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PMG 506 Advanced Project Management

LECTURE 9

Budgeting, Estimating times and costs

PMG506

ADVANCED PROJECT MANAGEMENT (APM)



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Introduction:

Lecture 1 Introduction to APM and Initial Project Strategy

Lecture 2 Project Quality Management

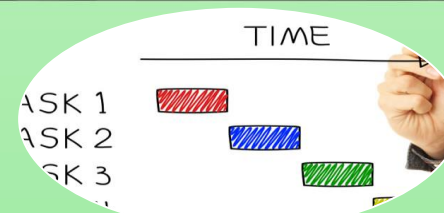


Project Initiation:

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 times and costs



Project **Integration**

Lecture 10 Monitoring and **Controlling**

Lecture 11 **PMOs and OPM**

Lecture 12 **Social and Professional Responsibility**

Lecture 13 **Open Discussion**

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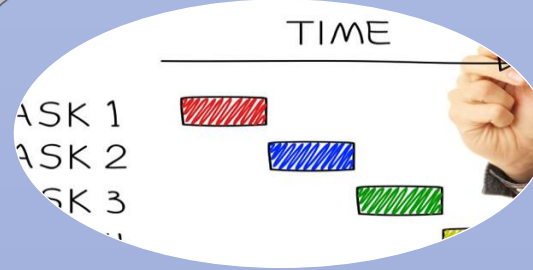


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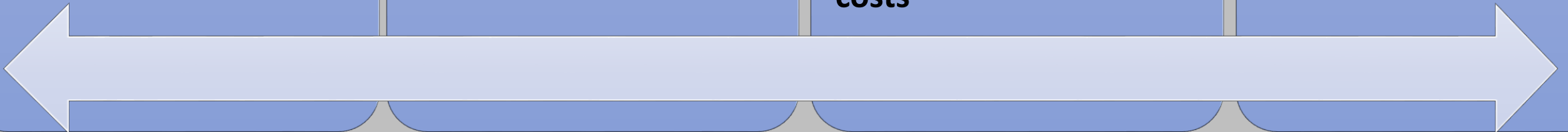
Project Execution

Lecture 10 Monitoring and information systems

Lecture 11 Project Control

Lecture 12 Project Auditing

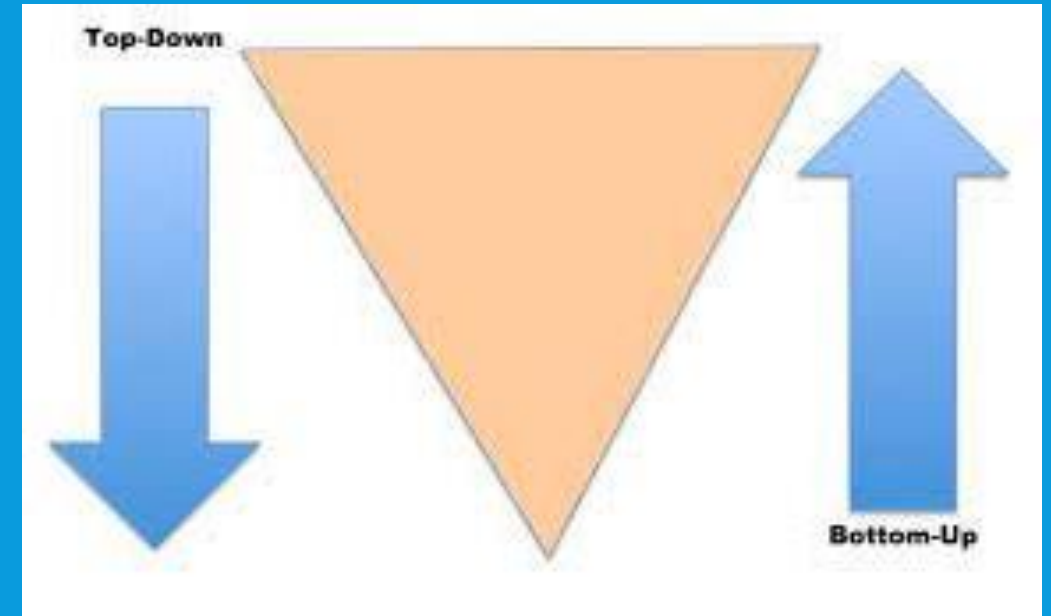
Lecture 13 Project termination



LEARNING OUTCOMES

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

- Understand estimating project times and costs are the foundation for project planning and control.
- Describe guidelines for estimating time, costs, and resources.
- Describe the methods, uses, and advantages and disadvantages of top-down and bottom-up estimating methods.
- Distinguish different kinds of costs associated with a project.



