PM TUTORIAL

The What, Why and How of
Project Work Breakdown Structures (WBS)

Purpose

This document is a guide for understanding, preparing and using a Work Breakdown Structure (WBS) as a part of planning and managing a project.

Contents

How to Use This Document

- **To Learn** - Read this document.
- **To Acquire a Quick Awareness of WBS Basics** - Scan the WBS Figures and associated text and read the WBS Summary Principles at the end.
- **To Build a WBS and You Are NOT Knowledgeable on WBSs** – Read this document and use the "HOW" section to guide your efforts.
- **To Build a WBS and You Are Knowledgeable on WBSs** – Use the "HOW" section to guide your efforts.

WHAT

What Is the Project WBS?

- The project Work Breakdown Structure (WBS) is a necessary component of managing any project as the WBS forms the framework for project plans and controls for work identification, work assignments, work scheduling and work budgets. As such, the WBS is the project's "Master Framework" for project management functions.
- The WBS is a hierarchal depiction of project "Work Products" where the composite set of all work products in the WBS being the total set of work needed to complete the project and provide the project's deliverable. A WBS dictionary contains work product descriptions.
- The WBS "Work Products" are physical things (nouns) that are the outcomes of work accomplished on the project. These work products (sometimes termed WBS elements or elements of the WBS) are not functional in nature (i.e. they are not verbs) but are the physical results of work. Examples of "WBS Work Products" can be hardware, software, facilities, infrastructure, designs, procedures, test reports, training, spares, manuals, study reports and any other physical thing that is an output of any work performed on a given project. WBS work products are nouns as nouns are physical things for which costs and schedule can generally be estimated. Verbs may not infer sufficient information about the work to support accurate estimates of costs and schedule as the specific outcomes may not be clear.
  (Note that the title "WBS" can be misleading as the word "Work" in WBS may infer actions/verbs to some vs. the correct view of physical "work products" or nouns. The title could be less misleading if it were "Work Product Breakdown Structure" but industry and government have long used the term "WBS").
- The WBS can be prepared as a multi-level outline or as a multi-level hierarchal graphic.
- The structure of the WBS is such that:
  - The top level of the WBS is the project's end product, deliverable, the outcome.
  - The second level of the WBS is the set of major work products that are collectively needed to form the primary deliverable that exists at the first level of the WBS.
  - Each lower level WBS element and any WBS element at any level, is a work product that is produced by all of the work products that fall below it.
  (See Figures 1, 2 & 3 for summary views of an example WBS and work products).
- The WBS is the "Master Framework" for managing a project and is the structure for both project planning and project controls. (See Figures 4, 5, 6 & 7 for depictions of these relationships).
  - The WBS identifies all work and is a hierarchal structure of all project work.
  - The WBS identifies the tasks to be included in the project schedules as the lowest level WBS elements are typically those tasks entered into the project schedule.
  - The WBS becomes the structure for project budgets where resources and budgets are estimated, typically at the lowest WBS level. Higher levels in the WBS become points of planned cost totals during planning and cost collection points for expended funds during project performance.
  - The WBS provides the basis for work assignments and work accountability as the WBS is matrixed with the project organization to form an allocation of each work product to someone or some team in the project. (See Figure 5 for these relationships).

What the Project WBS is NOT

- The WBS is NOT a project organization chart – This project organization hierarchy is a totally separate entity from the WBS. The project organization structure (or sometimes termed an "OBS" or **O**rganization **B**reakdown **S**tructure) is a separate hierarchy from the WBS and is a hierarchy of individuals and/or teams working on the project and is not a depiction of work products. Each lowest level WBS work element (work product) will map to a team or someone in the project organization (OBS). (See Figure 5 for a depiction of these relationships).

- The WBS is NOT a drawing or diagram of the project's deliverable – Many projects have various drawings and diagrams of the project deliverable or outcome that are needed to communicate project details during the project amongst various stakeholders. Different projects will have different drawings or diagrams and some examples include: block diagrams, construction drawings, physical layout drawings, physical and functional interface drawings, functional flow diagrams, process diagrams, data base drawings, user interface definitions and many others. The WBS is not any of these types of project drawings or diagrams as it is a hierarchy of the work needed to produce the project's deliverable not a depiction of the deliverable itself. The WBS will contain the development of all of these needed project drawings and diagrams but will also contain much more other work that is needed to complete the project.

- The WBS is NOT the project schedules - The WBS contains only a definition of work products to be prepared on the project and includes no information on how long that work will take nor the time sequencing relationships between these pieces of work. The project schedules are separate from the WBS but are related to the WBS as the lowest levels of the WBS will typically be the tasks entered into the schedule, but the WBS is not a schedule.

- The WBS is NOT optional – All projects need a WBS to manage a project as it is the master framework for the project plan and project controls.

- The WBS is NOT built after the detail schedules and budgets are prepared – The WBS is the master framework or outline or structure for the project schedules and budgets and needs to be completed before these other important project planning efforts are completed. (Note that a top level master schedule and/or a top level budget may precede the WBS completion but detail schedules and detail budgets follow WBS completion as the WBS defines the elements of work to be scheduled and to be budgeted for.

- The WBS is NOT static in nature – As the project is initially planned, the WBS is formed and establishes the definition of needed work forming the basis for the project plan. As the project progresses, and as changes to the project happen, changes to the WBS are often needed. Examples of changes can be a modification in the project's deliverable, a change in how some work will be accomplished or the surfacing of new work not previously known. When these or other changes occur, the WBS is modified to match these changes and subsequent changes in project work assignments, schedules and budgets are often needed. If the WBS, schedules, budgets and work assignments are updated and reflect the realities of the current project, then these components of project management can tell the project team "the truth" and effective management of the project is possible. When this is not done, trouble is on the horizon.

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WHY
Why is a WBS Needed?

The "Why" of a WBS is simple, the WBS is needed to plan and manage any project.

A project is a set of work to be accomplished and this work must be managed. To manage a project, a plan and project controls are needed. To plan a project, the work on the project needs to be known, assigned, scheduled and have needed resources estimated. To control a project, the status of work completion, schedules, budgets and work assignments need to be monitored. All of these fundamental and necessary project management functions require a clear understanding of what work is actually needed to perform the project and the project WBS provides this necessary work definition.

HOW
How is a WBS Prepared?

WBS Preparation Steps

- **Step 1 – Ensure WBS Development Predecessor Conditions Exist** - Ensure the following conditions exist, or will soon exist, before performing significant work on the WBS.
    - A business case that supports the project exists coupled with the respective project being authorized by management.
    - A project definition or charter that defines the scope, constraints and other key project boundary conditions that is accepted by most, or all, appropriate stakeholders.
    - The requirements for what the project will deliver are known. (An example: Requirements for a new car or new home).
    - The top level definition of what the project will deliver is documented as this is the basis for the definition of all needed work, i.e. the WBS. (An example: Drawings for a new home or top level drawings for a new car)
    - A project manager and some team members are known.

