

THE FUNCTIONAL RELATIONSHIP BETWEEN QFD AND VE

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ABSTRACT

This paper explores a few of the fundamental relationships between Quality Function Deployment (QFD) and Value Engineering (VE).

INTRODUCTION

Functions are basic to successful Value Analysis (VA) and VE. Functions are also an essential control used in QFD. Could it be that QFD is a subset of VE? Or is VE a subset of QFD? We will explore the relationship between the VE use of functions and the QFD use of functions. This leads to an understanding of when and how to apply VE and QFD and how they can work together.

PREMISE

Based upon my experience in industry and understanding of both QFD and VE, it is clear that there is a good relationship between QFD and VE.

- You need the VE perspective as a ingredient of your QFD efforts.
- You need the QFD perspective as a framework to your VE efforts.
- VE works best in focused, activity based, cost driven, creative problem solving.
- QFD works best in active, full scope, planning and decision making.

Each is legitimate technology. Each needs the other to maximize their respective success. Both are generally perceived incorrectly by the population at large. And both are relatively underused and in many cases even unknown.

VALUE ENGINEERING

VE begins with a carefully defined problem to solve. You express the problem as functions and a set of logical relationships. The function is a generic description of what drives an action or activity. It is a look at what the part does rather than what the part is or even how you do it currently. Once the team clearly understands the function then you investigate alternative ways of providing the same function at a lower cost.

When defining functions there are several possible approaches. You can look at the issues in essentially a random effort, or you can choose a structured approach. If you choose the structured approach, then you will likely use one of the Function Analysis System Technique (FAST) styles. There are three basic styles of FAST modeling. Task FAST usually looks at complete products or services with a strong emphasis on users needs or desires. Technical FAST follows a fairly strict set of rules. It usually looks at a portion of the product or process. It has a strong emphasis on the logical sequence of the functions and how crucial they are to the problem. Traditional FAST is similar to Technical FAST. It retains most of the same techniques, but with less emphasis on strictly following the rules.

QUALITY FUNCTION DEPLOYMENT

Quality Function Deployment (QFD) is a method for systematically focusing all organizations in your business unit towards the features of your product which are most important to the customer.

"QFD is a structured and disciplined process that provides a means to identify and carry the voice of the customer through each stage of product development and implementation. This process can be deployed horizontally through marketing, product planning, engineering, manufacturing, service, and all other departments in your organization involved in product development.

"QFD enables organizations to prioritize customer demands, develop innovative responses to those needs, and orchestrate a successful implementation involving all departments. QFD is a planning tool that carries the voice of the customer all the way through product development, to manufacturing, and into the marketplace. QFD focuses on planning and problem prevention early in the development process, thereby reducing design errors, which results in fewer problems in production."¹

THE LITERAL DEFINITION

The original Japanese words translated as Quality Function Deployment do not mean what an American English dictionary might lead you to think. The word translated to "Quality" is probably better translated as qualities or attributes. These begin with the qualities or attributes the customer wants. They extend through the entire production system, expressing the qualities or attributes in different terms, as necessary. QFD treats these different expressions each as a list.

The word translated to "Function" means the different functions within the organization. Examples might be Marketing, Engineering, Manufacturing, Purchasing, etc. This is a vastly different use of the word function from the way VE uses it.

The word translated to "Deployment" means to distribute or disseminate for future use. All-together, QFD is a method for systematically focusing all organizations in your business unit towards the features of your product which are most important to the customer.

PLANNED ACTION VS. REACTIVE

You should use QFD as to plan your actions before the crisis. It does not work well in a reactive mode. It is best used as a tool to bring out all of the issues before actions are taken. It ties the issues together in a useful way. You know what will happen throughout the organization before you make the product. It acts as an information link between all areas. If you already have a design and are looking to fix a problem, it is not fun to find out you should never have made the product in the first place.

DISTINGUISHING QFD CHARACTERISTICS

There are many good things accomplished through using QFD. There are, however, two distinctive features in which

QFD excels. First, it allows you to produce excellent documentation of your decisions. Second, it helps communication, both within the team and to those outside.

The documentation addresses both short and long term needs. It is very seldom that you find good documentation of why you made a particular decision. With QFD, producing good documentation becomes reasonable. The process breaks down decisions into smaller components of understanding. You can easily record the small details that go into your overall decision. If a question arises about a detail you discussed three weeks ago, you can check the record. In addition, it helps bring new team members up to speed on the project details. It also allows you to have a record for long term use. You can use it as a framework for future decisions that are similar. It is like marking up a print to make a new part. You take advantage of all of the efforts that went into the previous decision with a minor expenditure of effort.

