Designation: E 2013 – 06

Standard Practice for Constructing FAST Diagrams and Performing Function Analysis During Value Analysis Study[1]

This standard is issued under the fixed designation E 2013; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers a logical structure for the function analysis of a building project or process.

1.2 This practice provides a system to identify unnecessary costs of a project.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

E 631 Terminology of Building Constructions

E 833 Terminology of Building Economics

E 1557 Classification for Building Elements and Related Sitework—UNIFORMAT II

E 1699 Practice for Performing Value Analysis (VA) of Buildings and Building Systems

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this practice, refer to Terminologies E 631 and E 833.

4. Summary of Practice

4.1 This practice provides an organized approach for determining the needs and desires of the owners/users/stakeholders during the Value Analysis (VA) of a project. These needs and desires are presented as functions of the project.

4.2 This practice establishes a logical procedure for allocating cost to each function.

4.3 Function analysis helps design professionals justify the value of their concepts. It also provides the owners/users/stakeholders with a justification of their investments.

5. Significance and Use

5.1 This practice establishes a communication format through which all owners/users/stakeholders can understand, analyze, revise, and agree on the purposes of the project. This practice presents a method by which owners'/users'/stakeholders' needs and desires are compared to the cost to satisfy those needs and desires. This is done by identifying the low preference/high cost functions and high preference/low cost functions. These data will be used in the value analysis study as a basis to create alternative solutions.

5.2 This practice helps developers, owners, users, stakeholders, planners, contractors, architects, engineers, value analysts, cost professionals, and any one who is responsible for the budget, construction, maintenance, or operation of the project.

5.3 A Practice E 1699 has been published. As part of the value analysis study, perform function analysis after the collection of relevant information and prior to the identification of alternatives. Function Analysis Systems Technique (FAST) data helps the user identify the alternatives that are highly valued with respect to their cost.

6. Procedure

6.1 Function analysis consists of five sequential steps: (*1*) select a building component, (*2*) define the needs and desires (functions), (*3*) classify functions, (*4*) allocate cost to each function, and (*5*) analyze the importance and expected performance level of the functions.

6.2 *Selection of a Building Component*—For cost-effectiveness, select building components that offer a significant opportunity for improvement of performance, reduction in cost, or both.

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[1] This practice is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.81 on Building Economics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