    Note that other predecessor conditions may be required for any given project depending on the project type and the environment the project exists within.

- **Step 2 – Form a WBS (and Planning) Team and Educate the Team** – Form a team that will generate the WBS and ideally will also work to complete the project plan and ensure the team understands the need for a WBS and how it is developed. The WBS team can be the project team for a small or medium sized project. On a larger project, this team could be the set of team leads. The team might also include external experts that will not necessarily work on the project but will provide important information for the development of the project plan. A team is generally needed to build the WBS as typically no one individual will have all of the necessary knowledge or expertise to identify all work for a given project. Define how the WBS team will function, several WBS optional development approaches are:
    a) The team might work together on the WBS, as a team, in a group setting to complete the top levels and all of the details of the WBS.
    b) The team might work together to define the WBS Architecture (top levels of the WBS) and then the PM or WBS lead would work individually with team members to develop WBS detail in the areas of the WBS that the respective individual is knowledgeable in.
    c) The PM or WBS lead might develop the top levels of the WBS on their own, review with the team and then work individually with team members to develop WBS detail in the areas of the WBS that the respective individual is knowledgeable in.

Some pros and cons of these options include:
    o Option "a)" allows the full team to support the WBS development, builds ownership but requires significant more time invested by each individual team member as compared to other options. Another drawback to "a)" is that if the WBS sessions take some real time, and it usually does, the level of detail and quality of information may suffer as the team at some point will "just want to get it done." One advantage to "a)" is that the team will mutually learn about the project and will talk through some of the issues on the project and may resolve some important topics during these WBS development sessions.
    o Option "b)" allows the full team to support the top level WBS development and builds ownership. The WBS architecture maybe a compromise if differences exist amongst the team on what the top levels should be. This option reduces the time for each individual team member and a more accurate and complete WBS may exist with this option as compared to "a)" as time pressures from long full group sessions would not exist.
    o Option "c)" allows the PM or WBS lead to form an effective WBS architecture without compromise but at the possible expense of some level of ownership. A subsequent review and discussion of the top WBS levels with the team can lessen this disadvantage. This option reduces the time for each individual team member and a more accurate and complete WBS may exist with this option as compared to "a)" as time pressures from long full group sessions would not exist.
    o Any option can work, the author leans toward "c)" for many situations.

For any WBS development implementation approach selected, ensure the following:
    o Ensure the WBS team understands the basic "What, Why and How" of WBSs.
    o Ensure the WBS team understands and accepts the WBS Summary Principles.
    o Ensure the WBS team understands that taking the time to develop a good WBS at the start of a project will save significant time, pain and frustration later for that project.

- **Step 3 – Define the WBS Overall Architecture** - Define the top levels of the WBS, use an outline or hierarchal graphic to capture and communicate this information. The WBS architecture can include the first two or three levels of the WBS. (See Figures 1 & 2 for examples). These top WBS levels are defined as follows:
    - o The first level is the project deliverable (i.e. the project's outcome or result)
    - o The second level is the main work products needed to provide the project's deliverable
    - o The third level is a breakdown of needed work products to produce each respective second level WBS element

    Note that you want everyone on the WBS / planning team to accept the WBS architecture as a logical work breakdown before further work is accomplished. If agreement exists, the group can work as a team to do further detail work breakdowns and planning. If this is not the case, disagreements will continue on the details of what the WBS should contain and on the details of the overall plan itself. Handling different views of what the WBS "should be and should not be" can be supported by having the team understand and accept a set of "WBS Principles."

- **Step 4 – Prepare WBS Dictionary Entries for the WBS Top Levels** – The WBS dictionary is a set of short descriptions for each WBS element (work product). This is done to ensure that subsequent work breakdowns below a given WBS element and subsequent estimates of resource and schedule needs are based on a clear and accurate understanding of the work required. As the top WBS levels (WBS architecture) are established, WBS dictionary entries are prepared for all WBS elements (work products).

- **Step 5 – Review WBS Architecture and Associated WBS Dictionary Entries** – Before completing the lower level details in the WBS, review the top level WBS (WBS Architecture) and the corresponding WBS Dictionary entries with appropriate stakeholders for content accuracy and completeness. Conduct this review to also ensure that this WBS architecture makes logical sense to most or all. Make sure you have a solid WBS architecture before doing significant work on the more detail work breakdowns below these top WBS levels. If this is not done, significant re-work of the WBS maybe required later possibly including painful re-scheduling and re-budgeting work. The WBS architecture needs "to be right" as it is the "Master Framework" for all subsequent project planning and project control efforts. Get the WBS right and subsequent project planning and control can be done adequately and with limited turmoil and frustration. If you start with a bad WBS, prepare yourself for a challenging time for the entire project period as the team will constantly be performing management "work-arounds" trying to manage the project with an inadequate structure. This later situation is a classic component of project management failures.

- **Step 6 – Add WBS Detail and Corresponding WBS Dictionary Entries** – As the WBS top levels (WBS Architecture) are completed and accepted, work to add work breakdown detail to each area of the WBS until ALL of the following conditions exist in all parts of the WBS.
  a) Accurate estimates of resources and costs are possible
  b) Accurate estimates of schedule are possible
  c) Sufficiently accurate estimates of work completion status will be possible during project performance to support clear visibility of project progress and issues.
  d) Sufficient granularity of work breakdown exists such that the lowest level of work in the WBS can be clearly assigned to, and can be accountable by, a single individual, a single team lead or a single subcontractor (i.e. no dual accountabilities exist for any lowest level WBS element)
  e) All individuals managing work on the project have adequate visibility of work completion status to manage their respective work scope. Example, if a larger project has a PM and team leads where the team leads perform project management actions for their respective team's work scope, these team leads will typically need more granular views of project status as compared to the level of status granularity needed by the PM alone. In this situation, more detail work breakdowns must exist in the WBS beyond what the PM may need, to ensure the team leads have sufficient visibility to effectively manage their work.

  Where anyone of the above conditions do not exist in any given area of the WBS, the development of more detail in that specific area of the WBS is typically needed until all conditions are true. Note that different areas of the WBS may require different levels of detail to meet these conditions.

  When all detail level conditions noted above exist, further work breakdowns are probably not needed and are often not recommended. Further details will complicate project planning and control efforts and may not provide the management team with any additional value. WBSs with too much detail can cause the planning and subsequent project statusing efforts to be overwhelmed because of the magnitude of detail management tasks.

