IE 469 Manufacturing Systems

Chapter 2 Tutorial

Total number of product units = $Q_f = \sum_{j=1}^{P} Q_j$, $Q_f = PQ$

Product variety = $P = \sum_{j=1}^{P_1} P_{2j}$

Total number of parts = $n_{pf} = \sum_{j=1}^{P} (Q_j \times n_{pj})$, $n_{pf} = PQn_p$

Total Number of processes = $n_{of} = \sum_{j=1}^{P} (Q_j \times n_{pj}) \sum_{k=1}^{n_{pj}} (n_{ojk})$, $n_{of} = PQn_pn_o$

2.1 **(A)** A manufacturing plant produces three product lines in one of its plants: A, B, and C. Each product line has multiple models: 3 models within product line A, 5 models within B, and 7 within C. Average annual production quantities of model A is 400 units, 800 units for model B, and 500 units for model C. Determine the number of (a) different product models and (b) total quantity of products produced annually in this plant.

(a) $P = 3 + 5 + 7 = 15$ models

(b) $Q_f = 3(400) + 5(800) + 7(500) = 8{,}700$ units

2.2 Consider product line A in preceding Problem 2.1. Its three models have an average of 46 components each, and the average number of operations needed to produce each component is 3.5. All components are made in the same plant. Determine the total number of (a) components produced and (b) operations performed in the plant annually.

(a) $n_{pf} = PQn_p = 3(400)(46) = 55{,}200$ components

(b) $n_{of} = PQn_p n_o = 55{,}200(3.5) = 193{,}200$ components

2.5 The ABC Company is planning a new product line and a new plant to produce the parts for the line. The product line will include 8 different models. Annual production of each model is expected to be 900 units. Each product will be assembled of 180 components. All processing of parts will be accomplished in the new plant. On average, 6 processing operations are required to produce each component, and each operation takes an average of 1.0 min (including an allowance for setup time and part handling). All processing operations are performed at workstations, each of which includes a production machine and a human worker. The plant operates one shift. Determine the number of (a) components, (b) processing operations, and (c) workers that will be needed to accomplish the processing operations if each worker works 2000 hr/yr.

(T_p, n_o)

(a) $n_{pf} = PQn_p = 8(900)(180) = 1{,}296{,}000$ components

(b) $n_{of} = PQn_p n_o = 1{,}296{,}000(6) = 7{,}776{,}000$ ops.

(c) Total operation time $= TT = n_{of} T_p = 7{,}776{,}000(1)$
$= 7{,}776{,}000$ min
$= 129{,}600$ hr/yr

$w = \frac{129{,}600}{2000} = 64.8$ workers
≈ 65 workers

2.6 The XYZ Company is planning a new product line and a new factory to produce the parts and assembly the final products. The product line will include 10 different models. Annual production of each model is expected to be 1000 units. Each product will be assembled of 300 components, but 65% of these will be purchased parts (not made in the new factory). There are an average of 8 processing operations required to produce each component, and each processing step takes 30 sec (including an allowance for setup time and part handling). Each final unit of product takes 48 min to assemble. All processing operations are performed at work cells that include a production machine and a human worker. Products are assembled at single workstations consisting of one worker each plus assembly fixtures and tooling. Each work cell and each workstation require 25 m^2 of floor space and an additional allowance of 45% must be added to the total production area for aisles, work-in-process storage, shipping and receiving, rest rooms, and other utility space. The factory will operate one shift (the day shift, 2000 hr/yr). Determine (a) how many processing and assembly operations, (b) how many workers (direct labor only), and (c) how much total floor space will be required in the plant.

(a) $Q_f = PQ = 10(1000) = 10{,}000$ = number of assembly ops.

$n_{pf} = PQ\,n_p = 10{,}000 \times 300 = 3{,}000{,}000$ components

35% made in plant $= 3{,}000{,}000(0.35) = 1{,}050{,}000$

$n_{of} = 1{,}050{,}000(8) = 8{,}400{,}000$ proc. ops

$T_p = 30$ sec

(b) Total proc. time $TT_p = n_{of} T_p$

$= 8{,}400{,}000\,(0.5)$

$= 4{,}200{,}000$ min/yr

$= 70{,}000$ hr/yr

T_a

Total asby. time $= TT_a = 10{,}000(48)$

$= 480{,}000$ min/yr

$= 8{,}000$ hr/yr

$$W = \frac{70{,}000 + 8{,}000}{2000} = 39 \text{ workers}$$

(c) 1 worker per workstation

number of workstation $= n = W = 39$

Total floor space $= TA = n A_w (1 + AL)$

$A_w = 25\ m^2$, $AL = 45\%$

$= 39(25)(1 + 0.45) = 1{,}413.75\ m^2$