



Everyone's Smart
University

PMG 506

Advanced Project Management

LECTURE 7

Starting the project plan: The WBS

PMG506 Advanced Project Management (APM)



Introduction:

Lecture 1 Introduction to APM and Initial Project Strategy

Lecture 2 Project Quality Management

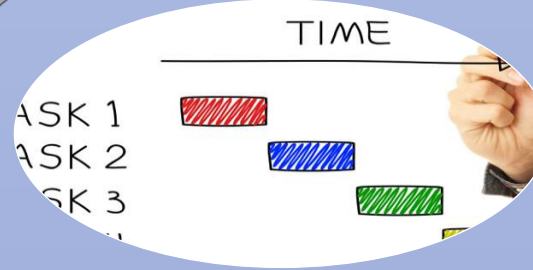


Project Initiation:

Lecture 3 Project Communication and team Management

Lecture 4 Managing conflicts and the art of communication

Lecture 5 Strategic Management and project selection



Project planning

Lecture 6 Initial project coordination and the project Charter

Lecture 7 Starting the project plan: The WBS

Lecture 8 Project risk management

Lecture 9 Budgeting, Estimating costs and risks



Project Execution

Lecture 10 Monitoring and information systems

Lecture 11 Project Control

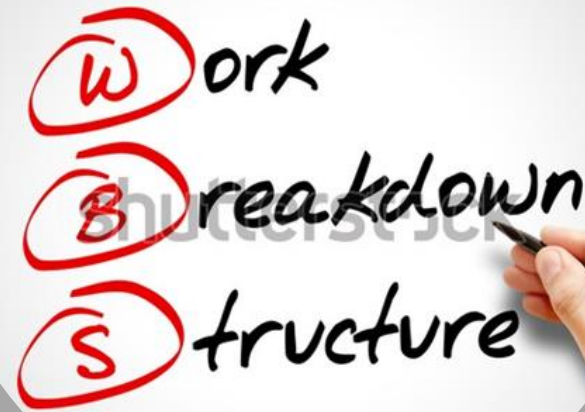
Lecture 12 Project Auditing

Lecture 13 Project termination

Learning Outcomes

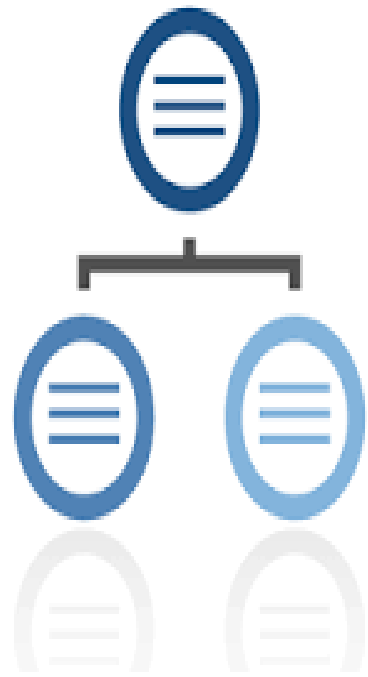
By the end of this lecture, you will be able to:

- Know what is a work breakdown structure (WBS).
- Explain the key components of the WBS.
- Describe the importance, use and design approaches of a Work Breakdown Structure (WBS).
- Assign the WBS identification codes.
- Explain the “Responsibility Matrices”.



Work
Breakdown
Structure





Level 1



Level 2



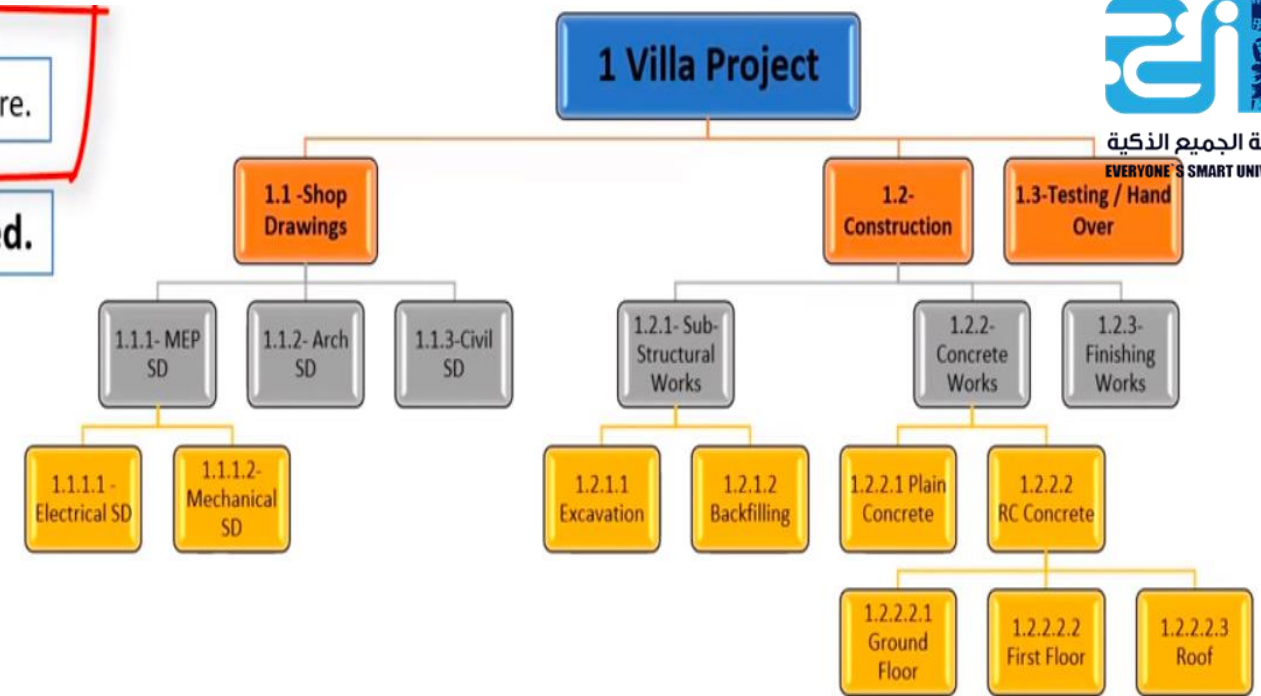
Level 3

Hierarchical planning process

Introduction

WBS = Work Breakdown Structure.

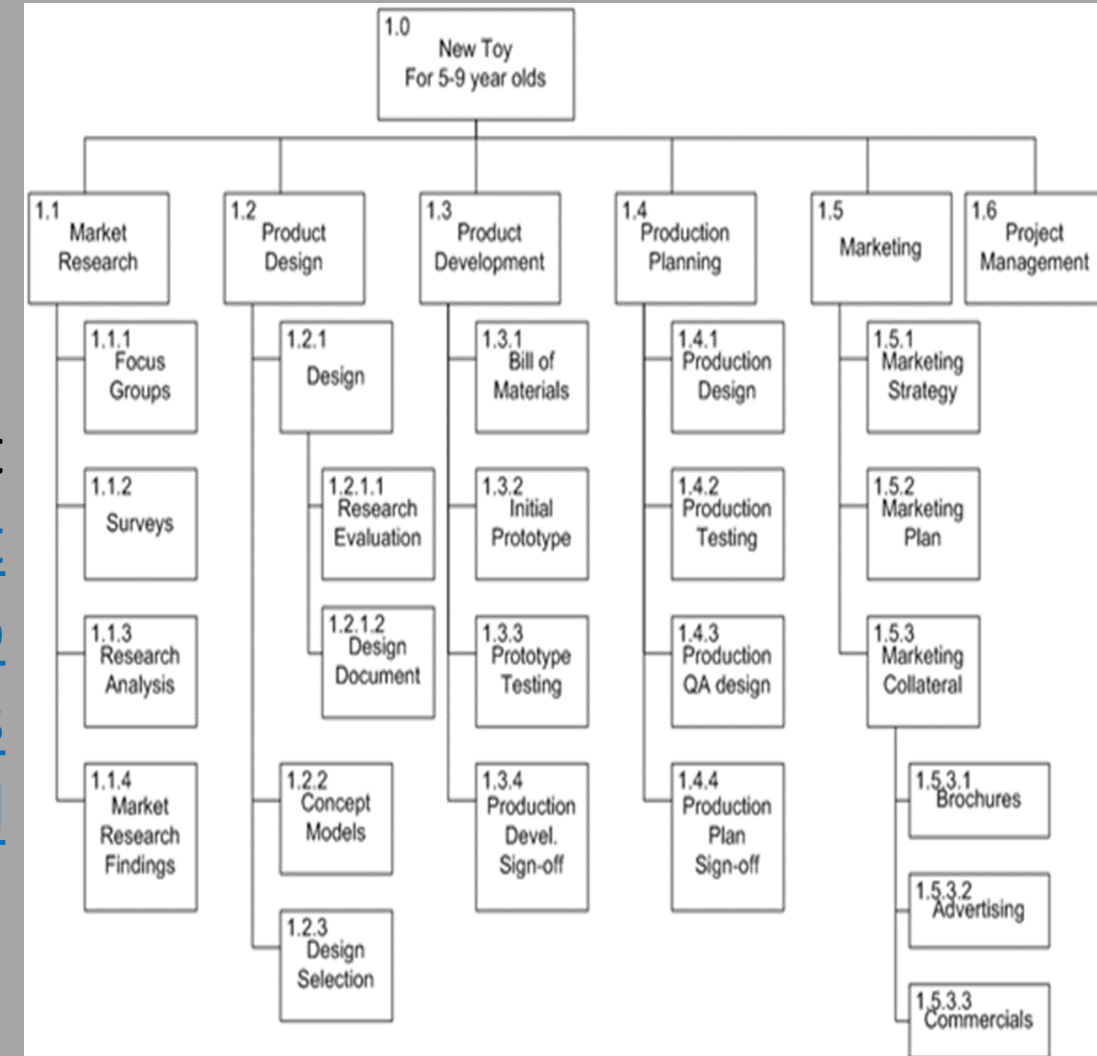
WBS is Deliverable Oriented.