It is critical that you have good communication within the team. QFD allows you to express the different viewpoints and define the transformation or translation between any two of the viewpoints. In developing the transformation, the structure of the process drives you to a thorough deliberation, more than you might normally use. As a result, there is much better communication and understanding within the team. After putting all of the effort into your project, it is crucial that this information be accurately and efficiently communicated to others who are not on the team. QFD makes this not only possible, but reasonable. The chart format is extremely efficient at communicating an immense amount of information. Each person finds the information easier to understand, because it is in their own terms and language. The hierarchical structure allows you to express an appropriate level summary of the information for each level of management.

FUNCTIONS IN QFD

The word "Function" in the name Quality Function Deployment isn't anything like function as VE uses it. There is, however, another use of the word or title "Function" in QFD. QFD considers many viewpoints, one of which is that of the engineer. This is often best done using functions and is called the function list. The reasons for using functions to represent the voice of the engineer are the same as those identified in VE.

QFD uses functions in cost breakdowns, in a very similar manner to VE. QFD does something different with functions than VE. In addition to using functions with costs, they are also compared against most of the other lists of different viewpoints. This helps determine the interactions between these lists. These discussions of interactions lead to a tremendous increase in team knowledge and understanding of the issues and allow us to document them. The use of a matrix structure causes a thorough investigation and assessment of the possibilities for relationships.

In QFD there are two basic comparisons with functions that should always happen. You compare functions against the list of customer needs which helps point out the items that a customer just assumes will be there. It also shows which needs customers did not expect, but will find exciting. These are items that would require additional market research to quantify their importance to the customers.

The second way QFD handles functions is by comparing functions against the list of company measures and controls. This comparison helps assure that you have ways of measuring and controlling the results of the functions.

In addition, you use all three of these lists (functions, customer needs, and measures) in evaluating alternatives. This assures a good broad based perspective and balance in considering the issues related to each of the alternatives.

Functions are also compared against other lists. Some of the other lists include new technologies, major systems, parts and subsystems, Fault Tree Analysis (FTA), Failure Modes and

There are various viewpoints of a problem.

- VE has recognized the viewpoint issues as different forms of FAST diagramming.

- QFD addresses the issues through the different lists.

It is important to have stable and logical behavior of your information (completeness, uniqueness, etc.)

- QFD achieves the needed behaviors through structural means.
- VE gets this behavior through the team context.

You can look at various scopes of a problem. These might range from the full system to a small subsystem.

- VE addresses different scopes of the issues separately.
- QFD looks at different scopes in an integrated fashion, all at once.

To make decisions, you need to know how important something is.

- VE's source of importance for each item is primarily a team decision.
- QFD's is the customer.

A measurable and controllable set of unitgive good feedback to teams about how happy the customer will be.

- QFD establishes a complete set of company measures and controls that identify when you are meeting the customer needs.
- VE concentrates exclusively on cost.

There are many possible levels of abstraction.

- VE requires a consistent level of abstraction.
- QFD allows many levels concurrently.

Interrelationships are key to insightful team knowledge and understanding.

- QFD considers and documents all of the interrelationships between the lists.
- VE considers the few that arise as a part of the problem solving process.

Good communication, within the team and to those not on the team, will have more to do with success than any other single issue.

- VE uses functions as an aid to smooth the technical communication within the team.
- QFD uses lists and matrices to cause methodical communication within the entire team and with all who need it outside of the team.

You need good documentation, both immediate and long term. This should include both what was considered and what was decided throughout the decision making process.

- VE uses FAST to organize the information and provide a framework for perspective, discussion, and documentation.
- QFD provides a detailed view of all of the issues and considerations that went into any process. This also provides long term documentation that radically improves future similar decisions.

Evaluating alternative solutions is key to innovative problem resolution.

- VE considers alternatives as they are suggested by the team.
- QFD applies strong mathematical techniques and produces extensive documentation of the alternative creation and decision making processes.

You can analyze the issues from many different time perspectives.

- VE looks at a single time frame.
- QFD simultaneously looks at both the current conditions and the future, in addition to the competitive environment. There are a lot of different methods you can use in planning, decision making, or problem solving.
- QFD couples with and makes use of a multitude of

- additional methodologies, including VE.
 - VE tends to be a solo methodology.
- Sequencing helps create useful views of a problem. This sequence may be based on time, flow, movement, etc.

- VE uses a logical sequence.
- The sequencing abilities within QFD are severely limited.

Both QFD and VE are steeped in some restrictive traditions. They both need to shed these wherever possible. The active verb/measurable noun is a strong tradition in VE. The real need is for accuracy and clarity. When you look beneath the traditions, you see many similarities across the various methodologies. QFD requires the same accuracy and clarity, but goes about it in a different fashion.

