Project Planning and Control

1

Project Planning and Control

- An attempt to develop accurate estimates for time, costs, and expected benefits, and to adjust the estimates if they prove inaccurate.

2

Project Planning and Control

Project planning estimates for:

- Time → On time
- Resources → Within budget
- Benefits → Provides the benefits

Project control involves monitoring:

3

Project Plan

- Primary documentation tool for this activity.
- Continues to evolve as the system evolves.
- Includes separate, smaller plans for each of the System Development Life Cycle phases.
- Allocates time and resources throughout the life of the project.

4

Structured Method of Estimating

- A structured method for accurately estimating time, costs, and benefits for delivering systems on time and within budget.
- Old method
  - Last system cost $100,000, and this one is bigger, so maybe $150,000...
  - Guesstimating, or WHIM (WHolely Inadequate Measurement)

5

Structured Method of Estimating

- Uses ***metrics/function points***: system characteristics that can be counted or measured.
  - *Size:* count use cases, data elements, records in database, number of transactions.
  - *Complexity:* count decisions, relationships in database.
  - *Both size and complexity:* count classes, messages and data repetitions.

6

Structured Method of Estimating

- *System type:* batch versus online versus ***real time:*** a system that monitors and controls a process without human intervention.

7

Structured Method of Estimating

- Also need to consider other "softer" characteristics like:
  - Personnel skills, experience, and turnover rate.
  - Number of expected system users, their computer experience and their expectations.
  - The development environment: are there adequate equipment and tools?
  - Vendor reliability.

8

Structured Method of Estimating

- Note that these metrics require that you use a structured methodology, and that the estimates cannot be done until much of the analysis is done.

9

Structured Method of Estimating

- Metrics are used in weighted formulas.
  - Can't give precise formulas because they don't translate well between organizations.
  - Each organization will be forced to discover by trial and error the weighting.
  - This is not like building a garage, when we have built lots of similar garages before, and when the local environment has a predictable effect on that building process.

10

Structured Method of Estimating

- Add a "fudge factor" each time you estimate.
  - Murphy's Law: double the number, then up the unit of measure.
- Standard accounting formula:

$$\frac{\text{Optimistic E.} + 4\,\text{Most Likely E.} + \text{Pessimistic E.}}{6}$$

- Refine estimates as we go along.

11

Structured Method of Estimating

- Document all assumptions
  - Inflation rate, no price increase, experienced staff, etc.
  - Why?
    - CYA.
    - Allows us to learn from our mistakes.
- Put estimates on spreadsheets, which have built-in financial functions like PVA.

12

Structured Method of Estimating

- Estimates should be predictions (realistic), not goals (hopes).
  - What *will* happen, not what we *want* to happen.
  - When a manager says, "It must be done in one month," that's goal setting, not estimation,
  - If an estimator says, "Even if you need it in one month, it will actually take six months," that's estimation.

13

Structured Method of Estimating

- Establish an ***estimating/metrics group***
  - Composed of former systems analysts who now concentrate solely on estimation.
  - Why?
    - Egos not wrapped up in the estimates.
    - They do it more often, so they get better at it.

14

Structured Method of Estimating

- Estimates for
  - Time
  - Costs
  - Benefits

15

Time Estimation

- Break the project down into small chunks and then predict when each chunk should be done.
- Mark the end of each of the project's chunks with a ***milestone***: a significant point in the development of the project.

16

Time Estimation

- Milestones must be measurable or verifiable points in time.
  - Why not "coding is half done"?
- Use considerations such as:
  - available personnel and their skills
  - equipment delivery dates
  - supply delivery dates

17

Project Management Tools & Techniques

PERT chart – a graphical network model used to depict the interdependencies between a project's tasks.

Gantt chart – a bar chart used to depict project tasks against a calendar.

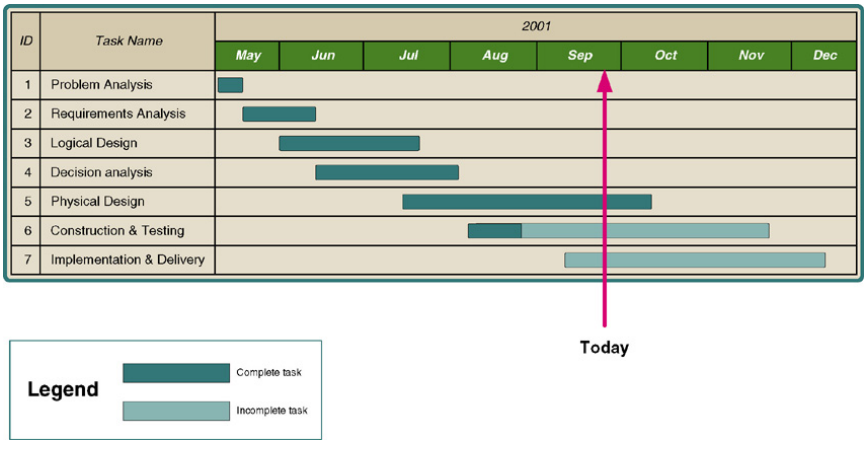
18

Gantt Chart

- Usually displays time across horizontal axis and activities on the vertical axis...
- Allows a manager to schedule activities graphically over time.
- Useful in determining the status of a project at any point in time.

