

Project Planning - Work Breakdown Structure (WBS)

Heerkens – Chapter 9
PMBOK – Chapter 5

Project Management Activities

◆ Planning

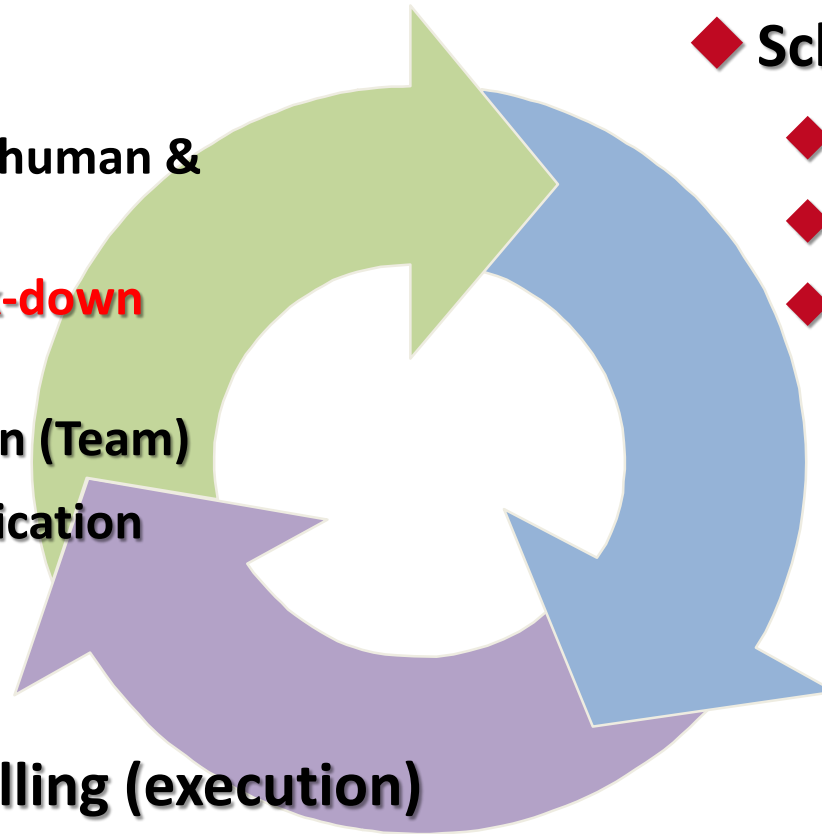
- ◆ Objectives
- ◆ Resources (human & other)
- ◆ **Work break-down structure**
- ◆ Organization (Team)
- ◆ Risk Identification

◆ Scheduling

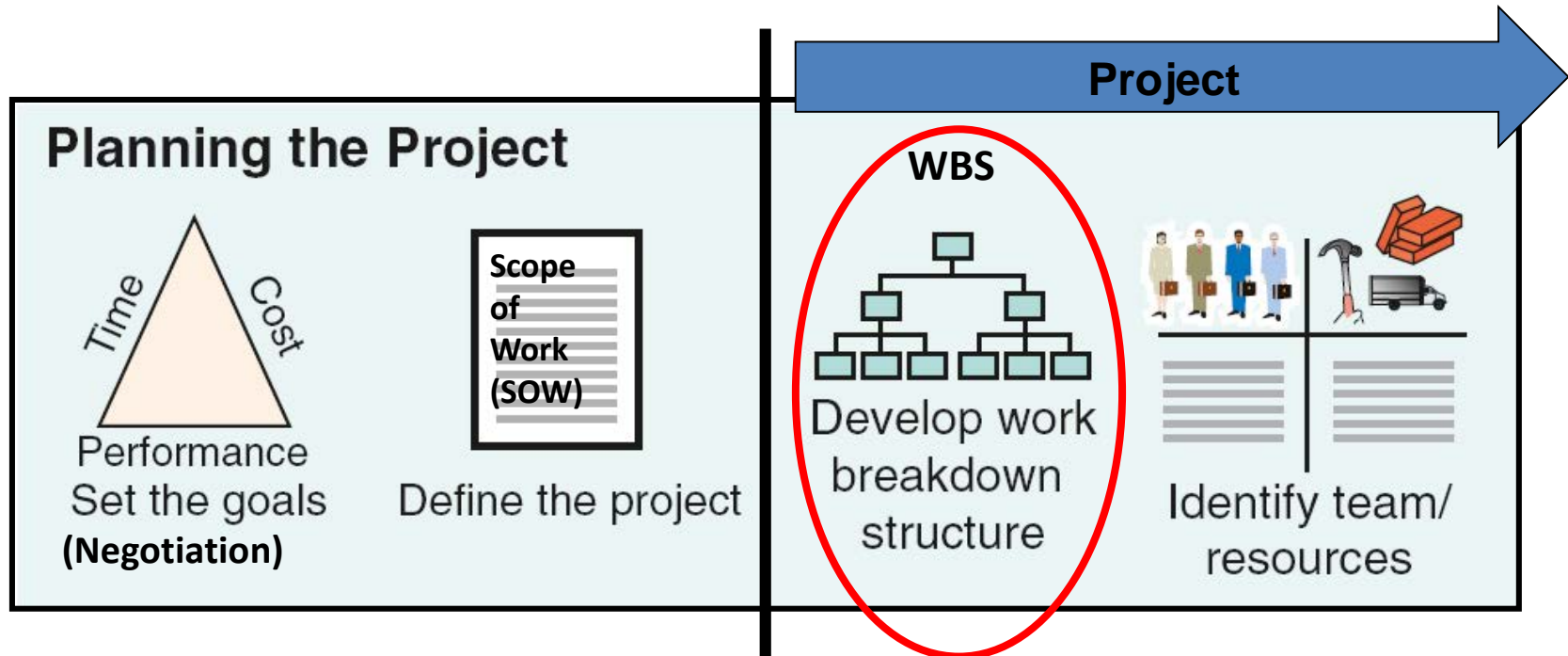
- ◆ **Project activities**
- ◆ **Start & end times**
- ◆ **Network**

◆ Controlling (execution)

