Chapter Eleven
The Impact of Scheduling Decision on Productivity
Working Overtime

* Work overtime is simply defined as more work in a smaller time frame.

- What will the impact be on productivity if workers are asked to work overtime?

  If they are asked to work overtime for two or three days, the adverse impact may hardly be noticeable or may be non-existent.

  So, working overtime for an extended period of time adversely impacts productivity.
Working Overtime (cont.)

The following formula is used to predict the productivity impact of working overtime for an extended period:

\[
\text{Eff (\%)} = 100 \% - 5\%[(\text{days} - 5) + (\text{hours} - 8)]\%
\]

Where:

\( \text{Eff} \) = worker efficiency based on 100\% for a regular 40-hr week.

\( \text{Days} \) = number of days worked per week.

\( \text{Hours} \) = number of hours worked per week.

* The normal 40-hr work week has been defined as the benchmark for 100\% efficiency.
Cost of Overtime

The cost of overtime is usually assume that the cost of additional time is time and a half.

*For Example:

If there are 20 workers and the wage is (12$) per hr what would be the cost of overtime?

The average wage of the workers is (12$) per hr, and since any work hours above 40 hours are paid at overtime rate of (18$).

*So, the overtime portion of the base wage is (6$) per hr.
Cost of lost productivity

- Cost of lost productivity is the difference of cost of all working hr per week and the cost of the effective hr per week. This difference is lost to the contractor.
Example

If there are 20 workers and the wage is (12$) per hr and each of them work 60 hr per week, but the effective work is only 48 hr per week, so this means that there is 12 hr of regular work hours lost each week per worker which equates to (144$) per week per worker or (2880$) for the 20 workers.
Savings

- Every day that the project duration is shortened will also reduce the number of days that the equipment and staff will be required for the project. Depending on the type of equipment being used on the site, there will be additional savings.
Increasing the workforce (Crowding)

* Working overtime maybe desirable in situations where a quick response is needed or where training costs for certain skills are high. So the contractor decides to add extra workers to the workface, this added workforce may be asked to work on second shift.
Increasing The Number of Starting Points

- To avoid crowding, it might be possible to assign workers to different areas, this will spread out the job, but some losses in productivity should be expected.

- For example: instead of doubling the number of workers at the face of a tunnel, it might be more effective to use the additional workers at a second tunnel face.

With the additional starting places, making material deliveries and satisfying equipment needs on each floor will become more complex.
The following equation compute the amount of schedule reduction that can be expected by increasing the number of starting points:

\[ T_{\text{new}} = \frac{T_{\text{old}}}{(\text{Points}_{\text{new}}/\text{Points}_{\text{old}})^{2/3}} \]

- Where:
  - \( T_{\text{new}} \) = time require to complete a new project/task.
  - \( T_{\text{old}} \) = time required to complete a past project/task.
  - \( \text{Points}_{\text{new}} \) = number of starting points on the new project/task.
  - \( \text{Points}_{\text{old}} \) = number of starting points on a past project/task.
Some of the benefits of increasing the number of starting points is savings in the overhead and goodwill established with the owner by completing the project earlier than currently scheduled.

Factors to address:

- Availability of workers.
- Ability to supply equipments and materials to all workers.
- Logistics of actually having all floors ready for the crews.

Identifying the Causes of Delays:

In reality there are many causes which can contribute to losses on a construction project. One general cause of productivity loss is delays.
Delays could result from:

1- Lack of supervision.
2- Interference with other crew.
3- Waiting for equipment and materials.

*Cost reports can identify where problems exist, but they do not identify the root cause of those problems. Delay survey have been developed which not only quantify the amount of delay time incurred, but they also isolate the source of delay. The most popular form of delay survey is known as the "foreman delay survey".
Impact of Lost Learning:

The observed characteristics of the improved performance is known as "learning". This learning can be shown graphically on a learning curve which also known as a manufacturing process curve or experience curve. In simple terms it means that the costs of production can be lowered by increasing quantity of production or increasing learning.

If the learning rate is known, it may be possible to estimate the cost of producing additional units based on learning information.
Levels of Learning

1- The first and most obvious is with the learning or experience acquired by direct labor.

2- The second is in the learning acquired in the management process.

* Learning curve principle can be applied to such divers operation as ship building, aircraft industries, computers, machine tools, building construction.
The concept of learning curves

1- High cost, especially in terms of labor.
2- Low volume.
3- Discrete item production.

*Some general points that apply to learning curves are as follows:

- The amount of time and cost required to produce each unit tends to decrease for successive units.
- The amount of time to produce each unit decreases at a decreasing rate.
- The reduction in time required to produce each unit follows a specific estimating model, that is the rate of learning.
Other Sources of Lost Productivity:

* A reduction in worker morale can be devastating to worker productivity. Morale can decline for number of reasons, including disregard for worker safety, excess changes that necessitate rework, poor site conditions, and so on.

* Changes, delays and rework are often sited as causes of production losses too.
Some situations might not have been anticipated at contract award that will impact productivity.

The nature of these situations will impact productivity, but the extent of that impact will depend on the nature of the work that must be performed.

While formulas cannot adequately compute many of these types of losses, the use of schedules can be very helpful to make a convincing argument. In some cases, judgment will need to be exercised to quantify the anticipated productivity losses, in fact this is almost the case.