Example 6

A plastic extrusion plant will be built to produce 30 million meters of plastic extrusions per year. The plant will run three 8 hour shifts per day, 360 days per year. For planning purposes, the average run length = 3000 meters of extruded plastic. The average changeover time between runs = 2.5 hr, and average extrusion speed = 15 m/min. Assume scrap rate = 1%, and average uptime proportion per extrusion machine = 95% during run time. Uptime proportion during changeover is assumed to be 100%. If each extrusion machine requires 500 sq. ft of floor space, and there is an allowance of 40% for aisles and office space, what is the total area of the extrusion plant?

$$WL = \frac{30{,}000{,}000 \text{ m/yr}}{15(60) \text{ m/hr}\,(1-0{,}01)} = 33{,}670{,}0 \text{ hr/yr}$$

$$AT = 360(3).(8).(0{,}95) = 8208 \text{ hr/yr}$$

$$\text{Changeover: number runs/yr} = \frac{30{,}000{,}000 \text{ m/yr}}{3000 \text{ m/run}} = 10{,}000 \text{ runs/yr}$$

$$WL = 10{,}000\,(2{,}5) = 25{,}000 \text{ hr/yr} \qquad = 10{,}000 \text{ changeover}$$

$$AT = 360\,(3).(8) = 8640 \text{ hr/yr per machine}$$

$$n = \frac{33{,}670}{8208} + \frac{25{,}00}{8640} = 4.102 + 2.894 = 6.995 = 7 \text{ machine}$$

$$A = 7.(500).(1 + 40\%) = 4900 \text{ ft}^2$$

Example 3

A total of 800 parts must be produced in the lathe section of the machine shop during a particular 40-hr week. The parts are identical. How many lathes will be needed to produce the 800 parts, given that each machine must be set up at the beginning of the week? Each set up takes 3.5 hr. availability on the lathes is 100%

$n = m$ — # of set up.

number of w.s

$WL = 153.33 + 3.5m$

$n = \frac{153.33 + 3.5m}{40}$

$n = 4.2 \Rightarrow 5$

$U = \frac{4.2}{5} = 84\%$

Given this unfortunate results, it might be preferable to offer overtime to the workers on four of the lathes. How much overtime above the regular 40 hours will be required

$OT = \left(3.5 + \frac{153.34}{4}\right) - 40 = 1.83 hr/lathe$

$\times 4 = 7.33 hr$

Example 4

Suppose that in Example 2 the anticipated availability of the lathe is 100% during setup and 92% during the production run. The fraction defect rate for lathe work of this type is 5%. Other data from Example 2 are applicable. How many lathes are required during the week, given this additional information?

$AT = H_{sh} \cdot A \cdot U$

H_{sh} = shift hours during the period

A = availability

U = utilization

Defect $\Rightarrow Q_0(1-q)$

Q_0: orginal amount

q = defect rate

Q = quantity of good units made in the system

$Q_0 = \frac{Q}{(1-q)}$

$WL = Q \cdot T_c$

$WL = \frac{Q}{(1-q)} \cdot T_c$

For set up $\Rightarrow WL = 20(3.5) = 70 hr$

The availability hours during the week on

$AT = (40) \cdot (1.0)(1.0) = 40 hr$

n_{su} = # of lathes required just for setup

$n_{su} = \frac{WL}{AT} = \frac{70}{40} = 1.75$ lathes

Total workload for the 20 production runs.

$WL = \frac{20 \cdot (40) \cdot (11.5/60)}{(1 - 0.05)} = 161.4 hr$

AT for process $\Rightarrow 40 \cdot (0.92) = 3.68 hr/machine$

$n_{pr} = \frac{161.4}{36.8} = 4.39$ lathes

Total $= 17.5 + 3.68 \Rightarrow 6.14$ lathes