Function Analysis and the Functional Performance Specification to Define Clients' Needs and Develop the Best Value

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This paper presents the Functional Performance Specification (FPS) which is a methodology used to describe the needs of a client which have to be taken into account when designing a new product. It will briefly explain the process, different methods used at each step and the final result.

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Mrs. Parrot is very much involved with the Canadian Society of Value Analysis, where she was president from 2010 to 2012 and is now Vice-President Communications. She also chairs the 2013 conference committee. She is a certified trainer in the value methodologies and is a frequent speaker on this and related topics.

Definition of Value

To start, it is imperative that the definition of Value be given, so all readers have the same understanding.

$$\text{value} = \frac{\text{level of satisfaction of needs}}{\text{cost (or other resources)}}$$

This means that the value of a product/service is equal to the ratio between the level of satisfaction of the needs of the clients when using the product/service compared to the cost (or resources) used to satisfy that need. It is important to notice that at a constant cost, if the level of satisfaction is increased with a better product, the value of that product increases. Also, for a constant level of satisfaction but at a lower cost, the value of the product increases. In the same direction, if the level of satisfaction is increased a lot but for a small increase in cost, value is increased; and if the level of satisfaction is decreased a little, with a big reduction in cost, value is also increased. This means that there are a lot of strategies to look at when one wants to increase the value of one's products or services, depending on the context.

There is throughout the world a recognized Value Engineering job plan; it is:

- Pre-workshop activities

  - What is the goal of the VE session and why?
  - Who will participate?
- Workshop activities
  - Information
  - Function and cost analysis
  - Creativity and evaluation
  - Development of Value proposals
  - Presentation of Value proposals
- Post-Workshop activities
  - Implement best proposals
  - Follow up

But this paper will focus on the function analysis phase and the context is the development of new products. Figure 1 shows the design strategy including the Function analysis and the Functional Performance Specification.