OVERVIEW

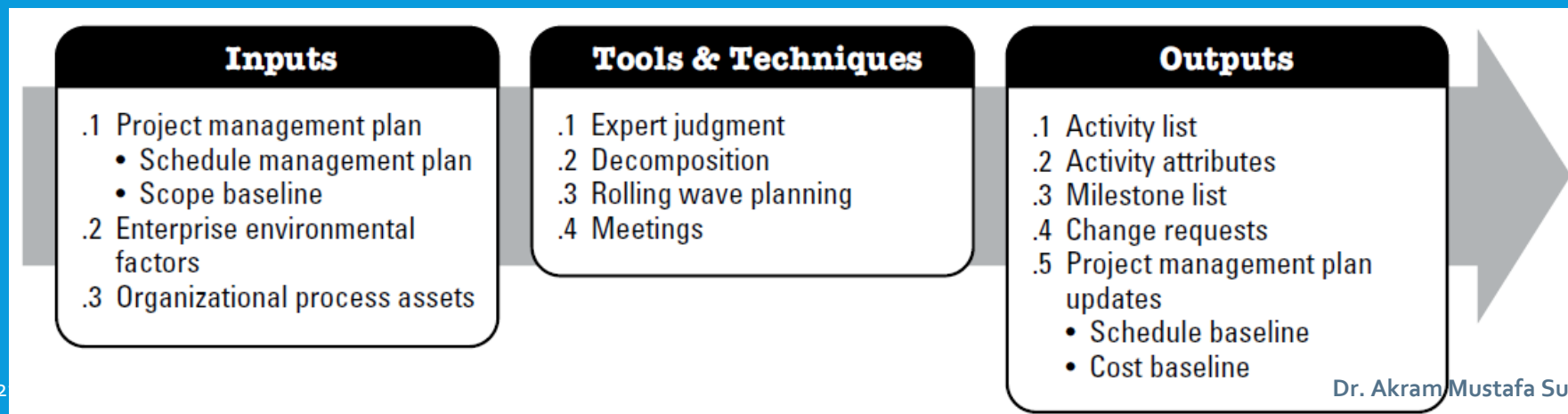


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ID	Process	Definition	Process Group
6.1	Plan Schedule Management	The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.	P
6.2	Define Activities	The process of identifying and documenting the specific actions to be performed to produce the project deliverables.	P
6.3	Sequence Activities	The process of identifying and documenting relationships among the project activities.	p
6.4	Estimate Activity Durations	The process of estimating the number of work periods needed to complete individual activities with estimated resources.	P
6.5	Develop Schedule	The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution, monitoring and controlling.	P
6.6	Control Schedule	The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline.	M&C

DEFINE ACTIVITIES

- The process of identifying and documenting the **specific actions** to be performed to produce the project deliverables.
- The key benefit of this process is that it decomposes work packages into schedule activities that provide a **basis** for estimating, scheduling, executing, monitoring, and controlling the project work.



THE WORK BREAKDOWN STRUCTURE (WBS) [1/2]

- ❑ WBS is the top level plan, out of which other plans cascade.
- ❑ It summarizes in a hierarchy all the project's
 - Sub-projects
 - Tasks
- ❑ The WBS
 - Allows breaking out sub-projects
 - Helps visualize sequence of performance
 - Allows break out of “work packages”.

THE WORK BREAKDOWN STRUCTURE (WBS) [2/2]

□ **Work packages** are the logical building blocks of activities and are used for

- Estimating work
- Scheduling work
- Assigning work
- Controlling work

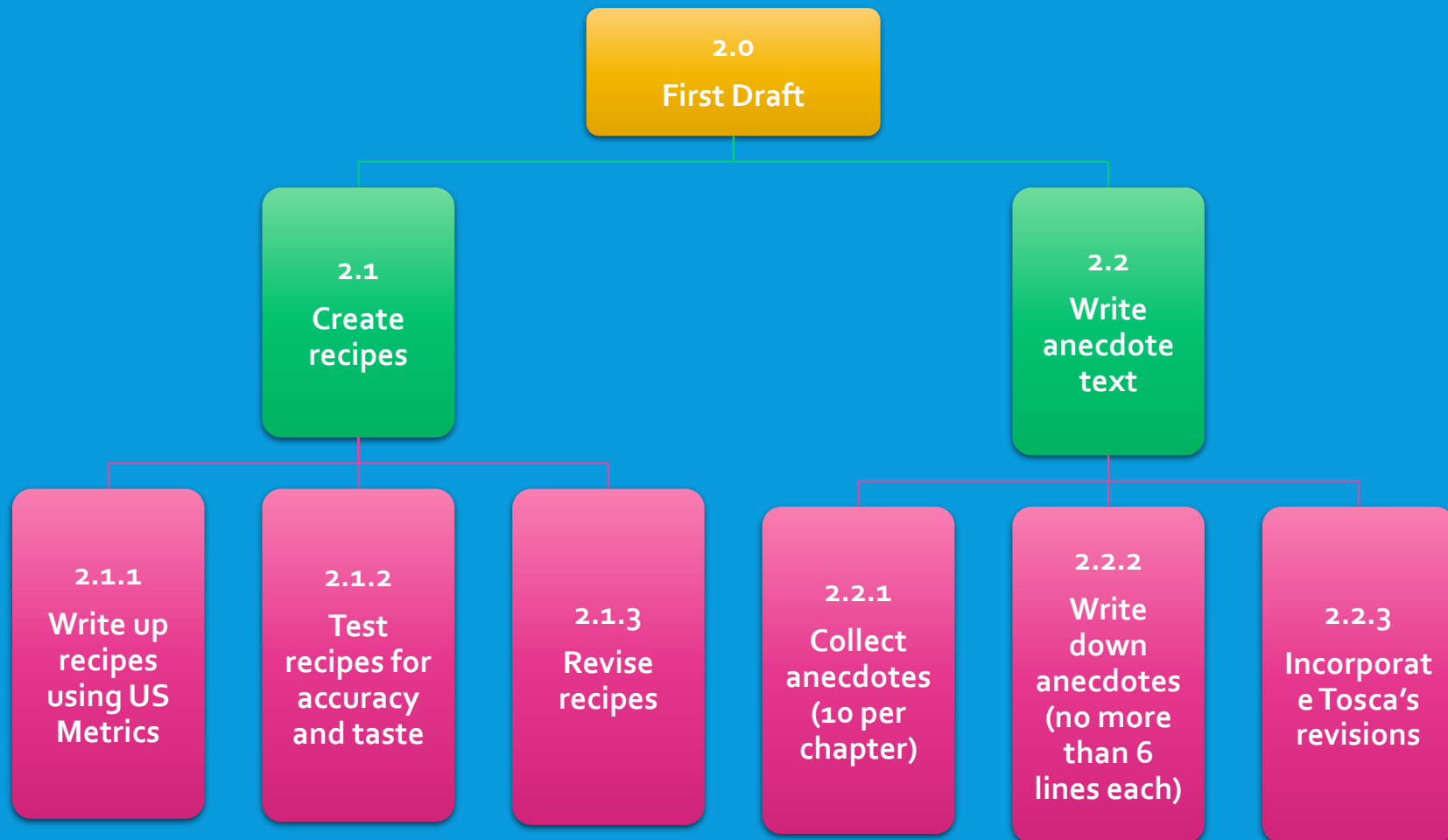
ELEMENTS AND LEVEL OF WBS

- ☐ WBS need to include
 - Project Objective or Goal
- ☐ Major Sub-projects
 - Summary tasks for each milestone
 - Detailed tasks/ work packages (measureable)

WBS HIERARCHY



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WBS RULES OF THUMB

- ☐ A summary task must be broken down to a maximum of 8 work packages.
- ☐ Work packages of less than $\frac{1}{2}$ a man-day can be consolidated with higher level tasks
- ☐ The 8/80 rule: If a task is shorter than 8 hours or longer than 80 hours, it needs to be adjusted.
- ☐ Final rule: If breaking these rules of thumb makes it easier to plan or do the project, then disregard the rule.

