

AD642

Spring 2020

Professor Greiman
LECTURE 7

Questions or Concerns???

- Ask your Facilitator for Guidance
- Email or schedule a call with your Professor one on one
- Reach out to your Classmates
- Post your Questions on the Discussion Board
- Raise questions during the Live Class
- Send an email to all concerned
- Ironically, some of my most successful students professionally never received an A in the course. Instead, they took the concepts and ideas from the course and applied them to their future endeavors.

Never waste time worrying about something that can be resolved quickly!

Upcoming Due Dates: Mark your Calendar

SEPTEMBER 2020 AD642 A3 Wednesday LfA						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
KEY: IA= Individual Assignment TA=Team Assignment Quizzes in red Discussions in green Lectures in blue	31	1	2 Lecture 1 Disc 0 already open Disc 1 opens	3	4	5 Disc 1 first post in
6	7 Labor Day	8	9 Lecture 2	10	11	12
13	14	15 Disc 1 closes 11:59PM IA1 (Project Example) due	16 Lecture 3 Quiz 1 opens 6AM Disc 2 opens	17 TA1: Scope/Charter in for review	18	19 Disc 2 first post in
20 Quiz 1 closes 11:59PM	21	22	23 Lecture 4	24	25	26
27 TA2: WBS in for review	28	29 Disc 2 closes 11:59PM	30 Lecture 5 Disc 3 opens	1	2	3

Looking Ahead: October Calendar

OCTOBER 2020 AD642 A3 Wednesday LfA						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
27	28	29	30	1	2	3 Disc 3 first post in
4	5	6	7 Lecture 6 Quiz 2 opens 6AM	8	9	10
11 Quiz 2 closes 11:59PM	12 Columbus Day	13 TA3: Hand - drawn Network Diagram in for review	14 Lecture 7 Quiz 3 opens 6AM Disc 3 closes 11:59PM	15 Disc 4 opens 11:59PM	16	17
18 Quiz 3 closes 11:59PM Disc 4 first post in	19 IA2 (Columbia Gas Case) draft due if you want feedback (optional)	20	21 Lecture 8	22	23	24
25	26	27 TA4: Budget in for review	28 Lecture 9 Disc 4 closes 11:59PM	29	30	31 Halloween

Team Leaders in this Class - A3

- Team 1 - Anna Gabriela Garcia Esquivel
- Team 2 – Xiumen Zhang
- Team 3 – Xueyang Long
- Team 4 – Danlin Wang
- Team 5 – Jiaxin Zhao
- Team 6 – Amish Shah Nishil
- Team 7 – Chih Chun Chen
- Team 8 – Jiaming Li

Team Leaders in this Class - A3

- Team 1 - Anna Gabriela Garcia Esquivel
- Team 2 – Xiumen Zhang
- Team 3 – Xueyang Long
- Team 4 – Danlin Wang
- Team 5 – Jiaxin Zhao
- Team 6 – Amish Shah Nishil
- Team 7 – Chih Chun Chen
- Team 8 – Jiaming Li

THE CASE ANALYSIS INDIVIDUAL ASSIGNMENT



- The idea is simple: Read the case material, analyze, create Solution Ideas, pick the best solution

Columbia Gas Agrees to Pay \$56M in New Gas Explosion Agreement

A \$53 million federal fine Columbia Gas was sentenced to last week is the largest ever imposed under the Pipeline Safety Act, and earlier this year, the utility settled a class action lawsuit for \$143 million

By **Mike Pescaro** • Published July 2, 2020 • Updated on July 2, 2020 at 10:12 pm



LOGIC FOR THE CASE STUDY ANALYSIS – INDIVIDUAL ASSIGNMENT 2

Step 0: Read the Case!

Step 1

Find three
key issues

Step 2

Identify solutions to the issues.
Some issues may have more than one
solution, some solutions may solve
more than one issue.

Solution1

Solution 2

Solution 3

Solution 4

Step 3



For each solution, use a table to show
the **pros and cons**
(difficulty in doing it... chance of
effectiveness...secondary positive
and negative effects)

Quiz 3 Review

- Review Hofstede Cultural Dimensions
- Program Management Organizations – What do they do?
- Network Diagram
 - Purpose of the Network Diagram
 - Elements of a Network Diagram
 - Critical v. Non-Critical Path
 - Mandatory Dependencies

Forward Pass Computation*

- Add activity times along each path in the network ($ES + \text{Duration} = EF$).
- Carry the early finish (EF) to the next activity where it becomes its early start (ES) *unless...*
- The next succeeding activity is a merge activity, in which case the largest EF of all preceding activities is selected.

*In the “1” method I will show you , instead of starting at “Day 0” or “Week 0” we start with Day 1 or week 1, so we’ll subtract 1 from this total in the forward pass. This will become clearer in the upcoming animation.

Backward Pass Computation

- Subtract activity times along each path in the network (LF - Duration = LS).
- Carry the late start (LS) to the next activity where it becomes its late finish (LF) *unless*
- The next succeeding activity is a burst activity, in which case the smallest LF of all preceding activities is selected.

*In the “1” method I will show you , instead of starting at “Day 0” or “Week 0” we start with Day 1 or week 1, so we’ll add 1 from this total in the backward pass. This will become clearer in the upcoming animation.

Determining Slack (or Float)

- **Slack (or Float)**
 - The amount of time an activity can be delayed after the start of a longer parallel activity or activities.
- **Total slack**
 - The amount of time an activity can be delayed without delaying the entire project.

Dependencies

- Usually are “finish to start”
- Show how the tasks relate
- i.e. **First coat must be dry** before **second coat is applied**

(finish)

(start)

Cultures

- *Norms* include the common knowledge regarding how to get the work done, what is acceptable, and who is influential.
- Organizational norms typically include:
 - Shared visions and beliefs: What makes your company good?
 - Unspoken company expectations: Is quality work expected?
 - Can you slip a deadline to get it right?
 - Work hours: Are you expected to work extra hours to get the job done?

Culture: not just about the country!

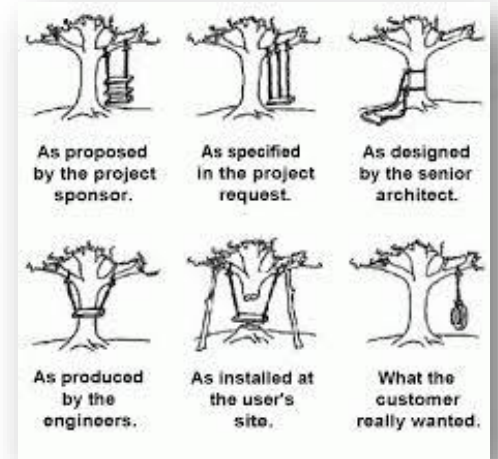


National

- Power Distance Index (PDI)
- Individualism versus Collectivism (IDV)
- Masculinity versus Femininity (MAS)
- Uncertainty Avoidance Index (UAI)
- Long Term Orientation versus Short Term Normative Orientation (LTO)
- Indulgence versus Restraint (IND)

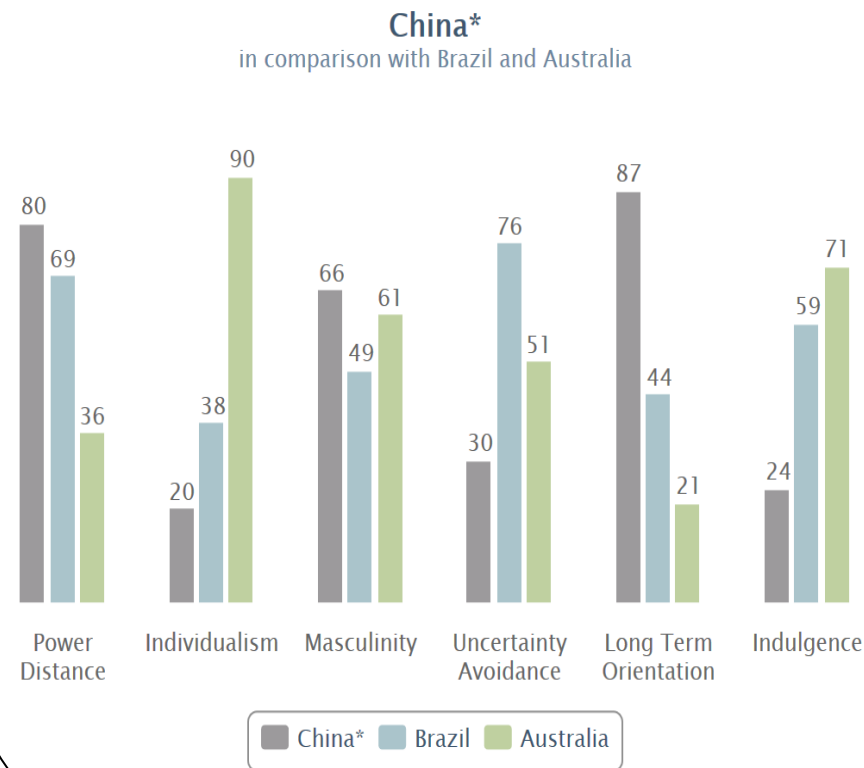
Organizational

- Means-oriented vs. Goal-oriented
- Internally driven vs. Externally driven
- Easygoing work discipline vs. Strict work discipline
- Local vs. Professional
- Open system vs. Closed system
- Employee-oriented vs. Work-oriented
- Degree of acceptance of leadership style
- Degree of identification with your organization

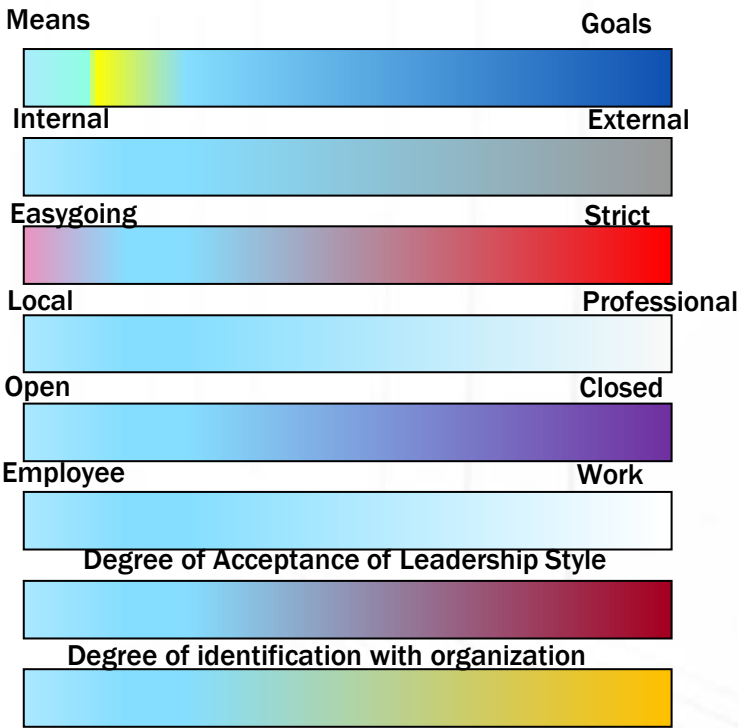


Culture: National and Organizational

National

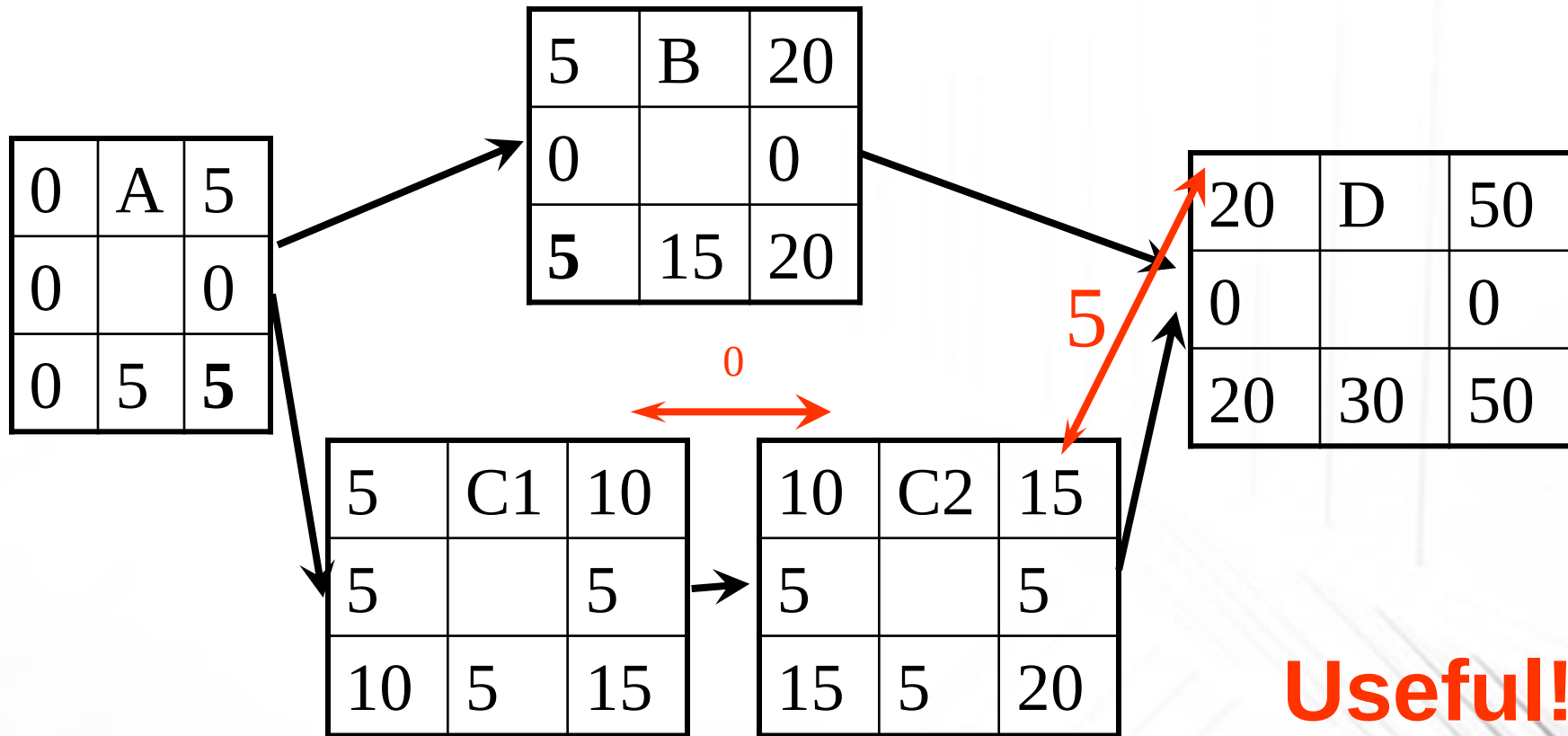


Organizational



Simple Example:

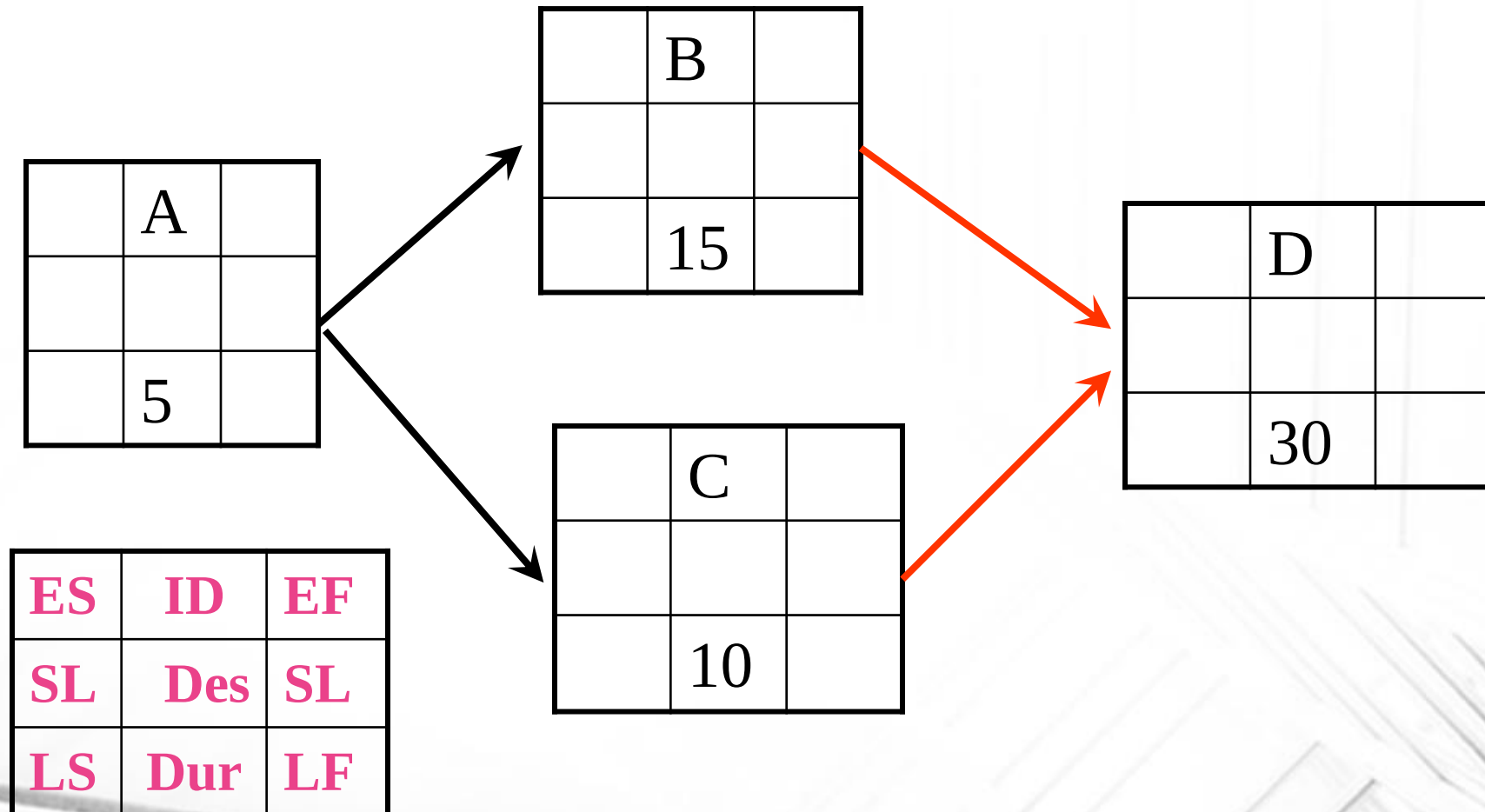
6) Free Slack



Useful!

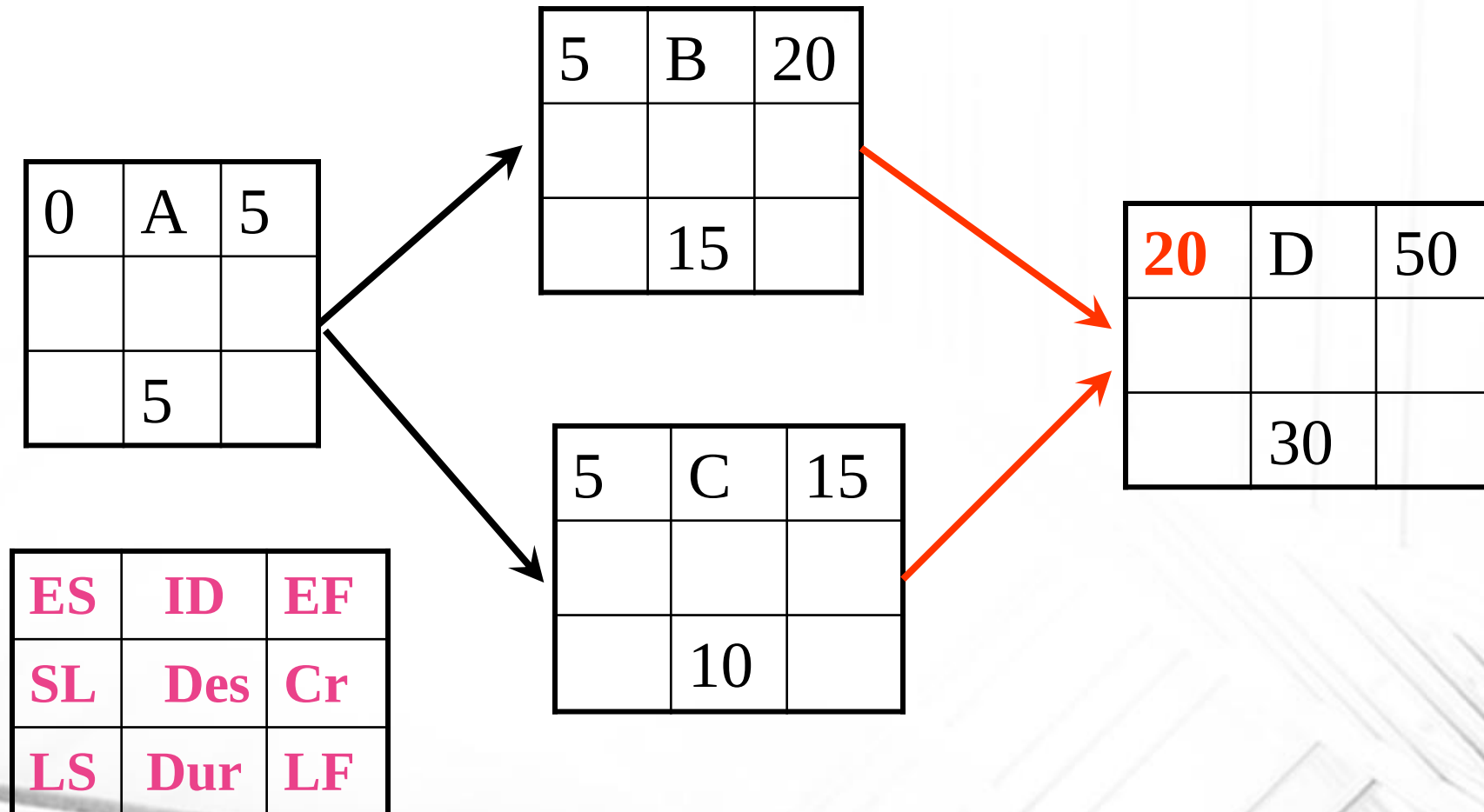
Simple Example:

1) Forward Pass (Earliest)



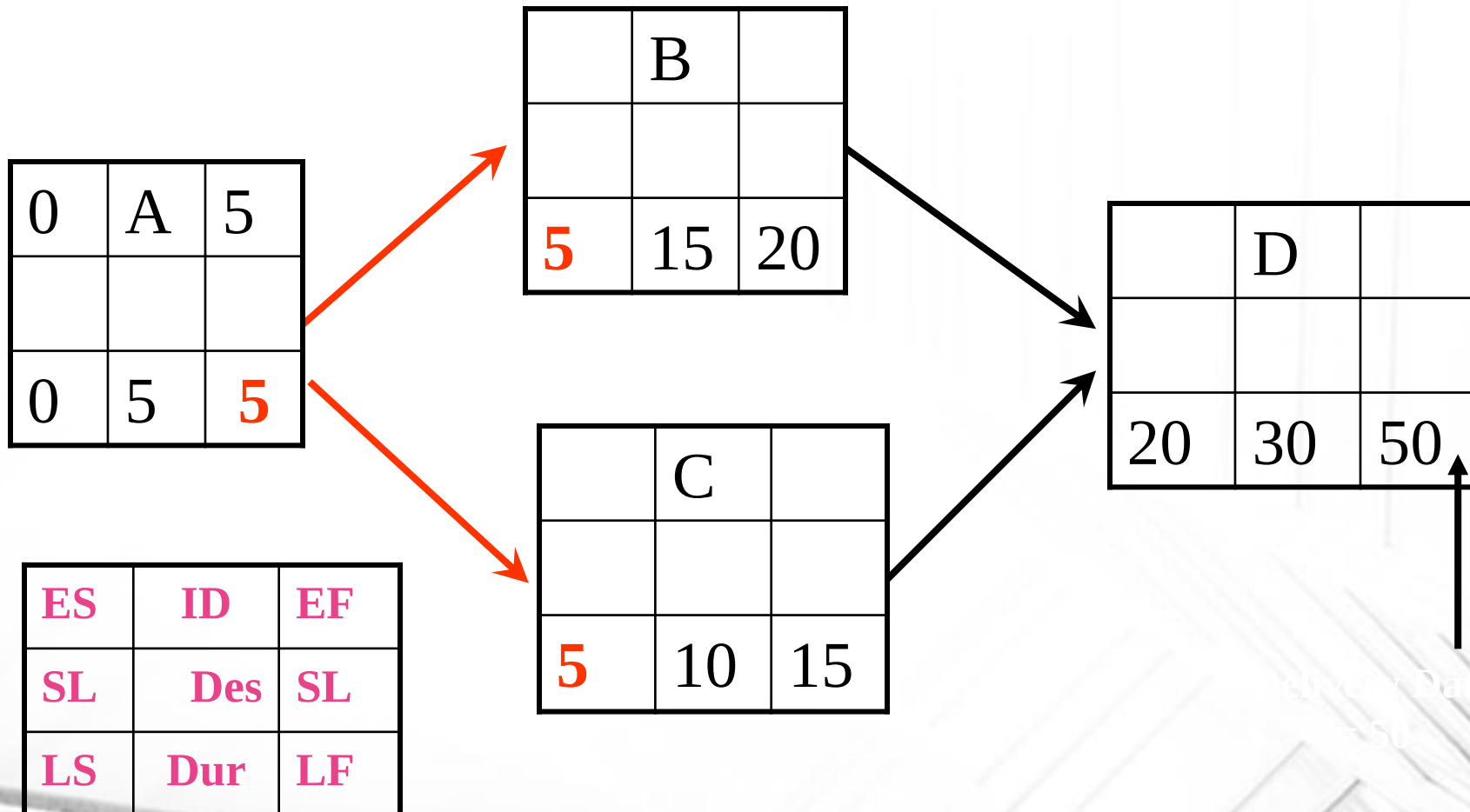
Simple Example:

1) Forward Pass (Earliest)

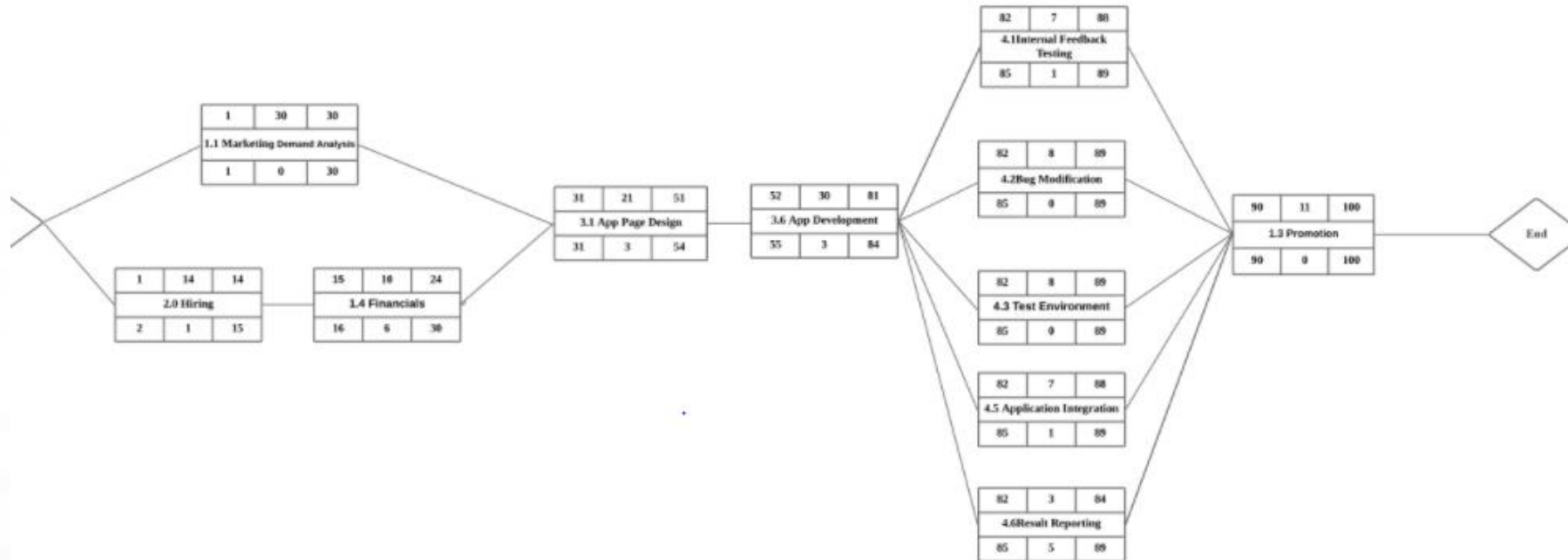


Simple Example:

2) Backward Pass (Latest)



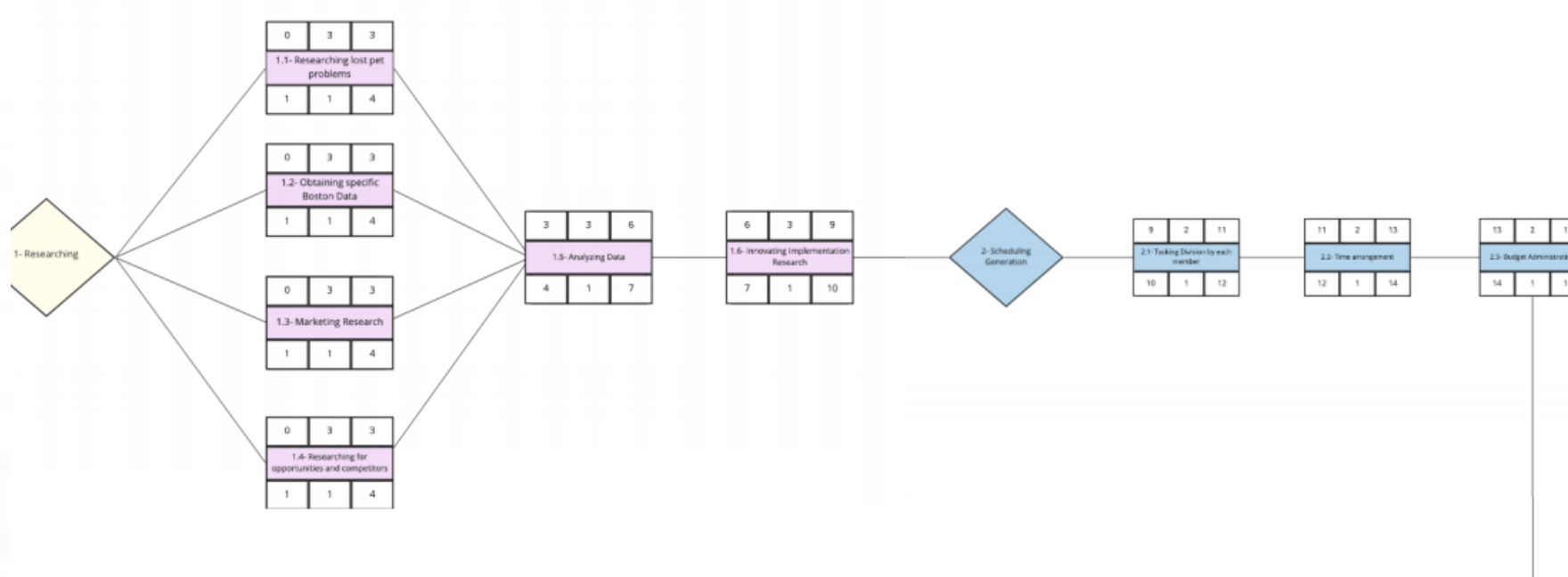
Team 4: Network Diagram



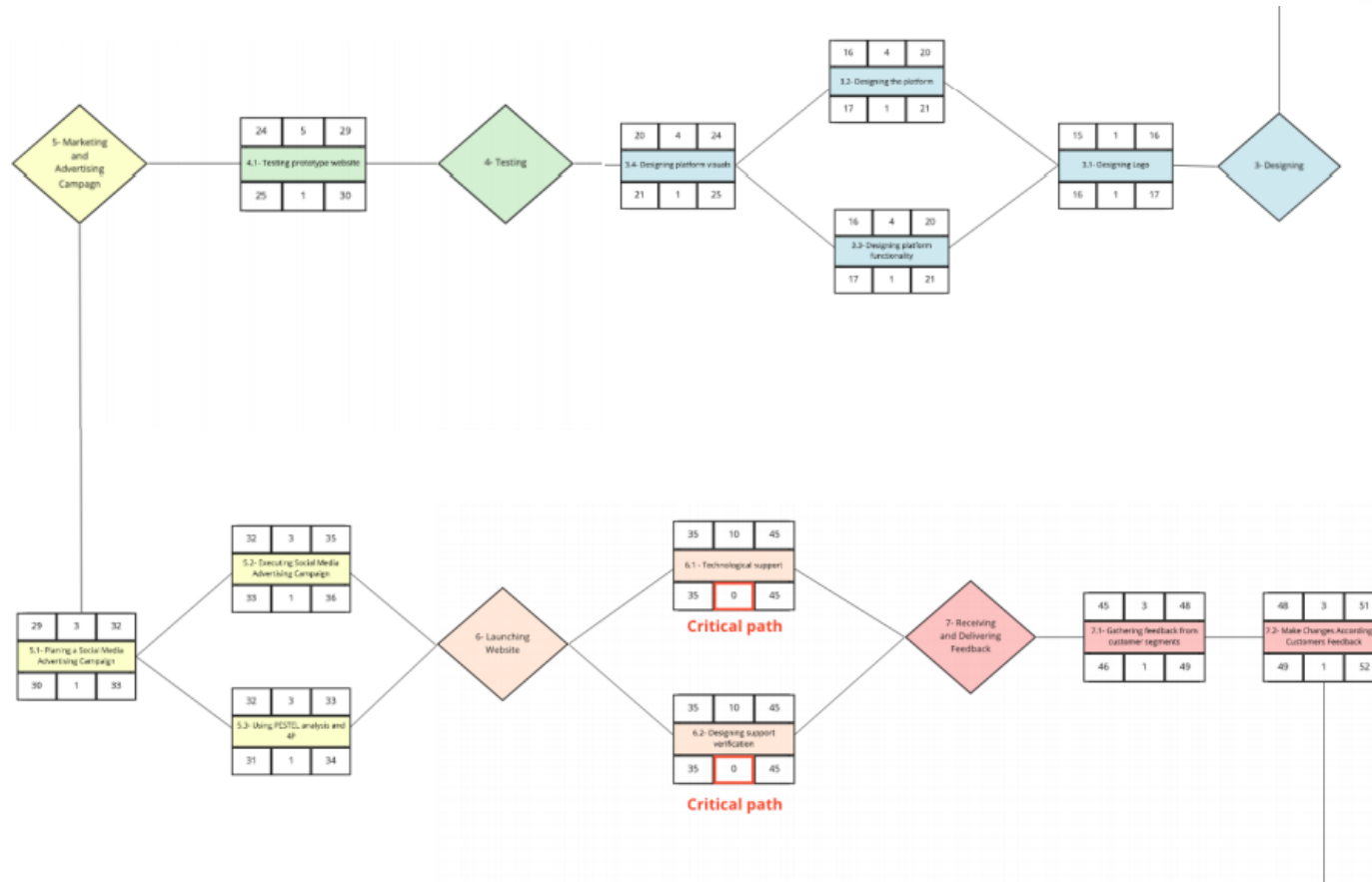
Team 1: Allocation of Resources and Hours

Researching	All the Team	18 hours
Researching lost pet problems	Ana Gabriela Garcia Esquivel	3 hours
Obtaining specific Boston Data	Lintong	3 hours
Inovating Implementation Research	Cong Duang	3 hours
Researching for opportunities and competitors	Ana Gabriela Garcia Esquivel	3 hours
Marketing Research	Xiukui	3 hours
Analyzing Data	Cong Duan	3 hours
Scheduling Generation	All the Team	6 hours
Tasking Division by each member	Ana Gabriela Garcia Esquivel	2 hours
Time arrengement	Lintong	2 hours
Budget Administration	Xiukui	2 hours
Designing	All the Team	13 hours
Design logo	Ana Gabriela Garcia Esquivel	1 hour
Designing the platform	Cong Duan	4 hours
Designing plataform functionality	Cong Duan	4 hours
Designing platform visuals	Cong Duan	4 hours

Team 1: Network Diagram



Team 1: Network Diagram Continued



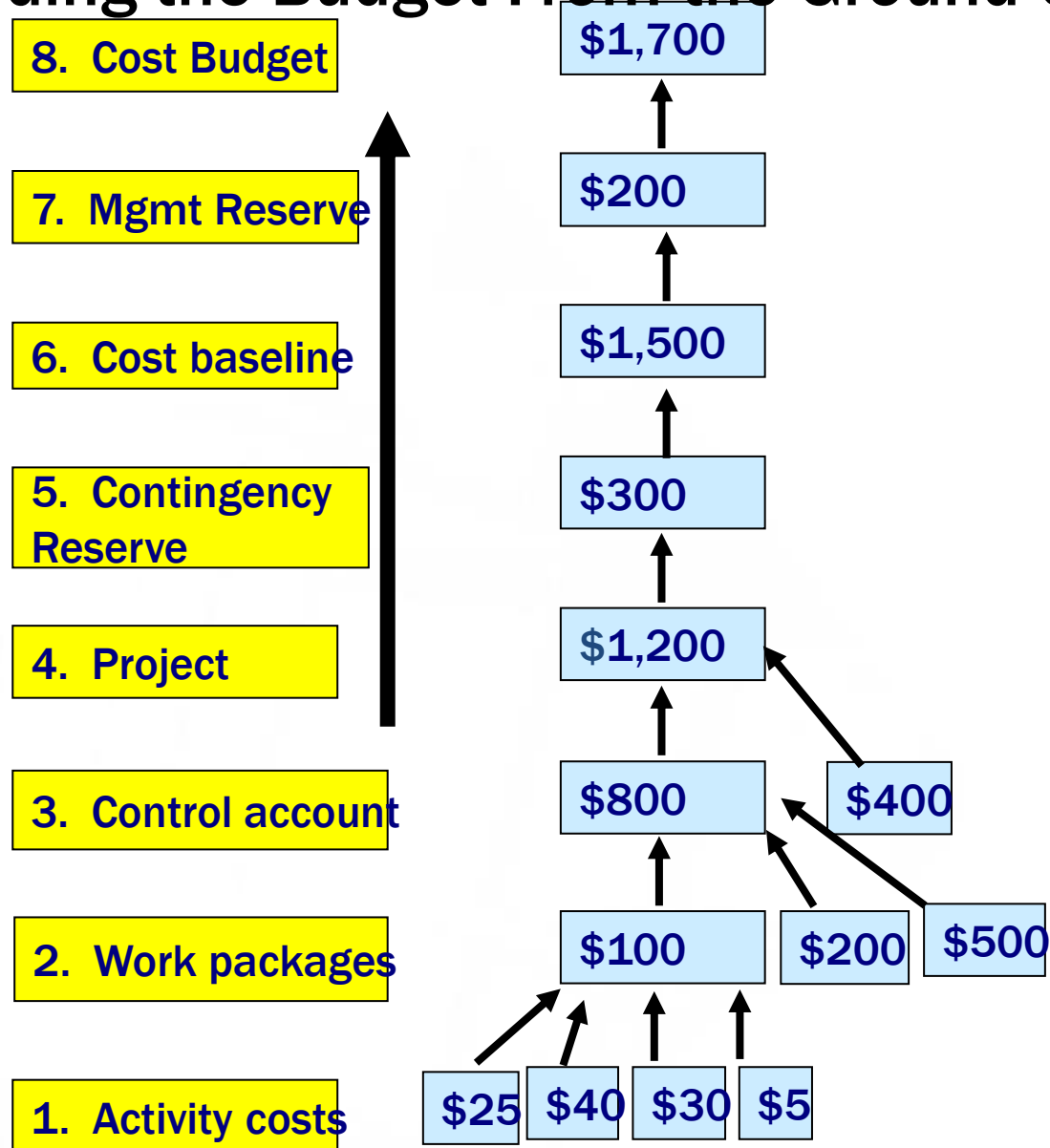
Lecture 7: Estimation and Project Cost Management