- ◆ Monitor, compare, revise, action



Project Planning, Scheduling, and Controlling



Before
project

Start of project
Timeline

During
project

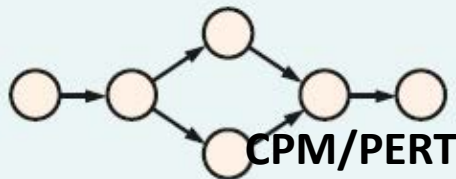
Project Life-cycle

Project Planning, Scheduling, and Controlling

Planning the Project



Scheduling the Project



Sequence activities



Schedule deliverables

Adams	✓			
Smith				✓
Jones		✓		

Assign people

June						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13



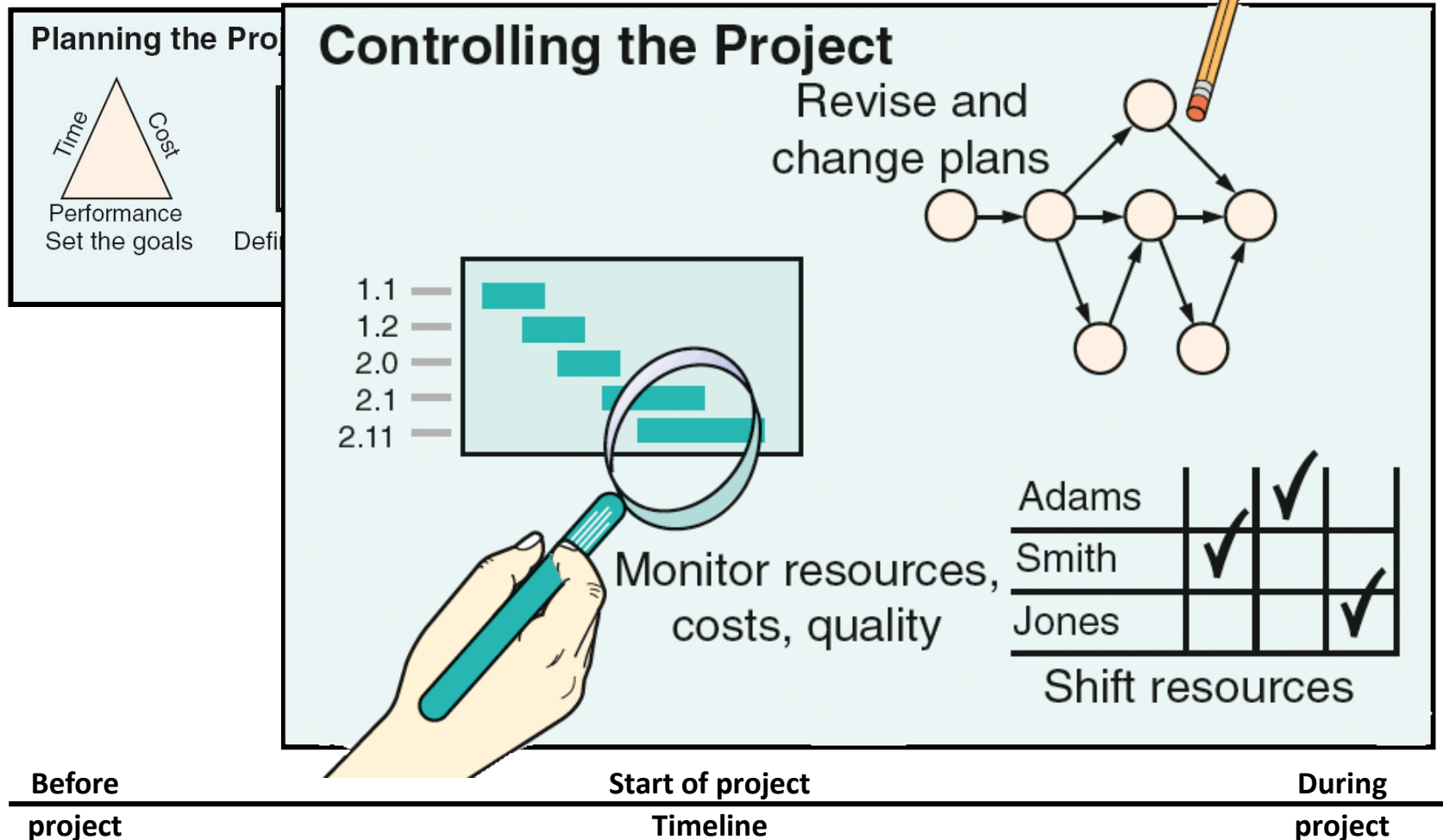
Schedule resources

Before
project

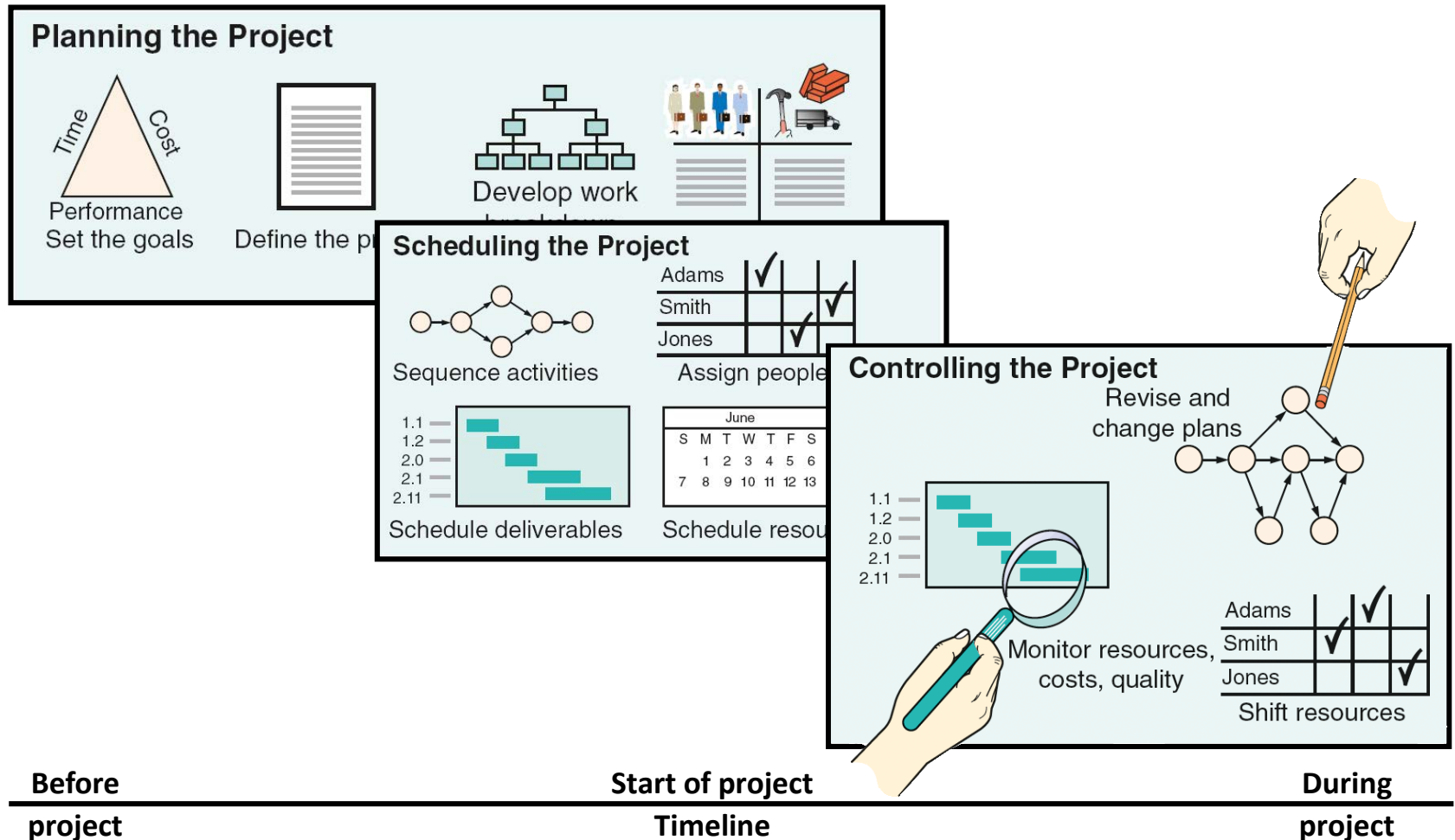
Start of project
Timeline

During
project

Project Planning, Scheduling, and Controlling



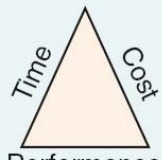
Project Planning, Scheduling, and Controlling



