THE POWER OF GENETIC ALGORITHM IN MODELLING A COMPANY RESOURCE SCHEDUALING

Dobrin Carmen [1] and Bondrea Ioan [2]
[1] "Lucian Blaga" University of Sibiu, carmendobrin12@yahoo.com
[2] „Lucian Blaga" University of Sibiu, ioan.bondrea@ulbsibiu.ro

ABSTRACT: One of the top challenges in manufacturing process is resource allocation and leveling which can be solved using heuristic methods. This aren't all the time offering the optimum solution, so using Genetic Algorithms technique can improve the resource allocation, because of the multiple searches for an optimum solution. This will also led to a better performance and lots of other benefits of whole system. On highly competitive business environment, managing all the costs will be a perfect task for good results. Reducing sharp variation in the resource demand histogram, maintaining also the duration of the project will guarantee minimization of project time and costs. Describing the appliance of genetic algorithms on purchasing program will re evaluate the basis of limited resource allocation. Using the Plant Simulation program with their Gas simulation will shorted the time of evaluating the best solution in real life.
KEY WORDS: Genetic Algorithms, modelling, improvement, Plant Simulation.

1. INTRODUCTION: SHORT DEFINITION OF GENETIC ALGORITHMS THE ELITIST ROULETTE WHEEL SELECTION OPERATOR

Keeping in mind that natural mechanisms of biological evolution had demonstrated their effectiveness in finding the environment's optimal solution, genetic algorithms come to apply the Darwin's evolution theory on modelling manufacturing processes. "Genetic Algorithms probably will not find the best solution, but they can find a solution near the perfect solution" [6]

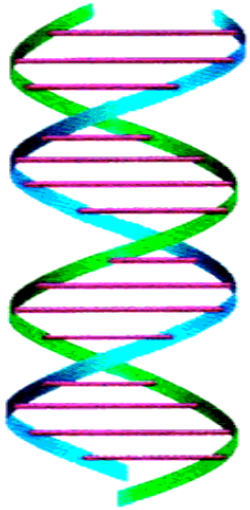

Figure 1. Human ADN

The stochastic iterative search for better solutions, will explore the integration of modelling with computational techniques, based on evaluation of performance results of analysis. The exhaustive searching of algorithms which are satisfying the design alternatives is really a great task because parametric models can be described by a relatively.[3]

large set of independent variables, which will make taking even more parametric design alternatives and also the decision even harder to be taken, in every stage of manufacturing process. [5] One of the most known heuristic algorithms in the minimum moment algorithm which minimize all daily fluctuation. Trying a series of heuristic rules, to obtain minimum duration has little diversity. Studying activities of twenty resource producers using GAs will improve the schedule. A constant daily demand whit out fluctuation is the first of the possibilities, after that it exist the resource fluctuation from 2-6 units.[8]

Studying lots of potential solutions applying genetic algorithms is more attractive for design engineers than finding only a single solution no matter if good or wrong.

Using GAs in solutions searching and optimization of 2D and 3D STRUCTURAL MODELS, became a revolutionary job in industry. Optimization techniques have been used in solving a specific (mono-disciplinary or interdisciplinary) design problem by searching for an optimum solution. In this light, "the role of optimization in design is to find within the design space the configuration that best matches desired performance goals. This is unquestionably one of the major potentials of optimization techniques." [7]

GAs are all the time looking for techniques which are generating a lot of solutions possibilities and here we can remember the re-combination and progressively selection of generation of solutions which perform better functions and better parameters. [1] Using parametric modelling and genetic algorithms offer a strong basis for interactive explorations for the designer. [9]