Once the scope and deliverables have been identified, the work of the project can be successively subdivided into smaller and smaller work elements. The outcome of this hierarchical process is called the **work breakdown structure (WBS)**. Use of a WBS helps to assure project managers that all products and work elements are identified, to integrate the project with the current organization, and to establish a basis for control. Basically, the WBS is an outline of the project with different levels of detail.

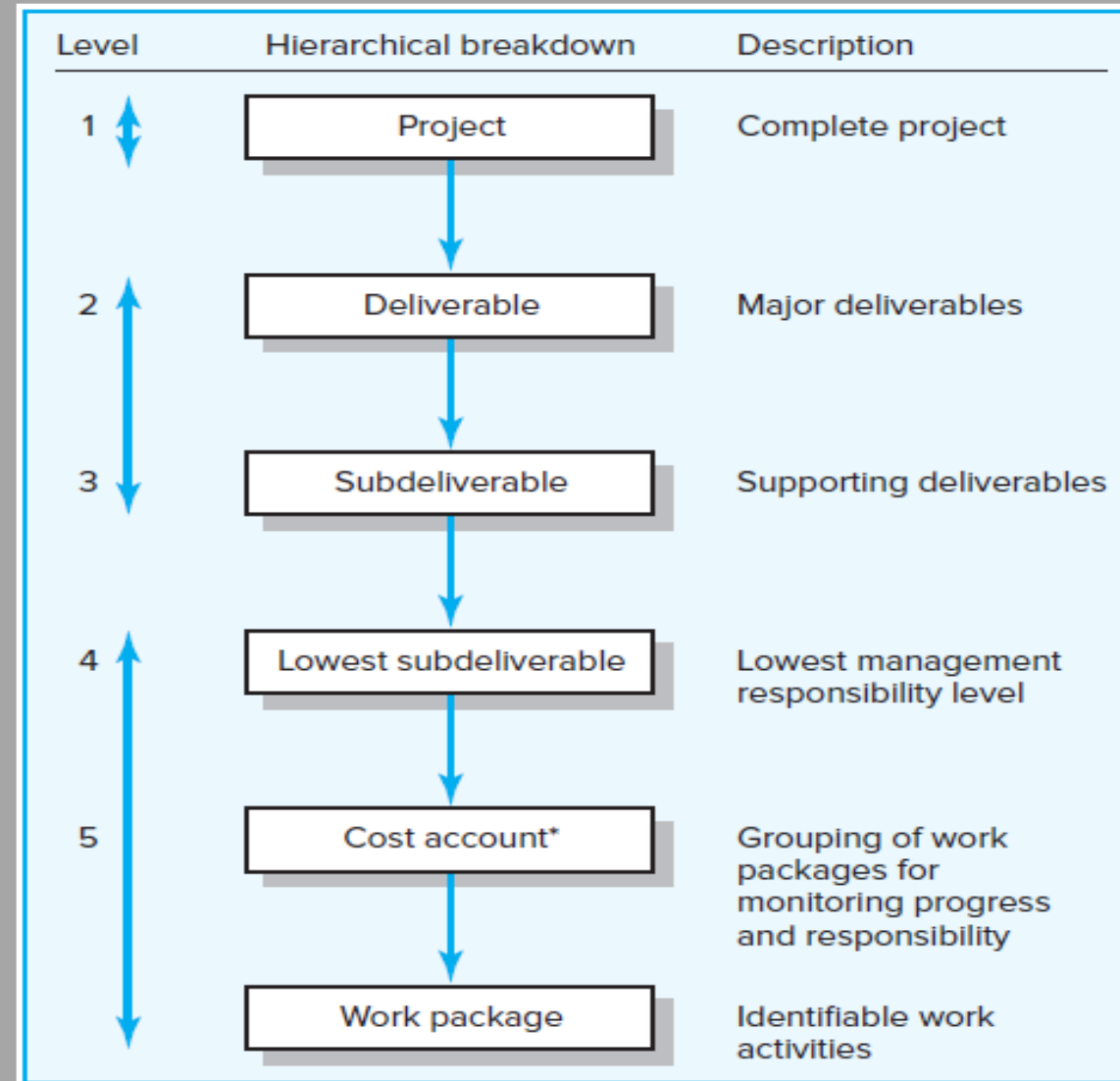
What is a WBS ?

- ✓ A work breakdown structure (WBS) is a chart or document used to organize project work into a list of work packages (activities and tasks) so that all work stays on track to meet project goals.
- ✓ A work breakdown is a project management tool that lays out everything a project must accomplish, organizes those tasks into multiple levels, and displays these elements graphically. It's a deliverable-based approach, meaning you'll end up with a detailed project plan of the deliverables you must create to finish the job.

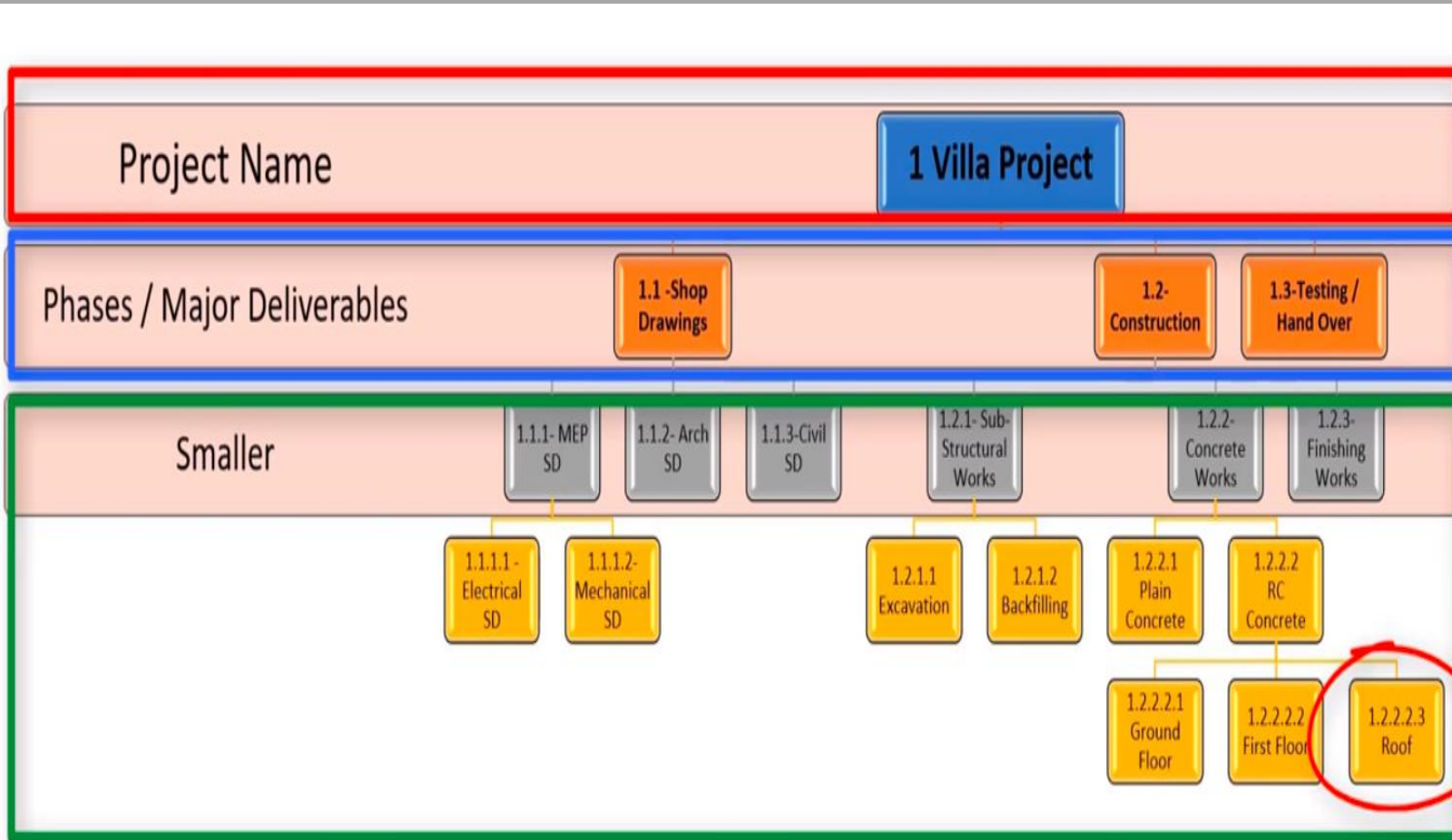


Major Groupings Found in a WBS

The WBS begins with the project as the final deliverable. Major project work deliverables/systems are identified first; then the sub deliverables necessary to accomplish the larger deliverables are defined. The process is repeated until the sub deliverable detail is small enough to be manageable and where one person can be responsible. This sub deliverable is further divided into work packages. Because the lowest sub deliverable usually includes several work packages, the work packages are grouped by type of work—for example, design and testing. These groupings within a sub deliverable are called cost accounts. This grouping facilitates a system for monitoring project progress by work, cost, and responsibility.



