

Project Management Professional



PMP PREPARATION COURSE

6TH EDITION

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/PMP TRICKS

A professional man in a dark suit and patterned tie is interacting with a large digital screen displaying a Gantt chart. He is pointing his right index finger towards the chart, which shows various tasks represented by colored bars (blue, green, orange) against a grid background. The chart includes columns labeled Q1, Q2, Q3, and Q4, and rows labeled T1 through T12. A thick yellow diagonal stripe cuts across the slide from the bottom-left to the top-right.

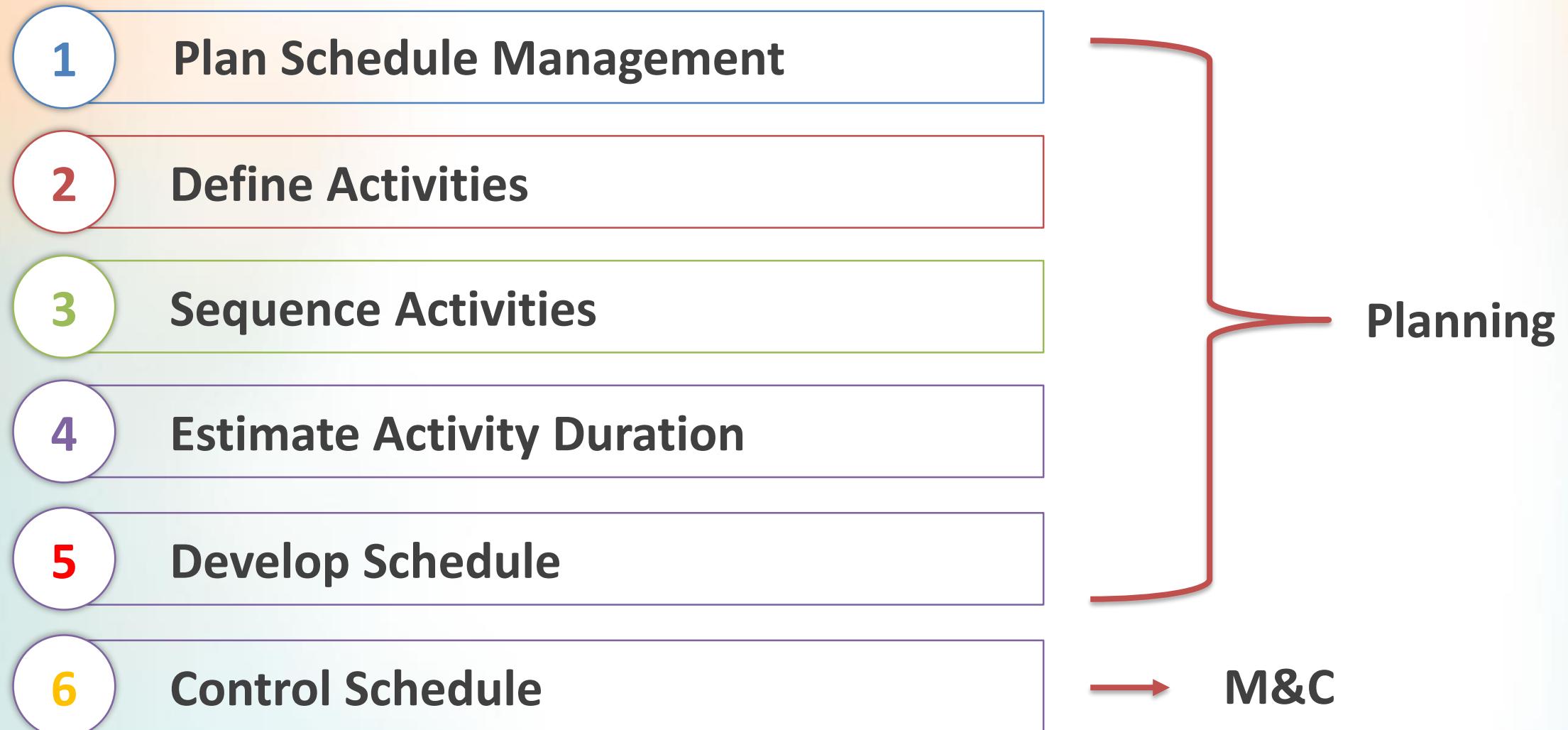
Chapter 6

PROJECT Schedule MANAGEMENT

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Lecture 03 : Project Schedule Management

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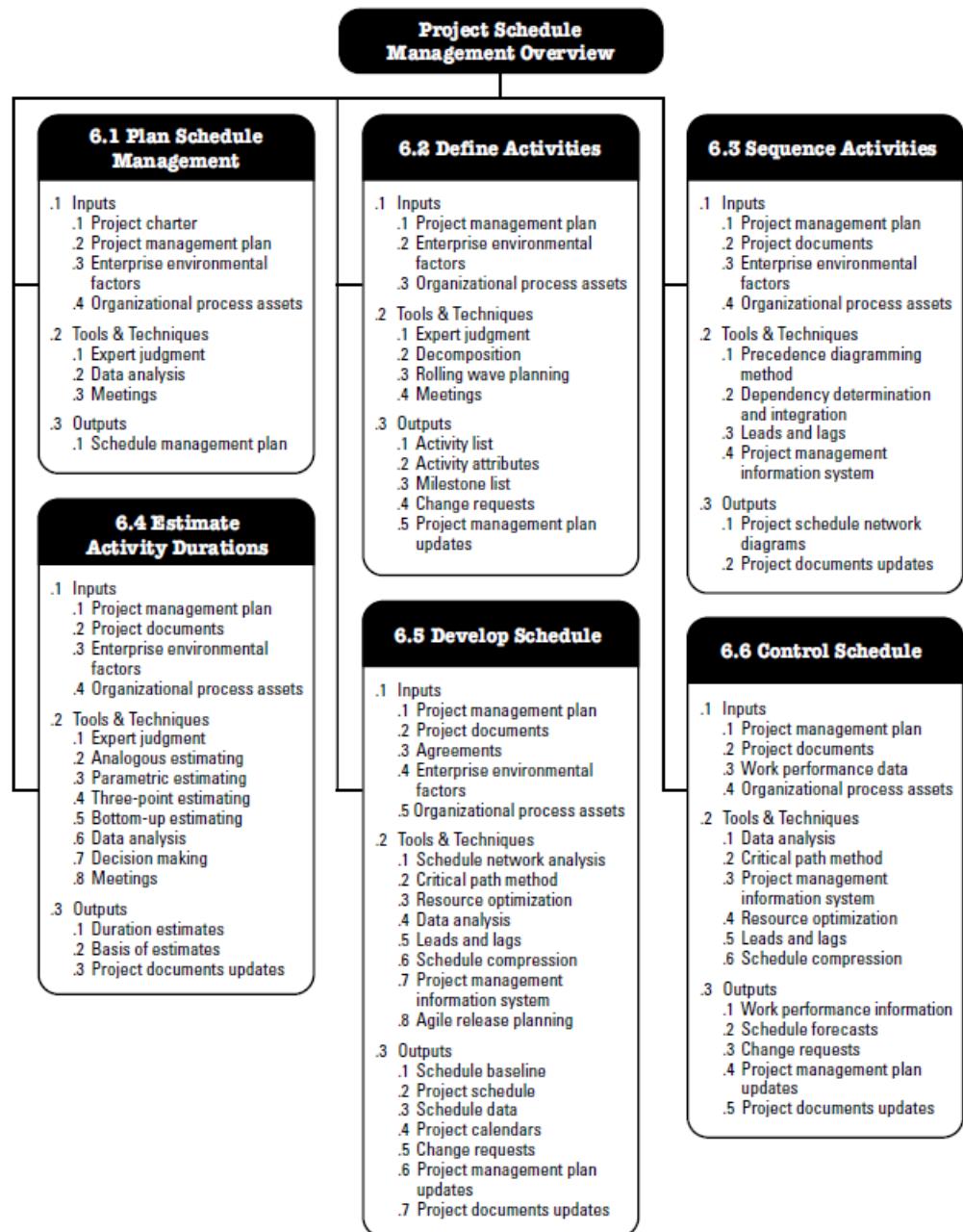


Figure 6-1. Project Schedule Management Overview

Lecture 03 : Project Schedule Management

1.Plan Schedule Management (Planning)



Lecture 02 : Project Schedule Management

1.Plan Schedule Management (Planning)

➤ Plan Schedule Management is the process of:

- Establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

• هي العملية التي تحدد السياسات والإجراءات والوثائق المستخدمة في تخطيط الجدول الزمني للمشروع وتطويره وإدارته وتنفيذها ومراقبته.

❖ The key benefit of this process:

- ✓ Provides guidance and direction on how the project schedule will be managed throughout the project.

✓ توفر الإرشاد والتوجيه بشأن كيفية إدارة الجدول الزمني للمشروع على مدار المشروع.



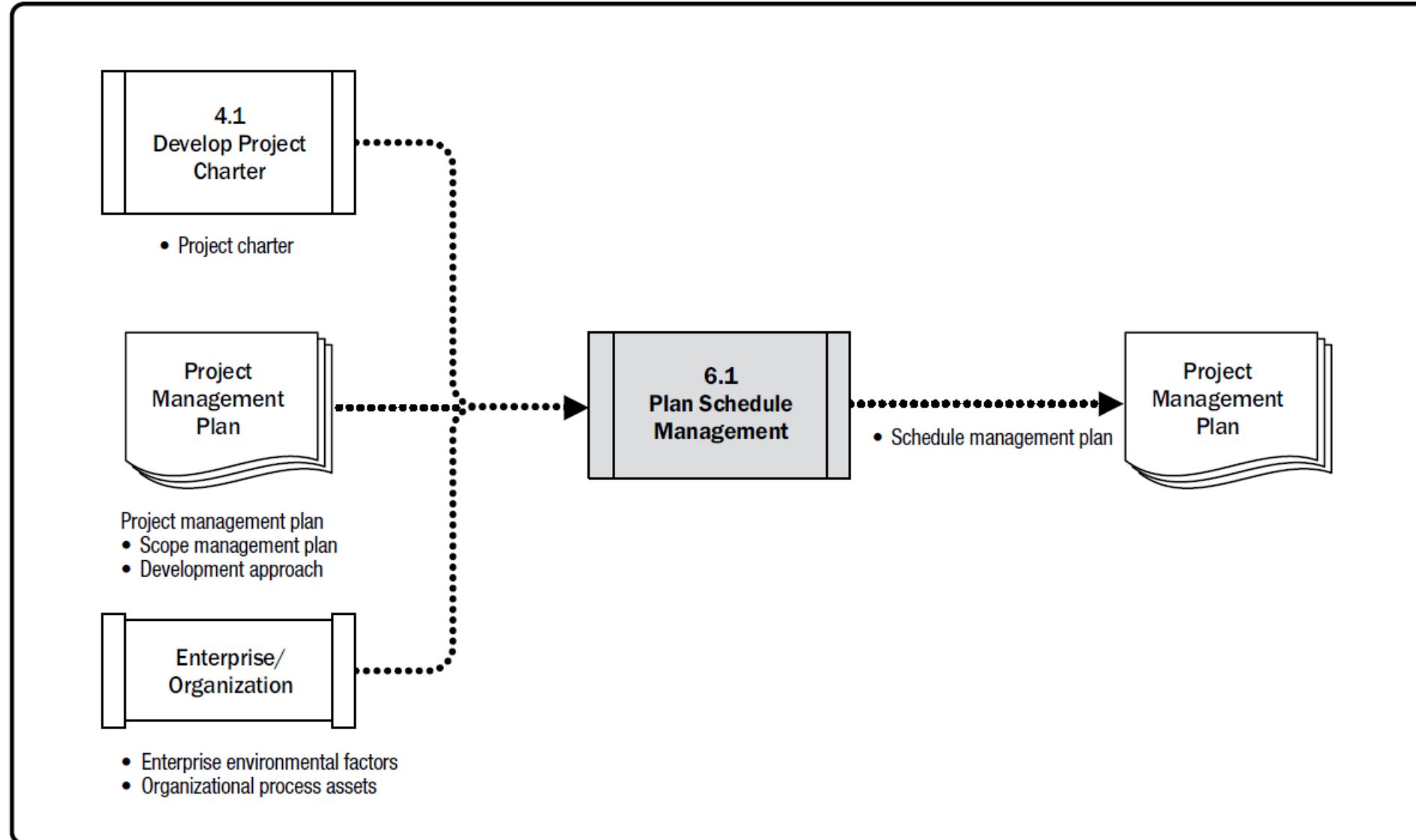


Figure 6-4. Plan Schedule Management: Data Flow Diagram

Project Schedule Management

(1) Plan Schedule Management



Input

1. Project Charter
2. Project management plan
 - Scope Management Plan
 - Development approach
3. Enterprise environmental factors
4. Organizational process assets



Tools &
Techniques

1. Expert Judgement
2. Data Analysis
3. Meetings



Outputs

1. Schedule Management plan

1. Plan Schedule Management (Planning)

Inputs

1- Project charter

- ✓ The project charter defines the **summary milestone schedule** that will influence the management of the project schedule.

2- Project management plan

- ✓ **Scope management plan.** describes how the scope will be defined and developed, which will provide information on how the schedule will be developed.
- ✓ **Development approach.** will help define the **scheduling approach, estimating techniques, scheduling tools, and techniques for controlling the schedule**.

3- Enterprise environmental factors

- ✓ Organizational culture and structure
- ✓ Team resource availability and skills
- ✓ Scheduling software

4- Organizational process assets

- ✓ Historical information and lessons learned Templates and forms.

1. Plan Schedule Management (Planning)

1- EXPERT JUDGMENT

Expertise should be considered from individuals or groups with specialized knowledge or training in previous, similar projects:

- Schedule development, management, and control;
- Scheduling methodologies (e.g., predictive or adaptive life cycle);
- Scheduling software The specific industry for which the project is developed.

2- DATA ANALYSIS

Alternatives analysis

Can include determining which **schedule methodology** to use, or It can also include determining **how detailed** the schedule needs to be, the **duration** of waves for rolling wave planning, and how often it should be **reviewed and updated**.

3- MEETINGS

Project teams may hold planning meetings to develop the schedule management plan. Participants at these meetings may include the project manager, the project sponsor, selected project team members, selected stakeholders, anyone with responsibility for schedule planning or execution, and others as needed.

1. Plan Schedule Management (Planning)

Outputs

❑ Schedule management plan

- It's a component of the project management plan. هي إحدى مكونات خطة إدارة المشروع
- Establishes the **criteria** and the **activities** for developing, monitoring, and controlling the schedule. تحدد معايير وأنشطة وضع الجدول الزمني ومراقبته والتحكم به.
- It can establish the following:
 - ✓ Project schedule model development (Methodology - Scheduling tool) منهجية وأداة الجدولة
 - ✓ Level of accuracy (acceptable range used in determining realistic activity duration estimates)
 - ✓ Units of measure (such as staff hours, staff days, or weeks for time measures, or meters, liters, tons, kilometers, or cubic yards for quantity measures)
 - ✓ Control thresholds (allowed Variance before some action needs to be taken)
 - ✓ Rules of performance measurement. (Earned value management (EVM) rules)
 - ✓ Reporting formats. أشكال رفع التقارير

SCHEDULE MANAGEMENT PLAN

Project Title: _____ Date: _____

Schedule Methodology:

Scheduling Tools:

Level of Accuracy:

Units of Measure:

Variance Thresholds:

Schedule Reporting and Format:

Schedule Updates:

Lecture 03 : Project Schedule Management

2. Define Activities (Planning)



Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

➤ Define Activities is the process of:

- Identifying and documenting the specific actions to be performed to produce the project deliverables.
- هي عملية تحديد وتوثيق إجراءات معينة تُنفَّذ كي يتم إنتاج مخرجات المشروع.

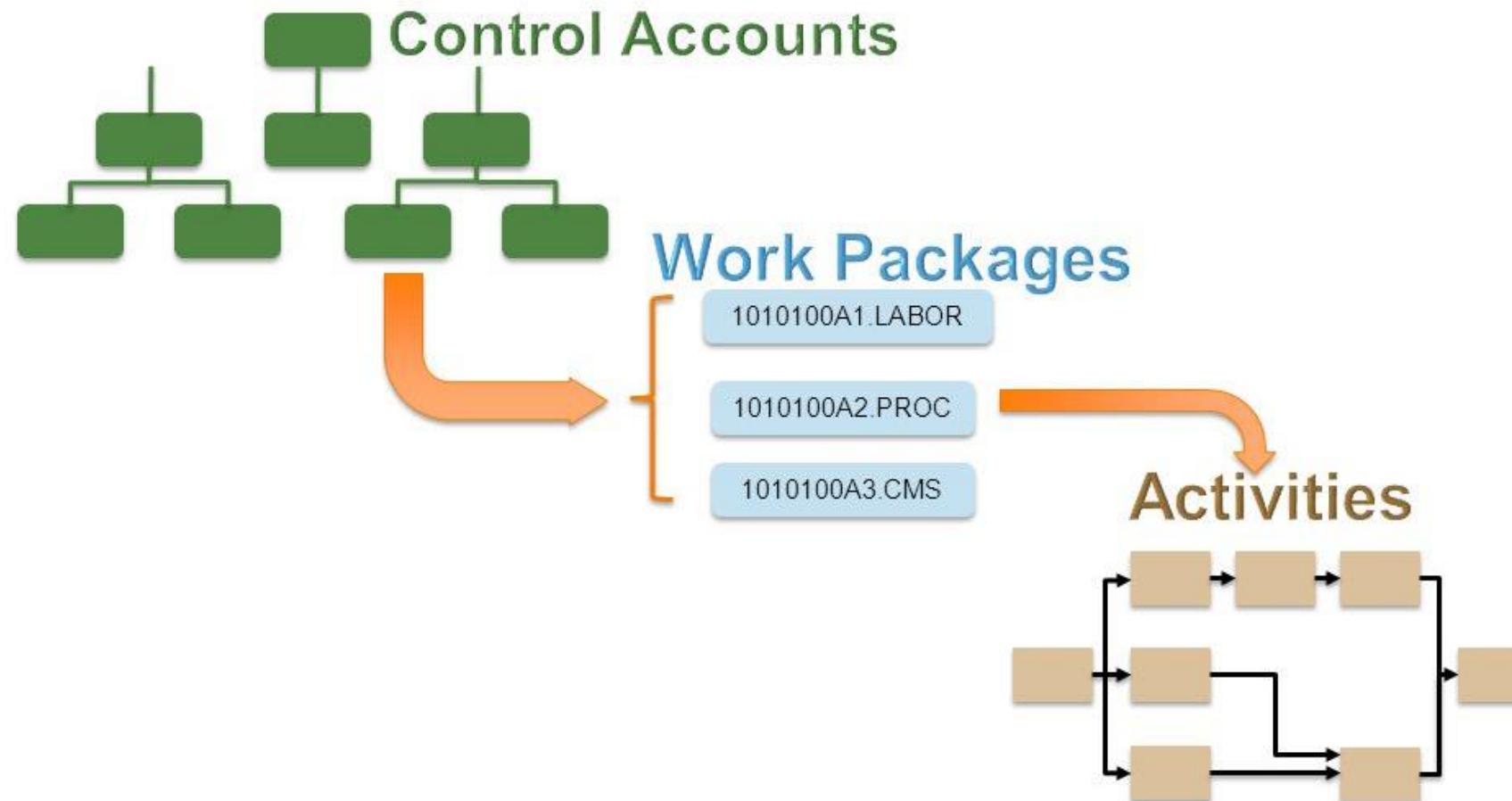
❖ The key benefit of this process:

- ✓ Decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work.
- ✓ تجزئة مجموعات العمل إلى أنشطة للجدول الزمني توفر أساساً لتقدير عمل المشروع، وجدولته، وتنفيذها، ومراقبتها والتحكم فيه.

Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

- ✓ Decomposes work packages into schedule activities that provide a basis for estimating, scheduling, executing, monitoring, and controlling the project work.



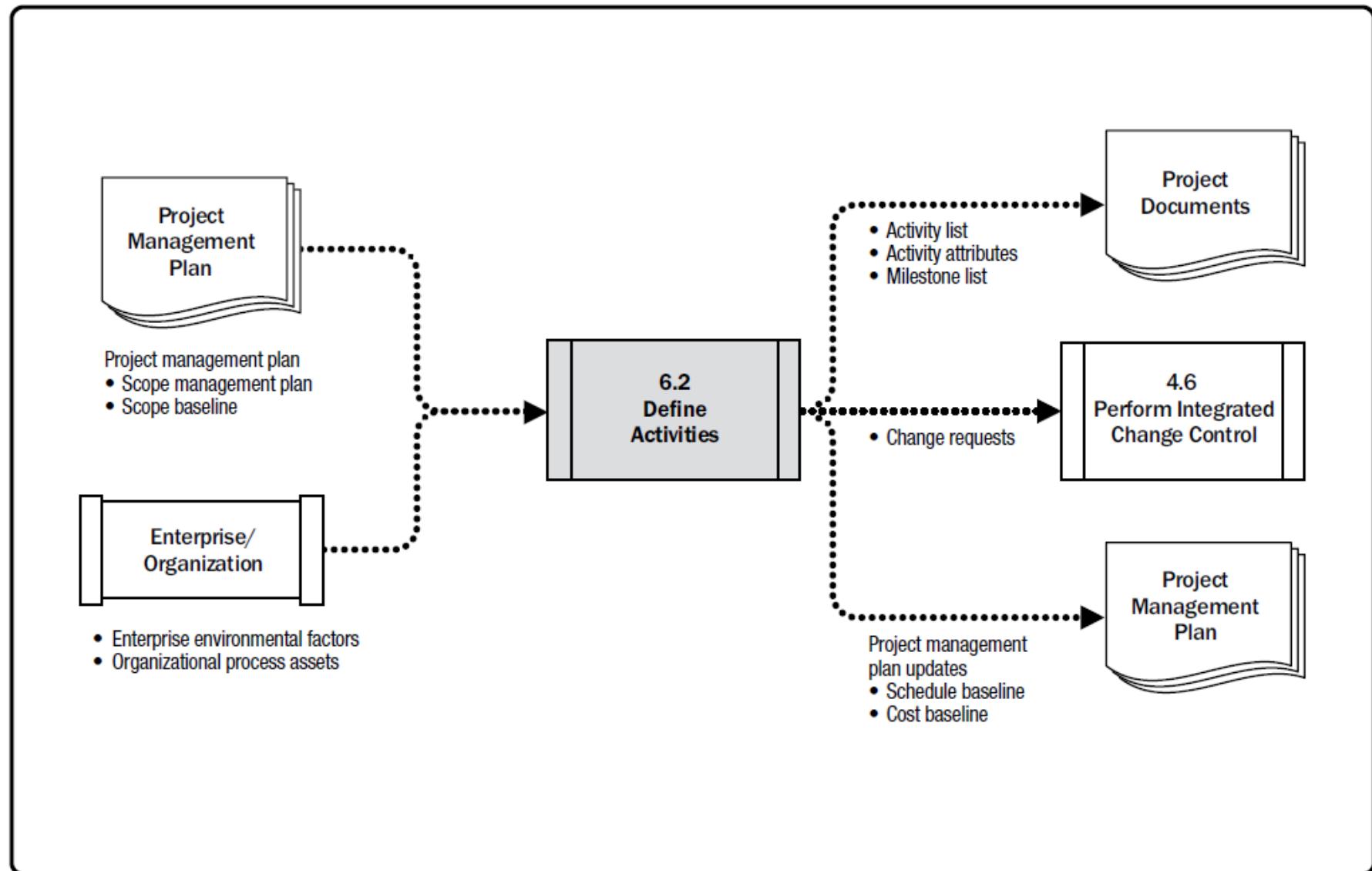


Figure 6-6. Define Activities: Data Flow Diagram

Project Schedule Management

(2) Define Activities



Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

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Decomposition

التجزئة

- ✓ Each work package within the WBS is decomposed into the activities required to produce the work package deliverables.

✓ ويجري تجزئة كل حزمة عمل داخل هيكل تجزئة العمل إلى الأنشطة اللاحقة لإنتاج تسليمات حزمة العمل.

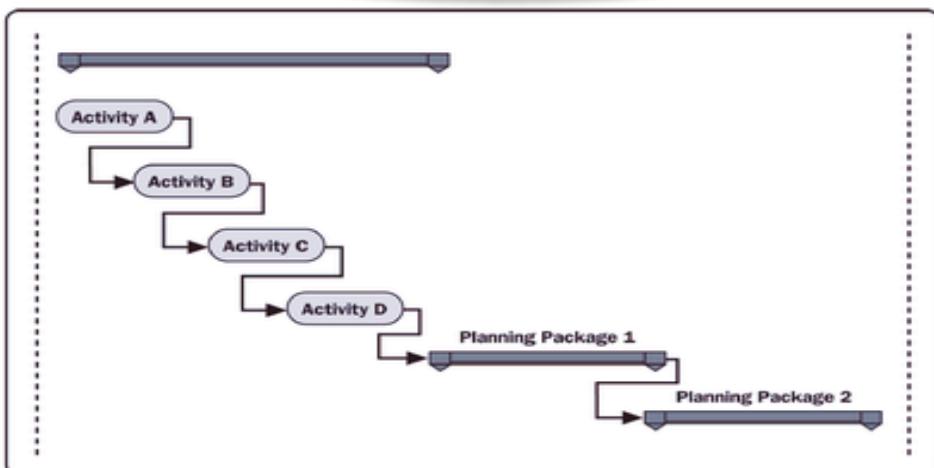
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Rolling Wave Planning

التخطيط المتدرج

- an iterative planning technique in which the work to be accomplished in the near term is planned in detail, while work further in the future is planned at a higher level.
- It is a form of progressive elaboration

فهو أحد أشكال الاتضاح المتدرج



هو أسلوب التخطيط التكراري الذي فيه يُخطط العمل الذي سيتم إنجازه على المدى القريب تخطيطاً تفصيلياً، بينما يُخطط العمل في المستقبل على مستوى أعلى

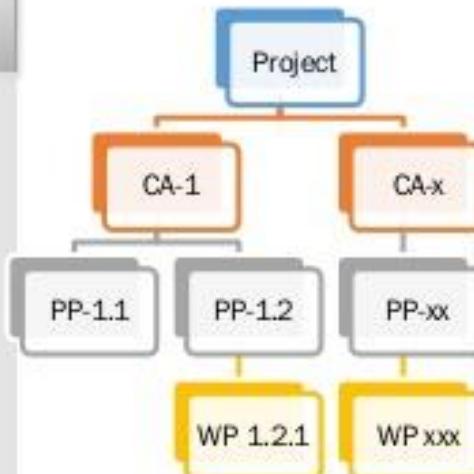
WBS some aspects

Control Account

- management control point where scope, budget, actual cost, and schedule are integrated and compared to the earned value for performance measurement.

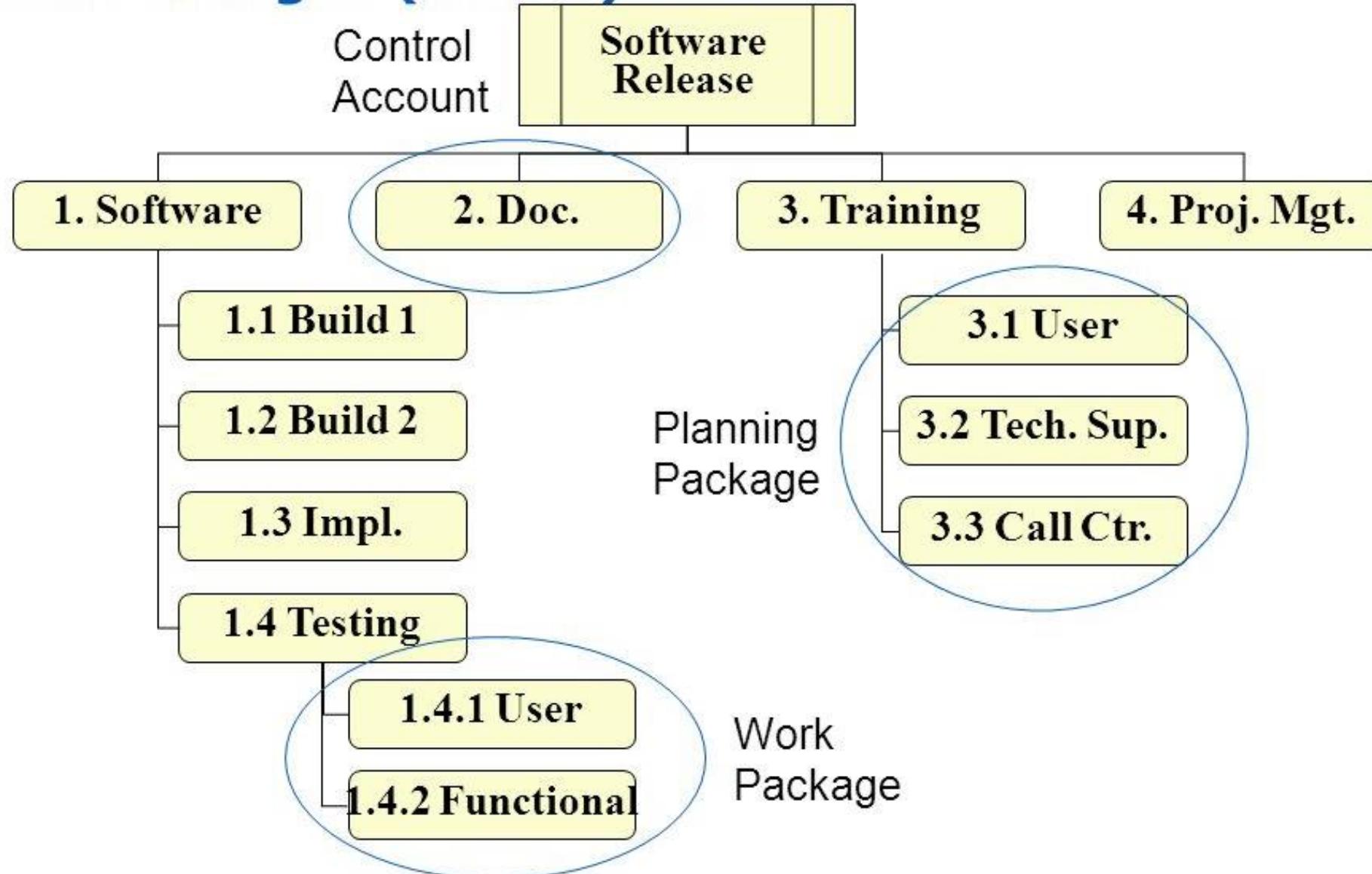
Planning Package

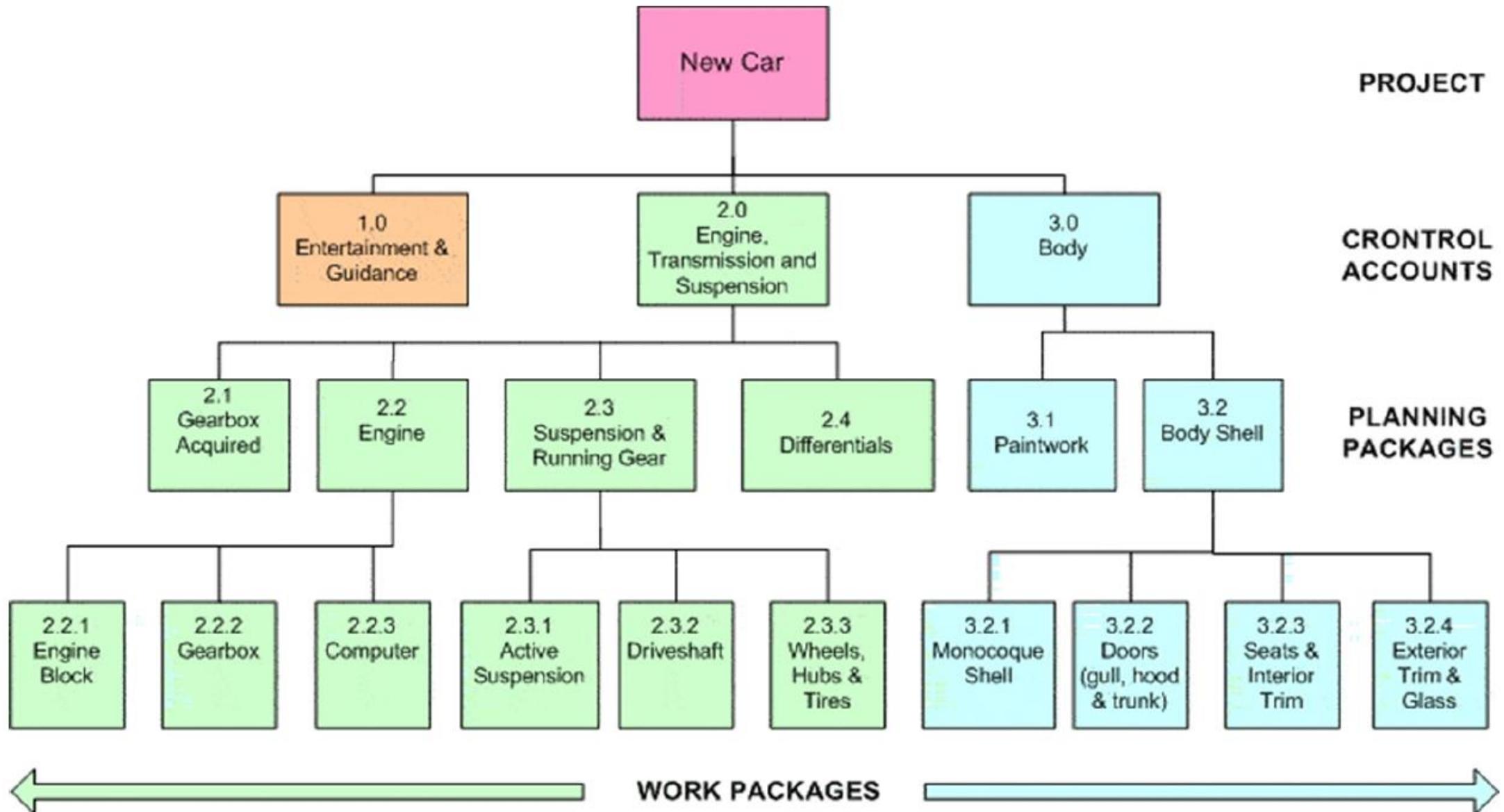
- a work breakdown structure component below the control account with known work content but without detailed schedule activities



- ✓ Control accounts are placed at selected management points in the WBS.
- ✓ Each control account may include one or more work packages,
- ✓ but each of the work packages should be associated with only one control account.
- ✓ A control account may include one or more planning packages.

WBS Packages (cont'd)





Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

Outputs

Activity List

قائمة الأنشطة

- Includes the schedule activities required on the project. تشمل قائمة الأنشطة أنشطة الجدول الزمني المطلوبة في المشروع.
 - Includes an activity identifier and a scope of work description for each activity in sufficient detail to ensure that project team members understand what work is required to be completed.

وتضم قائمة الأنشطة محدد النشاط ووصف لنطاق العمل لكل نشاط بتفاصيل كافية لضمان فهم أفراد فريق المشروع للعمل المطلوب إنجازه.

