

Quiz 3-2005 56:166 Production Systems

Problem 1 (5%)

- A. What type of kanban system is shown in Fig. 1?
- B. What do W and P mean?

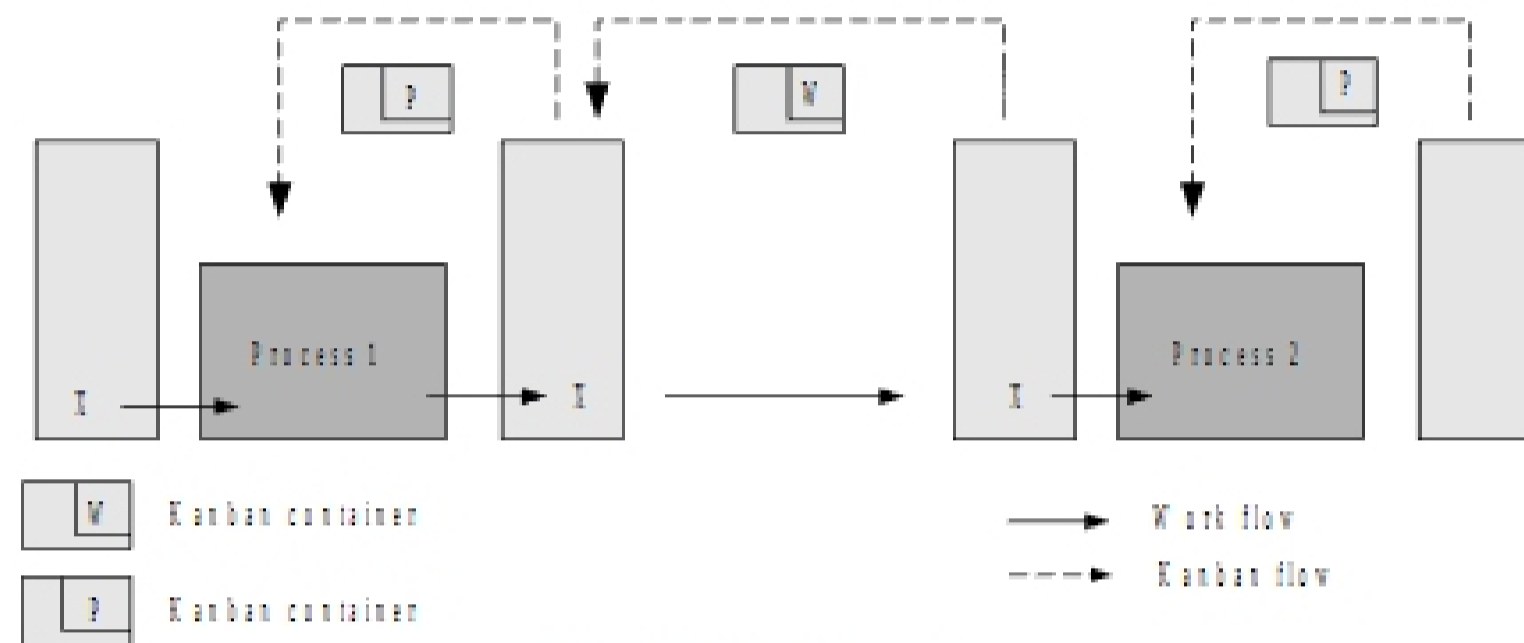


Figure 1. Kanban system

Solution:

- A. This is a pull system.
- B. W means container with a withdraw kanban, P means container with production kanban.

Problem 2 (25%)

An assembly system is to process 100 circuits per hour. It takes 20 minutes to receive the necessary components from the preceding workstation. Completed circuits are placed on a rack that holds 10 boards. The rack must be full before it is sent to the next station. The factory uses a safety factor of 5%. How many kanbans are needed for the circuit board assembly process?

Solution:

The number of Kanbans = $(\text{Units daily demand} * \text{order cycle time} * \text{safety factor}) / \text{Lot size}$
 $100 * (20/60) * 1.05 / (10) = 3.5$
So we can use 4 kanbans.

Problem 3 (35%)

Formulate a model for assignment of the newly introduced three parts in Table 1 to the existing three machine cells represented in Table 2. The model is to minimize the intercellular traffic of the new parts subject to the constraint that the number of newly assigned parts can not exceed 1 for cell 1, 2 for cell 2, and two for cell 3.

Table 1. Routes of the three parts.

Machine No.	Part No.		
	1	2	3
1		1	
2	1		1
3		1	
4	1		1

Table 2. Existing machine cells.

Cell No.	Machine No.		
	1	2	3
1	1	2	
2	1	3	4
3	2	3	4

Solution:

First, we list some sets.

