THE WOODSTOCK SAWMILL CASE

The Department of Natural Resources (DNR) of the State of Oregon decided to build a new modern sawmill near the town of Woodstock. The mill would be owned by the State and used both as a commercially viable milling operation and as a training center to teach sawmilling skills to Oregon residents. The total complex of buildings and machinery was expected to cost about $12,000,000. It was essential to get the mill into operation as quickly as possible because of DNR's commitment to supply a private investor with a large portion of the output of the mill for a box factory that was to be built adjacent to the sawmill. The box plant was planned for completion in 12 months; the mill's profits from sales to it were projected to be about $40,000 per week.

Mr. Warren Ellis, the newly appointed project manager, was in the process of planning the work to be done. He was concerned with the timing of the various activities and anxious that there be no avoidable delays. Since he was new to the job, and was also responsible for the actual design of the mill and the equipment specifications for it, Mr. Ellis was seriously pressed for time and wanted to lay out the total project so as to insure against leaving any task undone and so that he could see at a glance what had to be done next. He was also under very serious cost constraints and needed some means of controlling both the speed of the work and the expenditures for it.

He had heard of the Critical Path Method for planning and controlling complicated projects and was vaguely aware that costs could also be noted on the network. But he was uncertain as to whether this technique was suitable for the relatively simple project facing him.

One of the difficulties anticipated for the new plant construction was that much of the machinery and equipment had to come from China. Even though there were regularly scheduled freight services to nearby ports on the Pacific Ocean, ordering lead time was long, and delays were frequent. Dock-workers' strikes, ship delays due to weather and loading, lost goods, accidents, and the frequent unavailability of rail cars, all combined to make delivery dates highly uncertain. This situation also reduced flexibility on the part of the mill designer, since once the orders were placed, there was little that could be changed, even though construction had not yet started.

Most of the work would be done with unskilled manual labor. The number of men who could be applied to a task, however, was frequently limited by space, supervision, safety, or equipment constraints.

Information for the Network Plan

Mr. Ellis decided to go ahead and draw a CPM network, making simple estimates of time and cost to the best of his ability. Although much of the work would be let out to a contractor (including the actual construction of the mill), he wanted to diagram the whole project. This would help him evaluate bids when they were submitted and would be of assistance to the contractor.

Mr. Ellis estimated the most likely duration of each task, given that no unforeseen or unusual circumstances occurred. He tried to project the actual span of time that would be required for each task rather than the number of days of work involved. For example, the actual design would probably take about five weeks of full-time work, but the time required for policy decisions, inquiries and replies, etc., would stretch that phase out to 12 weeks. Time estimates were in units of a 6-day working week, including the overtime that would normally occur.

Direct labor and material costs were estimated from experience in comparable situations. Indirect costs were more difficult to determine. For his own or another officer's time, Ellis charged $2,800 per day to include salary and office overhead. This was expected to cover typists and technicians as well as telephone and other incidentals. The total cost for each activity was arrived at by building up elemental direct and indirect costs and making adjustments where experience suggested they should be made.

Mr. Ellis broke the project down into three main groups of activities:

1. Financing, design, and machinery ordering.

2. Site purchase and preparations.

3. Construction of the sawmill.

For each of these groups, he then listed the sequence of activities, his best estimate of the time involved, and the cost, where applicable. This information is given below.

Financing, Design, and Machinery Ordering:

- The negotiation of a loan to finance the project had to begin at the start of the project because, in the event that no soft loan was possible, the project would be terminated. This was estimated to take 3 weeks and cost $40,000 (3; $40,000).[1]

- Design of the mill could begin at the same time as the loan negotiations (12; $176,000).

- Approval of the design would be forthcoming after the design was all completed (1; $20,400).

- Final equipment and machinery specifications could then be prepared (2; $26,000).

- These would then have to have DNR approval (1; $8,400).

- Following approval, firm orders could be placed for Chinese and local machinery. This activity was dependent, however, on the successful completion of loan negotiations. Both batches of orders could be done simultaneously (l; $8,400) (1; $8,400).

[1] The notation (3; $40,000) means that the activity has a duration of 3 weeks and a cost of $40,000.

- Delivery of Chinese machinery was expected 24 weeks after the order was placed.
- Payment for those machines would be made on delivery ($3,252,000).
- Delivery of local equipment, including trucks from local inventory, was expected 8 weeks after the order.
- Payment for local equipment would be made on delivery ($1,620,000).
- Final blueprints of the mill could be prepared after the design was approved (1; $4,800).
- Requests for bids would be made when the blueprints were ready, but not before a loan agreement was signed (2; $5,600).
- The contract for the construction of the mill could then be signed (after bids were submitted and the winning bid was selected) (1; $5,600).