  Using experts or project team members that will do the work in each area to define these detail work breakdowns (vs. the PM doing it alone) can be very important to WBS accuracy and completeness. This approach is also a critical aspect of plan ownership by the team, a key component of successful project management.

  It is recommended that as each new WBS element (work product) is added, that a WBS Dictionary description be developed for that work product to support accurate and complete definitions of those further work products that will fall below that respective WBS element. The dictionary is also critical to supporting accurate subsequent estimates of costs and schedule needs. (See Figure 8 for an example WBS Dictionary entry).

- **Step 7 – Review the WBS Structure and WBS Dictionary and Baseline** – As the WBS is completed and WBS dictionary entries are finished, conduct a final WBS review to ensure the WBS is complete, accurate, "work product" based and meets the conditions noted in the prior step. The project team might perform this review themselves and/or the project may have external experts complete a review. When the review and final adjustments are completed, baseline (freeze) the WBS version to form the basis for the project schedules, budgeting and work assignments. Changes to the WBS may (probably will) happen later, but a "baselined" (i.e. frozen) WBS is now needed to form a solid foundation for the subsequent project planning efforts.

- **Step 8 – Ongoing, Keep the WBS Current** – Make sure the WBS content best reflects the reality of the needed project work at all times. Changes happen on projects such as the awareness of new work required that was not previously known, awareness of work not needed, work that is improperly defined, project scope changes and other changes. Where the WBS (and other plan components) are maintained and accurately reflect the realities of the project as currently understood, these plan components can best support the PM and team in managing the project. Where any plan component (WBS as one example) degrades in accuracy or completeness, the project is losing its ability to direct project work and to "see" true project status. Trouble often follows.

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How Is the WBS Related to
Other Parts of the Project Plan?

A Single Framework Is Needed!

- **WBS Integration** with Schedules and the Budget Structure during **Project Planning** – During planning, a project team is defining the work, developing schedules, developing cost estimates and assigning work. To do this effectively and with minimum confusion, a single framework is needed to ensure all work is identified, to ensure all work is scheduled, to ensure all work has defined resource needs and budget and to ensure all work is assigned to a single accountable individual or team. It would be very difficult to do all of this effectively if the schedules, budgets and work assignments all used different structures or frameworks. This might be further explained by "cutting the project pie" in a different way when developing work definitions and when scheduling work and when estimating resources and costs and when making work assignments. There is no reason to do this and doing this would cause significant extra work to be done during planning and the completeness and accuracy of the plan would certainly be in question. The most effective way to perform these essential planning actions is to use a single master framework, which is the WBS, to structure all of these components of the project plan. With the WBS as the project's master framework "you have one pie, cut one way and each piece of the pie is a known element of work that shows up in the schedules, that has a budget and that has a name attached to it for accountability." Lack of this integrated approach to planning is a classic cause of planning failure.

- **WBS Integration** with Schedules and the Budget Structure during **Project Controls** – During the execution and control phase of a project, the PM and other individuals managing project work are tracking the quality of work, schedule status, budgets expended, resources utilized and work assignments to ensure the project is being performed in a manner to meet all goals. If all of these "parts of the project control system" use the same master framework, the PM and others managing work can go to a single piece of work and see work quality measures and work schedule progress status and budget expenditures and work assignments and resources. This promotes "**an integrated view of the project**," an established project management best practice. If on the other hand, the same project has "the pie cut differently for these components of project management" then anyone managing project work is going to face a real challenge in trying to correlate information from multiple frameworks or will not be able to correlate this information. As one example, if the PM sees that a given area of work is over-spending their budgets and if the WBS, budgets, schedules, work assignment and quality checks all use different frameworks, the PM cannot easily find other status information directly related to the overrun budget. This inability to easily see "all status measures" for a given piece of work will mean two things. One, the ability to understand the true nature of the problem and find the root cause and define an effective corrective action will be diminished. Secondly, whatever corrective action is defined, it may not be possible to predict or track unintended negative consequences such as a cost reduction corrective action causing schedule delays. This lack of an integrated view of project status is a classic cause of project management failures. A single framework for all aspects of project plans and controls is essential to enable productive project management. The WBS is the heart of this needed framework.

- WBS and Schedule Integration - The lowest level WBS elements in all areas of the WBS typically become tasks in the project schedules. This ensures all work is initially included in the project schedules. (See Figure 6 for an example). Note that when additional schedule detail is desired below this lowest level in the WBS, that detail can be added to the schedule and is not typically retrofitted back into the WBS.

- WBS and Work Assignment Integration - The lowest level of the WBS contains work elements where one individual or one team leader or one subcontractor is accountable. A matrix of the WBS to the project organization captures these responsibilities. This is sometimes termed a "RAM – Responsibility Assignment Matrix or Responsibility Assignment Matrix." (See Figure 5 for an example).

- WBS and Cost Estimate/Budget Integration - The lowest level of the WBS contains work elements where resource needs will be estimated. Budgets may be defined at the same level or a level higher in the WBS. WBS levels above the lowest levels become points of cost collection during project performance. (See Figure 7 for example details).

WBS FIGURES

Figures Listing

WBS Figure 1
WBS Graphic Top Levels or WBS Architecture

As the project deliverable is defined, the WBS top levels or WBS architecture can be defined. Here is a simple example of a car breakdown where the major parts of the car are identified. The second level of this WBS are the major "products" (WBS work products) that are necessary to complete the car project. This would be the case for a car development or a car production project.

