Analyzing Construction Defects

5. A Sensible List

A. Why This Matters

B. By Importance

C. Room-by-Room (Location by Location)

D. SB 800

E. By Who did the Work: CSI Codes

F. By Assembly: Uniformat (PFCS Standard)

G. Work Breakdown Structure

A. Why This Matters

- We must create a Logic Structure, organization scheme or method so all individual pieces of information can be organized in a logically.
- Construction Defect Litigation can be very complex. Often, there is WAY more information than any one can keep in his/her head.
- This is either the easiest or hardest thing you will do.
- Human beings need to have a Logic Structure to grasp the big picture of a complicated subject.
- The magical number 7, plus or minus 2: A scientific paper that explores the human mind's ability to understand and remember.
- What if there is NO defect list?

A. Why This Matters

If the list is well composed it can be used to outline:

- Defect List
- Reports of All Experts
- Expert Responsibility Matrix: Who is testifying about what
- Scope of Repair
- Cost Estimates, Bids & Cost Comparisons
- Schedule for Construction / Repairs
- Payment Schedule for Construction / Repairs
- Allocation of Responsibility
- Trade Contractor "Claim Packages"

Analyzing Construction Defects

B. By Importance

A. The Dog Died from Mold Exposure

B. Window Leaks

C. Hairline Crack in Tile Counter

Analyzing Construction Defects

C. Room-by-Room (Location by Location)

A. Exterior
   1. Stucco Cracks
   2. Delaminating Paint

B. Living Room
   1. Cracked Floor Tile
   2. Poor Finish Work

C. Master Bath
   1. Cracked Floor Tile
   2. Delaminating Paint

D. SB 800

A. Water Issues
   1. The windows leak
   2. The doors leak
   3. Shower and bath enclosures leak

B. Plumbing and Sewer Issues
   1. The plumbing system Leaks
   2. The sewer system Leaks

C. Other Issues
   A. Air-conditioning is not consistent with the size and efficiency design criteria in Title 24 of the California Code of Regulations.

E. By Who Did the Work: CSI Codes

08-50 Windows
   A. Windows leaks
   B. Fogged Insulated Glazing Units

09-30 Tile
   A. Leaks
   B. Cracks

22-00 Plumbing
   A. Leaks
   B. Corrosion

23-00 HVAC
   A. Air-conditioning is not consistent with the size and efficiency design criteria in Title 24 of the California Code of Regulations.

F. By Assembly: Uniformat (PFCS Standard)

- B 2010 Siding
  - A. Leaks
  - B. Incorrect Nailing
- B 2060 Exterior Paint
  - A. Deteriorated Trim
  - B. Delaminating
- B 3001 Roof
  - A. Damage
  - B. Leaks
  - C. Missing Underlayment
- C 3011 Interior Paint
  - A. Inadequate Coverage
  - B. Wrong Color

F. By Assembly: Uniformat (PFCS Standard)

- Level 1 Structure
  - A. Substructure
  - B. Superstructure
  - C. Interiors
  - D. Services
  - E. Equipment & Furnishings
  - F. Special Construction & Demolition
  - G. Building Sitework
  - H. Other

Analyzing Construction Defects

F. By Assembly: Uniformat (Outhouse Case Study)

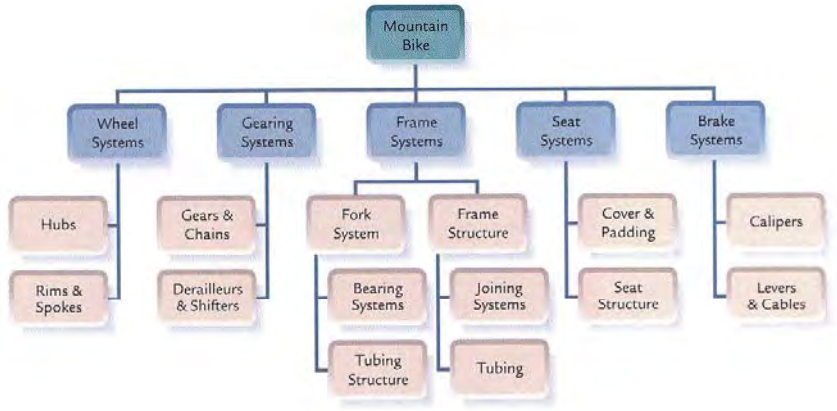
1. A1010 Foundations: The structure was constructed without a concrete foundation.
2. B2012 Exterior Enclosure: Siding & Trim: The nailing of the siding is grossly inadequate.
3. B2030 Exterior Doors: The doors leak, causing damage to the interior finishes.
4. D 1000 Conveying: The conveying system (ladder) is defective in it's manufacture and does not meet minimum ADA requirements.
5. D3000 HVAC: The heating system is inadequate to heat the interior to 70 degrees 3 feet above the floor.
6. G2050 Landscaping: Half the landscape planting died within the first year and required replacement.

