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ON PROGRAM REALIZATION OF FLEXIBLE MANUFACTURING SYSTEM MODELS DESCRIBED BY GENERALIZED NETS

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In the following article we will explain a model of a system for optimizing of flexible manufacturing producing process build up with a Generalized Net (GN; see [1]).

In the model we have three types of details (small, medium and large). Every detail has to undertake a specific processing. The type of detail is determining for the machine, (small, medium or large) on which they are going to be processed on. The details from type LARGE can only be processed on large machines. The details from type MEDIUM can be processed on medium or large machines and the details from type SMALL can be processed on all kind of machines. Every manipulation is associated with certain time needed, for processing, for the machine. After every manipulation a procedure is performed by which the quality of the newly produced detail is being checked. Depending on the presence of any digressions or if there are any unfinished procedures the detail goes to its predestination – for further processing, for waste or for stock.

The application appears the way given on Fig. 1.

The product includes standart components – menu:

- FILE – starting of new model, Print setup, prints and exit
- RUN – starts current model
- OPTIONS – allows set up the current model – Fig. 2.
- WINDOW – manipulation of all windows with models
- HELP

The window of a concrete model appears like the one on Fig. 3.

From this part the number of steps of work of the machine are assigned.

In the “GN Source” part (Fig. 4.) additional settings of the model can be made.

After starting of the machine the different levels of loading up can be tracked (traced) during work.

On Fig. 2. with green are shown the machines, which are not working and with red the ones which are proceesing detsails at the moment. Colours are available only in the computer project.

The results of work of the model are presented in “RESULTS” – see Fig. 5.

Where the times for processing of each detail are given, the average times for processing of the details, depending on the type, as well as information for the processed details (how many are processed and how many are Waste) are given, too.

The results of work of the GN model can be seen in the “Log File” – Fig. 6.

Reference:

[1] Atanassov Kr. Generalized Nets, World Scientific, Singapore, 1991.

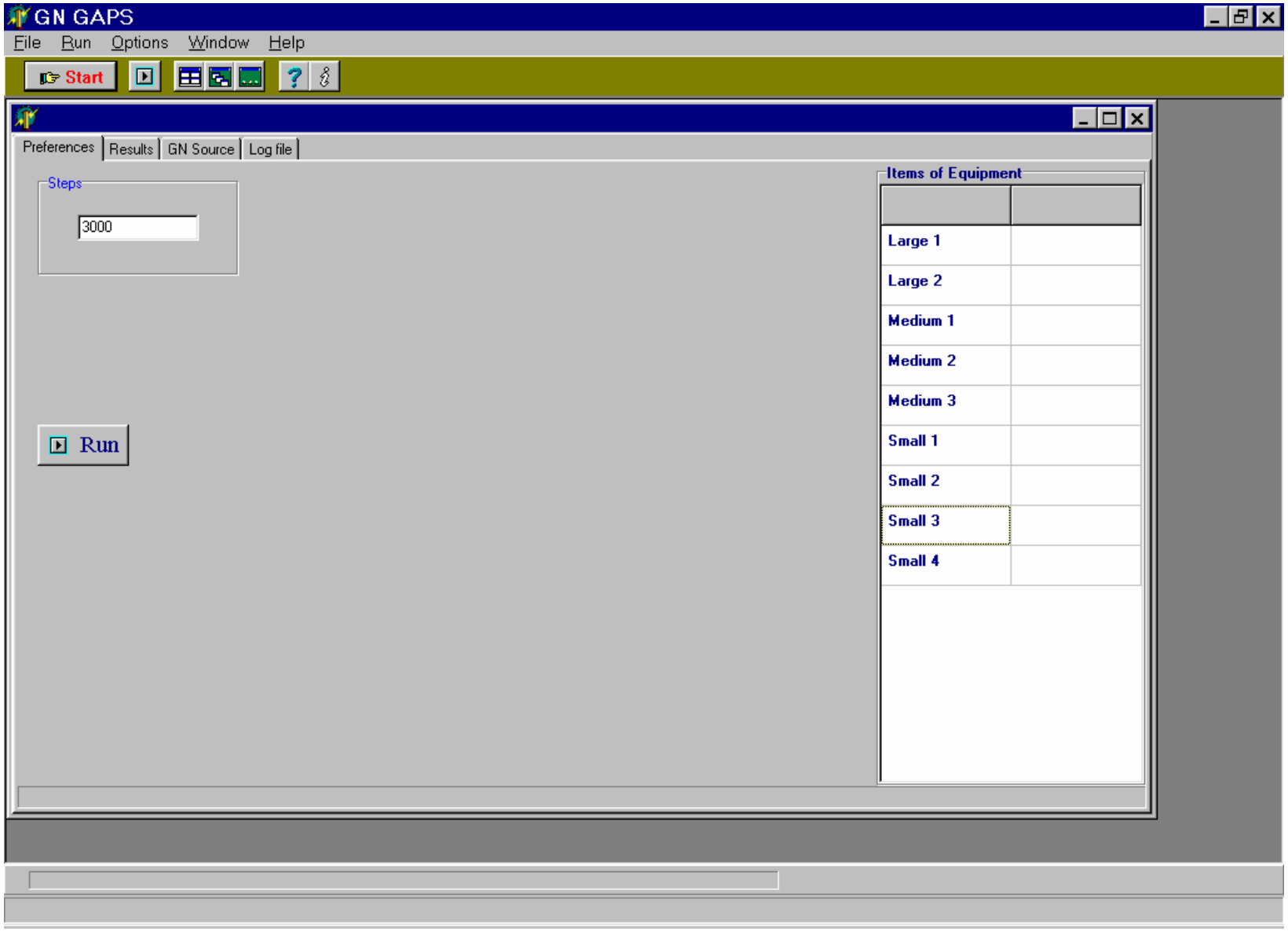
GN GAPS
File Run Options Window Help
Start
Preferences Results GN Source Log file
Steps
3000
Run
Items of Equipment
Large 1
Large 2
Medium 1
Medium 2
Medium 3
Small 1
Small 2
Small 3
Small 4