WBS Architecture for a Car
(Could be a Development or Production Project)
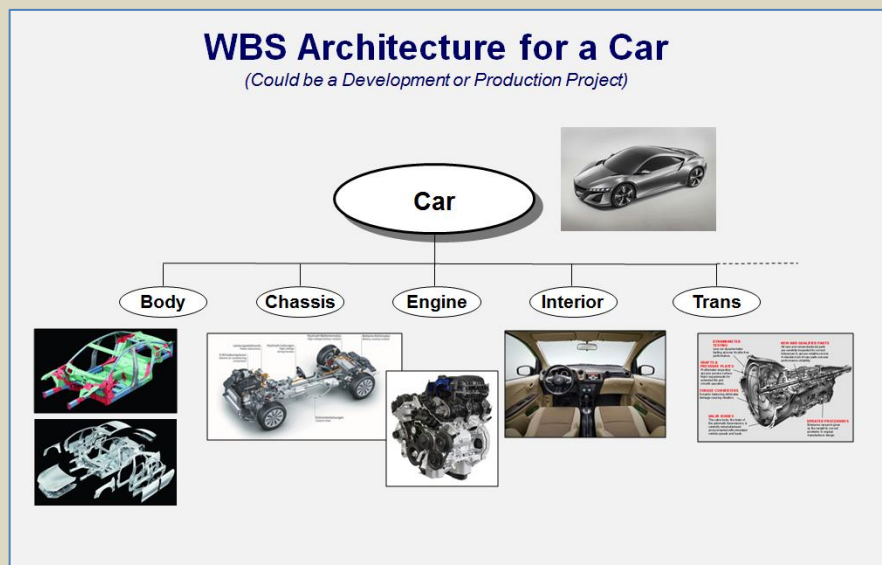
As another example, the second level of a WBS for a construction project could be the major parts of the intended facility. For a project that is developing a new service, the second level WBS work products might be the aspects of that new service such as a help desk, a website, training, documentation and other major parts. For a software development project, the second WBS level could be major components of the new software product.
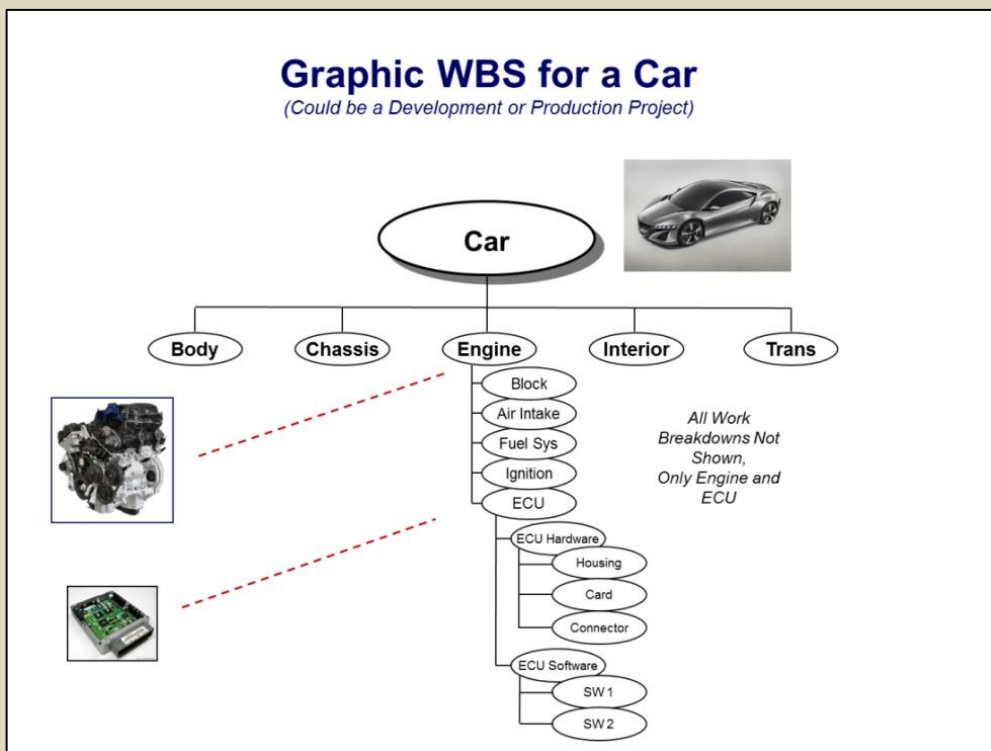
WBS Figure 2

WBS Graphic Details

As the top level WBS levels are complete, more detail is added to each area of the WBS. Here the work to complete the engine is defined in detail. The details below "Engine" are the "work products" needed to cause the engine to exist. This work breakdown below level 2 is sometimes termed a "leg" of the WBS.

As this WBS leg is developed, further work breakdowns are made to identify all work products needed. Under the ECU (Engine Control Unit) as an example, different hardware and software items are denoted.

Further and under the ECU hardware, different hardware parts are identified that includes the housing for the computer, the computer card itself and the connector needed to attach the ECU to the engine and sensors.

Under the ECU software, each software component necessary for ECU operation would be included which might be the application software and self-test software work products and interface software components.
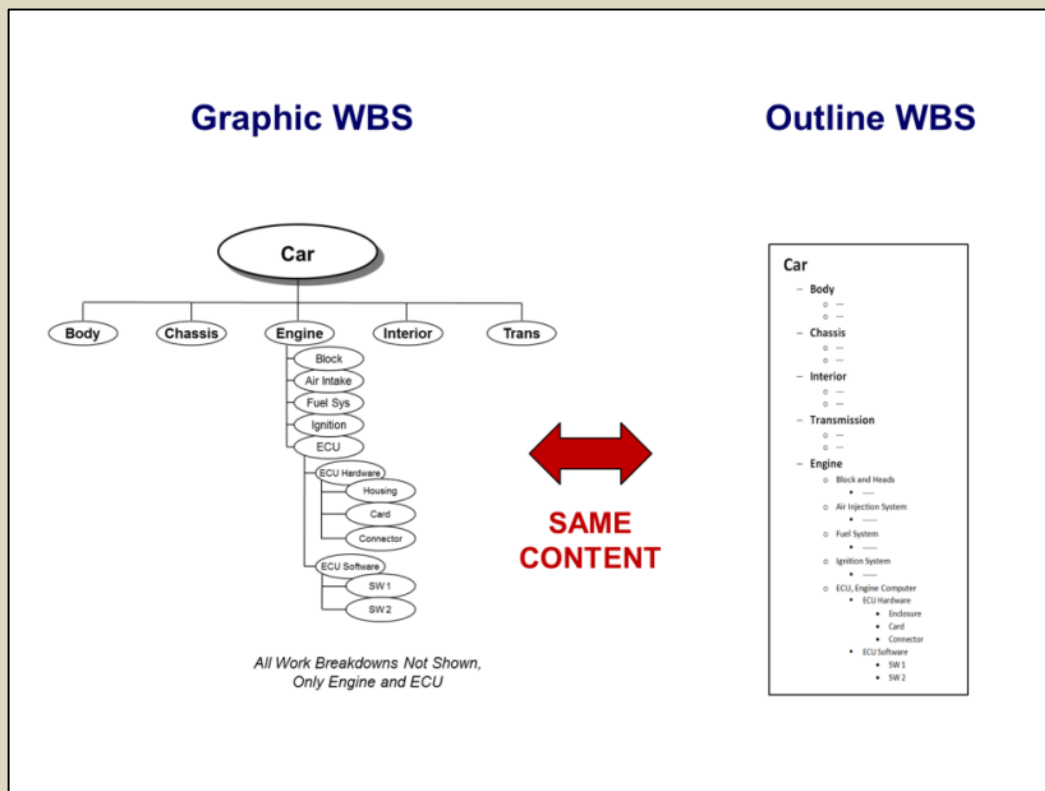

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WBS Figure 3

Graphic WBS vs. Outline WBS

The WBS can be depicted as a graphic or as an outline.
Note that either the graphic or the outline would include the same information.