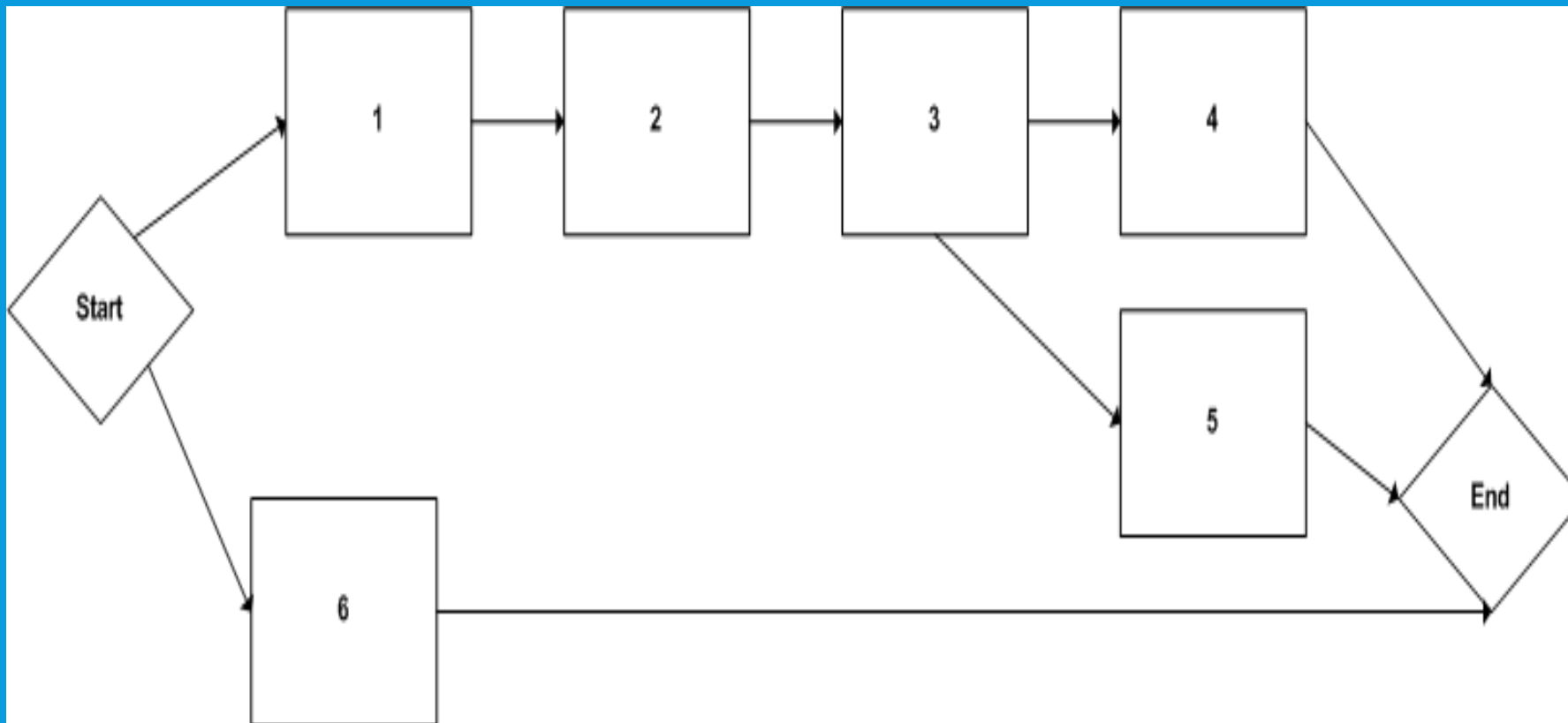
WORK PACKAGE SEQUENCING

• Dependency Table

ID	Task	Predecessors	Resources Needed
1	Write recipes		Tosca, Writer
2	Test recipes	1	Chef, Asst. Chef, Tosca
3	Revise recipes	2	Tosca, Writer, Chef, Asst. Chef
4	Lay out pages	3	Graphic artist
5	Take photos	3	Photographer, Food Stylist
6	Write introduction		Writer

THE NETWORK LOGIC DIAGRAM

- Precedence Diagramming Method (PDM)



REVIEW

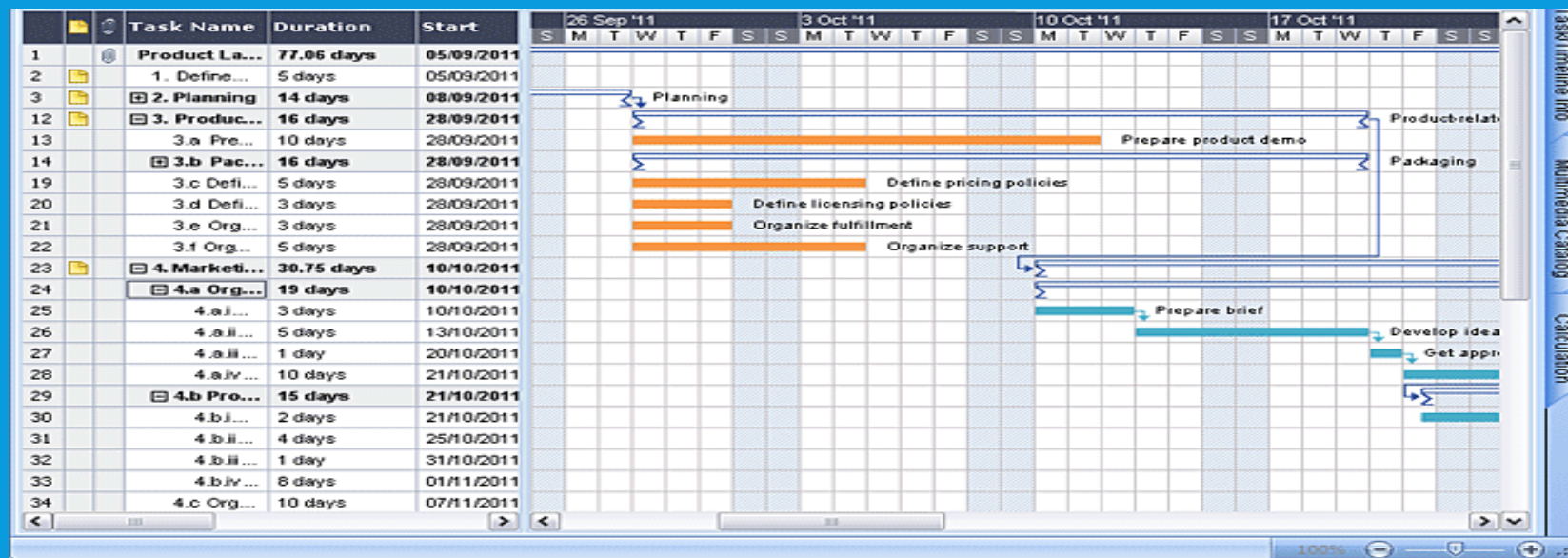
- Arrange these elements of a WBS into hierarchical order
 - Summary Tasks
 - Sub Project
 - Work Packages
 - Project Objective
- Sequencing in which a task must be completed before the next task can begin is called
 - a) Start to Finish
 - b) Start to Start
 - c) Finish to Finish
 - d) Finish to Start
- Which tool lists summary activities, and then breaks them down into detailed activities or work packages?
- Which tool helps you visualize the dependency relationships among work packages?

