When we talk about Productivity I am talking about the output, per unit input of labor. We will analyze the ways in which the construction industry can increase effectiveness by improved management.

A number of studies have shown that most on-site delays and inefficiencies lie with in the control of management. Poor planning, organizing, and controlling the work is the management’s fault.

One major way to improve productivity is Work Improvement, the techniques used are:

1. Time Studies: This is use to collect time data relating to a construction activity or determining the level of work activity.

2. Flow Process Charts: This traces the flow of material or work through a series of process steps (operations, transportation, inspections, delays or storage). After preparing a flow chart it should be analyzed and revised to reduce the number of processes.

3. Layout Diagram: A scaled diagram that shows the location of all physical facilities, machines, and material involved in a process. The goal is to analyze this and reduce the number of steps.

4. Crew Balance Chart: Use a graphical format to document activities of each member of a group of workers during one complete cycle of an operation.

5. Quantitative Management Methods: Linear Programming is by far the most widely used mathematical optimization technique for management purposes. Linear Programming must be a linear function – need set of linear constraints/equations and a linear objective function which to be maximized or minimized.
PRODUCTIVITY ANALYSIS AND IMPROVEMENTS

Example 1: A project manager for a large earthmoving project is faced with the task of selecting the dozers to be used on a relatively remote project. The project manager is advised by the equipment division manager that both heavy and medium dozers are available for the project. However, only 10 heavy dozers are available. The supply of medium dozers is relatively unlimited. Because of time and transportation limitations, a maximum of 1080 tons of dozers may be transported to the site. The project manager also has the following information on dozer performance and weight.

<table>
<thead>
<tr>
<th>Dozer</th>
<th>Weight (tons)</th>
<th>Production Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy</td>
<td>60</td>
<td>2 units/day</td>
</tr>
<tr>
<td>Medium</td>
<td>40</td>
<td>1 unit/day</td>
</tr>
</tbody>
</table>

What is the optimized number of Heavy and Medium Dozer that the project manager should request?

Ans
a. 10 Heavy, 12 Medium
b. 8 Heavy, 15 Medium
c. 9 Heavy, 13 Medium
d. 12 Heavy, 9 Medium
Step 1: Formulate the constraint equations defining the limits of the solution.

1. Obviously, the number of each type of dozer must be zero or greater.
   → Let $X_1$ represent the number of heavy dozers
   → Let $X_2$ represent the number of medium dozers
   So $X_1 \geq 0$, $X_2 \geq 0$

2. The number of heavy dozers cannot exceed 10.
   → so $X_1 \leq 10$

3. The maximum weight to be transported is 1080 tons
   → so $60X_1 + 40X_2 \leq 1080$

Step 2: Define the objective function that is to be maximized or minimized.

→ In this case we want to maximize some measure of production of the dozer fleet. Since each heavy dozer will produce twice as much as each medium dozer, the objective function can be expressed as

→ $2X_1 + X_2$

As you can see from the graphs the optimum solution is $X_1 = 10$, $X_2 = 12$ and the objective is $2X_1 + X_2 = 32$
Example 2. You are the project engineer, you have only 2 days to remove 7000 Banked Cubic Ft from the site. The soil has a 35% swell. The trucks you are being in to move the soil have a load capacity of 15 cy. One of the trucks can make 3 hauls per day and the other trucks will only take two loads per day. How many trucks are required?

a) 2 trucks  
b) 3 trucks  
c) 4 trucks  
d) 5 trucks

Answer #2

Step 1: Convert the BCF to LCY.
\[
\frac{7000 \text{ BCF}}{27 \text{ CF/CY} (1+.35)} = 350 \text{ LCY}
\]

Step 2: Setup equation to find out how many trucks you will need.
\[
350 \text{ LCY to be removed} = 2 \text{ days} ( (1\text{truck})45 \text{ CY} + 30 \text{ CY}(x \text{ trucks}) \\
\rightarrow \text{solve for } x \\
150 = 45 + 30x; 105 = 30x; x = 3.5 \rightarrow \text{so to get the soil moved you will need at 4 trucks for the 2 days.}