Informatik-Projektentwicklung
– Lecture 5 –

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Software Component Technology

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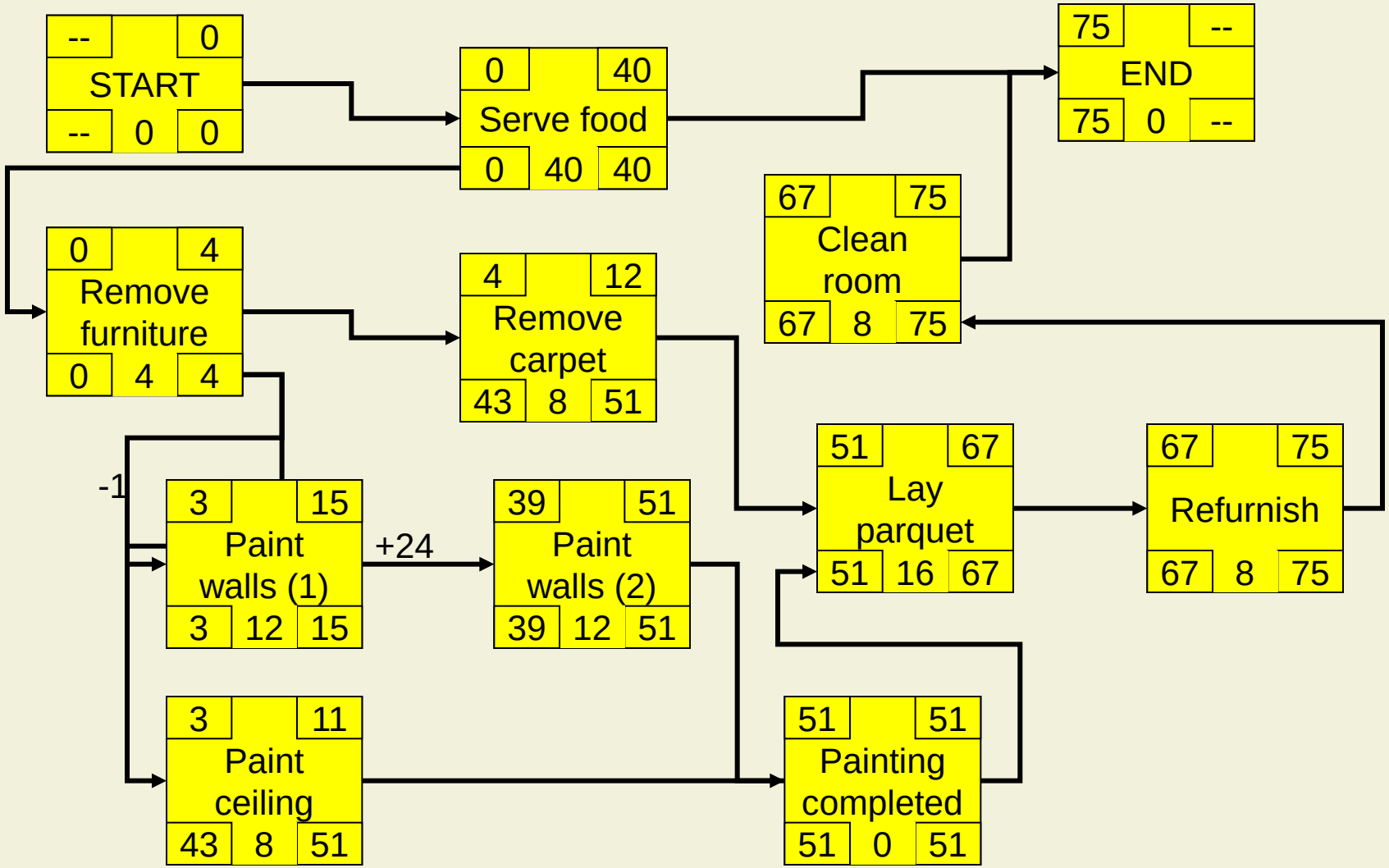
Project Planning

Which of the following is the BEST project management tool to use to determine the longest time the project will take?

a. WBS
b. Network diagram
c. Gantt chart
d. Project charter

Network Diagrams

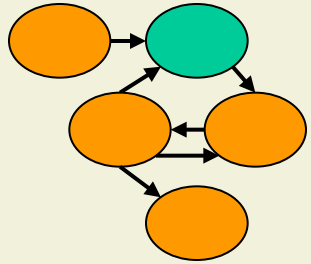


Schedule Analysis

The float of an activity is determined by:

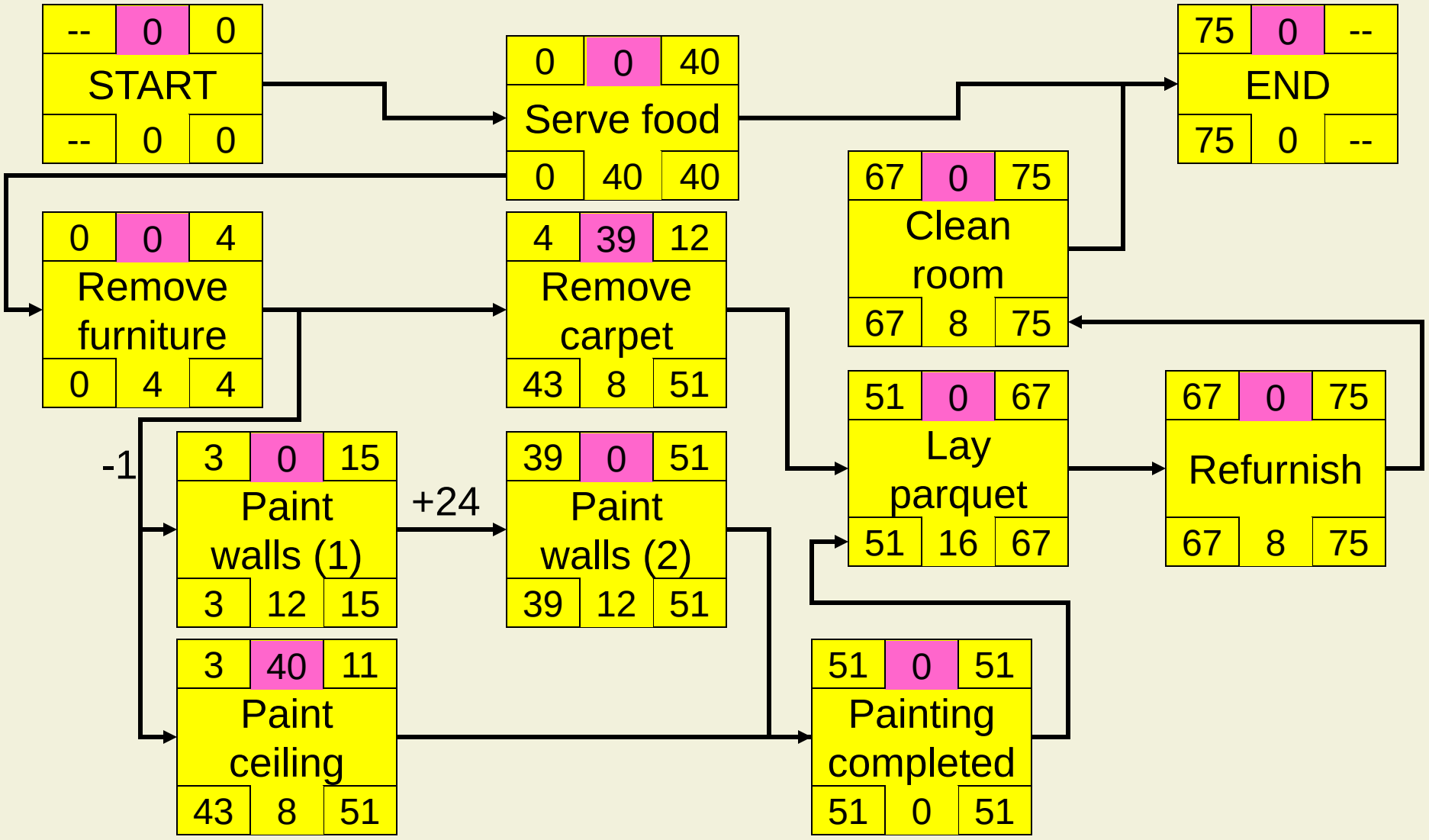
a. The waiting time between tasks
b. Lag
c. The amount of time the activity can be delayed before it delays the critical path
d. The amount of time the activity can be delayed before it delays one of its direct successor activities