Fig.1.

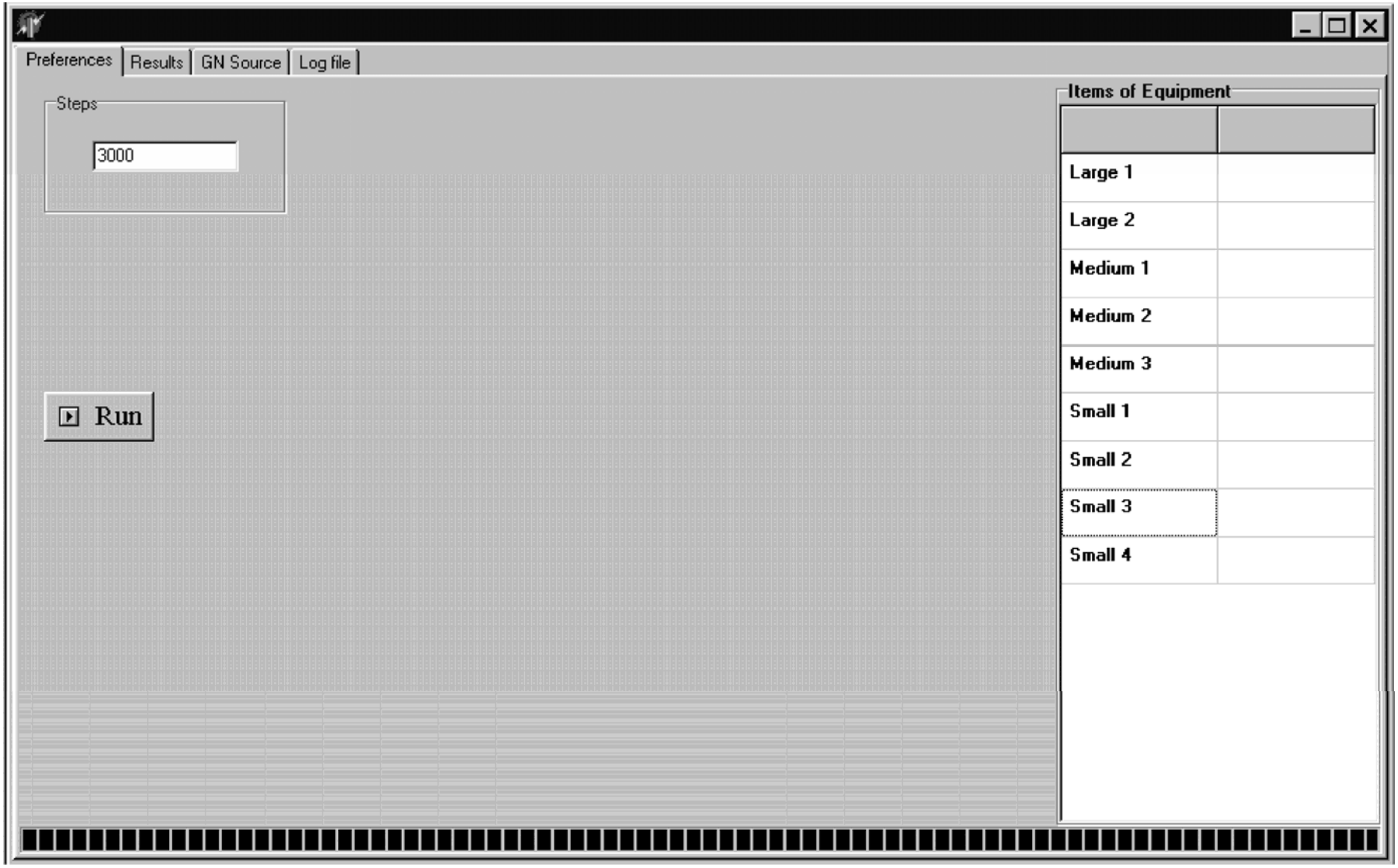
Preferences
Results
GN Source
Log file
Steps
3000
Run
Items of Equipment
Large 1
Large 2
Medium 1
Medium 2
Medium 3
Small 1
Small 2
Small 3
Small 4