Site Purchase and Preparation:

- Location of a suitable site could begin at the start of the project, concurrently with mill design and loan negotiations (3; $12,000).
- Negotiation and purchase of the site follows, but it is dependent on a loan having been arranged (3; $320,000).
- A survey and leveling of the site follows (1; $20,000).
- At the same time as the start of the site survey, the negotiations and ordering of a railway spur to the site could begin (4; $8,400); also, the necessary utility services (water, electricity, and sewer) could be ordered (1; $8,400). Installation of these utility services would require an additional 11 weeks.
- After the rail spur was ordered, spur construction could be carried out by the railway company. The time required would be 12 weeks, and upon completion, payment would be due ($120,000).
- After survey and leveling, and after the construction contract for the mill had been signed, the contractor could begin (a) clearing and grading (2; $56,000) and, at the same time, (b) fencing the property (3; $432,000).
- After clearing and grading, two activities could start: (a) construction of roads and parking lots (2; $80,000), and (b) surveying the foundation for the mill (½ week; $8,000).
- Payment for these and all subsequent activities would be based on the total contract price and the completion of stages as described below.

Construction of the Sawmill:

- The contract would provide for payments to be made on a weekly basis during mill construction. The concrete phase was budgeted to cost $1,400,000 and last 2½ weeks, for a weekly payment of $560,000. The steel-work phase would last 6 weeks and cost $2,000,000 or $333,333 per week. The final machine installation stage would cost $600,000 and last 8½ weeks or $70,588 per week.

- With the foundations surveyed, the formwork for the foundations that the steel girders would rest upon could be constructed (2 weeks). At the end of the 1st week, they could begin to pour concrete for ½ week (while also working on the 2nd week of formwork) and finish pouring in another ½ week after the end of the 2nd week of formwork.

- With the foundations surveyed, the formwork for the foundations for the three saws could also be constructed (concurrently with the formwork for the foundations for the steel girders). The formwork for the saw foundations would take 1½ weeks, at which time concrete pouring would start and take ½ week.

- The foundations for the steel girders would require 1 week to cure. Steel column erection could then begin and would last 2 weeks. Roof trusses could then be erected (2 weeks). When all trusses were in place, roof decking could begin (1 week). When that was completed, floor joists could be put in (1 week). This would complete the steelwork phase. Finally, the floor decking could be installed (1½; $20,000).

- The saw foundations would require 3 weeks to cure and would then be ready for the installation of the saws.

- An important project milestone "M" would be reached when
  (a) all machinery (foreign and local) had been delivered,
  (b) utility services (water, electricity, sewers) had been installed on site,
  (c) the concrete for the saw foundations had cured, and
  (d) the floor decking had been installed.

  When milestone "M" was reached, the following 3 tasks could start at the same time:
  (e) installation of the waste disposal system (1 week)
  (f) installation of the saws, conveyors and control boxes (3 weeks)
  (g) connections to utility services (water, electricity, sewers) (3 weeks).

  After (e), (f) and (g) were done,
  (h) the saws could be set up and broken in (3 weeks).

  And after the saws were set up and broken in ,
  (i) the exterior walls could be erected (2½ weeks).

- The project would then be completed if the fencing, roads, and rail spur were in place.

Planning and Scheduling the Project

Following the instructions given in a book on the Critical Path Method which he had purchased, Mr. Ellis drew a network based on the information given above and determined that the project should be completed in about 50 weeks if all went well. He doubted that this would be the case, however, and knew that he would probably have to revise the schedule as work progressed. However, he was determined to stick as closely as possible to his original estimates. He was particularly concerned about cost expenditures during the sawmill construction phase because of the contract provision for weekly payments.

Progress of the Project

The project started in mid-autumn (the exact date is specified in the assignment), and events proceeded smoothly for about the first 4 months of the project. Early next year, 21 weeks after the project start, Mr. Ellis decided to review the progress of the project. The following activities were completed as of the Data Date, i.e., at the end of the 21st week:

- loan negotiations
- site selection and purchase of land
- mill design and approval
- specifications and approval
- blueprints
- bids
- signed contract
- site survey and leveling
- rail spur ordered

The following activities were about to begin:

- machinery orders
- site clear and grade
- fencing

Expenditures to date for direct cost items totaled $740,800.

With this information, Mr. Ellis sat down to put together a picture of where the project was with regard to the original schedule of time and cost expenditures.