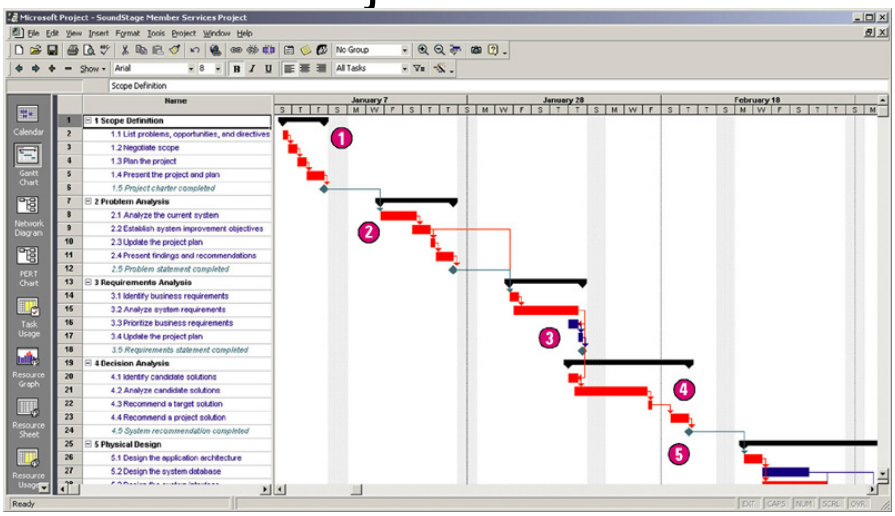
19

Gantt Chart



20

Microsoft Project Gantt Chart



21

Gantt Chart

- A Gantt Chart does not show the relationships between events.

22

PERT Chart

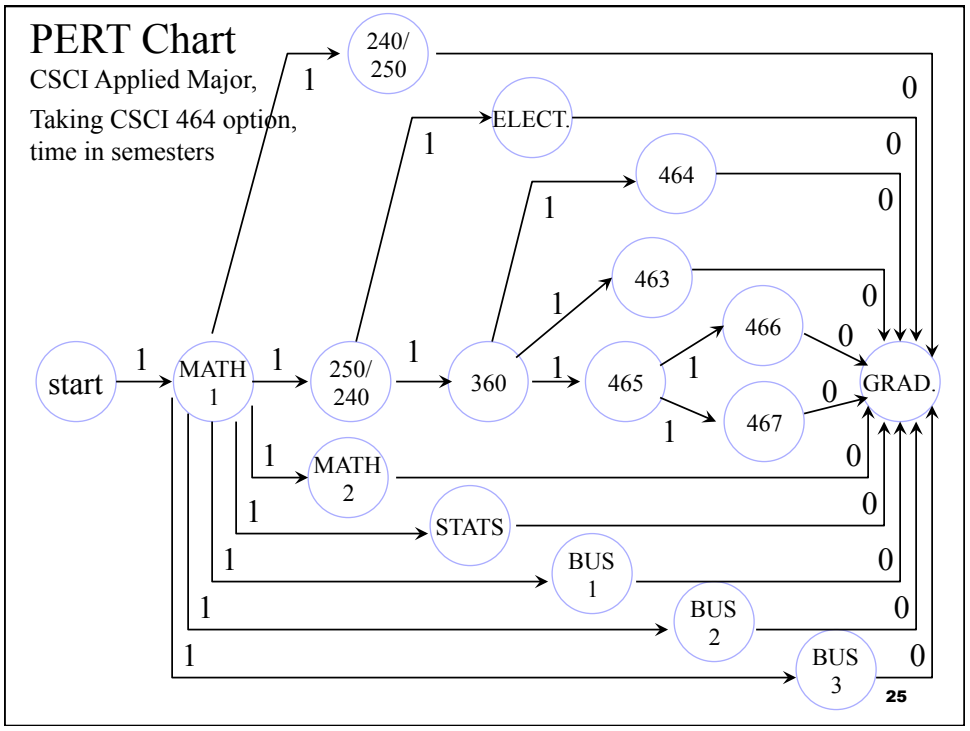
- Performance Evaluation and Review Technique
- Shows the time to accomplish an activity, plus the relationships and dependencies between events.
- It shows the network of activities, some of which some must be completed before others can begin.