Analyzing Construction Defects

G. Work Breakdown Structure

1. A WBS is a results-oriented family tree that captures all the work of a project in an organized way.
2. It defines a set of *planned outcomes* that collectively and exclusively represent 100% of the project scope and captures all deliverables – internal, external, interim – in terms of the work to be completed, including project management.
3. Large, complex projects are organized and comprehended by breaking them into progressively smaller pieces until they are a collection of defined work packages that may include a number of tasks. (A $1,000,000,000 project is simply a lot of $50,000 projects joined together.)

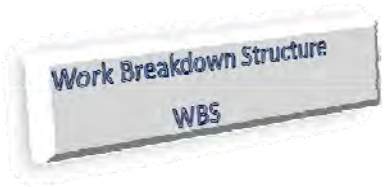
G. Work Breakdown Structure



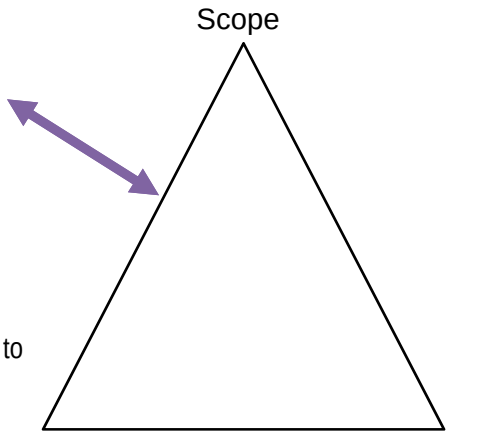
G. Work Breakdown Structure

4. In planning a project, it is normal to find oneself momentarily overwhelmed and confused, when one begins to grasp the details and scope of even a modest size project.
5. This results from one person trying to understand the details of work that will be performed by a number of people over a period of time. The way to get beyond being overwhelmed and confused is to break the project into pieces, organize the pieces in a logical way using a WBS, and then get help from the rest of your project team.
6. The psychologists say our brains can normally comprehend around 7-9 items simultaneously. A project with thousands or even dozens of tasks goes way over our ability to grasp all at once.

G. Work Breakdown Structure



The WBS is the *core* of integrated Project Management and the Scope, Budget, and Schedule must <u>always</u> refer back to the WBS



G. Work Breakdown Structure

7. The solution is to divide and conquer. The WBS helps break thousands of tasks into chunks that we can understand and assimilate.
8. Preparing and understanding a WBS for your project is a big step towards managing and mastering its inherent complexity.
9. The WBS is commonly used at the beginning of a project for defining project scope, organizing Gantt schedules and estimating costs. It lives on, throughout the project, in the project schedule and often is the main path for reporting project costs.
10. On larger projects, the WBS may be used throughout the project to identify and track work packages, to organize data for Earned Value Analysis (EVA) reporting, for tracking deliverables, etc.

Work Breakdown Structure

From Wikipedia, the free encyclopedia

A (WBS) is a fundamental project management technique for defining and organizing the total scope of a project, using a hierarchical tree structure (see example below). The first two levels of the WBS (the root node and Level 2) define a set of planned outcomes that collectively and exclusively represent 100% of the project scope. At each subsequent level, the children of a parent node collectively and exclusively represent 100% of the scope of their parent node. A well-designed WBS describes planned outcomes instead of planned actions. Outcomes are the desired ends of the project, and can be predicted accurately; actions comprise the project plan and may be difficult to predict accurately. A well-designed WBS makes it easy to assign any project activity to one and only one terminal element of the WBS.

