis and specifically Functional Analysis System Technique (FAST), are essential elements of this strategic planning approach.

Strategy without action does not lead to success. The critical, and maybe the most difficult part, is implementing the plans developed during the process. Obviously, management commitment is paramount. Leading the organization toward the vision and mission creates excitement and interest for employees and customers. Employees align their personal goals to the organization’s goals and the cohesiveness increases as the strategy is implemented.

Definitions

Function Analysis System Technique (FAST): The FAST diagramming technique was developed in 1964 by Charles W. Bytheway to help identify the dependencies and relationships between functions. A FAST diagram is not time-oriented like a PERT chart or flow chart. It is a function-oriented model that applies intuitive logic to test the functions that make up the critical path.

Goals: The general ends toward which the organization directs its efforts. Goals address the primary issues facing the organization within broad groupings of interrelated concerns. They are founded on the vision and may involve coordination among several organizations with similar functions.

Mission: The reason for an organization’s existence. It succinctly identifies what the org does, why, and for whom. A mission statement reminds everyone of the unique purposes promoted and served by the organization.

An organization’s mission statement concisely states the basic purpose for the organization’s existence. The mission provides the essential foundation for strategic planning. It should be brief (25 words or less) and understandable so the main points are clear to all members of the organization. The mission statement provides answers to the following questions: What do we do? For whom? Why? How do we do it?

Objectives: Clear targets for specific action. They mark interim steps toward achieving an organizations long-range mission and goals. Linked directly to goals, objectives are measurable, time-based statements of intent. They emphasize the results of actions at the end of a specific time.

Strategic Planning: A long-term, future-oriented process of assessment, goal setting, and decision-making that maps an explicit path between the present and a vision of the future; that relies on careful consideration of an organization's capabilities and environment; and that leads to priority-based resource allocation and other decisions.

Strategies: Methods to achieve goals and objectives. Formulated from goals and objectives, a strategy is the means for transforming inputs into outputs and ultimately, outcomes, with the best use of resources. A strategy reflects budgetary and other resources.

Value Engineering: Value Engineering is an organized interdisciplinary team approach that uses a facilitated problem-solving technique to provide for a reliable quality product, process, or service at the lowest possible cost.

Vision: An inspiring picture of a preferred future. A vision is not bound by time, but represents global and continuing purposes, and serves as a foundation for a system of strategic planning. A vision is a short, simple statement of an ideal and unique image of the future of an organization. Vision statements provide the vital spark, energy, power, and passion necessary to achieve goals.

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Biographies

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Alison Conner, CVS, has spent most of her time tenure at the Idaho National Engineering Laboratory working as a Systems and Value Engineer. She utilizes advanced systems engineering and project management skills to effectively plan, manage, and conduct multi-disciplined projects that meet customer requirements and expectations. She has a Bachelor of Science degree in Engineering and a Master of Engineering degree in Engineering Management. She is Life-certified as a Certified Value Specialist with SAVE. Alison is an active member of INCOSE and is the Secretary of the Snake River Chapter.

Jodi Grgich, AVS, has been part of the Systems Engineering group at Idaho National Laboratory (INL) for almost 4 years. She is currently working on her Bachelor of Science degree in Business Administration. Jodi was recently recognized as the 2009 Administrative Professional of the Year by the Rocky Mountain Chapter of Administrative Professionals.

Margie Jeffs, AVS, has 21 years experience in business management, electrical contracting, human resources, facilitation, and training. She has a B.S. degree in Psychology from Idaho State University. She earned a post Bachelor's 15 credit Certificate in Human Performance Improvement and is currently working on her Masters degree in Adult and Organizational Learning, both from University of Idaho. Margie obtained her AVS in June of 2008 and has been a member of the International Society of American Value Engineers (SAVE) also since 2008. She is an active member of INCOSE.

Darcie M. Martinson, AVS, has over 21 years experience in management, facilitation, and application of industrial engineering, systems engineering and value engineering tools and techniques. She has facilitated and led many value engineering, problem solving, decision making, brainstorming, strategic planning, team building, organizational improvement, cost reduction, process improvement, and change management meetings and workshops. She obtained a CVS designation in 1990. Darcie holds a B.S. degree in Industrial and Management Engineering from Montana State University and currently works as a systems engineer at the Idaho National Laboratory.