Fig. 2.

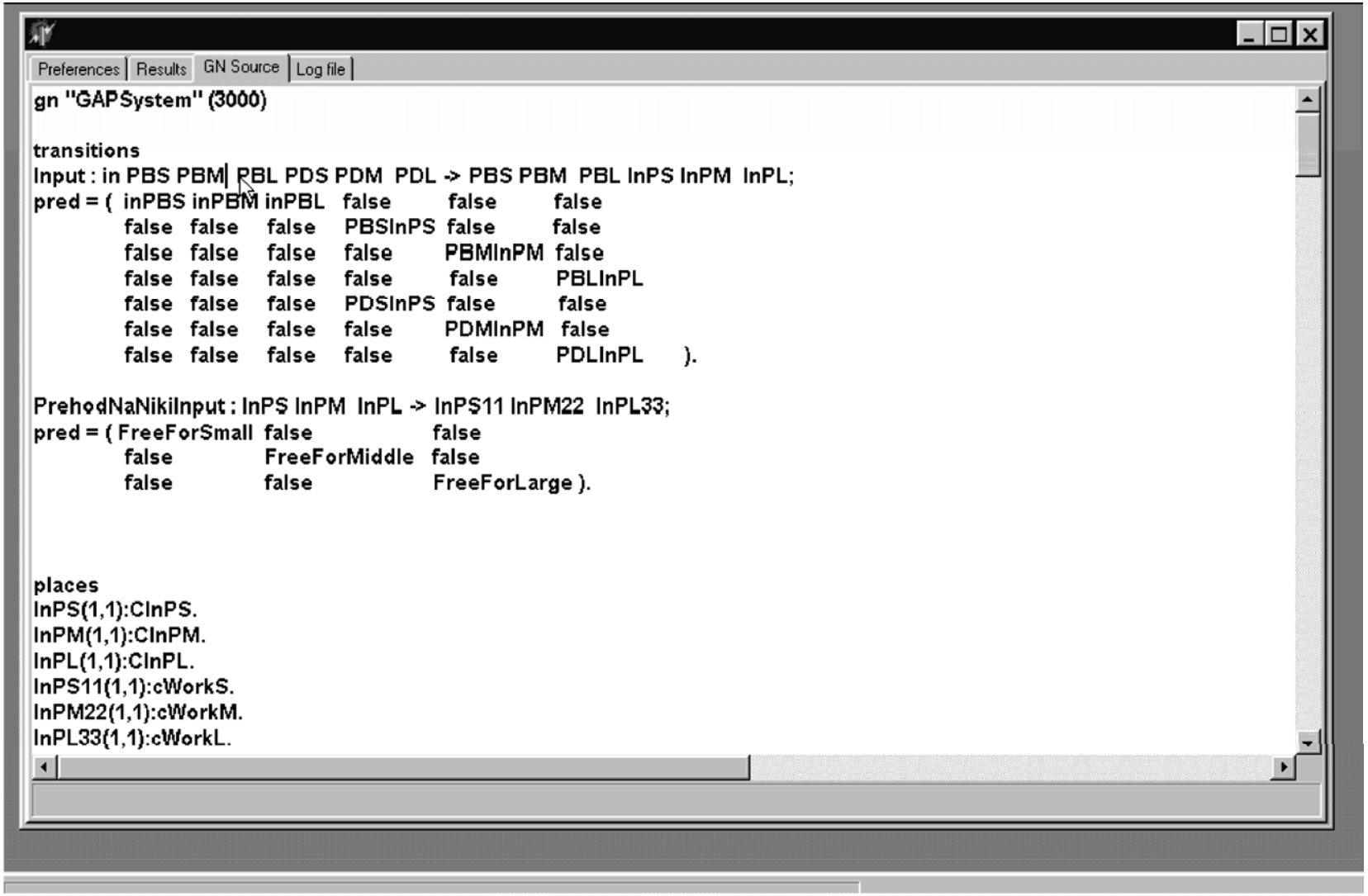
Preferences
Results
GN Source
Log file
gn "GAPSystem" (3000)
transitions
Input : in PBS PBM PBL PDS PDM PDL -> PBS PBM PBL InPS InPM InPL;
pred = (inPBS inPBM inPBL false false false
false false false PBSInPS false false
false false false false PBMInPM false
false false false false false PBLInPL
false false false PDSInPS false false
false false false false PDMInPM false
false false false false false PDLInPL).
PrehodNaNikiInput : InPS InPM InPL -> InPS11 InPM22 InPL33;
pred = (FreeForSmall false false
false FreeForMiddle false
false false FreeForLarge).
places
InPS(1,1):CInPS.
InPM(1,1):CInPM.
InPL(1,1):CInPL.
InPS11(1,1):cWorkS.
InPM22(1,1):cWorkM.
InPL33(1,1):cWorkL.

Fig. 4.