Activity ID	Activity Name	OD	Predecessors	Successors	Discipline
Super Structure					
Roof					
A1080	Columns (Roof)	3	A1070	A1090	
A1090	Slab & Beams (Roof)	11	A1080	A1110	
A1115	Insulation (Roof)	7	A1110	A1165	
A1165	Roof Tiles	2	A1115	A0001	
Ground Floor					
Civil Work					
Concrete Work					
A1030	Ground Floor Columns	4	A1020	A1040	Civil
A1070	Slab & Beams (Ground Floor)	16	A1060	A1100, A1080	Civil
Brick Work					
A1100	Brick Work (Ground)	10	A1070	A1120, A1210	Arch
A1110	Brick Work (Roof)	5	A1090	A1115, A1135	Arch
Plastering					
A1120	Plastering Preparation	2	A1100	A1290, A1290, A1170, A1170	Arch
A1130	Plastering Work	16	A1290, A1170	A1300, A1232, A1140, A1300	Arch
Tiles Work					
A1140	Floor Tiles for Rooms	10	A1130	A1220	Arch
A1150	Floor Tiles For Path and Kitchen	5	A1260, A1240	A1160	Arch

Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

Outputs

Activity attributes

خصائص النشاط

Activity attributes are the details about the activity. Sometimes the information is entered directly into the schedule software. Other times the information is collected in a form that can be used later to assist in building the schedule model. Activity attributes can include:

- Activity identifier or code
- Activity name
- Activity description
- Predecessor and successor activities
- Logical relationships
- Leads and lags
- Imposed dates
- Constraints
- Assumptions
- Resource requirements and skill levels
- Location of performance
- Type of effort

ACTIVITY ATTRIBUTES					
Project Title: _____		Date Prepared: _____			
ID:	Activity: _____				
Description of Work:					
Predecessors	Relationship	Lead or Lag	Successor	Relationship	Lead or Lag
Number and Type of Team Resources Required:		Skill Requirements:		Required Resources:	
Type of Effort:					
Location of Performance:					
Imposed Dates or Other Constraints:					
Assumptions:					

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Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

Outputs

Milestone List

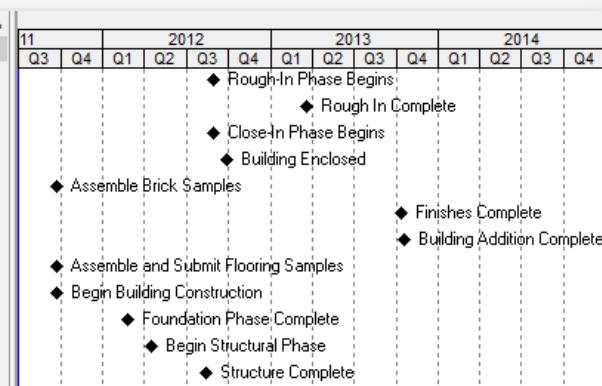
قائمة المعالم

- Is a significant point or event in a project.
- Milestones have zero duration because they represent a significant point or event.

نقطة هامة أو حدث هام في مشروع ما.

لا تضمن المعالم أي فترات زمنية لأنها تمثل نقطة أو حدث هام

Activity ID	Activity Name	OD	Activity Type
EC1490	Rough-In Phase Begins	0	Finish Milestone
EC1690	Rough In Complete	0	Finish Milestone
EC1590	Close-In Phase Begins	0	Start Milestone
EC1620	Building Enclosed	0	Finish Milestone
EC1040	Assemble Brick Samples	0	Start Milestone
EC1840	Finishes Complete	0	Finish Milestone
EC1860	Building Addition Complete	0	Finish Milestone
EC1060	Assemble and Submit Flooring Samples	0	Start Milestone
EC1090	Begin Building Construction	0	Start Milestone
EC1380	Foundation Phase Complete	0	Finish Milestone
EC1410	Begin Structural Phase	0	Start Milestone
EC1540	Structure Complete	0	Finish Milestone



MILESTONE LIST		
Project Title:	Date Prepared:	
Milestone	Milestone Description	Type

Lecture 03 : Project Schedule Management

2. Define Activities (Planning)

Outputs

Change Request

Once the project has been baselined, the progressive elaboration of deliverables into activities may reveal work that was **not initially part of the project baselines**. This may result in a change request.

عند إرساء الخط المرجعي للمشروع، فإن الاتضاح المتدرج للتسليمات في الأنشطة يمكنه أن يكشف عن العمل الذي لم يكن مبدئياً جزءاً من الخطوط المرجعية للمشروع، ويمكن أن ينجم عن ذلك طلب التغيير.



Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)



Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

➤ **Sequence Activities is the process of :**

- Identifying and documenting relationships among the project activities.
- تسلسل الأنشطة هي عملية تحديد وتوثيق العلاقات بين أنشطة المشروع.

❖ **The key benefit of this process:**

- ✓ Defines the logical sequence of work to obtain the greatest efficiency given all project constraints.
- ✓ تحدد التسلسل المنطقي للعمل للحصول على أكبر قدر من الكفاءة في ضوء جميع قيود المشروع.

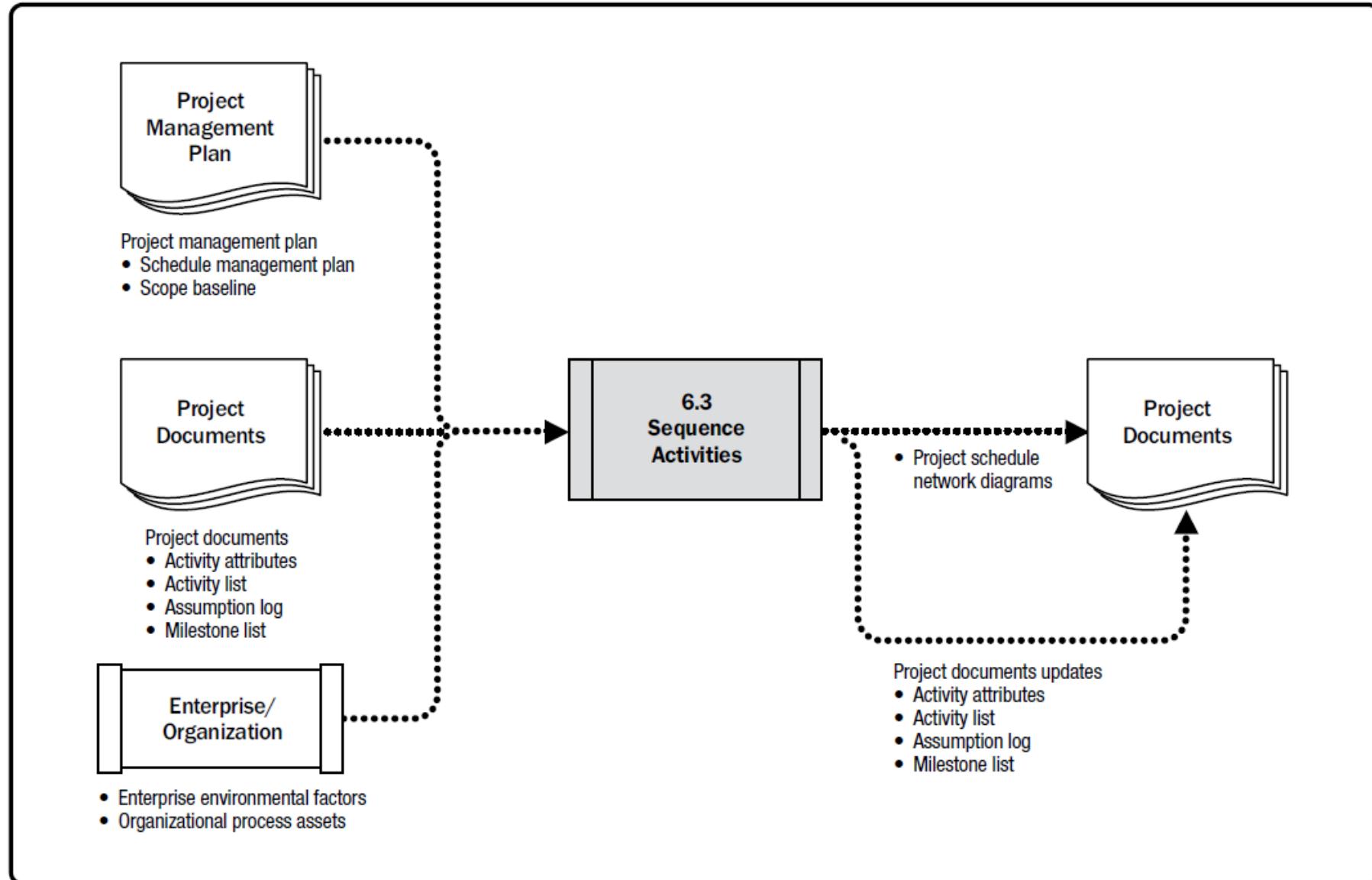


Figure 6-8. Sequence Activities: Data Flow Diagram

Project Schedule Management

(3) Sequence Activities



Input

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



Tools & Techniques

1. Precedence diagramming method
2. Dependency determination and integration
3. Leads and lags
4. Project management information system



Outputs

1. Project Schedule network diagram
2. Project document updates

Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

TT

Precedence Diagramming Method (PDM)

طريقة التخطيط التتابعي

أنواع العلاقات :

1- Finish-to-Start: a successor activity cannot start until a predecessor activity has finished.

لا يبدأ النشاط الثاني الا بعد انتهاء النشاط الأول (مثال: صب الخرسانة والمعالجة)

2- Finish-to-Finish: a successor activity cannot finish until a predecessor activity has finished

لا ينتهي النشاط الثاني الا بعد نهاية النشاط الأول (مثال: التسليم واعمال النظافة)

3- Start-to-Start: a successor activity cannot start until a predecessor activity has started.

لا يبدأ النشاط الثاني الا بعد بداية النشاط الأول (مثال: ال LIABILITY بعد مواسير الكهرباء)

4- Start-to-Finish: a successor activity cannot finish until a predecessor activity has started.

لا ينتهي النشاط الثاني الا بعد بداية النشاط الأول (مثال: تغيير وردية)

Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

PDM includes four types of dependencies or logical relationships.

1. Finish-to-Start: (most commonly used)

Predecessor activity (A) must finish before successor activity (B) can start

Figure 6-5. Example of Finish to Start relationship



2. Finish-to-Finish:

Predecessor activity (C) must finish before successor activity (D) can finish

Figure 6-6. Example of Finish to Finish relationship



3. Start-to-Start:

Predecessor activity (E) must start before the successor activity (F) can start

Figure 6-7. Example of Finish to Finish relationship



4. Start-to-Finish: (rarely used)

Predecessor activity (G) must start before successor activity (H) can finish

Figure 6-8. Example of Finish to Finish relationship



Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

TT

DEPENDENCY DETERMINATION AND INTEGRATION

تحديد وتكامل الاعتمادية

➤ Mandatory dependencies: الاعتمادات الإلزامية

- ✓ Mandatory dependencies are those that are **legally or contractually required or inherent in the nature of the work.**

الاعتمادات الإلزامية هي تلك الاعتمادات المطلوبة من الناحية القانونية أو الناحية التعاقدية أو المتأصلة في طبيعة العمل.

- ✓ where it is impossible to erect the superstructure until after the foundation has been built

مثلاً يوجد في مشروع إنشائي، حيث يكون من المستحيل إقامة البنية الفوقيّة حتى يتم بناء الأساس.

➤ Discretionary dependencies: الاعتمادات التقديرية

- ✓ Sometimes referred to as preferred logic, or soft logic. المنطق المفضل او المنطق السهل

- ✓ Established based on knowledge of best practices within a particular application area.

- ✓ During construction, the electrical work should start after finishing the plumbing work. This order is not mandatory and both activities may occur at the same time.

Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

TT

DEPENDENCY DETERMINATION AND INTEGRATION

تحديد وتكامل الاعتمادية

➤ External dependencies

الاعتمادات الخارجية.

- ✓ External dependencies involve a relationship between project activities and non project activities.

تنطوي الاعتمادات الخارجية على علاقة بين أنشطة المشاريع والأنشطة غير المرتبطة بالمشاريع.

- ✓ These dependencies are usually **outside** of the project team's control.

➤ Internal dependencies

الاعتمادات الداخلية.

- ✓ a precedence relationship between project activities and are generally **inside** the project team's control.

علاقة أسبقية بين أنشطة المشروع وعادة ما تكون تحت سيطرة فريق المشروع.

- ✓ For example, if the team **cannot test a machine until they assemble it**, there is an internal mandatory dependency.

إذا كان الفريق غير قادر على اختبار آلة حتى يجمعونها، فهناك اعتمادية إلزامية داخلية.

Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

TT

Leads and Lags

فترات السبق وفترات التأخير

Lead: Is the amount of time a successor activity can be advanced with respect to a predecessor activity.

(Starting the activity before completing its predecessor)

هي مقدار الفترة الزمنية التي بها يمكن تقديم نشاط لاحق بالنسبة لنشاط سابق (بدء النشاط قبل انتهاء النشاط السابق له)

Lag: Is the amount of time a successor activity will be delayed with respect to a predecessor activity.

(Waiting time between activities)

هي مقدار الوقت الذي بواسطته سيتم تأخير نشاط لاحق فيما يخص نشاط سابق (عبارة عن ارمنة انتظار بين النشاطين المتتالين)

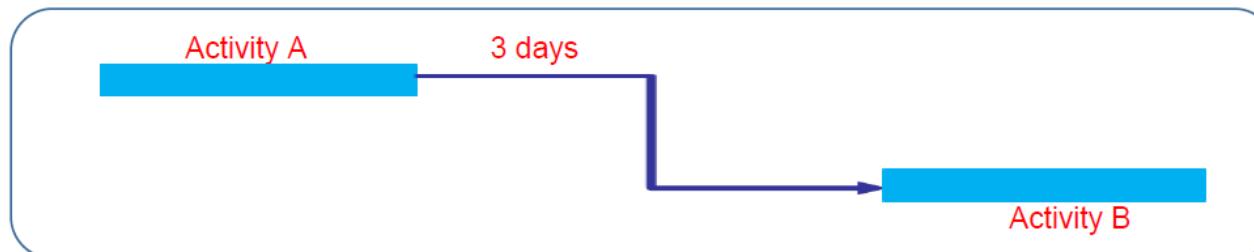
Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)

Lag:

“Amount of time whereby a successor activity is required to be **delayed** with respect to a predecessor activity” Example: Three day curing period for special epoxy glue

Figure 6-10. Example of Lag

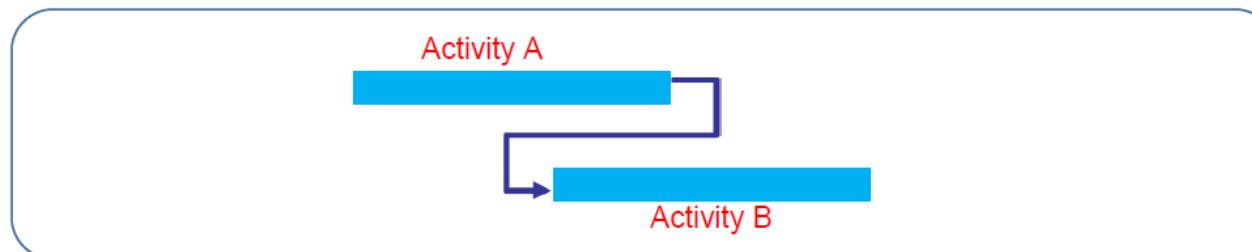


Lead:

“Amount of time whereby a successor activity can be **advanced** with respect to a predecessor activity”

Example: Begin developing prototype one day before design complete

Figure 6-11. Example of Lead



Lecture 03 : Project Schedule Management

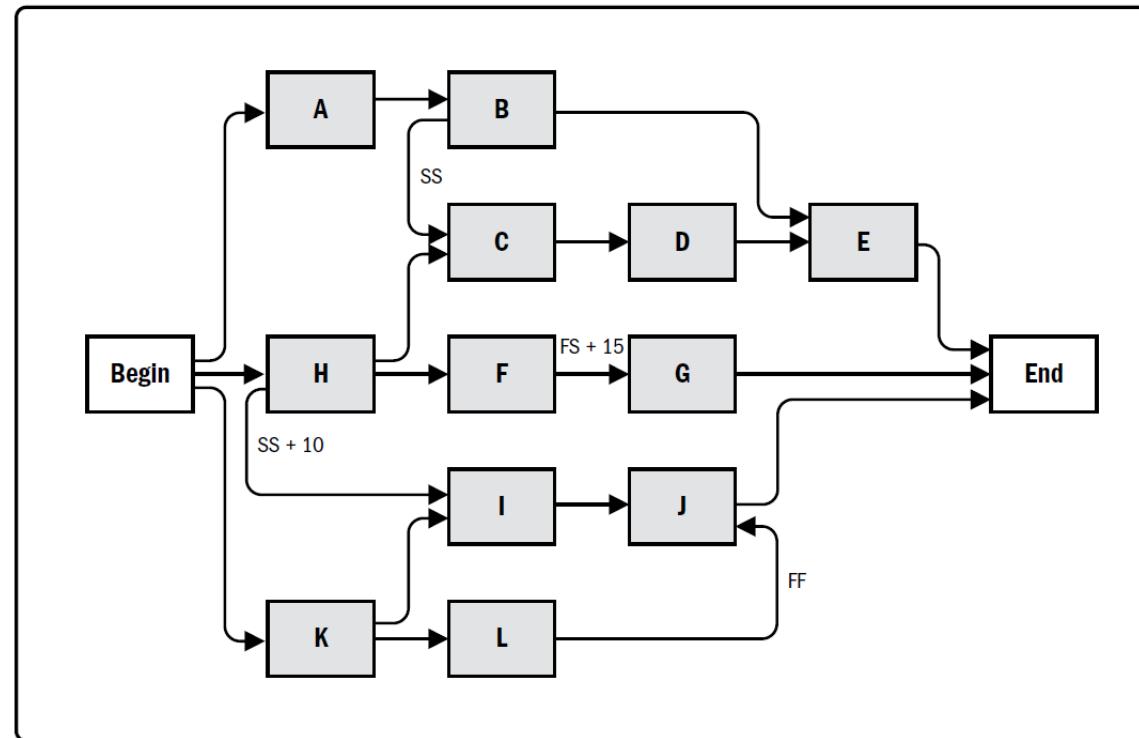
3. Sequence Activities (Planning)

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Project Schedule Network Diagram