History

The concept of the WBS developed with the Program Evaluation and Review Technique (PERT) in the United States Department of Defense (DoD). PERT was introduced by the U.S. Navy in 1957 to support the development of its Polaris missile program. [1] While the term "work breakdown structure" was not used, this first implementation of PERT did organize the tasks into product oriented categories.[1]

By June of 1962, DoD, NASA and the aerospace industry published a guidance document for the PERT Cost system which included an extensive description of the WBS approach. [2] This guide was endorsed by the Secretary of Defense for adoption by all services. [3]

In 1968, the DoD issued "Work Breakdown Structures for Defense Materiel Items" (MIL-STD-881), a military standard mandating the use of work breakdown structures across the DoD. [4] This standard established top-level templates for common defense materiel items along with associated descriptions (WBS dictionary) for their elements. The document has been revised several times, most recently in 2005. The current version of this guidance can be found in "Work Breakdown Structures for Defense Materiel Items" (MIL-HDBK-881A). [5]

It includes guidance for preparing work breakdown structures, templates for the top three levels of typical systems (Appendices A through H), and a set of "common elements" that are applicable to all major systems and subsystems (Appendix I)

Defense Materiel Item categories from MIL-HDBK-881A:

- Aircraft Systems
- Electronic/Automated Software Systems
- Missile Systems
- Ordnance Systems
- Sea Systems
- Space Systems
- Surface Vehicle Systems
- Unmanned Air Vehicle Systems
- Common Elements

The Common Elements identified in MIL-HDBK-881A, Appendix I are: Integration, assembly, test, and checkout; Systems engineering; Program management; Training; Data; System test and evaluation; Peculiar support equipment; Common support equipment; Operational and site activation; Industrial facilities; and Initial spares and repair parts

In 1987, the Project Management Institute (PMI) documented the expanion of these techniques across non-defense organizations. The Project Management

Body of Knowledge (PMBOK) Guide provides an overview of the WBS concept, while the "Practice Standard for Work Breakdown Structures" is comparable to the DoD handbook, but is intended for more general application.[6]

WBS Design Principles

THE 100% RULE

One of the most important WBS design principles is called the 100% Rule. The Practice Standard for Work Breakdown Structures (Second Edition), published by the Project Management Institute (PMI) defines the 100% Rule as follows:

The 100% Rule*...states that the WBS includes 100% of the work defined by the project scope and captures all deliverables – internal, external, interim – in terms of the work to be completed, including project management. The 100% rule is one of the most important principles guiding the development, decomposition and evaluation of the WBS. The rule applies at all levels within the hierarchy: the sum of the work at the "child" level must equal 100% of the work represented by the "parent" and the WBS should not include any work that falls outside the actual scope of the project, that is, it cannot include more than 100% of the work… It is important to remember that the 100% rule also applies to the activity level. The work represented by the activities in each work package must add up to 100% of the work necessary to complete the work package. (p. 8)*

PLANNED OUTCOMES, NOT PLANNED ACTIONS

If the WBS designer attempts to capture any action-oriented details in the WBS, he/she will likely include either too many actions or too few actions. Too many actions will exceed 100% of the parent's scope and too few will fall short of 100% of the parent's scope. The best way to adhere to the 100% Rule is to define WBS elements in terms of outcomes or results. This also ensures that the WBS is not overly prescriptive of methods, allowing for greater ingenuity and creative thinking on the part of the project participants. For new product development projects, the most common technique to ensure an outcome-oriented WBS is to use a product breakdown structure. Feature-driven software projects may use a similar technique which is to employ a feature breakdown structure. When a project provides professional services, a common technique is to capture all planned deliverables to create a deliverable-oriented WBS. Work breakdown structures that subdivide work by project phases (e.g. Preliminary Design Phase, Critical Design Phase) must ensure that phases are clearly separated by a deliverable also used in defining Entry and Exit Criteria (e.g. an approved Preliminary Design Review document, or an approved Critical Design Review document).

MUTUALLY EXCLUSIVE ELEMENTS

In addition to the 100% Rule, it is important that there is no overlap in scope definition between two elements of a WBS. This ambiguity could result in duplicated work or miscommunications about responsibility and authority. Likewise, such overlap is likely to cause confusion regarding project cost accounting. If the WBS element names are ambiguous, a WBS dictionary can help clarify the distinctions between WBS elements. The WBS Dictionary describes components of the WBS with milestones, deliverables, activities, scope, etc.

LEVEL OF DETAIL

A question to be answered in the design of any WBS is when to stop dividing work into smaller elements.

