11th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2007, Hammamet, Tunisia, 05-09 September, 2007.

OPTIMISATION OF THE RESOURCES AT ASSEMBLING FLEXIBLE SYSTEM OF ELECTROMOTORS

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ABSTRACT
Assembling flexible systems of the electromotors are very complicated systems. As such, they are designed for a certain series of electromotors.
But, in many cases other different types of electromotors are required to be manufacture, therefore for them the reconfiguration of the system resources and optimal distribution of an active labour force is needed.
In this paper the problem of optimisation for the system resources is analysed using OPTQUEST for ARENA. The acquired results are for a certain series of electromotors taken as a subject of study and research.
Key words: Assembling Flexible Systems, Optimisation, KANBAN, CONWIP, HYBRID

1. OPTIMISATION OF A FLEXIBLE ASSEMBLY SYSTEM
An electromotor assembling is a very sophisticated and complicated system and needs to be designed for certain series. Because the different types of electromotors require different labour and system resources, the paper analysis optimal distribution of such a resources.
The analyses has been made using OPTQUEST fo ARENA and results are graphically presented.

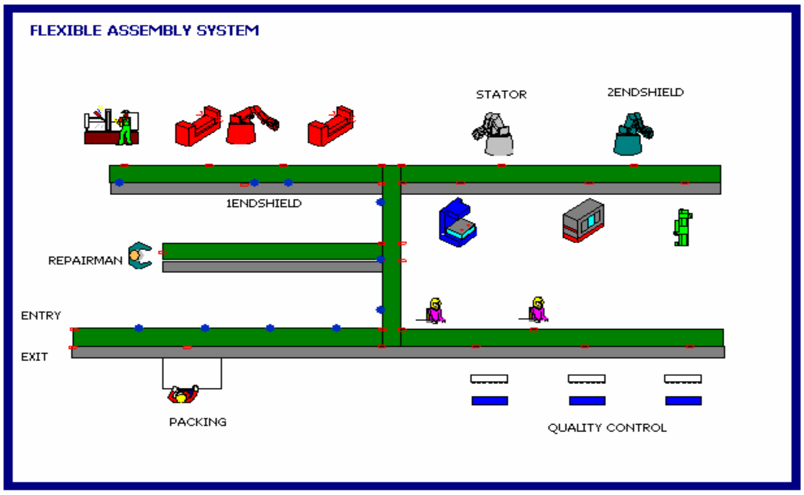
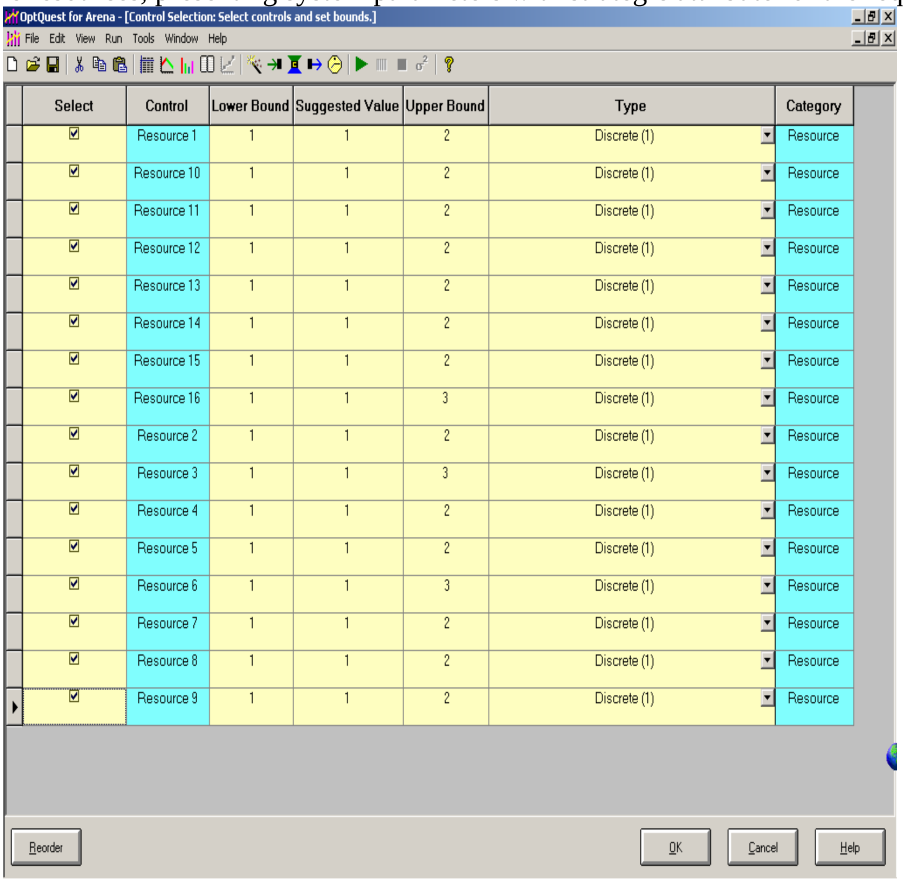


