Project Planning and Control Methods

Lecture #4

Project Scope Management (Planning)

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Outline

- Introduction

- Plan scope management

- Collect requirements

- Define scope

- Create WBS

  - WBS presentation

  - WBS decomposition

  - WBS rules

  - WBS dictionary

  - Using M.S. Project

Introduction

- Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. Managing the project scope is primarily concerned with defining and controlling what is and is not included in the project.

- In the project context, the term scope can refer to:

  - Project scope: The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions; and/or

  - Product scope: The features and functions that characterize a product, service, or result, which underlies the project scope

Introduction

The approved detailed

project scope statement

and its associated WBS

and WBS dictionary are the

scope baseline for the

project. This scope baseline

is then monitored,

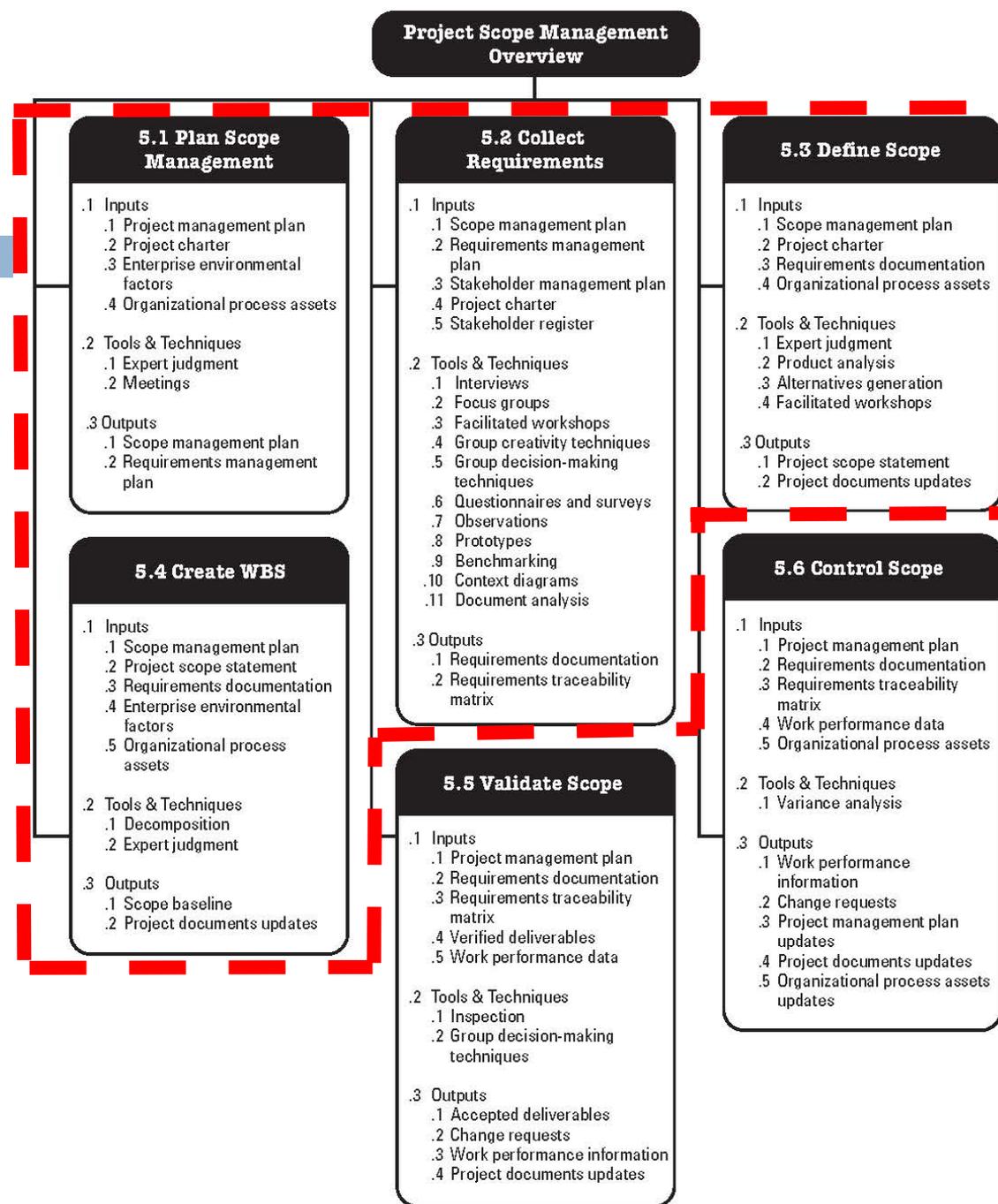validated, and controlled

throughout the lifecycle of

the project.