Example:

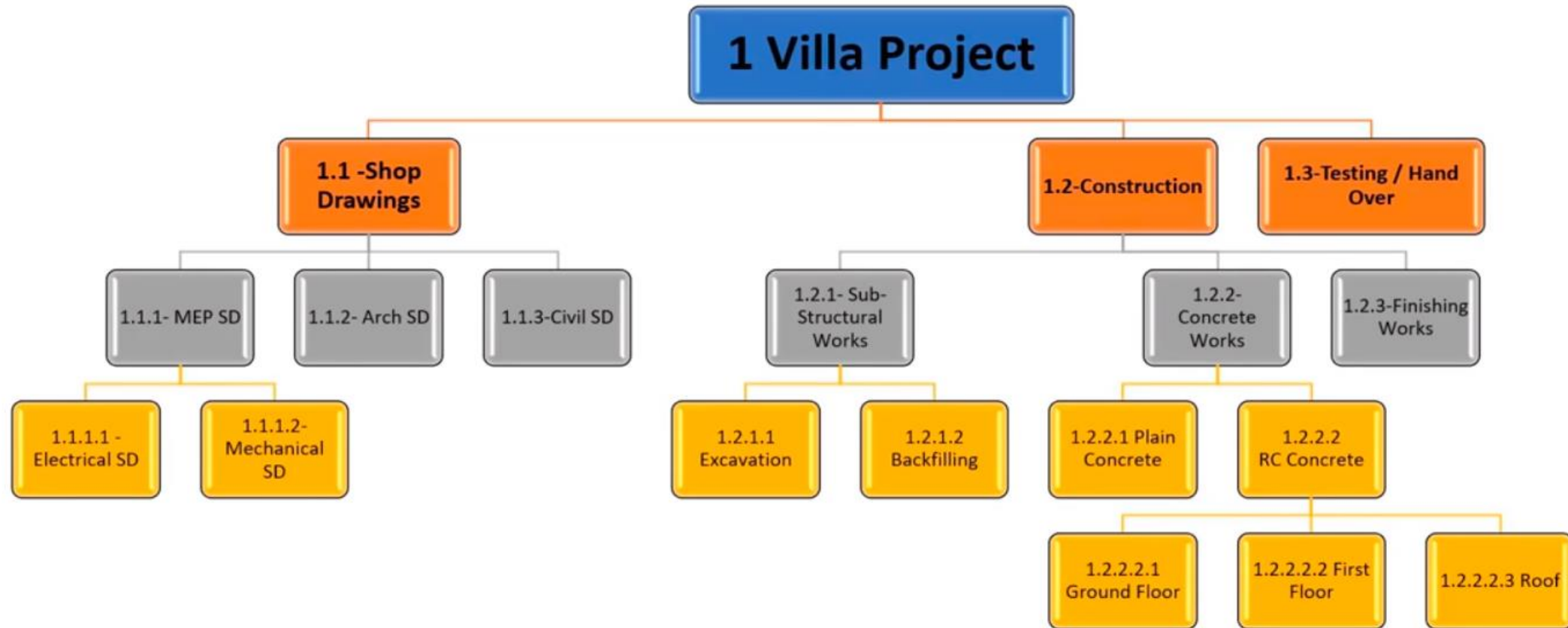


Work package:

- Planned work is contained within **the lowest level** of WBS components.
- A work package can be used to **group the activities** where work is **scheduled and estimated, monitored and controlled**.

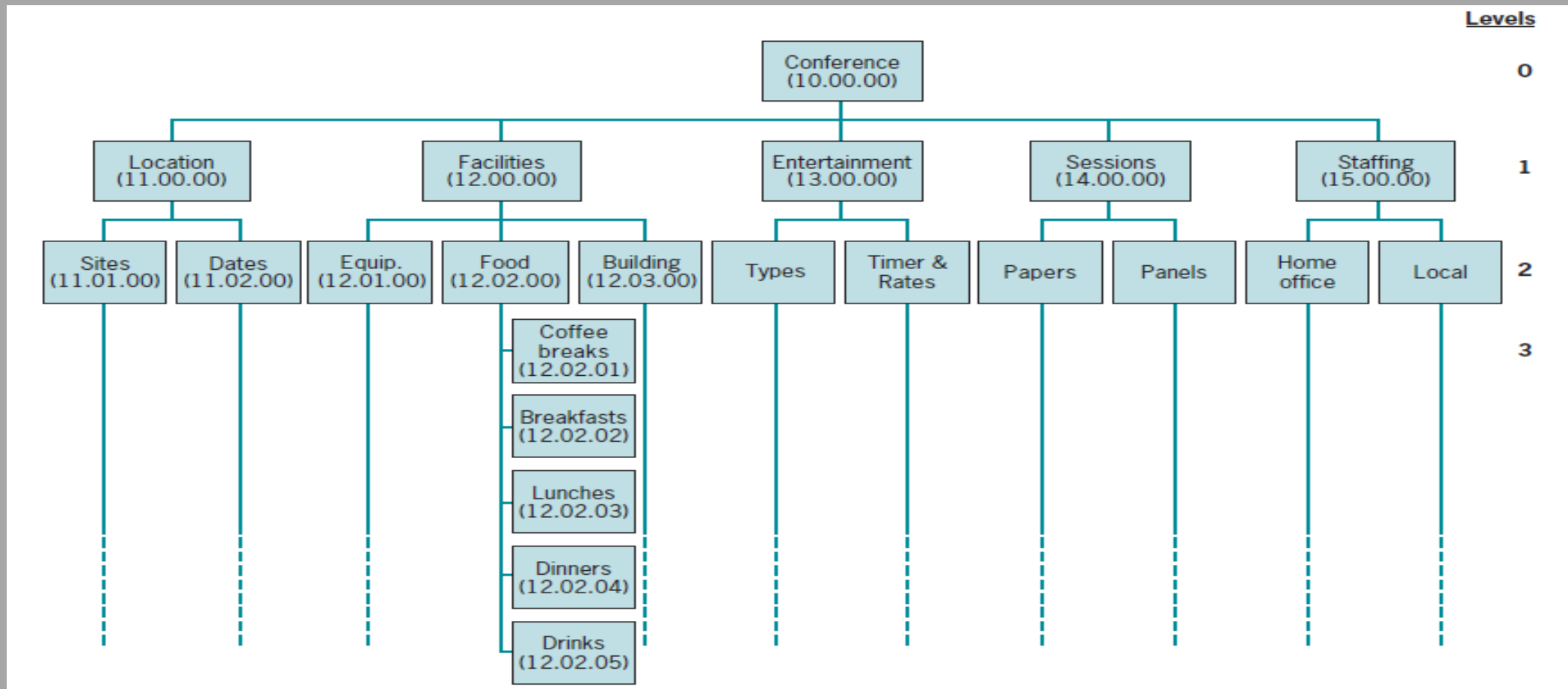
How many work packages can you see ?