Figure 1. Simulation sketch of fitted electromotor systems

A system of electromotor is adopted under certain conditions, *Fig.1*. The parameters assuring optimal solution of the fitted system electromotor will be found with an assumption that issue on the

flexible fitted system are personnel. This product respectively on the current type of the electromotor that has to be fitted, the personnel **number** and their **dispatch** has to be solved.
In the *Fig. 2* are presented resources respectively system's personnel on 16 assemble stations, including 15 assemble stations and the repair line. As shown in the figure, in the first column are selected all the resources, presenting system parameters with strategic attribute for the requested goal.



OptQuest for Arena - [Control Selection: Select controls and set bounds.]

Select	Control	Lower Bound	Suggested Value	Upper Bound	Type	Category
☑	Resource 1	1	1	2	Discrete (1)	Resource
☑	Resource 10	1	1	2	Discrete (1)	Resource
☑	Resource 11	1	1	2	Discrete (1)	Resource
☑	Resource 12	1	1	2	Discrete (1)	Resource
☑	Resource 13	1	1	2	Discrete (1)	Resource
☑	Resource 14	1	1	2	Discrete (1)	Resource
☑	Resource 15	1	1	2	Discrete (1)	Resource
☑	Resource 16	1	1	3	Discrete (1)	Resource
☑	Resource 2	1	1	2	Discrete (1)	Resource
☑	Resource 3	1	1	3	Discrete (1)	Resource
☑	Resource 4	1	1	2	Discrete (1)	Resource
☑	Resource 5	1	1	2	Discrete (1)	Resource
☑	Resource 6	1	1	3	Discrete (1)	Resource
☑	Resource 7	1	1	2	Discrete (1)	Resource
☑	Resource 8	1	1	2	Discrete (1)	Resource
☑	Resource 9	1	1	2	Discrete (1)	Resource

Reorder OK Cancel Help

Figure 2. Parameters of fitted flexible system

On the third, fourth and fifth column are tagged the possible values that parameters can have. So it is indicated the lower bound, upper bound and premeditate values as initiation conditions for the start of the system simulation. Type of these parameters is discrete; implicating that system in general is discrete and discontinued, or mixed. The last column, the fourth one, shows to us that we have to deal with resource category. If the complete staff with their names was in simulation then it would appear in the second column, and the last column with its presence shows the Arena module meaning.
After we have assigned the system parameters, we begin with setup of conditional ranges. In this specific case the minimal number of people involved can be 16 and the maximum 32. These conditions can be viewed in the beginning. Further according to the engineers of the workshop, there is the possibility that at the repair lane (Resource 16), station two, four and six, altogether 10 people can be located and regularly there it has to be equal or more than four, (*Fig. 3*).
In the second column all the system resources can be viewed. While pressing these buttons it immediately presents on the left side, and the only thing is to build the relation between them. On the mentioned case they present linear relation. Mathematically they only present lines limiting this zone. Now, OptQuest-i is warned that it has to find a solution only in the solutions group within this zone.