Project Scope Management Overview

5.1 Plan Scope Management

.1 Inputs
  .1 Project management plan
  .2 Project charter
  .3 Enterprise environmental factors
  .4 Organizational process assets

.2 Tools & Techniques
  .1 Expert judgment
  .2 Meetings

.3 Outputs
  .1 Scope management plan
  .2 Requirements management plan

5.2 Collect Requirements

.1 Inputs
  .1 Scope management plan
  .2 Requirements management plan
  .3 Stakeholder management plan
  .4 Project charter
  .5 Stakeholder register

.2 Tools & Techniques
  .1 Interviews
  .2 Focus groups
  .3 Facilitated workshops
  .4 Group creativity techniques
  .5 Group decision-making techniques
  .6 Questionnaires and surveys
  .7 Observations
  .8 Prototypes
  .9 Benchmarking
  .10 Context diagrams
  .11 Document analysis

.3 Outputs
  .1 Requirements documentation
  .2 Requirements traceability matrix

5.3 Define Scope

.1 Inputs
  .1 Scope management plan
  .2 Project charter
  .3 Requirements documentation
  .4 Organizational process assets

.2 Tools & Techniques
  .1 Expert judgment
  .2 Product analysis
  .3 Alternatives generation
  .4 Facilitated workshops

.3 Outputs
  .1 Project scope statement
  .2 Project documents updates

5.4 Create WBS

.1 Inputs
  .1 Scope management plan
  .2 Project scope statement
  .3 Requirements documentation
  .4 Enterprise environmental factors
  .5 Organizational process assets

.2 Tools & Techniques
  .1 Decomposition
  .2 Expert judgment

.3 Outputs
  .1 Scope baseline
  .2 Project documents updates

5.5 Validate Scope

.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Verified deliverables
  .5 Work performance data

.2 Tools & Techniques
  .1 Inspection
  .2 Group decision-making techniques

.3 Outputs
  .1 Accepted deliverables
  .2 Change requests
  .3 Work performance information
  .4 Project documents updates

5.6 Control Scope

.1 Inputs
  .1 Project management plan
  .2 Requirements documentation
  .3 Requirements traceability matrix
  .4 Work performance data
  .5 Organizational process assets

.2 Tools & Techniques
  .1 Variance analysis

.3 Outputs
  .1 Work performance information
  .2 Change requests
  .3 Project management plan updates
  .4 Project documents updates
  .5 Organizational process assets updates

Figure 5-1. Project Scope Management Overview

Plan scope management

- Creating a scope management plan that documents how the project scope will be defined, validated, and controlled. The components of a **scope management plan** include (Example 1 and 2):

  - Process for preparing a detailed project scope statement;

  - Process that enables the creation of the WBS from the detailed project scope statement;

  - Process that establishes how the WBS will be maintained and approved;

  - Process that specifies how formal acceptance of the completed project deliverables will be obtained; and

  - Process to control how requests for changes to the detailed project scope statement will be processed. This process is directly linked to the Perform Integrated Change Control process.

Collect Requirements

- Collect Requirements is the process of defining and documenting stakeholders' needs to meet the project objectives. Run *interviews*, do observations, review documents, etc. to collect requirements from stakeholders

- The main outputs of the collect requirements process *CAN* be:

  1. Requirements Documentation: It describes how individual requirements meet the business need for the project. All requirements need to be unambiguous (measurable or testable), traceable and acceptable to key stakeholders.

     - Example for a Shomal highway project:
       - 120 km highway length between Tehran and Challoos
       - Total 4 lanes (2 lanes each direction) for an average of 15k car traffic per day and fluent rush hour traffic of 2k car per hour. (it is still ambiguous! More clarification is required?)
       - Minimum interruption to the currently operating 2-lane highway and local roads (it is still ambiguous! More clarification is required.). Maximum of total 4 hours and maximum of continuous 30 minutes of traffic blocking from 11 pm to 7 am is acceptable.

Collect Requirements

- The main outputs of the collect requirements process *CAN* be (Cont'd):

  2. Requirements Management Plan: It documents how requirements will be analyzed, documented, and managed throughout the project.

     - Example for a shomal highway project:

       - 120 km highway length between Tehran and Challoos : During the construction phase highway length is calculated based on the design drawings, after project completion final highway length will be determined by Road Measuring Wheel. Any deviations to the highway length identified (during or after construction phase) will be reported to client, consultant and constructor companies. Any length increase within 3% will contribute to the project cost and time the same as cost and time rate presented in the contract. Further highway length increment requires new work schedule and its cost rate will be calculated based on monthly an annual updated inflation rates provided by central bank.

Collect Requirements

- The main outputs of the collect requirements process *CAN* be (Cont'd):

    3. Requirements Traceability Matrix: The requirements traceability matrix is a table that links requirements to their origin and traces them throughout the project life cycle.

#	Requirement	Stakeholder	Priority	Status	Completion date
1	120 km highway length	Client (ministry of transportation)	Medium		
2	Total 4 lanes	Client (ministry of transportation)	High		
3	Minimum interruption to other roads	Passengers, local residents	Medium		
4	Minimum environmental damage	Natural resources	High		
	...				