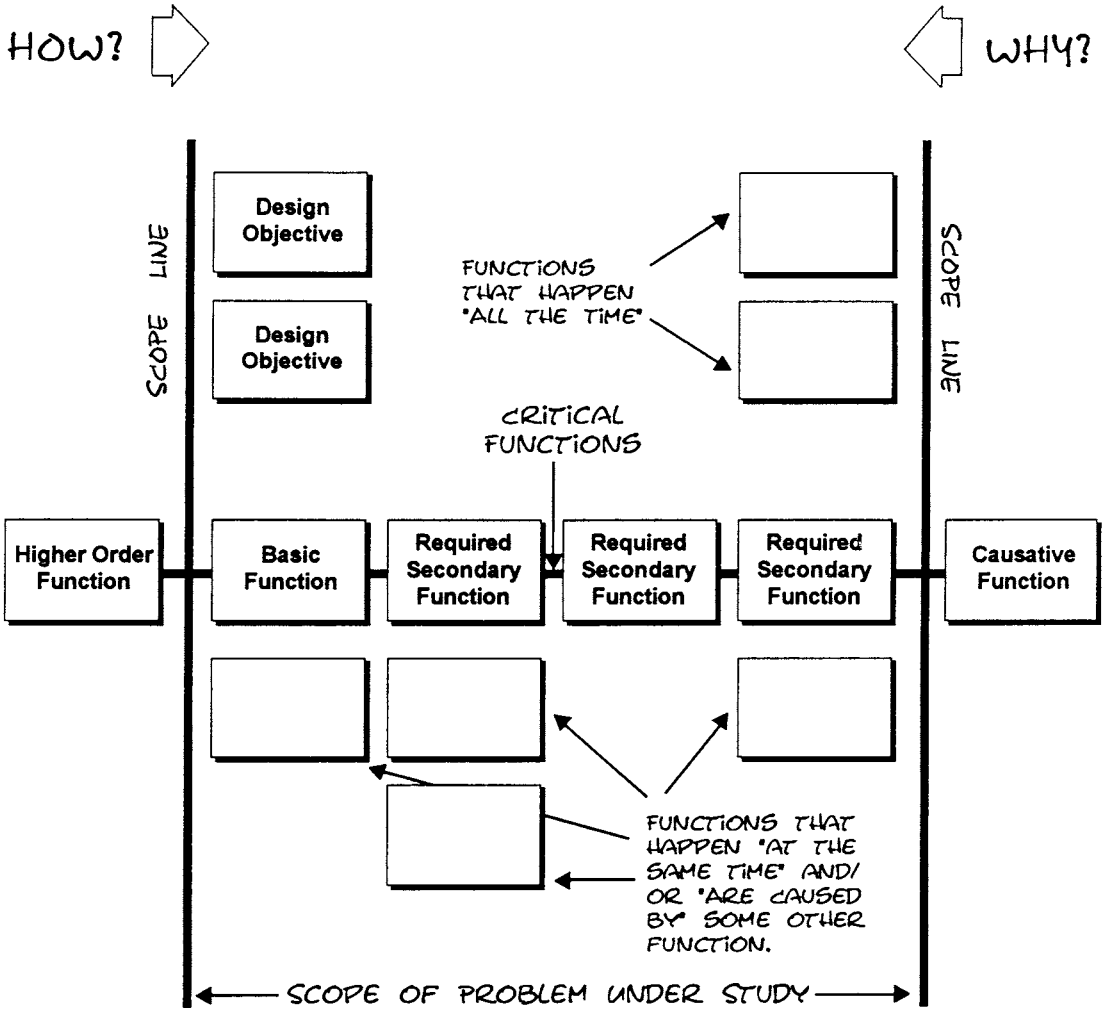

FIG. 1 Function Analysis Systems Technique (Technical FAST)

6.3 *Definition of Needs and Desires (Functions)*—Define each significant need or desire of the owners/users/stakeholders in two words using an active verb and a descriptive noun. The two-word definitions are the functions of the project.

6.4 *Classification of Functions*—Categorize the functions of the building component as basic (essential to meet the owners'/users'/stakeholders' needs) or supporting (enhances the satisfaction of the owners'/users'/stakeholders' needs and desires).

6.5 *Distribution of Cost to Functions*—Divide cost of each component into smaller sections based on the specific use of the project and distribute cost to each function.

6.6 *Analysis of Functions*:

6.6.1 Analyze functions through a structured logical format called Function Analysis Systems Technique (FAST). FAST is a diagramming technique which specifically illustrates the relationships and interrelationships of all functions within a specific project using a "How-Why" logic pattern. There are two FAST variations.

6.6.2 One variation, known as Technical FAST, develops a critical path to define the basic needs of the project. This diagram helps the user calculate the ratio of total cost to critical functions.[3]

6.6.2.1 Technical FAST diagramming is effective in a specific situation or element within a project. The situation or element is an assembly or a portion of a construction design. Terms or functions are oriented to technical activities. A Technical FAST diagram has a specific structural form (Fig. 1).

6.6.2.2 There are four important concepts in a Technical FAST diagram:

1. "How-Why" Logic Questions
2. Scope Line
   - Higher Order Function
   - Basic Function
   - Required Secondary Functions
   - Causative Function

[3] *Certification Examination Guidelines*, SAVE International, Dayton, OH.

3. Critical Functions

4. Supporting Functions
   - Design Objectives
   - All The Time Functions
   - Caused-by/Same-time Functions

6.6.2.3 Function analysis requires analyzing why a function exists and how a function satisfies other functions to complete the link between them. This "How-Why" logic assures that all the required functions are listed in the FAST diagram.[4]

6.6.2.4 Begin the Technical FAST diagramming with a higher order function of the project and two scope lines. All functions that the selected element fulfills are bounded by the two scope lines. The basic function is on the right of the left-hand scope line, and the higher order function is on the left. The purpose of the element or project for which a FAST diagram is developed is the higher order function. The relationship between the higher order function and the basic function is determined by asking "Why" the basic function candidate performs as it does. The answer should be the higher order function. The logic check must be completed by asking "How" the higher order function performs. The logical answer must be the basic function candidate. It is still necessary to confirm the required secondary function to the left of the right-hand scope line. When the "How" question is asked of this function, the answer will be an outside function candidate. The outside function is called the *causative function*, since it really starts the critical functions.