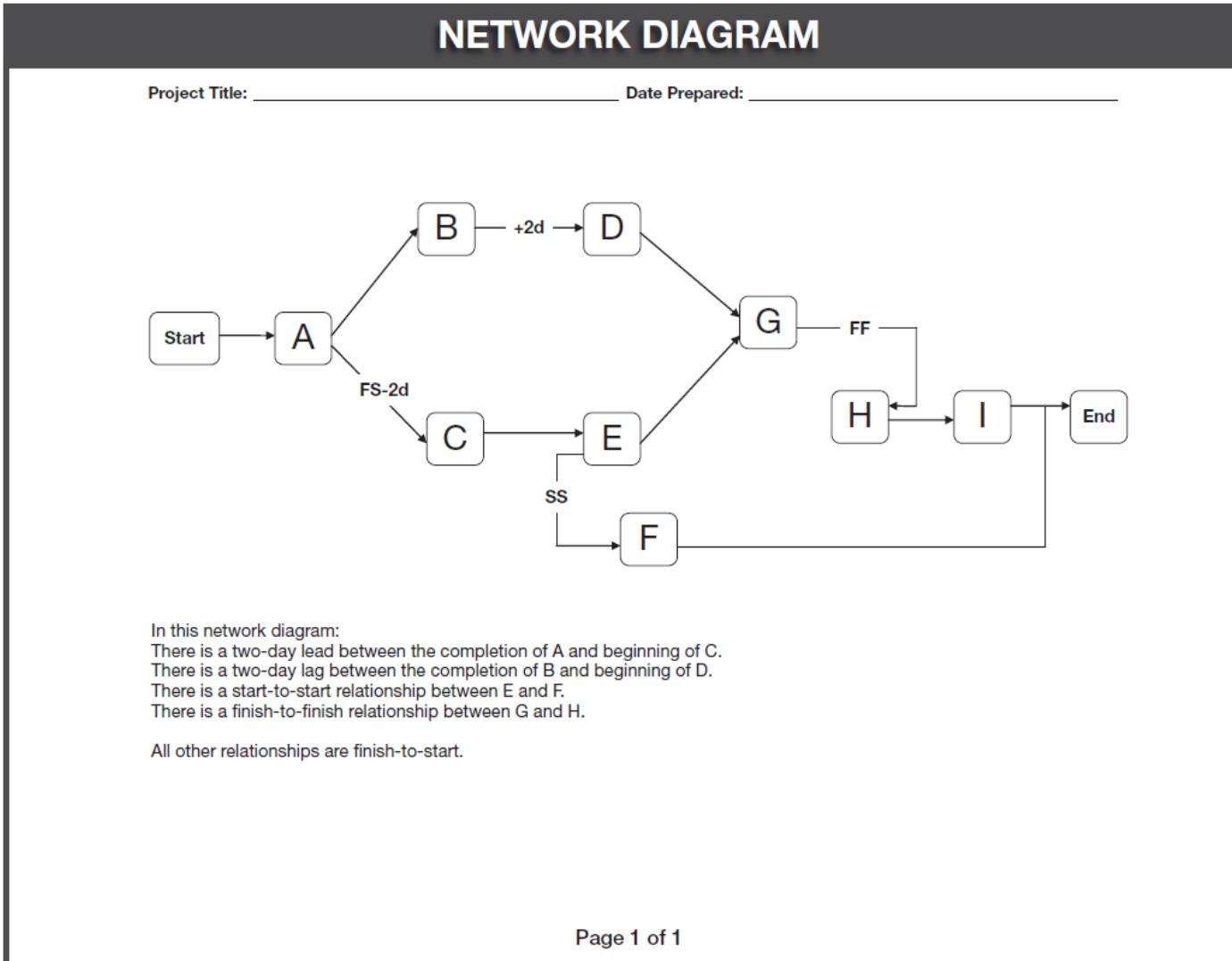
مخططات شبكة الجدول الزمني للمشروع

- ✓ is a graphical representation of the logical relationships, also referred to as dependencies, among the project schedule activities.



Lecture 03 : Project Schedule Management

3. Sequence Activities (Planning)



Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)



Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

➤ Estimate Activity Durations is the process of :

- Estimating the number of work periods needed to complete individual activities with estimated resources.
- عملية تقدير عدد فترات العمل اللازمة لإنكماض الأنشطة المنفردة باستخدام الموارد التي تم تقديرها.

❖ The key benefit of this process:

- ✓ توفر مقدار الوقت اللازم لكل نشاط كي يكتمل.
- ✓ It provides the amount of time each activity will take to complete.



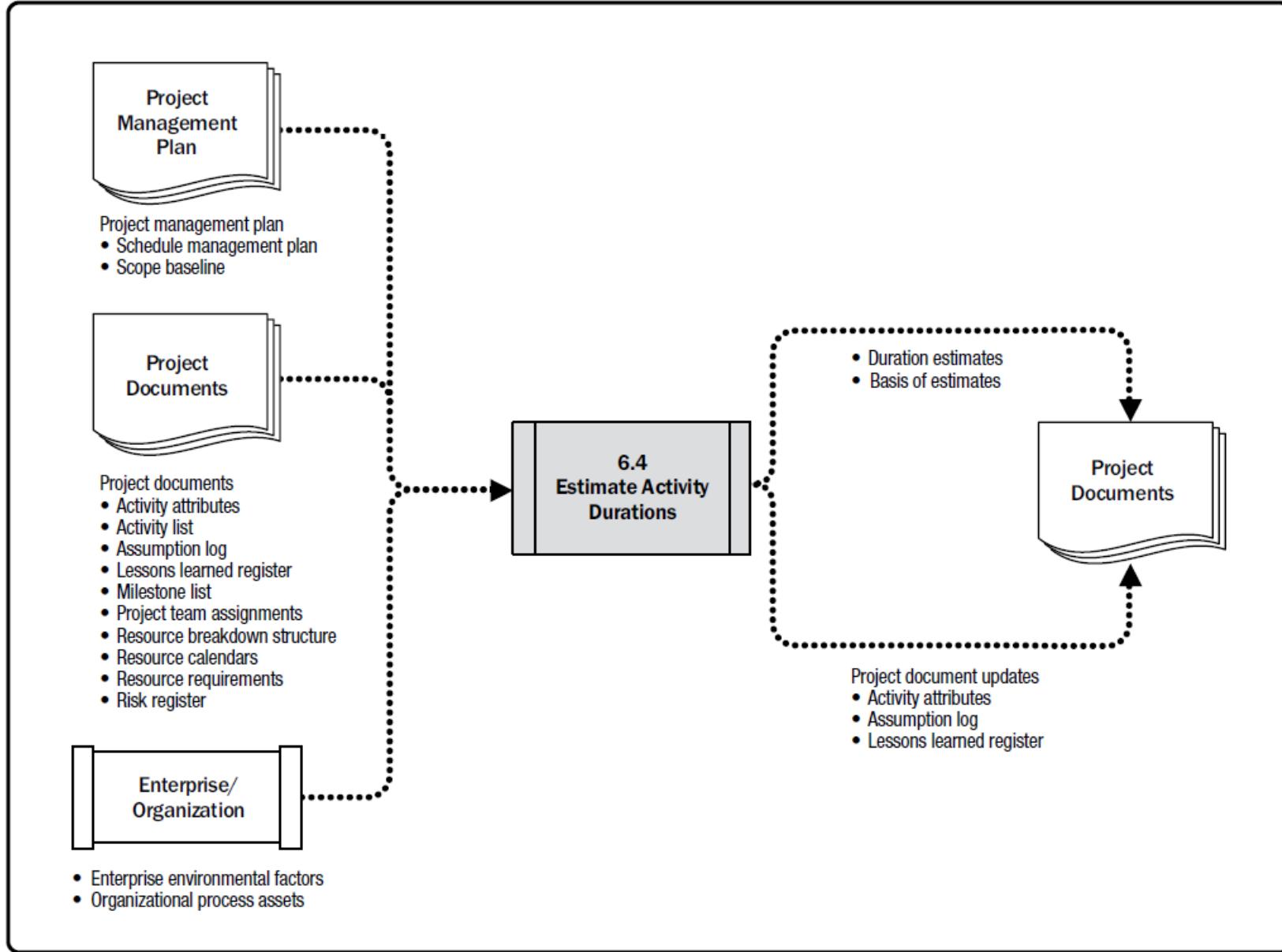
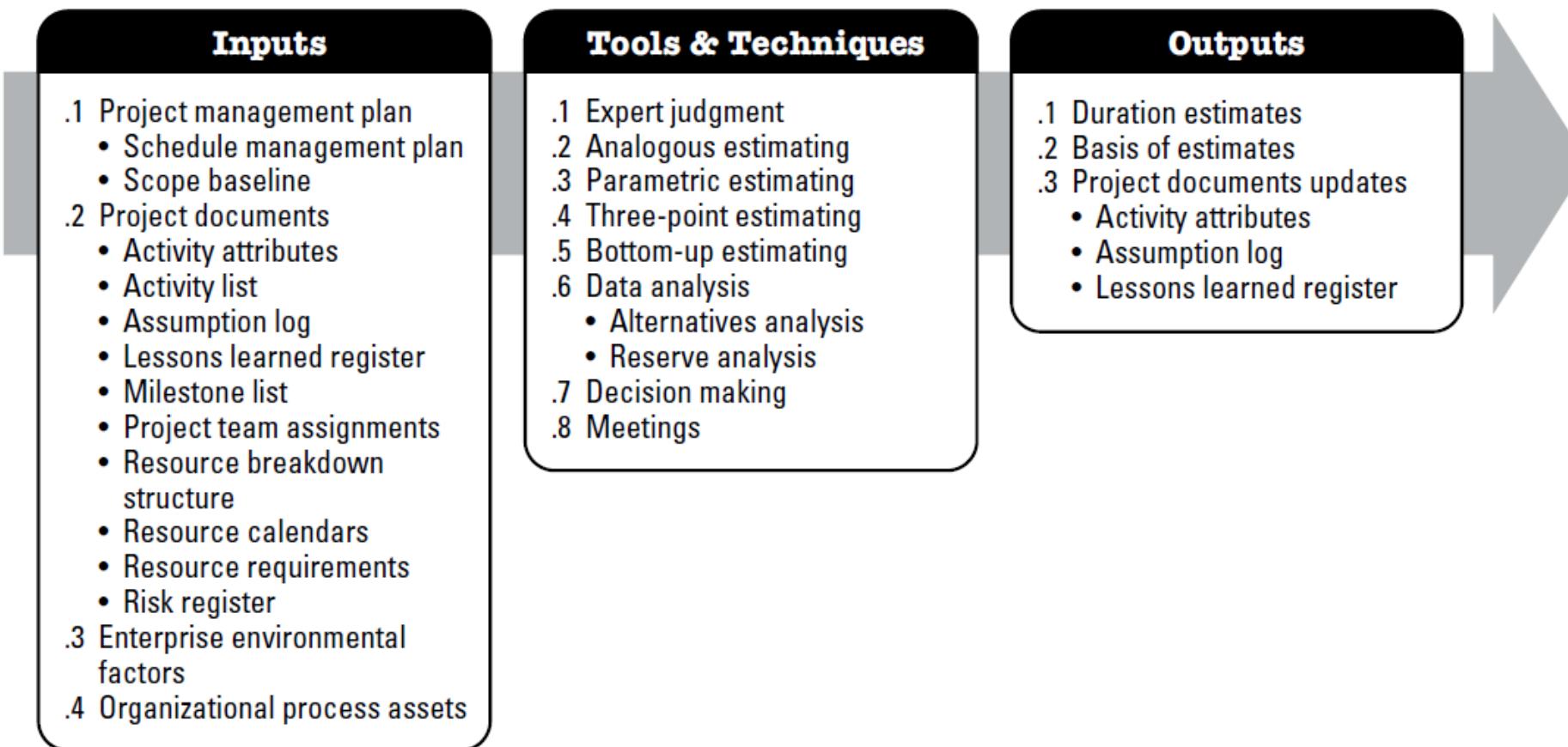


Figure 6-13. Estimate Activity Durations: Data Flow Diagram

Project Schedule Management

Estimate Activity Durations



Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

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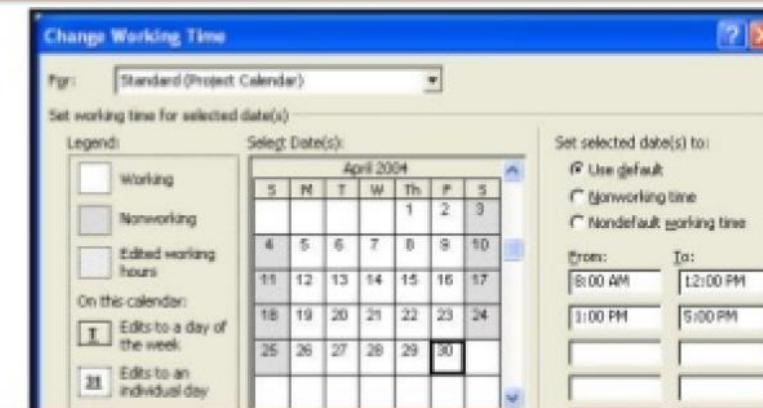
□ Recourse Calendars



Identifies working days & shifts when each resource is available.

Details about how long resource will be available.

Other details – Skill, Skill levels, location etc

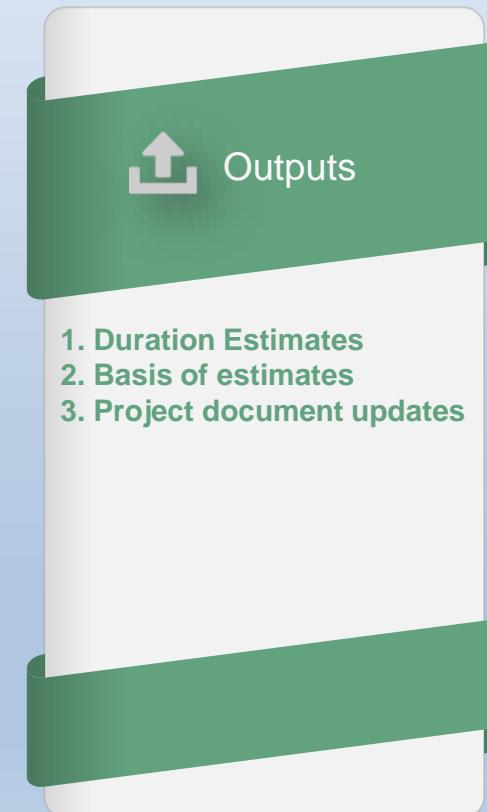


Remember:

- Resource may be material, human resources, equipment etc

Project Schedule Management

(4) Estimate Activity Durations



Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

TT

Analogous Estimate

التقدير التناظري

- ✓ Using historical data from a similar activity or project. باستخدام بيانات من مشاريع سابقة.
- ✓ Used when there is a limited amount of detailed information. عند وجود قدر محدود من المعلومات.
- ✓ Less costly and less time-consuming but less accurate. الأقل في التكلفة والوقت ولكن الأقل دقة.

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Parametric estimating

التقدير باستخدام المعاملات

- ✓ Used to calculate cost or duration based on historical data and project parameters.
(e.g., square footage in construction) to calculate an estimate for activity parameters, such as cost, budget, and duration.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

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Three-Point Estimating

التقدير ثلاثي النقاط

- ✓ The accuracy of single-point duration estimates may be improved by considering estimation uncertainty and risk.

M : Most likely duration (الزمن المعتمد والأكثر حدوثاً)

O : Optimistic duration (أقل زمن تم انجاز النشاط فيه)

P : Pessimistic duration (أكبر زمن تم انجاز النشاط فيه)

➤ One commonly used formula is triangular distribution:

$$E = (O + M + P) / 3$$

Triangular distribution is used when there is insufficient historical data.

يستخدم التوزيع الثلاثي حينما لا تكون البيانات السابقة كافية

DURATION ESTIMATING WORKSHEET

Project Title: _____ Date Prepared: _____

Analogous Estimates

ID	Previous Activity	Previous Duration	Current Activity	Multiplier	Duration Estimate

Three-Point Estimates

ID	Optimistic Duration	Most Likely Duration	Pessimistic Duration	Weighting Equation	Expected Duration Estimate

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

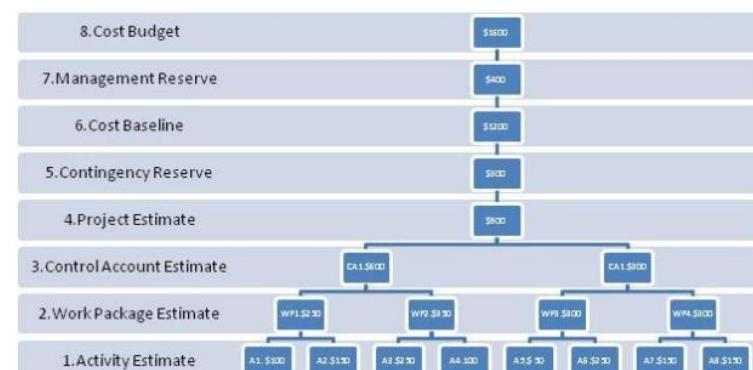
TT

Bottom-up estimating

التقدير من القاعدة إلى القمة

- ✓ A method of estimating project duration or cost by **aggregating** the estimates of the lower level components of the WBS. هي طريقة لتقدير مدة المشروع أو تكاليفه من خلال تجميع التقديرات للمكونات ذات المستوى الأدنى من هيكل تجزئة العمل.
- ✓ When an activity's duration **cannot be estimated** with a reasonable degree of **confidence**, the work within the activity is **decomposed** into more detail. The detail durations are **estimated**. These estimates are then **aggregated** into a total quantity for each of the activity's durations.

وعندما لا يمكن تقدير مدة أحد الأنشطة بدرجة معقولة من الثقة، يتم تجزئة العمل داخل النشاط بمزيد من التفاصيل. وتُقدر مدد التفاصيل، ثم يتم تجميع هذه التقديرات في رقم إجمالي لكل مدة من مدد النشاط .



- ✓ This method need WBS.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

TT

Data analysis

Alternatives analysis: تحليل البدائل

- ✓ Compare various levels of resource capability or skills. لمقارنة مستويات عديدة من إمكانيات الموارد أو مهاراتهم.
- ✓ Comparing (manual versus automated) and make, rent, or buy decisions regarding the resources.
- ✓ This allows the team to weigh resource, cost, and duration variables to determine an optimal approach for accomplishing project work. يسمح ذلك للفريق لتحديد الأسلوب الأمثل لإنجاز عمل المشروع.

Reserve Analysis: تحليل الاحتياطي

- ✓ Used to determine the amount of contingency and management reserve needed for the project.
- ✓ Duration estimates may include contingency reserves:
 - Sometimes referred to as schedule reserves, to account for schedule uncertainty.
 - Contingency reserves are the estimated duration within the schedule baseline.
 - allocated for identified risks that are accepted.
 - associated with the known-unknowns.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

TT

Data analysis

Reserve Analysis: تحليل الاحتياطي

- ✓ Estimates may also be produced for the amount of management reserve
 - Management reserves are a specified amount of the project budget.
 - for management control purposes and are reserved for unforeseen work that is within scope of the project.
 - To address the unknown-unknowns that can affect a project.
 - Management reserve is not included in the schedule baseline, but it is part of the overall project duration requirements.
 - Use of management reserves may require a change to the schedule baseline.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

TT

DECISION MAKING

Voting:



- ✓ One variation of the **voting** method that is often used **in agile-based projects** is called the **fist of five**.
- ✓ The project manager **asks the team** to show their level of support for a decision by **holding up a closed fist** (**indicating no support**) **up to five fingers** (**indicating full support**).
- ✓ If a team member holds up **fewer than three fingers**, the team member is **given the opportunity** to discuss any objections with the team.
- ✓ The project manager **continues** the fist-of-five process until the team achieves **consensus** (**everyone holds up three or more fingers**) or **agrees** to move on to the next decision.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

Outputs

Duration Estimates

- ✓ Duration estimates are quantitative assessments of the likely number of time periods that are required to complete an activity, a phase, or a project
- ✓ Duration estimates do not include any lags.

