

How to Select Functions for the Creative Phase

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Author's Bio

James (Jim) Rains is President of the Advanced Value Group, LLC (AVG). Formed in 2000, AVG specializes in value engineering and synchronous process improvements (lean manufacturing) in the factory and/or office environment. Training in target costing, which includes Quality Function Deployment and Voice of the Customer is also a part of AVG's long list of services. Jim has been trained by Yoshihiko Sato to conduct Japanese style competitive benchmarking tear-down workshops. This workshop integrates the Design for Assembly methodology. Jim has conducted numerous construction-oriented VE workshops throughout the Middle East. He has also worked in Australia, China, Korea, India and many European countries. Jim is retired after more than thirty-one years with General Motors. He has served on the SAVE International Board of Directors in several capacities, including President and Chairman. Mr. Rains became a Certified Value Specialist® in 1988 and is currently a Life - CVS®. He was elected into the SAVE International College of Fellows in 2002. He has volunteered over 20 years to the Lawrence D. Miles Value Foundation Board of Directors and serves on its Executive Committee.

Jim has facilitated over 800 projects in the past 35 plus years. Just in the past ten years he has worked with over 50 different top global companies. These projects conducted in 21 different countries obtain significant results by adding value and profit for manufacturing businesses. In addition he has achieved superb results for US government projects and international construction projects.

Abstract

One of the main objectives of the Function Analysis Phase is to determine the best opportunities to improve value. In other words what functions of any given project should be used in the Creative Phase. From a list of forty to eighty functions for any given project, which functions should be selected to meet the project and team objectives.

To select the best and proper functions for the Creative Phase, there are three essential elements:

1. Specific and agreed upon project objectives,
2. A complete function analysis phase that results in a FAST diagram with the measured resources (cost, time, weight) for each function,
3. Function selection for the Creative Phase, which means functions are used for creativity.

It has been stated many times that if you do not do function analysis it is not value analysis/value engineering (VA/VE). This author also believes that if you do not brainstorm by function you also are not doing VA/VE. It does not make any sense to go through a function analysis effort and not use the resulting information in the remainder of the VA/VE job plan. VA/VE gets its strength by using function oriented thinking to divert the team member's minds away from specifics. To not brainstorm by function means that the minds of the team members are not being stretched to obtain the best possible results. Ideas taken to the Evaluation Phase should also be evaluated by function. We need to implement the best ideas that reliably perform the function. This paper will address each of the above mentioned essential elements.

Specific and agreed upon project objectives

After the project and team members are selected for any given VA/VE workshop the next item on my list is for the team to prepare their specific workshop objectives, and then agree and commit to them. Based on many years of experience it has been determined that this pre-workshop event is extremely important. Developing the common team objectives is actually one of the first team building opportunities you will have with a team. A team cannot be a team, unless they have committed to the team goal where the

team goal supersedes any individual goals. Note that the word committed has been mentioned a couple of times. If some team members are not 100 percent committed to achieve the objective the chances of obtaining that objective is significantly reduced. If a certain team objective is not committed to, then it needs to be changed to obtain the necessary commitment.

Here are samples of good team objectives from actual workshops recently conducted:

An oil and gas valve team had the following objectives:

- Reduce cost by 15 percent
- Reduce vibration
- Address leakage problems
- Improve fabrication of cage and plug
- Reduce erosion
- Improve porosity
- Change geometry to improve handling

Note that this is from a manufactured product. In manufactured products it is preferred to have team objectives that address three areas of concern: marketplace issues, internal issues, and cost. You will note that each area of concern is identified in this objective. Marketplace issues should include any customer complaints, product failures/shortcoming, customer dislikes and competitive threats. The marketplace issues listed in this specific objective are: vibration, leaks, distortion, part erosion and handling. Internal issues include part fabrication problems (scrap, reoperation, fabrication difficulties) in the entire supply chain, difficult to assemble problems, assembly line scrap, reoperation or required major adjustments, final test failures, etc. The internal issues listed in this specific objective are: venting the valve for testing, machining of the sealing surface, cage and plug fabrication and part porosity.

