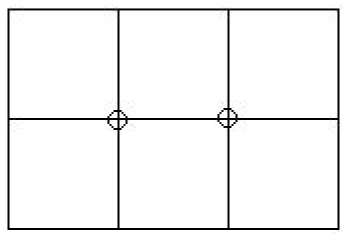
TOOL CRIB SYSTEM DESIGN

A certain large shop doing light fabrication work uses a single central storage facility (dispatch station) for material in in-process storage. The typical procedure is that each employee personally delivers his finished work (by hand, tote box, or hand cart) and receives new work and materials at the facility. Although this procedure worked well in earlier years when the shop was smaller, it appears that it may now be advisable to divide the shop into two semi-independent parts, with a separate storage facility for each one. You have been assigned the job of comparing the use of two facilities and of one facility from a cost standpoint.

The factory has the shape of a rectangle 150 by 100 yards. Thus, by letting 1 yard be the unit of distance, the (x,y) coordinates of the corners are (0,0), (150,0), (150,100), and (0,100). With this coordinate system, the existing facility is located at (50,50) and the location available for the second facility is (100,50).

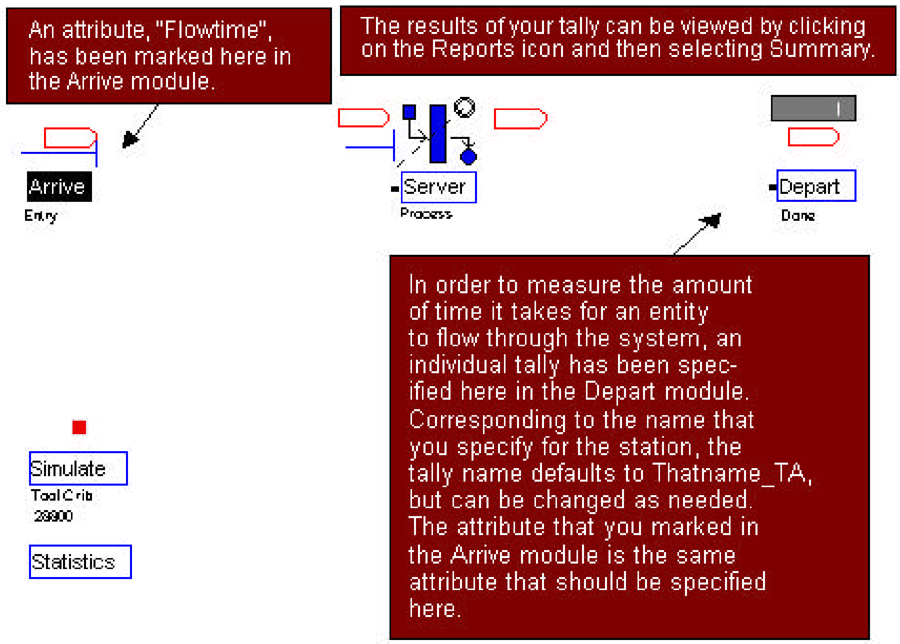


- Each facility would be operated by a single clerk.
- The time required by a clerk to service a caller has an Erlang-2 distribution, with a mean of 2 minutes.
- Employees arrive at the present facility according to a Poisson input process at a mean rate of 24 per hour.
- The employees are rather uniformly distributed throughout the shop, and if the second facility were installed, each employee would normally use the nearer of the two facilities.
- Employees walk at an average speed of about 1 yard/second.
- All aisles are parallel to the outer walls of the shop.
- The net cost of providing each facility is estimated to be about $20/hour, plus $15/hour for the clerk.
- The estimated total cost of an employee being idled by traveling or waiting at the facility is $25/hour.

Given the preceding information, build and simulate a ARENA model in order to determine which alternative minimizes the average total cost per hour.