Lecture 03 : Project Schedule Management

4. Estimate Activity Duration (Planning)

Outputs

BASIS OF ESTIMATES

- ✓ The amount and type of additional details supporting the duration estimate vary by application area
 - ✓ Documentation of the basis of the estimate (i.e., how it was developed),
 - ✓ Documentation of all assumptions made,
 - ✓ Documentation of any known constraints,
 - ✓ Indication of the range of possible estimates (e.g., ±10%) to indicate that the duration is estimated between a range of values),
 - ✓ Documentation of individual project risks influencing this estimate.

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

➤ Develop Schedule is the process of :

- Analyzing activity sequences, durations, resource requirements, and schedule constraints to create a schedule model for project execution and monitoring and controlling.
 - عملية تحليل تسلسل الأنشطة وفتراتها الزمنية ومتطلبات الموارد والقيود على الجدول الزمني لإنشاء نموذج الجدول الزمني لتنفيذ المشروع ومراقبته والتحكم فيه.

❖ The key benefit of this process:

- ✓ Generates a schedule model with planned dates for completing project activities
 - ✓ تصدر نموذج للجدول الزمني بتواريخ مخططة لاستكمال أنشطة المشروع.

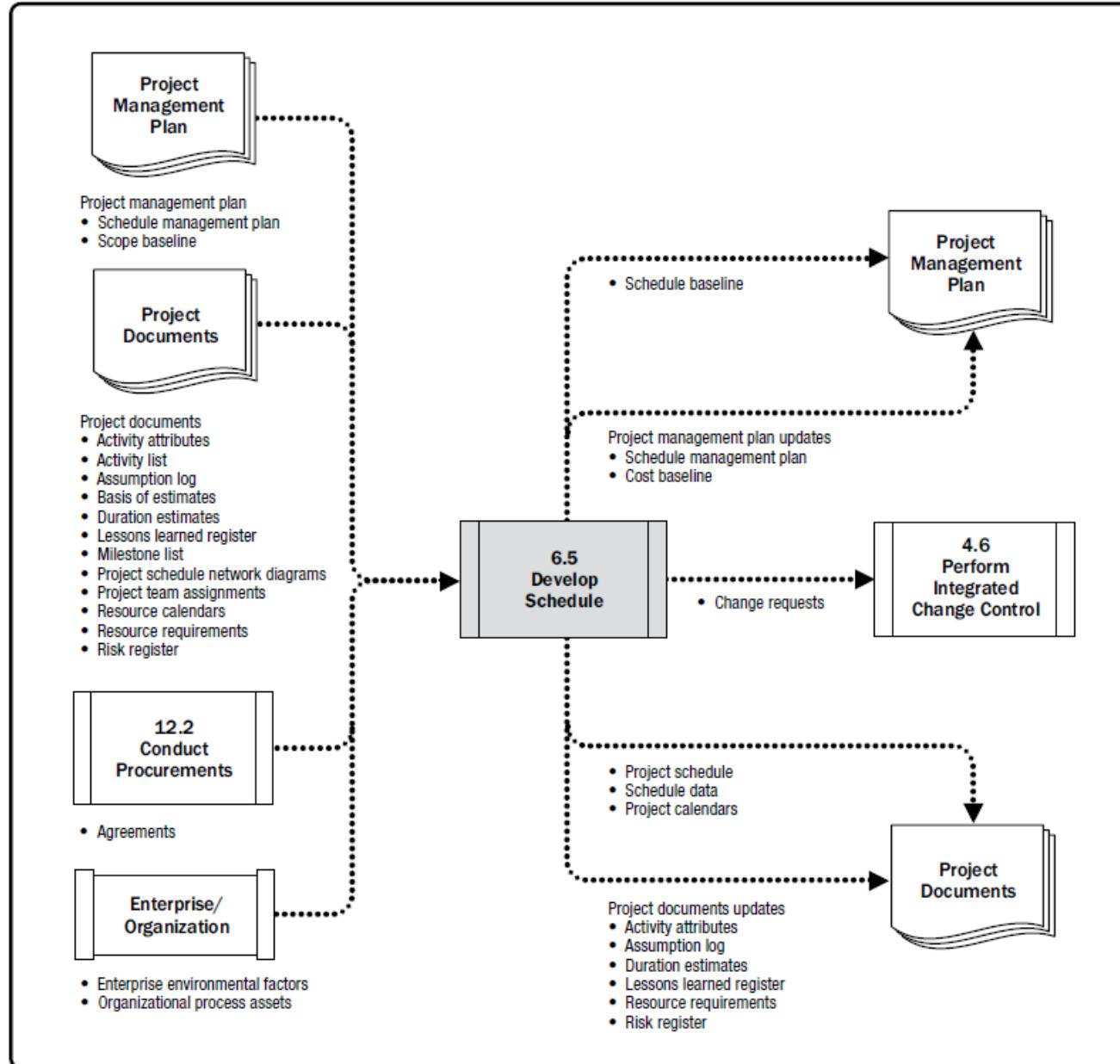
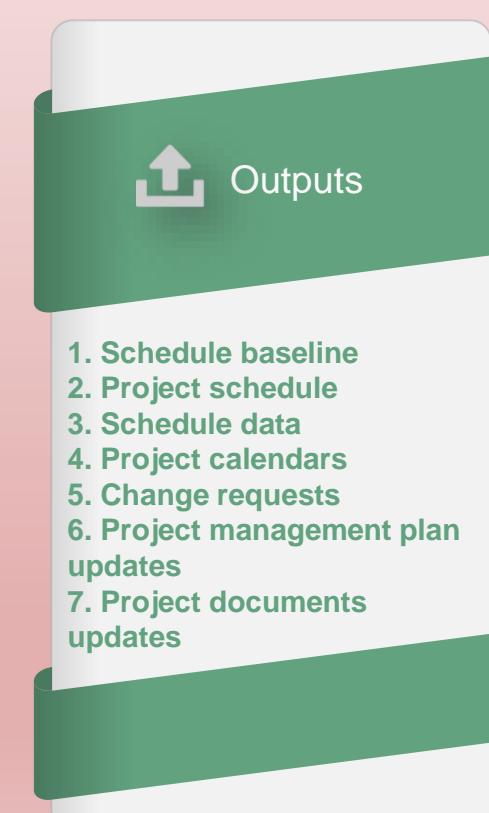


Figure 6-15. Develop Schedule: Data Flow Diagram

Project Schedule Management

(5) Develop Schedule



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

TT

Schedule Network Analysis

تحليل شبكة الجدول الزمني

- Technique used to generate the project schedule model. توليد نموذج الجدول الزمني للمشروع
- It employs several other techniques such as critical path method, resource optimization techniques and modeling techniques.

TT

Critical Path Method

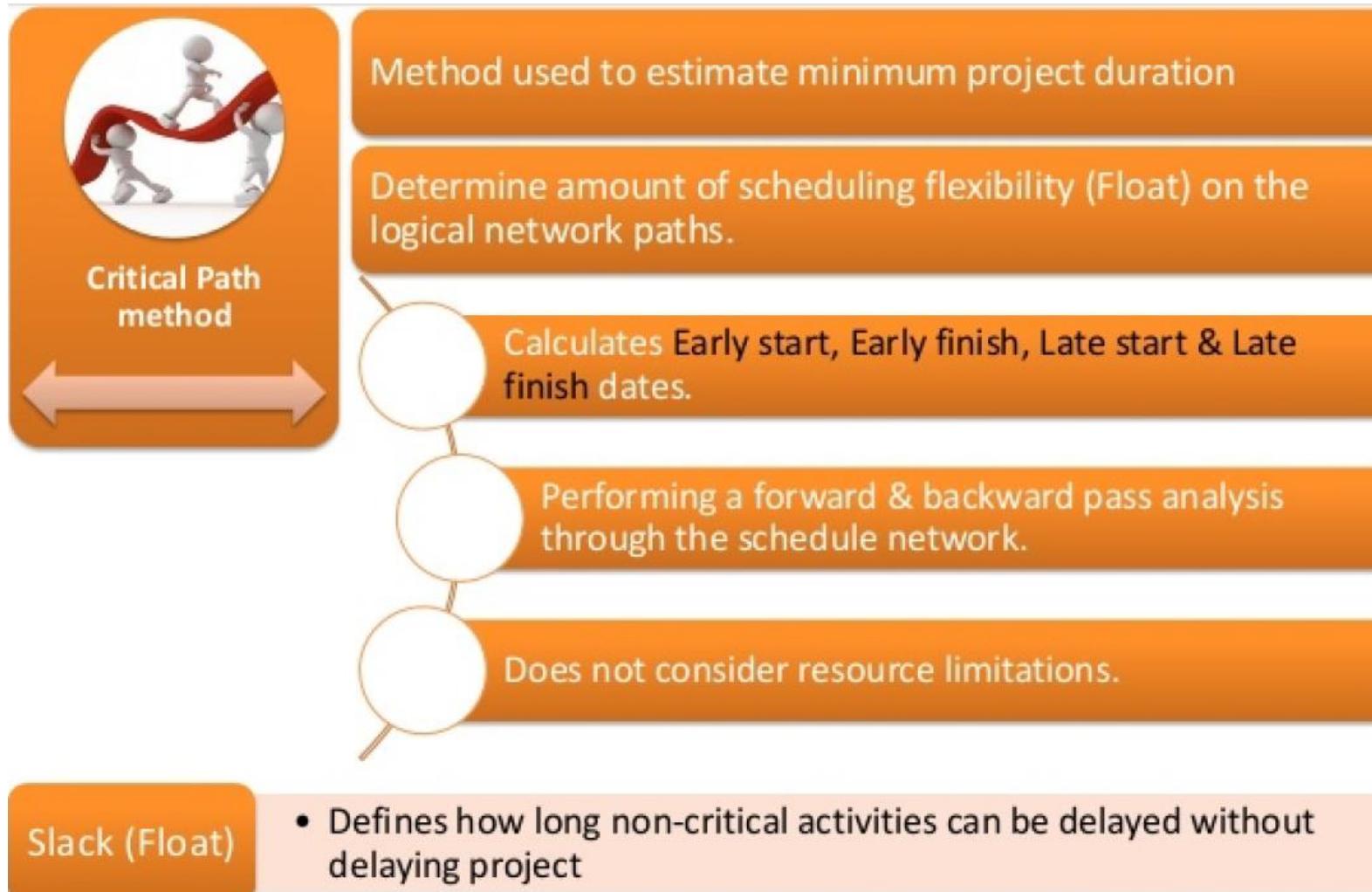
طريقة المسار الحرج

- Used to estimate the **minimum** project duration. لتقدير الحد الأدنى لمدة المشروع
- Calculates the early start, early finish, late start, and late finish dates for all activities without regard for any **resource limitations** by performing a forward and backward pass analysis
- The critical path is the sequence of activities that represents the **longest path** through a project
- A critical path is normally characterized by **zero total float** on the critical path.

الأنشطة على المسار الحرج عادة لها فترة سماح اجمالية تساوي صفر

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

Critical Path Method

ES : Early Start البداية المبكرة

LS : Late Start البداية المتأخرة

EF: Early Finish النهاية المبكرة

LF : Late Finish النهاية المتأخرة

Total Float: amount of time that a schedule activity can be delayed without delaying the project finish date.

فترة السماح الكلية (التي يمكن للنشاط ان يتاخرها دون تأخر المشروع)

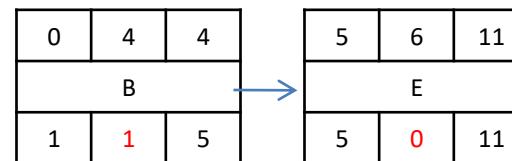
$$TF = (LF - EF) = (LS - ES)$$

Free Float: amount of time that a schedule activity can be delayed without delaying the early start date of any successor.

فترة السماح الحر (يمكن ان يتاخرها النشاط دون تأخر البداية المبكرة للنشاط التالي)

$$FF = ESE - EFB$$

ES	D	EF
Activity Name		
LS	TF	LF



Lecture 03 : Project Schedule Management

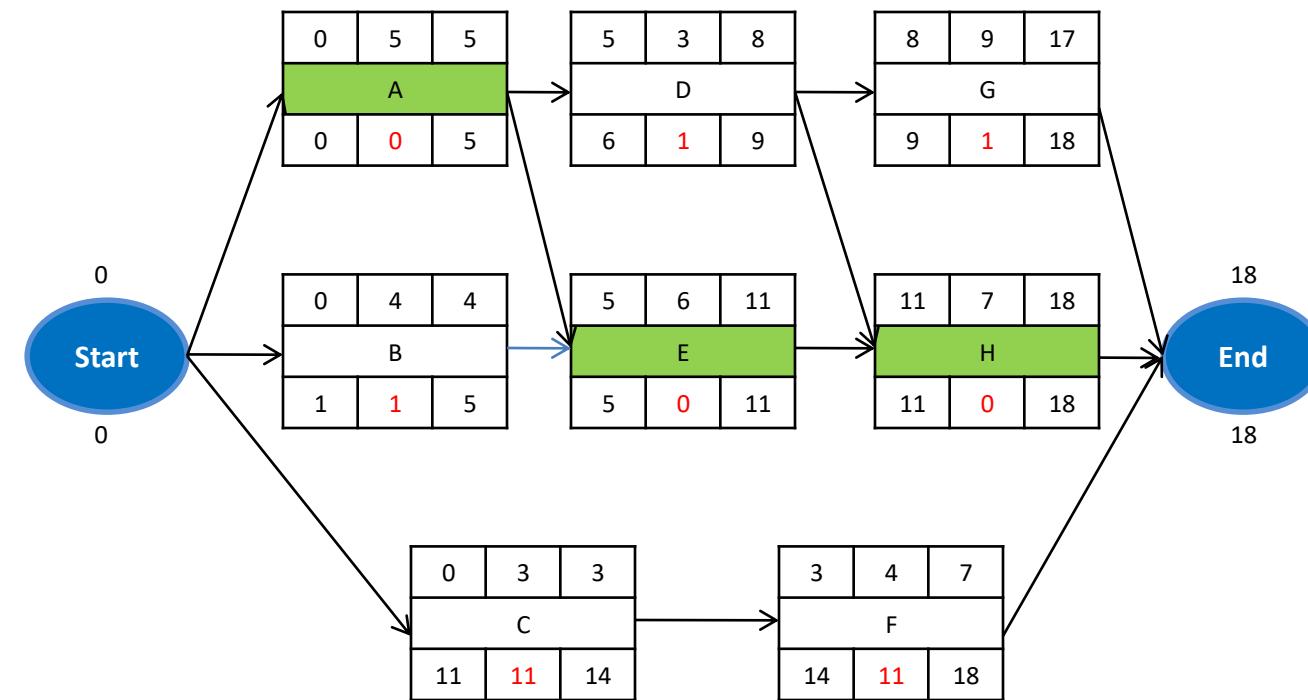
5. Develop Schedule (Planning)

Activity	D (Days)	Dependency
A	5	Start
B	4	Start
C	3	Start
D	3	A
E	6	A, B
F	4	C
G	9	D
H	7	D, E
Consider all relationships are FS=0		

Example for Activity Form

ES	D	EF
Activity Name		
LS	TF	LF

Critical Path Method (Example)



- Critical Path is : A – E – H
- FF.B = 1
- TF.H = 0

Lecture 03 : Project Schedule Management

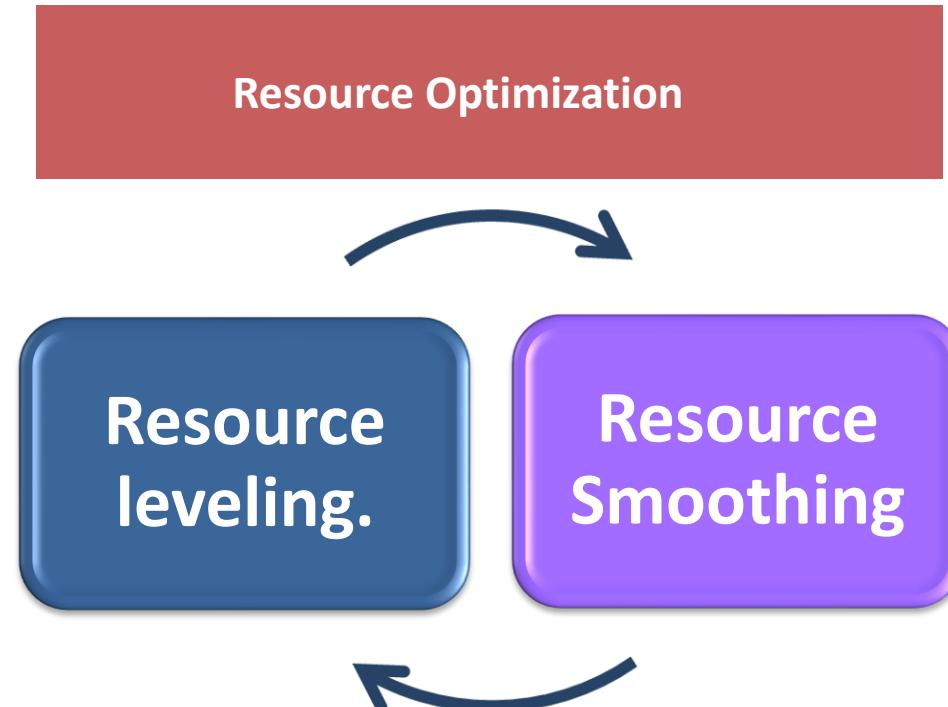
5. Develop Schedule (Planning)

TT

Resource optimization

الاستغلال الأمثل للموارد

يستخدم الاستغلال الأمثل للموارد لتعديل تواريخ بداية ونهاية الأنشطة لتعديل استخدام المخطط للموارد لكي يتساوى مع مستوى توفر أو قلة الموارد.