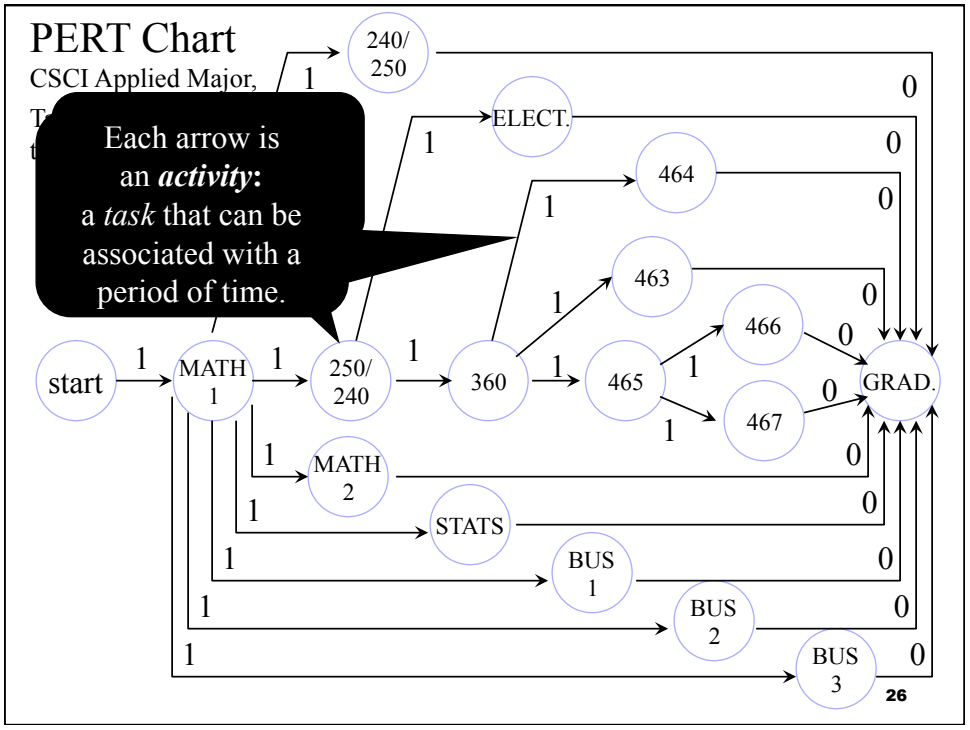
23

PERT Chart

- Look at an example you should be somewhat familiar with...

24

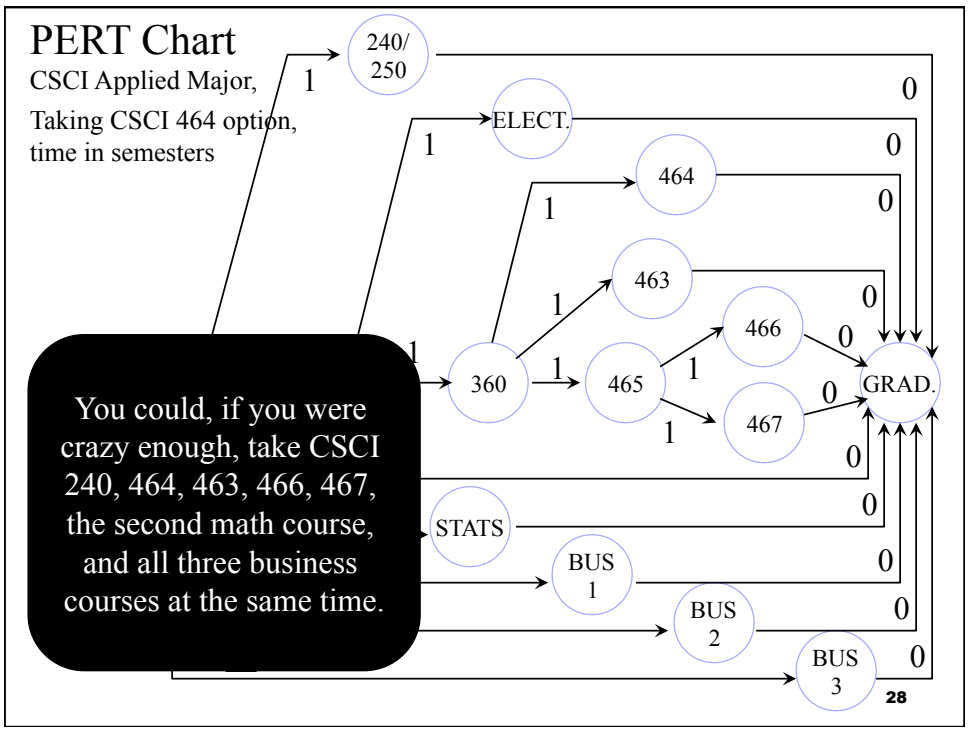

PERT Chart
CSCI Applied Major,
Taking CSCI 464 option,
time in semesters
start
MATH 1
250/ 240
240/ 250
360
ELECT.
464
463
465
466
467
MATH 2
STATS
BUS 1
BUS 2
BUS 3
GRAD.
25


