Algebra: Semiconductor Engineer

Micron Technology, Inc

Job Description: Evaluate production lots suspected of quality or reliability issues and ensure lots are held until all concerns have been addressed. Identify the root cause of failure and respond with appropriate corrective actions.

Problem:

Micron's manufacturing areas function 24 hours per day, 7 days a week. Nitride deposition is the capacity bottleneck in the fab. The fab has 3 nitride furnaces and runs the following nitride recipes with total run time per number of wafers run as indicated below:

Recipe	# Wafers Run	Total Time per Run
X	100	3.7 hrs
Y	50	2.3 hrs
Z	100	4.8 hrs

The fab runs the following part types with potential revenue and profit as indicated below:

Part Type	Nitride Deps	Potential Revenue per Wafer	Potential Profit per Wafer	Required Ships per Week
3	X, Y	$500	$100	1000
5	Z	$300	$75	1500
7	X, Y, Z	$525	$100	500
11	X, Z	$475	$125	3000

How many wafer starts of each part type (including the required ships per week) will maximize revenue?

How many wafer starts of each part type (including the required ships per week) will maximize profit?

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Solution: *(See problem for details)*

Calculate time per wafer per recipe:
t_r = time per wafer (each recipe)
h_r = hours per run (each recipe)
W_r = number of wafers run (each recipe)
$t_r = h_r / W_r$
$t_X = h_X / W_X$ = 3.7⁄100 = **.037** hrs per wafer (recipe X)
$t_Y = h_Y / W_Y$ = 2.3⁄50 = **.046** hrs per wafer (recipe Y)
$t_Z = h_Z / W_Z$ = 4.8⁄100 = **.048** hrs per wafer (recipe Z)

Calculate the time needed per required ship for each part type:
T_p = time per wafer (each part type)
t_p = time per recipe (each part type)
S_p = ships required per week (each part type)
H_p = hours per week per required ship (each part type)
$H_p = (\Sigma t_r)\ (S_p)$
H_3 = (.037 + .046) = .083 hrs x 1000 = 83.0 hrs per week
H_5 = (.048) = .048 hrs x 1500 = 72.0 hrs per week
H_7 = (.037 + .046 + .048) = .131 hrs x 500 = 65.5 hrs per week
H_{11} = (.037 + .048) = .085 hrs x 3000 = 255.0 hrs per week
Total Required Hours 475.5 hrs per week

Calculate number of hours left to maximize profit/revenue
X= (hrs/day)(days/wk)(furnaces) - required hours
X = 24 x 7 x 3 = 504 - 475.5 = **28.5** extra hours per week

Calculate potential revenue and profit per hour for each part type:
r_p = revenue per wafer (each part type)
R_p = revenue per hour (each part type)
p_p = profit per wafer (each part type)
P_p = profit per hour (each part type)
$R_p = r_p / h_p$
$P_p = p_p / h_p$
R_3 = \$500⁄.083 hrs = \$6,024 revenue per hour
P_3 = \$100⁄.083 hrs = \$1,205 profit per hour
R_5 = \$300⁄.048 hrs = \$6,250 revenue per hour

P_5 = \$75⁄.048 hrs = \$1,563 profit per hour
R_7 = \$525⁄.131 hrs = \$4,008 revenue per hour
P_7 = \$100⁄.131 hrs = \$ 763 profit per hour
R_{11} = \$475⁄.085 hrs = \$5,588 revenue per hour
P_{11} = \$125⁄.085 hrs = \$1,471 profit per hour
Running part **type 5** will maximize revenue and profits from extra capacity.

Calculate the number of extra part type 5 wafers that can be run in the extra hours:
n = extra hrs⁄hrs/wafer
n = 28.5 hrs⁄.048 hrs/wafer = **593** additional wafers of part type 5
Number of wafer starts of each part type (including required ships) to maximize revenue and profit:

Part Type	Wafer Starts
3	**1,000**
5	**1500 + 593 = 2,093**
7	**500**
11	**3,000**