Given these areas where QFD and VE cross paths, let's look at each in more detail.

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In addition, you use all three of these lists (functions, customer needs, and measures) in evaluating alternatives. This assures a good broad based perspective and balance in considering the issues related to each of the alternatives.

Functions are also compared against other lists. Some of the other lists include new technologies, major systems, parts and subsystems, Fault Tree Analysis, Failure Modes and Effects Analysis process plans, etc. You use these other comparisons as necessary to understand and investigate specific issues of development. They are not all required for every project, but should only be used as necessary. As you can see, QFD uses functions quite extensively throughout the design process. QFD does a lot to formalize and document the use and interaction of functions to other areas of planning and decision making.

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WHERE QFD AND VE CROSS PATHS

There are a number of areas that are addressed by both QFD and VE. This is an collection of some of those areas and a short perspective on the position of QFD and VE.

There are various viewpoints of a problem. You can look at the issues from the viewpoint of the user of a drill, the drill, or the hole being created.

- VE has recognized the viewpoint issues and often uses different forms of FAST diagramming depending on the viewpoint chosen.
- QFD addresses the issues in the different viewpoints through different lists for each viewpoint.

It is important to have stable and logical behavior of your information (completeness, uniqueness, etc.)

- VE gets this behavior through the team context.
- QFD achieves the needed behaviors through structural means. You can look at various scopes of a problem. These might range from the full system to a small subsystem.
- VE addresses different scopes of the issues separately.
- QFD looks at different scopes in an integrated fashion, all at once.

Completing your project in a timely manner is important. How fast you can do something is dependent on what it is you are doing and how much of it you are trying to do.

- VE projects are usually measured in days or weeks.
- QFD projects are usually measured in weeks or months. You usually don't use QFD when "you need the answer yesterday."

To make decisions, you need to know how important something is.

- VE usually defines the "next in line" as the customer and includes them on the team. This person is the source of importance for each item. You usually do not look outside of the team for defining the importance.
- QFD uses the end user as the customer. They are usually not on the team. Capturing the voice of the customer requires good market research. This research determines how important an item is.

A measurable and controllable set of units give good feedback to teams about how happy the customer will be.

- VE measures are usually specified in the problem statement. This is often cost and occasionally time. It is rarely more than one type of measure.
- QFD establishes a complete set of company measures and controls that identify when you are meeting the customer needs.

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- VE requires a consistent level of abstraction.
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- VE considers alternatives as they are suggested by the team.
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You can analyze the issues from many different time perspectives.

- VE models the situation today and considers the full life cycle.
- QFD simultaneously looks at both the current conditions and the future, in addition to the competitive environment as it models the full life cycle.

There are many existing methodologies you can use in planning, decision making, or problem solving.

- VE tends to have many customizations to its methodology, but seldom couples with other existing methodologies.
- QFD couples with and makes use of a multitude of these additional methodologies, including VE.

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- The sequencing abilities within QFD are severely limited.

Both QFD and VE are steeped in some restrictive traditions. They both need to shed these wherever possible. The active verb/measurable noun is a strong tradition in VE. The real need is for accuracy and clarity. When you look beneath the traditions, you see many similarities across the various methodologies. QFD requires the same accuracy and clarity, but goes about it in a different fashion.

CONCLUSION

Both methodologies have been around for years. Both work very well in their respective spheres. We need to mix QFD's horizontal perspectives, as appropriate, with VE's vertical strengths. As QFD combines other technologies' vertical strengths, that will greatly leverage existing VE efforts. Both techniques are powerful in their own way and we need both. Just as cooperation within the team leads to success, so does cooperation between the technologies. Through this cooperation, we will achieve customer satisfaction, and thereby achieve success for our companies.

REFERENCES

1. Marsh, S, Moran J. W., Nakui, S. and Hoffherr, G., *Facilitating and Training in Quality Function Deployment, GOAL/QPC*, Methuen, MA, 1991
2. Akao, Joki, *Quality Function Deployment: Integrating Customer Requirements into Product Design*, Productivity Press, 1990
3. Snodgrass, Thomas A. and Kasi, Muthiah, *Function Analysis: The Stepping Stones to Good Value*, University of Wisconsin, 1986
4. Kaufman, J. J., *Value Engineering for the Practitioner*, North Carolina State University, 1990
5. *Save Proceedings, 1991*
6. Bhote, Keki R. *Strategic Supply Management: "A Blueprint for Revitalizing the Manufacturer-Supplier Partnership, AMACOM"*, American Management Association, 1989