Float



- Definition:
  The amount of time that an activity may be delayed from its early start without delaying the project finish date
- Float = LF – EF = LS – ES
- Interpretation
  - Float > 0: Time is available
  - Float = 0: Situation is critical
  - Float < 0: Project is behind
- Sometimes called *Total Float*, *Slack*, or *Total Slack*

Float Example

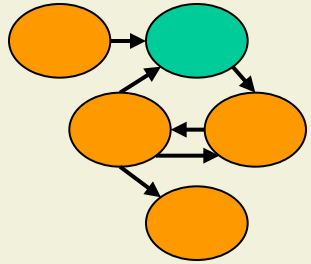


Schedule Analysis

The critical path in a schedule network is the path that:

a. Takes the longest time to complete
b. Must be done before any other tasks
c. Allows some flexibility in scheduling start time
d. Is not affected by schedule slippage

Critical Path



- Definition:
  The series of activities that determines the duration of the project (the longest path through the network)
- Sum of float on critical path is zero (or negative)
- Critical path is important
  - To shorten project duration
  - To focus progress control
  - To identify schedule risks
- There can be several critical paths in a project

Agenda for Today

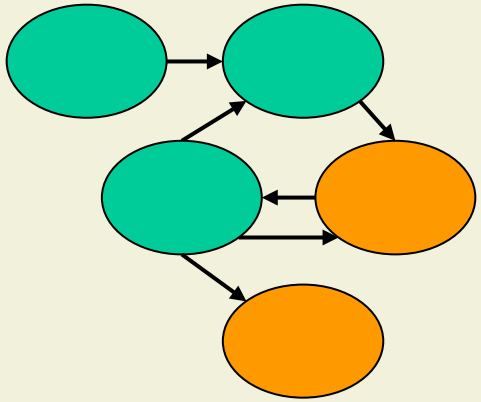
5. Cost Management

5.1 Estimating

5.2 Budgeting

5.3 Lifecycle Costing

5.4 Earned Value



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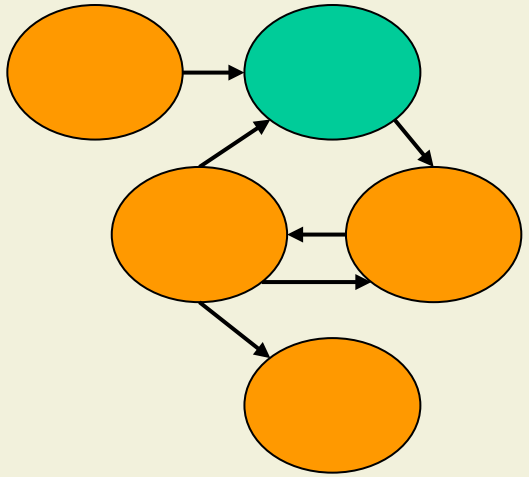
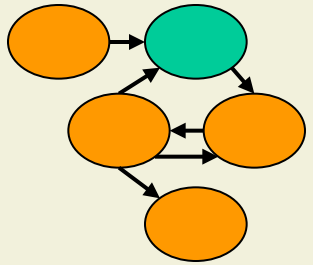
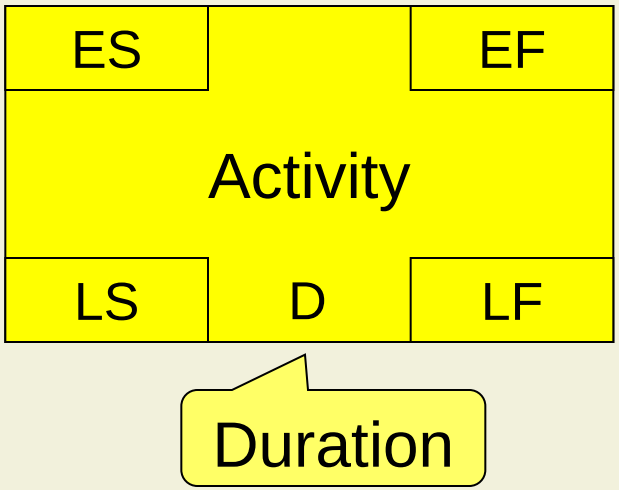


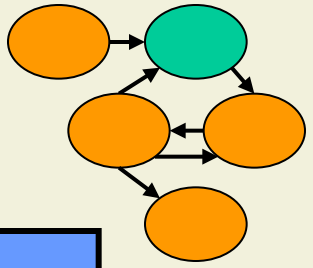
Effort Estimations

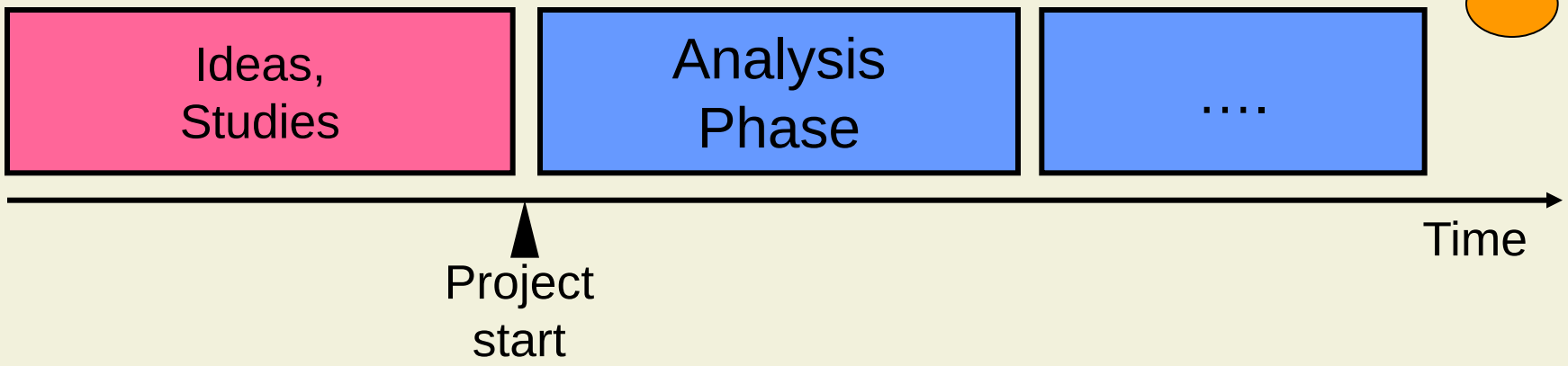


- Duration = Effort / Resources
- The effort of an activity is not known before the activity is completed
- Efforts have to be estimated as basis for planning