Collect Requirements

□ The main outputs of the collect requirements process *CAN* be (Cont'd):

3. Requirements Traceability Matrix:

An example for the table with control data can be as in below:

#	Requirement	Stakeholder	Priority	Status	Completion date
1	120 km highway length	Client (ministry of transportation)	Medium	In-prog	
2	Total 4 lanes	Client (ministry of transportation)	High	In-prog	
3	Minimum interruption to other roads	Passengers, local residents	Medium	Completed	Esfand 3, 1391
4	Minimum environmental damage	Natural resources	High	In-prog	
	...				

Define Scope
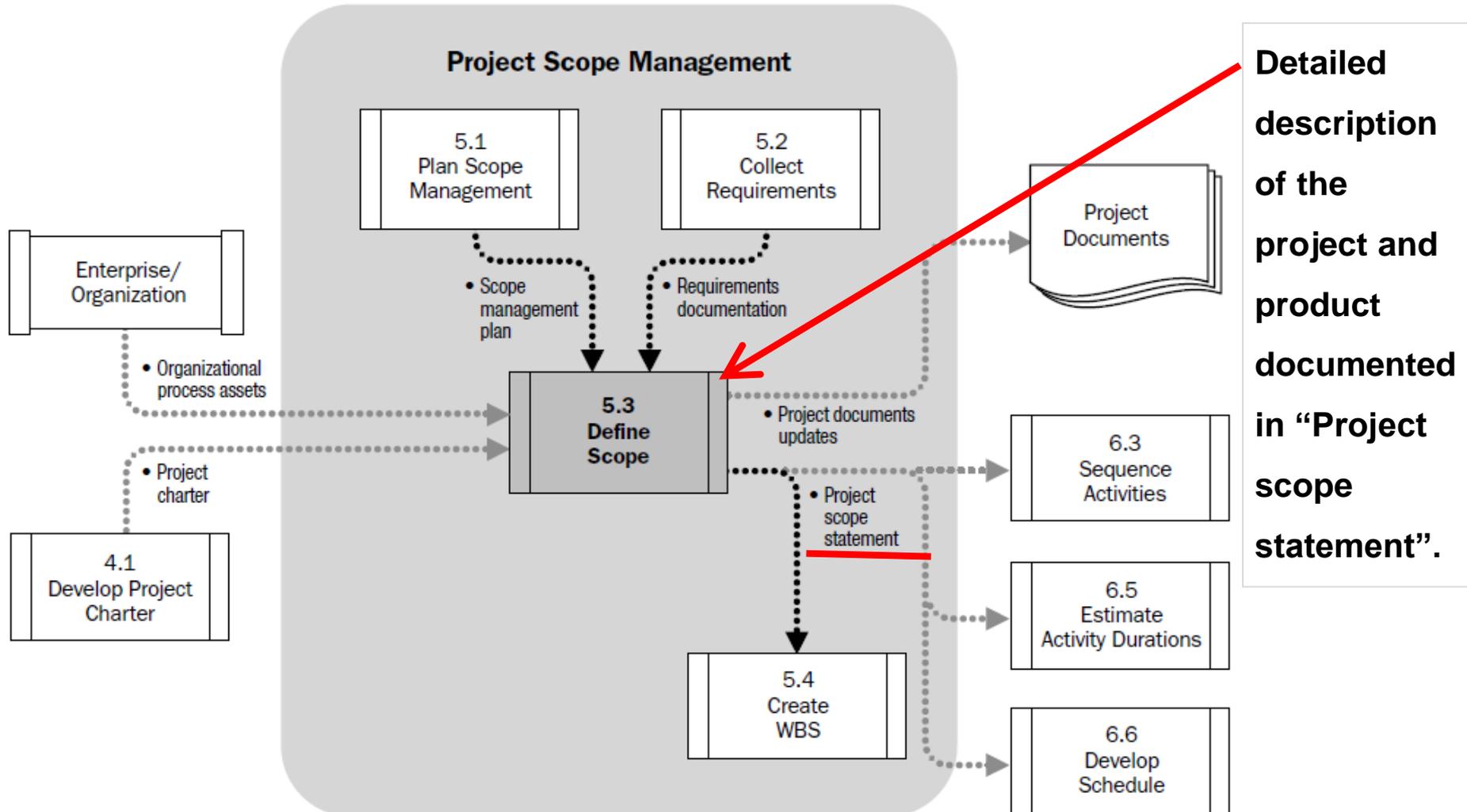
Figure 5-8. Define Scope Data Flow Diagram

Define Scope

Scope statement (example 1, 2 and 3; template 1) may directly or by reference include:

Product scope description. Progressively elaborates the characteristics of the product, service, or result described in the project charter and requirements documentation.

Project deliverables. The deliverables (project output including products, services, reports, drawings, prototypes, etc.) may be described at a summary level or in great detail.