Estimation: Background/Context

- Applies to COST **and** TIME (budget and schedule)



Building the Budget From the Ground Up

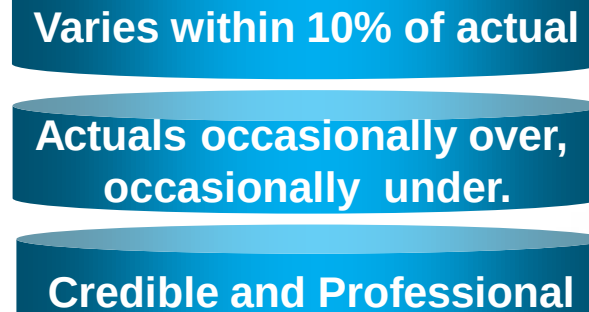


Reputation of Project Estimators

Overly Pessimistic



Balanced



Overly Optimistic



Ways of Formulating Estimates

1 Analogous (Top-Down) Estimates



Parametric Estimates



3 Engineering (Bottom-Up) Estimates



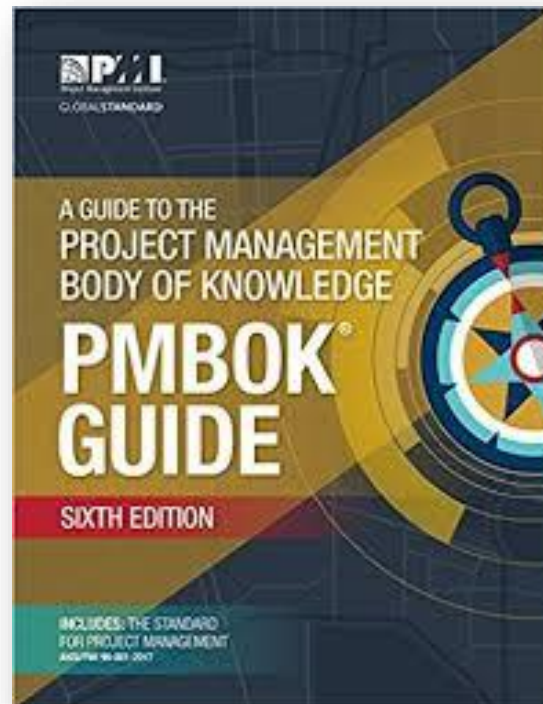
3-Point Estimates



5 Consensual Techniques (Delphi)



We will return to these estimate types in detail when we review the “Estimate Costs” process from the PMBOK® Guide.



When Estimating, State An Indication of Accuracy

Definitive

-10% to +10%

Construct

-15% to +15%

Deterministic, Fixed Constraints

-20% to +50%

Design, Order of Magnitude

-25% to +75%

Preliminary

-50% to +100%

Concept

-30% to +120%

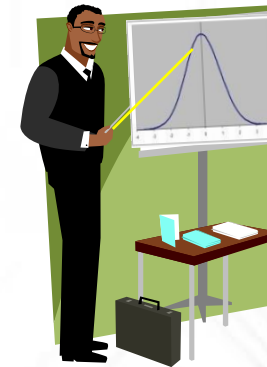
Budget, Ballpark, SWAG

-50% to +150%

Avoid single-point estimates – work something like this...

- “This work is estimated at 10 business days $\pm$ 4 days.”
- “The cost is estimated at \$5,000 $\pm$ \$3,500.”
- “This part is expected to take from 3-4 months, with our most likely time at 3 months 1 week.”
- “Our ballpark estimate is 16 months, however once the project is clear, we will provide a construct estimate.”

To convince stakeholders of
the known variability...
use historic records of
variation as a basis



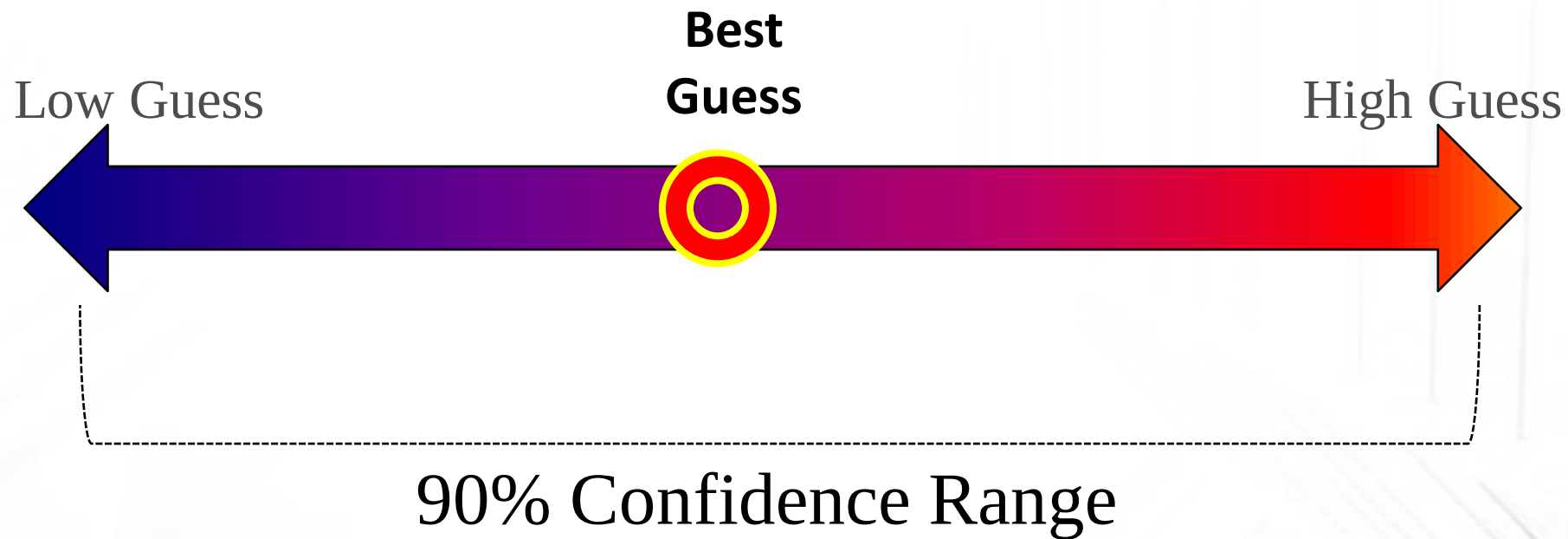
Challenging Your Overconfidence

- For each of the questions, enter a range (low and high boundaries) for which you are 90% confident you are correct.

	Lower Bound	Upper Bound
1. Length of the Equator (in km)?		
2. World record in men's 100m running (in seconds)?		
3. Area of the continent Africa (in million km ²)?		
4. Year of birth of Martin Luther King, Jr.?		
5. Height of the K2 (in m)?		
6. Volume of the Atlantic Ocean (in million km ³)?		
7. How much was the budget of "Lord of the Rings: Return of the King" (in Mio. US \$)?		
8. Length of the Nile (in km)?		
9. How old was Elvis Presley when he died?		
10. Length of the largest killer whale (in m)?		

Challenging Your Overconfidence

- For each of the questions, enter a range (low and high boundaries) for which you are 90% confident you are correct.



Challenging Your Overconfidence: answers

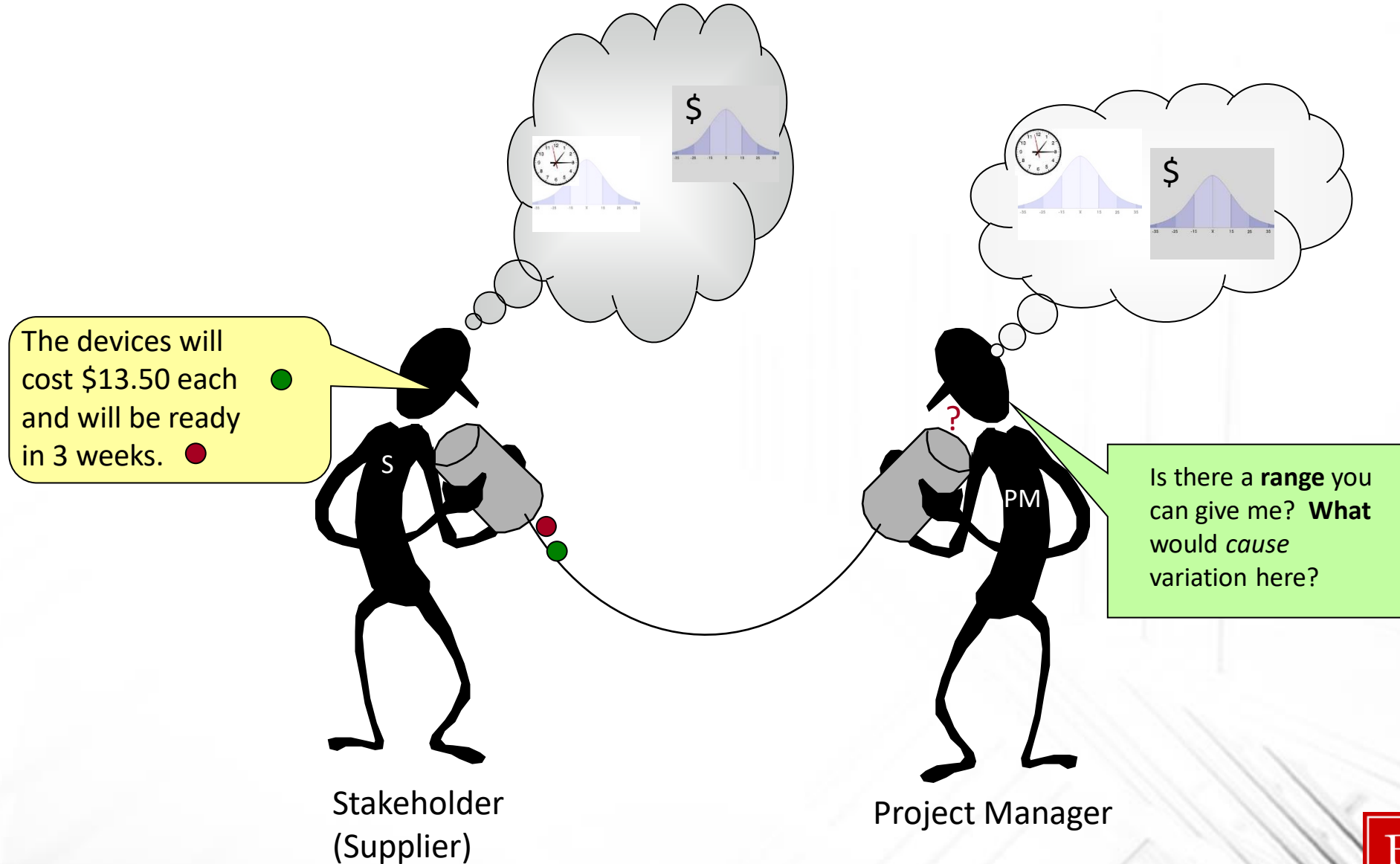
1. Length of the Equator (in km)? **40,007 km**
2. World record in men's 100m running (in seconds)? **9.58 s**
3. Area of the continent Africa (in million km²)? **30.2 million km²**
4. Year of birth of Martin Luther King, Jr.? **1929**
5. Height of the K2 (in m)? **8,611 m**
6. Volume of the Atlantic Ocean (in million km³)? **354.7 million km³**
7. How much was the budget of "Lord of the Rings: Return of the King" (in Mio. US \$)? **\$94 million**
8. Length of the Nile (in km)? **6,758 km**
9. How old was Elvis Presley when he died? **42 Years**
10. Length of the largest killer whale (in m)? **9.8 m**

Remember



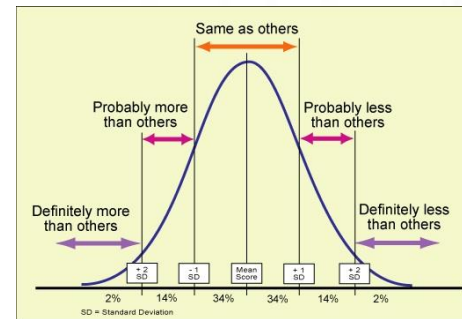
1. Time and cost estimates are very risky business and you should indicate your level of accuracy
2. Be careful about attacking people when they are off
3. What gets measured gets understood and improved
4. Past experience helps the most if you operate in a state of hyper-awareness
5. Ask more questions of customers and Subject Matter Experts (SMEs)

Avoid hidden assumptions – push back for *ranges*!