A common way of deciding the detailing level is the time between status reports/meetings. If the team reports bi-weekly the largest work package should be 80 hours. Then at reporting time a package is either not started, finished or late. This way makes it easy catching delays.

A work package is a piece that:

- Can be realistically estimated
- Cannot be logically subdivided further
- Can be completed quickly
- Have a conclusion and deliverable
- Can be completed without interruption (without the need for more information)
- Will be outsourced or contracted out

DECOMPOSITION CONSIDERATIONS (BREADTH VS. DEPTH)

A WBS will tend to be most useful for project management when its breadth and depth are thoughtfully balanced. A common pitfall is to inadequately group related elements, resulting in one or more nodes of the WBS becoming "too wide" to support effective management. This can make it difficult for management to find risk-relevant roll-up points within the WBS, requiring manual subtotaling of nodes or eventual restructuring of the WBS in order to make useful cost data more readily accessible. While no concrete standard exists for optimal depth or breadth, a common rule-of-thumb is to avoid having more than 7 immediate sub-elements below any given node of the WBS. This rule-of-thumb appears to be derived from psychological studies indicating that an average human brain is only capable of processing about 7 to 9 considerations simultaneously. The relevance of that psychological consideration to any particular WBS elaboration is left to the discretion of the WBS designer. At a minimum, the existence of more than 7 sister-nodes at any point in the WBS should prompt the designer to carefully consider whether those sub-elements might not best be expressed (and tracked) in more logical sub-groupings.

WBS CODING SCHEME

It is common for WBS elements to be numbered sequentially to reveal the hierarchical structure. For example 1.3.2 Rear Wheel identifies this item as a Level 3 WBS element, since there are three numbers separated by a decimal point. A coding scheme also helps WBS elements to be recognized in any written context.

Common Pitfalls and Misconceptions

A WBS is not an exhaustive list of work. It is instead a comprehensive classification of project scope.

A WBS is not a project plan or a project schedule and it is not a chronological listing. It is considered poor practice to construct a project schedule (e.g. using project management software) before designing a proper WBS. This would be similar to scheduling the activities of home construction before completing the house design. Without concentrating on planned outcomes, it is difficult to follow the 100% Rule at all levels of the WBS hierarchy.

A WBS is not an organizational hierarchy. Some practitioners make the mistake of creating a WBS that shadows the organizational chart. While it is common for responsibility to be assigned to organizational elements, a WBS that shadows the organizational structure is not descriptive of the project scope and is not outcome-oriented. See also: responsibility assignment matrix (also called a Staffing Matrix).

WBS updates, other than progressive elaboration of details, require formal change control. This is another reason why a WBS

should be outcome-oriented and not be prescriptive of methods. Methods can, and do, change frequently, but changes in planned outcomes require a higher degree of formality. If outcomes and actions are blended, change control may be too rigid for actions and too informal for outcomes.

See Also

- List of project management topics
- Project planning
- Product breakdown structure
- Project management software

Figure 1 shows a WBS construction technique that demonstrates the 100% Rule quantitatively. At the beginning of the design process, the project manager has assigned 100 points to the total scope of this project, which is designing and building a custom bicycle. At WBS Level 2, the 100 total points are subdivided into seven comprehensive elements. The number of points allocated to each is a judgment based on the relative effort involved; it is NOT an estimate of duration. The three largest elements of WBS Level 2 are further subdivided at Level 3, and so forth. The largest terminal elements at Level 3 represent only 17% of the total scope of work. These larger elements may be further subdivided using the progressive elaboration technique described above. In this example, the WBS coding scheme includes a trailing "underscore" character ("_") to identify terminal elements. This is a useful coding scheme because planned activities (e.g. "Install inner tube and tire") will be assigned to terminal elements instead of parent elements. Incidentally, this quantitiative method is related to the Earned Value Management technique.

It is recommended that WBS design be initiated with software (i.e. spreadsheet) that allows automatic rolling up of point values. Another recommended practice is to discuss the point estimations with project team members. This collaborative technique builds greater insight into scope definitions, underlying assumptions, and consensus regarding the level of granularity required to manage the project.

Figure 1: WBS Construction Technique. This exemplary WBS is from PMI's Practice Standard for Work Breakdown Structures (2nd Edition). This image illustrates an objective method of employing the 100% Rule during WBS construction.

WBS Construction Example (Figure 1)