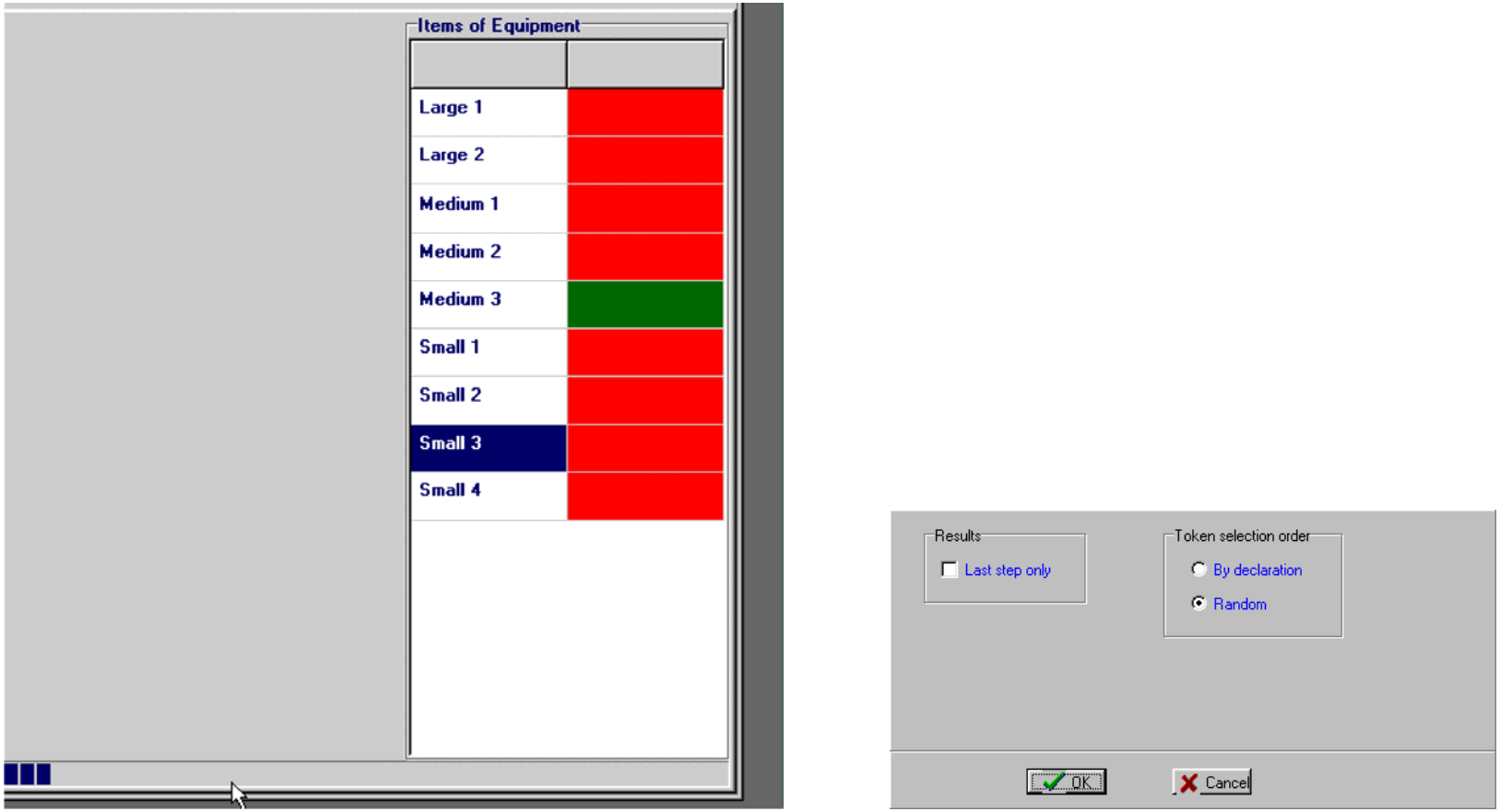
Items of Equipment
Large 1
Large 2
Medium 1
Medium 2
Medium 3
Small 1
Small 2
Small 3
Small 4
Results
Last step only
Token selection order
By declaration
Random
OK
Cancel

Fig. 3.