100 percent rule

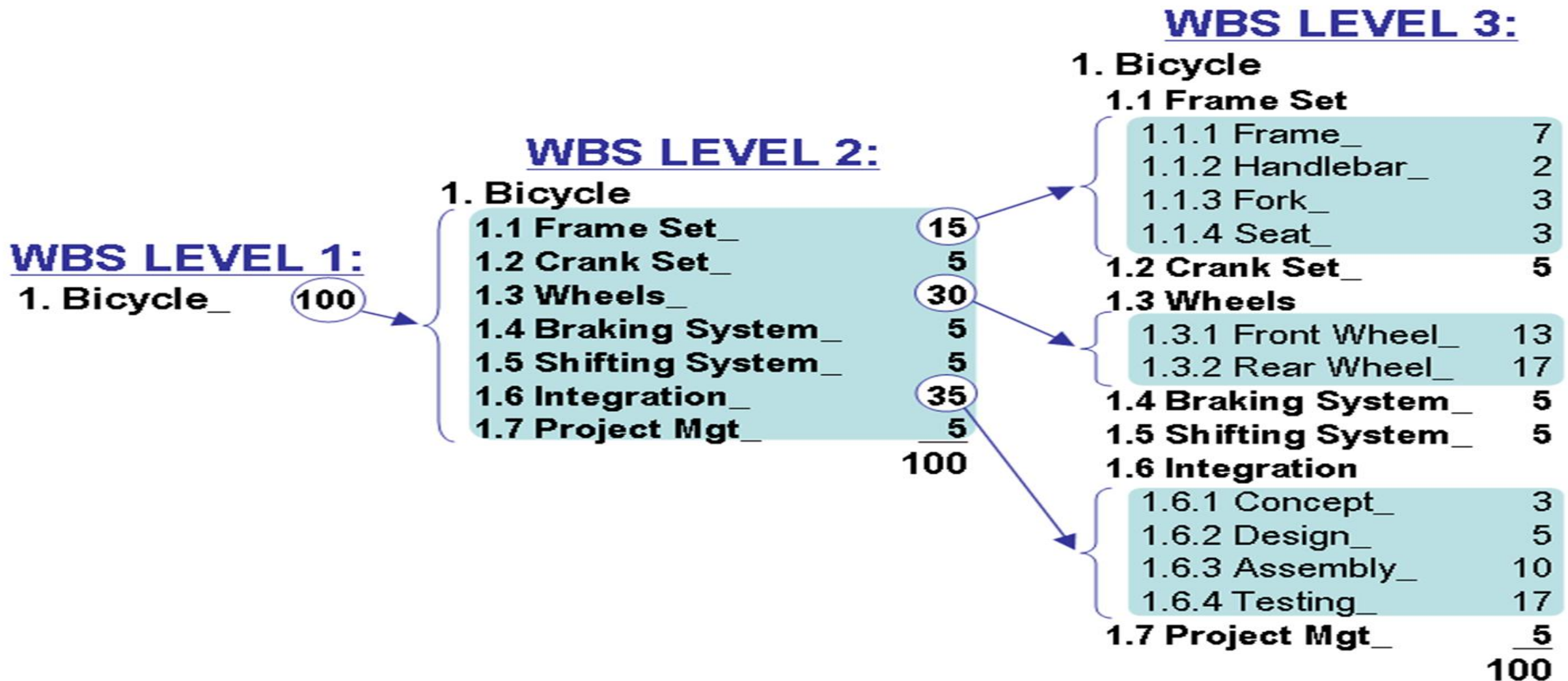


100 percent rule: nothing is left out and no extra work is performed

Example: WBS Chart



Example: WBS Chart



Example: WBS Table

Objective Career Day				
Steps	Responsibility	Time (weeks)	Prec.	Resources
1. Contact Organizations				
a. Print forms	Secretary	6	—	Print shop
b. Contact organizations	Program manager	15	1.a	Word processing
c. Collect display information	Office manager	4	1.b	
d. Gather college particulars	Secretary	4	1.b	
e. Print programs	Secretary	6	1.d	Print shop
f. Print participants' certificates	Graduate assistant	8	—	Print Shop
2. Banquet and Refreshments				
a. Select guest speaker	Program manager	14	—	
b. Organize food	Program manager	3	1.b	Caterer
c. Organize liquor	Director	10	1.b	Dept. of Liquor Control
d. Organize refreshments	Graduate assistant	7	1.b	Purchasing
3. Publicity and Promotion				
a. Send invitations	Graduate assistant	2	—	Word processing
b. Organize gift certificates	Graduate assistant	5.5	—	
c. Arrange banner	Graduate assistant	5	1.d	Print shop
d. Contact faculty	Program manager	1.5	1.d	Word processing
e. Advertise in college paper	Secretary	5	1.d	Newspaper
f. Class announcements	Graduate assistant	1	3.d	Registrar's office
g. Organize posters	Secretary	4.5	1.d	Print shop
4. Facilities				
a. Arrange facility for event	Program manager	2.5	1.c	
b. Transport materials	Office manager	.5	4.a	Movers

Example: WBS Memo

MEMO

To allow Ajax to operate like a department of Instat by April 1, 1996, we must do the following by the dates indicated.

September 24

Ajax Management to be advised of coming under Instat operation. The Instat sales department will begin selling Ajax Consumer Division production effective Jan. 1, 1996. There will be two sales groups: (1) Instat, (2) Ajax Builder Group.

October 15

Instat Regional Managers advised—Instat sales department to assume sales responsibility for Ajax products to distribution channels, Jan. 1, 1996.

October 15

Ajax regional managers advised of sales changes effective Jan. 1, 1996.

October 15

Instat Management, Bob Carl, Van Baker, and Val Walters visit Ajax management and plant. Discuss how operations will merge into Instat.

October 22

Ajax regional managers advise Ajax sales personnel and agents of change effective Jan. 1, 1996.

October 24

Brent Sharp and Ken Roadway visit Instat to coordinate changeover.

October 29

Instat regional managers begin interviewing Ajax sales personnel for possible positions in Instat's sales organization.

November 5

Instat regional managers at Ajax for sales training session.

November 26

Walters visits Ajax to obtain more information.

November 30

Data Processing (Morrie Reddish) and Mfg. Engineering (Sam Newfield): Request DP tapes from Bob Cawley, Ajax, for conversion of Ajax to Instat eng. records: master inventory file, structure file, bill of materials file, where-used file, cross-reference Instat to Ajax part numbers, etc. Allow maximum two weeks until December 14, 1995, for tapes to be at Instat.

December 3

ADMINISTRATIVE (Val Walters): Offer Norwood warehouse for sublease.

December 3

SALES (Abbott and Crutchfield): Week of sales meeting . . . Instruction of salespeople in Ajax line . . . including procedure in writing Ajax orders on separate forms from Instat orders . . . temporarily, adding weight and shipping information, and procedure below: Crutchfield to write procedure regarding transmission of orders to Instat, credit check, and transmission of order information to shipping point, whether Norwood, San Francisco, or, later, Instat Cincinnati.

How WBS Helps the Project Manager?

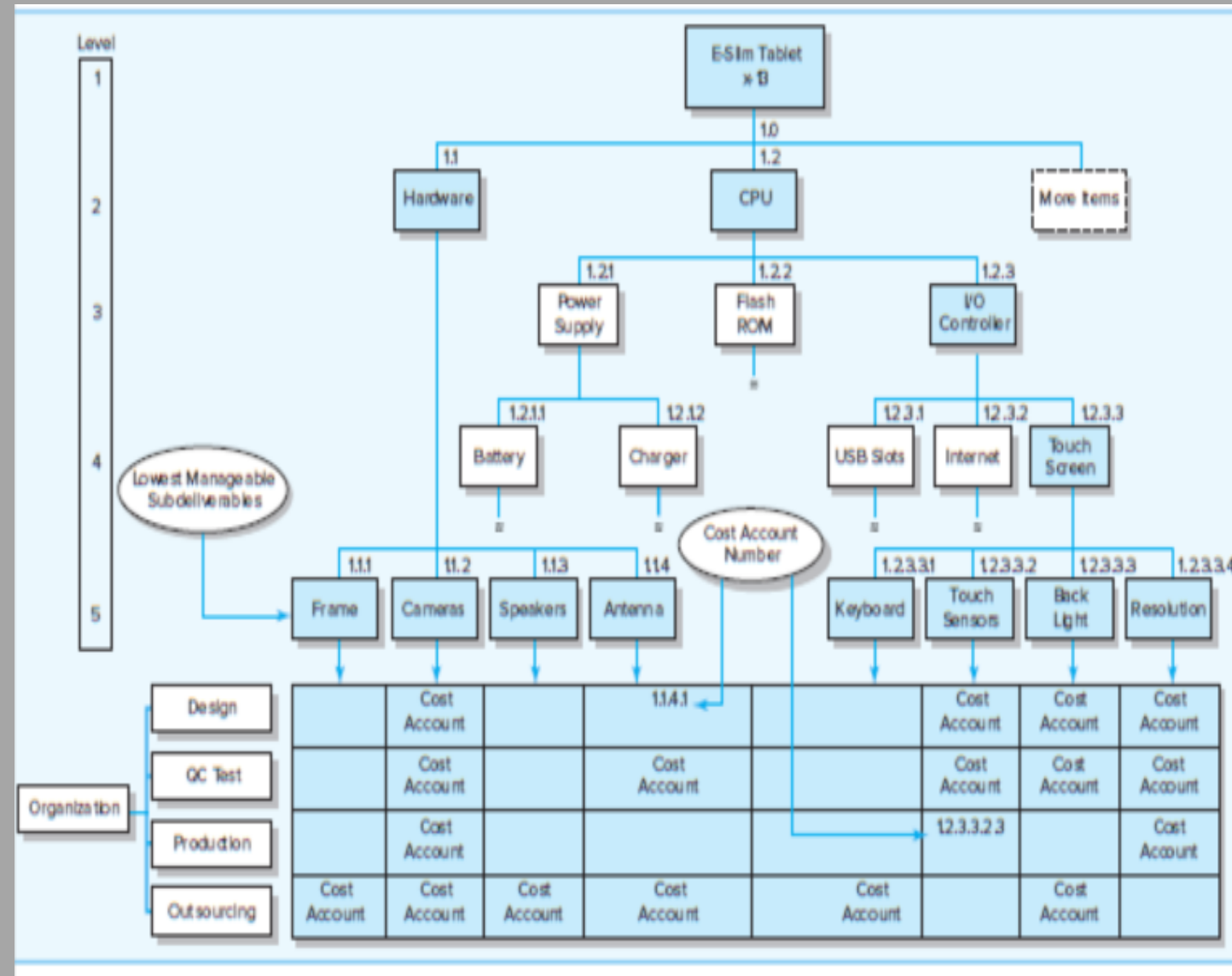
- The WBS defines all the elements of the project in a hierarchical framework and establishes their relationships to the project end item(s).
- Think of the project as a large work package that is successively broken down into smaller work packages; the total project is the summation of all the smaller work packages.
- This hierarchical structure facilitates evaluation of cost, time, and technical performance at all levels in the organization over the life of the project.
- The WBS also provides management with information appropriate to each level. For example, top management deals primarily with major deliverables, while first-line supervisors deal with smaller sub deliverables and work packages.

- Each item in the WBS needs a time and cost estimate. With this information it is possible to plan, schedule, and budget your project. The WBS also serves as a framework for tracking cost and work performance.
- As the WBS is developed, organizational units and individuals are assigned responsibility for executing work packages. This integrates the work and the organization. In practice, this process is sometimes called the organization breakdown structure (OBS).
- Use of the WBS provides the opportunity to “roll up” (sum) the budget and actual costs of the smaller work packages into larger work elements so that performance can be measured by organizational units and work accomplishment.
- The WBS can also be used to define communication channels and assist in understanding and coordinating many parts of the project. The structure shows the work and organizational units responsible and suggests where written communication should be directed. Problems can be quickly addressed and coordinated because the structure integrates work and responsibility.