Project Planning and Control

Time/cost estimates
Budgets
Engineering diagrams
Cash flow charts
Material availability details

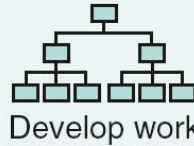
Planning the Project



Performance
Set the goals



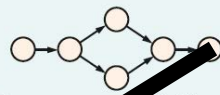
Define the project



Develop work



Scheduling the Project



Sequence activities

Adams	✓		
Smith			✓
Jones		✓	

Assign people



Define deliverables

June						
S	M	T	W	T	F	S
1	2	3	4	5	6	
7	8	9	10	11	12	13

Schedule resources

Budgets

Delayed activities report
Slack activities report

CPM/PERT

Gantt charts

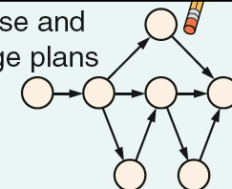
Milestone charts

Cash flow schedules

Figure 3.1

Control

Revise and change plans



Monitor resources, costs, quality

Adams			
Smith	✓		
Jones			✓

Shift resources

Before project

Start of project
Timeline

During project

A handy checklist

Planning <i>General approach</i> <ul style="list-style-type: none">■ Preferred process■ Who should be involved■ Required documentation <i>Scope definition</i> <ul style="list-style-type: none">■ Defining tasks■ Sizing of work packages■ Use of a WBS dictionary <i>Time estimating</i> <ul style="list-style-type: none">■ Estimating effort■ Estimating duration■ Estimating contingency■ Preparing a basis of estimate <i>Cost estimating</i> <ul style="list-style-type: none">■ Preferred procedure■ Estimating contingency■ Preparing a basis of estimate <i>Schedule preparation</i> <ul style="list-style-type: none">■ Graphical format■ Use of software	Execution and Control <i>Progress measurement</i> <ul style="list-style-type: none">■ Methods of measuring■ Verification requirements■ Required documentation <i>Change management procedures</i> <ul style="list-style-type: none">■ When to report a change■ Required documentation■ Approval limits and procedure■ Distribution of contingency <i>Team meeting guidelines</i> <ul style="list-style-type: none">■ Frequency■ Attendance expectations■ General agenda■ Format for status reports Communications/Personnel <i>Roles and responsibilities</i> <i>Rules of engagement</i> <i>Mutual expectations</i> <i>Review and approval procedures</i>
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Figure 9-1. Portion of a Project Management Configuration Plan

What's a WBS ?

- A technique for **defining and organizing the total scope** of a project, using a hierarchical **tree structure**
- Often **numeric designations** are given to each block and used as accounting codes for charging time and materials
- A WBS demonstrates that **all the work** that is needed to do to **accomplish a project** is accounted for (100%)
- Prompts questions - **discover required but unanticipated effort early enough in the process to deal with it**
 - Alternate design solutions that eliminate work
 - Alter schedules to accommodate the work
 - Seek additional resources
 - Warn people of potential schedule delays

What is a WBS ?

- 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.

How to Build a WBS

1. List all the anticipated work for the project
 - Identify all parts to be built
 - Include design, materials and manufacturing
 - Include analysis, assembly, integration and test
 - Include project management, systems engineering and indirect costs (facility costs, utilities)
2. Organize the work into bins/groups of related work
3. Place bins into a hierarchy
4. Apply a numbering system