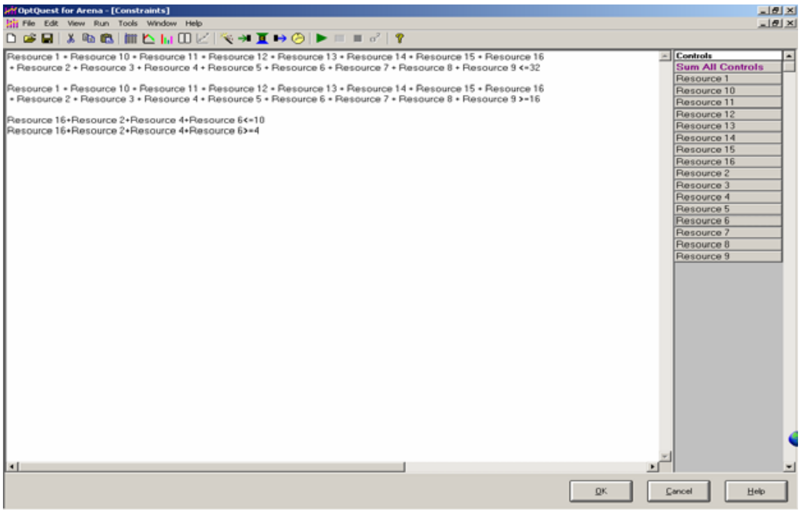


Figure 3. Parameters of fitted flexible system

In the fig.4, the objective of flexible fitted system is presented. In this case we target on: “Entity total time” expressing to us the meaning on the total time that electromotor will spend in the flexible system. Naturally, the target value is to reduce time, which is selected on the left side, respectively on the first column. The “Minimize objective” is selected and accordingly to the case other options can be selected i.e. “Maximize objective”.

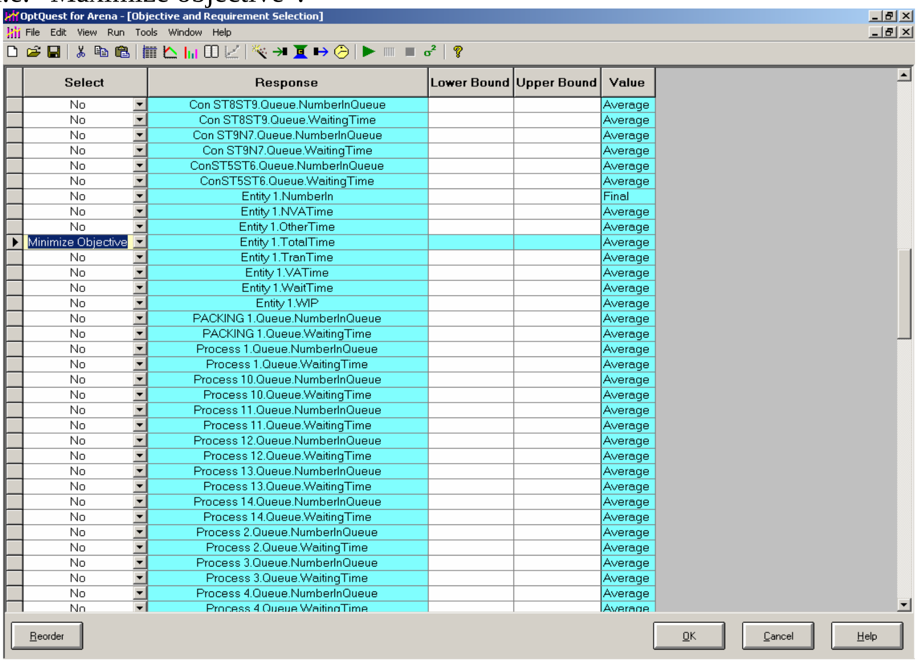


Figure 4. Target objective of the flexible assembly system

In the second column are presented system responses as described before. Automatically, OptQuest generates all the possible answers in relation with selected options in Arena. On OptQuest we see them, if they are included. Definitions of requests are tagged on columns three and four with Lower Bound and Upper Bound. Resulting on, that the final result within delimitation assigned accordingly to case and personal experience as simulation analyst can be found.