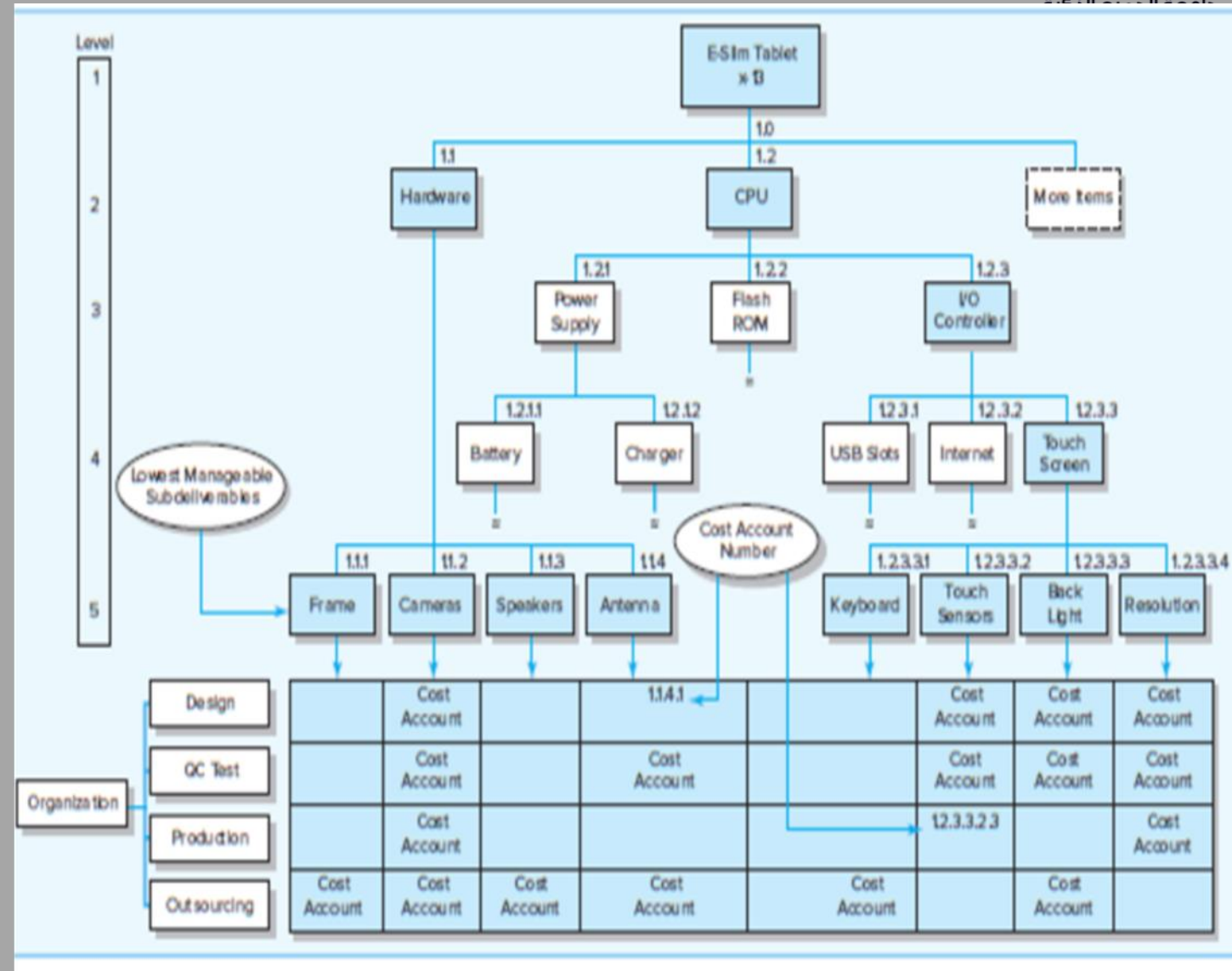
WBS Development

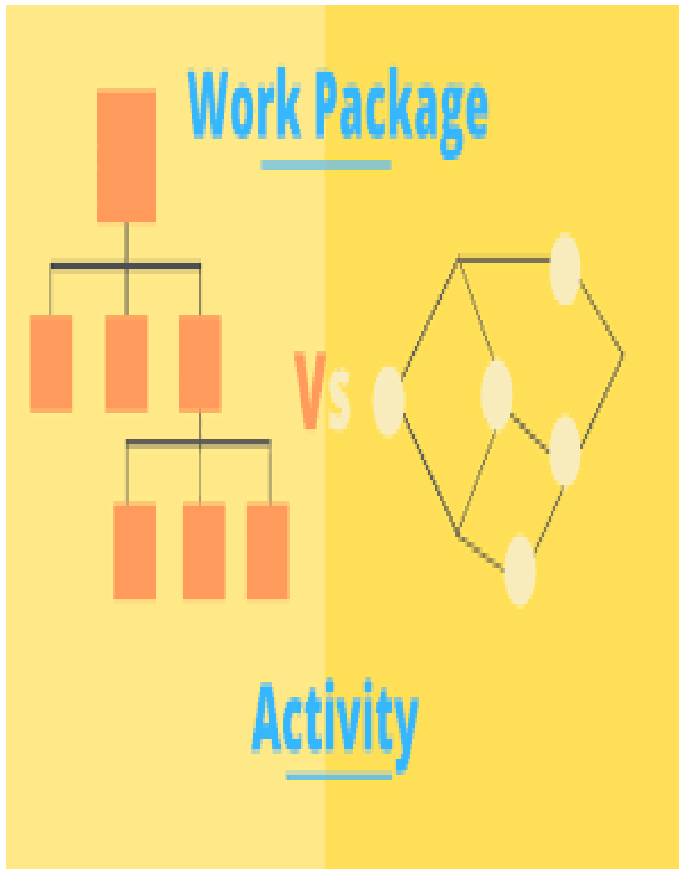
This figure shows a simplified WBS to develop a new prototype tablet computer.

At the top of the chart (level 1) is the project end item—the E-Slim Tablet x-13 Prototype. The sub deliverables levels (2–5) below level 1 represent further decomposition of work. The levels of the structure can also represent information for different levels of management. For example, level 1 information represents the total project objective and is useful to top management; levels 2, 3, and 4 are suitable for middle management; and level 5 is for first-line managers.



level 2 indicates there are two major deliverables—Hardware and CPU, or central processing unit. At level 3, the CPU is connected to three deliverables—Power Supply, Flash ROM, and I/O Controller. The I/O Controller has three sub deliverables at level 4—USB Slots, Internet, and Touch Screen. The many sub deliverables for USB Slots and Internet have not been decomposed. The Touch Screen (shaded) has been decomposed down to level 5 and to the work package level.





The lowest level of the WBS is called a **work package**. Work packages are short duration tasks that have a definite start and stop point, consume resources, and represent cost. Each work package is a control point. A work package manager is responsible for seeing that the package is completed on time, within budget, and according to technical specifications. Practice suggests a work package should not exceed 10 workdays or one reporting period. If a work package has a duration exceeding 10 days, check or monitoring points should be established within the duration, say, every three to five days, so progress and problems can be identified before too much time has passed. Each work package of the WBS should be as independent of other packages of the project as possible. No work package is described in more than one sub deliverable of the WBS.

Work package, Planning package and Control account

Work package: is a group of related tasks within a project. Because they look like projects themselves, they are often thought of as sub-projects within a larger project. Work packages are the smallest unit of work that a project can be broken down to when creating your Work Breakdown Structure (WBS)

Planning Package is a work breakdown structure component below the control account with known work content but without detailed schedule. A planning package may be converted to a work package when the lowest-level details of the work are defined, budgeted, and scheduled. a planning package stores future work until the work can be broken down into specific tasks and assigned to actual resources, when it becomes part of the Work Breakdown Structure (WBS) in the form of work breakdown packages.

Control Account is a management control point where scope, cost, and schedule are integrated and compared to the earned value for performance measurement. Control Accounts are placed at selected management points in the WBS. Each Control Account is defined with a unique code or an accounting number which can be used to link to the performing account system.

1 Villa Project

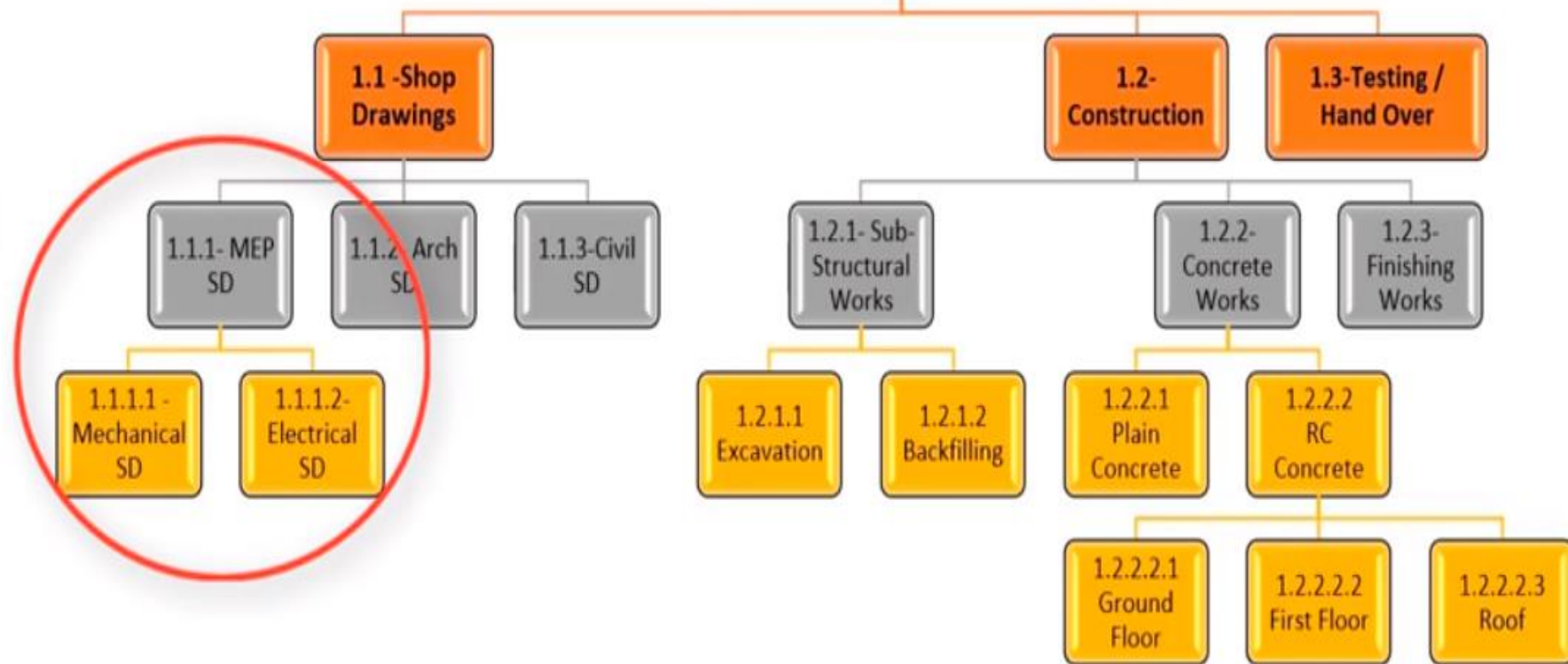
$$1.1.1 = 1.1.1.1 + 1.1.1.2$$

MEP = Mechanical + Electrical

Control
account

Planning
Package

Work
Package



A control account has two or more work packages, though each work package is associated with a single control account. A control account is a management control point where scope, budget, and schedule are integrated and compared to the Earned value for performance measurement.