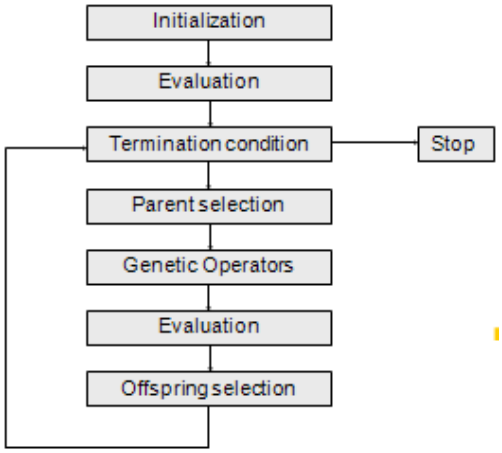

Figure 2. Stages of genetic algorithms structure [6]

2 MULTI – OBJECTIVE GENETIC ALGORITHM

When designers face with problems that have unaccepted characteristics by traditional methods, they have to use multi-objective GA, which allow the creation of individual vectors with equal size for each considered objective. [1]The first steps in this direction were taken in the 85' by Schaffer with "Vector evaluated genetic algorithms (VEGA), Fonseca and Flaming in '93 with Multi-objective genetic algorithm (MOGA).

For a more realistic representation of the dynamic behavioural of a system, the multi-objective genetic algorithm can be united with Monte Carlo simulation for making more easy the creation of ''typical" scenario which allows the evaluation of most important features.[3]

In the global context where almost everything is connected, solving the problems of purchasing became a matter of time. Using GIS (Global Information System) the information (quantities, due dates, delivery delays, etc.) about the producers can be easy managed, including manufacturing, warehousing and transportations costs. [1]

Finding the best sequence of orders, reducing the sum of delivery delays and total costs are only some of this multiple target optimization. Because delivery delays come together with penalties, this will influence also the costs, so first step will be made by avoidance of penalty costs.

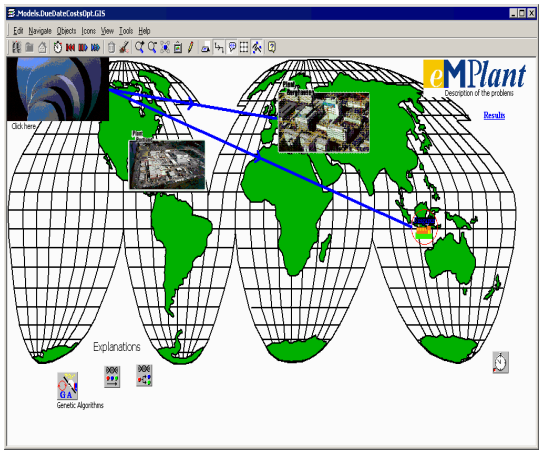

Figure 3. Starting Plant Simulation [10]

For obtaining algorithm performance and runtime, the computational results and analysis section describes data and variables followed by statistical results and analysis. [10]

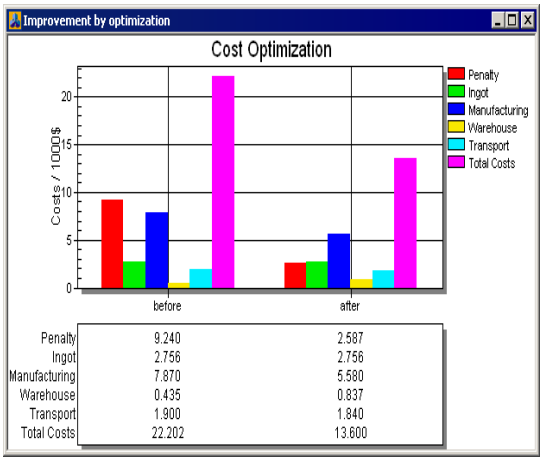

Figure 4. Improvement by optimization [11]

The distances between the factories and the transportations routs can be also optimized. The starting and the terminal point will be part of the tour in finding the best permutation rate for minimizing the distance length.