THE SCHEDULING PROCESS

- Estimating duration and effort for each work package.
- Calculating the critical path, or set of activities which cannot be delayed, in order to accomplish project work on time.
- Calculating activities which have float, or additional time, during which resources can be assigned to help accomplish Critical Path activities.

6B FROM DURATION TO SCHEDULE

- After calculating the Critical Path, use the network logic diagram and calculations and project them onto a calendar.
- A Gant Chart is the best way to display the schedule information.



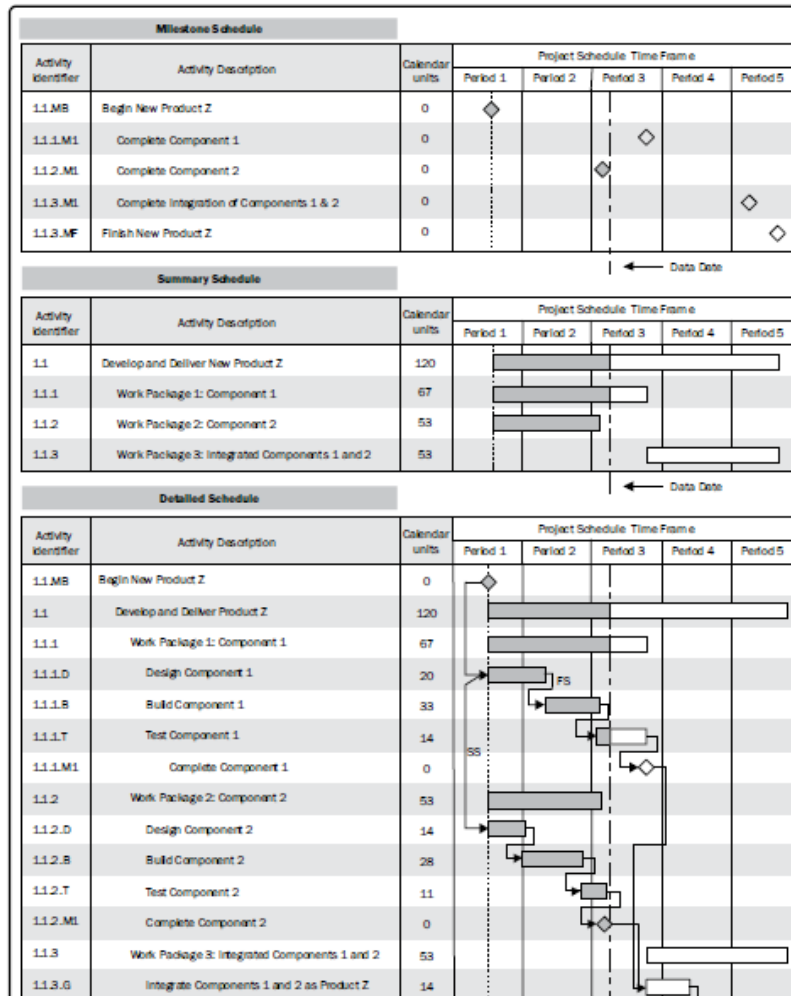
WORK PACKAGE SEQUENCING

- Mandatory Dependency
- Discretionary Dependency
- External Dependency

REVIEW



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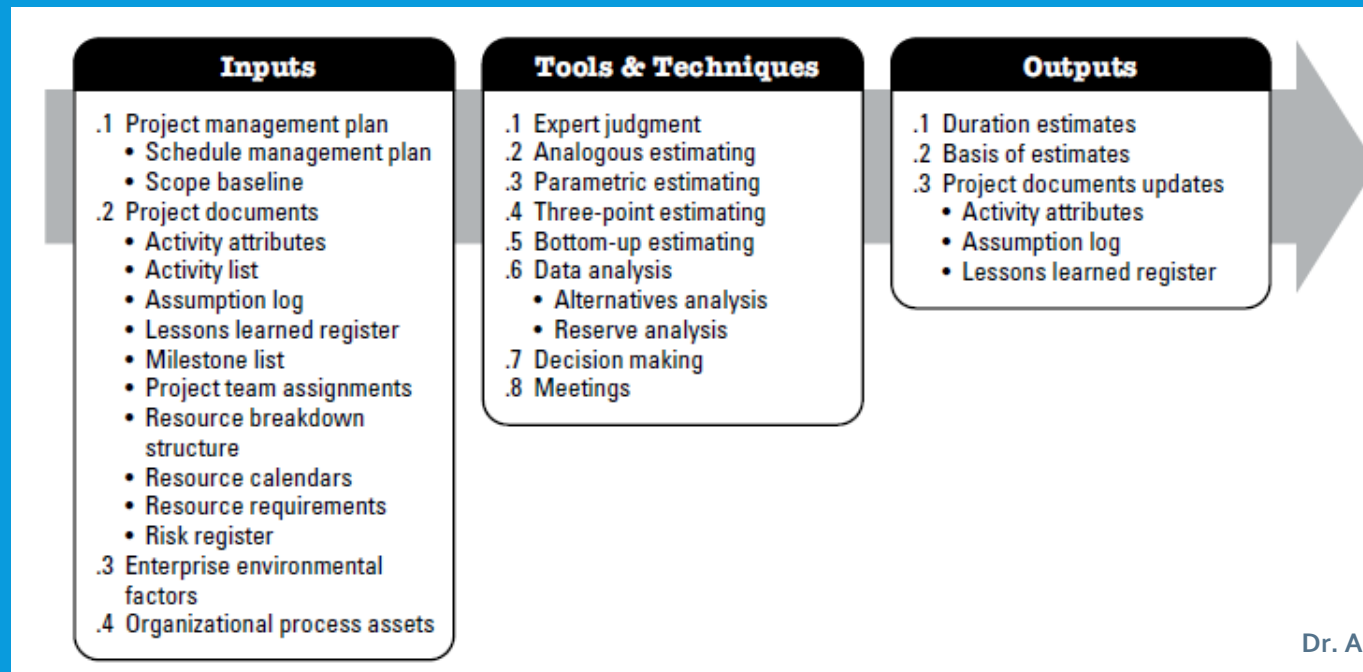
Milestone charts