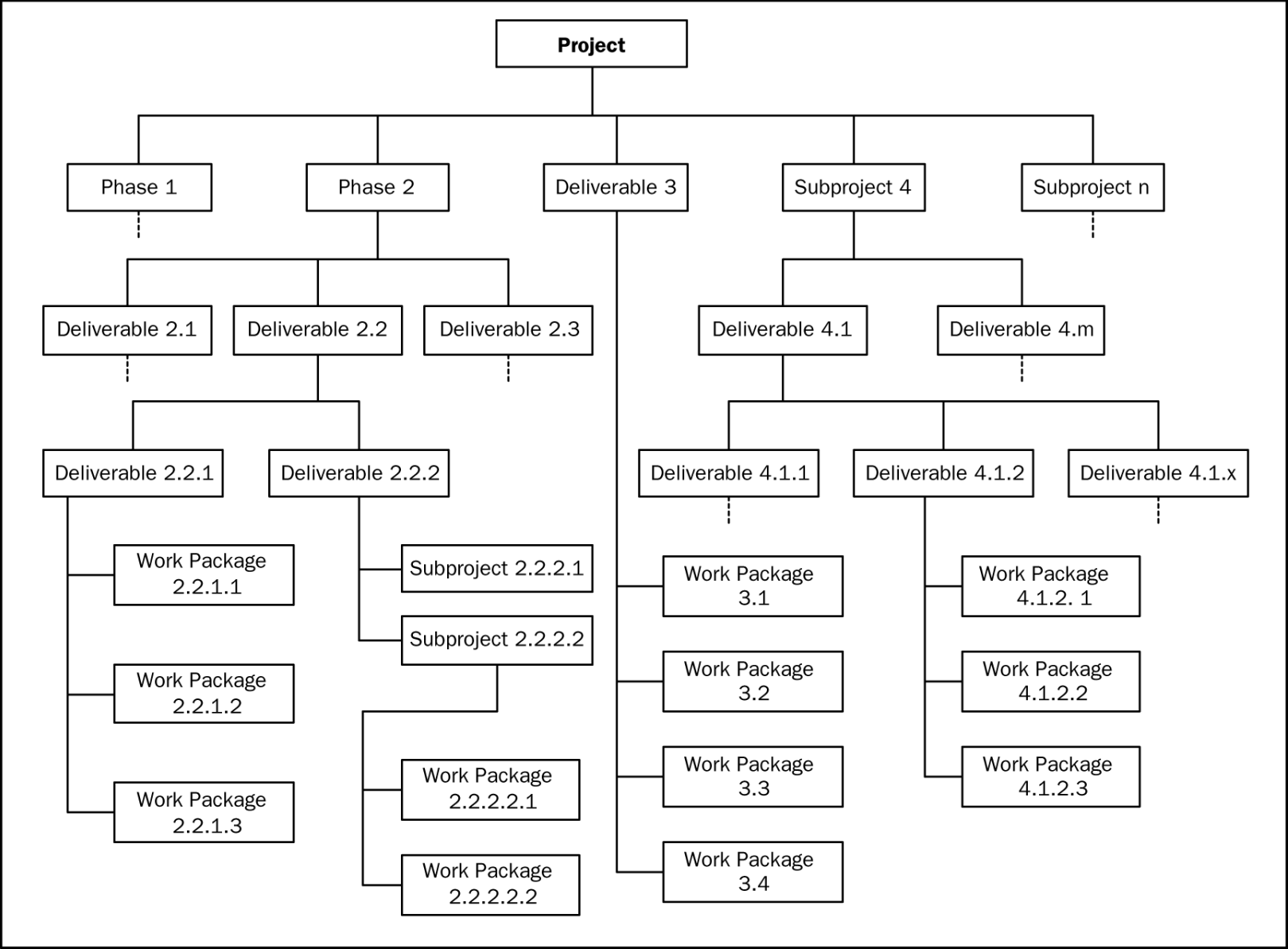
Work Breakdown Structure

Level

1. Project
2. Major tasks in the project (Deliverables)
3. Subtasks in the major tasks
4. Activities (or **work packages**) to be completed

A Work Breakdown Structure forms the foundation for the entire project planning process.

Figure 5-6. Sample Work Breakdown Structure with Some Branches Decomposed Down Through Work Packages (p114)



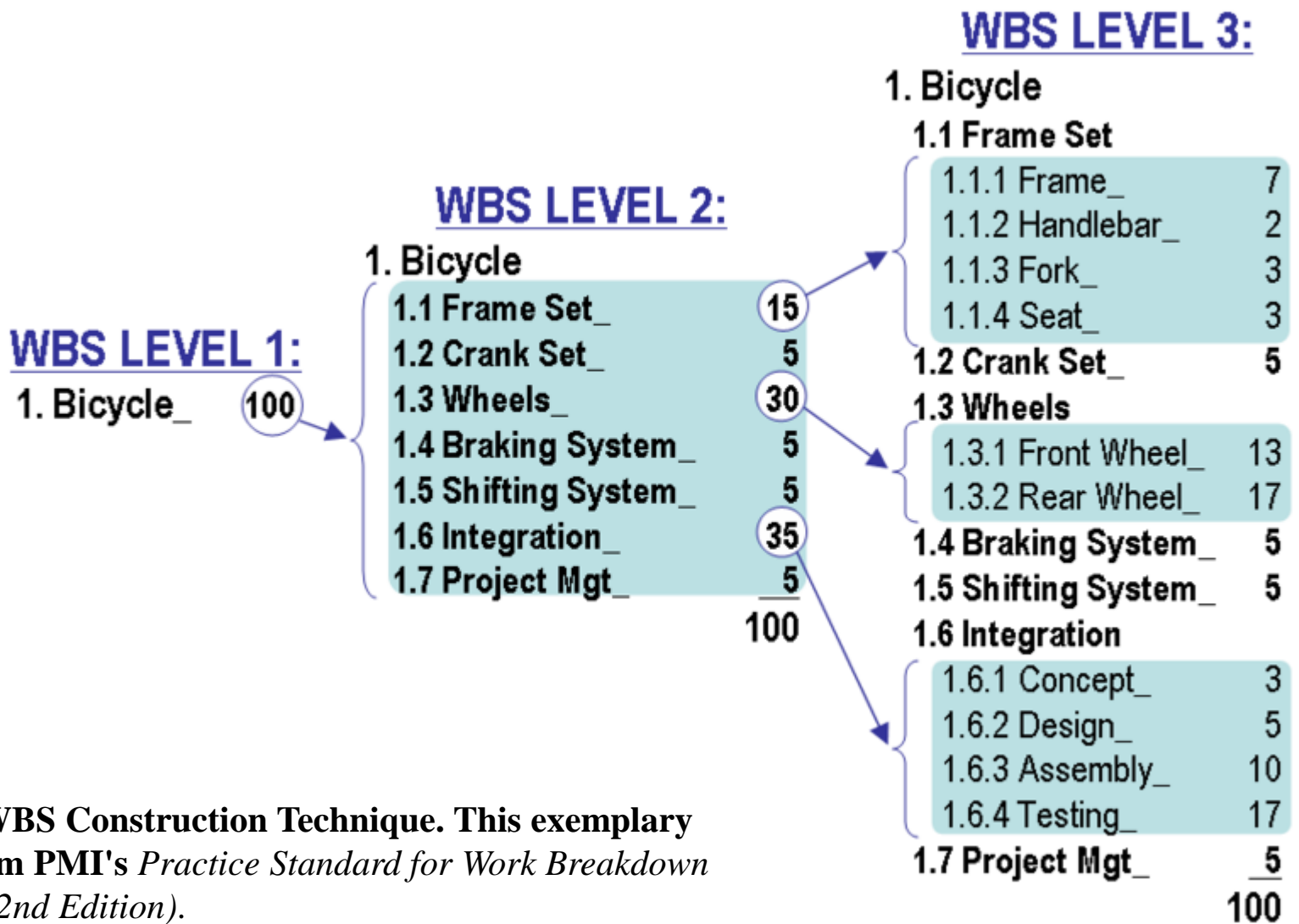
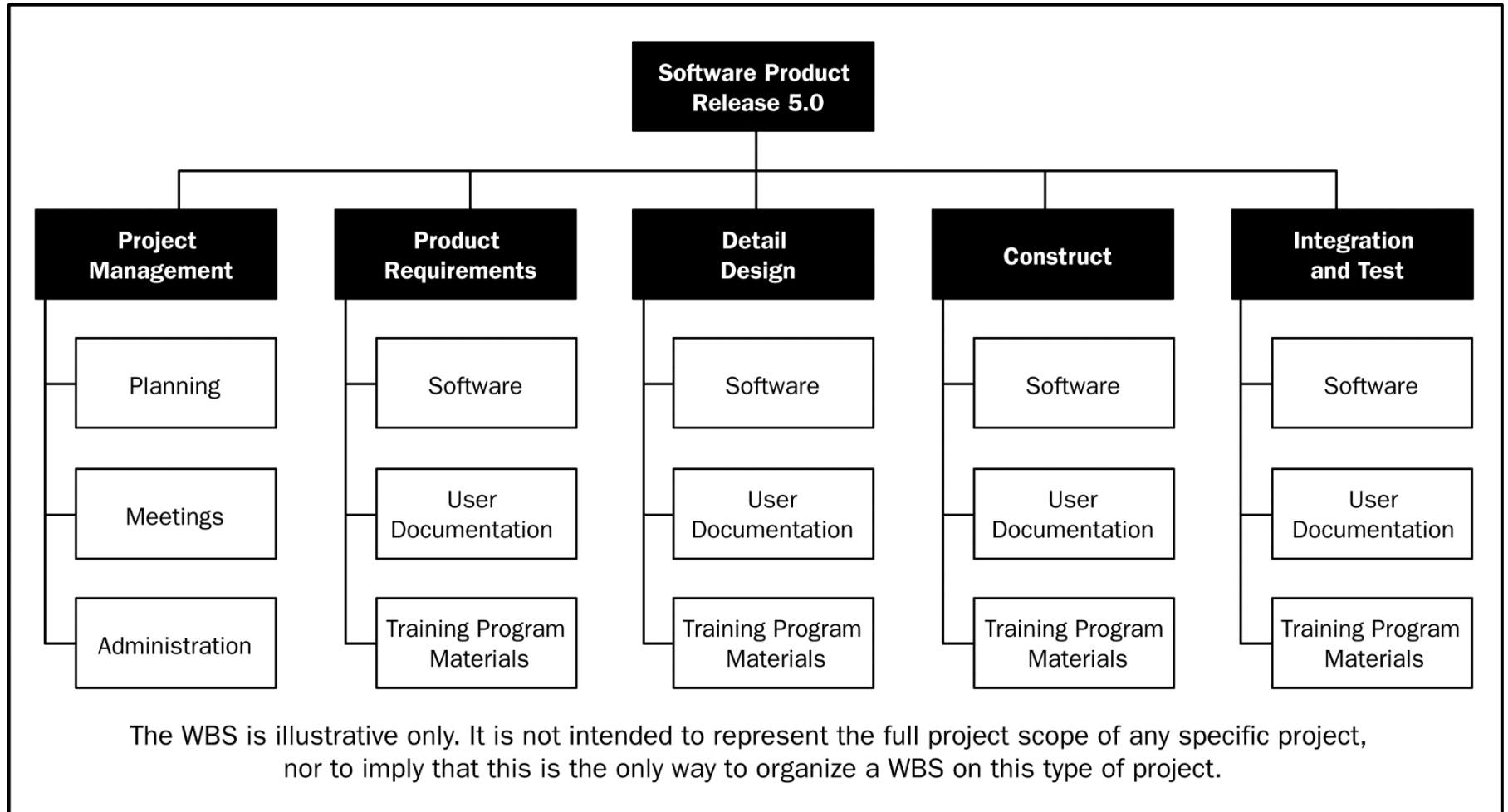