Product acceptance criteria. Defines the process and criteria for accepting completed products, services, or results.

Project exclusions. Explicitly stating what is out of scope for the project helps to manage stakeholders' expectations.

Project constraints. Information on constraints (e.g., predefined budget, schedule milestones and contractual provisions) may be listed in the project scope statement or in a separate log.

Project assumptions. Information on assumptions (e.g. $ exchange rate, customs duty rate, etc.) may be listed in the project scope statement or in a separate log.

Create WBS

- Create WBS (work breakdown structure) is the *process* of subdividing project deliverables and project work into smaller, more manageable components.

  💡 **Question:** What do we mean by more manageable components?

- Each descending level of the WBS represents an increase in the detailed definition of the project work.

- At the scope planning stage we usually break down the work up to the ***work package*** level.

- Work package is a subset of a project that can be assigned to a single group for execution (usually with specific profession).

- Work packages usually are done through supporting procedures (with **steps, tasks** or **activities**) which are usually more specified during time planning (Lec 5)!

Create WBS - OBS/ WBS Linkages
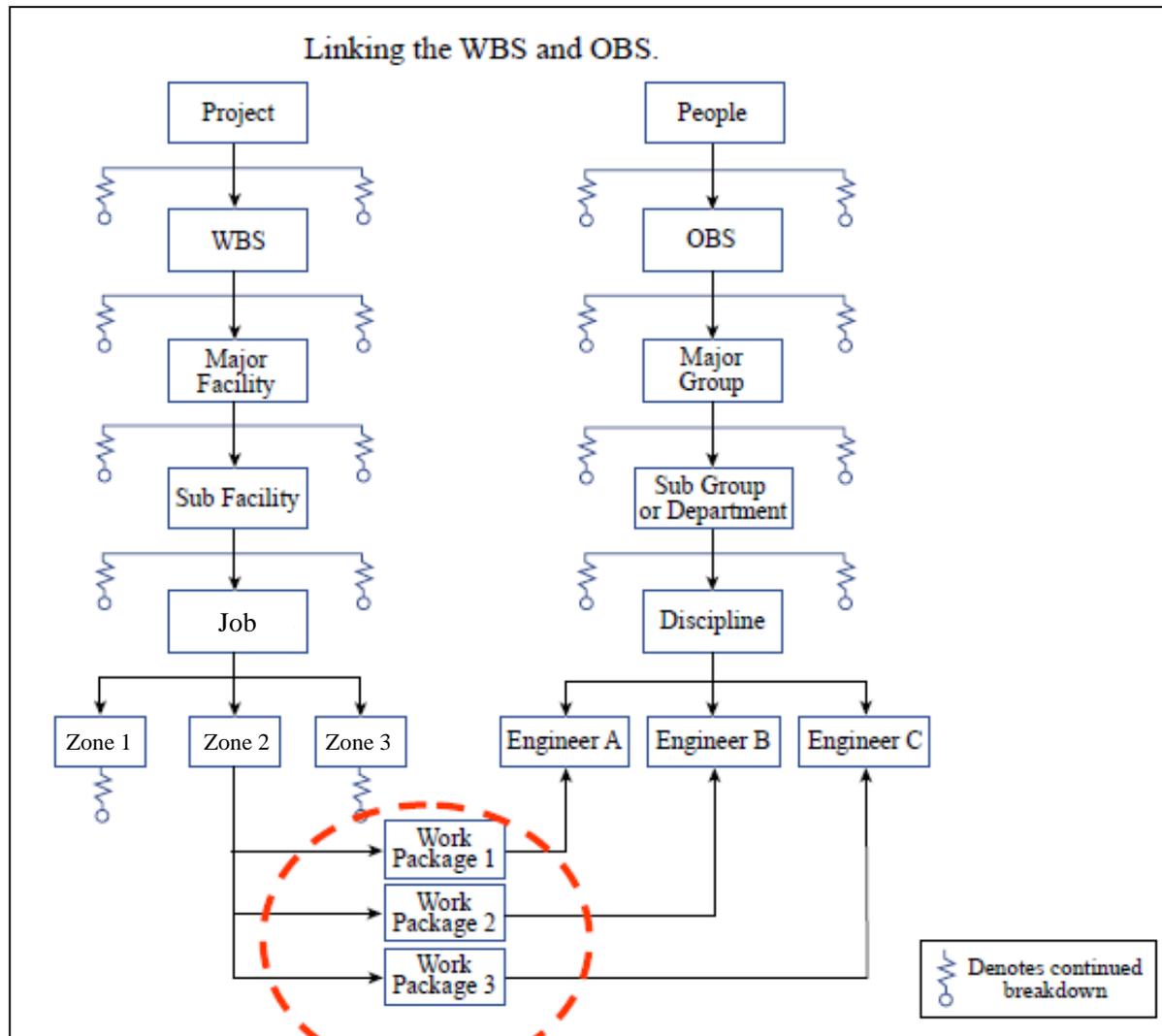
Create WBS - decomposition

□ The WBS is a deliverable (or result) oriented hierarchical decomposition (*not action oriented decomposition*) of the work to be executed by the project team to accomplish the project objectives and create the deliverables required.