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

TT

Resource optimization

الاستغلال الأمثل للموارد

➤ **Resource leveling** المساواة بين الموارد

- ✓ A technique in which start and finish dates are adjusted based on resource constraints with the goal of balancing the demand for resources with the available supply.

أسلوب يتم فيه تعديل تواريخ البدء والنهاية حسب القيود المتعلقة بمورد ما بهدف تحقيق التوازن بين الطلب على الموارد والمتاح منها

- ✓ Can be used when a resource has been assigned to two or more activities during the same time period.

عندما يتم تعيين مورد لنشاطين أو أكثر خلال نفس الفترة الزمنية.

- ✓ Resource leveling can often cause the original critical path to change.

المساواة بين الموارد يمكن أن تسبب في كثير من الأحيان تغيير المسار الحرج الأصلي.

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

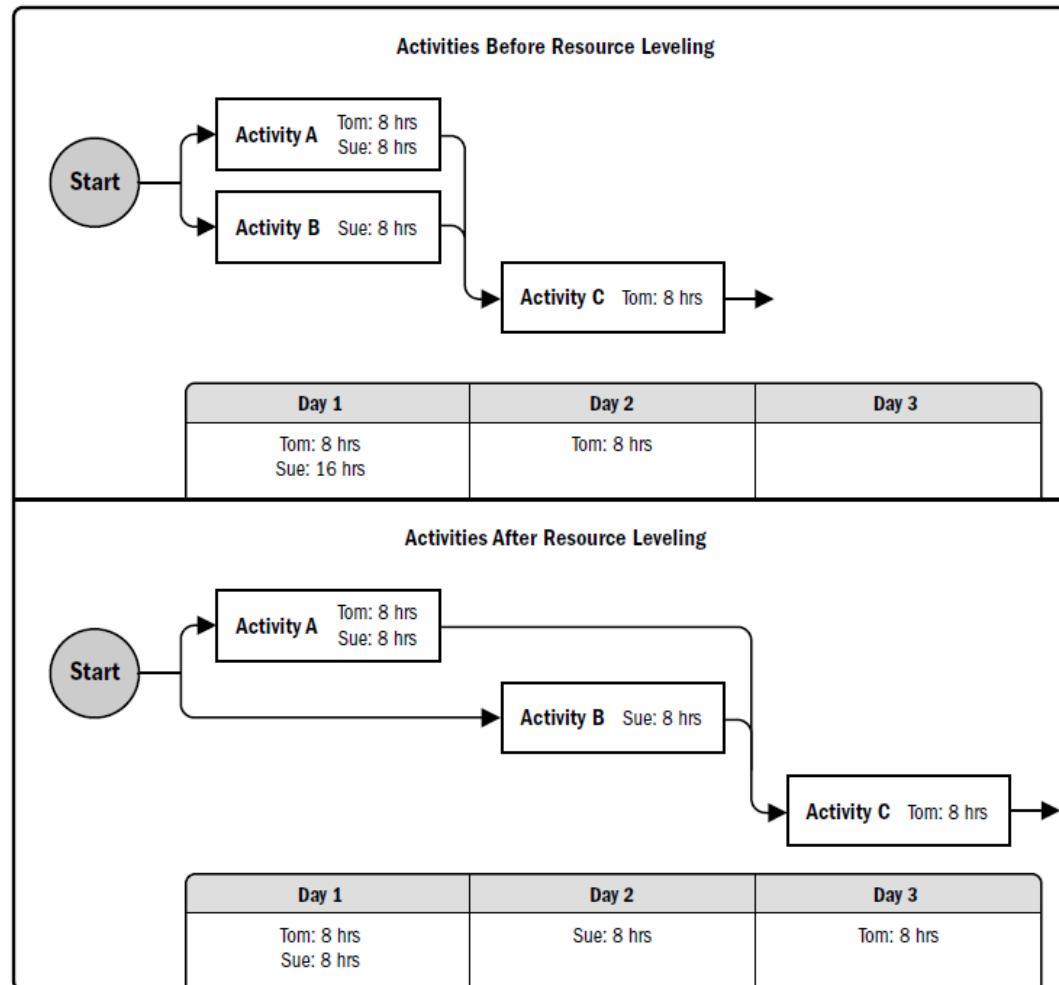


Figure 6-20. Resource Leveling

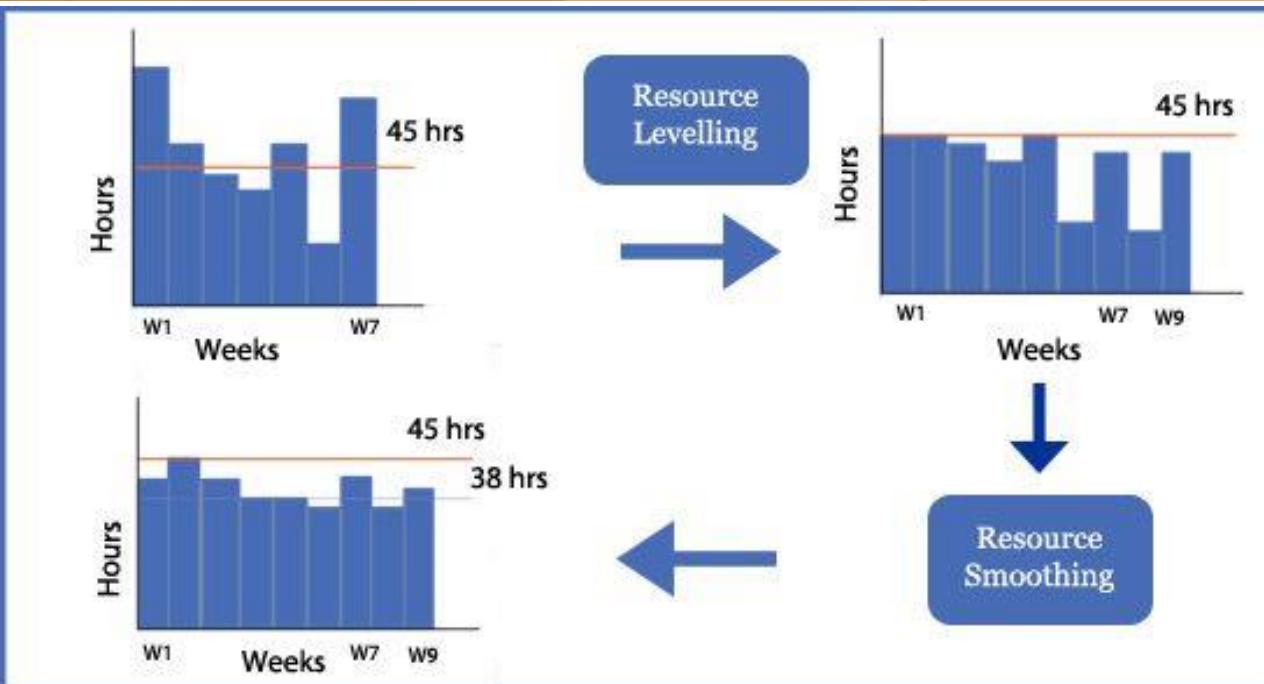
Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)



Resource Levelling:

- Notice Change in Duration (Critical path changed)
- Timelines extended to adjust resource constraint



Resource Smoothing:

- Critical path is not changed & completion date is same
- Activities may be delayed within their free & total float.

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

TT

Resource optimization

الاستغلال الأمثل للموارد

➤ Resource smoothing تمهيد الموارد.

- ✓ A technique that **adjusts** the activities of a schedule model such that the requirements for resources on the project do not exceed certain **predefined resource limits**.

الأسلوب الذي يضبط أنشطة نموذج جدول زمني ما بحيث لا تتعدي الاحتياجات إلى الموارد في المشروع قيود معينة مفروضة على الموارد مسبقاً

- ✓ Resource smoothing, as opposed to resource leveling, the project's critical path is not changed and the completion date may not be delayed.
- ✓ Activities may only be delayed within their free and total float.
- ✓ The project's **critical path is not changed** and the completion date may **not** be delayed.

لا يتم تغيير المسار الحرج للمشروع وقد لا يتغير تاريخ الانتهاء للمشروع

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

TT

Data Analysis

➤ What-if scenario analysis تحليل الخيارات الافتراضي.

- Is the process of evaluating scenarios in order to predict their effect, positive or negative, on project objectives. ex (a Strike) الاضراب

هو عملية تقييم السيناريوهات من أجل التنبؤ بتأثيرها، الإيجابي أو السلبي، على اهداف المشروع.

➤ Simulation محاكاة

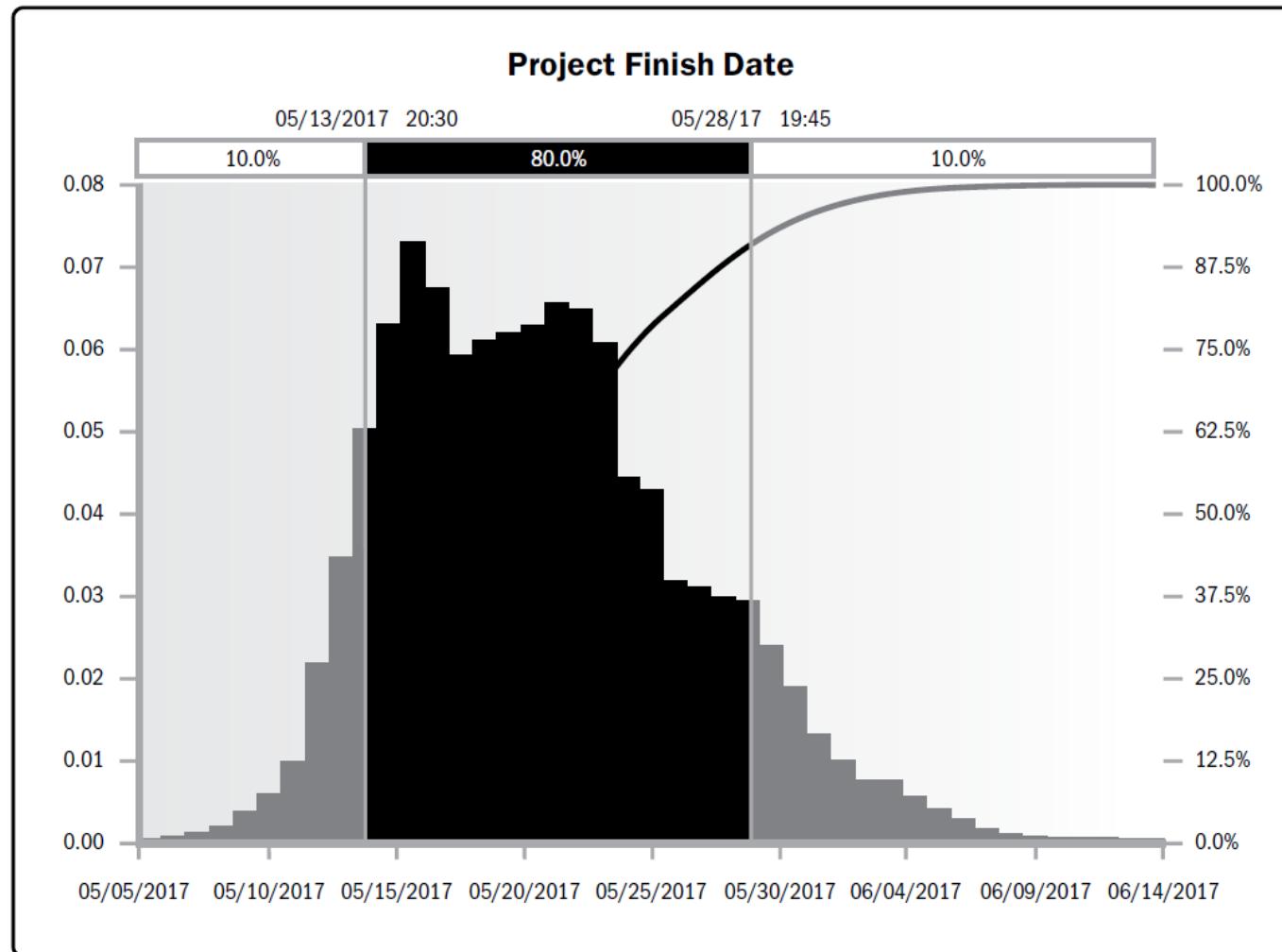
- Simulation models the combined effects of individual project risks and other sources of uncertainty to evaluate their potential impact on achieving project objectives.

مجموعة من التأثيرات لمخاطر المشروع الفردية وغيرها من مصادر الشك لتقييم تأثيرها المحتمل على تحقيق أهداف المشروع

- The most common simulation technique is Monte Carlo analysis.
- example, there is a 90% probability of completing the project by May 28.

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

TT

Schedule Compression

ضغط الجدول الزمني

- Schedule compression techniques are used to shorten or accelerate the schedule duration without reducing the project scope.

تستخدم أساليب ضغط الجدول الزمني لتقصير أو تعجيل مدة الجدول الزمني دون التقليل من نطاق المشروع.

Crashing: A technique used to shorten the schedule duration by adding resources.

- Examples of crashing include approving overtime, bringing in additional resources
- Crashing works only for activities on the critical path.

Fast tracking: Activities are performed in parallel.

تنفذ الأنشطة على التوازي

- An example is constructing the foundation for a building before completing all of the architectural drawings.

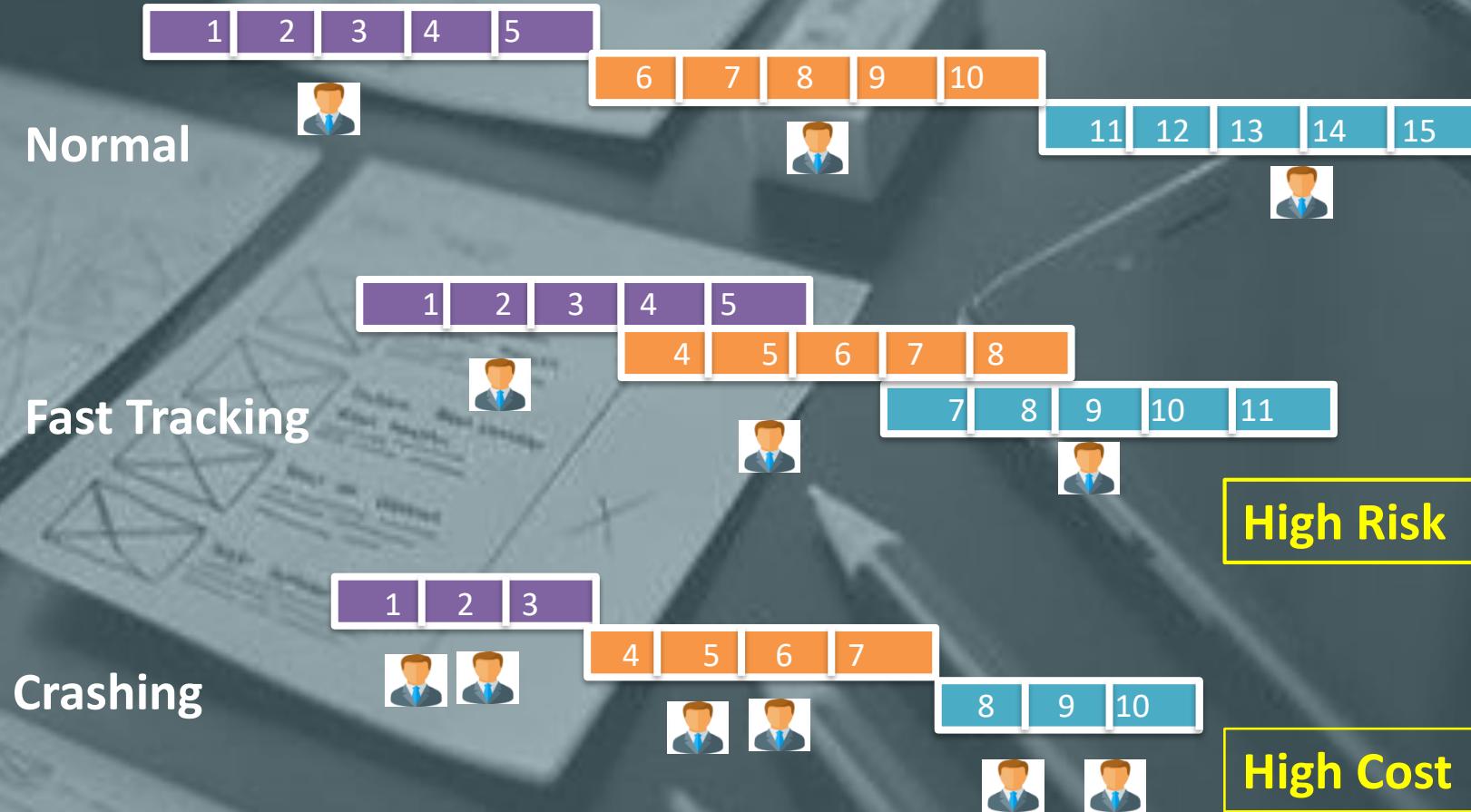
مثال ذلك بناء الأساس لمبني قبل إتمام كافة الرسومات المعمارية

- Fast tracking may result in rework and increased risk.

إعادة تنفيذ العمل وزيادة المخاطر

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

o

Schedule Baseline

الخط المرجعي للجدول الزمني

- Is the **approved version of a schedule model** that can be changed only through **formal change control procedures**.
هو الإصدار المعتمد لنموذج الجدول الزمني
- Used as a basis for comparison to actual results.
يستخدم كأساس للمقارنة مع النتائج الفعلية
- During monitoring and controlling, the **approved baseline dates** are **compared to the actual start and finish dates** to determine if variances have occurred.
أثناء المراقبة والتحكم، يتم مقارنة تواريخ الخط المرجعي المعتمدة بتواريخ البدء والانتهاء الفعلية لتحديد ما إذا وجدت هذه الفروق
- The schedule baseline is a **component** of the project management plan.