To review, each work package in the WBS

1. Defines work (what).
2. Identifies time to complete a work package (how long).
3. Identifies a time-phased budget to complete a work package (cost).
4. Identifies resources needed to complete a work package (how much).
5. Identifies a single person responsible for units of work (who).
6. Identifies monitoring points for measuring progress (how well).

Remember!



- Project managers should take advantage of relevant examples from previous projects to begin the process.
- WBSs are products of group efforts. If the project is small, the entire project team may be involved breaking down the project into its components. For large, complex projects, the people responsible for the major deliverables are likely to meet to establish the first two levels of deliverables. In turn, further detail would be delegated to the people responsible for the specific work. Collectively this information would be gathered and integrated into a formal WBS by a project support person.
- The final version would be reviewed by the inner echelon of the project team. Relevant stakeholders (most notably customers) would be consulted to confirm agreement and revise when appropriate.



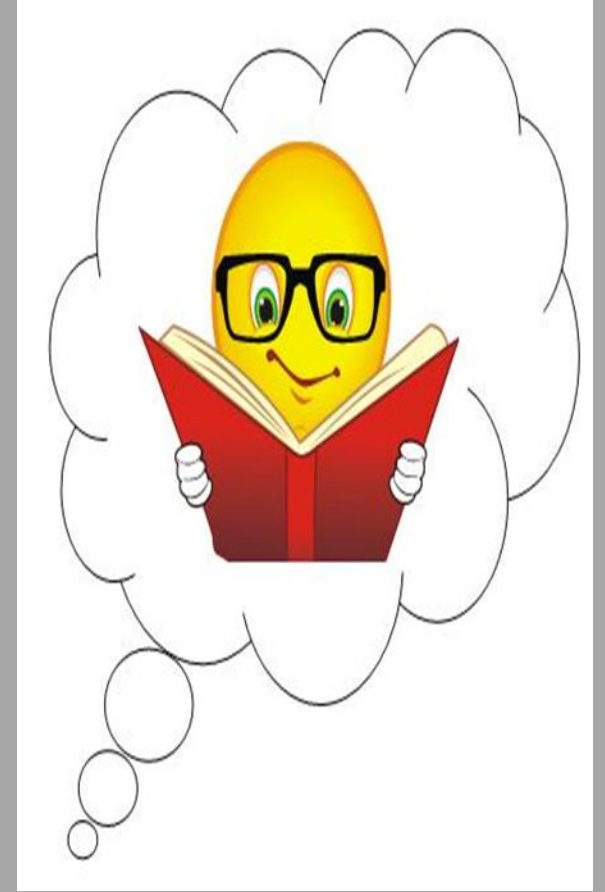
Remember!



- Project teams developing their first WBS frequently forget that the structure should be end-item, output oriented.
- First attempts often result in a WBS that follows the organization structure—design, marketing, production, finance. If a WBS follows the organization structure, the focus will be on the organization function and processes rather than the project output or deliverables.
- A WBS with a process focus will become an accounting tool that records costs by function rather than a tool for “output” management.
- Every effort should be made to develop a WBS that is output oriented in order to concentrate on concrete deliverables.

Learning Summary and Evaluation 1

- The main idea I have learnt?
- A new word I have learnt today is? It means.....
- How could I apply these ideas towards my course studies and career aspiration?





1. What is a WBS?

A work breakdown structure (WBS) is a chart or document used to organize project work into a list of work packages (activities and tasks) so that all work stays on track to meet project goals.

Learning Check

Can you work out where you would put the following elements?

Planning package

Work package

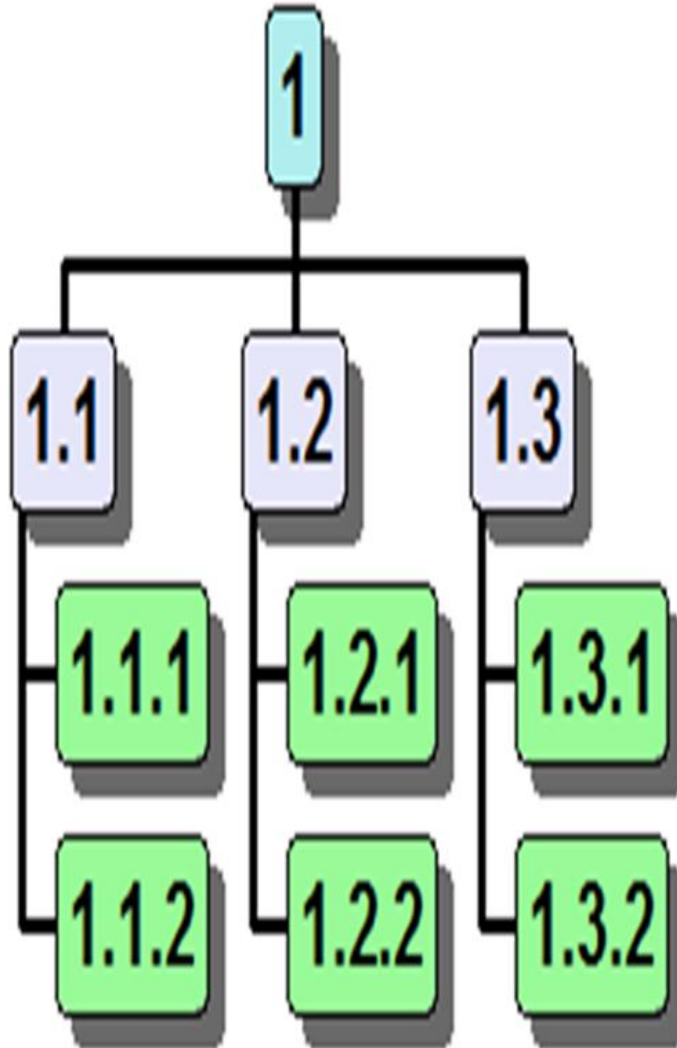
Control account

1. The lowest level of the WBS is called _____.
2. _____ is a work breakdown structure component with known work content but without detailed schedule.
3. _____ is a management control point where scope, cost, and schedule are integrated and compared to the earned value for performance measurement.

How many did you get right?

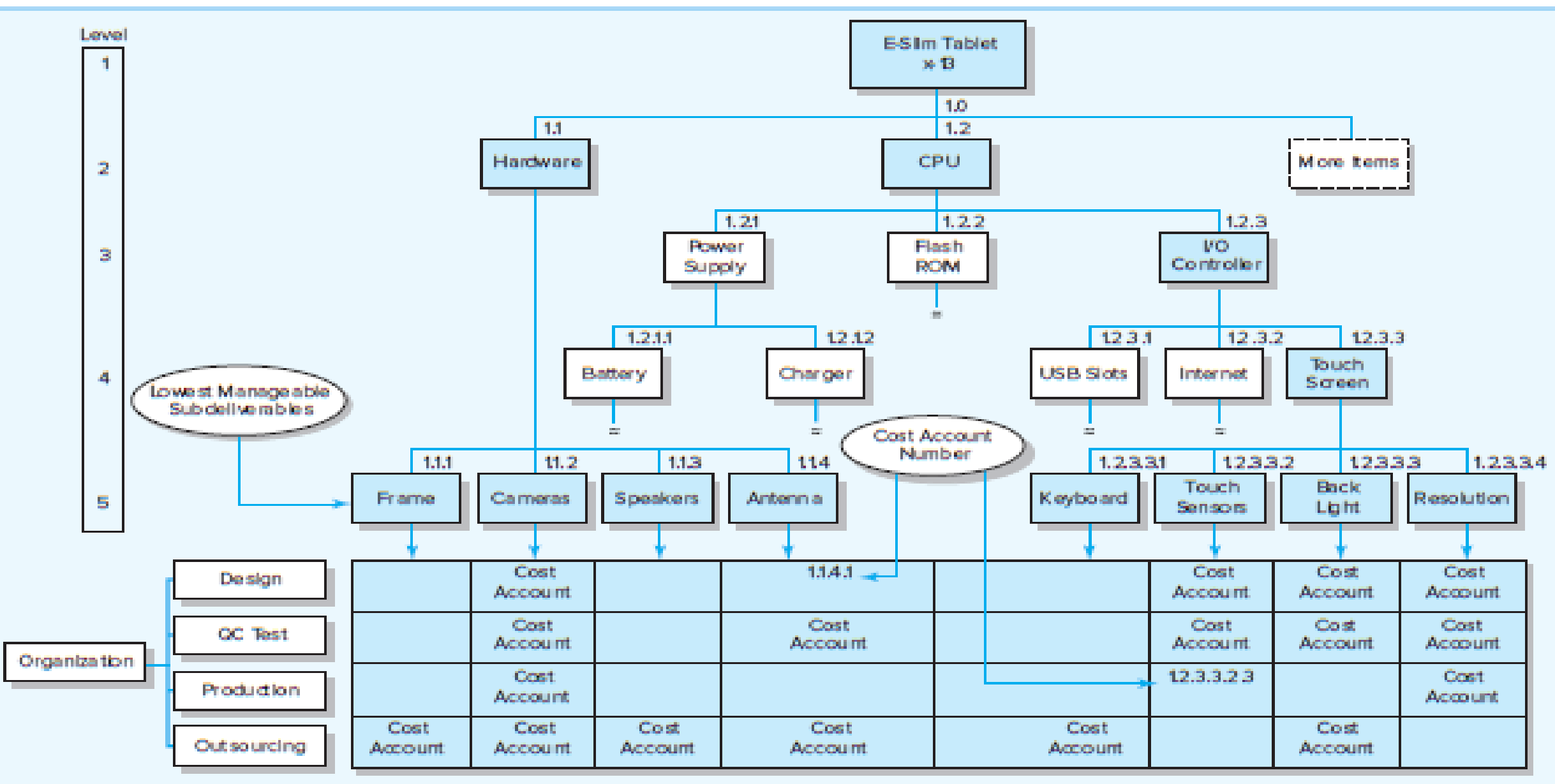
Coding the WBS

- Gaining the maximum usefulness of a breakdown structure depends on a coding system.
- The codes are used to define levels and elements in the WBS, organization elements, work packages, and budget and cost information.
- The codes allow reports to be consolidated at any level in the structure. The most used scheme in practice is numeric indentation. Note the project identification is 1.0. Each successive indentation represents a lower element or work package. Ultimately the numeric scheme reaches down to the work package level, and all tasks and elements in the structure have an identification code. The “cost account” is the focal point because all budgets, work assignments, time, cost, and technical performance come together at this point.