Question: What are differences between result oriented and action oriented WBS?

Are these result or action driven?

- Interviewing project stakeholders

- Detecting *project requirement* (Requirements Documentation) by interviewing stakeholders

- Holding monthly project management group meetings

- Assessing *project progress* through monthly project management meetings

- Safety manager's site visit on bi-weekly basis

- Preparing *site safety condition report* on bi-weekly basis by safety manager

- Inspecting sub-contractor's shop on monthly basis

- Preparing *sub-contractor's shop inspection report* on monthly basis

Create WBS - decomposition

- How to decompose?

  - Use high level deliverables (or project phases/ project lifecycle/ sub-projects) to break the project at the first level usually

    - Example: conceptual design, detail design, procurement, fabrication, shipping and construction, project management

  - Decompose sub-levels base on function/ discipline

    - Example 1: Design (structural design, electrical design, mechanical design, process design)

    - Example 2: Fabrication (structural steel fabrication, spool fabrication, precast concrete fabrication)

  - Decompose sub-levels base on physical and geographical locations

    - Example 1: Design (north tunnel design, south tunnel design)

    - Example 2: Pipe installation (First 20km, 20 to 55km, 55 to 80km, 80 to 103 km)

Create WBS - decomposition

- How to decompose? (cont'd)

  - Decompose sub-levels base on responsible organization/ stakeholder (usually used by main contractors)

    - Example 1: Fabrication (fabricator 1, fabricator 2, fabricator 3)

    - Example 2: Side walk repair (contractor 1 side walk repair, contractor 2 side walk repair)

  - Decompose sub-levels base on implementation method (usually at the lowest levels

    - Example 1: Steel construction (erecting, bolting, welding, Isolation)

    - Example 2: Steel fabrication (cutting, fitting, welding, painting)

- Be consistent in your method when decomposing from one level to a lower level:

  - Wrong example: Design (North tunnel design, South tunnel geotechnical design, South tunnel structural design, South tunnel electrical design, South tunnel mechanical design)

WBS decomposition

💡 Stop decomposing at a proper(?) level,

- Is a work package with estimated 10,000 man hours of work a suitable task at the lowest level?

- Is a work package with estimated 1 man hours of work a suitable task at the lowest level?

- Is a work package with 200 steps (activities) to be followed a suitable task at the lowest level?

- Is a 1 step (activity) work package a suitable task at the lowest level?

- Decomposing may stop at different levels in different decomposition branches, according to the level of details in different deliverables.

  - Example: if *Design* is outsourced and we stop decomposing at a higher level. Meanwhile if *Construction* is done directly by our workers we need to continue the decomposition to lower levels.

Create WBS - WBS presentation

☐ The WBS can be presented in a number of forms:

WBS in organizational chart format:
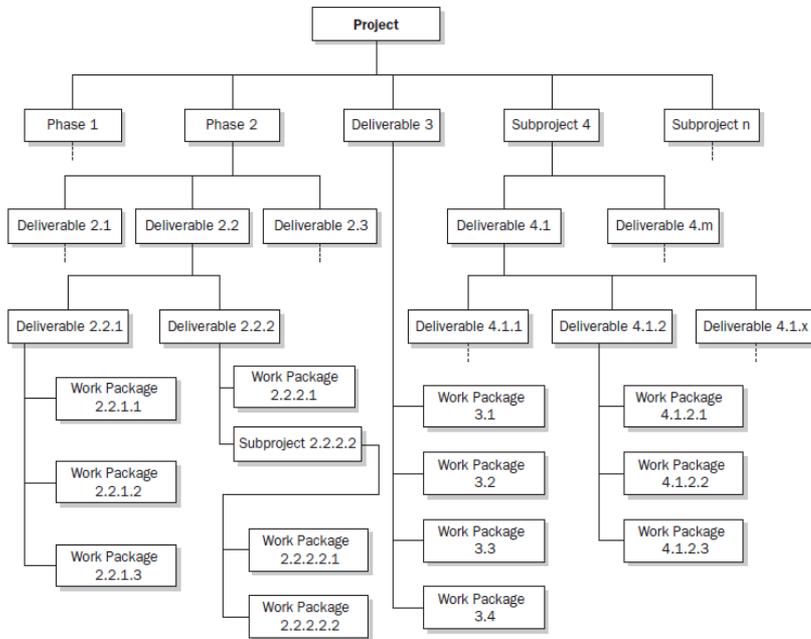
WBS in text format:

1. Develop Project Plan
   - 1.1. Create Work Breakdown Structure
     - 1.1.1. Divide the Project into Major Deliverables
     - 1.1.2. List major activity groups for each deliverable
     - 1.1.3. Breakdown the activity groups into specific tasks
     - 1.1.4. Submit WBS to Project Sponsor
     - **1.1.5. WBS approved and finalized**
   - 1.2. Develop Network Diagram
     - 1.2.1. Organize WBS into a Logical Sequence
       - 1.2.1.1. Show all Work Packages (Deliverables)
       - 1.2.1.2. Establish dependencies (Predecessors & Successors)
       - 1.2.1.3. Identify Major Milestones
       - 1.2.1.4. Diagram tasks and milestones (Start-to-Finish Relationships)
     - **1.2.2. Complete Network Diagram**
   - 1.3. Determine Resource Requirements
     - 1.3.1. Develop Responsibility Assignment Matrix (RAM)
       - 1.3.1.1. Show major project Activities
       - 1.3.1.2. Show Project Team Members & Key Stakeholders
       - 1.3.1.3. Determine level of participation by resource
       - 1.3.1.4. RAM delivery to Project Sponsor
     - **1.3.2. RAM approved and finalized**
   - 1.4. Develop Project Budget
     - 1.4.1. Develop Resource-Loaded Schedule for each Work Package
     - 1.4.2. Bottom-Up Estimate for each Work Package
     - 1.4.3. List Assumptions for each estimate
     - 1.4.4. Include indirect costs
     - 1.4.5. Summarize Budget
     - 1.4.6. Submit to Project Sponsor
     - **1.4.7. Finalize Budget as "Cost Baseline"**
   - 1.5. Provide Project Organization
   - 1.6. Specify the Change Control Methodology
   - 1.7. Define Project Constraints, Assumptions and Risks
   - 1.8. Create a Communications Plan
   - 1.9. Provide a Quality Management Plan
   - 1.10. Develop a Procurement Plan
   - **1.11. Complete Project Plan**

WBS in table format:

		Task Name	WBS
0		⊟ **Marketing Event Planning**	**0**
1	📝	⊟ **Marketing Event Planning a**	**1**
2		⊟ **Define and Plan the Ever**	**1.1**
3		Choose the type of ever	1.1.1
4		Identify the target audie	1.1.2
5		Determine demand gene	1.1.3
6		Determine event objectiv	1.1.4
7		State the overall event t	1.1.5
8		Establish preliminary ev	1.1.6
9		Identify the event team	1.1.7
10		Develop event schedule	1.1.8
11		Determine communicatio	1.1.9
12		Create feedback mecha	1.1.10
13		Determine event budget	1.1.11
14		Event Plan Complete	1.1.12
15		⊟ **Select Speakers**	**1.2**
16		Select presentation topi	1.2.1
17		Identify speakers	1.2.2
18		Obtain speaker informat	1.2.3

Create WBS - example

☐ **Example 1**: WBS of a one storey residential building (work package level)

      1- Design phase

      2- Implementation phase

- At the first level we break the work down base on main phases

-Can we assign each item to a working group and consider it as a work package?

Create WBS - example

□ **Example 1**: WBS of a one storey residential building (work package level)

    1- Design phase

      1-1- Architectural design

      1-2- Structural design

      1-3- Mechanical design

      1-4- Electrical Design

    2- Implementation phase

      2-1- Earth moving

      2-2- Foundation

      2-3- Structure

      2-4- Interior building

      2-5- Mechanical utility building

      2-6- Electrical utility building

      2-7- Exterior building

-We decompose the *Design phase* at the next level base on different disciplines

-We decompose the *Implementation phase* at the next level base on implementation method/ stages

- Is each item assignable to a working group?

Create WBS - example

□ **Example 1**: WBS of a one storey residential building (work package level)

    2- Implementation phase

      ...

      2-4- Interior building

          2-4-1- Building walls

          2-4-2- Building windows

          2-4-3- Building Isolation

          2-4-4- Roof finishing

          2-4-5- Ceiling finishing

          2-4-6- Wall finishing

          2-4-7- Floor finishing

          2-4-8- Bathroom finishing

          2-4-9- Kitchen finishing

      ...

-We decompose the *interior building* at the next level base on different disciplines

- Is each item assignable to a working group?

Create WBS - example

☐ **Example 2**: WBS of a 120km of highway construction

   1- Feasibility studies

   2- Topography studies

   3- Geotechnical studies

   4- Road design

   5- Road construction

- At the first level we break the work down base on main deliverables

-Can we assign *Feasibility studies* to a feasibility study team*?*

-What about Topography studies, Geotechnical studies, Road design and Road construction!

Create WBS - example

□ **Example 2**: WBS of a 120km of highway construction

  1- Feasibility studies

  2- Topography studies

  3- Geotechnical studies

  4- Road design

    4-1- Designing road map

    4-2- Designing traffic aspects of the road

    4-3- Designing road structure

    4-3- Designing utilities (light, phone, drainage, rest area)

    4-4- Designing auxiliary facilities (gas station, restaurants and stores, road service stations)

  5- Road construction

-We decompose the *Road design* at the next level base on different design disciplines

-Can we assign each design item to a working group?