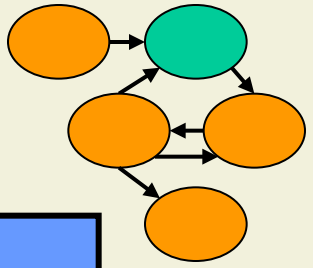
When to Estimate

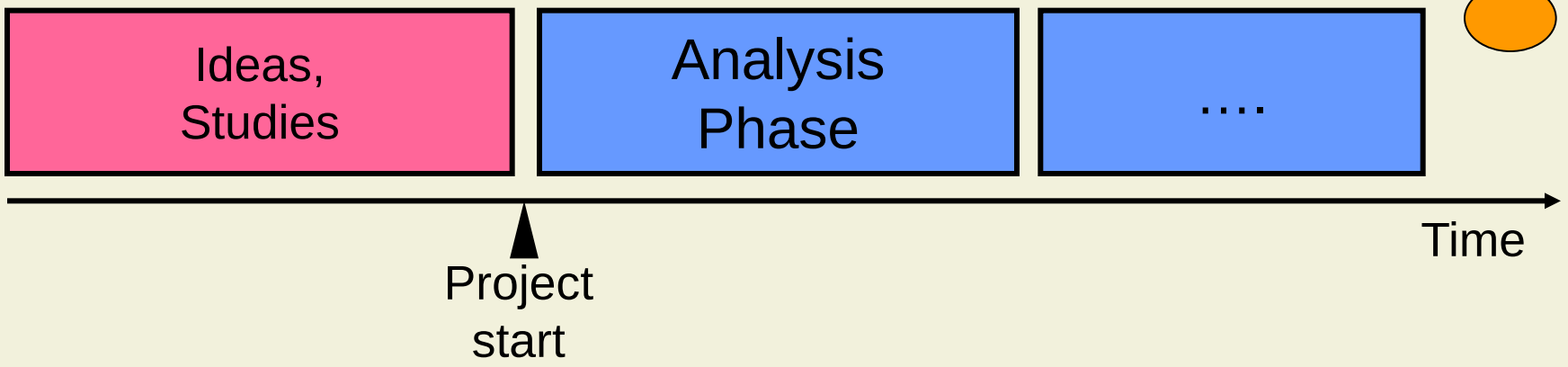




- When determining whether to bid on an opportunity
- After the WBS is developed
- When moving to the next phase of a project
- When the WBS changes
- When taking over a project to validate estimates