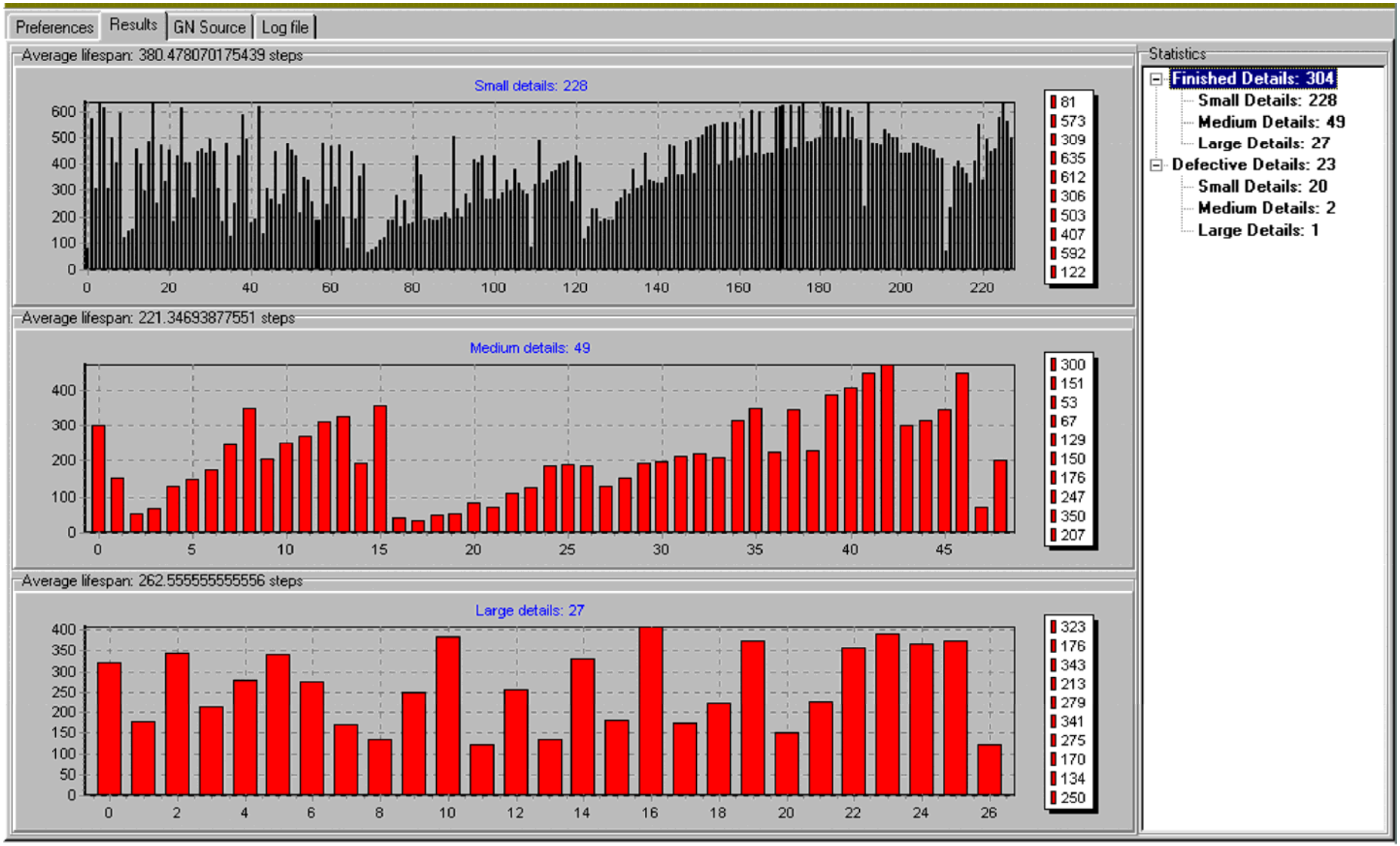
Preferences
Results
GN Source
Log file
Average lifespan: 380.478070175439 steps
Small details: 228
600
500
400
300
200
100
0
0 20 40 60 80 100 120 140 160 180 200 220
81
573
309
635
612
306
503
407
592
122
Average lifespan: 221.34693877551 steps
Medium details: 49
400
300
200
100
0
0 5 10 15 20 25 30 35 40 45
300
151
53
67
129
150
176
247
350
207
Average lifespan: 262.555555555556 steps
Large details: 27
400
350
300
250
200
150
100
50
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
323
176
343
213
279
341
275
170
134
250
Statistics
Finished Details: 304
Small Details: 228
Medium Details: 49
Large Details: 27
Defective Details: 23
Small Details: 20
Medium Details: 2
Large Details: 1

Fig. 5.