PERT Chart
CSCI Applied Major,
Each arrow is an *activity*: a *task* that can be associated with a period of time.
start
MATH 1
250/ 240
240/ 250
360
ELECT.
464
463
465
466
467
MATH 2
STATS
BUS 1
BUS 2
BUS 3
GRAD.
26

PERT Chart

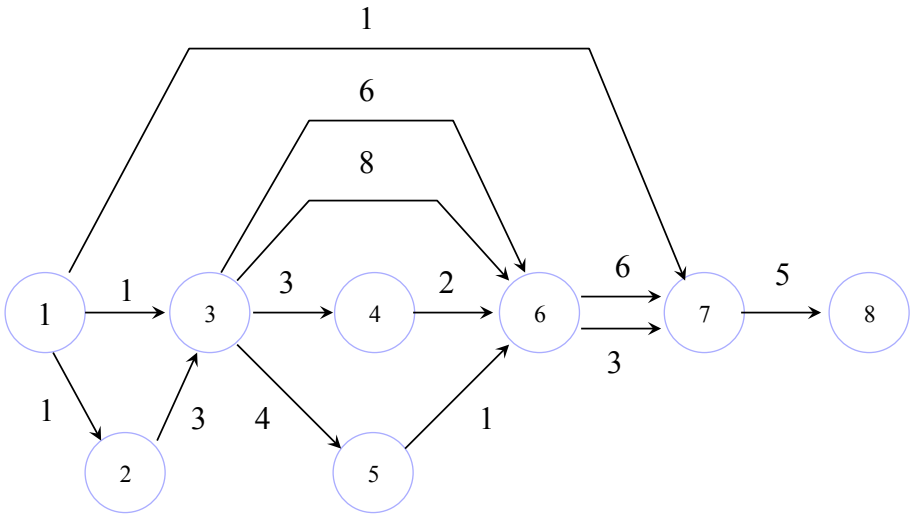
- Note that it is a network of activities: multiple things can be going on at once.
- For example...

27



28

PERT Chart



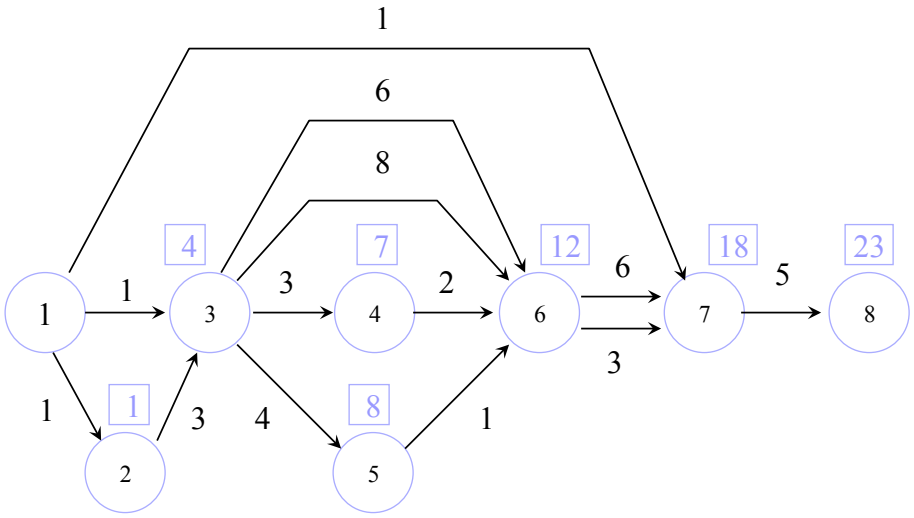
29

PERT Chart

- ***Event time:*** The time it takes to ***fire*** (complete) an event.
- To calculate, add up the longest time it takes to get to an event.

