Chapter 15

Using the Schedule to Forecast and Balance Resources

ARC 226 CONSTRUCTION SCHEDULING
Introduction

- CPM offers the ability to balance resources
  - Use resources evenly throughout the project
- Achieved by manipulating the float to start and finish activities when resources are available
- Resources to balance
  - Equipment
  - Number of workers on site
  - Cash flow
Creating Resource Relationships

- **Physical relationships**
  - Predecessor must be complete before the successor can start

- **Quality relationships**
  - Predecessor is completed to ensure higher quality for the successor
    - Exterior siding and drywall example

- **Safety relationships**
  - Predecessor is completed to ensure higher safety standards for the successor

- **Resource relationships**
  - Two activities that need the same piece of equipment
    - Equipment, costs, materials, workers
Forecasting and Balancing Cash Flow

- **Cost loaded schedule**
  - Costs are included in the schedule

- **Activity values must be known**
  - Amount the owner owes after an activity is completed
  - All direct and indirect costs
  - Bid price becomes the project budget

- The total of the activity values should equal the project budget
Monthly Cash Flow

- Monthly value =
  - Estimated activity value / Duration

- A bar chart is then created based on ES and EF and also showing float for each activity
  - Lower portion shows a resource profile
    - How much is used in a particular time period (month)

- How can resources be arranged so that cash flows remain steady or do not exceed a prescribed amount
  - Easily done with a computer
Cash Flows, cont.

- The cash flows (amount the owner owes after completion of an activity) need to be forecast for the project.
- If the amounts are too high for a particular month, activities with float need to be manipulated to even out the cash flows.
- The importance of understanding the different types of float becomes paramount.
  - Knowing how to handle the activities with float can be as or more important than handling the critical activities.
Progress S-Curves

- Plots the cumulative costs over the time
- Cost usually slow to accumulate early and again late in the project
  - Steep curve early may indicate front-loaded billing
- Often based on the early start dates
  - The progress curve can be refigured from the late start dates
Banana Curves

- Early and late S-curves plotted together
  - Loosely resembles a banana figure
- If the actual progress curve is above the banana, the project is either over budget or ahead of schedule
- If the actual progress curve is below the banana, the project is either under budget or behind schedule
  - The actual line should be between the ES or LS lines
  - May work as a good early warning system
    - MS Project will only do ES or LS, but not both
Forecasting and Balancing Equipment

- **Equipment loaded schedule**
  - Equipment is added to the schedule

- **Similar methods to balancing for cash flows**
  - Analyze the number of pieces of equipment for each activity
  - Then create a bar chart showing float and load the chart with the equipment to be analyzed
  - Examine the loadings and adjust the bars within the float as desired

- **How can the project be complete under the constraints of the required equipment with the equipment that is available**
Forecasting and Balancing Human Resources

- Labor loaded schedule
  - Crew size is added to the schedule
  - Number of workers is forecast and balanced in the same way as the equipment and costs

- Determine the number of workers and crew size for each activity

- How can the project be completed with the crew that is available?
  - Manage the float activities
  - Difficult without the use of a computer
Automatically Balancing with Computers

- Two methods generally used
  - Minimum float rule
    - More common
  - Minimum duration rule

- The automatic results may not always be the most efficient method for the jobsite
  - It may make more sense to use a piece of equipment in one area vs the other
  - It may make more sense to do some of the work manually
    - Activities may be sorted by resources, etc.
Duration-Driven vs. Resource Driven Schedules

- So far, the schedule has a set duration and then resources are assigned
  - More common method
- Or, the project can have set resources and then assigned durations
  - Not as common of a method because projects are typically duration constrained
Conclusion

- For realistic scheduling, the required and available resources must be considered
  - Each project has its associated resource constraints
- Labor, equipment, money, and material must be available in sufficient but realistic quantities
- Understanding the different types of float helps balance the resource requirements