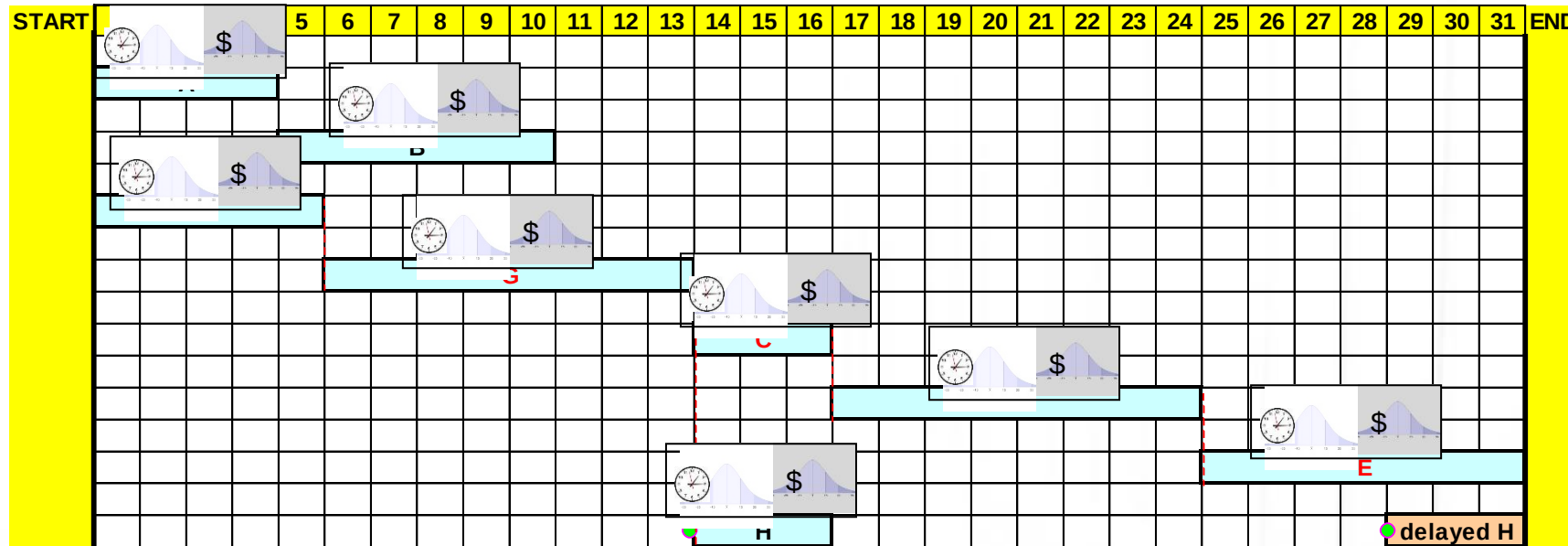


My advice on estimates

- Never take a single-point estimate
 - Always push back for a range
 - Always push back for the drivers which make the range
 - Consider the **ranges** and **not the average** or the point you're given



Allow for schedule and cost variation in each element of your schedule



Applying Monte Carlo analysis

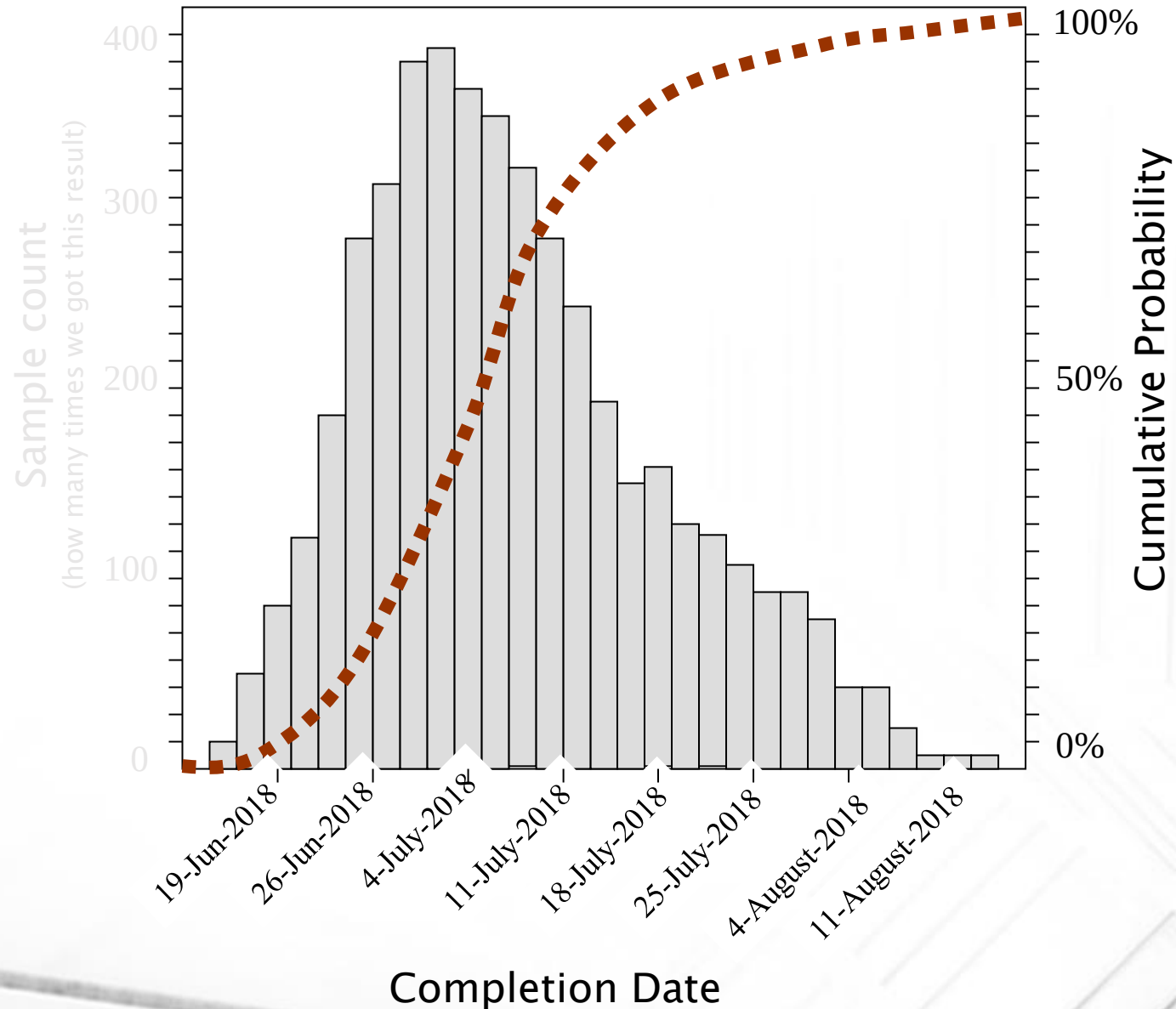
Just some basics:

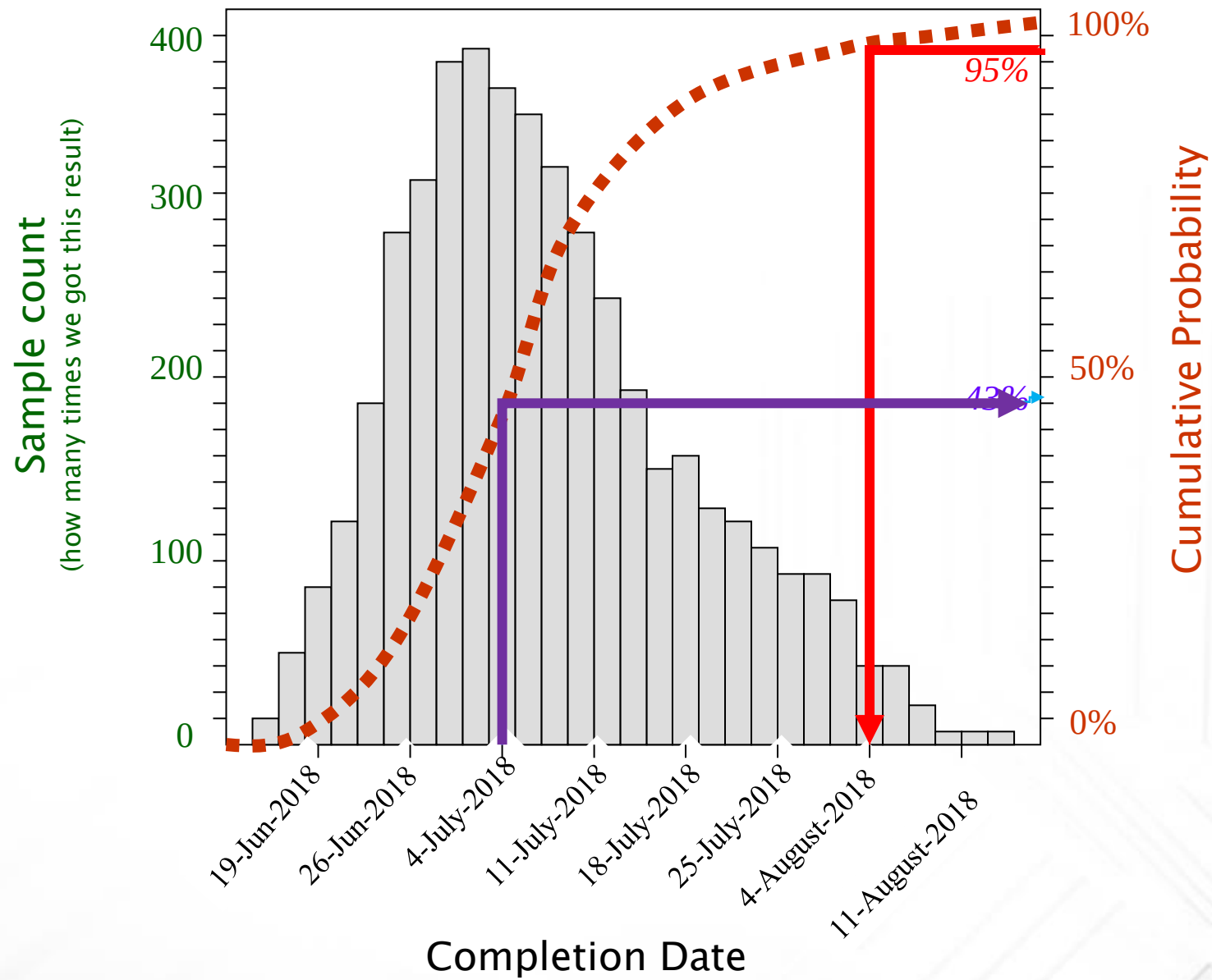
- Monte Carlo is a form of simulation in which the project's characteristics are modeled, mathematically.
- Let's say we're looking at schedule. Each duration estimate is allowed to vary according to a distribution you have associated with it. For example, UAT may be estimated at 10 weeks, but that is not a point, it is a median of a normal population distribution centered at 10 weeks.
- Other durations will have other distributions, some may be heavily skewed to the more pessimistic or optimistic (12 weeks, +2 weeks, -7 weeks).
- The project is run through a simulator program over and over again, perhaps hundreds of thousands of times to generate an overall project distribution.

In a way, it's just about allowing the schedule to 'admit' that risk exists!

Effect of Risk on your schedule!