When building the WBS, often a graphic is best to start team discussions and to develop the WBS as the hierarchy of the work products can be easily depicted and understood. For a large project with many work products, a detail outline is often needed as too much information would exist to depict all levels in a graphic.

Consideration to using both approaches where the graphic is used to capture and communicate the top 3-5 levels of the WBS and then the outline is used to capture those initial levels and all further lower level breakdowns. Using this method, the structure of the WBS can be effectively communicated using the graphic and the outline provides all of the needed details for subsequent work assignments, scheduling and budgeting.

WBS Figure 4

Detail Work Breakdowns to Support Work Assignments, Scheduling and Budgeting

The level of detail in the WBS must meet a number of conditions that include the ability to assign the work to only one entity, the ability to accurately estimate needed resources, and the ability to status progress. (See "Step 6" in the "HOW to Develop a WBS" for the conditions key to adequate WBS detail).

In the example of building a new car, the engine leg of the WBS contained the ECU (Engine Control Unit). The ECU was then broken down into a number of sub-components. To meet the required conditions for an adequate level of WBS detail, further work breakdowns were needed. As one example in the figure, the computer card in the ECU had to be broken down further to allow accurate estimates of cost and schedule and to assign work to a single entity.
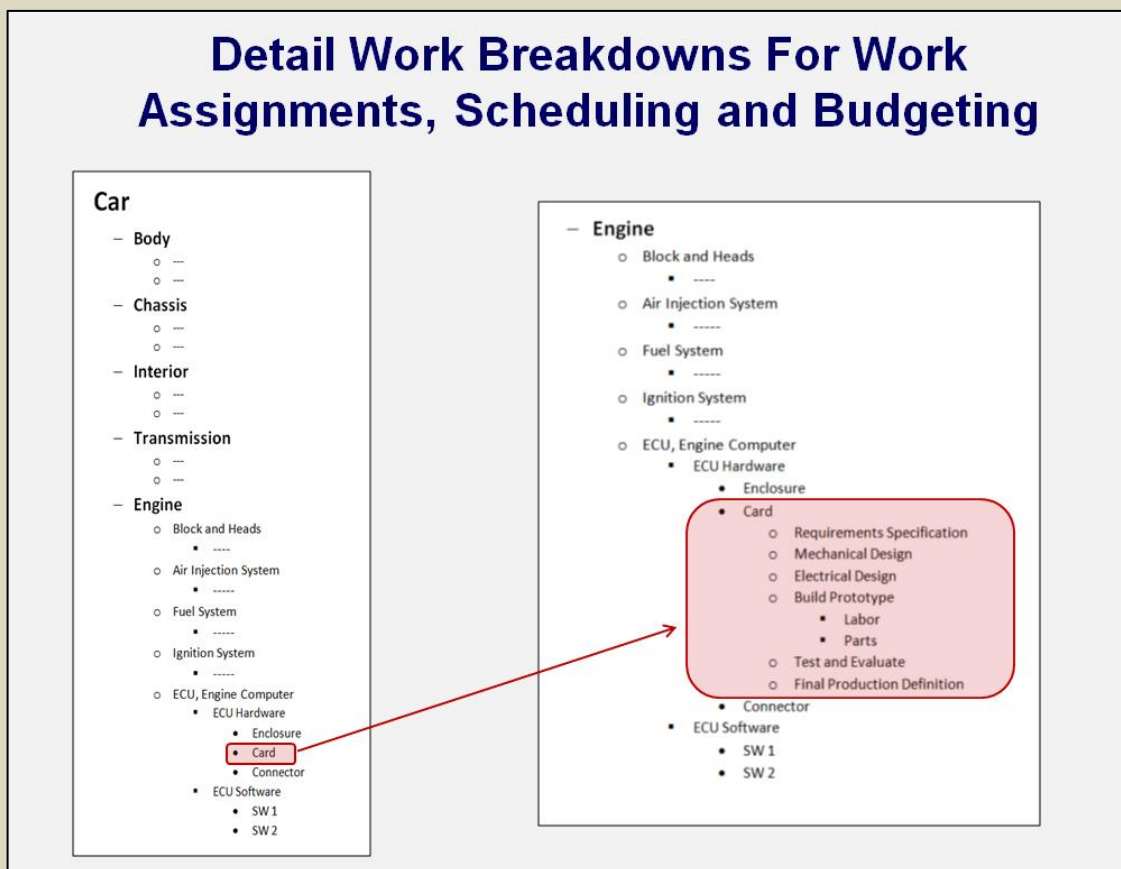
WBS Figure 5

WBS and Project Organization Relationships and Work Assignments

The WBS, in part, is the basis for project work assignments. All work in the WBS is assigned to someone working on the respective project. In a functional sense, one could envision a graphic where the project WBS and the project organization structure (OBS) are orthogonal and that the intersections of the two form a work assignment matrix.
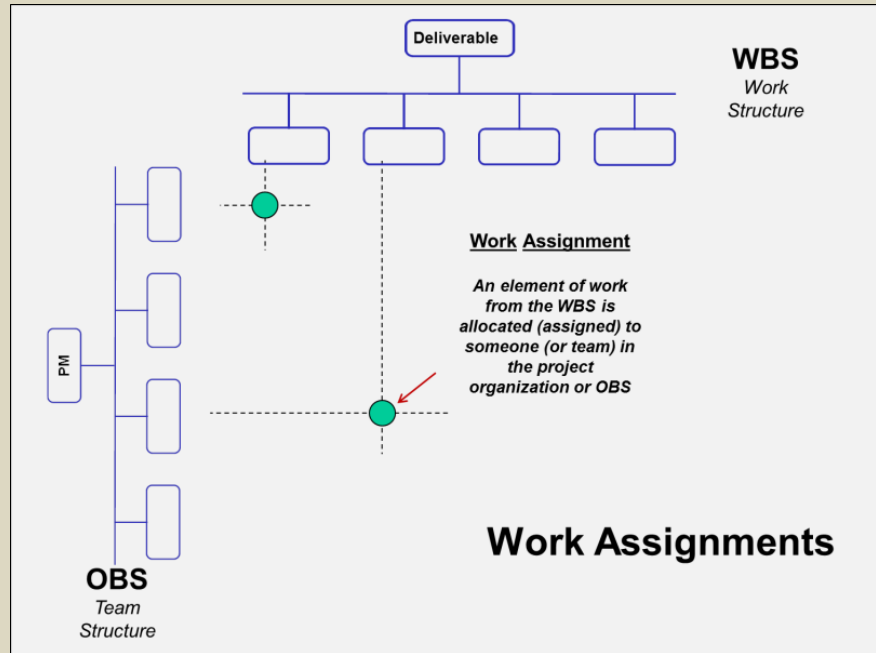
In practice such drawings as the above are used for communicating the concept of work assignment for education purposes only and the real work assignments are captured in a matrix.