The objectives for a Bureau of Reclamation building project in California at its 30 percent design stage were:

- Confirm functional layout
- Resolution of space requirements
- Confirm architectural finish
- Confirm construction type
- Determine design loads
- Identify areas to reduce life cycle costs
- Resolve and simplify structural design issues
- Investigate constructability issues
- Meet sustainable requirements (LEED silver or gold)

The facility site did not offer enough space for required parking. The facility layout was not designed properly for effective and efficient people flow. Note that a specific cost target was not identified. It was well understood that any result had to stay within the project budget. Fortunately the team was able to exceed all of its objectives and still report a significant cost savings.

You will see later in this paper how we use the objectives to assist in the function selection for the creative phase of the VA/VE job plan.

A complete function analysis phase that results in a FAST diagram with the measured resources (cost, time, weight) for each function

The author uses the following four key steps to perform function analysis. The steps are:

1. Random function identification
2. Functional Analysis System Technique or FAST Diagramming
3. Resource (usually cost) to Function Relationships
4. Identify the functions that have the best opportunity to improve value and take to the Creative Phase.

Random function identification is the beginning of the function analysis phase. In this step we are doing exactly as the name of this step implies, randomly determining verb-noun combinations that describe the functions of the project under study. For a product design study the team lists a few functions for the entire product and identify the basic function from this group. Then by exploring in detail each component of the Bill of Materials (BOM) and identify the function or functions of each part in the BOM. In administrative or in manufacturing process studies you need to start with a detailed description of the process being studied. The steps of the process are documented in a sequence flow chart, process chart or value stream map. For each step of the process the actual time and elapsed time are important data to work from. In the Function Analysis Phase you take each step of the process and identify all the functions that that step performs. The random list of functions for construction projects starts with the detailed cost estimate or the most current cost estimate available. Then by going through each item, just as done for a product design study the team identifies the functions that each of those costs represent. The random list can become very long, perhaps over 50 unique functions for even a simple product and much more for complex products. Having repeated functions for different components or process steps is very common. I know many people believe this seems like a very laborious step of the process and agreed it is. But it is worth it. In Miles' book and many other texts we can find verb and noun lists that may assist the team in developing the most appropriate and precise functions. Another source is the Function iTool found on the Miles Value Foundation web site (www.valuefoundation.org).

People that know me, and that includes all of my clients, also know that FAST diagrams are always used in my workshops. When a team creates their own FAST diagram, the real changing of the mindset begins. Understanding the function relationships and the team dialogue to agree on those relationships clearly improves every team member's understanding of the project under study. The intent of this paper is not to train the reader in how to create FAST diagrams, but instead help the reader better understand the importance of doing a correct FAST diagram. In addition to improved understanding, all team members also gain new knowledge of the project is being studied. When various organizational disciplines are on the same team, each person has a unique skill set that can and should be used in creating the FAST diagram. No one person knows all there is to know. The change of mindset or in other words the change of viewpoint is the largest benefit of not just FAST but the entire Function Analysis Phase. If the team members do not have an altered mindset of their project the Function Analysis Phase did not do its job and neither did the facilitator.

Another labor intensive step in function analysis is resource allocation to function. Most projects (for this author over 98%) use a cost to function allocation, but other resources such as time, weight and risk are used. Most designers of products, highways, systems or buildings pay little to no attention to cost when they create their designs. And if they know any cost information it is for the project item or component part. Since people in the marketplace buy functions, not items or parts, understanding function cost is critical. A totally new awareness of cost for all team members is discovered through this exercise.

Function selection for the Creative Phase

We have finally arrived to the section of this paper; to answer the question in its title. How to select functions for the Creative Phase. The best way to explain this is to show you some actual examples.

The first example is a large valve used in the oil and gas industry. The objectives for this team are identified earlier in this paper. The FAST diagram for this product is shown in Figure 1.