30

PERT Chart

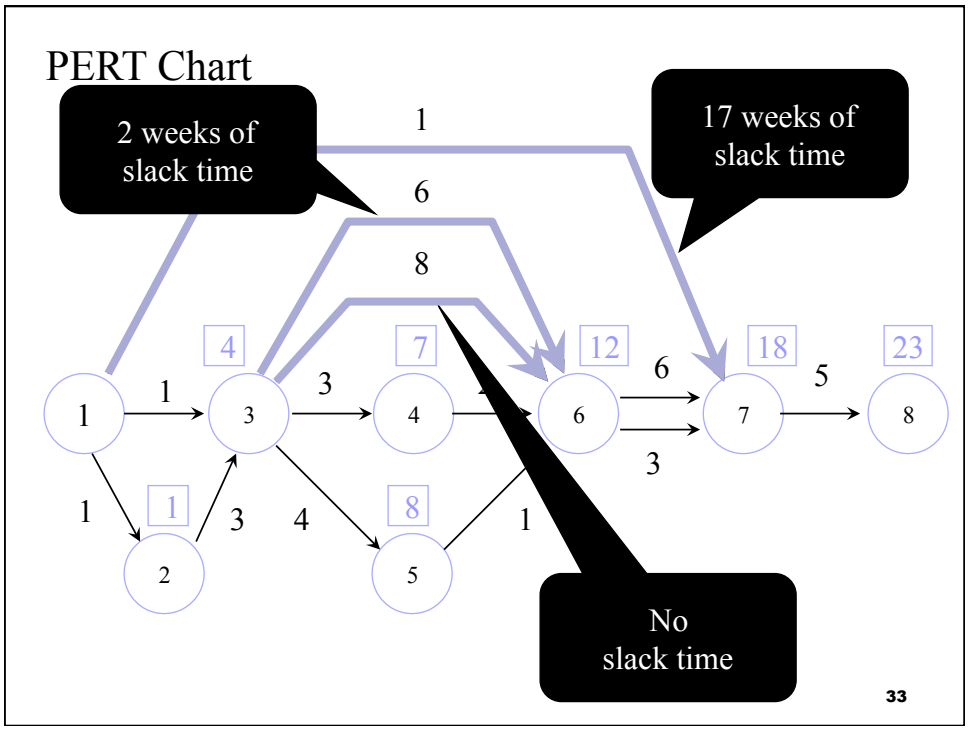


31

PERT Chart

- ***Slack time:*** When there is excess (unneeded) time in a path.

32



PERT Chart

- Slack time means that we do not have to be quite so careful about monitoring the schedule for that activity.
- However, if you let such an activity get further behind than the available slack time, it can still be a problem.
- ***Critical path***: the path with no slack time.
  - Shows which activities need closest monitoring.

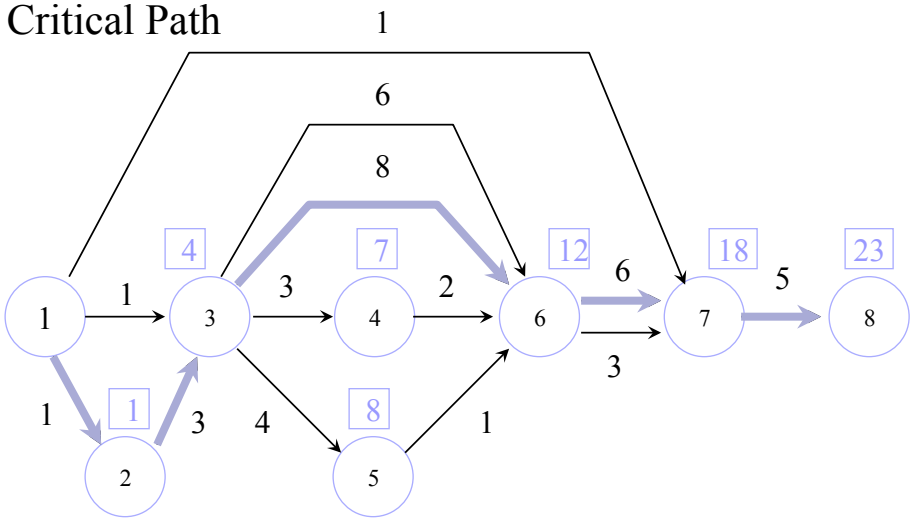
34

PERT Chart

- To find the critical path:
  - Fill in all of the activity and event times.
  - Beginning at the final event, work backward through the activities, choosing the activities that gave the event time which follows it.