For smaller projects, work assignment information can be captured in a spreadsheet as depicted in the figure to the right. For larger projects where an organization employs schedule and budget management systems, this information would be contained in such systems. This table or matrix is sometimes termed a "RAM" where "Responsibility Assignment Matrix" and "Responsibility Allocation Matrix" are common names.

Note that in this example, Mary is the lead for the "ECU" card development" and is responsible for the overall card schedule and budget management. Work assignments at lower levels in the card development are defined. When budgets and schedule are defined for the ECU card development, Mary will become the "Control Account" lead or manager for this work.
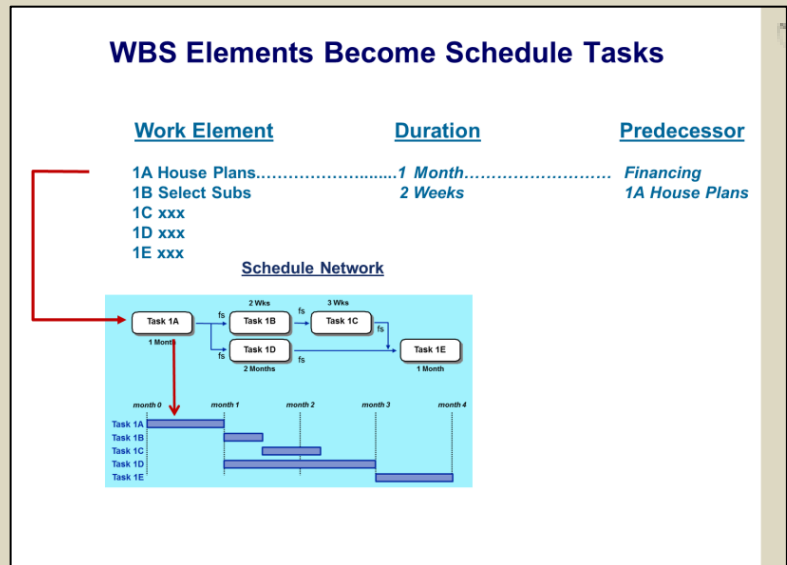
WBS Figure 6

WBS and Schedule Relationships

The WBS is directly linked to the project schedules as the lowest level of work breakdown in any area of the WBS generally becomes the basis for the identification of tasks in the schedule.

In this first figure, the WBS example is a home build and the lowest level of work breakdown is used to identify what tasks will be included in the project schedule. For each task, both task duration and task predecessor information is defined. This information can be used to manually prepare a project schedule or can be used as information inputs to a schedule network system.

Where a schedule activity network system is used for project scheduling (such as Microsoft Project or high end systems like Primavera), the task name, task duration and task predecessor information is entered into the scheduling system to generate project schedules.

Where needed by the project team for sufficient schedule visibility, lower levels of detail in the schedules can be developed below the lowest level in the WBS. If this is done, this additional schedule detail usually only exists in the schedule and is typically not retrofitted back into the WBS nor back into the budgeting structure though this can be done if a need exists to do so.
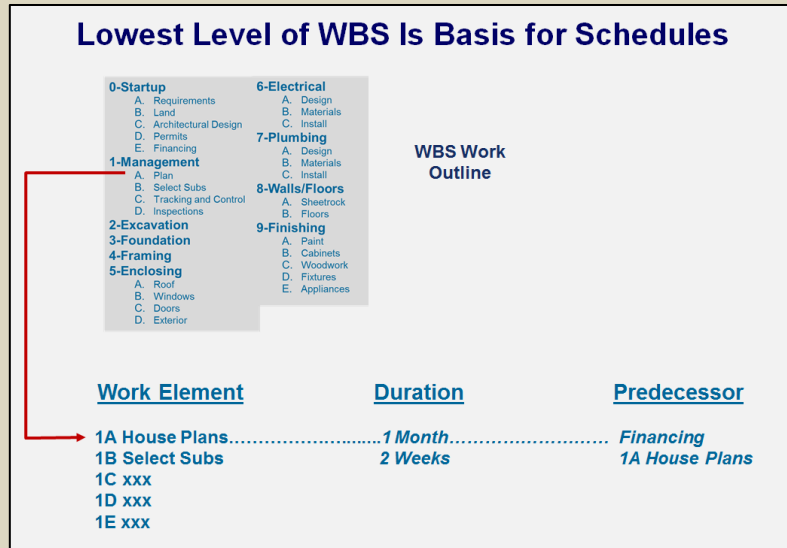
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WBS Figure 7

WBS and Budget Relationships

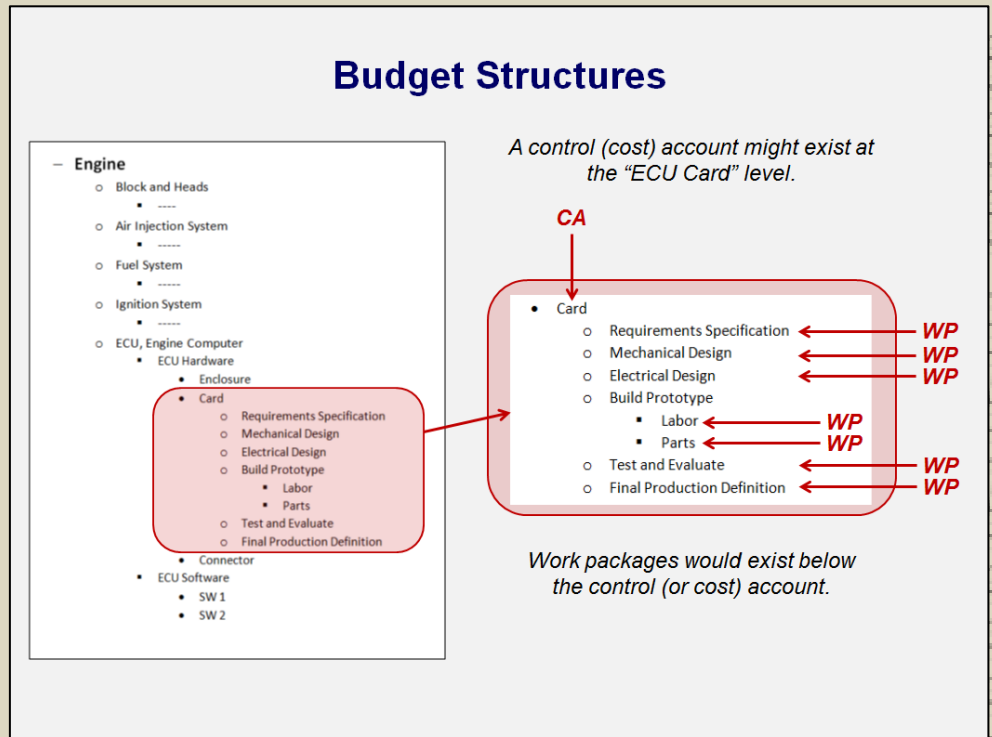The WBS is directly linked to project budgets. Labor, material and other resource needs are estimated, typically for each lowest level WBS element. In the figure, a control account is established at the "Card" Level and work below that level is identified as "work packages" where individual estimates of resources and costs will be made. The control account level becomes a point of cost collection and an individual accountable for the control account is identified.