After simulating the project thousands of times





Conclusions to the general topic on PM Estimation

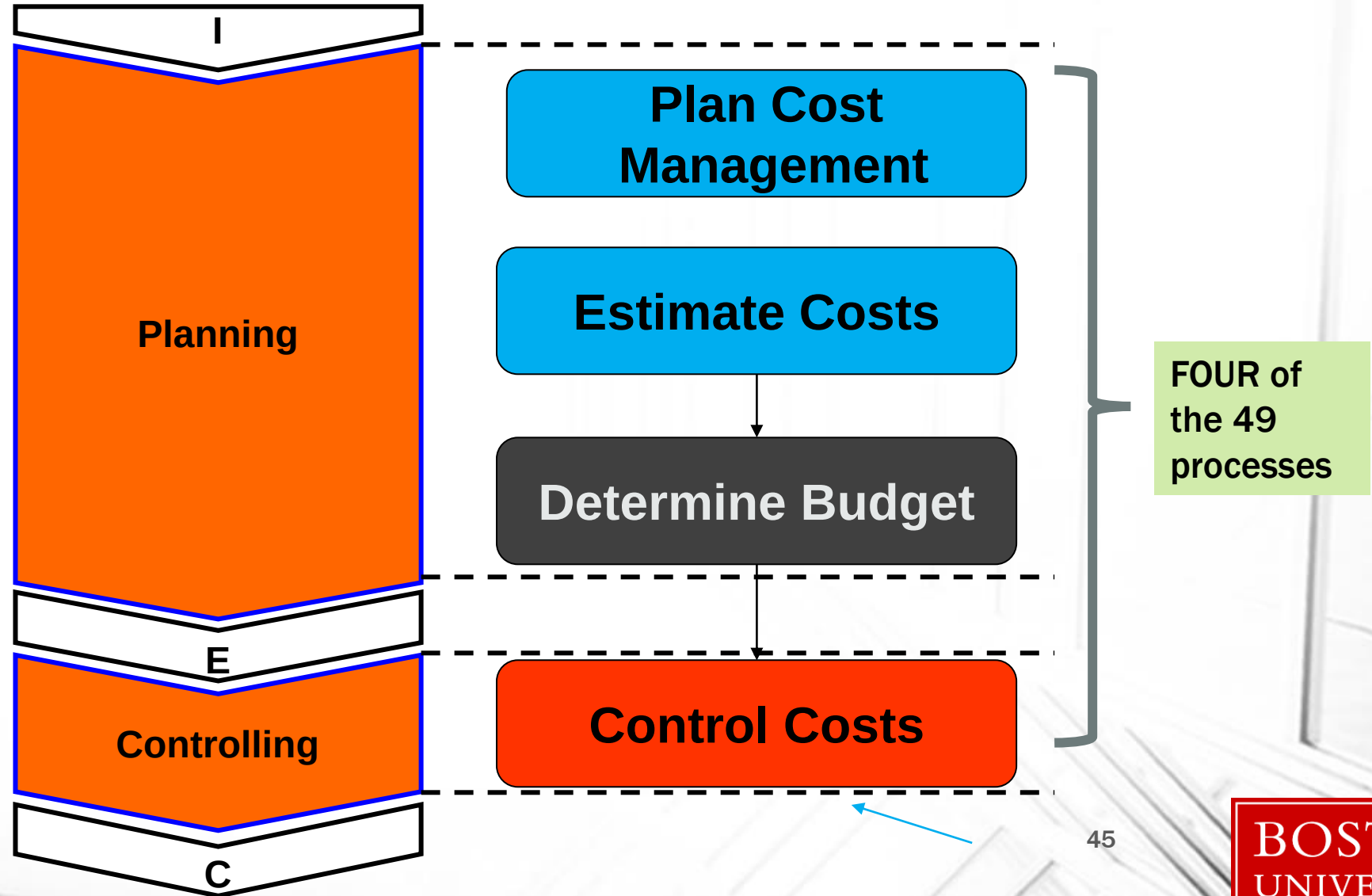


- Same principles apply to Cost (covered here) and Time (duration) estimation
- **ASK QUESTIONS TO GET BETTER ESTIMATES!** Don't settle for a point when you can get much more intelligence from a range – and the drivers that make that point into a range
- Humans think they are very good at estimation, but that estimate itself is a poor estimate. Rely on your gut but also use science and math to help you.
- We haven't yet covered risk, but think about it – each estimate you make in a project contains a risk because it is a forecast into the future and has an unknown element to it!

Connection to the 6th Edition PMBOK® Guide

- Direct costs: Costs incurred for a specific project
- Equipment bought specifically for the project
- Indirect costs: Costs span over multiple projects (“overhead”)
- Quality assurance department
- Rooms, electricity, heating
- Training Costs

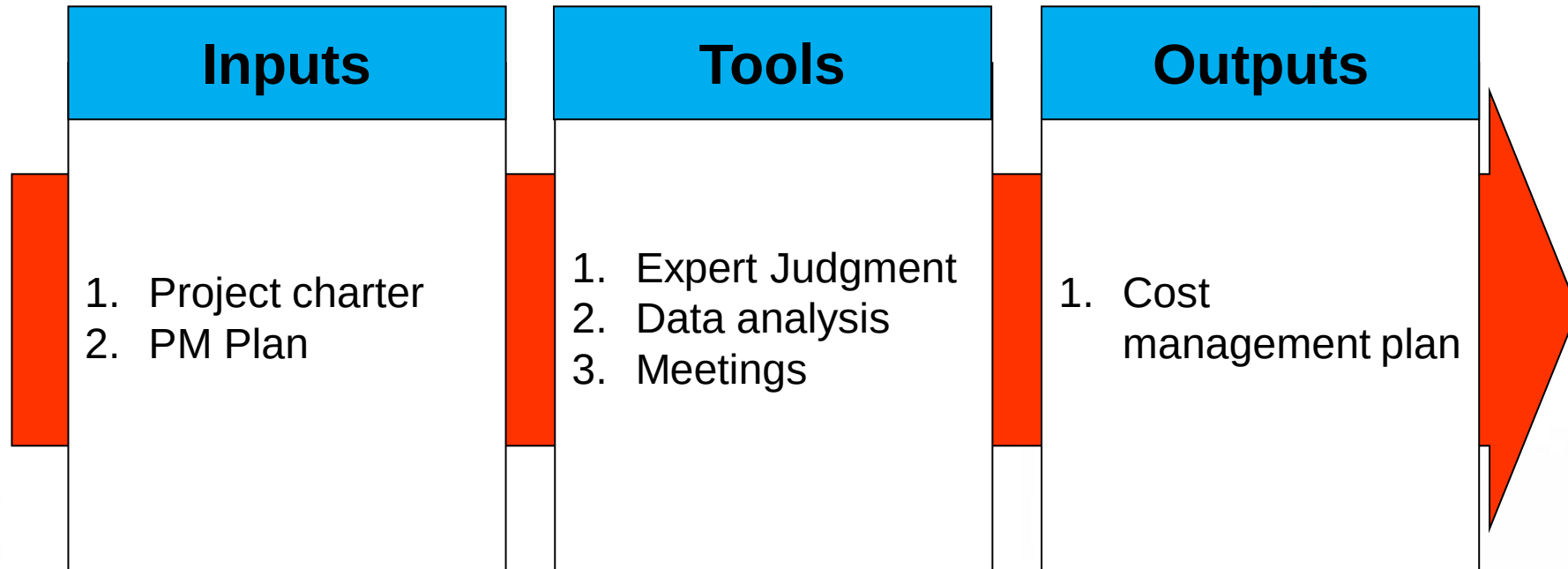
Project Cost Management: PMBOK® Guide View (6th Edition)



Plan Cost Management

HOW will we manage costs on this project?

Plan Cost Management: key process inputs, tools, and outputs (paraphrased summary)



Plan Cost Management

- Main output: The Cost Management Plan: how-in-general we will manage costs on the project. NOT the budget! But, for example, will include whether we use Euros or Dollars for our units, how often budget info is reported, and so on, and what sort of magnitudes of running over budget will trigger alarm and point out the need for corrections/changes.

Cost Management Plan

- Identify the types of estimates, unit of measure, level of precision and accuracy, organizational links – WBS code, control accounts
- Control thresholds – when to raise flag if budgets are out of control.

Cost Management Plan

- Summary: You are planning ahead for:
 - Estimating techniques
 - Metrics for estimation (currency, hours, months, etc)
 - Accuracy – order of magnitude, detailed
 - Reporting templates
 - Who will be involved with estimating?
 - What tools and techniques will be used?
 - Risks, assumptions and more documented.
 - Budgeting codes
 - Rules of performance measurement for EVM.

Estimate Costs

Let's approximate the costs of our resources needed to complete the project.

Estimate Costs

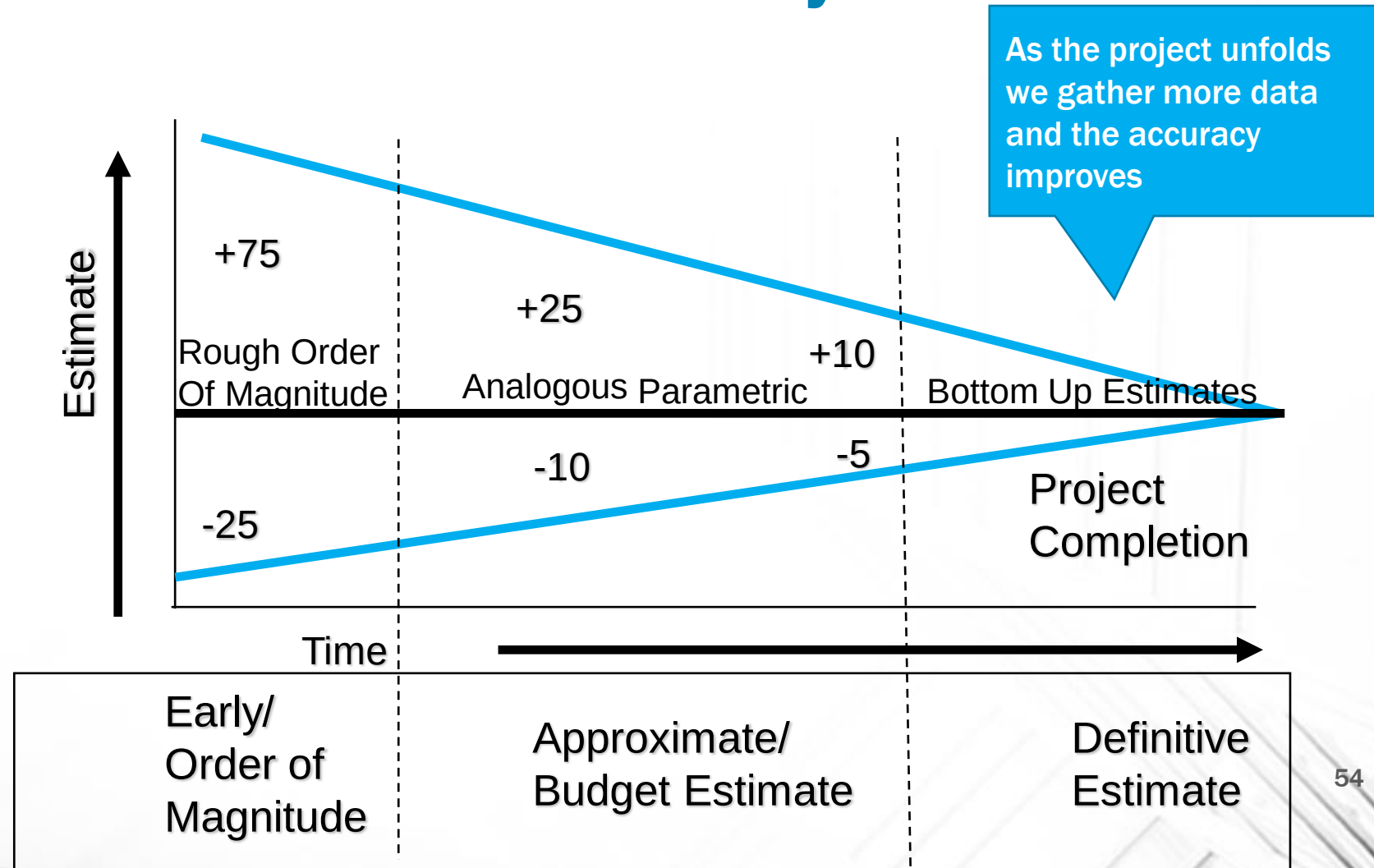
(same principles we saw in Estimating Durations!)

- Cost estimation is an important topic!
- First let us understand the differences between Cost estimating and Pricing:
 - Cost estimating: how much will it cost the performing organization to provide the product or service involved?
 - Pricing: how much will the performing organization charge for the product or service? *Business decision.*

Why are so many Cost Estimates Wrong?