Figure 1: WBS Construction Technique. This exemplary WBS is from PMI's *Practice Standard for Work Breakdown Structures (2nd Edition)*.

Figure 5-7. Sample Work Breakdown Structure Organized by Phase



Identifying the Dimensions of Work

- **Scope:** The work that must be done to complete each activity, how it will be done, and what will be produced.
- **Responsibility:** The person accountable (normally to the project manager) for the successful completion of the activity.
- **Resources:** A description of the labor, materials, or supplies needed to complete the activity.
- **Duration:** The window of time within which the activity is expected to be completed.
- **Effort:** The number of days or weeks that resources will actually spend working on the activity.
- **Cost:** How much money will be spent on labor and materials to execute the activity.
- **Quality:** How well the work should be done or how well any activity outputs should perform.
- **Sequential relationship with other activities:** Identification of any other activities that must be completed before this activity can start.

A Nifty Application of the WBS

A well-developed WBS can be used as the basis for a fill-in-the-blank template to capture and display some of the dimensions of work as they become known. Figure 9-6 illustrates this nifty use of the WBS.

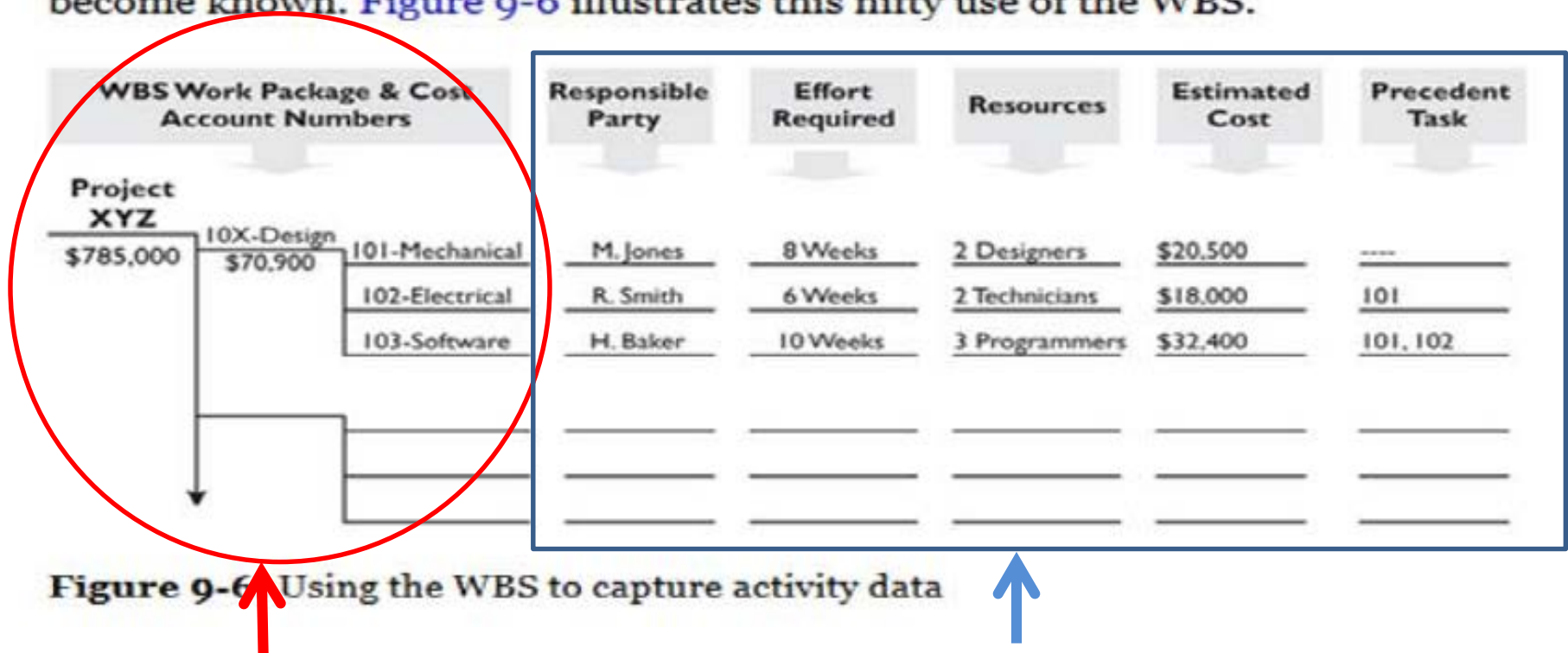


Figure 9-6 Using the WBS to capture activity data

MindGenius

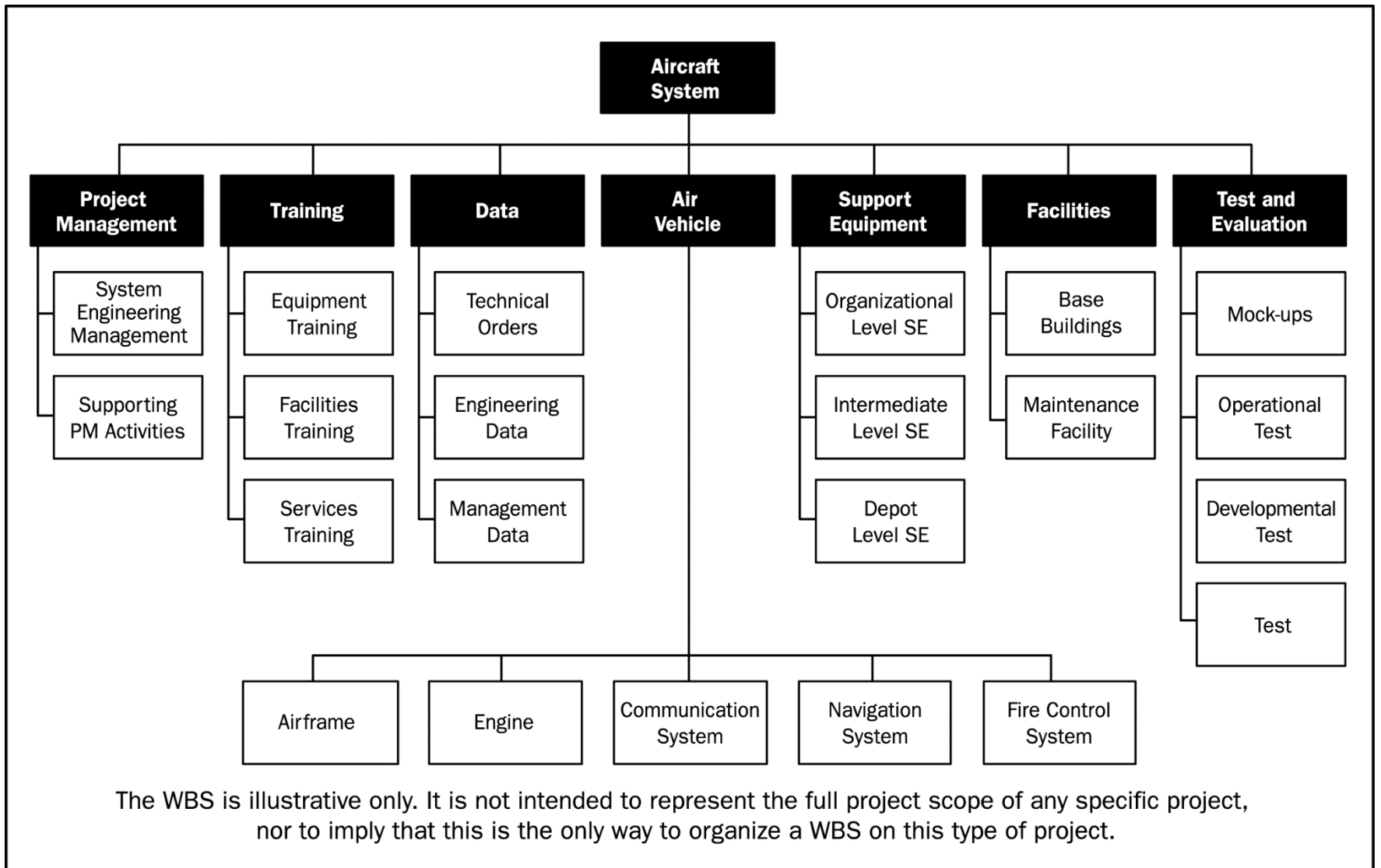
MSProject

Once you have the WBS
(in MindGenius)

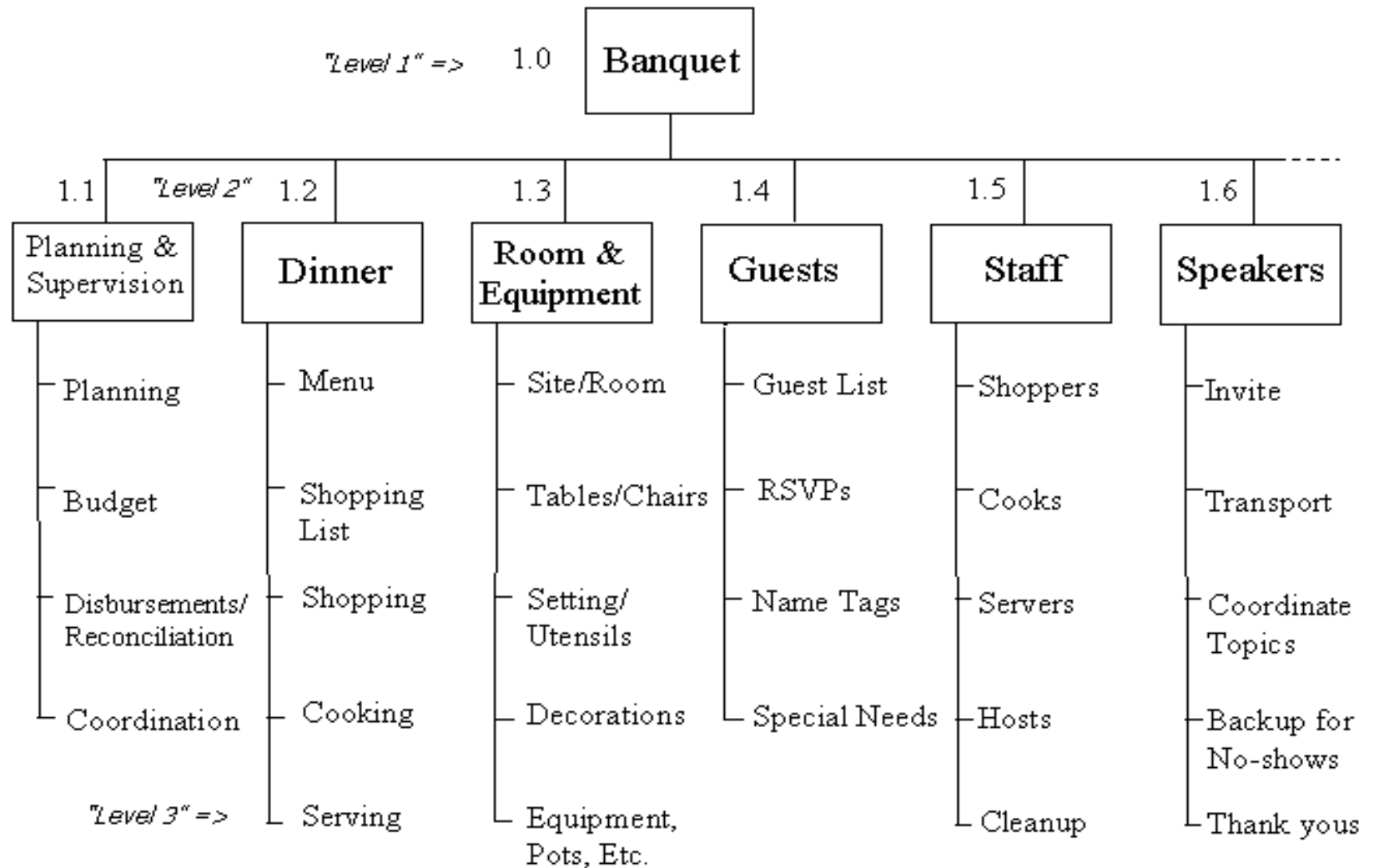
- you have the elements to build a schedule (*Import into MSPProject*)
 - There should be **a schedule** with milestones for every item in the WBS