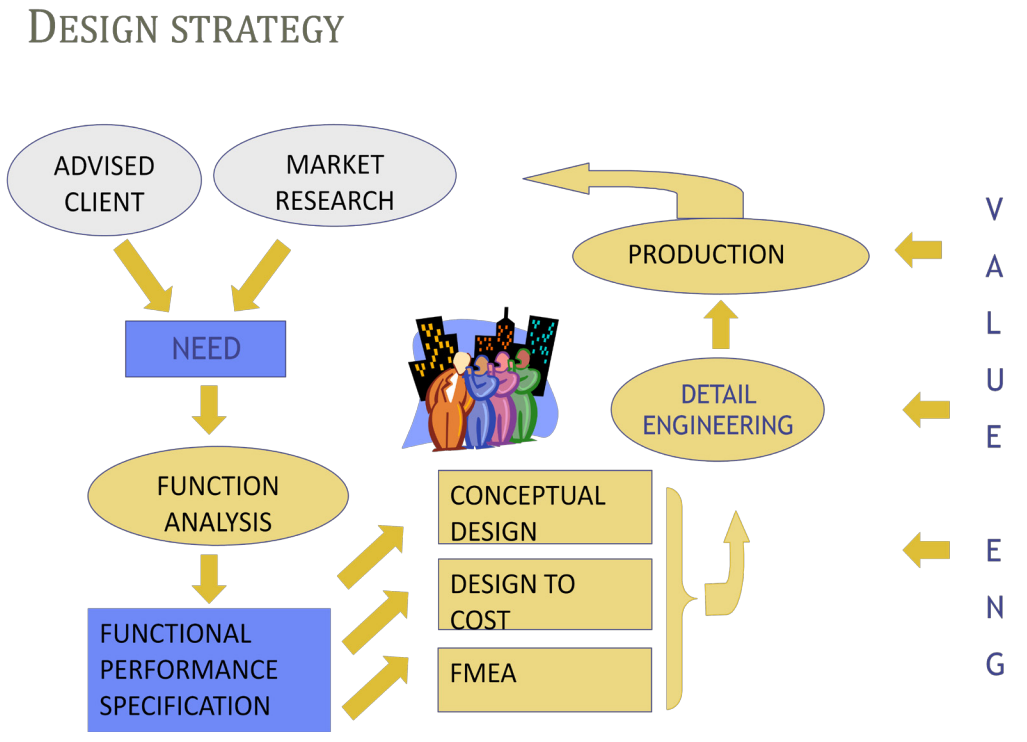

Figure 1 - Design strategy

It shows that the design process starts either with an advised client (when you are developing a product for a unique client) or with a market research (when you are developing a product for a mass market). Both of them have needs that are not yet satisfied. To be able to capture and understand those needs, a function analysis is required. The results of this analysis will be documented in a Functional Performance Specification (FPS) who will then be used by the designers to do the conceptual design(s). It is also necessary if the project will be done in a "design-to-cost" manner. It will also be used for a first Failure

Mode and Effect Analysis (FMEA) where as assessment can be made of the consequences of not accomplishing a function, no matter what solution is envisaged.

At this point, a first value assessment can be made, to pick the best concept, before going into detail engineering and production where value engineering can also be applied to optimize the value at each stage of the development.

Function analysis

The standardized process for function analysis consists of 5 steps:

1. Identify the functions of the product
2. Organize the functions of the product
3. Characterize the functions
4. Prioritize them
5. Estimate the cost of these functions

This paper will explain the 5 steps of the function analysis.

What are functions?

Again, a definition must be given, to make sure everybody follows. A function, in this context, is a short sentence describing each part of the need of the client; in this case, not only the end use is considered, but also, it is necessary to identify if any needs are specifically required by the installer or the recycling process or maybe even marketing or manufacturing. Functions describe what must be done by the product to satisfy each and every one aspect of these needs. It does not describe a solution. A function is stated with an active verb and a measurable noun.

There are 6 documented methods used to identify the functions.

- Intuitive research
- Environment analysis
- Sequential analysis
- Reference product analysis
- Efforts and movement analysis
- Rules and regulations analysis

Each of these methods identifies a set of functions. Not all methods are required all the time. It is to the facilitator to decide which ones are most effective according to the context of the project.

As an example, here are some functions for the development of a pool shed designed for outdooring purposes:

- Store related products (an obvious one!)
- Allow participants to get ready
    - Allow swimmers to change into their trunks

- Allow to take a shower

- Ensure safety
  - Prevent falls
  - Resist mildew

- Decorate backyard

But having a list of functions is not sufficient for the design team to work with. Most of the time, the functions are identified in a random way. It is important to place them in some kind of order, to be able to use the list. To do so, the method used is the functional diagram. Figure 2 shows the functional diagram of the pool shed.