35

PERT Chart,
Critical Path



36

PERT Chart

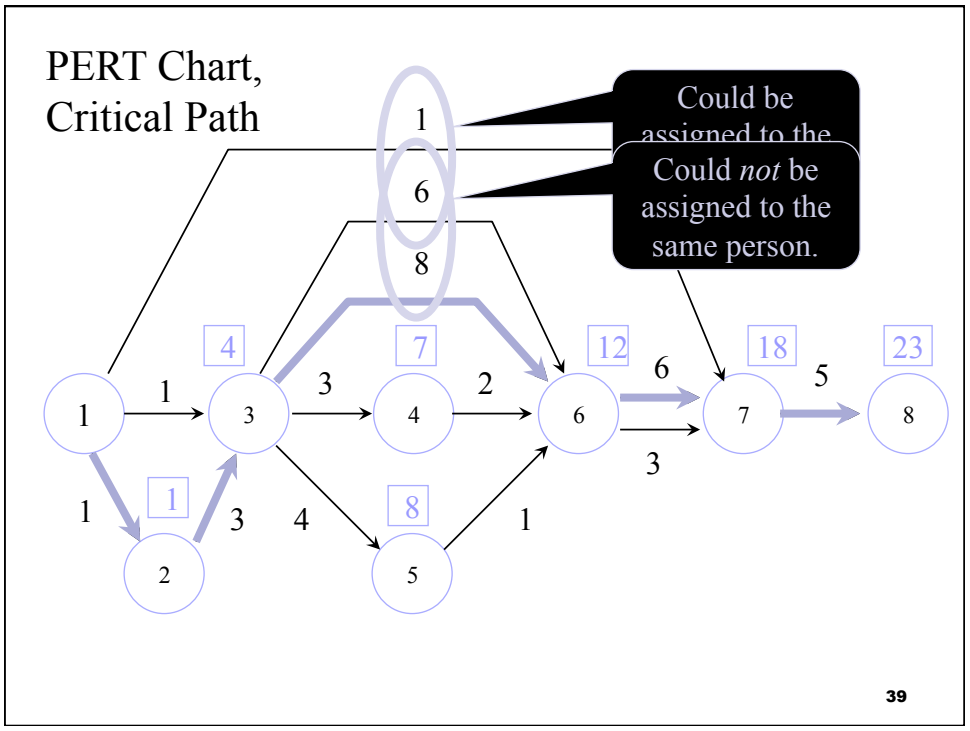
- Advantages of PERT over the Gantt chart:
  - Allows us to focus on the danger areas in the schedule.
  - Provides a more accurate time estimate because it takes into account dependencies (like prerequisites).
  - Can be used to evaluate proposed schedule changes.

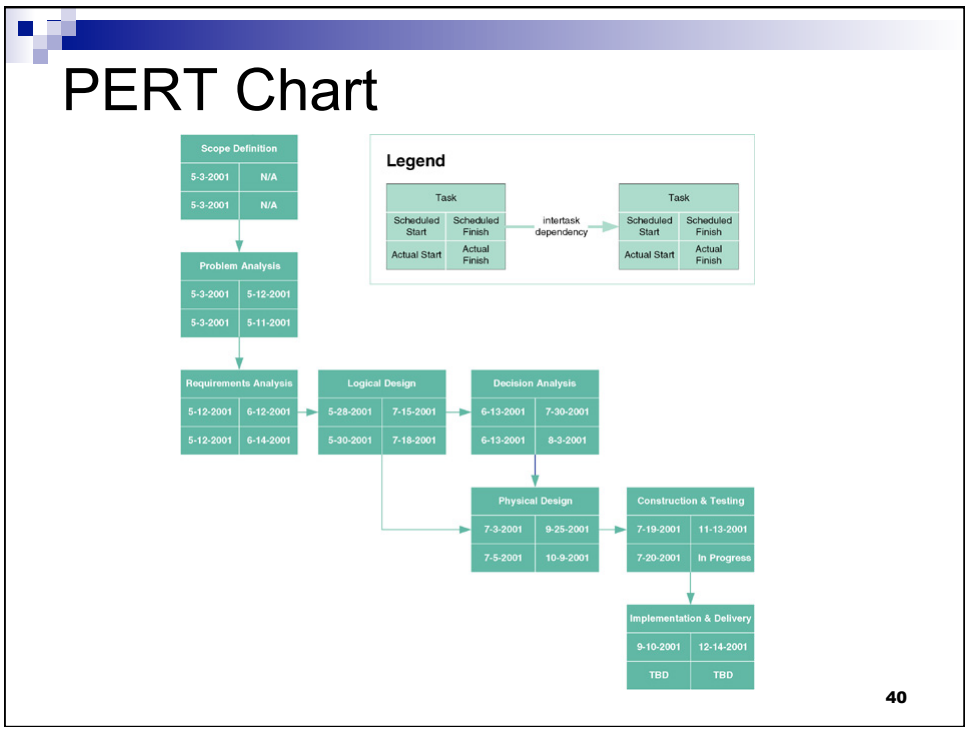
37

PERT Chart

- Can be used in simulations in which the purpose is to try to shorten the critical path and therefore the time it takes to complete the project.
- Activity times can be used as an aid in assigning tasks to the project team...