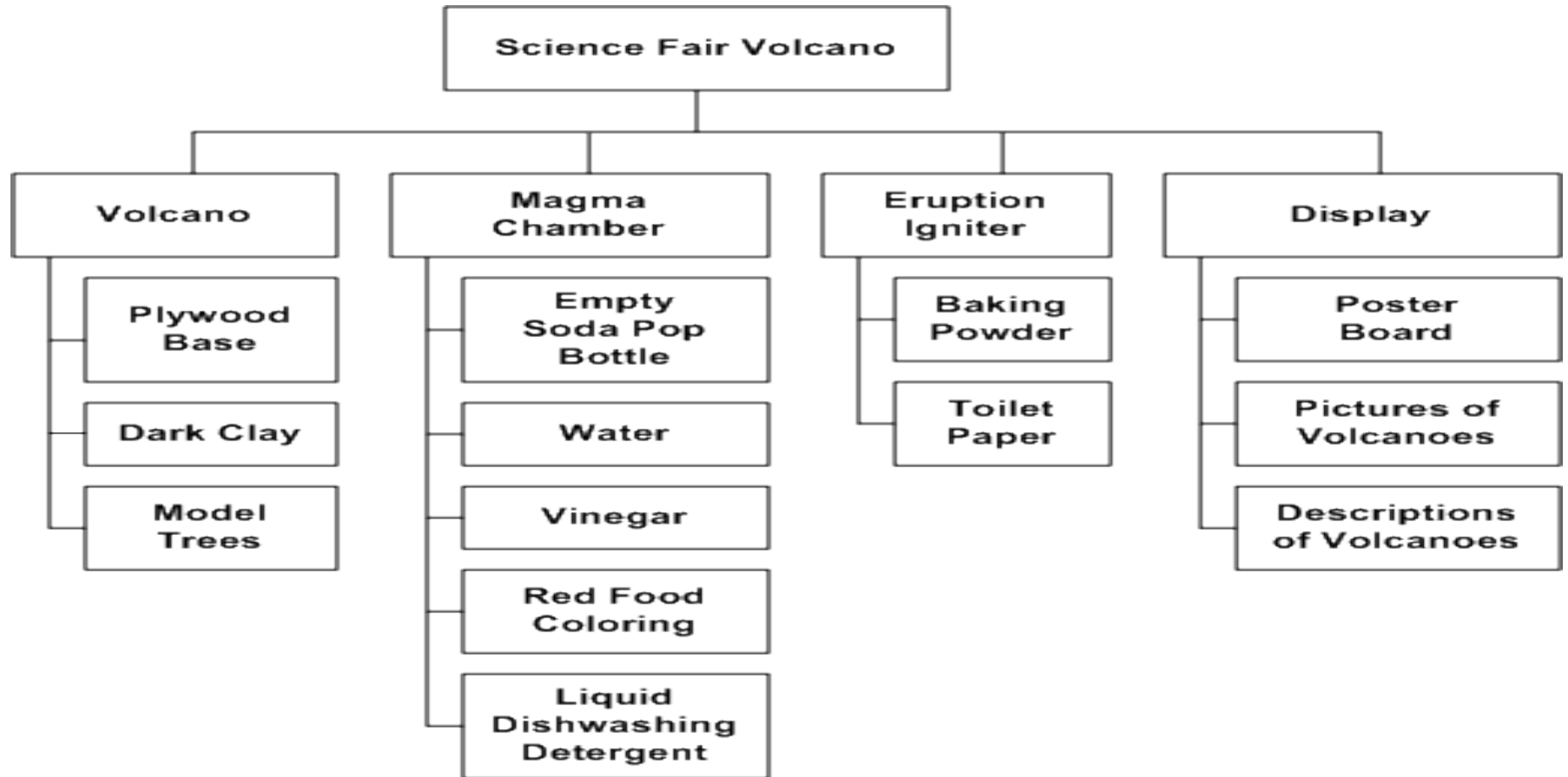
APPENDIX

Extra Notes on WBS



WBS Example - Banquet





<http://www.opfro.org/index.html?Components/WorkProducts/ManagementSet/WorkBreakdownStructure/WorkBreakdownStructure.html~Contents>

Note – Systems Engineering at 4 different levels

- Project - integrating all of the systems of the project
- Observatory System – integrating all of the parts of the observatory – instruments and facility
- Airborne Facility Segment – integrating all of the parts on the aircraft
- Telescope Element - integrating the parts of the telescope

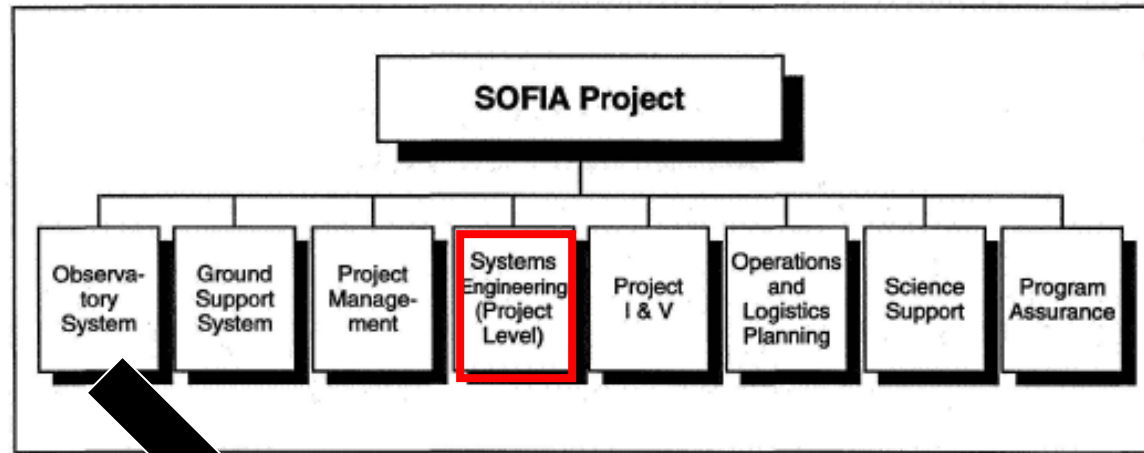


Figure B-2 — SOFIA Project WBS (Level 3).