Bar Charts

Network Diagram

ESTIMATE ACTIVITY DURATIONS

- The process of estimating the **number of work periods** needed to complete individual activities with estimated resources.
- The key benefit of this process is that it provides the **amount of time** each activity will take to complete.



ESTIMATE ACTIVITY DURATIONS

- **Tools and Techniques**

- **Expert judgment:** expertise in schedule development – estimating or discipline knowledge (SMEs)
- **Analogous estimating:** uses parameters from previous similar projects to estimate the same parameter (duration) for a future project
 - *A gross value estimating (adjusted for known differences)*
 - *Less costly and time consuming – less accurate (limited amount of details)*
- **Parametric estimating:** uses algorithm (statistical relationships) to calculate durations based on historical data
 - *Duration may be obtained by dividing the quantity of work by the crew production rate*

ESTIMATE ACTIVITY DURATIONS

- **Tools and Techniques**

- **Three- Point estimating (PERT):** improving a single estimate by considering uncertainty and risk

- **Optimistic (T_o):** *best case scenario*
 - **Most likely (T_m):** *probable scenario*
 - **Pessimistic (T_p):** *worst case scenario*

$$t_E = \frac{t_O + 4t_M + t_P}{6}$$

- **Bottom-Up estimating:** estimating duration by aggregating the estimates of the lower level components of WBS
 - monitor dependencies and overlap!!

ESTIMATE ACTIVITY DURATIONS

- **Tools and Techniques**

- Data analysis

- **Alternative analysis:** comparing various options of resource skills, scheduling methods, tools and make-or- buy decisions

- **Reserve analysis:** determining the amount of contingency or management reserve needed to account for schedule uncertainty

- **Decision making:** PM asks the team to show their level of support to estimates (e.g. 1→5)

- **Meetings:** to discuss assumptions, concerns, risk, dependencies, decisions and actions that may affect duration estimates

ESTIMATE ACTIVITY DURATIONS

- **Outputs**
 - **Duration estimates:** quantitative assessments of the likely number of time periods that are required to complete an activity, a phase or a project
 - single estimate or range (3 weeks $\pm$ 2days)
 - **Basis of estimates:** additional details supporting the duration estimate (basis of estimates – assumptions - risks –confidence level)
 - **Project documents updates:** activity attributes – assumption log – lessons learned

TYPES OF COST ESTIMATES



Type/ Level	Description	Accuracy
Rough Order of Magnitude (ROM) or Order of Magnitude	Generally made early in the project. Developed without benefit of detailed data and often based on historical data, expert judgment, or a costing model.	-25% : +75%
Budgetary	Often used for appropriation purposes	-10% : 25%
Range of Estimate	Often used as an alternative to ROM where the accuracy of the estimate is not well known.	+/- 35%
Approximate Estimate	Based on more information than ROM estimates, but still lack the detail required for high accuracy. May be possible if the project is similar to previous ones with reliable historical data for costing or where a proven costing model is applicable	+/- 15%
Definitive Estimate (Control or Detailed Estimate)	Based of detailed information about the project work. Developed by estimating the cost for each work package in the WBS	-5%
Phased Estimate (Rolling Wave or Moving Wave Estimate)	Allows the use of ROM or approximate estimates for some later parts of the work. While work that must be done earlier in the project life cycle is estimated at the definitive level.	+/- 5% : +/- 15% in the window closest to present time, +/- 35% farther in the future

TIME ESTIMATES

Term	Definition
Task Time	The amount of labor or resource time it will take to do the activities in the task. Sometimes referred to as “work effort” or “billable hours”.
Duration Effort	The total time needed to complete the task, including waiting times. Sometimes referred to as “elapsed time”.

ANALOGOUS ESTIMATING

Advantages of Analogous Estimating	Disadvantages of Analogous Estimating
Quick	Less accurate
Activities need not be identified	Estimates are prepared with a limited amount of detailed information and understanding of the project
Less costly to create	Requires considerable experience to do well
Cost constraints created by management in project initiating give the project manager data to evaluate high-level project feasibility	There may be infighting to gain the biggest piece of the budget without being able to justify the need.
Overall project costs will be capped (for a project analogous estimate)	Extremely difficult for project with uncertainty
	Does not take into account the difference between projects

BOTTOM-UP ESTIMATING

Advantages of Bottom-up Estimating	Disadvantages of Bottom-up Estimating
More accurate	Takes time and expense to use this estimating technique
Gains buy-in from the team because the team creates estimates they can live with	Tendency for the team to pad estimates unless they understand the use of reserves
Based on a detailed analysis of the project	Requires that the project be defined and well understood before estimating begins
Provides a basis for monitoring and controlling, performance measurement, and management	Requires time to break the project down into smaller pieces

Top-Down Estimates

Intended Use

Feasibility/conceptual phase
Rough time/cost estimate
Fund requirements
Resource capacity planning

Preparation Cost

1/10 to 3/10
of a percent
of total project cost

Accuracy

Minus 20%,
to plus 60%

Method

Consensus
Ratio
Apportion
Function point
Learning curves

Bottom-Up Estimates

Intended Use

Budgeting
Scheduling
Resource requirements
Fund timing

Preparation Cost

3/10 of a percent
to 1.0 percent
of total project cost

Accuracy

Minus 10%,
to plus 30%

Method

Template
Parametric
WBS packages
Range estimates

WHAT IS PROJECT BUDGET?