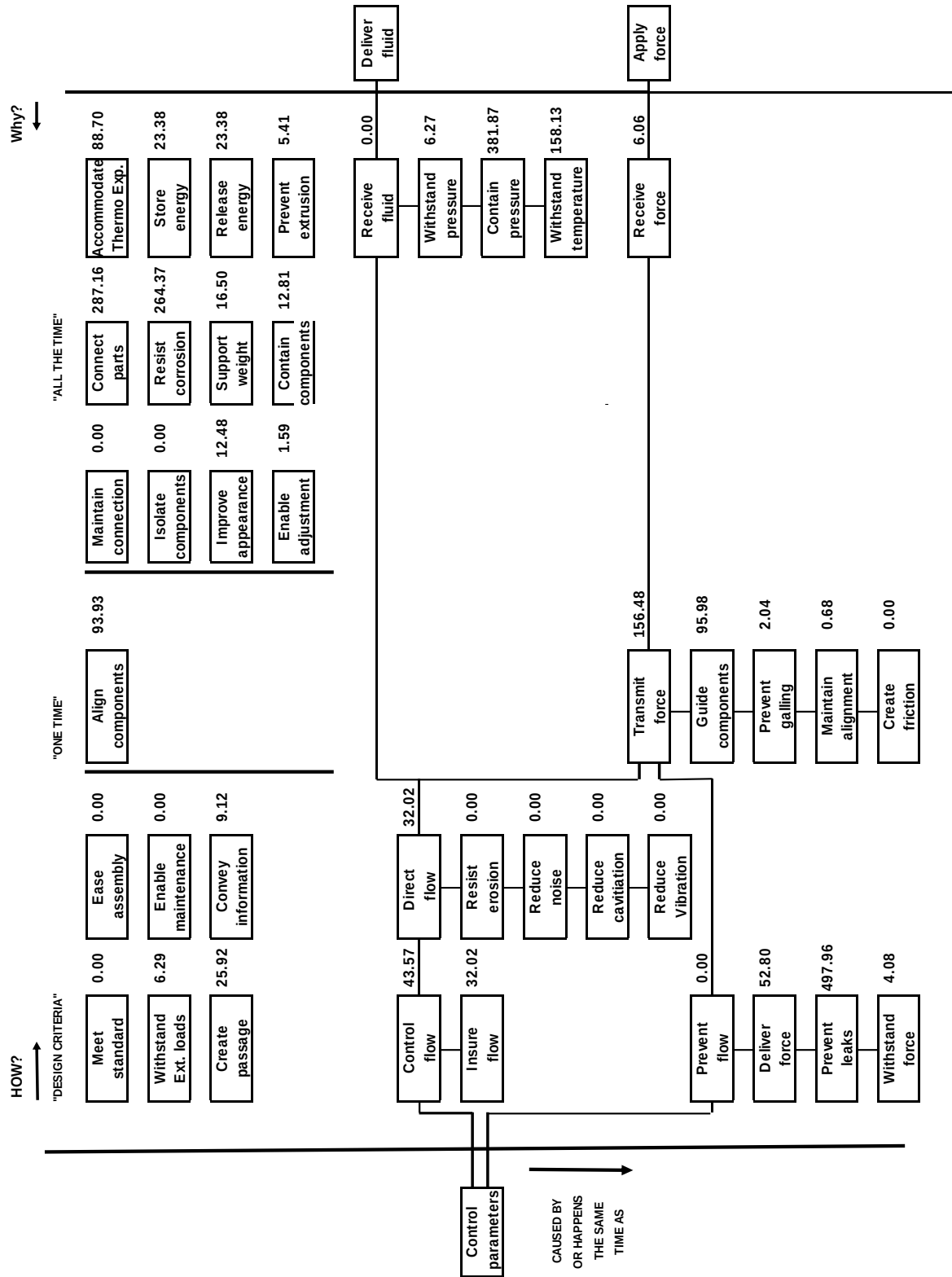


Figure 1

Note the high cost functions that include Prevent Leaks, Contain Pressure, Transfer Force and Connect Parts. Since Prevent Leaks is a high cost function and also a function that needed improvement it was selected for the Creative Phase. Also selected because of its high cost is Contain Pressure. Since this function relates to the high cost function Withstand Temperature, both of these functions were addressed by brainstorming the function Contain Pressure. This relationship can only be determined via a completed FAST diagram. Transfer Force was selected because of the cost reduction opportunity. Since Guide Components, Prevent Galling, Maintain Alignment and Create Friction are all "caused by or happens the same time as" Transfer Force, ideas to improve those functions are addressed when we brainstormed Transfer Force. The vibration issue was solved by brainstorming this function as well. Connect Parts is always an expensive function in product studies, especially when assembly labor is included in the product cost. The team discussed the high cost function of Resist Corrosion, but because of customer requirements there seemed little opportunity to impact the cost of this function.