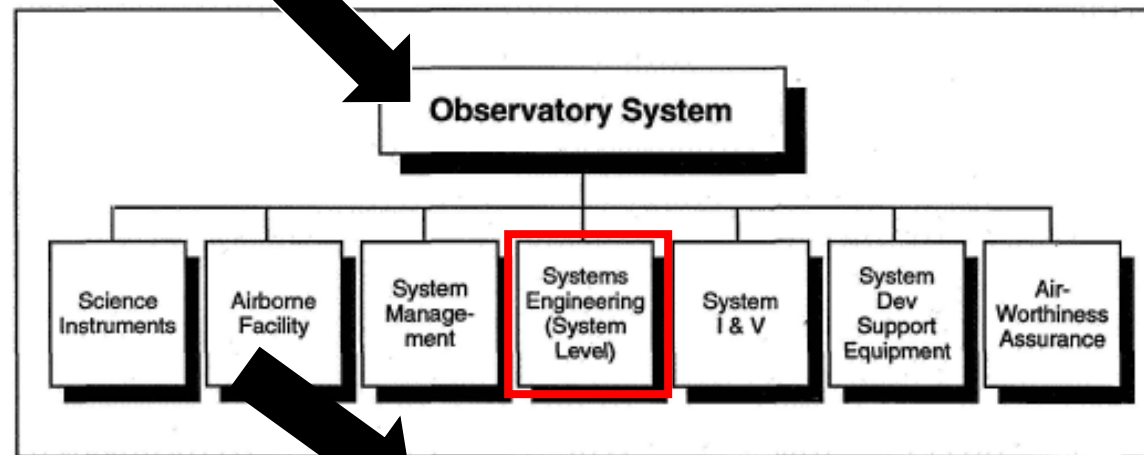


Figure B-3 — SOFIA Observatory System WBS (Level 4).

SOFIA

Stratospheric Observatory for Infrared Astronomy
Managed for NASA by the Universities Space Research Association (USRA)



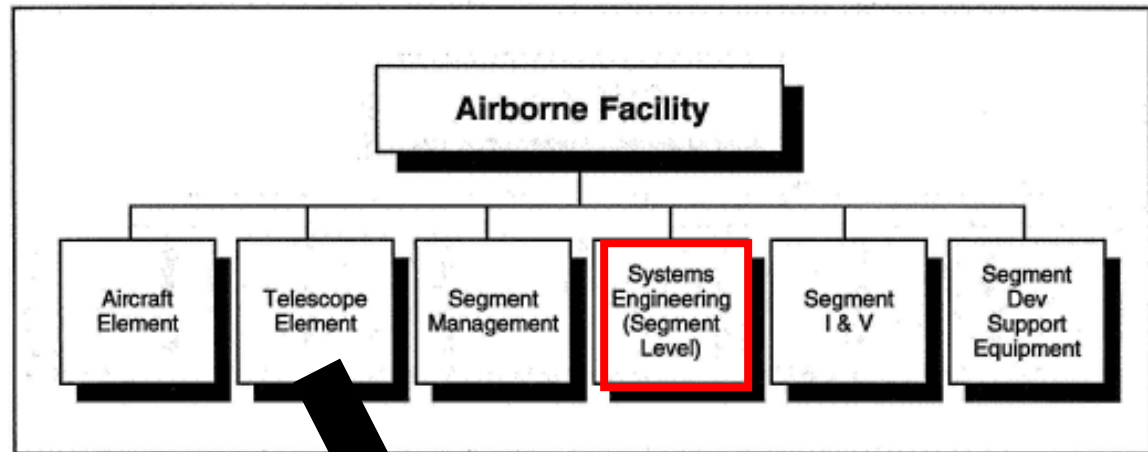


Figure B-4 — SOFIA Airborne Facility WBS (Level 5).

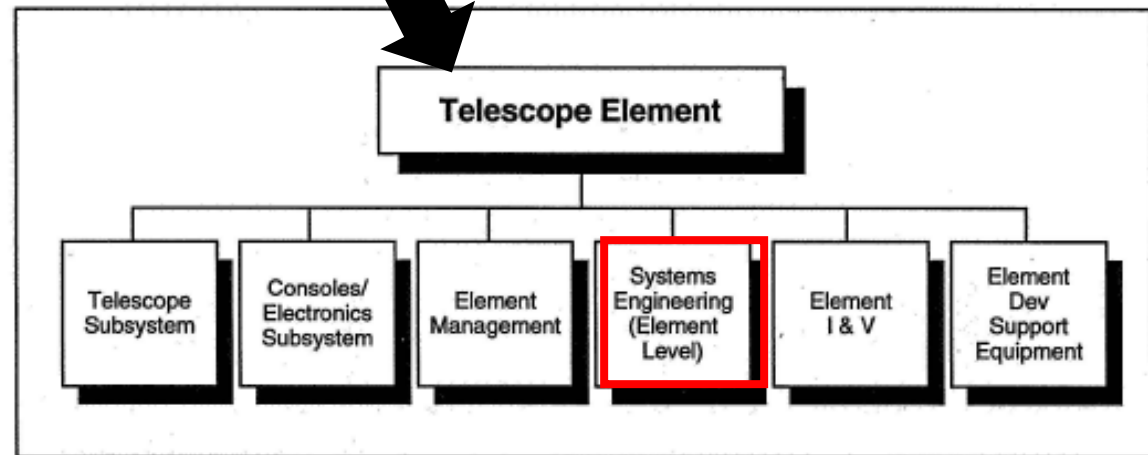
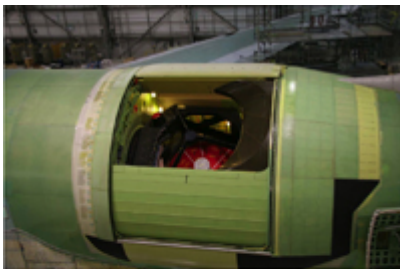


Figure B-5 — SOFIA Telescope Element WBS (Level 6).



A view through the partially open telescope cavity door showing the aperture assembly (brown), telescope assembly structure (black) and cover over the primary mirror (red). February 3, 2006

Why is a WBS Important to a Systems Engineer ?

1. The proper way to **get effort budgeted in a big project** is to get it into the WBS – so if you want systems engineering to have a budget, need to understand the WBS
2. Systems Engineering effort may exist at many levels in the project, examining the WBS allows you to see **where you need to insert Systems Engineering effort**
3. If Systems Engineering is going to integrate a project, it needs to know what is going on. The budgeted effort is reflected in a WBS. The WBS is the place to **see where effort is being expended that may require integration**.
4. It is a good **place to start for building technical budgets**, like weight or electrical power
5. Systems Engineers are always heavily involved in **cost estimating and scheduling and the WBS is a good tool** for both of these efforts

Rules for WBS

- 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 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 very 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.

Rules for WBS

- 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.
- 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 each component of the WBS with milestones, deliverables, activities, scope, and sometimes dates, resources, costs, quality, etc.