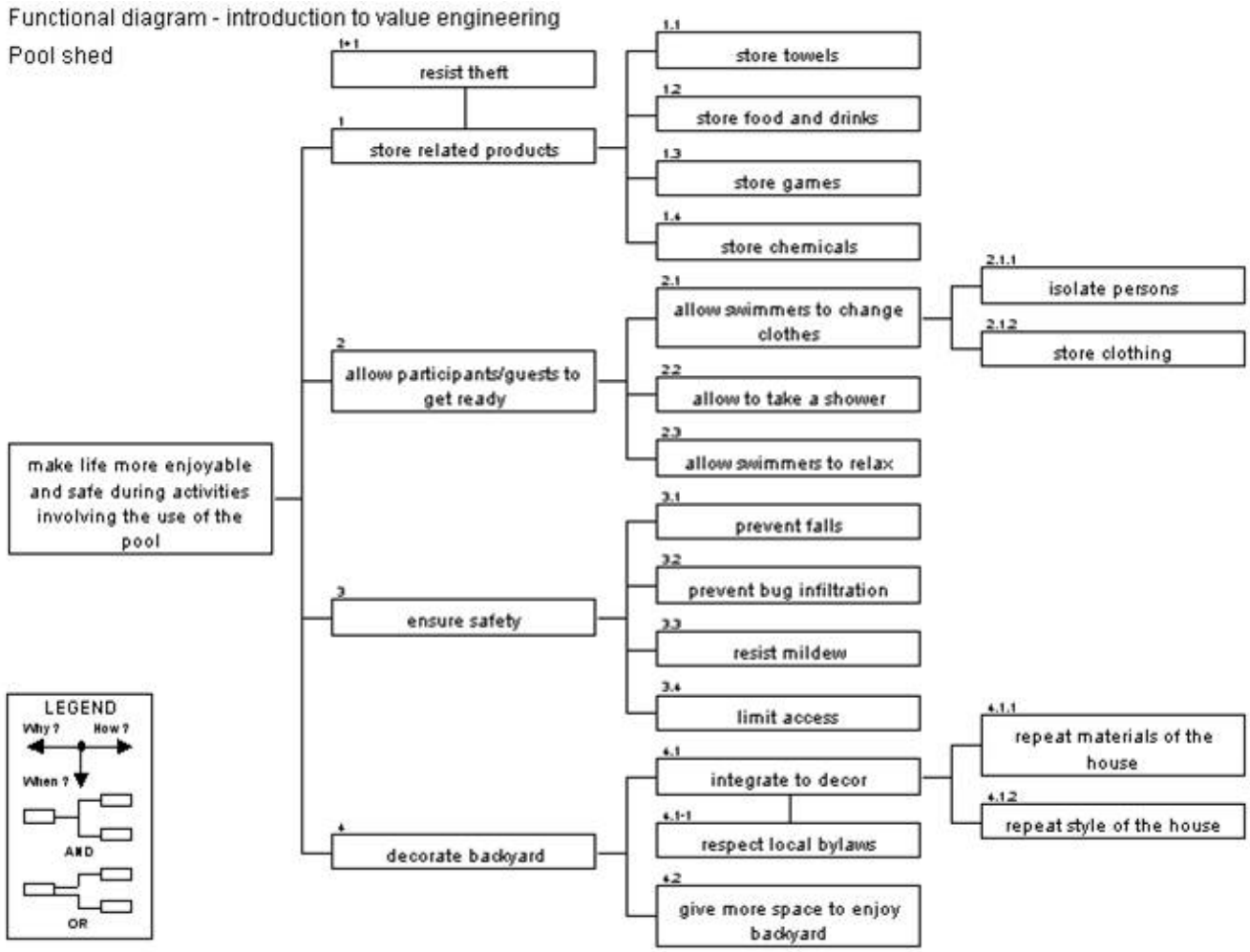

Figure 2 - Functional diagram

It is a diagram showing the logic between the functions, by linking them through a why-how relation. Such a diagram is read from left to right by answering the question HOW and from right to left by answering the question WHY. In the end, a model of what the product must do is achieved and can be

used by the designers for many purposes, such as a checklist not to leave out anything. The functional diagram is not a Work Breakdown Structure (WBS) or a Critical Path showing chronology. The functional diagram can also be used for resource allocation and for cost analysis.

Once the functions are identified and organized, they can now be characterized. This means that for each appropriate function, one needs to state a performance criteria (what will be measured when accomplishing the function) with its performance level (the actual measurement) and its flexibility, indicating how "negotiable" this level is to satisfy the client. For example, the following table shows part of the functional characteristics of the pool shed described in the previous functional diagram.

number	function	criteria	level	flex	comments
0	**make life more enjoyable and safe during activities involving the use of the pool**				
1	**store related products**				
1+1	resist theft				
1.1	store towels	number of clean towels number of dirty towels	8 8	F2	
1.2	store food and drinks	type of refrigerator storage space	bar 5 cu ft	F0 F1	open storage for dishes and glasses
1.3	store games	storage space access type of storage	18 cu ft large adjustable	F2 F0 F0	
1.4	store chemicals	linear ft of storage access to products	6 limited	F1 F0	
2	**allow participants/guests to get ready**				
2.1	allow swimmers to change clothes				
2.1.1	isolate persons	number of persons together	2	F1	
2.1.2	store clothing	organization	separated spaces	F2	
2.2	allow swimmers to take a shower	number of persons together	2	F1	could be outside cabana

Table 1 - FPS of pool shed (Partial)

Then, functions may be prioritized according to many parameters like level of IT involvement, level of public interest, importance identified through survey and so on.

The results are that your design team now understand the client's business better and know what the project must deliver, in terms of performance. It's up to this team to now come up with the best solution to achieve this.