Create WBS - example

☐ **Example 2**: WBS of a 120km of highway construction

...

5- Road construction

    5-1- Constructing bridges on the road

    5-2- Constructing road

    5-3- Constructing utilities

    5-4- Constructing auxiliary facilities

-We decompose the *Road construction base on different disciplines*

-Can we assign each construction item to a working group and consider it as a work package?

Create WBS - example

☐ **Example 2**: WBS of a 120km of highway construction

...

5- Road construction

    5-1- Constructing bridges on the road

        5-1-1- Constructing bridge 1

        5-1-2- Constructing bridge 2

        5-1-2- Constructing bridge 3

        5-1-2- Constructing bridge 4

    5-2- Constructing road

        5-2-1- Constructing road 0-30

        5-2-2- Constructing road 30-55

        5-2-3- Constructing road 55-85

        5-2-4- Constructing road 85-120

...

-We decompose the *constructing bridges on the road* base on geographical location

-We decompose the *constructing road* base on geographical location

Create WBS - example

☐ **Example 2**: WBS of a 120km of highway construction

...

5-3- Constructing utilities

5-3-1- Construction road light

5-3-2- Construction road drainage

5-3-3- Construction road phones

5-3-4- Constructing rest areas

5-4- Constructing auxiliary facilities

5-4-1- Constructing gas stations

5-4-2- Constructing restaurants and stores

5-4-3- Constructing road service

-We decompose the *Constructing utilities and Constructing auxiliary facilities base on different disciplines*

-Can we assign each item to a working group and consider it as a work package?

Create WBS - rules

- **100% rule:** The 100% rule states that the WBS includes 100% of the work defined by the project scope (indicated in the scope statement) and captures all deliverables in terms of the work to be completed, including project management.

- **Mutually exclusive**: There should be no overlap in scope definition between two elements of a WBS.

  - **Example:** Following elements require clarification in scope definition

1.2.1.Land leveling
1.2.2. Yard preparation

4.1. 1. Preparing project financial report on monthly basis
4.1.2. Report on the project performance on monthly basis

3.4.1. Laying bricks
…
3.4.5. Building exterior wall

Create WBS - rules

- **Rolling wave plan:** Decomposition may not be possible for a deliverable or subproject that will be accomplished far into the future. The project management team usually waits until the deliverable or subproject is clarified so the details of the WBS can be developed.

  - Example: Decomposition of yard landscape element in the WBS can be postponed to the later stages of the project when the building is almost finished and you get more sense on what will be implemented!

Create WBS– In class exercise

Decompose a typical recreational park building (with the area of 20,000 m2) project in three levels (three times decomposition).

Create WBS – In class exercise

Decompose a typical recreational park building (with the area of 20,000 m2) project in three levels (three times decomposition).

1. **Conceptual design**

2. **Detail design**

2.1. Topography studies

2.2. Landscape design

2.3. Building design

      2.3.1. Main theater and park office building design

      2.3.2. Park meditation and rest room building design

      2.3.3. Park restaurant building design

2.4. Utility design

      2.4.1. Park utility design

      2.4.2. Main theater and park office building utility design

      2.4.3. Park meditation and rest room building utility design

      2.4.4. Park restaurant building utility design

2.5. Playground design

Create WBS – In class exercise

Decompose a typical recreational park building (with the area of 20,000 m2) project in three levels (three times decomposition).

3. Construction

3.1. Land preparation

3.2. Landscape and garden construction

    3.2.1. Garden construction

    3.2.2. Water fountain construction

    3.2.3. Walking trail construction

    3.2.4. Park utility construction

3.3. Building construction

    3.3.1. Main theater and park office construction

    3.3.2. Park meditation and rest room construction

    3.3.3. Park restaurant construction

3.4. Playground construction

Create WBS - WBS dictionary

□ The WBS dictionary is a document generated for supporting the WBS and provides more detailed descriptions of the components in the WBS such as:

- Code of WBS identifier
- Description of work
- Responsible organization
- List of schedule milestones
- Associated schedule activities

- Resources required
- Cost estimates
- Quality requirements
- Acceptance criteria
- Risk factor

- Contract information
- Technical references

WBS Dictionary

WBS #	WBS Task	Deliverable	Owner	Duration	Budget	Risk Factor
2	Phase 2	Phase 2 Report	Chandler	5 months	$900,000	See Risk Plan
2.1	Design Development	Design Release	Monica	5 months	$685,000	Resources
2.1.1	Build Prototypes	Prototypes	Ross	3 months	$81,000	Design Change
2.1.1.1	Build Prototype #1	Prototype #1	Joey	8 days	$12,500	