38


PERT Chart,
Critical Path
1
6
8
Could be assigned to the
Could *not* be assigned to the same person.
4
7
12
18
23
1
1
3
3
2
6
5
1
1
3
4
8
1
3
1
2
3
4
5
6
7
8
39


PERT Chart
Scope Definition
5-3-2001 N/A
5-3-2001 N/A
Problem Analysis
5-3-2001 5-12-2001
5-3-2001 5-11-2001
Requirements Analysis
5-12-2001 6-12-2001
5-12-2001 6-14-2001
Logical Design
5-28-2001 7-15-2001
5-30-2001 7-18-2001
Decision Analysis
6-13-2001 7-30-2001
6-13-2001 8-3-2001
Physical Design
7-3-2001 9-25-2001
7-5-2001 10-9-2001
Construction & Testing
7-19-2001 11-13-2001
7-20-2001 In Progress
Implementation & Delivery
9-10-2001 12-14-2001
TBD TBD
Legend
Task
Scheduled Start
Scheduled Finish
Actual Start
Actual Finish
intertask dependency
Task
Scheduled Start
Scheduled Finish
Actual Start
Actual Finish
40

Q & A

41

Cost Estimation

- Costs are the resources, in financial terms, needed to complete the project, including:
  - Personnel, hardware, software, supplies, utilities, construction, etc.

42

Cost Estimation

- ***Developmental costs*** (start-up costs)
  - The resources that expended while creating the system.
  - All of the above, plus site prep, initial training, development tools, etc.
- ***Operating costs***
  - The costs that occur on a daily basis throughout the life of the system.
    - Salaries for data processing staff, hardware lease fees, supplies, etc.

43

Cost Estimation

- ***Variable costs*** increase as the volume of work increases.
  - Paper, overtime wages
- ***Fixed costs*** are not immediately affected by the work volume.
  - Hardware lease fees, regular wages

44

Cost Estimation

- ***Tangible costs*** can be easily assigned a dollar value.
  - Wages, loan payments, supply costs
- ***Intangible costs*** are difficult or impossible to quantify.
  - Customer dissatisfaction
  - Poor employee moral
  - Time wasted because of inefficient methods

45

Benefits Estimation

- ***Benefits*** are the functions a system delivers, measured as either an increase in revenues or a decrease in expenses.

46

Benefits Estimation

- ***Tangible benefits*** can be easily assigned a dollar value.
  - Reduced hardware leasing fees, replacing reports on paper with screen displays
- ***Intangible benefits*** are difficult or impossible to quantify.
  - Improved employee morale
  - Improved collection of accounts receivable because of better reporting methodology

47

Cost-Benefit Analysis

- Helps us to find the system that delivers the most benefits for the money spent.
- Used to evaluate alternatives, because costs or benefits have no meaning in isolation.

48

Cost-Benefit Analysis

- Assume that we have two systems:
  - System A costs $1,000,000.
  - System B costs $100,000.
  - Which one?
- Or,
  - System A delivers 95% of the stated goals.
  - System B delivers 75% of the stated goals.
  - Which one?

49

Cost-Benefit Analysis

- Put it all together:
  - System A costs $1,000,000 and delivers 95%
  - System B costs $100,000 and delivers 75%.
- Now, we can make an informed decision: is the extra 20% worth the extra $900,000?

50

Cost-Benefit Analysis

- Three methods of cost/benefit analysis that we will look at:
  - Payback analysis
  - Return on investment (ROI) analysis
  - Net present value analysis
- Start with the first (the easiest) and work your way to the third (most complex).
- If the project fails any step along the way, there is no need to do further analysis.

51

Cost-Benefit Analysis

- First, fill in a table of the costs and benefits for each year of the expected lifespan of the system...

52

Cost-Benefit Analysis

Year	0	1	2	3	4	5
Development Costs	$156K	$34K				
Operating Costs		$54K	$45K	$48K	$57K	$65K
Total Lifetime Costs	$156K	$244K	$289K	$337K	$394K	$459K
Benefits		$145K	$110K	$86K	$65K	$55K
Total Lifetime Benefits		$145K	$255K	$341K	$406K	$461K

53

Payback Analysis

- How soon the lifetime benefits of the system surpass the lifetime costs.

54

Payback Analysis

Year	0	1	2	3	4	5
Development Costs	$156K	$34K				
Operating Costs		$54K	$45K	$48K	$57K	$65K
Total Lifeti Costs			$289K	$337K	$394K	$459K
Benefits			10K	$86K	$65K	$55K
Total Lifetime Benefits		$145K	$255K	$341K	$406K	$461K

Payback period: somewhere between year 2 and year 3 (close enough).

55

Payback Analysis

- Drawbacks
  - Does not take into account the time value of money.
  - Does not consider any benefits of the system that are accrued after the payback period.
  - An alternate solution might produce the greatest benefits at the lowest cost a year after the payback period has ended.

