TABLE 10-3
CONWIP performance evaluation

	$N_1(l)$	$N_2(l)$	$N_3(l)$	$N_4(l)$	$N_5(l)$	$F_1(l)$	$F_2(l)$	$F_3(l)$	$F_4(l)$	$F_5(l)$	$W(l)$
$l = 1$	0.25	0.19	0.19	0.19	0.19	1	0.77	0.77	0.77	0.77	0.25
$l = 2$	0.51	0.37	0.37	0.37	0.37	1.25	0.91	0.91	0.91	0.91	0.41
$l = 3$	0.79	0.55	0.55	0.55	0.55	1.51	1.06	1.06	1.06	1.06	0.52
$l = 4$	1.09	0.73	0.73	0.73	0.73	1.79	1.19	1.19	1.19	1.19	0.61
$l = 5$	1.41	0.90	0.90	0.90	0.90	2.09	1.33	1.33	1.33	1.33	0.68
$l = 6$	1.75	1.06	1.06	1.06	1.06	2.41	1.46	1.46	1.46	1.46	0.73
$l = 7$	2.12	1.22	1.22	1.22	1.22	2.75	1.59	1.59	1.59	1.59	0.77
$l = 8$	2.51	1.37	1.37	1.37	1.37	3.12	1.71	1.71	1.71	1.71	0.80

μ_1 = 1.0 units per minute and

μ_i = 1.3 units per minute ($i = 2, 3, 4, 5$)

Move times are negligible. Station 1 is the bottleneck.

We first estimate the minimum number of containers needed for the bottleneck to work all the time. We have $t_1 = 1/1$ minute per unit and $t_i = 1/1.3$ minutes per unit for $i = 2, 3, 4, 5$. Then

$$n = \sum_{i=1}^{5} t_i/t_1 = 4.07 \qquad \longrightarrow \qquad \text{5 containers}$$

Using a spreadsheet, we evaluate the performance with the MVA algorithm. The results are shown in Table 10-3.

With five containers, the expected number of containers at the bottleneck (workstation 1) is more than 1. However, throughput at this stage is below the theoretical throughput. As the number of containers increases, the expected flowtime and throughput also increase. Thus, for eight containers the assembly line reaches 80 percent of its theoretical output.

Throughput will reach the theoretical value of 1 only when queue sizes are unrestricted; i.e., the number of containers reaches infinity. There is a clear trade-off between system throughput and expected flowtime. Figure 10-17 describes the relationship between the number of containers and the resulting throughput. Note (Table 10-3) that queues form also in front of nonbottleneck machines.

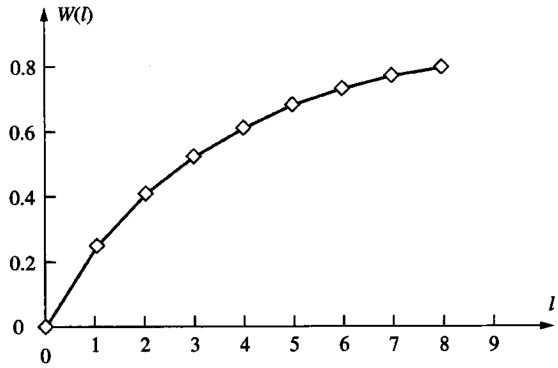

FIGURE 10-17
CONWIP throughput