The target objective value for this simulation is seen in the fifth column. It can have values such as Average, Final Value, etc. It all depends on the type of the value. When this step is finished it is verified by clicking OK, which tells OptQuest that the data has been accepted.Before starting the optimization process we have to define some other program parameters that are of crucial importance.

2. ANALYSIS OF OPTIMISATION RESULTS AND CONCLUSION

Optimization results can be monitored in direct graphical manner during the entire solution finding process. In this way we can only decide on the end of the optimization process, when there is no improvement of the value of target objective. In this way we can establish that the algorithm has converged in the solution finding process, and we can stop the optimization.

In *Fig.5* we notice that there are a total of 32 executed experiments, and many replicas have been executed during these experiments, while a 95% interval of normal dispatch has been achieved. We can conclude that 95% of all experiments are within the normal dispatch. This shows that there is a high probability of an event happening.

In the first experiment for a group of system solution parameters, a 1780.79 second interval for an entity continuance in system has been achieved, but the optimal value has been achieved only on the 13th simulation and the interval was 944.169 seconds. This is clearly visible in the green graph line. After this the graph stays constant by which we can establish that the algorithm has converged to an optimal solution.

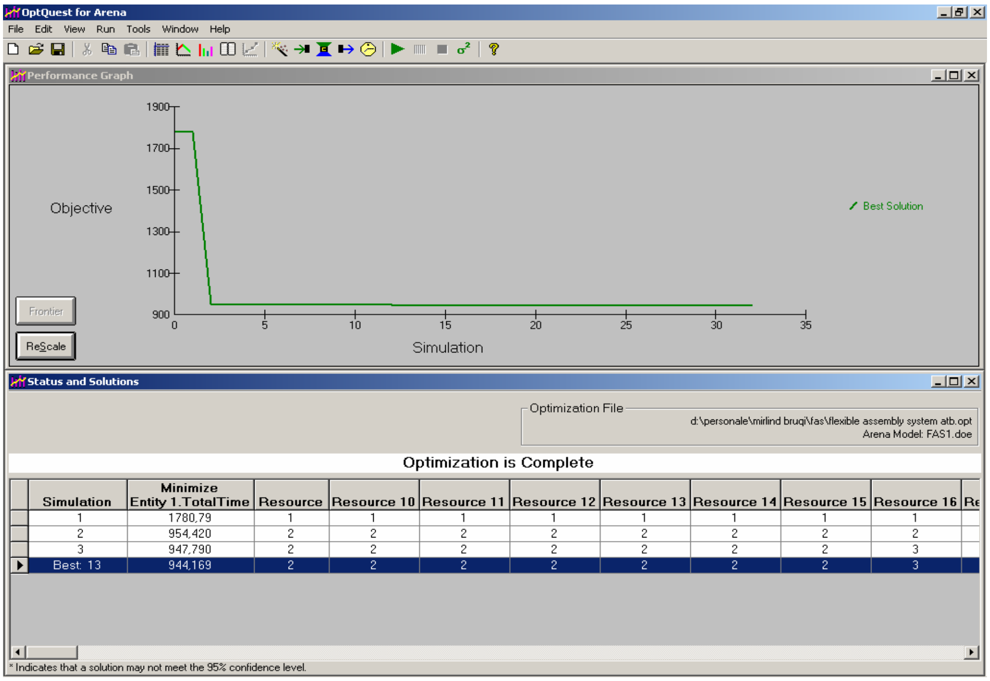


Figure 5. Optimization results

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