Wafer manufacturing system

Basic Description

This is a semiconductor manufacturing system. In our simplified version indicated in Figure 1, the production process consists of two basic steps, diffusion and lithography. Sub-steps of the system are indicated in Figure 2.

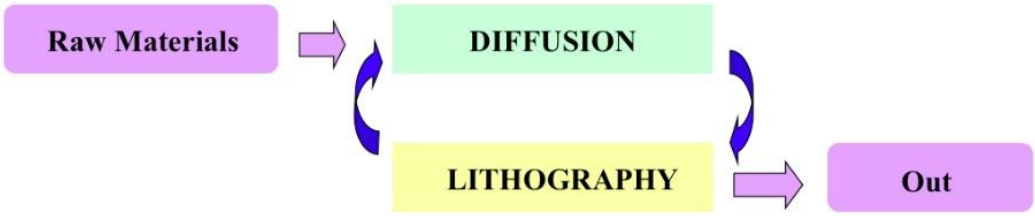

Figure 1 (Schematic Diagram)

Sub-steps description:

Raw material will be released in cassettes at the rate of 1 cassette/hour, 7 days per week, 8-hours per day. The raw material will begin at the diffusion process, and after diffusion it proceeds to the lithography process. The diffusion and lithography then alternate until the product completes processing. The movement of material from the end of diffusion to the start of lithography (or vice versa) will be handled by an AGV (Automatic Guided Vehicle) or a conveyor. The release of the raw material, the processing of material at each station and the transportation between diffusion and lithography steps are all modeled as exponentially distributed random variables.

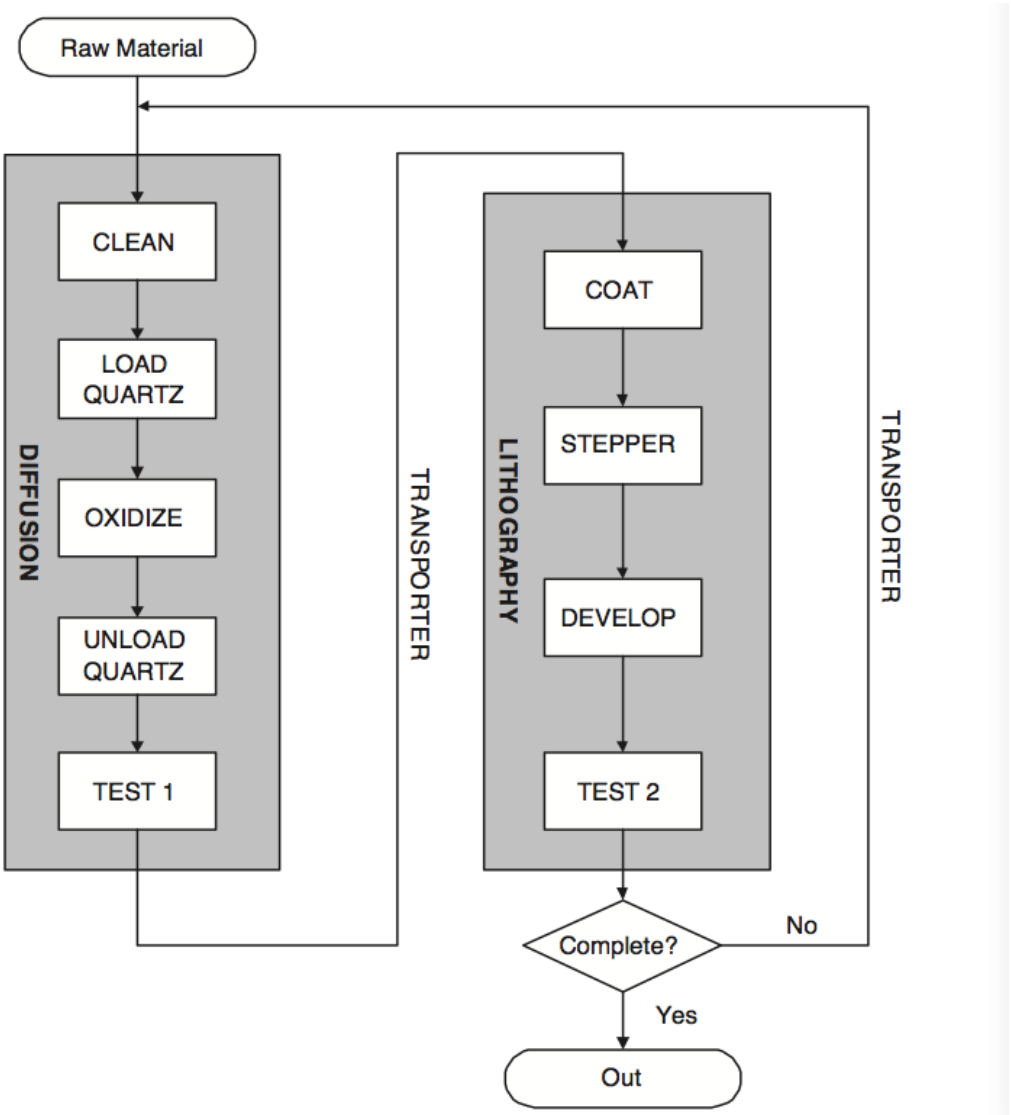

Figure 2 (Schematic Diagram)

In this example, data on anticipated product mix and material handling requirement are provided in Table 4. Mean processing time per cassette for each step (hours) and cost of machines for all available machines and transporters are provided in Table 5. Factor description and levels (Unit Number) are provided in Table 6.

Table 4: Production Mix and Passes

Product Types	Mix%	Passes Required for Diffusion and Lithography Process
A	15%	20
B	35%	15
C	30%	10
D	20%	12

Table 5: Mean Processing Time per Cassette for Each Step (Hours) and Cost of Machines ($Millions)

Stations	Fast Machine	Cost per Unit	Slow Machine	Cost per Unit
CLEAN	1.5	1.38	2.5	0.83
LOAD QUARTZ	0.19	0.63	0.31	0.38
OXIDIZE	3.5	3.25	5.4	1.95
UNLOAD QUARTZ	0.19	0.63	0.31	0.38
TEST 1	0.5	1.25	1.25	0.75
COAT	0.75	1.13	1.50	0.68
STEPPER	0.85	2.25	1.8	1.35
DEVELOP	0.38	0.25	0.63	0.15
TEST 2	0.5	1.25	1.25	0.75
AGV	0.028	1.05	NA	NA
CONVEYOR	NA	NA	0.19	0.635

Table 6: Factor Description and Levels (Unit Number)

Factor id	Factor Description	Low Level	High Level
1	Number of slow machines in OXIDIZE	92	93
2	Number of fast machines in STEPPER	0	1
3	Number of fast machines in COAT	0	2
4	Number of slow machines in CLEAN	42	45
5	Number of fast machines in TEST1	0	2
6	Number of fast machines in TEST2	0	2
7	Number of slow machines in STEPPER	30	32
8	Number of slow machines in COAT	25	29
9	Number of fast machines in CLEAN	0	2
10	Number of slow machines in TEST1	21	25
11	Number of slow machines in TEST2	21	25
12	Number of slow machines in LOAD QUARTZ	5	13
13	Number of slow machines in UNLOAD QUARTZ	5	13
14	Number of fast machines in LOAD QUARTZ	0	5
15	Number of fast machines in UNLOAD QUARTZ	0	5
16	Number of AGVs	0	5
17	Number of slow machines in DEVELOP	10	31
18	Number of CONVEYORS	6	9
19	Number of fast machines in OXIDIZE	0	1
20	Number of fast machines in DEVELOP	0	13