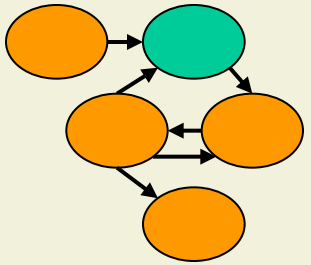
Estimate Types

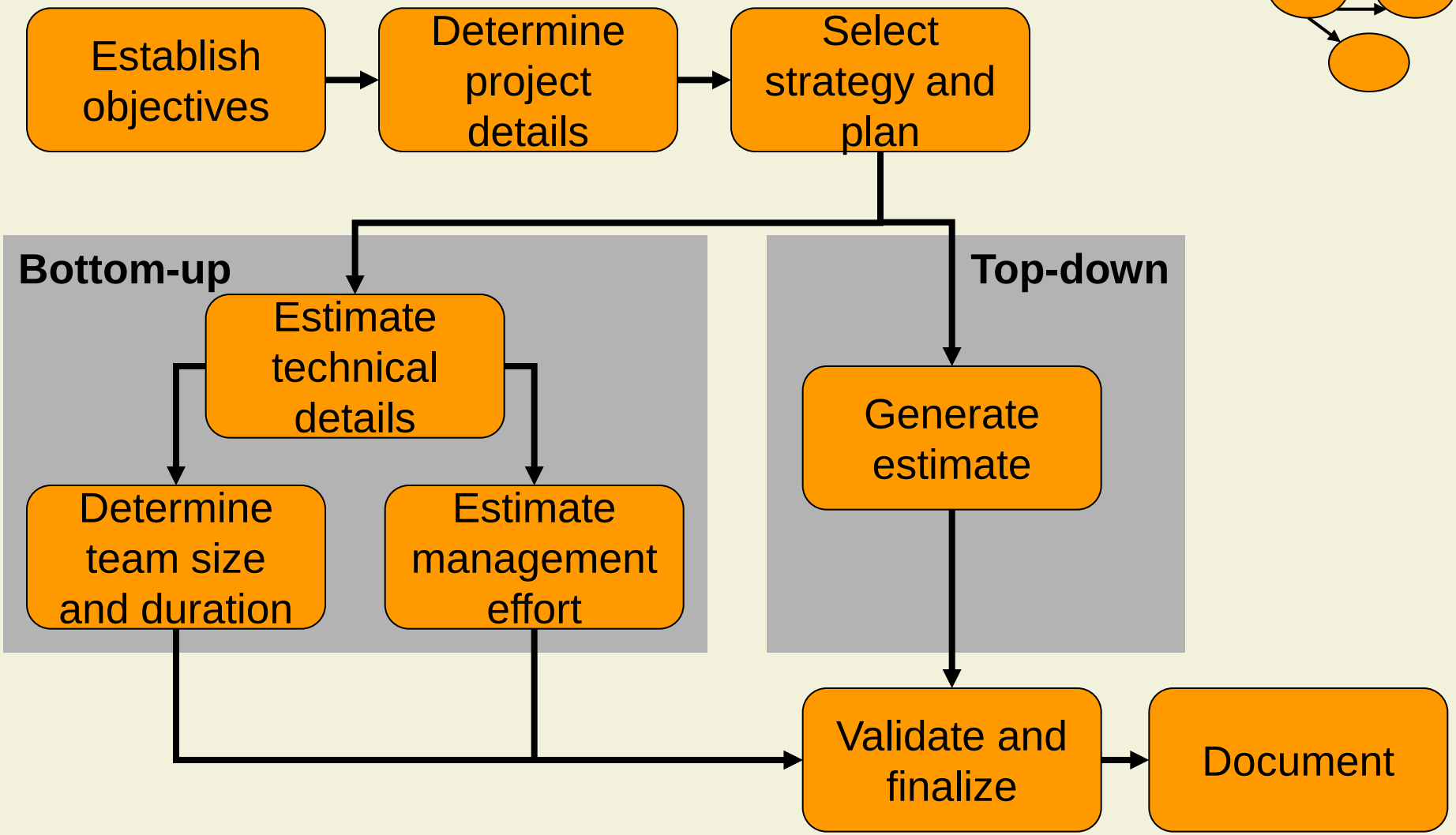




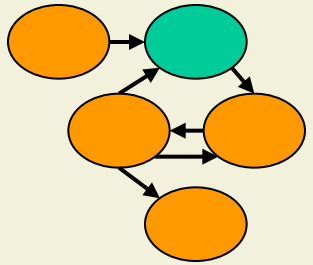
Rough order of magnitude	Budgetary	Definitive
-25 / +75% Initial estimates	-10 / +25% Decision making, response to proposals	-5 / +10% Project plan, proposals

Estimating Process

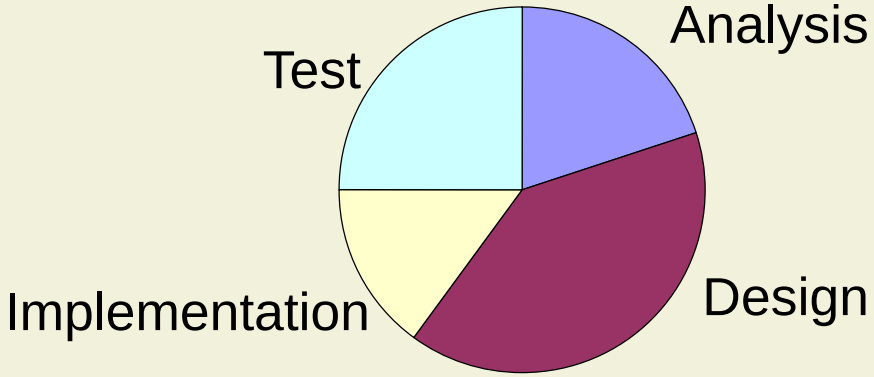




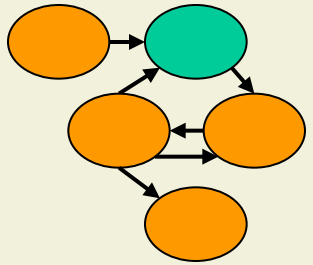
Top-Down Estimates



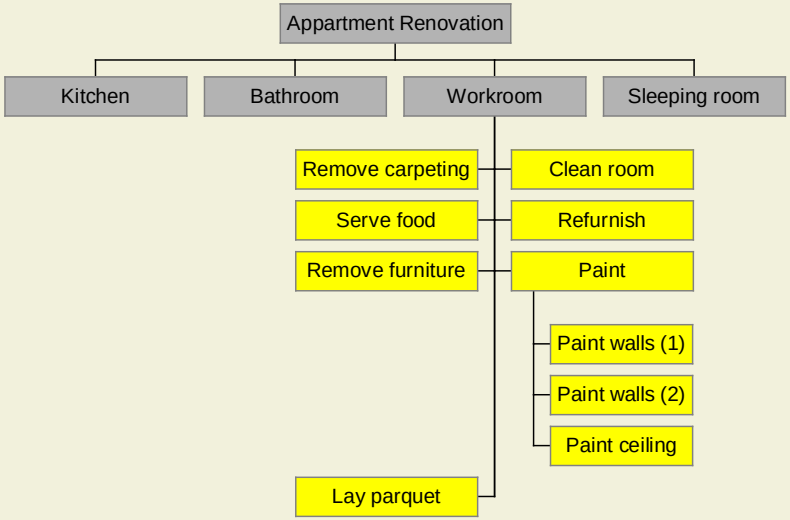
- Estimation by analogy or comparison
- Estimate is based on experience and historical data
- Characteristics
  - Less accurate than other methods
  - Quicker and less expensive than other methods
  - No WBS needed
- Typical figures for software development
  - Analysis 20%
  - Design 40%
  - Implementation 15%
  - Test 25%



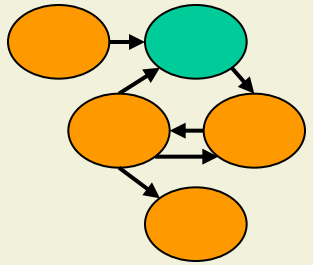
Bottom-up Estimates



- Estimating the effort for individual work packages or activities
- Cost and accuracy depends on size of the work packages or activities
- Characteristics
  - More accurate than other methods
  - Gains buy-in from team
  - Teams tend to pad estimates



Parametric Estimates



- Quantifiable estimating units
  - Lines of code, function points

	Sim.	Aver.	Comp.
S	1	4	9
M	3	7	12
L	7	10	16

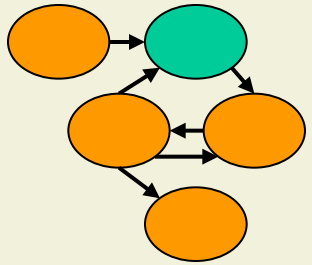
X

	Sim.	Aver.	Compl.
S	10	0	0
M	5	20	7
L	2	3	3

= 341

- Accuracy depends on
  - Reliable historical data
  - Quantifiable estimating units
  - Scalable model
- Cocomo (Constructive cost model)

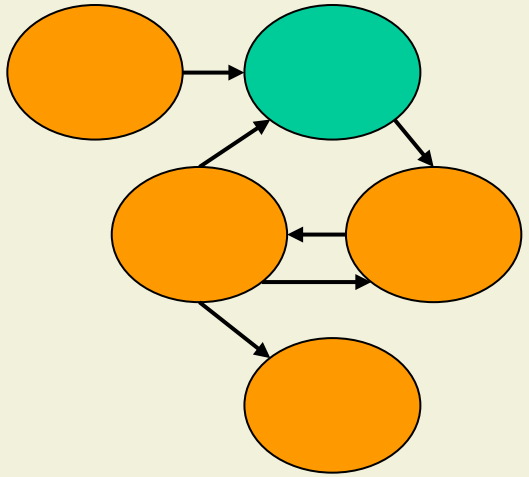
Cost Estimating: Summary



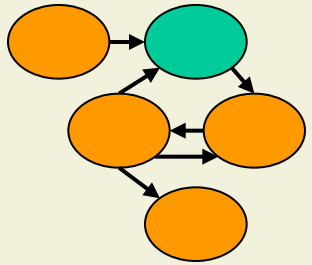
- Purpose
  - To develop an approximation (estimate) of the costs of the resources needed to complete project activities

Inputs	Tools & Techniques	Outputs
1. WBS 2. Resource requirements 3. Resource rates 4. Historical information	1. Analogous estimating 2. Parametric modeling 3. Bottom-up estimating	1. Cost estimates 2. Supporting detail 3. Cost management plan