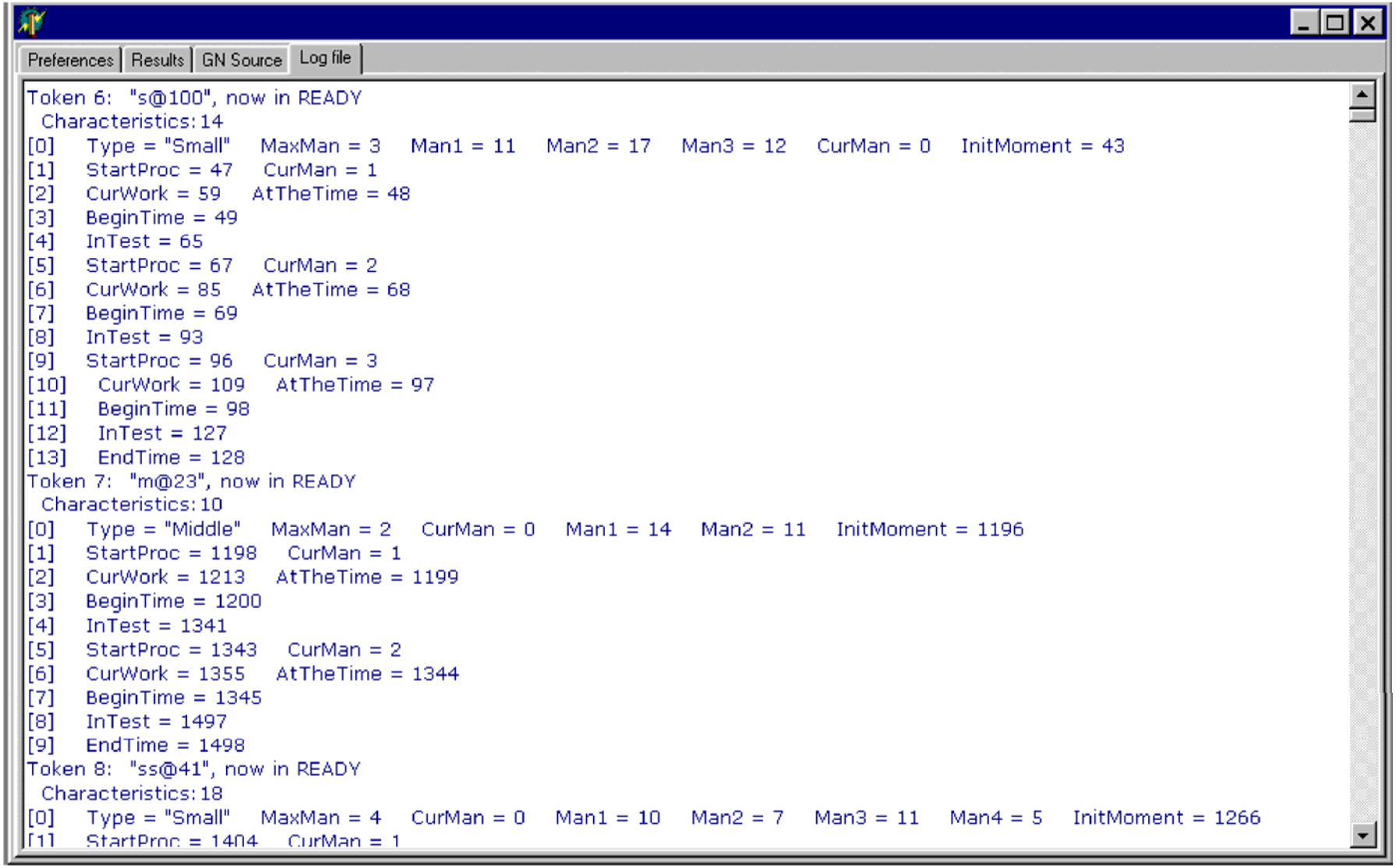
Preferences
Results
GN Source
Log file
Token 6: "s@100", now in READY
Characteristics:14
[0] Type = "Small" MaxMan = 3 Man1 = 11 Man2 = 17 Man3 = 12 CurMan = 0 InitMoment = 43
[1] StartProc = 47 CurMan = 1
[2] CurWork = 59 AtTheTime = 48
[3] BeginTime = 49
[4] InTest = 65
[5] StartProc = 67 CurMan = 2
[6] CurWork = 85 AtTheTime = 68
[7] BeginTime = 69
[8] InTest = 93
[9] StartProc = 96 CurMan = 3
[10] CurWork = 109 AtTheTime = 97
[11] BeginTime = 98
[12] InTest = 127
[13] EndTime = 128
Token 7: "m@23", now in READY
Characteristics:10
[0] Type = "Middle" MaxMan = 2 CurMan = 0 Man1 = 14 Man2 = 11 InitMoment = 1196
[1] StartProc = 1198 CurMan = 1
[2] CurWork = 1213 AtTheTime = 1199
[3] BeginTime = 1200
[4] InTest = 1341
[5] StartProc = 1343 CurMan = 2
[6] CurWork = 1355 AtTheTime = 1344
[7] BeginTime = 1345
[8] InTest = 1497
[9] EndTime = 1498
Token 8: "ss@41", now in READY
Characteristics:18
[0] Type = "Small" MaxMan = 4 CurMan = 0 Man1 = 10 Man2 = 7 Man3 = 11 Man4 = 5 InitMoment = 1266
[1] StartProc = 1404 CurMan = 1

Fig. 6.