$K1=\{1, 2\}$: set of machines cells containing machine 1;

$K2=\{1, 3\}$: set of machines cells containing machine 2;

$K3=\{2, 3\}$: set of machines cells containing machine 3;

$K4=\{2, 3\}$: set of machines cells containing machine 4;

$M1=\{2, 4\}$: set of machines have to be visited by part 1;

$M2=\{1, 3\}$: set of machines have to be visited by part 2;

$M3=\{2, 4\}$: set of machines have to be visited by part 3;

Var $X\{1..3, 1..3\}$: part i is assigned to machine cell j .

Minimize $\text{Sum } \{i \text{ in } 1..3, j \text{ in } 1..3\} X[i, j]$;

Subject to:

$$\sum_{j \in K_i} x_{ij} \geq 1, \text{ for all } i \in M_i; i = 1..3$$

$$x[1,1]+x[2,1]+x[3,1] \leq 1; \text{ the capacity for machine cell 1 is 1}$$

$$x[1,2]+x[2,2]+x[3,2] \leq 2; \text{ the capacity for machine cell 2 is 2}$$

$$x[1,3]+x[2,3]+x[3,3] \leq 2; \text{ the capacity for machine cell 3 is 2}$$

x are binary variables

Problem 4 (25%)

For the part (shown in two dimensions) in Fig. 2 with 18 elementary features list five machining features (columns of the elementary_feature - machining_feature matrix).

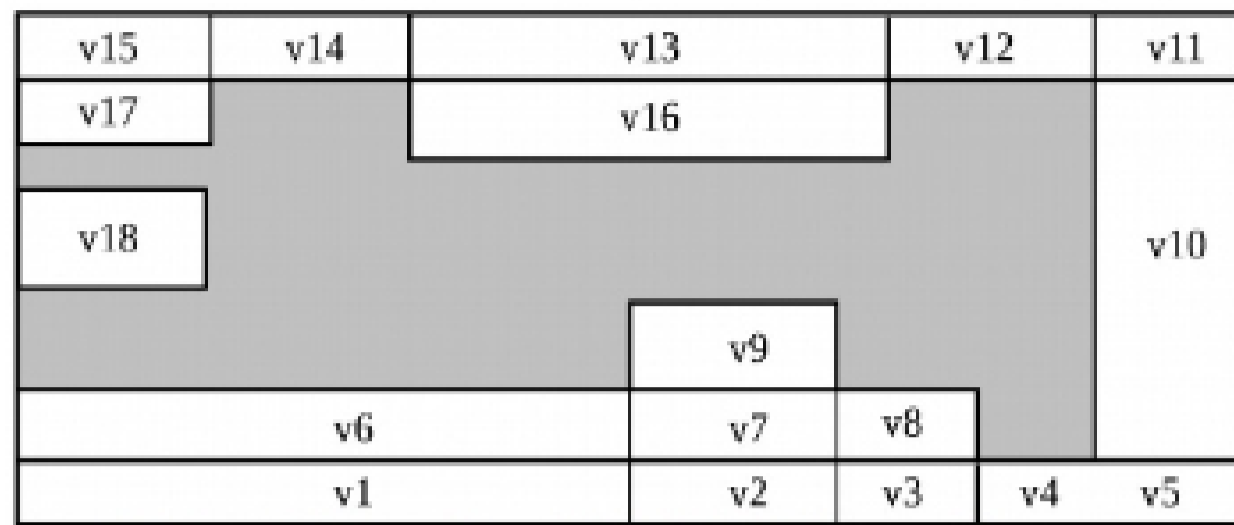


Figure 2. Prismatic part with 18 elementary features.

Solution:

One possible lists:

$V1 = \{v1, v2, v3, v4, v5\}$;

$V2 = \{v10, v11, v5\}$;

$V3 = \{v15, v17\}$

$V4 = \{v18\}$

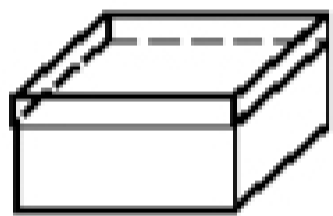
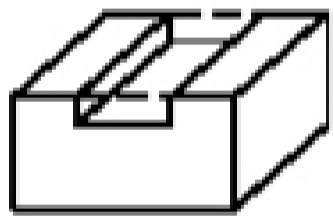

$V5 = \{v9\}$

Problem 5 (10%)

What is the difference between design feature and manufacturing feature? Illustrate the difference with a graphical example.

Solution:

Manufacturing feature *is the volume of material* to be removed to produce a design feature.

Geometry	Form feature	Machining feature
	Plane	Block
	Slot	Block
	Hole	Cylinder