5. Cost Management

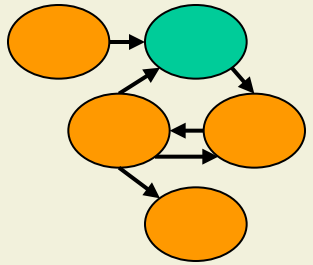


Direct and Indirect Costs



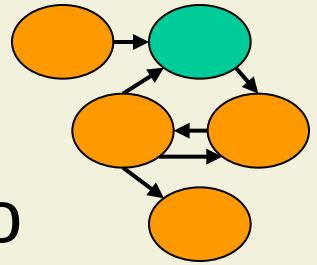
- Direct costs: Costs incurred for the benefit of a specific project
  - Salaries of project staff
  - Equipment bought specifically for the project
  - Travel expenses
- Indirect costs: Costs incurred for the joint benefit over multiple projects (“overhead”)
  - Accounting, quality assurance department
  - Line management
  - Rooms, electricity, heating

Unit Costs



- Projects have to budget for
  - Direct costs
  - A certain share of indirect costs
- Budgets are usually determined by using unit costs
  - Unit cost: Price per unit of a resource
  - Loaded rate: Including indirect costs
  - Unloaded rate: Without indirect costs
- Examples
  - Loaded day rate for senior IT consultant: CHF 3.500
  - Loaded day rate for internal developer: CHF 1.200

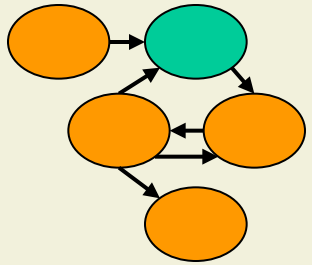
Effort, Duration, and Cost



- Effort: The number of labor units required to complete an activity
- Availability: Time a staff person is able to work
  - For long projects approximately 70% per person
- Productivity: The relative measure of work in a time unit

- Duration = (Effort / Productivity) / (Resources x Availability)
- Cost = (Effort / Productivity) x Unit Cost

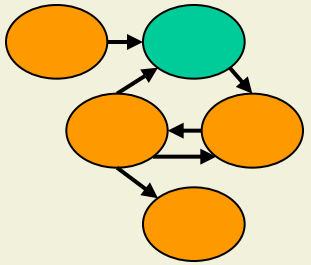
Cost Budgeting: Summary



- Purpose
  - To allocate the overall cost estimates to individual activities or work packages to establish a cost baseline for measuring project performance

Inputs	Tools & Techniques	Outputs
1. Cost estimates 2. WBS 3. Project schedule	1. Estimating techniques	1. Cost baseline

Pricing



- The price is often based on the costs and a margin
- Price = Costs / (1 - Margin)
- Example
  - Costs = CHF 1.000.000
  - Margin = 5%
  - Price = CHF 1.052.632
- Price is influenced by
  - Market situation
  - Business strategy

5. Cost Management

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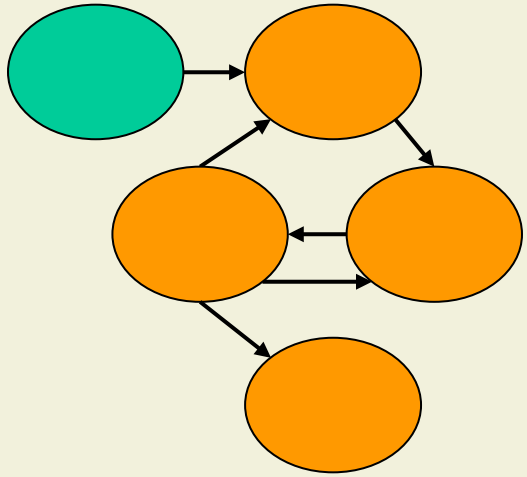
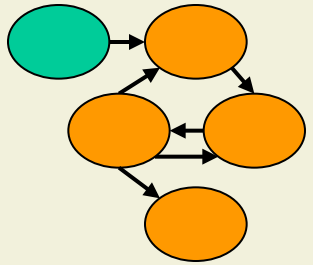
5.4 Earned Value

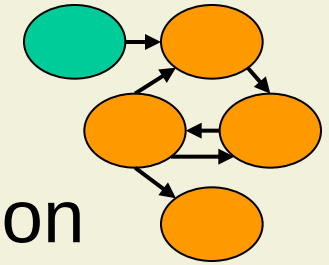


Lifecycle Costing

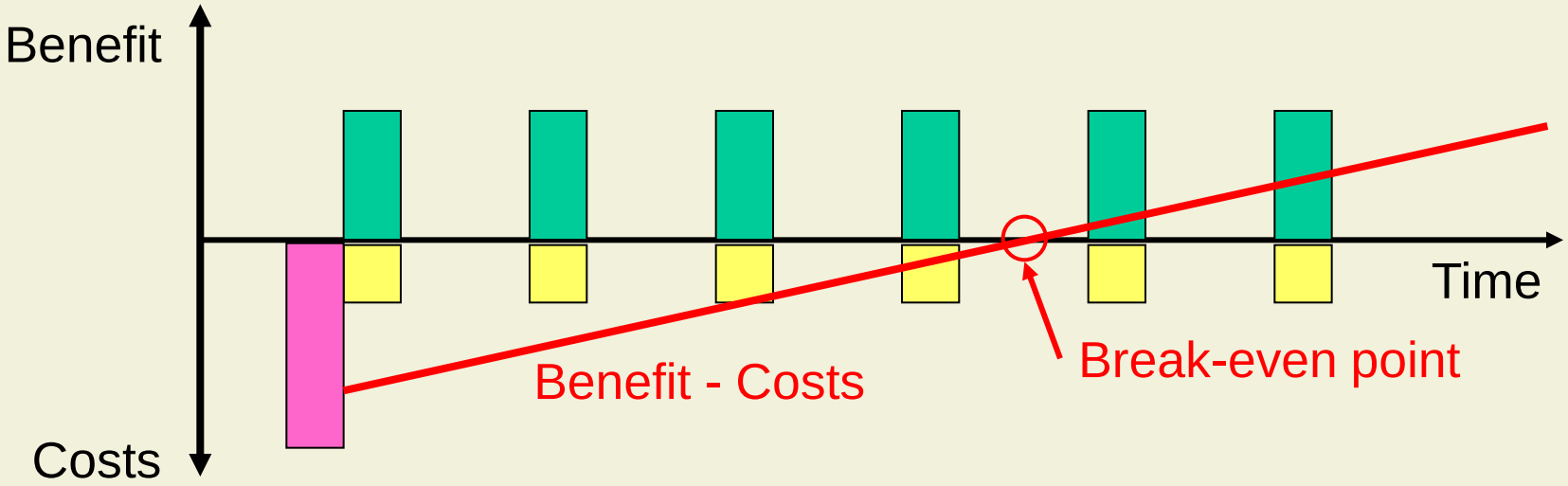


- Profitability of a project depends on the product or service it creates
- Lifecycle costing considers cost for development and operation of a product
  - Maintainability
  - Usability
  - Reliability
- Buzzword: Total cost of ownership