Create WBS – using M.S. Project

M.S. Project working environment

Gantt Chart is the default view of MSP

Enter/ view task (phase, work package, activity, etc) information

View/adjust project Gantt chart

Create WBS – using M.S. Project

All views are available through more views!
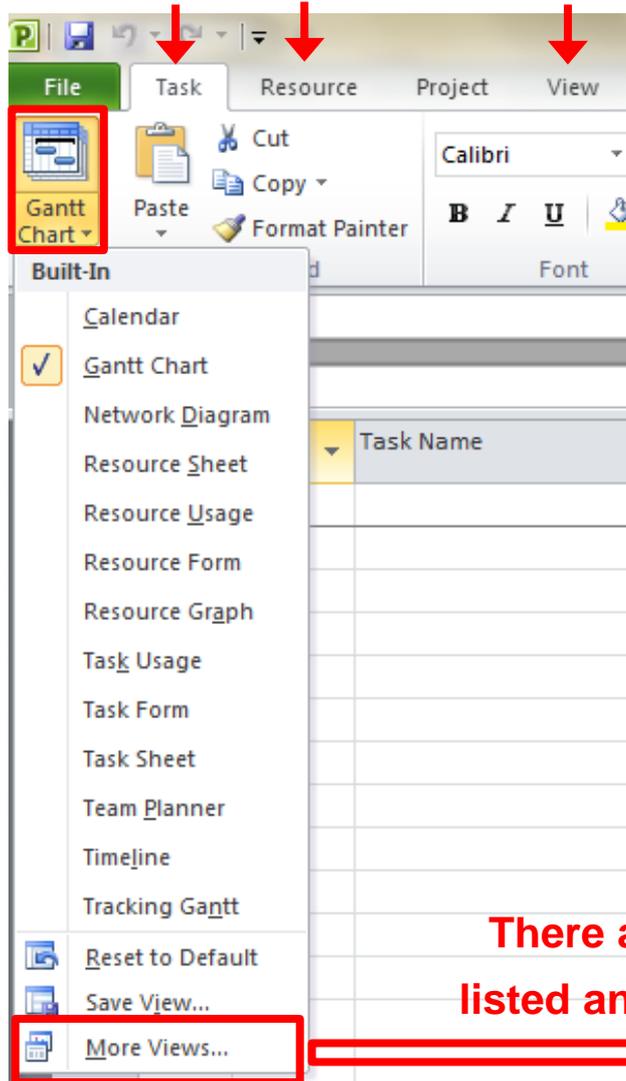
There are different views for different project planning purposes available!

There are more views than listed and can be accessed ...

Create WBS – using M.S. Project

Defining WBS

☐ You can start directly writing tasks in the Task column of Gantt chart view Or

☐ Copy and paste previously prepared list of tasks (in MS. Excel sheet in our case *1-WBS-RawData.xlsx* file or MS. Word tables) in the task column of the of the Gantt chart view!

Task Name ▾
Three-story Office Building (76,000 square feet)
General Conditions
Receive notice to proceed and sign contract
Submit bond and insurance documents
Prepare and submit project schedule
Prepare and submit schedule of values
Obtain building permits
Submit preliminary shop drawings
Submit monthly requests for payment
Long Lead Procurement
Submit shop drawings and order long lead items – steel

Create WBS – using M.S. Project

□ Start defining task levels by indent tool in MSP!

Selected tasks
Main Title

Select all tasks you want to put under a main task title

	Task Name
1	**Three-story Office Building (76,000 square feet)**
2	**General Conditions**
3	Receive notice to proceed and sign contract
4	Submit bond and insurance documents
5	Prepare and submit project schedule
6	Prepare and submit schedule of values
7	Obtain building permits
8	Submit preliminary shop drawings
9	Submit monthly requests
10	**Long Lead Procurement**
11	Submit shop drawings a...

...

□ Continue Indenting until your WBS is complete!

□ Use Outdenting in case you made mistake and want to reverse indenting!

Outdent is for increasing WBS level

Indent is for decreasing WBS level

Indent Task (Alt+Shift+Right)

Indent the selected tasks one level at a time.

When you indent a task, it becomes a subtask of the nearest preceding task at a higher level in the task list.
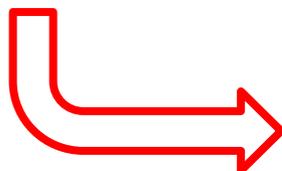
Create WBS – using M.S. Project

Hands on MSP!

Home assignment – scope planning

Use the project charter you prepared for your M.Sc. Project, to prepare:

- Requirement management plan (mark: 20%)
- Requirement traceability matrix (mark: 20%)
- Scope statement (mark: 40%)
- WBS using M.S. Project (mark: 20%)
- WBS dictionary (optional mark: 20%)

- **Due two weeks-before class**

Reference

- PMI (2013) "A Guide to the Project Management Body of Knowledge" Project Management Institute, Inc: Pennsylvania 19073-3299 USA, Chapter 5.

Thank you!