- ❑ A plan for how you will spend money on each work package in a project.
 - It estimates how much and when needed.
 - It includes “contingency” or “management reserve” to cover unexpected expenses

FROM COST ESTIMATES TO BUDGET

[1/2]

Cost Element	Description	Formula
Labor	The cost of the people working on the project. Include expected overtime. May include overhead and fringe benefits, depending on the organization. Both formulae are shown at right	• (Regular hours X hourly rate) + (Overtime hours X overtime rate) • (Regular hours X hourly rate) + (Overtime hours X overtime rate) + (pro-rated overhead and fringe benefits)
Equipment	The purchase, lease or rental price and cost of usage	• Purchase price • Lease or rental price X time period

FROM COST ESTIMATES TO BUDGET

[2/2]

Cost Element	Description	Formula
Facilities	The cost of space to house your team, provide electric and phone service, etc.	• Rental costs X time period • Organizational burden rate X time period
Supplies	The consumables your team will use during the project	• Estimated volume X (Cost + inflation adjustment)
Special Expenses	Specialized services, miscellaneous items, etc.	Estimated cost of service or item

WORK PACKAGE ESTIMATION TABLE



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ID #	Task Description	Duration (Days)	Task Time	Predessors	Resources

CREATING A PRELIMINARY BUDGET 1/3

- Converting Task Time Data to Cost Estimates
 1. Review the two tables below. Follow the flow of data from one table to the next

ID	Task	Dur Time	Task Time	Predecessors	Resources
2	Test recipes	10 wks	10 wks		• Chef (10 wks, 50 hrs/ week) • Asst. Chef (10 wks, 50 hrs/ week) • Tosca (10 days)
3	Photograph recipes	2 wks	1 wk		• Photographer (5 days, 8 hrs/ day) • Food stylist (10 day contract)

CREATING A PRELIMINARY BUDGET 2/3

ID	Resource	Total Hrs	OT Hrs	Reg Rate	OT Rate	Total Cost
2	Asst. Chef	400	100			
3	Photographer	40	0			

2. In the Test Recipes work package, you expect to need an assistant chef for 10 weeks. You expect that the assistant chef will work 10 hours a day, from Monday to Friday. An assistant chef's hourly rate is \$20/hr for an 8 hour day. Standard Publishing's overtime rate is time-and-a-half. Calculate the total labor cost estimate for the assistant chef's work in this work package.

CREATING A PRELIMINARY BUDGET 3/3

3. In the Photograph Recipes work package, you expect to need a professional photographer on a one-day-a-week basis, from 9 to 5, for 4 weeks. A professional photographer's hourly rate is \$50/hr for an 8 hour day. What is the total labor estimate for the photographer?

BUDGET AND SCHEDULE BALANCING

- Cost and Time tradeoff
 - Will adding overtime hours help? Or are the people stretched too thin already?
 - Will adding additional people help? Or is this task in which adding additional people will complicate things to the point that time is not saved?
 - What other costs am I adding? (for example, if I add an additional assistant chef, do I need additional kitchen facilities or equipment also?)
 - Am I adjusting an activity that is on the Critical Path? If so, can the project survive with a lengthened schedule?
 - Am I adding new costs by revising the schedule? (If I lengthen the schedule will additional equipment rental costs offset my labor cost savings?)
 - Will these changes make it more difficult to meet quality goals?

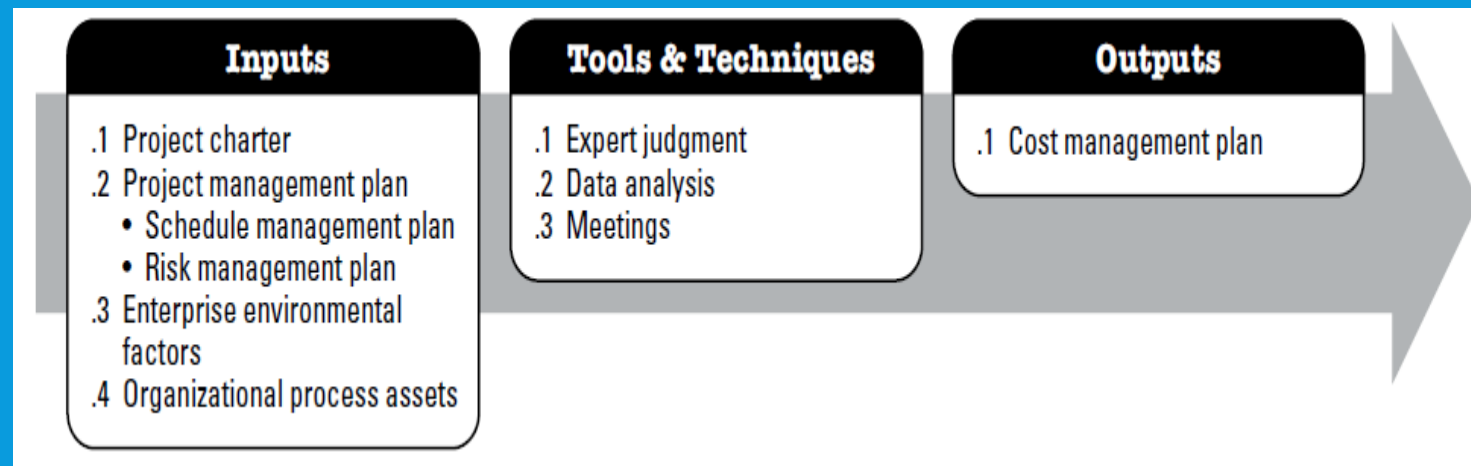
OVERVIEW

- Project cost management includes the processes involved in planning, estimating, budgeting, financing, funding, managing and controlling **costs** so that the project can be completed within the approved **budget**.