"There are many algorithms that can be used for solving this type of problem, but all of them require a computational time, that increases exponentially with respect to the problem size **n**." and finding the best of them is an open problem. [7]

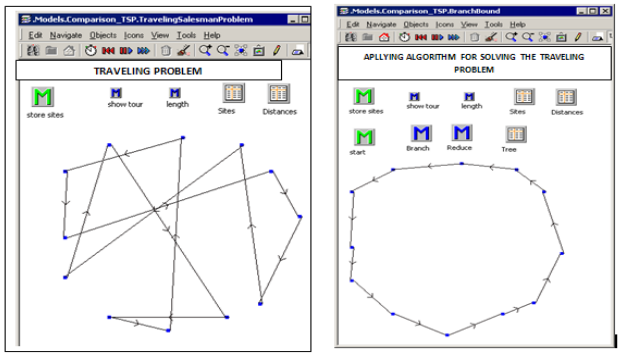

Figure 5. Branch and bound algorithms -models comparison of routes [8]

3 USING PLANT SIMULATION GENETIC ALGORITHMS

The work for finding a suitable solution, not necessarily the best one, is almost done by using some ingenious algorithms that can be applied in this case. Finding the algorithm for optimizing the polynomial time of the factory tour, (n^3) keeping account of all constraints will be solved by a nondeterministic algorithm.

Studying the best solutions to fulfil all the positions restriction one by one, will led us to the best valid solution no matter of the consistency of restrictions for mutations (exchanging of two elements) by making a cross-over. [3] Exchanging two elements for the material flow of a sequence will allow the mutation of locations in the way of obtaining the minimum transport cost.

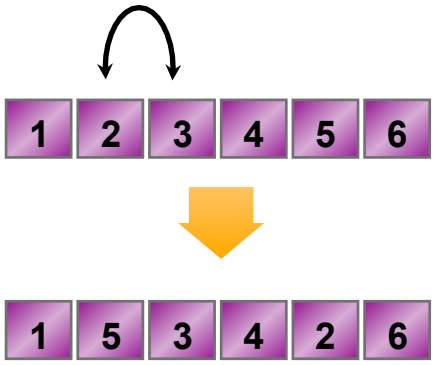

Figure 6. Exchanging of locations [3]

Considering the resources and the amount of material transported, the optimum route will be put on page by the Layout-Optimizer-Wizard. The resources position changes made will led to a new sum of transport cost but keeping in mind that every resource is moveable a new generation of default settings will be born. [5]

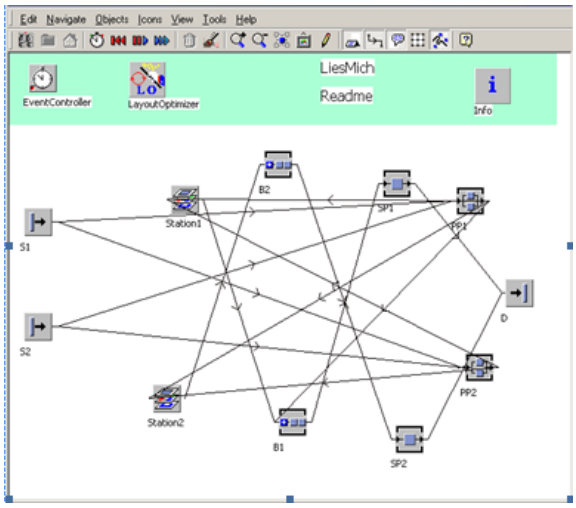

Figure 7. Applying Genetic Algorithms to Layout Optimization [10]

4 RESOURCE SCHEDULING WITH HELP FROM GENETIC ALGORITHM

Four of the major versions of problems can be defined as:

1. Minimization of time;
2. Minimization of cost;
3. Maximization of cash flow;
4. Using the best level of resource.

One of the most used methods in solving this kind of problems was finding out by combining the meta-heuristic method with GA and applying this on engineering optimization problems. GA is now adopted in many applications with remarkable advantages because of mathematical programming. The similarity of GA with the flexibility of movement of an individual chromosome is determining the predecessor activity and the successor activity. After choosing the individual chromosome the activity with all possible positions can be adjusted by iteratively values. [9]