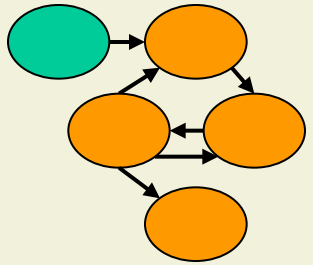
Payback Period



- The time until the development and operation costs for a product are amortized by its benefit
- Important for project selection
  - Managers prefer projects with short payback periods



Return on Investment



- ROI measures profitability by comparing a project's total net benefits (the return) to its total costs (the investment)

- ROI = (total benefits - total costs) / total costs

- ROI ignores the timing of costs and benefits
  - ROI only measures the overall rate of return for the total period
  - Annual rates can vary considerably

5. Cost Management

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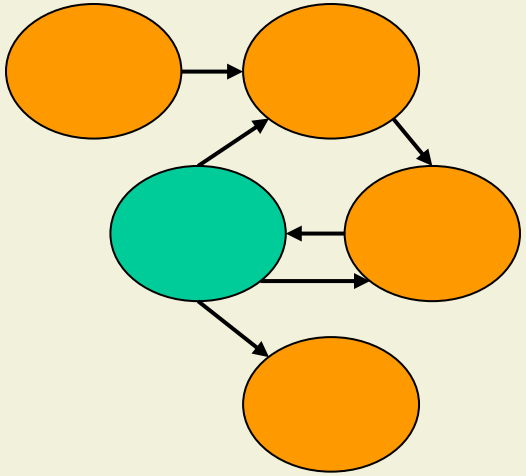
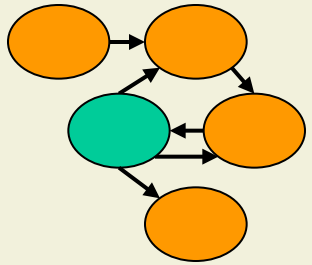


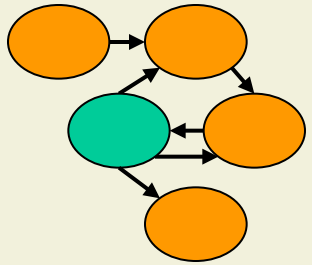
Performance Reporting: Summary



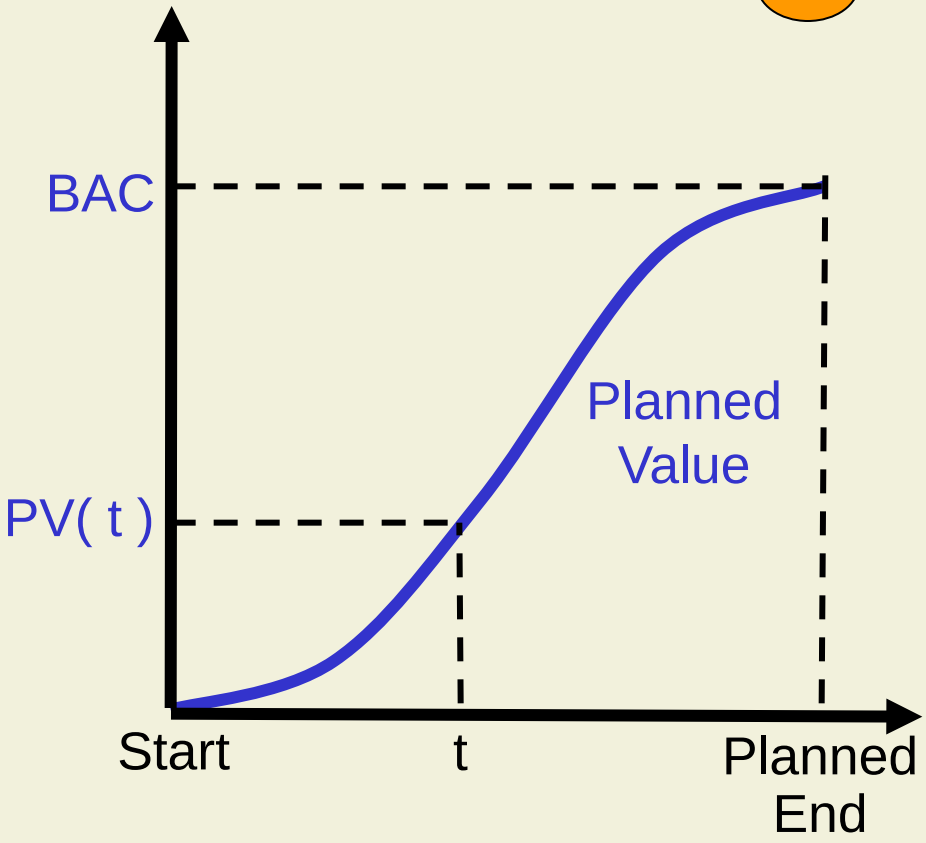
- Purpose
  - To collect and disseminate performance information to provide stakeholders with information about how resources are being used to achieve project objectives

Inputs	Tools & Techniques	Outputs
1. Project plan 2. Work results	1. Performance reviews 2. Earned value analysis	1. Performance reports 2. Change requests

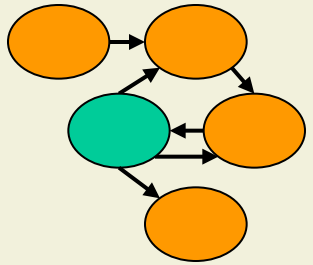
Planned Value (PV)



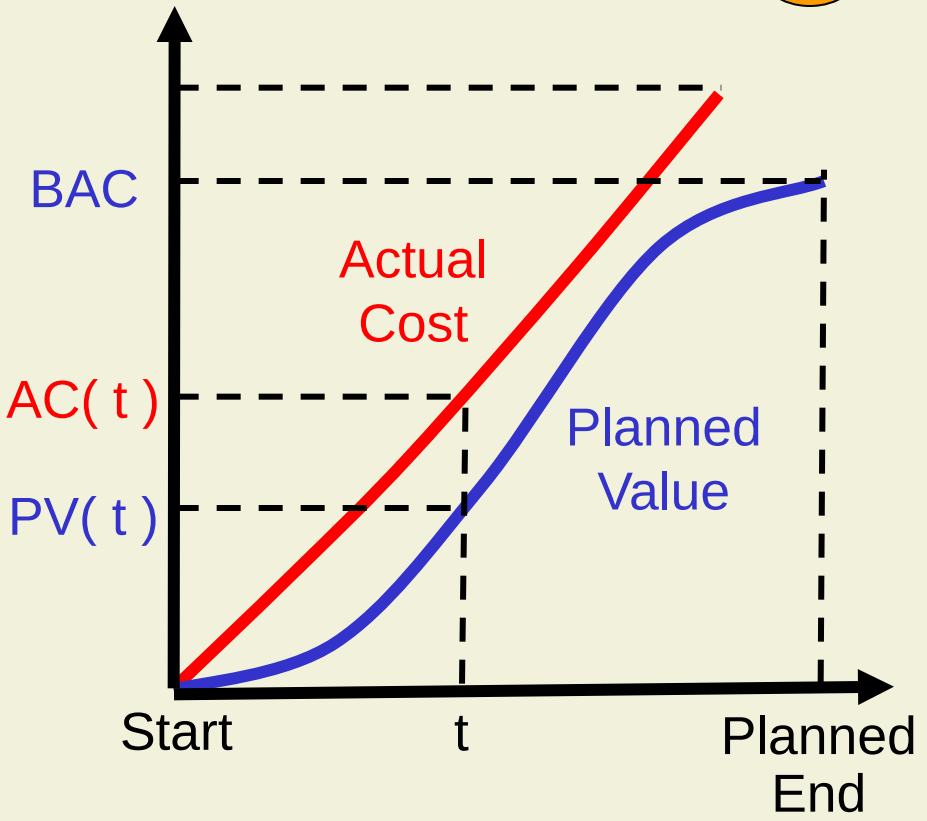
- The **cumulative** sum of the **approved** cost for activities **scheduled**
- Corresponds to the **cost baseline**
- **Budget at completion** is the estimated baseline total cost: BAC = PV(end)