ID	Process	Definition	Process Group
7.1	Plan Cost Management	<i>The process of defining how the project costs will be estimated, budgeted, managed, monitored and controlled</i>	P
7.2	Estimate Costs	<i>The process of developing an approximation of the monetary resources needed to complete project work.</i>	P
7.3	Determine Budget	<i>The process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.</i>	P
7.4	Control Costs	<i>The process of monitoring the status of the project to update the project costs and manage changes to the cost baseline.</i>	M&C

PLAN COST MANAGEMENT

- The process of defining how the project **costs** will be estimated, budgeted, managed, monitored, and controlled.
- The key benefit of this process is that it provides guidance and direction on **how** the project costs will be managed throughout the project.

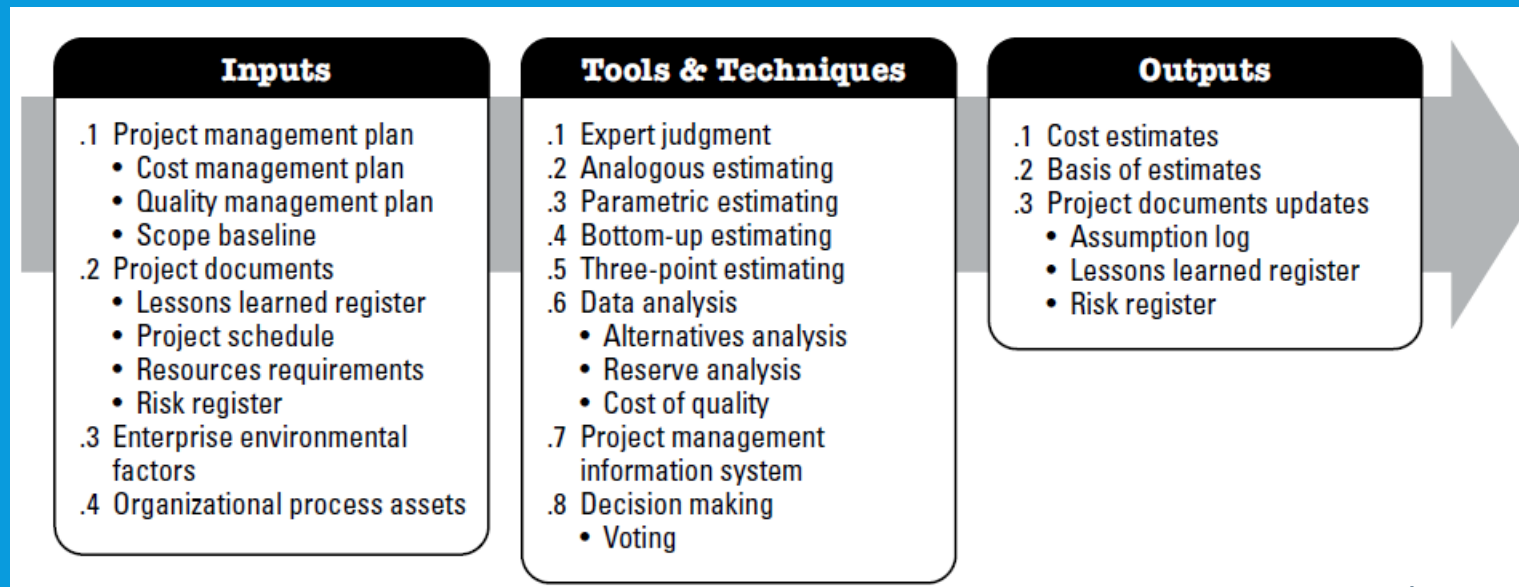


COST CATEGORIES

Type	Description	Example
Fixed Costs	Project costs that remain constant regardless to the phase or output.	Set-up
Variable Costs	Project costs that vary in relation to the output.	Materials, supplies
Direct Costs	Costs that are directly attributable to the work of the project	Training, travel
Indirect Costs	Costs that are directly attributable to more than one project (overhead)	Taxes
Cost reserves	Amount of money needed above the estimate to reduce risk of overruns of project objectives to a level acceptable to the organization	

7.2 ESTIMATE COSTS

- The process of developing an **approximation** of the cost of resources needed to complete project work.
- The key benefit of this process is that it determines the **monetary** resources required for the project.



7.2 ESTIMATE COSTS

- **Tools and Techniques**

- **Expert judgment:** previous similar projects – discipline – cost estimating
- **Analogous estimating:** gross value estimate of project cost based on historical data – less costly and time consuming – less accurate
- **Parametric estimating:** statistical relationship between historical data and cost estimate of project work (square meter in construction)
- **Bottom-up estimating:** the cost of activities or work packages is estimated in detail, then rolled up to higher levels **(WBS !!)**

7.2 ESTIMATE COSTS

- **Tools and Techniques**

- Three- point estimating:
- Data analysis:

$$C_E = \frac{C_O + 4C_M + C_P}{6}$$

- **Alternative analysis:** available cost options (cash vs. credit – make vs. buy)
- **Reserve analysis:** amount of money to account for uncertainty (risks)
- ❖ **Contingency reserves** (known risks) – **Management reserves** (unknown risks)
- **Cost of quality:** cost of conformance – cost of NON conformance
- **Project management information system:** spread sheets - software
- **Decision making:** voting to select cost options – improve accuracy