ARENA Model: Tool Crib System Design

We begin with the **SMARTS42** model in the *SMART Files Library*:



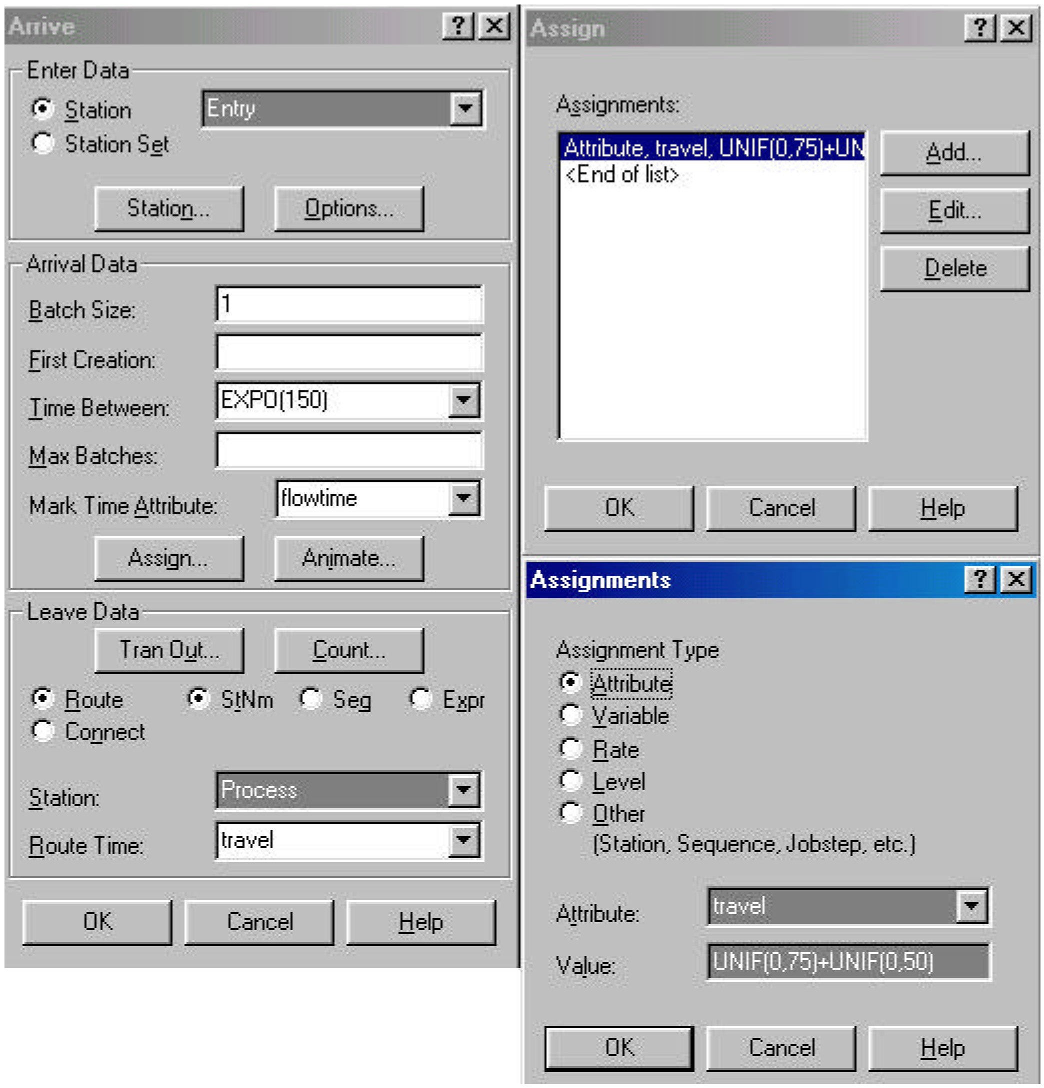
We then make a few modifications in order to take care of the travel time of workers from their workplace to the tool crib and back.