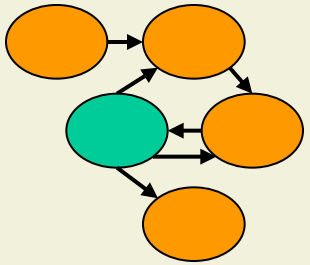
Actual Cost (AC)



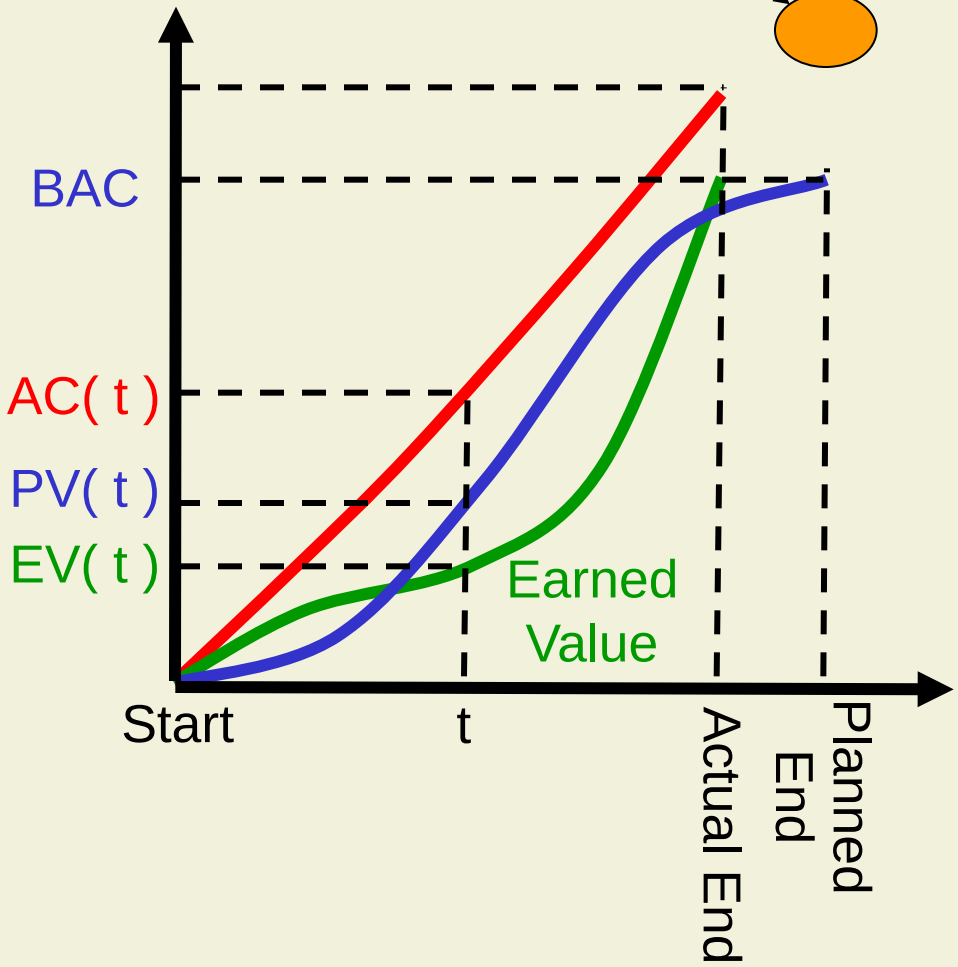
- Total **cost incurred** for the project up to a specified date
- The **actual** or **real** cost of work performed
- Contains both direct and indirect cost



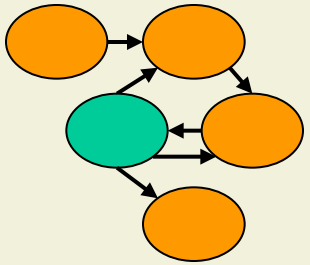
Earned Value (EV)



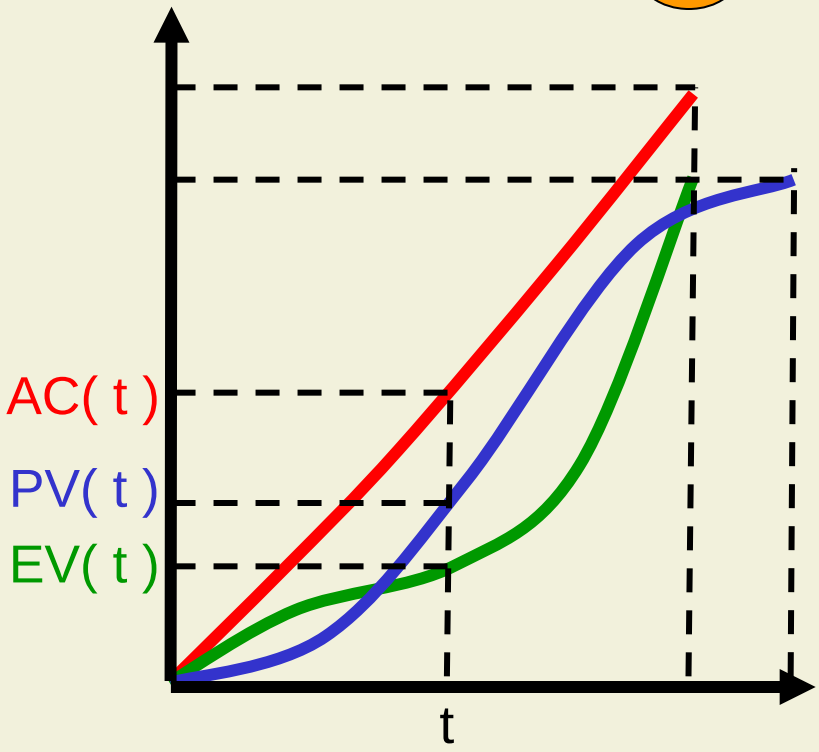
- The sum of **approved cost estimates** for activities **completed** up to a specified date
- An activity is completed if PV=EV, regardless of the actual cost