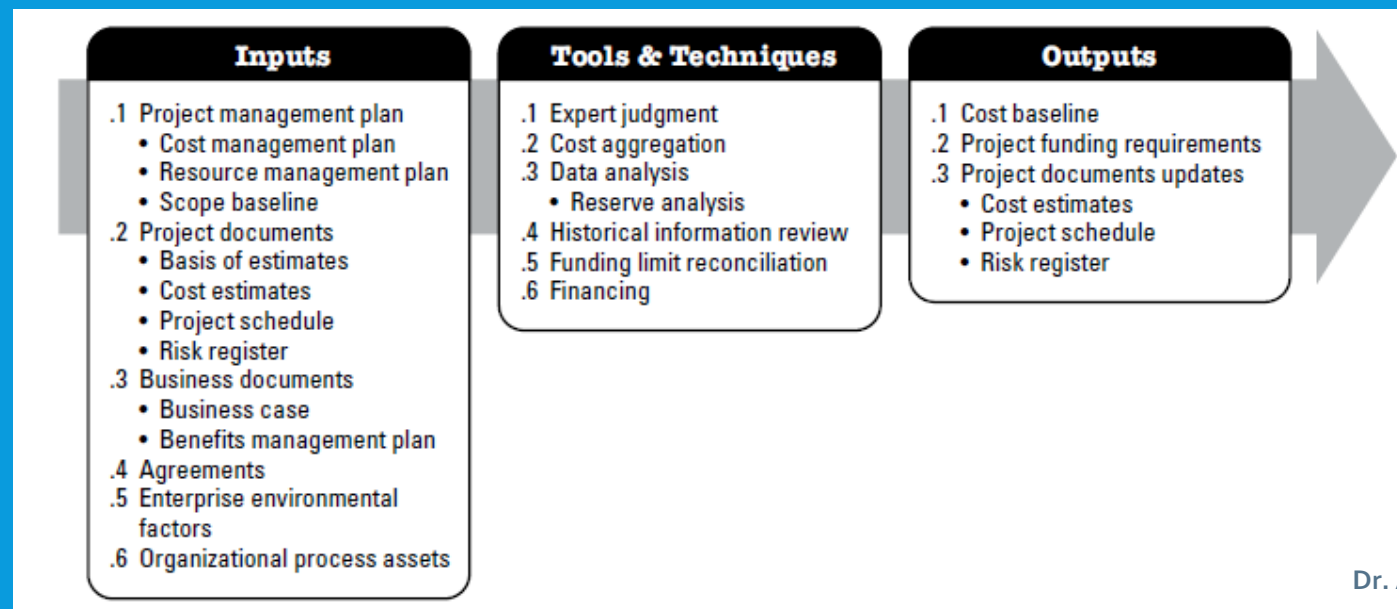
7.2 ESTIMATE COSTS

- **Outputs**

- **Cost estimates:** quantitative assessments of the probable costs required to complete the project work and contingency amounts for identified risks:
 - Labor, material, equipment, services, facilities, IT, funding charges, inflation allowance and reserves
- **Basis of estimates:** additional details supporting cost estimates (calculations, assumptions, constraints, risks and confidence level)
- **Project documents updates:**
 - assumption log (updates) – lessons learned register
 - risk register (risk response costs)

DETERMINE BUDGET

- The process of **aggregating** the estimated costs of individual activities or work packages to establish an authorized **cost baseline**.
- The key benefit of this process is that it determines the cost baseline against which project performance can be monitored and controlled.



DETERMINE BUDGET

- **Tools and Techniques**

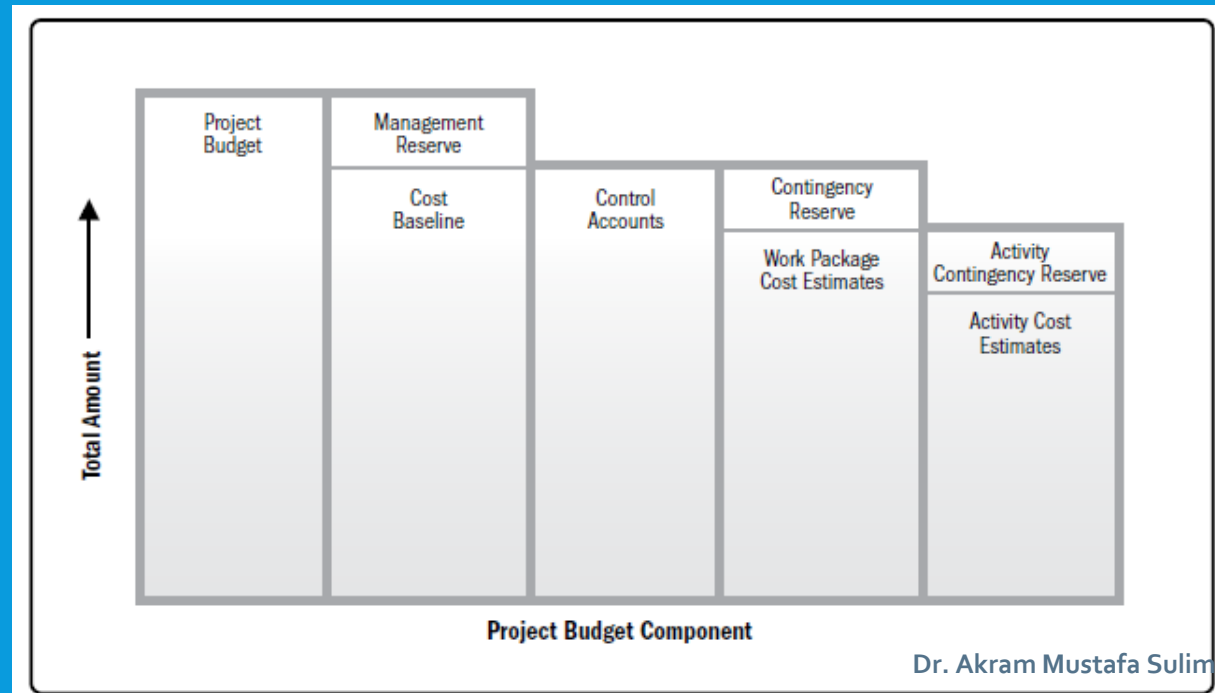
- **Expert judgment:** previous similar projects – financial principles - funding
- **Cost aggregation:** cost estimates are aggregated by work packages in using **WBS**, then for control accounts and ultimately for the entire project.
- **Data analysis:** management reserve analysis
- **Historical information review:** mathematical models to predict total cost
- **Funding limit reconciliation :** expenditure limits (monthly – quarterly)
- **Financing:** acquiring funding for the project

DETERMINE BUDGET

▪ Outputs

- **Cost baseline:** the approved version of the **time-phased project budget**, excluding any management reserves, which can only be **CHANGED** through formal change control procedure. It is used as a basis for comparison to actual results.

Project Budget Components



DETERMINE BUDGET

- **Outputs**

- **Project funding requirements:** projected expenditures + anticipated liabilities
- **Project documents updates:** cost estimates – project schedule – risk register