This coding system can be extended to cover large projects. Additional schemes can be added for special reports. For example, adding a “23” after the code could indicate a site location, an elevation, or a special account such as labor. Some letters can be used as special identifiers such as “M” for materials or “E” for engineers. You are not limited to only 10 subdivisions (0–9); you can extend each subdivision to large numbers—for example, .1–.99 or .1–.9999. If the project is small, you can use whole numbers

FIGURE 4.5 Integration of WBS and OBS



	i	Task Mode	Task Name
1			1 E-Slim Tablet x-13 Prototype
2			1.1 Hardware
3			1.1.1 Cameras
4			1.1.2 Speakers
5			1.1.3 Antenna
6			1.2 CPU
7			1.2.1 Power supply
8			1.2.1.1 Battery (more items)
9			1.2.1.2 Charger (more items)
10			1.2.2 Flash Rom (more items)
11			1.2.2.1 I/O controller
12			1.2.2.2 USB slots (more items)
13			1.2.2.3 Internet (more items)
14			1.2.3 Touch screen
15			1.2.3.1 Keyboard
16			1.2.3.1.1 Work package
17			1.2.3.2 Touch sensors
18			1.2.3.2.1 Work package
19			1.2.3.2.2 Work package
20			1.2.3.2.3 Work package
21			1.2.3.3 Back light (more items)
22			1.2.3.4 Resolution (more items)



Responsibility Matrices

One tool that is widely used by project managers is the **responsibility matrix** (RM). The RM (sometimes called a linear responsibility chart) summarizes the tasks to be accomplished and who is responsible for what on a project. In its simplest form an RM consists of a chart listing all the project activities and the participants responsible for each activity.

Why responsibility Matrices?

- Responsibility matrices provide a means for all participants in a project to view their responsibilities and agree on their assignments.
- They also help clarify the extent or type of authority exercised by each participant in performing an activity in which two or more parties have overlapping involvement.
- By using an RM and by defining authority, responsibility, and communications within its framework, the relationship between different organizational units and the work content of the project is made clear

Project Team

Task	Richard	Dan	Dave	Linda	Elizabeth
Identify target customers	R	S		S	
Develop draft questionnaire	R	S	S		
Pilot-test questionnaire		R		S	
Finalize questionnaire	R	S	S	S	
Print questionnaire					R
Prepare mailing labels					R
Mail questionnaires					R
Receive and monitor returned questionnaires				R	S
Input response data			R		
Analyze results		R	S	S	
Prepare draft of report	S	R	S	S	
Prepare final report	R		S		

R = Responsible
S = Supports/assists

- This figure illustrates a RM for a market research study.
- In this matrix the R is used to identify the committee member who is responsible for coordinating the efforts of other team members assigned to the task and making sure that the task is completed.
- The S is used to identify members of the five-person team who will support and/or assist the individual responsible.
- Simple RMs like this one are useful not only for organizing and assigning responsibilities for small projects but also for subprojects of large, more complex projects.

Example 1

Organization								
Deliverables	Design	Development	Documentation	Assembly	Testing	Purchasing	Quality Assur	Manufacturing
Architectural designs	1	2			2		3	3
Hardware specifications	2	1				2	3	
Kernel specifications	1	3						3
Utilities specifications	2	1			3			
Hardware design	1			3		3		3
Disk drivers	3	1	2					
Memory management	1	3			3			
Operating system documentation	2	2	1					3
Prototypes	5		4	1	3	3	3	4
Integrated acceptance test	5	2	2		1		5	5

- 1 Responsible
- 2 Support
- 3 Consult
- 4 Notification
- 5 Approval

Example 2

More complex RMs not only identify individual responsibilities but also clarify critical interfaces between units and individuals that require coordination.

For example, This is an RM for a larger, more complex project to develop a new piece of automated equipment. Notice that within each cell a numeric coding scheme is used to define the nature of involvement on that specific task. Such an RM extends the WBS/OBS and provides a clear and concise method for depicting responsibility, authority, and communication channels.

WBS		Responsibility					
		Project Office				Field Oper.	
Subproject	Task	Project Manager	Contract Admin.	Project Eng.	Industrial Eng.	Field Manager	
Determine need	A1	○		●	▲		
	A2	■	○	▲	●		
Solicit quotations	B1	○	■	▲		●	
Write approp. request.	C1	■	▲	○	●		
	C2		●	○	▲		
	C3	●	■	▲		■	
"	"						
"	"						
"	"						

Legend:

- ▲ Responsible
- Support
- Notification
- Approval

	Vice-president	General manager	Project manager	Manager engineering	Manager software	Manager manufacturing	Manager marketing	Subprogram manager manufacturing	Subprogram manager software	Subprogram manager hardware	Subprogram manager services
Establish project plan	6	2	1	3	3	3	3	4	4	4	4
Define WBS		5	1	3	3	3	3	3	3	3	3
Establish hardware specs		2	3	1	4	4	4				
Establish software specs		2	3	4	1		4				
Establish interface specs		2	3	1	4	4	4				
Establish manufacturing specs		2	3	4	4	1	4				
Define documentation		2	1	4	4	4	4				
Establish market plan	5	3	5	4	4	4	1				
Prepare labor estimate			3	1	1	1		4	4	4	4
Prepare equipment cost estimate		3	1	1	1			4	4	4	4
Prepare material costs			3	1	1	1		4	4	4	4
Make program assignments			3	1	1	1		4	4	4	4
Establish time schedules		5	3	1	1	1	3	4	4	4	4