The second example (Figure 2) shown in this paper is a building project for the Bureau of Reclamation. The team's objectives are described above. They were key to deciding which functions to take to the creative phase of the job plan. It was also key to determine the high cost functions. Below are the FAST diagram and the result of the detailed cost function allocation exercise.

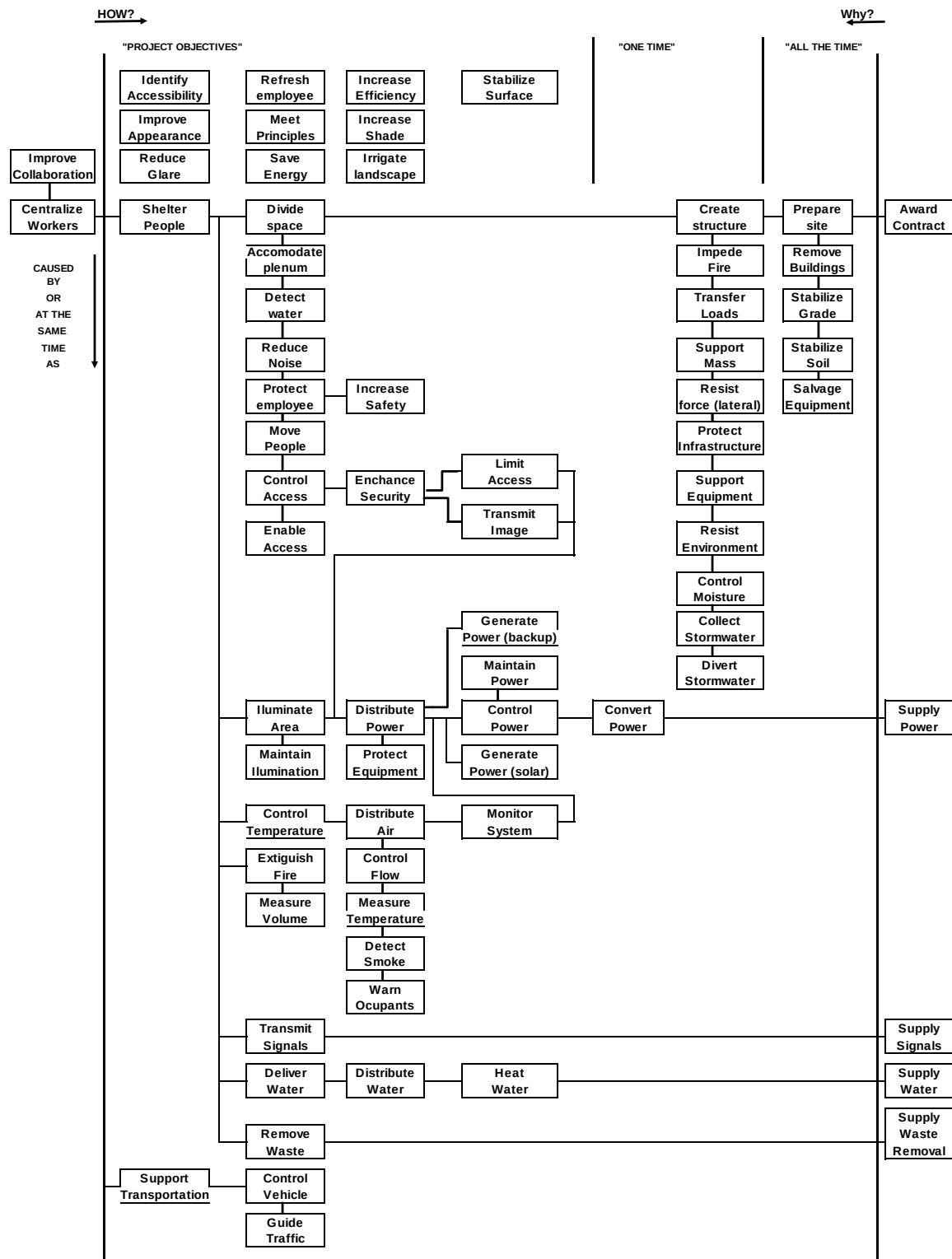


Figure 2

The FAST diagram has 64 functions between the scope lines. Below (Figures 3 and 4) you will see that 49% of the total building cost estimate went into only 6 of those functions. Note that this spreadsheet has been modified by hiding several of the low cost functions to improve the readability but is included as an example to show a cost function allocation matrix.

PART or OPERATION	DIRECT COST	FUNCTION - Active Verb / Measurable Noun																					
		Accommodate plenum	Collect stormwater	Control access	Control temperature	Create structure	Deliver water	Distribute power	Divide space	Extinguish fire	Generate power (solar)	Guide traffic	Heat water	Illuminate area	Improve appearance	Increase safety	Increase shade	Move people	Prepare site	Resist environment	Support transportation		
NORMAL POWER SERVICE ENTRANCE	344,100							53%															
EMERGENCY POWER SERVICE ENTRANCE	120,300							37%															
SOLAR POWER DISTRIBUTION	277,740									100%													
MAIN POWER DISTRIBUTION	152,000							77%															
NORMAL POWER DISTRIBUTION (148 FV)	71,500							95%															
NORMAL POWER DISTRIBUTION (204) FV	87,000							97%															