Case I: Single facility in center of area (x=75, y=50)

ARRIVE module: Arrival rate is 24/hr, i.e., 1 per 150 seconds. Therefore, time between arrivals is EXPO(150), where time is measured in seconds.

Travel time to server module is a variable "travel", which is assigned a random value UNIF(0,75) + UNIF(0,50).

A "Mark Time Attribute" is defined, i.e., the entity is given an attribute whose value is the "arrival time" (time that worker begins trip to tool crib).



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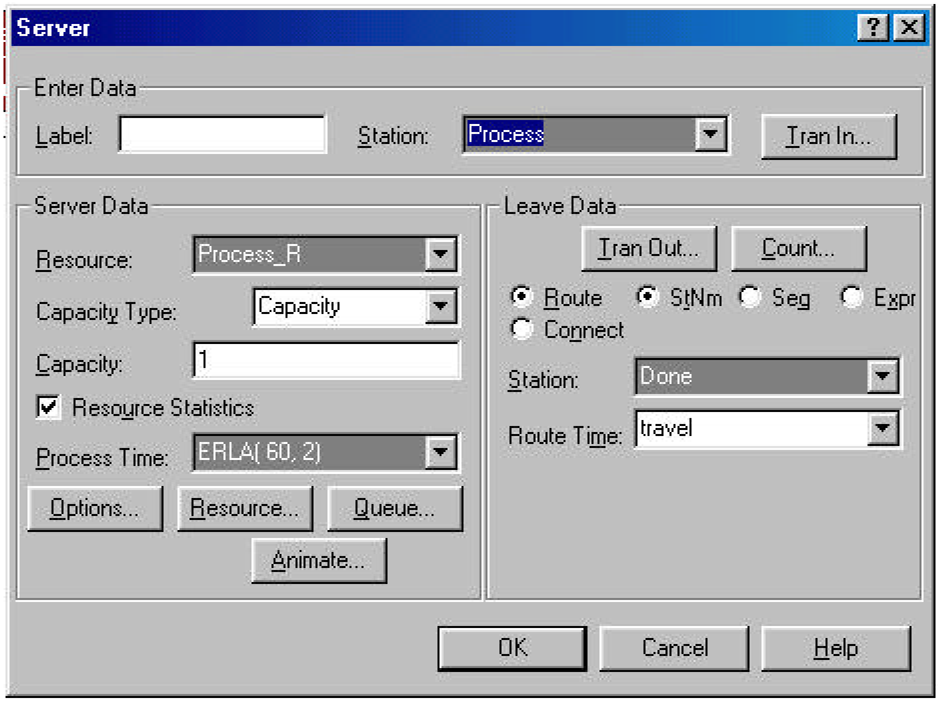
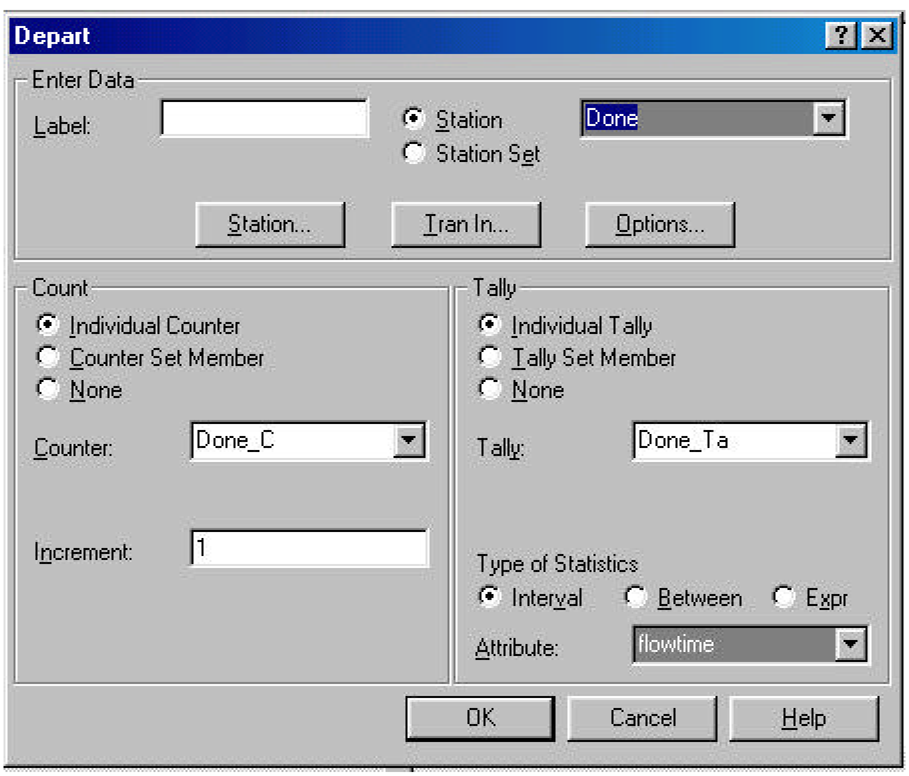
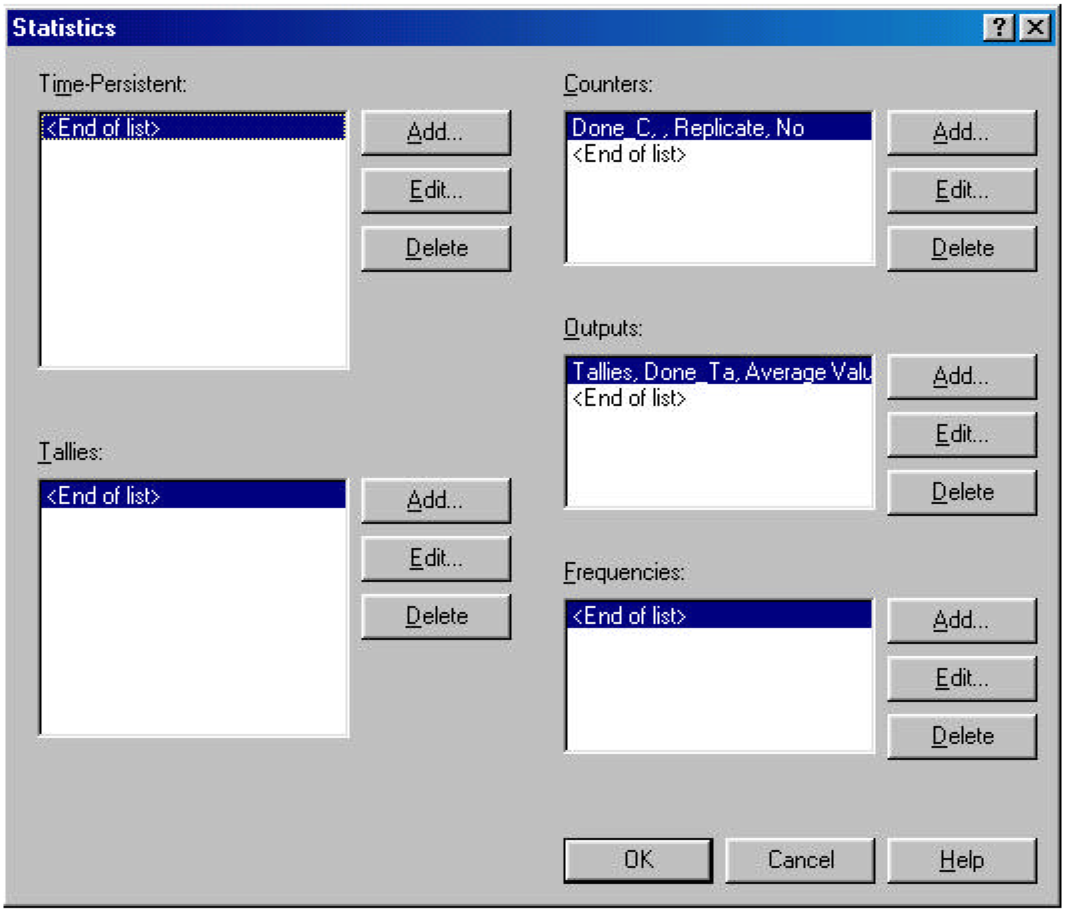


SERVER Module: Process time is ERLA(60,2), i.e., Erlang-2 distribution which is sum of two times each having exponential distribution with mean 60 seconds.