- We need to define the work first and then estimate the work.
- But quite often we estimate first and then identify the work.
- Failure to assess and mitigate risks
- Contingency budget for the mitigated risks is not included.
- Poor change control: Not saying 'No' to requests for changes or no formal process exists for change control.
- Poor quality—work has to be redone
- Poor communication
- You've seen this in our summary of the 'Human Pyramid' cost estimation exercise

Types of Estimates & Accuracy



Accuracy

Estimate	Accuracy
Order of Magnitude (Early)	-25% +75%
Budget Estimate	-10% +25
Definitive Estimate	-5% 10%

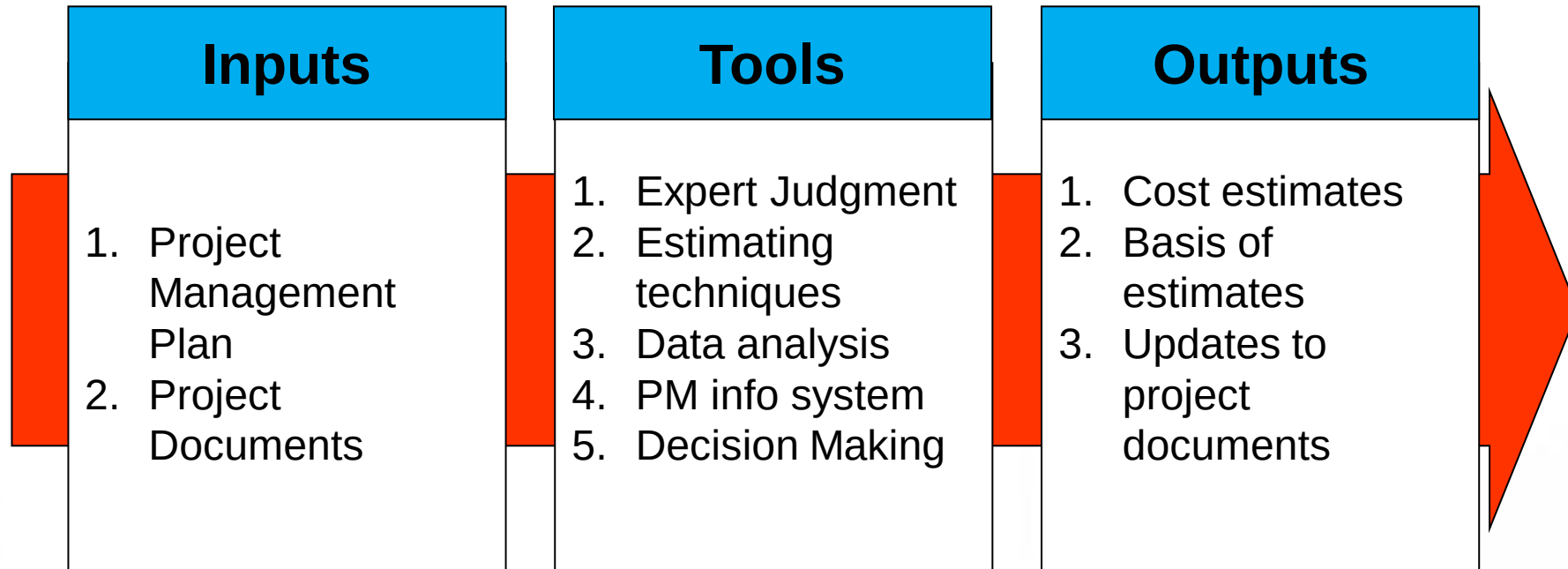
- Most difficult to estimate as very little project info is available

- Used to finalize the Request for Authorization (RFA), and establish commitment

- Development stage estimate. Needed to predict revised project completion date

55

Estimate Costs: key process inputs, tools, and outputs (paraphrased summary)



Key Output: Cost Estimate

- The Cost Estimate is generally:
 - expressed in units of currency to facilitate comparisons both within and across projects.
 - includes appropriate risk contingency funding
- Supporting details of the cost estimate must include:
 - Reference to WBS.
 - How it was developed
 - Assumptions made
- The *cost management plan* should indicate how cost variances will be managed.

Techniques for Estimating

Top Down Estimating	➤ Accuracy depends on experience ➤ Fast, but estimates are rough
Bottom Up Estimating	➤ Slow, but reliable ➤ High cost (time) / WBS needed ➤ Buy-in from the team
Parametric Modeling	➤ Mathematical models to predict costs ➤ Two types: REGRESSION ANALYSIS, and LEARNING CURVE
Delphi Method (analogous)	➤ Expert judgment ➤ Tasks need not to be identified ➤ Considerable experience needed

Estimates vs. Accuracy

Estimate Type	Accuracy
Order of Magnitude (Early)	-25% +75%
Budget Estimate	-10% +25
Definitive Estimate	-5% 10%

- Most difficult to estimate as very little project info is available

➤ Used to finalize the Request for Authorization (RFA), and establish commitment

➤ Development stage estimate. Needed to predict revised project completion date

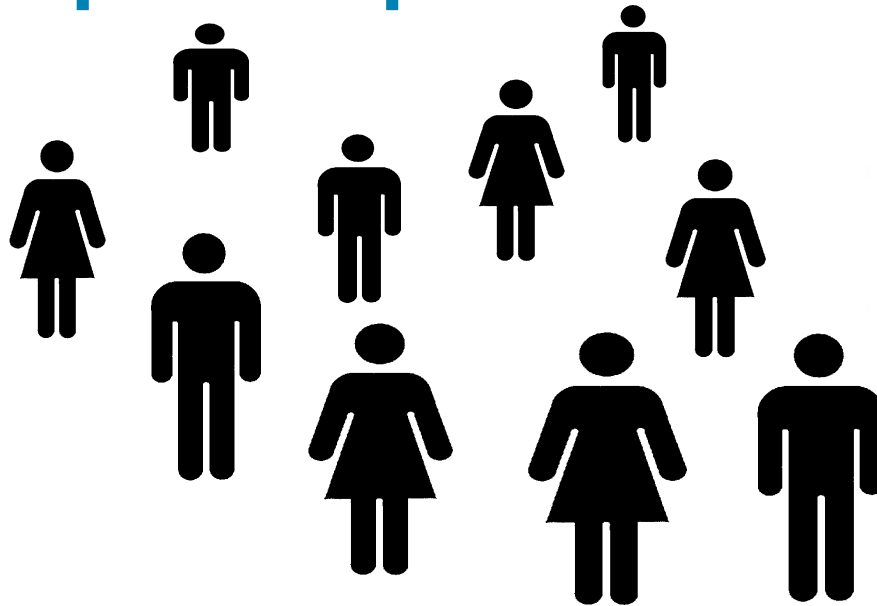
Analogous – a.k.a. Top Down

- We built a 200 sq. foot garage for \$20,000 in the past.
- The current estimate we seek is for a 400 sq. foot garage.
- We can safely estimate the cost of building the garage at \$45,000 (+ \$5000 added due to size increase).

Consensus techniques: example - Delphi

- Provides a formal structured approach for the exchange of “opinions” – in our case estimates.
- Can be used when no historical data exists. Useful when
 - installing a new product methodology
 - making a significant change to an existing one.
 - implementing a unique product/project
- Based on the theory that
 - Group opinions are fairly reliable.
 - Extreme views get annulled.
 - Informal one-on-one conversations are susceptible to bias & intimidation.

Delphi Group



*Delphi
Facilitator*

Group should consist of experts on the topic under discussion. Can include: marketing people, vendors, customers... Should consist of a minimum of 10 people, all with experience in the area. All communications is done in writing and is anonymous. Several 'cycles' let you hone in on a final answer.

The Delphi Process

Two key words: **anonymous** and **iterative**

ANONYMOUS

- A. The experts do not know the other participating experts are
- B. This avoids bias and pre-judgment about information being brought in for consensus

ITERATIVE

- A. The process is repeated for several cycles which allows for consensus to start to 'hone in' on a best, most informed, most intelligent and considered estimate

Parametric Estimating

- Used for estimates that are quantitatively based, such as dollars per square foot or number of installations **per hour, per mile** or KM.
- Generally is quick simple approach
- But not every activity or cost can be estimated quantitatively as historic data may not exist.

Parametric Models

Good “statistical based” tool for **early estimating**.

Parametric cost models use *predictors*.

A predictor has correlation with later results.

$$\text{Effort} = K * \text{Predictor}$$

House Cost per sq... foot = **\$100/sq... foot.**

Purchase cost of a **2500** sq.. foot house:

$$= \$2500 * 100$$

$$= \$ \mathbf{250,000}.$$

Three-Point Estimates

Simple (Triangular)

PERT (Program Evaluation and Review Technique) or weighted

Three-Point Estimating Method (Simple)

- Consider the Pessimistic (**P**), Optimistic (**O**) and Most Likely (**ML**) estimate.
- Add the three numbers and divide by 3 (simple average)

$$\text{Mean} = \frac{[P + ML + O]}{3}$$

Three-Point Estimating Method (PERT)

- Consider the Pessimistic (**P**), Optimistic (**O**) and Most Likely (**ML**) estimate.
- Give a weight of 4 to the Most Likely estimate.
- This gives a total of 6 “votes”, one each for P and O, and 4 for ML. So we divide by 6.

$$\text{Mean} = \frac{[P + 4ML + O]}{6}$$

Three Point or PERT* Method

- Takes into consideration uncertainty by determining an optimistic (best case scenario, represented by O), most likely (represented by ML), and pessimistic (worst case, represented by P) scenario.
- The most likely estimate L is weighted most heavily - four times more than P or O
- The total number of 'votes' is 6 (that's why the denominator has a 6).
- Standard Deviation (σ) for PERT is $\sigma = (P-O)/6$
- Variance is $\sigma^2 = [(P-O)/6]^2$

Three Point or PERT* Method

- Example:
- Your software developer tells you that she can *most likely* write the code in **10 days**. When you ask her how long it **COULD** take, she says... hmmm, well that **could be as much as 27 days**. “What if everything goes **RIGHT?**”, you ask. She says, that’s unlikely, but, **say...5 days**.
- You would calculate [**5** + (4***10**) + **27**] / 6 or 72 / 6 which is **12 days**.
- You now have a more intelligent estimate which *takes the pessimism and optimism into account*. You also may be able to derive some root causes for the optimism and pessimism and **increase opportunity** and/or **reduce threat!**

Bottom Up (aka “engineering”) Estimates

- The Most Accurate.
- Requires construction of WBS.
- Can’t be done right away, you need to have ‘decomposed’ the work.
- Used when there is significant detail about the activity.
- A detailed assessment of the resources, capabilities, and amounts are used to determine an accurate duration or cost estimate.
- Drawback it is most time-consuming and therefore most expensive form of estimating.

Bottom-up Estimate: Accurate but Not Always!

- This is the most accurate method.
- But not necessarily always. If you miss out on the broader system picture you will miss some estimates.
- You are counting on an accurate and 100%-inclusive WBS for a Bottom-up estimate to work.
- TIP: Combine estimating practices. An analogous estimate may be 'quick and dirty' but it will always include things that could conceivably have been left out of the WBS.

WBS Outline Roll up (aggregation)

Task Name	Work
PMA PROJECT	522 hrs
- Initiation Processes	24 hrs
- Review Inputs to Initiation	12 hrs
Create Project Statement of Work	12 hrs
- Produce Outputs from Initiation	12 hrs
Develop Project Charter (3.2.1.1)	6 hrs
Develop Stakeholder Register	6 hrs
Initiation Processes COMPLETE	0 hrs
- Planning Processes (3.2.2.1)	143 hrs
- Scope Management Processes	50 hrs
Complete Scope Definition (3.2.2.3)	30 hrs
Create WBS to level of Work Packages (3.2.2.4)	20 hrs
+ Activity Planning	20 hrs

A Detailed Package

Your Team Project
Can Use a Form
Like This

Activity Cost Estimates		
WBS ID 12	Activity Start Date: 3/15/2015	Activity End Date: 4/20/2015
	Description of Activity: Identify Food Vendors Total: \$400	

Human (Work)	Project Personnel	Cost Per Hour (include all expenses such as Taxes and Benefits)	Hours	Total Multiply Cost by Hours worked
	Project Leader	\$50	2	\$100

Materials	Material Name	Cost Per Unit	Quantity	Total Multiply Cost per unit by Quantity
	Food Containers	\$10	5	\$50

Costs	Project Costs that vary	Description	Total
	Taxi to Food Vendors	Three vendors will be visited to check the menu and try the food out.	\$ 150
	Food Sampling	Menu items will be purchased and taken-out in food containers.	\$100

Cost Estimate

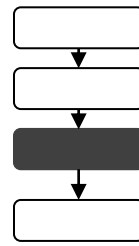
Construction Cost Estimate Worksheet							
Property Address _____							
Neighborhood: _____							
Company Name: _____ Contact: _____ Phone #: _____							
Type of property: ☐ 1 family ☐ 2 family ☐ 3+ family ☐ Condo ☐ Other _____							
Type of Improvements	Repair/ New	Qty	Cost \$	Type of Improvements	Repair/ New	Qty	Cost \$
	R or N				R or N		
General:				Heating:			
Permits		1	30.00	Boiler / Furnace	N	1	5,000.00
Demolition		1	2,500.00	Duct Work	N	4	2,000.00
Trash Removal			22,000.00	Baseboard Fin Tube	N	2	2,220.00
Lead Abatement			0.00	Radiator	N	1	3,570.00
Asbestos Abatement				Hot Water Tank/Heat	N	2	1,000.00

Influencing Factors

- Two sets of factors influence the ultimate cost of a system
- Size Factors
 - Number, and type of functions
- Project Complexity
- Complexity: Project parameters that influence project costs.