Budget Structures

A control (cost) account might exist at the "ECU Card" level.

```
−  Engine
     o  Block and Heads
          •  -----
     o  Air Injection System
          •  -----
     o  Fuel System
          •  -----
     o  Ignition System
          •  ------
     o  ECU, Engine Computer
          •  ECU Hardware
               •  Enclosure
               •  Card
                    o  Requirements Specification
                    o  Mechanical Design
                    o  Electrical Design
                    o  Build Prototype
                         •  Labor
                         •  Parts
                    o  Test and Evaluate
                    o  Final Production Definition
               •  Connector
          •  ECU Software
               •  SW 1
               •  SW 2
```

CA

```
•  Card
     o  Requirements Specification   ←── WP
     o  Mechanical Design            ←── WP
     o  Electrical Design            ←── WP
     o  Build Prototype
          •  Labor                   ←── WP
          •  Parts                   ←── WP
     o  Test and Evaluate            ←── WP
     o  Final Production Definition  ←── WP
```

Work packages would exist below the control (or cost) account.

For this same car example, the WBS can be put into a matrix such as the one at the right, where work assignments, labor needs, material costs and any other related and necessary planning information can be assembled and cross-referenced.

For smaller projects, this information can be captured in a spreadsheet. For larger projects where an organization employs schedule and budget management systems, this information would be contained in such systems.

WBS, Work Assignment & Resources Matrix

| WBS Entry	Assignment	Labor Time/Category	Material $s
3 ENGINE			
3.1 Block and Heads			
3.5 ECU			
3.5.1 ECU Hardware			
3.5.1.1 Housing			

3.5.1.2 Card	- Mary		
3.5.1.2.1 Requirements Spec	- Mary	X Months / Cat x	------
3.5.1.2.2 Mechanical Design	- John	X Months / Cat x	$ X,000
3.5.1.2.3 Electrical Design	- Nathan	X Months / Cat x	$ X,000
3.5.1.2.4 Build Prototype	- Beth	X Months / Cat x	$ X,000
3.5.1.2.4.1 Labor		X Months / Cat x	-------
3.5.1.2.4.2 Parts			$ X,000
3.5.1.2.5 Test and Evaluate	- Nathan	X Months / Cat x	$ X,000
3.5.1.2.6 Production Definition	- Mary	X Months / Cat x	---------
3.5.1.3 Connector			

WBS Figure 8

WBS Dictionary

The WBS dictionary is a set of descriptions, one for each WBS element (work product) that defines what the work in a given WBS element is. Any given WBS dictionary entry may also include what work is not included, assumptions made about the work or methods to be used to complete the work.

The WBS dictionary is important for multiple reasons that include:
- Capturing the necessary information to support accurate estimates of cost and schedule needs
- Capturing the necessary information for the accurate work breakdowns existing below a given WBS element
- Providing work direction information to the individual responsible for that work including what the work is, assumptions, methods and what work the given work element does not include

A "lesson learned" for WBS dictionary entries is that often the most important part of the dictionary entry is a definition of what work is NOT included in a given WBS element as this is a common cause of inaccurate work resource and schedule estimates.

For smaller projects where manual methods are used, the WBS and WBS dictionary could be captured in a table format in a word processor or spreadsheet. This information can also be captured in a simple data base. For larger projects in organizations that employ cost and schedule management systems, this information is captured in those systems.
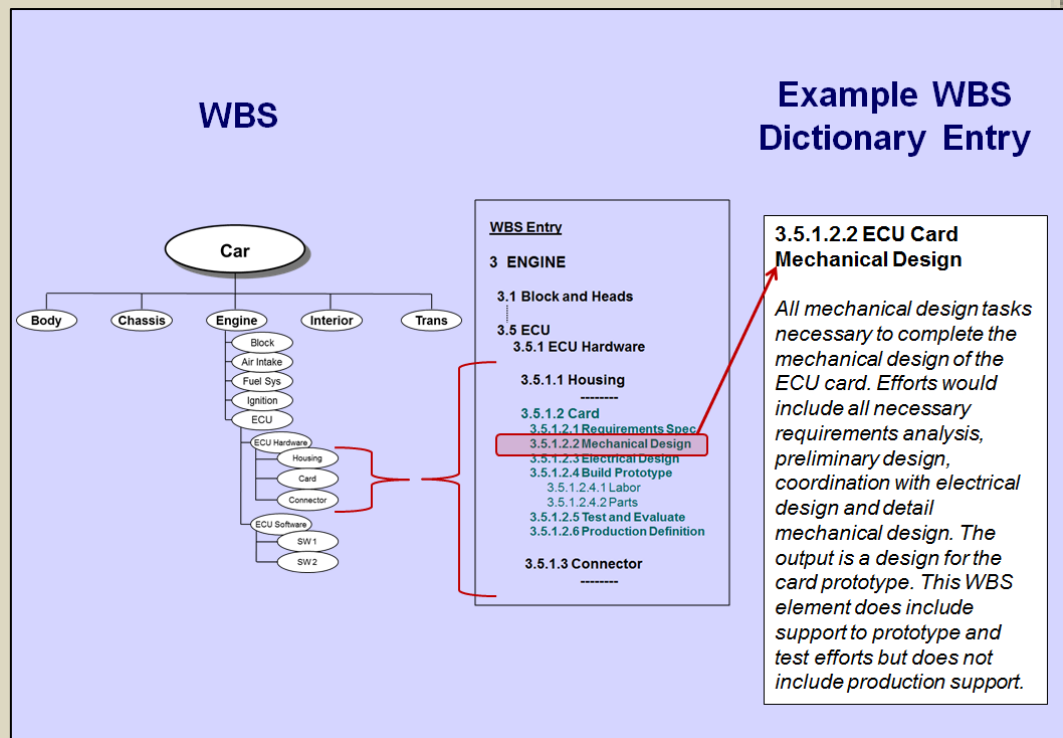
WBS Additional Considerations