5 RESULTS AND ANALISYS

Individual optimization in finding out the activities' priorities is not an easy task. That's why, proving the efficiently daily resource fluctuation reduces project duration and costs. Usually, GAs need a representation scheme similar to so called gene or chromosome representing one of resource producers to follow the fittest process. The steps to be taken are:

1. Setting gene structure;
2. Evaluation with objective function;
3. Generating an initial level;
4. Choosing the mechanism;
5. Coding the procedure. [8]

Finding the answer to the best schedule duration depends on the limited resource allocation algorithm. There are several approaches in finding out the optimally solution. All of this are based on activity characteristics which are also based on sever heuristic rules which have the advantage to be simple to understand, for limited resource. The scheduling process starts from implementation of project start time and choosing of eligible activities. [4] The minimum moment algorithm has the role of reducing the resource histogram around the horizontal axis, and with each time step another good feasible solution will be applied. From a comparison between a histogram with a constant daily demand of resources program with one with

daily fluctuation will emerge the important moment from horizontal axis where is found a better resource leveling calculated as follows:

$$M_\lambda = \sum_{j=1}^{n} [(1x \text{ Resource Demand}) \times \tfrac{1}{2} \text{ Resource Demand}] \quad (1)$$

where: n = working day number of the project finish date.

After, the minimum moment will be:

$$M_\lambda = \sum_{j=1}^{n} (\text{Resource Demand})^2, \quad (2)$$

Surprising, this method doesn't take into consideration the resource utilization period and also doesn't consider the extended assignment of the resource. Results prove that using GA brings a lot of benefits in resource allocation which can be transformed in cost savings. [8]

This GA procedure has several important characteristics as:

- Using powerful commercial software;
- Get to solution by searching fraction space and reproducing the others;
- Developing the objective function for resource allocation and levelling;
- An additional user input is not required;
- Incorporation of new objectives is not charging extra time because of the mathematical optimization;
- Implementation of GA from Plant Simulation software allows possible approaches for combining iterative procedures;
- Plant Simulation GA will choose the optimal parameters to start the simulation end to evaluate the results automatically; [5]

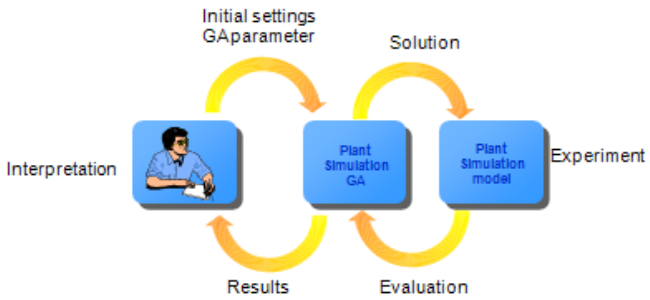

Figure 8. Iterative Optimization with Plant Simulation [10]

- Searching the properties of similar values based on solutions concentrate on the **dominant peak;**
- Only very few solutions fulfil all hard constraints.

Figure 9. One dominant maximum [7]

- Fitness does not direct the algorithm towards the peak, maximum is not found.

6 CONCLUSIONS

Determining the amount of material transported on diverse routes will be optimized through the Layout-Optimizer-Wizard. This will refer also to the material flow and the transport costs. Changing the resource position will involve another transport cost to be calculated. This is an easy task for Plant Simulation because of the moveable resources simulator.

Optimizing this into real world, will be difficult because of non-predictable influences [2] But trying this on models and performing multiple simulation each with specific values, than choosing from minimum and maximum of sample will determine the optimum calculated sample.

This paper shows the potential of alternatives and multiple levels of abstraction in achieving the desired solutions. Also very important is the early performance evaluations for optimizing the purchasing process. For obtaining reliable results would be important the integration of performance analysis which implies frameworks where every aspect is driven by development digital aspects . GAs joins the potentials of different techniques with the require of an abstract thinking and allows finding performing solutions, integrating them in real time design which has a crucial role in data managing and visualization.

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