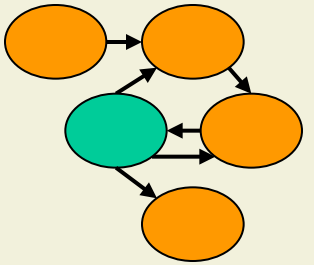
Earned Value Method

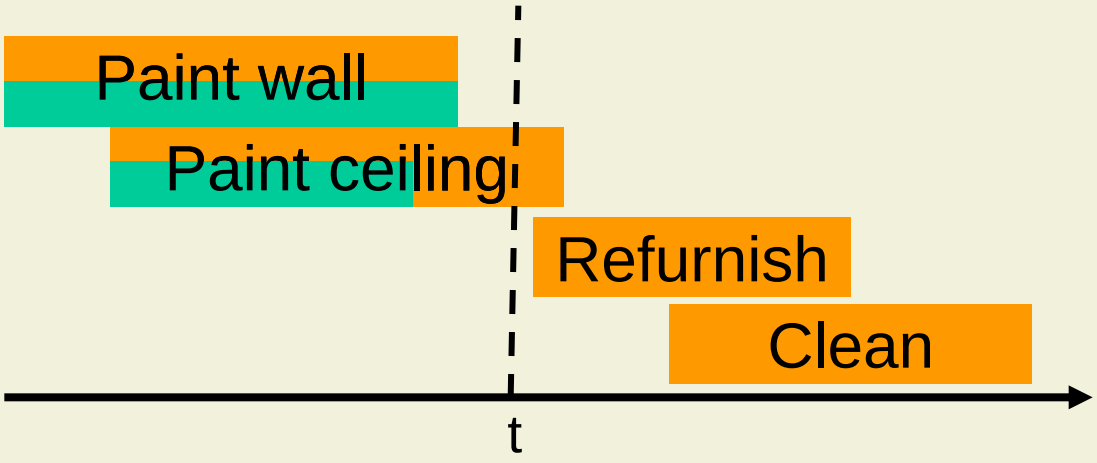


- Expresses effort, cost, and time as **monetary value**
  - PV(t): Worth of the activities scheduled (planned)
  - AC(t): Cost spent
  - EV(t): Worth of the activities performed
- Compares the amount of work planned to what was actually accomplished to **determine cost and schedule performance**



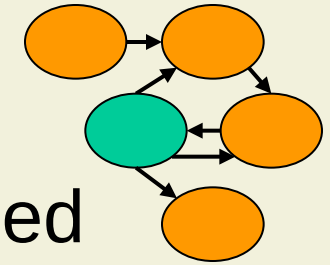
Example





Activity	PV(t)	AC(t)	EV(t)
Paint wall	800	1000	800
Paint ceiling	400	300	300
Total	1.200	1.300	1.100

Cost Performance Index (CPI)



- Compares **budgeted cost** of work performed to **actual cost**
- Indicates the **efficiency** of the project

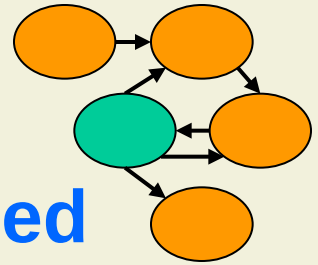
$$CPI = \frac{EV}{AC}$$

- How much do we get out of one Franc we spend?

Activity	PV(t)	AC(t)	EV(t)
Paint wall	800	1000	800
Paint ceiling	400	300	300
Total	1.200	1.300	1.100

$$CPI = \frac{1.100}{1.300} = 85\%$$

Schedule Performance Index (SPI)



- Compares **work performed** to **work planned**

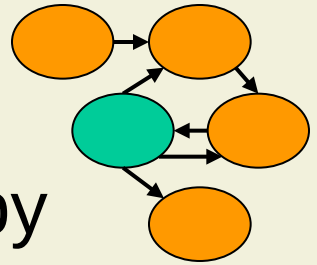
$$SPI = \frac{EV}{PV}$$

- How fast does the project progress in relation to how fast it is expected to progress?

Activity	PV(t)	AC(t)	EV(t)
Paint wall	800	1000	800
Paint ceiling	400	300	300
Total	1.200	1.300	1.100

$$SPI = \frac{1.100}{1.200} = 92\%$$

Calculated Estimate at Completion



$$CEAC_1 = \frac{BAC}{CPI}$$

$$CEAC_2 = AC + BAC - EV$$

$$CEAC_3 = AC + ETC$$

- Budget modified by performance
  - If the current variances are **typical for the future**
- Actual to date plus remaining budget
  - If the current variances are **atypical for the future**
- Actual plus a new estimate for remaining work
  - If the original estimate was **fundamentally flawed**

To Complete Performance Index (TCPI)

- The **efficiency** that must be achieved to complete the **remaining work** with the **remaining money**

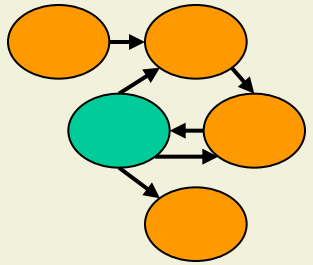
$$TCPI = \frac{BAC - EV}{BAC - AC}$$

Activity	PV(t)	AC(t)	EV(t)
Paint wall	800	1000	800
Paint ceiling	400	300	300
Total	1.200	1.300	1.100

	BAC
Total	10.000

$$TCPI = \frac{(10.000 - 1.100)}{(10.000 - 1.300)} = 102\%$$

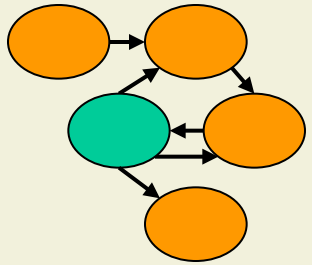
Interpreting EV-Indicators



- Typically, indicators are **stable after 20%** of the project duration

- CPI > 1: Project is in budget
- CPI < 1: Project is over budget
- SPI > 1: Project is ahead of schedule
- SPI < 1: Project is behind schedule

Golden Rules of Earned Value



- Rule 1: Earned value should be verified by **physically examining** the **work product** associated with the activity
- Rule 2: For unfinished activities, earned value estimates are usually just a guess. Apply one of the following rules consistently
  - **50/50 Rule**: A task is considered 50% complete when it begins and 100% only when it is completed
  - **20/80 Rule**: A task is considered 20% complete when it begins and 100% only when it is completed
  - **0/100 Rule**: A task does not get credit for partial completion, only for full completion

	Initiating	Planning	Executing	Controlling	Closing
Integration		Project Plan Dev.	Project Plan Execution	Integr. Change Ctrl	
Scope	Initiation	Scope Planning Scope Definition			
Time		Act. Definition, Act. Sequencing, Schedule Dev.			
Cost		Resource Planning Cost Estimating Cost Budgeting			
Quality					
HR					
Comm.					
Risk					
Procurement