56

Return on Investment Analysis

- The rate of return (similar to interest on a bank account) that the investment provides over its life span.
- An organization will generally set a minimum acceptable rate of return for all investments.

57

Return on Investment Analysis

$$\frac{\text{lifetime benefits - lifetime costs}}{\text{lifetime costs}} * 100 = \text{ROI}$$

$$\frac{\$461K - 459K}{\$459K} * 100 = .436\% \quad \text{(not good!)}$$

58

Return on Investment Analysis

- What if we had done RIO on our example on year 4 instead of year 5?
- What does that tell us?

59

Net Present Value Analysis

- What if you won the lottery, and had a choice between taking $1,000,000 now or $100,000 every year for 10 years?
- Net present value analysis takes into account the time value of money by expressing all costs and benefits as their equivalents in today's dollars.
- It would help you to evaluate better ways of handling your lottery winnings.

60

Net Present Value Analysis

- Example: $1.00 today is the equivalent of $1.05 one year from now if you can get a 5% interest rate on your investment.
- Turn that around: $1.05 a year from now is the equivalent of $1.00 today, again assuming 5%.
- Present value looks at a future amount and provides its equivalent in today's dollars, using the interest rate that you decide upon.

61

Net Present Value Analysis

- Formula for the present value of a future amount:

$$\text{Present value} = \text{amount} * \frac{1}{(1 + \text{rate})^n}$$

  - *amount:* future value of the cost or benefit
  - *rate:* expected annual rate of return on the investment
  - *n:* number of years that will pass before the cost or benefit will occur

62

Net Present Value Analysis

- What if someone wanted to give us $1.00 two years from now, or $.90 now?
- Which is better, assuming 5% return on our money?

$$\$1.00 * \frac{1}{(1 + .05)^2} = \$.91$$

- We would have to get $.91, not $.90, to be equivalent.

63

Net Present Value Analysis

- The first step in finding the *net* present value is to find the present value of each individual amount in the chart we did.
  - Do *not* use the totals for this analysis!
- For our example, we will assume that we need to meet a 14% rate.

64

Costs at Present Value

Year 0	$156,000	$156,000
Year 1	$\frac{\$88,000}{(1.14)^1}$	$77,193
Year 2	$\frac{\$45,000}{(1.14)^2}$	$34,615
Year 3	$\frac{\$48,000}{(1.14)^3}$	$32, 432
Year 4	$\frac{\$57,000}{(1.14)^4}$	$33,728
Year 5	$\frac{\$65,000}{(1.14)^5}$	$33,679

65

Benefits at Present Value

Year 0	$0	$0
Year 1	$\frac{\$145,000}{(1.14)^1}$	$127,193
Year 2	$\frac{\$110,000}{(1.14)^2}$	$84,615
Year 3	$\frac{\$86,000}{(1.14)^3}$	$58,108
Year 4	$\frac{\$65,000}{(1.14)^4}$	$38,462
Year 5	$\frac{\$55,000}{(1.14)^5}$	$28,497

66

Net Present Value Analysis

Total Costs at Present Value:

$156,000
77,193
34,615
32,432
33,728
33,679
$367,647

67

Net Present Value Analysis

Total Benefits at Present Value:

$127,193
84,615
58,108
38,462
28,497
$336,875

68

Net Present Value Analysis

Net Present Value = PVA Benefits - PVA Costs

- A positive value means the investment met the rate that you specified.
- A negative value means that it did not.

69

Net Present Value Analysis

NPVA = PVA Benefits - PVA Costs
NPVA = $336,875 - $367,647
NPVA = ($30,772) (a negative amount)

- This investment did not meet the 14% rate that was specified.
- NPVA does not tell you what rate it did meet.
- When comparing several options, the one with the highest positive answer is the winner.

70

Cost Benefit Analysis

- For calculating ROI, do it manually or use the ROI function built into most spreadsheets.
- For calculating PVA, either do it manually, or use the PVA function built into most spreadsheets, or use PVA tables from the appendix of a good accounting textbook.
  - Note: the results may vary up to $200, depending upon the rounding used by the method you choose.

71

Slippage

- ***Slippage:*** The process of falling behind schedule or going over budget.
- What to do?
  - Extend the deadline, often taken by default.
  - Throw more resources at the problem.
    - This works only if done intelligently.
    - For example, more people will help only if the problem is partitionable, and that solution has plenty of drawbacks.
  - Trim the benefits.

72

"Make No Small Slips"

- Famous quote from Frederick Brooks, author of *The Mythical Man Month.*
- Boss will probably bargain down anyway.
- Your original estimate was low, so this one probably is, too.
- You don't want to go back multiple times asking for more time or money.
- If you come in under, you will look good.

73

Q & A

74