يعتبر الخط المرجعي للجدول الزمني من عناصر خطة إدارة المشروع

Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

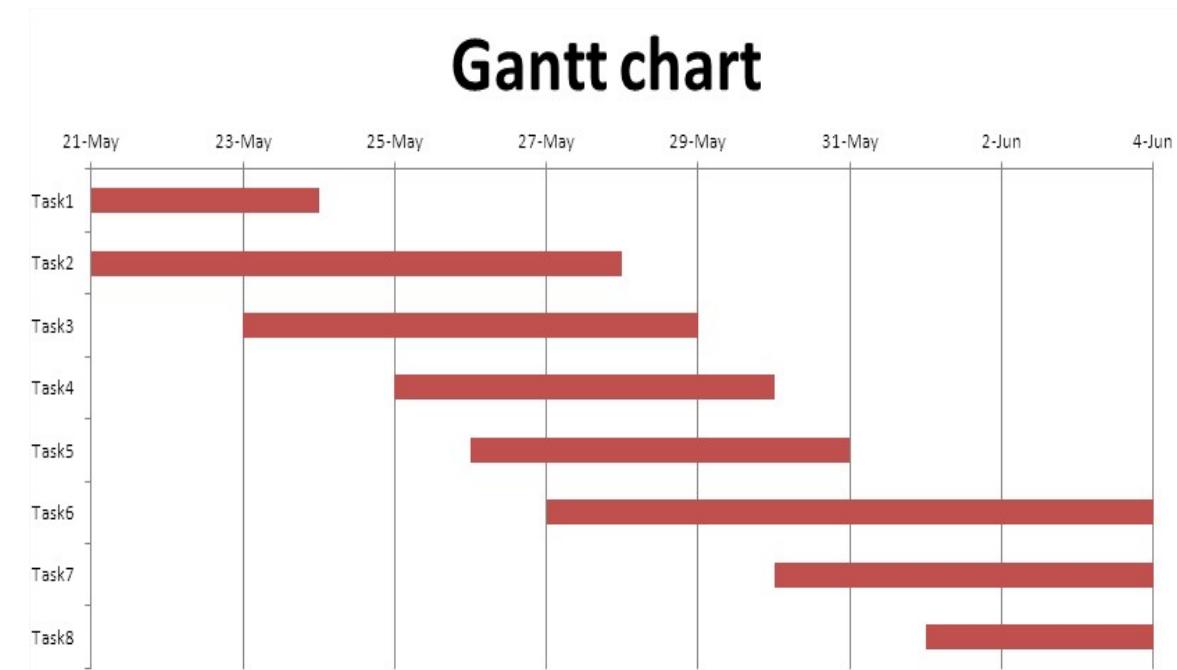
- o Project Schedule

الجدول الزمني للمشروع

يعد الجدول الزمني أحد المخرجات الهامة، ويمكن تمثيله بالمخططات الشرطية او مخططات الأهداف او المخططات الشبكية.

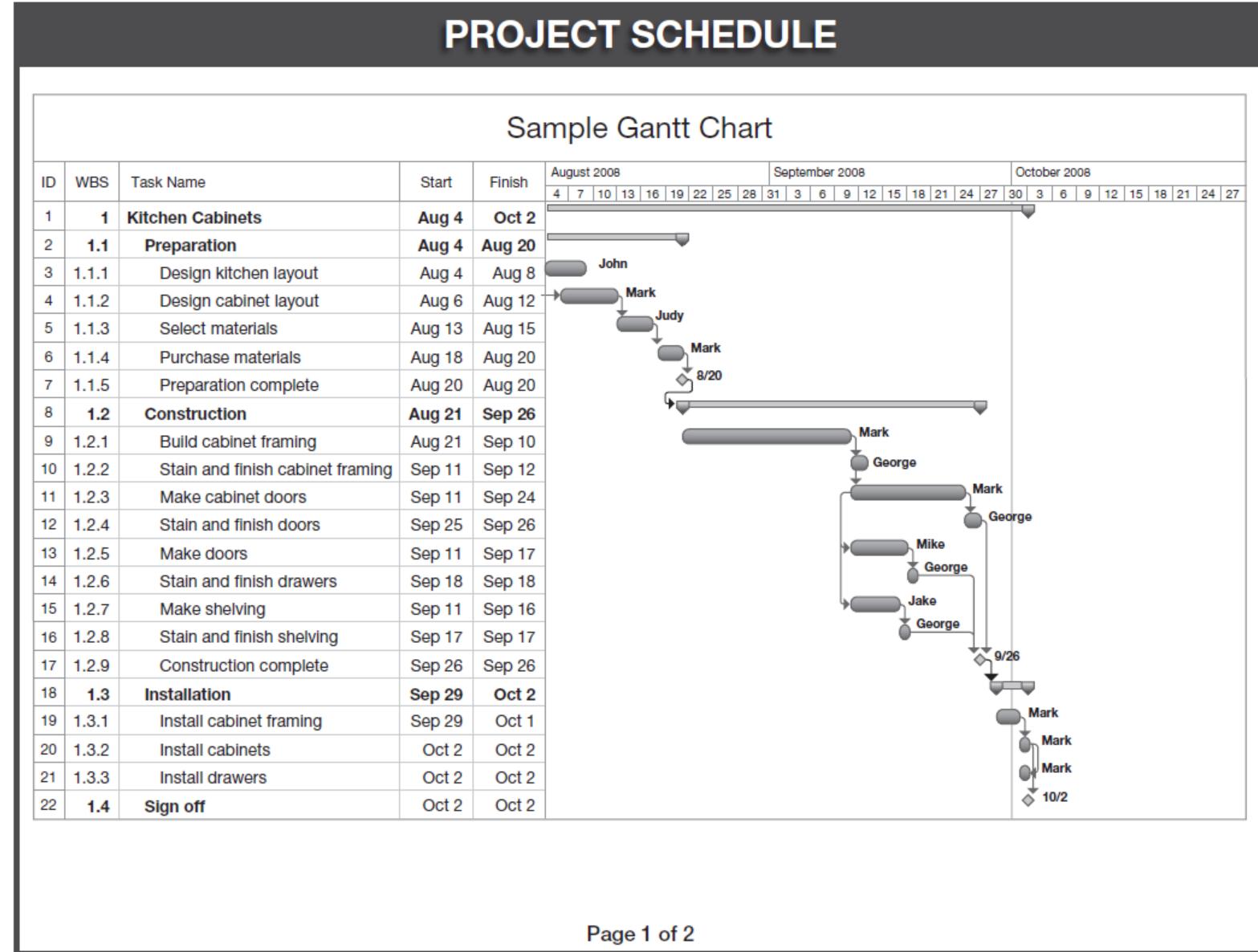
Bar charts

- Also known as Gantt charts, bar charts



Bar charts

- Also known as Gantt charts, bar charts



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

- o

Project Schedule

الجدول الزمني للمشروع

Milestone charts

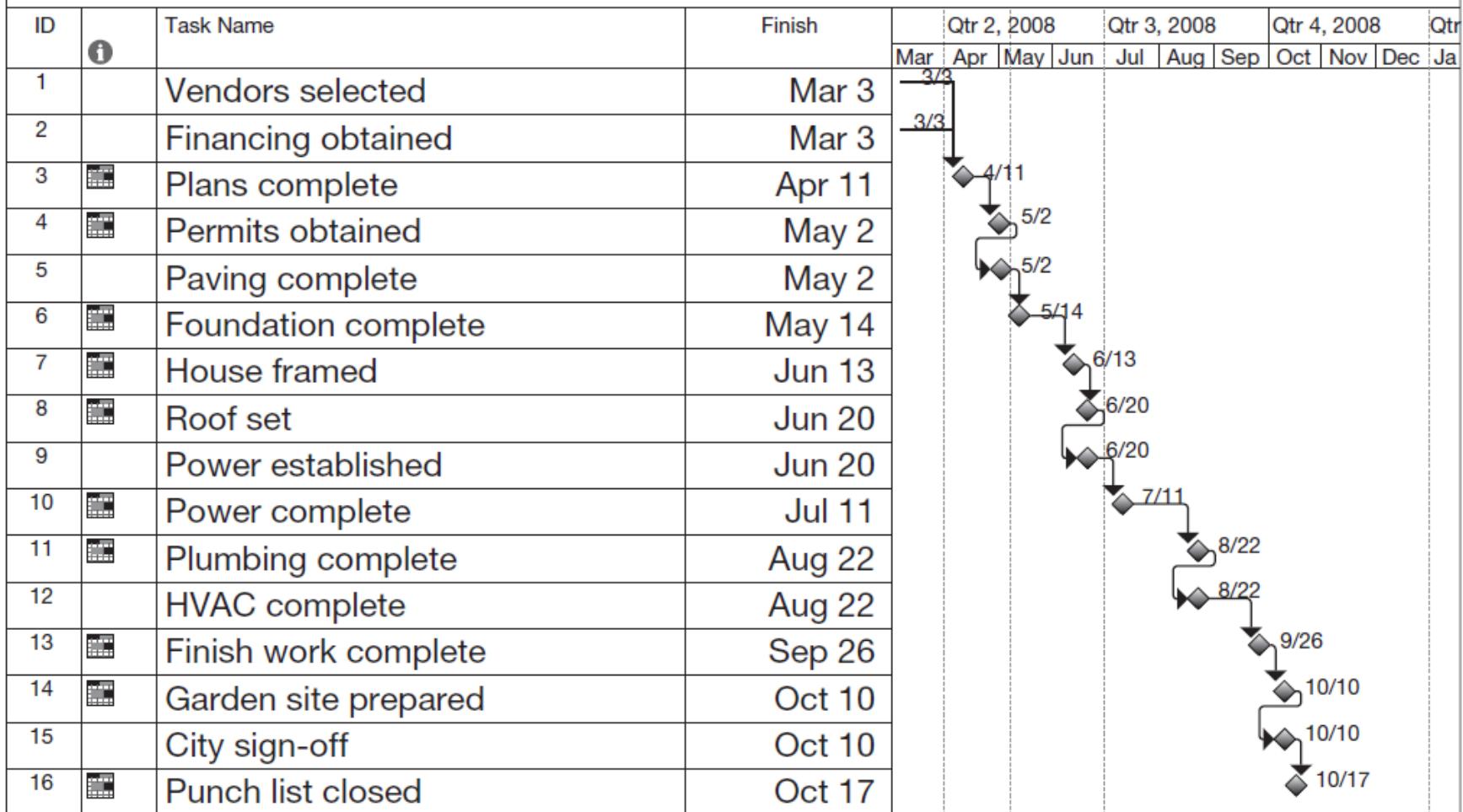
- Only identify the scheduled start or completion of major deliverables and key external interfaces

تحدد فقط بداية الجدول الزمني أو استكمال التسليمات الرئيسية والواجهات الخارجية الرئيسية.

ID	Activity Name	Duration	Jan	Feb	March	April
01	Substructure	0	◆			
02	Superstructure	0		◆		
03	Finishing Works	0			◆	

PROJECT SCHEDULE

Sample Milestone Chart



Lecture 03 : Project Schedule Management

5. Develop Schedule (Planning)

o

Change Request

- Modifications to the project scope or project schedule may result in change requests to the scope baseline, and/or other components of the project management plan.

من الممكن أن ينتج عن إجراء تعديلات على نطاق المشروع أو الجدول الزمني للمشروع طلبات تغيير على الخط المرجعي للنطاق وغيرها من مكونات خطة إدارة المشروع

Lecture 03 : Project Schedule Management

6. Control Schedule (M/C)



Lecture 03 : Project Schedule Management

6. Control Schedule (M/C)

➤ Control Schedule is the process of :

- Monitoring the status of the project to update the project schedule and managing changes to the schedule baseline.
 - عملية مراقبة حالة المشروع من أجل تحديث الجدول الزمني للمشروع وإدارة التغييرات التي تطرأ على الخط المرجعي للجدول الزمني.

❖ The key benefit of this process:

- ✓ The schedule baseline is maintained throughout the project
 - ✓ الحفاظ على الخط المرجعي للجدول الزمني على مدار المشروع.

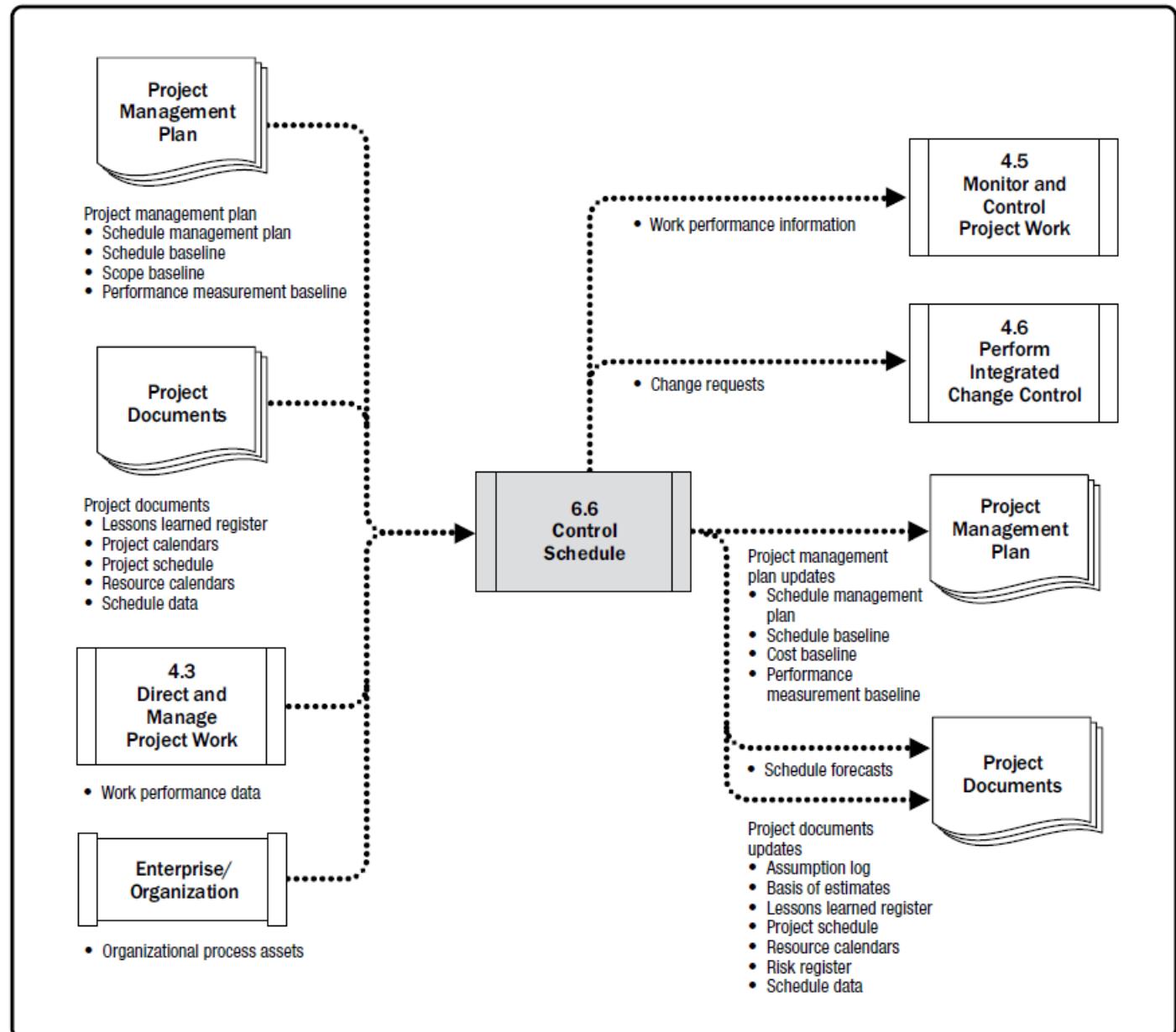


Figure 6-23. Control Schedule: Data Flow Diagram

Project Schedule Management

(6) Control Schedule



Input

1. Project management plan
2. Project documents
3. Work Performance Data
4. Organizational process assets



Tools &
Techniques

1. Data analysis
2. Critical path method
3. Project management information system (PMIS)
4. Resource optimization techniques
5. Leads and lags
6. Schedule compression



Outputs

1. Work Performance Information
2. Schedule forecasts
3. Change requests
4. Project management plan updates
5. Project documents updates

Lecture 03 : Project Schedule Management

6. Control Schedule (M/C)

TT

Data analysis

Earned value analysis

تحليل القيمة المكتسبة

Performance Reviews

مراجعةات الأداء

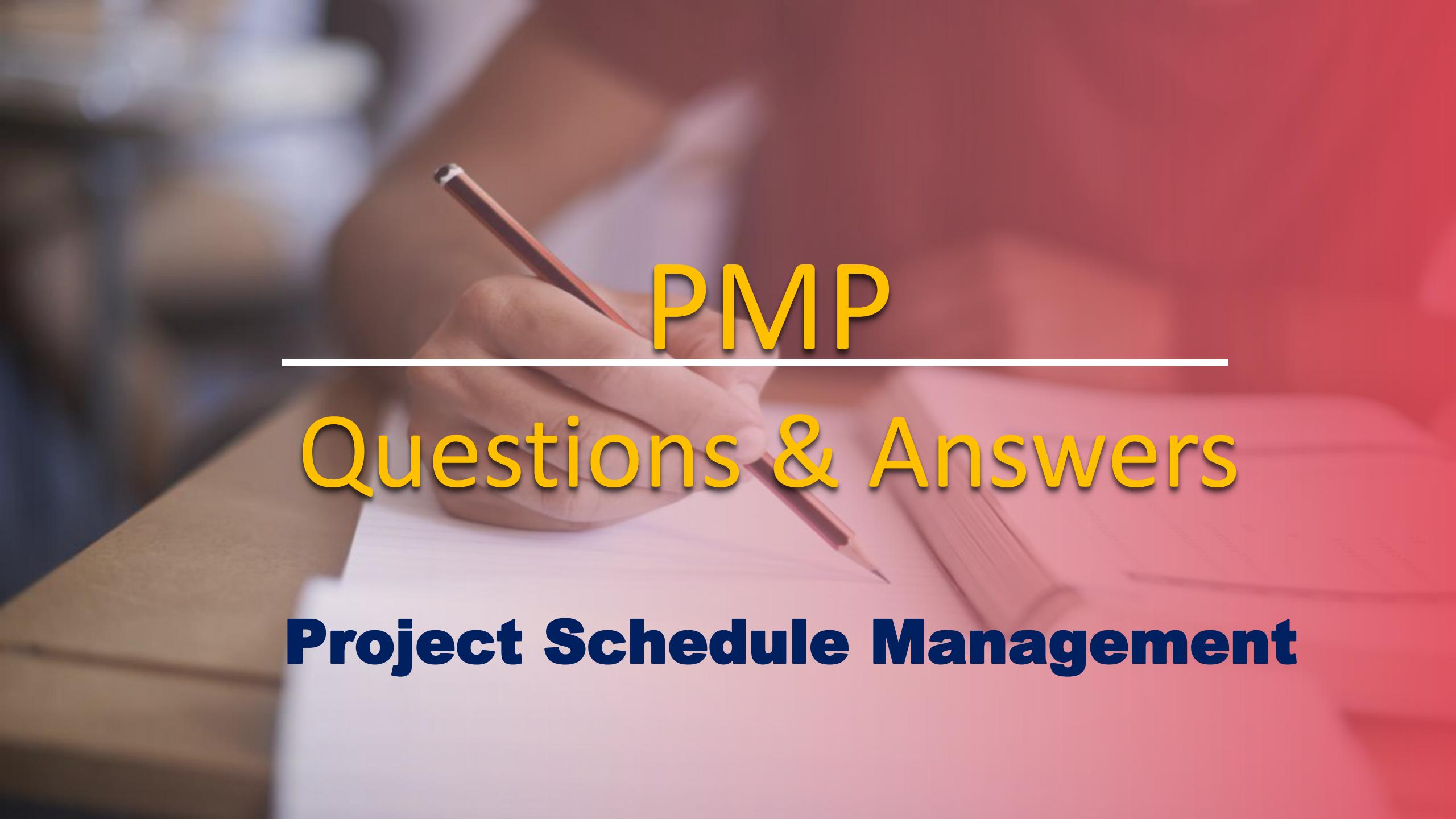
Measure, compare, and analyze schedule performance against the schedule baseline such as actual start and finish dates, percent complete, and remaining duration for work in progress.