CRITICAL POWER DISTRIBUTION (187) FV	145,840							96%															
CRITICAL POWER DISTRIBUTION (204) FV	110,250							97%															
LIGHTING (277V UNLESS NOTED OTHERWISE)	191,500												65%		4%								
POWER	67,510			48%				13%															
TELECOMMUNICATION SYSTEM	103,810								1%														
FIRE PROTECTION SYSTEM	94,600																						
SITE DEVELOPMENT	1,174,328		8%									4%			7%	3%	1%		24%		22%		
SUPERSTRUCTURE STEEL	1,208,840					100%																	
STAIRS	40,490																	100%					
ARCH. FEATURES AND ENTRANCE	32,850														100%								
PARKING SUNSHADES	393,080									25%							75%						
FOUNDATION	275,430					94%																	
ACHTECTURAL	2,541,686	17%	2%	4%					11%				11%	18%	2%					21%			
ELEVATOR	168,000																	100%					
PLUMBING	276,000		12%				23%					15%											
FIRE PROTECTION PLUMBING	305,000								100%														
HVAC SYSTEM	690,000				100%																		
POTABLE WATER	158,930						92%		8%														
SANITARY SEWER	28,895																						
TOTALS	9,019,679	\$432,087	\$177,900	\$134,072	\$650,000	\$1,467,744	\$209,696	\$751,964	\$279,585	\$318,753	\$376,010	\$46,973	\$41,400	\$404,060	\$572,556	\$93,724	\$306,553	\$208,490	\$281,839	\$533,754	\$258,352	\$9,019,679	
Direct Costs EXCLUDE all Fixed burden & Overhead, S,G,&A, Margin																							
FUNCTION - PERCENTAGE:		100.00%	4.79%	1.97%	1.49%	7.21%	16.27%	2.32%	8.34%	3.10%	3.53%	4.17%	0.52%	0.46%	4.48%	6.35%	1.04%	3.40%	2.31%	3.12%	5.92%	2.86%	100%

Figure 3

Figure 4 below came from this detailed cost function allocation worksheet shown.