Determine Budget

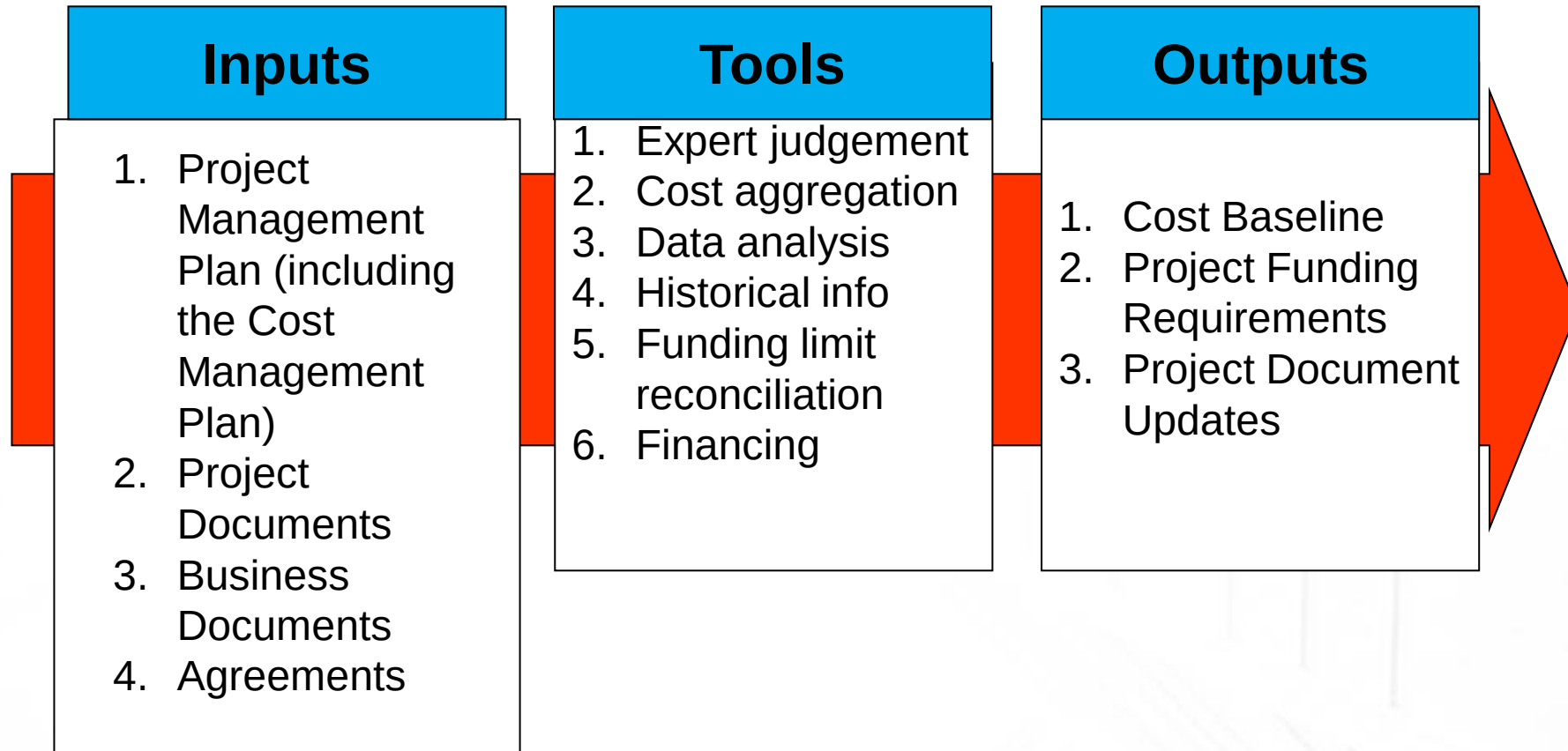
Once you have estimates and schedule you can create a budget



Determine Budget

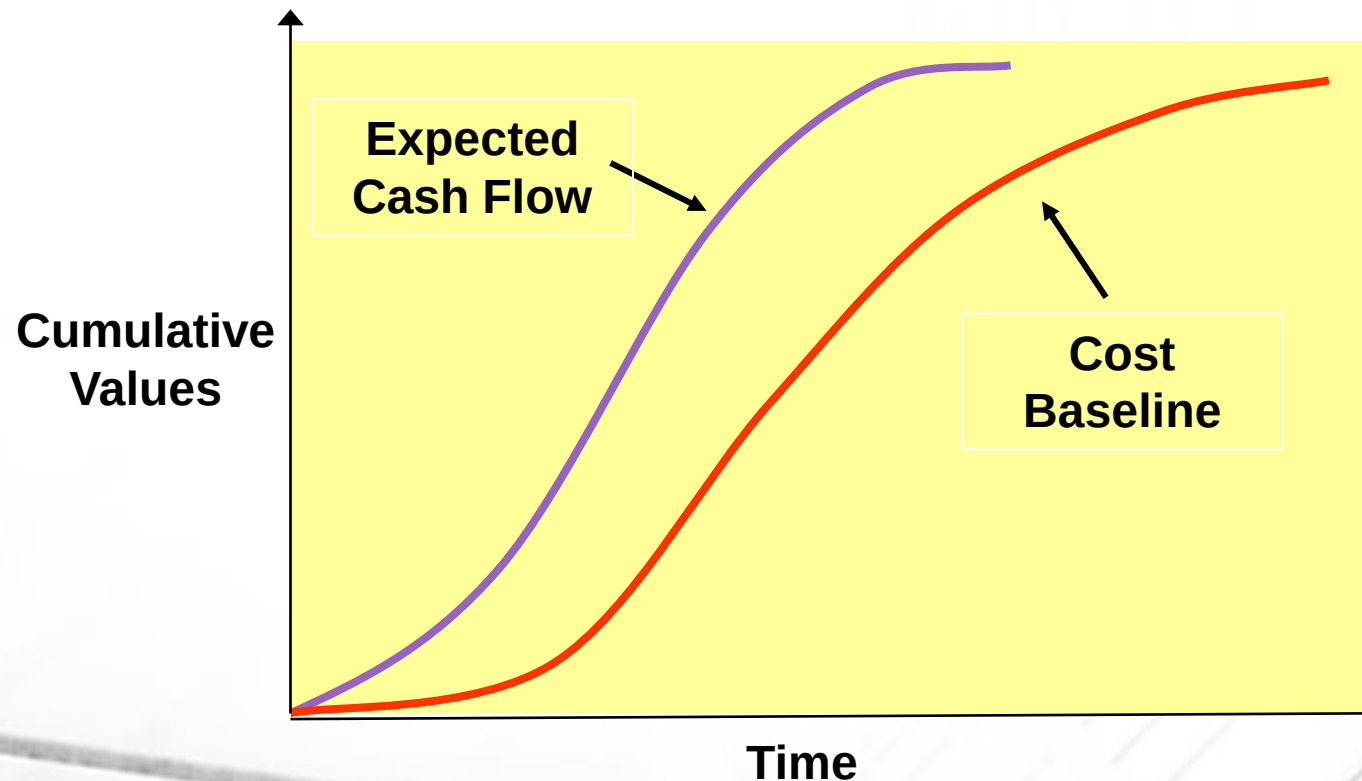
- Budgeting is the process of aggregating the estimated costs of individual activities or work packages to establish an authorized cost baseline.
- This cost baseline plays a key role in the Earned Value Management approach (EVM) to measure project performance.

Determine Budget (PMBOK® Guide 6th Edition – paraphrased)



Budget Costs

- The cost baseline will be used to measure and monitor cost performance of the project.



Core Concepts

- Effort, Duration, and Cost
- Effort: The number of labor units required to complete an activity
- Availability: Time a staff person is able to work
- $\text{Duration} = \text{Effort} / \text{Resources}$

Costs to consider

- Labor: Wages paid to all staff.
- Overhead: Cost of payroll taxes and fringe benefits.
 - Usually % of Labor
- Materials: Items used in the project.
 - cement, lumber, paint
- Supplies: Cost of tools, office supplies, equipment.
 - Should be prorated if expected life is beyond the project.
- General & Administrative: Cost of management & support services such as:
 - purchasing, accounting, secretarial
 - usually % of project cost.
- Equipment Rental:
 - computers, printers
 - compressors, cranes, trucks
- Profit
 - Reward for successfully completing the project
 - Calculated as % of project cost.

Other Costs

- **Life Cycle Costing:** Looking at the life of a product, not just the cost of the project.
- **Variable Costs:** Costs that change with the amount of production or work. (e.g. materials, supplies, wages.)
- **Fixed Costs:** Costs that do not change as the product changes. (e.g. set up, rental.)

Reserves Added to the Cost Baseline

Management Reserve: *Unforeseen Risks – Funds allocated for unknown risks.*

Contingency Reserve: *Foreseen Risks that are mitigated (will be covered under risk management chapter)*

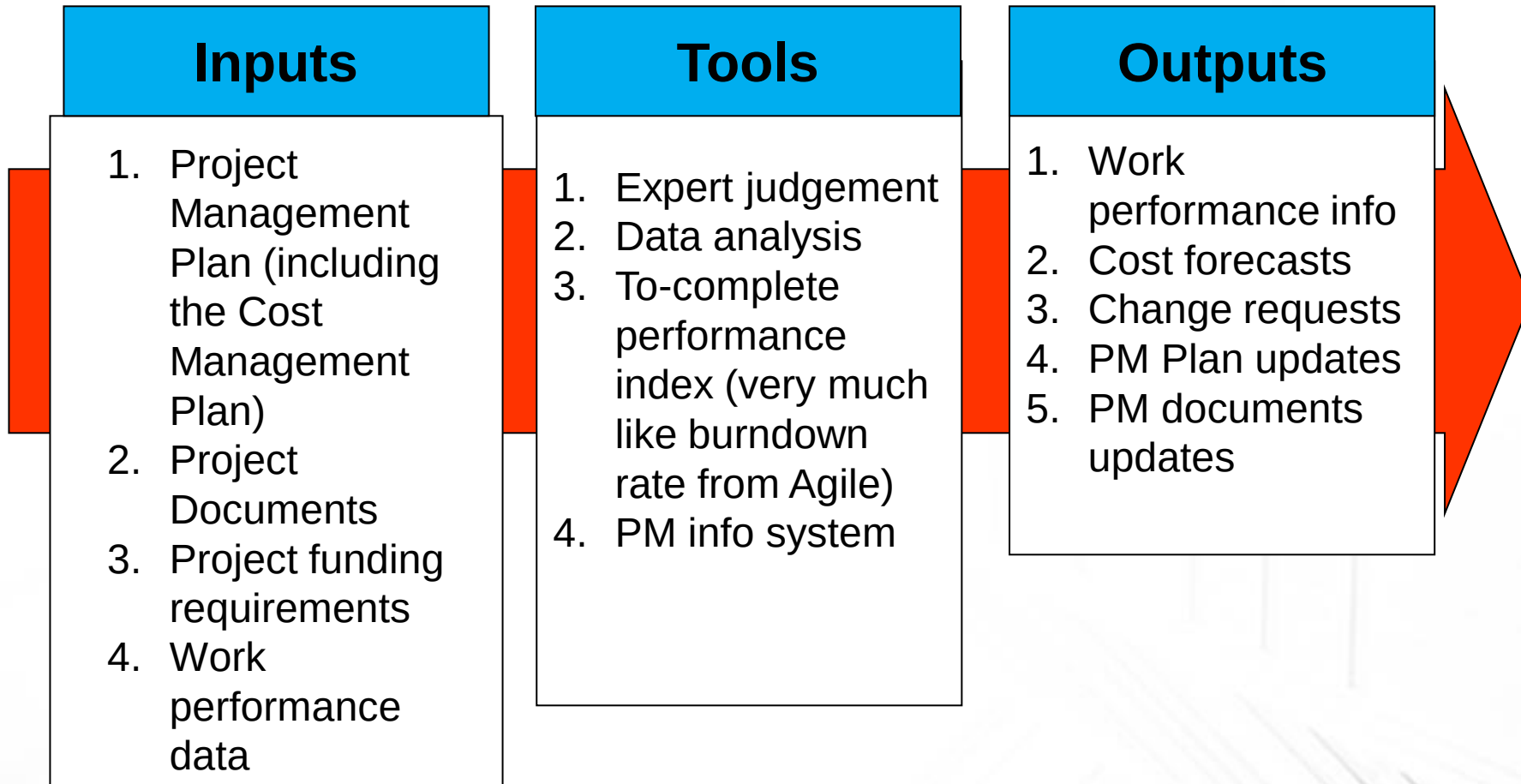
Consider Direct and Indirect Costs

- Direct costs: Costs incurred for a specific project
- Equipment bought specifically for the project
- Indirect costs: Costs span over multiple projects (“overhead”)
- Quality assurance department
- Rooms, electricity, heating
- Training Costs

Control Costs

We need to compare actual to planned and check for variance.
When that happens we may need to take action!

Control Costs(PMBOK® Guide 6th Edition – paraphrased)





Next up: Project Quality Management

Team Time