قياس ومقارنة أداء الجدول الزمني مقابل الخط الزمني المرجعي للجدول الفعلي للبدء والانتهاء، والنسبة المئوية للالكمال، والفترة المتبقية للعمل الجاري

Trend analysis

Examines project performance over time to determine whether performance is improving or deteriorating.

يفحص تحليل الاتجاه أداء المشروع بمرور الوقت لتحديد ما إذا كان الأداء يتحسن أم ينحدر

A close-up photograph of a person's hands writing in a notebook with a pencil. The hands are positioned in the upper left corner of the frame, with one hand holding the pencil and the other hand resting on the page. The notebook has horizontal ruling lines. The background is blurred, showing what appears to be a wooden desk and some papers.

PMP

Questions & Answers

Project Schedule Management



Q1) You are the project manager of a project. As part of the planning process, you use a planning technique to subdivide the project scope and deliverables into smaller, more manageable components. What is this technique called?

A- Decomposition

B- Rolling Wave Planning

C- Expert judgment

D- Deconstruction

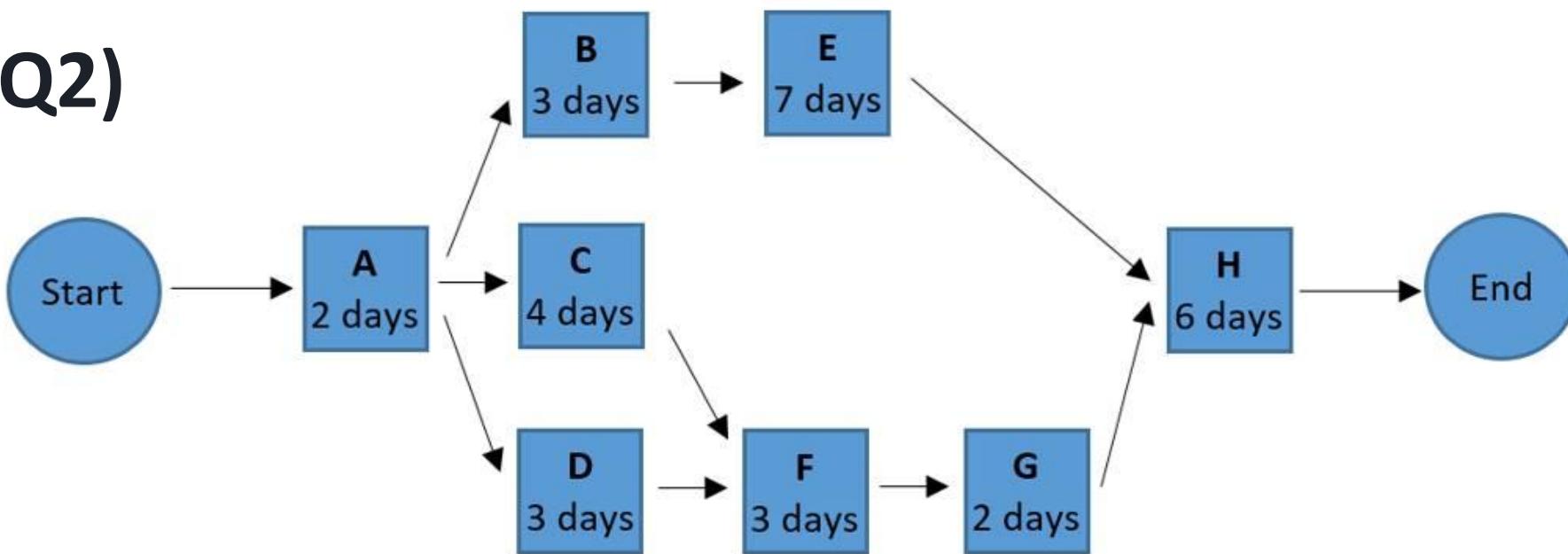
PMBOK 158

Correct answer is (A). Decomposition is the process of subdividing the project scope and deliverables into smaller, more manageable components. [PMBOK 6th edition, Page 158]





Q2)

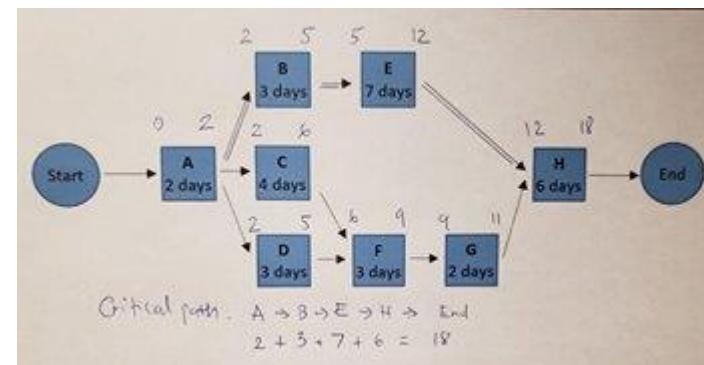


What is the shortest time possible to complete this project? (critical path)

- A. 17 days**
- B. 18 days**
- C. 20 days**
- D. 22 days**



B



VERY IMPORTANT

BY: EL-Sayed Mohsen , PMP®, PMI- RMP®



Q3) You are completing the sequence of activities and note that one of your activities can not proceed until consent is granted by the local government agency. This is an example of what sort of dependency?

A- Discretionary

B- External

C- Environmental

D- Mandatory

PMBOK 192

Correct answer is (B). External dependencies involve a relationship between project activities and nonproject activities. These dependencies are usually outside of the project team's control. [PMBOK 6th edition, Page 192]



B



Q4) The amount of time an activity can be delayed without delaying any successor activity, is known as:

A- Lead

B- Free Float

C- Lag

D- Total Float



PMBOK 210

Correct answer is (B). Free Float is the amount of time that a schedule activity can be delayed without delaying the early start date of any successor or violating a schedule constraint.
PMBOK® Guide, 6th Ed; Ch 6, Pg 210



Q5) During the execution of a project, the project manager feels that a major adjustment to the project schedule needs to be made. This adjustment will affect the project baselines. What should be done as the first step?

A- Issuing a Change Request

B- Adjusting the project schedule

C- Updating the project documents

D- Asking the sponsor for an intervention

PMBOK 229

Correct answer is (A). any adjustment on the Project baselines need to Proper change control procedures needs to be followed. This requires a change request to be issued as the first step. [PMBOK 6th edition, Page 229]





Q6) A project's WBS has been decomposed into activities. However, the project activities are still very complex and the activity duration cannot be estimated with a reasonable degree of confidence. Which of the following estimating tools and techniques can be used in this case that would produce the best results?

A- Expert Judgment

PMBOK 202

B- Bottom-Up Estimating

C- Alternative Analysis

D- Published Estimating Data

Correct answer is (B). Think about which of the answer choices enables the highest degree of activity decomposition. The duration cannot be estimated because the activities are complex. Therefore, the best way is to further decompose the activities into smaller parts to develop a better estimate. This technique is called Bottom-Up Estimating.





Q7) You are the project manager of a construction company. You know that the builders start painting the walls 30 days after they start installing the drywall. This waiting time can also be referred to as:

A- Lead time

B- Project float

C- Constraint

D- Lag

PMBOK 193

Correct answer is (D). lag is the amount of time a successor activity will be delayed with respect to a predecessor activity. Waiting time is also referred to as lag. [PMBOK 6th edition, Page 193]





Q8) which of these types of precedence relationships is most commonly used in the Precedence Diagramming Method?

A- Start to Start

B- Finish to Finish

C- Finish to Start

D- Start to Finish



C

PMBOK 190

In PDM, FS is the most commonly used type of precedence relationship. The SF relationship is very rarely used, but is included to present a complete list of the PDM relationship types.



Q9) You are running one week behind on a project due to a late delivery by a vendor. You are forced to compress your project schedule due to a government-mandated end date that constrains your project. After meeting with your team, the decision is to work several tasks in parallel that were scheduled to be run consecutively. This is an example of

- A- Risk Acceptance
- B- Crashing
- C- Resource Leveling
- D- Fast Tracking



D

PMBOK 215

◆ **Fast tracking.** A schedule compression technique in which activities or phases normally done in sequence are performed in parallel for at least a portion of their duration. An example is constructing the foundation for a building before completing all of the architectural drawings. Fast tracking may result in rework and increased



Q10) During a presentation to management, you want to display the project schedule with only the key deliverables displayed. What is the correct tool for this purpose?

- A- Project schedule network diagram**
- B- Critical path network**
- C- Milestone chart**
- D- Critical chain diagram**



A milestone chart displays only the key deliverables and is simple and easy to understand. [PMBOK 6th edition, Page 218]



Q11) Which of these is not an established Estimate Activity Durations technique?

- A- Three Point Estimating**
- B- Parametric Estimating**
- C- Analogous Estimating**
- D- Critical Path Estimation**



PMBOK 195

Tools & Techniques

- .1 Expert judgment
- .2 Analogous estimating
- .3 Parametric estimating
- .4 Three-point estimating
- .5 Bottom-up estimating
- .6 Data analysis
 - Alternatives analysis
 - Reserve analysis
- .7 Decision making
- .8 Meetings



Q12) A manager asked to see a list of milestones in the project. This would be available as an output from the:

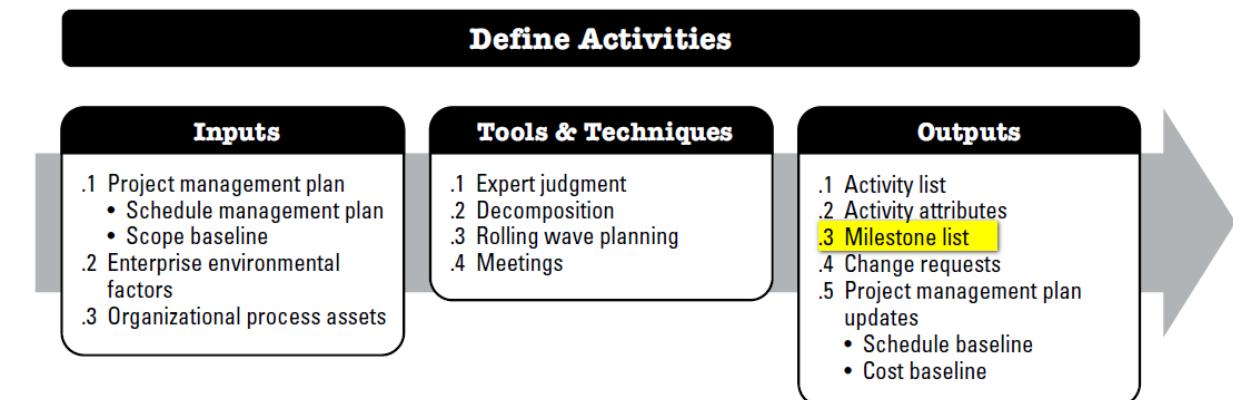
A- Sequence Activities process

B- Define Scope process

C- Estimate Activity Durations process

D- Define Activities process

PMBOK 183





Q13) A construction project requires that government environmental hearings be held prior to site preparation. What kind of dependency is this?

- A- External dependency**
- B- Discretionary dependency**
- C- Soft logic**
- D- Optional dependency**



This is called an external dependency. It involves a relationship between project and non-project activities (for example, government environmental hearings). [PMBOK 6th edition, Page 192]



Q14) A project manager estimates the work to be accomplished in the near term in detail at a low level of the Work Breakdown Structure (WBS). He estimates work far in the future as WBS components that are at a relatively high level of the WBS. What is this technique called?

- A- Decomposition**
- B- Rolling wave planning**
- C- Scope Creep**
- D- Earned value planning**

PMBOK 185



B

6.2.2.3 ROLLING WAVE PLANNING

Rolling wave planning is an iterative planning technique in which the work to be accomplished in the near term is planned in detail, while work further in the future is planned at a higher level. It is a form of progressive elaboration applicable to work packages, planning packages, and release planning when using an agile or waterfall approach.



Q15) Jane is worried about her project because many of her tasks are moving slowly, and two critical tasks may slip. She conducts a thorough resource analysis and finds out that there are five people who will be free next week. She would like to assign those people to finish her tasks early and prevent the project completion date from slipping. This is an example of.

- A- Management reserves
- B- Resource Leveling
- C- Crashing
- D- Fast tracking

PMBOK 215

◆ **Crashing.** A technique used to shorten the schedule duration for the least incremental cost by adding resources. Examples of crashing include approving overtime, bringing in additional resources, or paying to expedite delivery to activities on the critical path. Crashing works only for activities on the critical path where additional resources will shorten the activity's duration. Crashing does not always produce a viable alternative and may result in increased risk and/or cost.

ANSWERS

C



Q16) You are a project manager, you requested others to help in estimate duration, who is the best person can assist you?

A- Project Sponsor

B- All Stakeholders

C- Customer

D- Subject Matter Expert (SME)



PMBOK 200

6.4.2.1 EXPERT JUDGMENT

Described in Section 4.1.2.1. Expertise should be considered from individuals or groups with specialized knowledge or training in the following topics:

- ◆ Schedule development, management, and control;
- ◆ Expertise in estimating; and
- ◆ Discipline or application knowledge.



Q17) You are a Project manager in construction Project . If an pessimistic estimate (P) =12 days, optimistic estimate for an activity (O) = 8 days, Most likely (M) =10 days. What is the estimate activity duration by triangular distribution?

- A- 9.5 DAYS**
- B- 10 DAYS**
- C- 11 DAYS**
- D- 9 DAYS**



$$12+8+10 / 3 = 10$$



Q18) You are a project manager in XYZ project for your organization. A strike by local workers occurs due to the lateness workers' payments. That leads to delays in a major component delivery. What could have been done differently to prevent this type of situation?

- A- Crashing**
- B- What-if scenario analysis**
- C- Leads and Lags**
- D- Fast Tracking**

PMBOK 213

◆ **What-if scenario analysis.** What-if scenario analysis is the process of evaluating scenarios in order to predict their effect, positive or negative, on project objectives. This is an analysis of the question, "What if the situation represented by scenario X happens?" A schedule network analysis is performed using the schedule to compute the different scenarios, such as delaying a major component delivery, extending specific engineering durations, or introducing external factors, such as **a strike** or a change in the permit process. The outcome of the what-if





Q19) You are starting with your team to map the schedule required for each task. You analyzed few tasks where:

Task A had 5 days to complete

Task B had 3 days and follow task A

Tack C had 2 days and follow task B

Task D had 2 days and follow tasks (A & B)

Task E had 3 days and follow tasks (C & D)

While having all tasks as FS relation you counted the float for task D which was:

A- 1 Day

B- 2 Days

C- 0 Days

D- 3 Days

First you should Drawing the Network then you will found that Activity D in the Critical Path, any Activity on the Critical path the Float equal (0)



C



Q20) You are using a methodology that calculates the amount of float on various paths in the network diagram to determine the minimum project duration. What tool or technique are you using?

A- Critical path method

B- Critical chain method

C- Parametric estimating

D- Three- point estimating

PMBOK 210

6.5.2.2 CRITICAL PATH METHOD

The critical path method is used to **estimate the minimum project duration** and determine the amount of schedule flexibility on the logical network paths within the schedule model. This schedule network analysis technique calculates the early start, early finish, late start, and late finish dates for all activities without regard for any resource limitations.





Q21) In any project there are deliverables that need to be produced. These deliverables are produced during the executing phase as the team carries out their assigned activities. During the planning phase, you wish to identify and document the specific actions to be performed to produce the deliverables. This is done as part of:

A- Define Activities

B- Decomposition

C- Define Scope

D- Sequence Activities

PMBOK 183

Correct answer is (A). Define Activities is the process of identifying and documenting the specific actions to be performed to produce the project deliverables. [PMBOK 6th edition, Page 183]





Q22) You are the project manager on a research project. You have received the news that your shipment of supplies will be delayed by two weeks due to bad weather.
What will be your FIRST step?

- A- Fast track the project to ensure that the project schedule is not delayed**
- B- Determine how much float is available in that task**
- C- Try to get additional supplies from an alternate location as soon as possible**
- D- Take corrective action to minimize the impact of delay**



B

Correct answer is (B). Before you take corrective measures, determine the impact of the delay in shipment. For example, if the task has 3 weeks float, you need not resort to options 1, 3, or



Q23) Your project SPI is 0.86, and the management has recommended that you should fast track the project. You agree with the management, but caution them that fast-tracking could:

A- Facilitate duration compression

B- Increase risk

C- Ensure activities are done in parallel, which would normally be done in sequence

D- Help shorten the project schedule without changing the project scope

PMBOK 215



B

Correct answer is (B). Fast-tracking may result in rework and increased risk. [PMBOK 6th edition, Page 215]

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