Benefits of function analysis

The benefits of using function analysis are numerous:

- Effective Use of Resources
- Mid-course Spec Changes Minimized
- Use of Disciplined Effective Methodologies
- Tradeoffs Between Cost / Features / Performance
- "Voice of Customer" instead of "Voice of Engineer or Management"

The Functional Performance Specification

So, what is the Functional Performance Specification? As per the European standard, it is the document by which a client expresses his needs in terms of functions and constraints. It presents the results of the function analysis. It thus includes a description of the context of the new product, the functional diagram showing all the functions and their relation, the list of the functions with their characteristics: performance criteria, level and flexibility. It also indicates to the designers if any constraints exist. This document becomes an agreement between the client and the design team.

Finding the best project

Once the design team has a complete list of all the functions their product must do, in order to achieve client satisfaction, they must now find the best solution. According to the product development process, a concept is the first thing to come up with. Usually a team will find 3 or 4 concepts that can do the job; they must now determine which one suits the mandate best. To do so, the following steps can help:

- Identify functions with their Criteria-Level-Flexibility (from the FPS)
- Find all potential concepts/solutions to fulfill these functions
- Select comparison/evaluation criteria and give them a relative weight
- Evaluate performance of each concept, one criterion at a time (The sum of these results with yield the level of satisfaction)
- Estimate the cost of each concept
- Plot Value Graph = level of satisfaction/cost

Figure 3 shows a value graph, where the Y axis is the level of satisfaction and the X axis is the cost. Thus the slope of each line represents the value of the concept, (value = satisfaction of the needs / cost), the best value being in the left upper most area of the graph, where satisfaction is at its greatest, at the lowest cost. It is where the needs of the different stakeholders will be most balanced at the best cost.

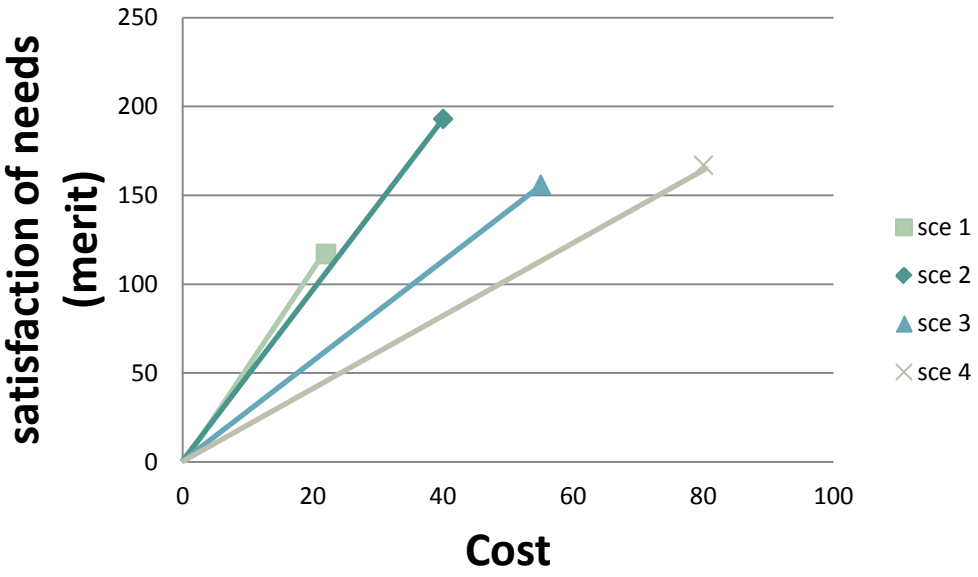

Figure 3 - Value graph

In this case, scenario 1 and 2 have almost the same value, scenario 2 satisfying more of the needs but at a higher cost. The strategy evolving of this could be that the company decides to do 2 models, one top of the line and one bottom of the line, two versions of the same product.

Conclusion

Function analysis is a methodology that serves many purposes, one of them being innovation. Tangible benefits are:

- Function analysis helps identify better the clients' needs before any attempt to design anything is done;
- It gives the designers more latitude to chose the best solution because the client specifies the performance he expects from the product, no matter what the product looks like or is built with;
- A value graph will help identify the concept with the most value.

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