1 Actual responsibility

2 General supervision

3 Must be consulted

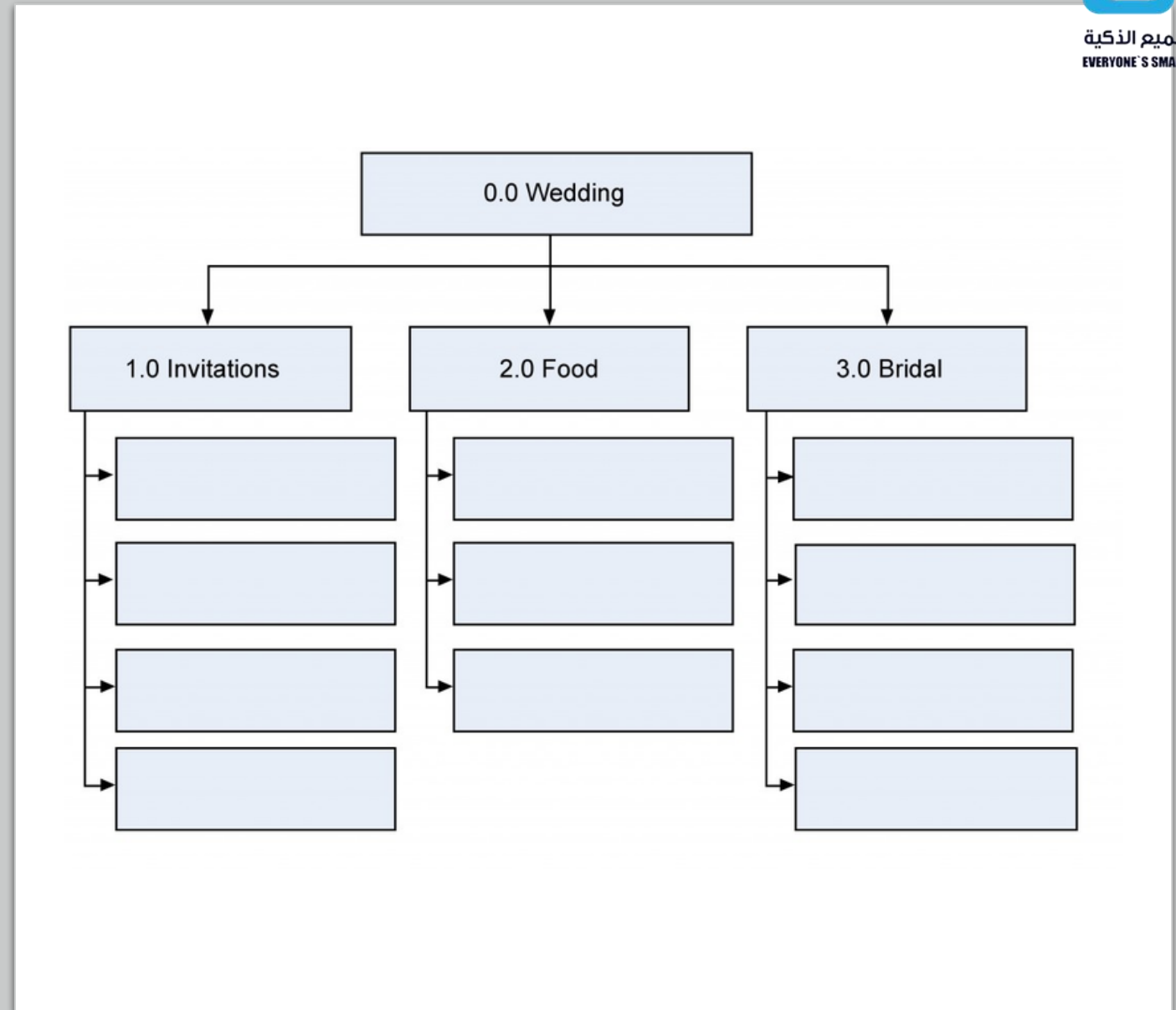
4 May be consulted

5 Must be notified

6 Final approval

Case Study: Wedding Deliverables

- Remember!
WBS follows 100% rule



Deliverables Decompose into Work Packages

Shop for shoes

Create guest list

Have the tailoring and fitting done

Shop for dress

Find caterer

Cater the wedding

Wait for RSVPs

Mail the invitations

Finalize the menu

Print the invitations

Choose the bouquet

Summary

- The scope definition provides focus and emphasis on the end item(s) of the project. Establishing project priorities allows managers to make appropriate trade-off decisions. The WBS structure helps ensure all tasks of the project are identified and provides two views of the project—one on deliverables and one on organization responsibility
- The WBS avoids having the project driven by organization function or by a finance system. The structure forces attention to realistic requirements of personnel, hardware, and budgets.
- Use of the structure provides a powerful framework for project control that identifies deviations from plan, identifies responsibility, and spots areas for improved performance.

- The greatest benefit of developing a work breakdown structure is providing a common understanding of all the work required to deliver the product or service.
- The hierarchical approach (level planning process) to project planning is most appropriate and can be aided by a tree diagram of project subsets, called a Gozinto chart, and a Work Breakdown Structure (WBS).
- The WBS relates the details of each subtask to its task and provides the final basis for the project budget, schedule, personnel, and control.
- A linear responsibility chart is often helpful to illustrate the relationship of personnel to project tasks and to identify where coordination is necessary.

What is next?

In the next lecture, we will we cover the knowledge area and discuss “Budgeting, Estimating costs and Project risk management”, the process of identifying, analyzing, and responding to project risk.

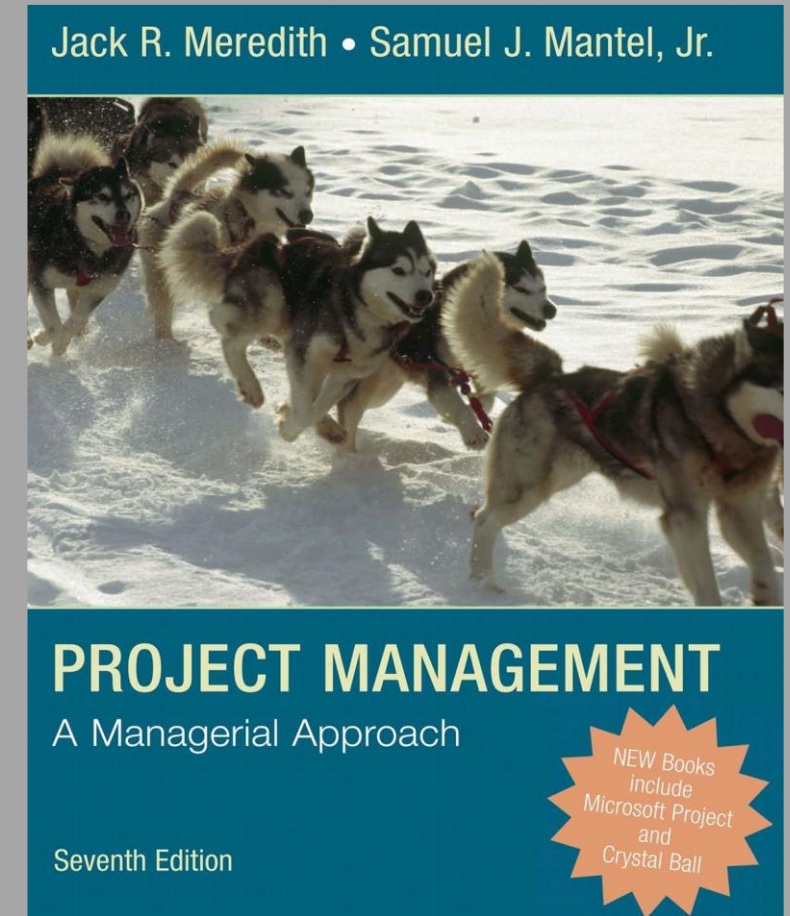
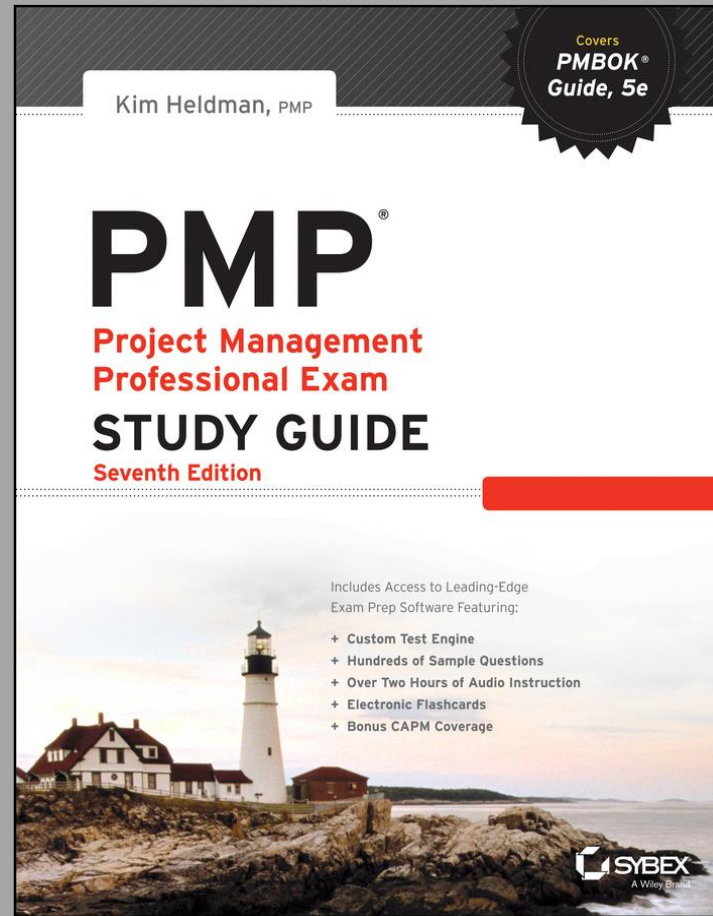
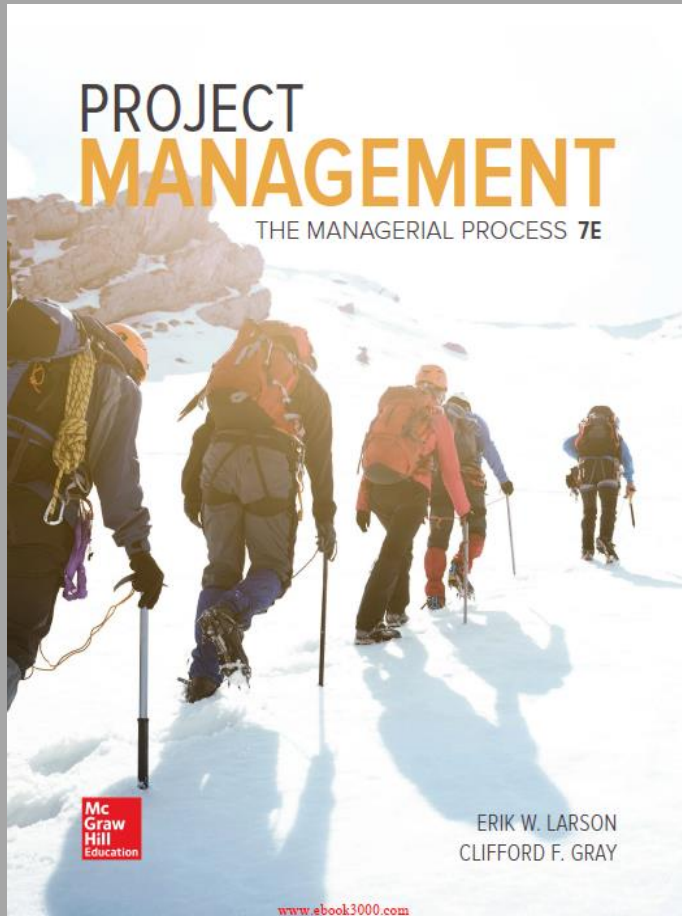
Glossary

- **Hierarchical Planning** A planning approach that breaks the planning task down into the activities that must be done at each managerial level. Typically, the upper level sets the objectives for the next lower level.
- **Milestones** Natural subproject ending points where payments may occur, evaluations may be made, or progress may be reassessed.
- **Deliverables** The physical items to be delivered from a project. This typically includes reports and plans as well as physical objects.
- **RACI matrix**: A table showing for each project task, who is responsible, accountable, who can be consulted, and who needs to be informed.(Also known as responsibility or assignment chart)

Discussion Questions

- Assignment Discussion.
- In what ways may the WBS be used as a key document to monitor and control a project?
- Describe the process of subdivision of activities and events that composes the Work Breakdown Structure. Why is the input of responsible managers and workers so important an aspect of this process?

Resources





**THANK
YOU**