6.6.2.5 Determining the basic function often requires selecting functions from the list of suggestions and applying the "How" and "Why" questions. If the "Why" question is answered by another identified function, that function is the next candidate for the basic function. The function to the right becomes a required secondary function. Once the basic function is verified, the remaining required secondary functions are identified. This group makes up the *critical functions.*

6.6.2.6 The last group of functions is *supporting functions*. There are three types. The first type, *caused by* or *same time* functions, connects directly to a critical function. These functions result from the performance characteristics of particular critical functions and act as modifiers. The second type, *all-the-time functions*, modifies two or more of the critical functions. The third type, *design objectives*, represents specifications that are added to the design, often by the stakeholder or group that is developing or operating the process.

6.6.3 The second variation, known as Task-oriented FAST, creates distinct functions for owners'/users'/stakeholders' concerns and is always headed by four primary functions: (*1*) assure dependability, (*2*) assure convenience, (*3*) satisfy owners/users/stakeholders, and (*4*) attract owners/users/stakeholders.

6.6.3.1 The Task-oriented FAST diagram logically displays the owners'/users'/stakeholders' needs and desires (see Fig. 2). Task-oriented FAST diagramming is especially effective in the planning or conceptual phase. Use conceptual layout and building plans to develop these FAST diagrams.

6.6.3.2 There are four parts to the Task-oriented FAST diagram:

1. Task

2. Basic Functions
   - Primary
   - Secondary

3. Supporting Functions
   - Assure Dependability
   - Assure Convenience
   - Satisfy Owners/Users/Stakeholders
   - Attract Owners/Users/Stakeholders

4. Classify Functions
   - Primary
   - Secondary
   - Tertiary

6.6.3.3 The first step is to determine the task. The task satisfies the overall needs of the stakeholder. Establish a scope line just to the right of the task. Functions that answer "why perform the task" lie outside of the scope.

6.6.3.4 The second step is to separate the identified functions into basic and supporting functions. Basic functions are those which are essential to the performance of the task. Without the primary basic functions, the project or process will not work.

6.6.3.5 The third step is to group the remaining functions into the four primary supporting function groups. Supporting functions play an important role in a building. Structural engineers, for instance, concentrate primarily on the basic functions, with heavy emphasis on the primary supporting function *Assure Dependability*. Mechanical engineers and electrical engineers pay more attention to the supporting function *Assure Convenience*, while architects' ideas satisfy the basic and supporting functions *Satisfy Owners/Users/Stakeholders* and *Attract Owners/Users/Stakeholders*.

6.6.4 *Assure Dependability*—Any function that assures dependability has at least one of the following attributes:

6.6.4.1 Makes the elements of the project stronger or more reliable or effective,

6.6.4.2 Makes it safer to use,

6.6.4.3 Lengthens the life of the parts or minimizes maintenance cost, or both, and

6.6.4.4 Protects the environment.

6.6.5 *Assure Convenience*—Any function that assures convenience has at least one of the following attributes:

6.6.5.1 Modifies the basic function to make it convenient to use,

6.6.5.2 Enhances spatial arrangements,

6.6.5.3 Facilitates maintenance and repairs, and

6.6.5.4 Furnishes instructions and directions to owners/users/stakeholders.

6.6.6 *Satisfy Owners/Users/Stakeholders*—Any function that satisfies owners/users/stakeholders has at least one of the following attributes:

6.6.6.1 Modifies the basic function to satisfy the individual desires,

6.6.6.2 Makes the stakeholders' life more pleasant; for example, minimizes noise, and

[4] "Function Analysis-The Stepping Stone to Good Value," Snodgrass, Thomas J. and Kasi, Muthiah, University of Wisconsin, Madison, 1983.