- **How to Depict Management Work in the WBS** – The management of the project is necessary work and should be included in the WBS. Some may be confused on why that would be included since a major part of what management does is handling problems which are generally not predictable or plannable. Actually project managers and other management personnel on the project do have work products in terms of plans, status reports, change definitions, issues and corrective actions, contract and other management related information products. Then the question arises, would the area of the WBS that includes management also include all of these detail work products where each product is separately identified, scheduled and budgeted? Typically the answer is no. The management function is a combination of plannable and un-plannable things and is included in the WBS, only for overall project cost completeness reasons. The dozens (or even hundreds) of individual management work products are typically not identified, scheduled and tracked as little or no payback exists to do so. Major management work products like plans, reviews and other discrete efforts that must happen at a given point in time can be included in the schedules to ensure a timely completion, but separate budgets are not typically included for these in all but the very largest projects. For budgeting the PM is often viewed as a "level of effort" for the full project period and budget breakdowns for all of the individual efforts a PM performs provides little or no value in managing that budget. A single work element in the WBS titled "Project Manager" or "Project Management" might suffice to cover the PMs work and costs. On larger projects where a separate project control, cost and/or schedule management functions exist, separate WBS elements (and costs) can be included for these efforts.

- **How to Handle General Support Work on a Project in the WBS** – As an example, let's say we have a full time "Quality" individual assigned to the project and this individual performs hundreds of quality related tasks. If we followed a strict interpretation of what the WBS is, we would have individual WBS elements for each test, inspection and other quality effort performed. This "technically correct" approach could require many dozens or even hundreds of budget elements and schedule elements and would add significant planning and statusing work with little or no value realized. A common, and acceptable, approach would be to include this quality work in a single WBS element in a "Management Leg" of the WBS. This removes the need to identify individual budgets for potentially hundreds of small tasks and removes the need to schedule these same tasks. Management of this type of work is often best served by having a checklist of all work items that are related to schedule milestones and statusing this checklist as the project progresses. Each project needs to decide what is best for situations such as this.

WBS Terms

- **WBS – Work Breakdown Structure** – The hierarchal depiction of all work products needed to complete a given project. A necessary component of managing any project. Precedes the project planning efforts of work assignments, scheduling, resource estimates and budgeting.

- **Work Product** – Work products in the WBS are "products of project work" and are physical results of what work the project will perform. Work products are nouns and are not verbs. Examples of work products are requirements specifications, design documents, testing reports, hardware, software, a new process, management reports, studies and anything else a given project will "produce" as a part of performing project work to provide the project's end product or primary deliverable.

- **WBS Levels** – The WBS is a hierarchal depiction of all work products needed to complete the project and as such, the WBS has different levels of work products. Level 1 would be the project's outcome or primary deliverable. Level 2 would be the major work products needed to produce the item at level 1. Level three will be the work products necessary to produce the major work products defined at level 2 and so on. Any work product at any level is produced by all of the work products below that given work product. A WBS can have few or many levels depending on the size and nature of the work. Different areas of the WBS may be developed to different levels. See Figure 2 and Figure 4 for examples of WBS levels.

- **WBS Architecture** – A term that denotes the top levels of the WBS which maybe the top 2 or 3 levels. The WBS architecture is completed before the details levels of the WBS are developed. See Figures 1 & 2 for examples.

- **WBS Element or WBS Entry** – Informal terms used to denote any given WBS "work product" at any level.

- **WBS Dictionary** – Each WBS element or work product needs a description. The WBS dictionary is the set of information that defines what each individual WBS element or work product is. The description defines the work product associated with a given WBS element and may also contain information about how that work will be accomplished. The dictionary entry may define what work is NOT included in the respective work element. The WBS dictionary is very important as it describes each element of work to support effective work assignment, schedule and budgeting actions. See Figure 8 for an example of a WBS Dictionary Entry.

- **WBS Leg** – Term commonly used to identify all of the work falling below one work product at level 2 in the WBS. See Figure 2 for an example WBS leg representing the engine work product within a WBS for a car development or production project.

- **OBS – Organization Breakdown Structure** – This is the project organization depicted in graphic or outline form. The OBS and WBS are separate and unique hierarchies. The OBS is the breakdown and structure of the project team. (See Figure 5 for a depiction of the WBS and OBS being matrixed to form work assignments and budget structures.)

- **RAM – Responsibility Assignment Matrix** – The matrix formed by mapping the WBS to the Project OBS to assign all work in the WBS to an individual or team in the project organization (OBS). (See Figure 5 for graphical depictions of work assignments)

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WBS Summary Principles

- The WBS is needed to manage a project. It is the master framework that is the heart of integrated project management.
- The WBS forms the basis for work identification, work scheduling , work budgeting and work assignments for both project planning and project controls.
- The WBS is a hierarchal depiction of all needed work necessary to complete the project and to provide the project's deliverable.
- The WBS is composed of work products that are things produced as a result of project work. Work products are "nouns" and are not "verbs."
- The structure of the WBS is such that the top level of the WBS is the project's end product or primary deliverable and the second level of the WBS contains the work products needed to cause the project deliverable (the first level) to exist. Subsequent lower levels of the WBS provide further breakdowns of work products needed to produce any given work product at the next higher level.
- Before the WBS can be developed, the project's deliverable must be known to a level of detail that will support an accurate and complete understanding of all work needed to complete the project.
- The needed detail level of the WBS has multiple requirements.
    - The detail level of the WBS must be such that <u>ALL</u> of the following conditions exist.
        - a) Estimates of work costs are possible
        - b) Estimates of schedule are possible
        - c) Estimates of work completion status are possible
        - d) Sufficient granularity of work breakdown exists such that the lowest level of work in the WBS is clearly assignable to a single individual or team
        - e) Sufficient granularity of work breakdown exists such that all levels of individuals managing work on the project will have adequate visibility of work status
    - Note that if any of the above conditions are not true, an adequate WBS does not exist and this usually means that additional detail is needed.
    - Note that if all above conditions exist, further lower level WBS detail is not usually needed nor recommended as this adds more planning and control statusing work that provides little or no value.
    - Note that the level of detail in different areas of the WBS can be different so long as all other WBS detail conditions listed exist.
- The WBS has a WBS Dictionary Entry for each WBS element that adequately defines the work element to support accurate cost and schedule estimates.
- It is a requirement of the WBS that the structure, detail level and dictionary work descriptions make sense to all those that will plan and control the project.

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END OF

The What, Why and How of
Project Work Breakdown Structures (WBS)

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