Operations of manufacturing systems

Sheet # 1

(Just-in-time (JIT))

Problem # 1. Calculate the number of Kanbans needed at the ABC company for the following two products, produced in a factory that works eight hours per day, five days per week.

	Product 1	**Product 2**
Usage	300/week	150/day
Lead time	1 week	2 week
Container size	20 units	30 units
Safety stock	15 percent	0

Solution:

Variable	**Product 1**	**Product 2**
Daily Demand (D)	$\frac{300}{5}$	150
Lead Time (L)	5 days	10 days
Safety Stock (SS) , α	15%	0
EOQ	20	30
# of Kanbans= $\frac{D.L(1+\alpha)}{EOQ}$	17.25 ≈18 Cards	50 Cards
Total number of kanbans in the system	18+50=68 Cards	

Problem # 2. Krupp Refrigeration, Inc., is trying to reduce inventory and wants to install a Kanban system for compressors one of its assembly lines. Determine the **size** of containers and **number** of Kanban cards (number of containers) needed, given the following data:
Setup cost = $10
Annual holding cost per compressor = $100
Daily production = 200 compressors
Annual usage = 25,000 (50 weeks x 5 days each x daily usage of 100 compressor)
Lead time = 3 days
Safety stock = 1/2 day's production of compressors

Solution:

1- **size** of containers(EOQ)= $\sqrt{\frac{2AD}{H*(1-\frac{Daily\ usage}{Daily\ production})}} = \sqrt{\frac{2*10*25{,}000}{100*(1-\frac{100}{200})}}$

$=100$units

If the daily usage and daily production were not given, as in Prob.1

Then, EOQ = $\sqrt{\frac{2AD}{H}}$

2- # of kanbans = ?

Here, we should note that the Safety stock given to us as half of the daily production (Not same as **Problem # 1**)

# of kanbans = $\frac{D.L+SS}{EOQ} = \frac{100*3+0.5*200}{100} = 4\ Cards$

Problem # 3. The DEF Company produces three products using a mixed-model assembly line, which is operated 16 hours per day (2 shifts of 8 hours each) for 250 days per year. The annual demand forecasts for the products are as follows:

Product	Forecasts
1	20,000
2	10,000
3	5,000

a. Determine a mixed-model master production schedule for a daily batch, based on minimum batch size for each product.
b. Prepare a daily schedule indicating the **number** of each product to be produced each day.
c. Product 1 requires 2 units of component A and one unit of component B. If component A is manufactured internally at DEF, how many kanbans would be required for this component if the lead time is 2 days, the safety factor is 15 percent, and the container size is 25 units?

Solution:

a. A mixed-model master production schedule (MPS) for a daily batch, based on minimum batch size for each product:

	P_1	P_2	P_3
Daily batch **MPS** (Minimum)	$\frac{20{,}000}{250} = 80$	40	20

b. A daily schedule indicating the number of each product to be produced each day:
This means the mixed model final assembly schedule (**FAS**)
FAS must be prepared according to the proportion of each product: 80, 40, 20.
This is equivalent to ***proportion of 4, 2, 1***. Now FAS should be as follows:

1 2 1 2 1 3 1…….this schedule should be repeated **20 times daily**

Note: in case of large change over costs between products, the following schedule can be used:

1 1 1 1 2 2 3….. this schedule should be repeated again 20 times daily

c. Product 1 requires 2 units of component A and one unit of component B. If component A is manufactured internally at DEF, how many kanbans would be required for this component if the lead time is 2 days, the safety factor is 15 percent, and the container size is 25 units?

The number of kanbans required for component A:
The daily demand of A = 80 x 2 = 160
Container capacity (CC) = 25 units
Lead time = 2 days
Safetey stock percent (α) = 15%

Number of Kanbans of component A = $\frac{DL(1+\alpha)}{CC}$

$= \frac{160\ x\ 2\ (1.15)}{25}$ = 17.42 = 15 kanban cards

Problem # 4. The EFG Company works an 8-hour/day, 250-day/year schedule, producing four models with the following annual demand forecast:

Product	Forecasts
I	500
II	1,500
III	4,500
IV	6,000

a. A mixed-model minimum batch **M**aster **P**roduction **S**chedule for EFG, based on a daily batch and an hourly batch:

	P_1	P_2	P_3	P_4
Daily batch MPS (Minimum)	$\frac{500}{250}$ = 2	6	18	24
Hourly batch MPS (Minimum)	$\frac{2}{8}$ = 0.25	0.75	2.25	3

b. A detailed mixed-model schedule for an eight-hour day using minimum batch sizes:
The **mixed-model schedule (FAS)** for a day is made according to the proportion of the products daily quantities:
2, 6, 18, 24 equivalent to 1, 3, 9, 12
The mixed model schedule should be:

4 3 4 3 4 3 4 2 4 3 4 3 4 3 4 3 2 4 3 4 3 4 3 4 3 2 1

….this schedule should be repeated **twice** each day during the 8 hours in order to have smooth, level production, and to satisfy annual forecast.

Note: in case of large change over costs between products, the following schedule can be used:

444444444443333333332221….. this schedule should be repeated again 2 times daily.