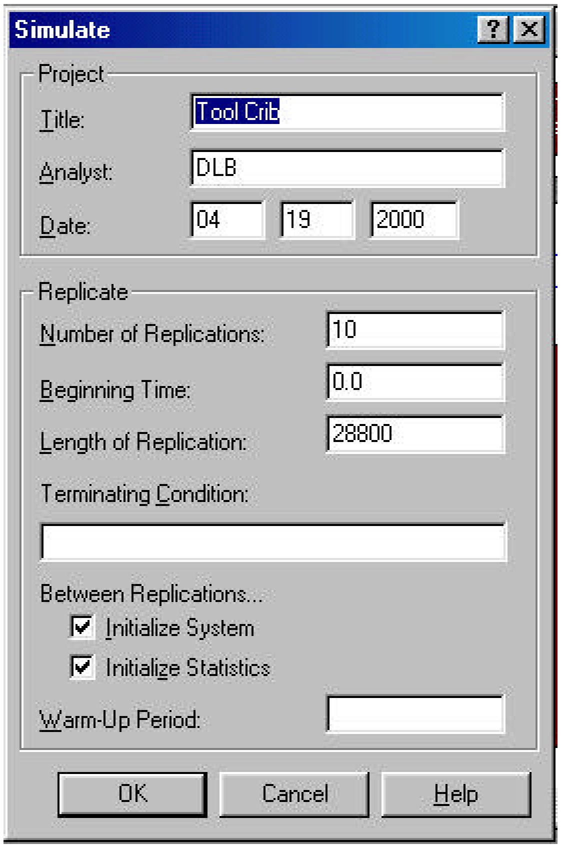
The routing time to the DEPART module again has value given by the variable "travel".



DEPART Module: A counter is defined to count the number of departures, and a "tally" statistic is defined whose value is the interval between the attribute "flowtime" and the current time, i.e., the time between a worker starting to the tool crib and his/her return.



STATISTICS Module: Statistics are to be kept on both the count of the entities and the flowtime.



SIMULATE Module: We will do ten replications, each of them 28800 seconds = 8 hours in length.

Results:

```
Summary for Replication 1 of 10

Project:  Tool Crib                           Run execution date :    4/19/2000
Analyst:  DLB                                 Model revision date:    4/19/2000

Replication ended at time      : 28800.0

                                 TALLY VARIABLES

Identifier                Average    Half Width   Minimum     Maximum
Observations
____________________________________________________________________

Done_Ta                   405.25      (Insuf)     100.04      854.66
178

                           DISCRETE-CHANGE VARIABLES

Identifier           Average    Half Width   Minimum     Maximum
____________________________________________________________________

# in Process_R_Q     1.0242      (Insuf)      .00000      6.0000
Process_R Busy       .72071      (Insuf)      .00000      1.0000
Process_R Avail     1.0000      (Insuf)     1.0000      1.0000
```

COUNTERS

Identifier	Count	Limit
Done_C	178	Infinite

OUTPUTS

Identifier	Value
TRAVEL TIME	405.25

Output Summary for 10 Replications

Project: Tool Crib
Analyst: DLB

Run execution date : 4/19/2000
Model revision date: 4/19/2000

OUTPUTS

Identifier	Average	Half-width	Minimum	Maximum	# Replications
TRAVEL TIME	570.57	84.435	405.25	790.36	10