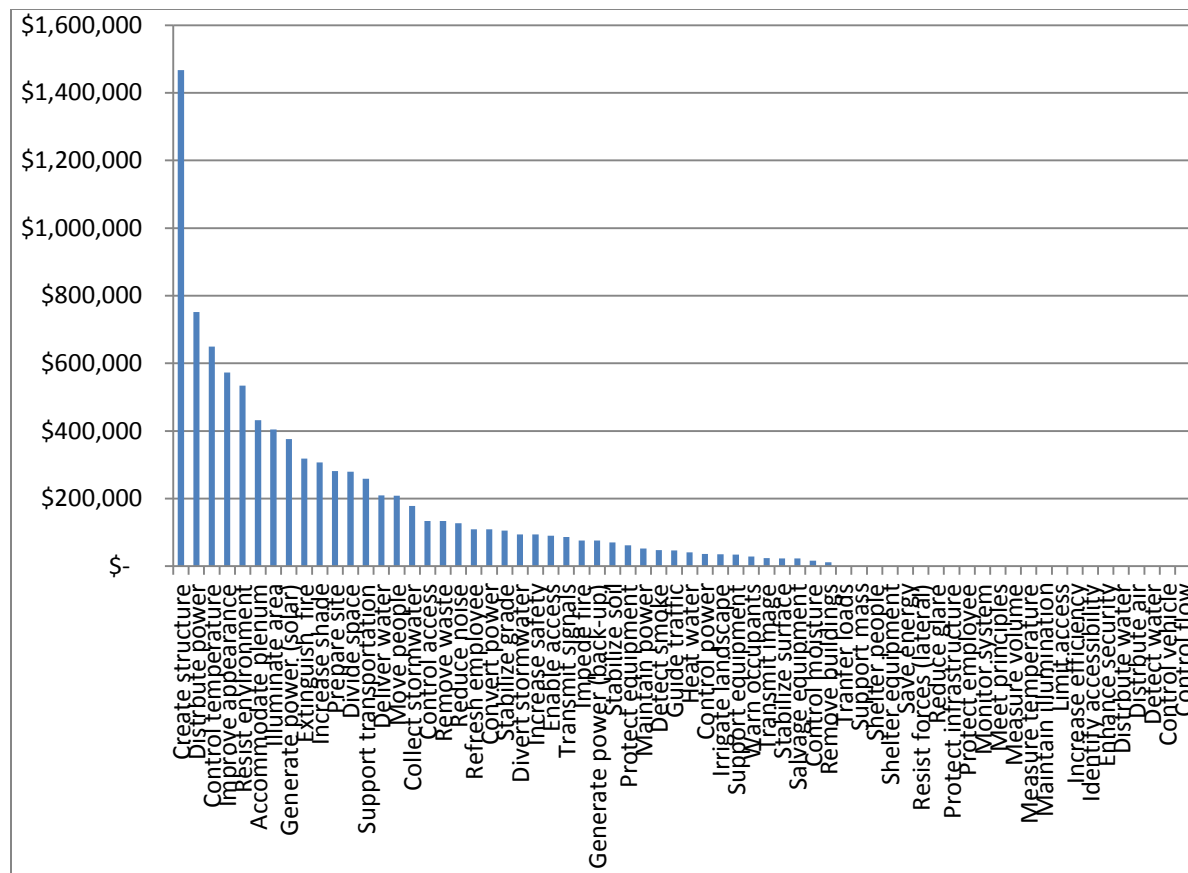


Figure 4

Conclusion

The Value Methodology developed by Larry Miles is a function oriented discipline. It was intended to use functions to change the way people think. To accomplish that it seems an incomplete Function Analysis Phase will achieve subpar results when compared to teams performing function analysis and create by function. A few years ago I performed a Module I Workshop for an A/E firm in Saudi Arabia. The team used a real project for the workshop. The tangible results by applying the training to their project were significant. However, what the team told me afterwards was shocking. They had brought in a CVS consultant to VA/VE the same project a few months before my training. The savings from the Module I Workshop exceeded the savings from the previous effort. When the team was asked why, the reply was that the CVS did not do the complete function analysis phase. They created a FAST diagram and did not use it. They brainstormed ideas from the drawings, not by function. Thus the minds of team members were not stretched.

It seems to this author that it would be very difficult to determine which functions offered the best opportunity to improve value without doing a complete FAST diagram and cost function allocation. In addition the team understanding of product functions, their relationships and of course, a new and complete understanding of cost is tremendously important. Customers do not buy things, we buy functions. Thus it is critical to know the cost of the functions that our products, projects and processes perform.