Finding Optimal Strategies for Supply Chain Management

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Supply Chain Management

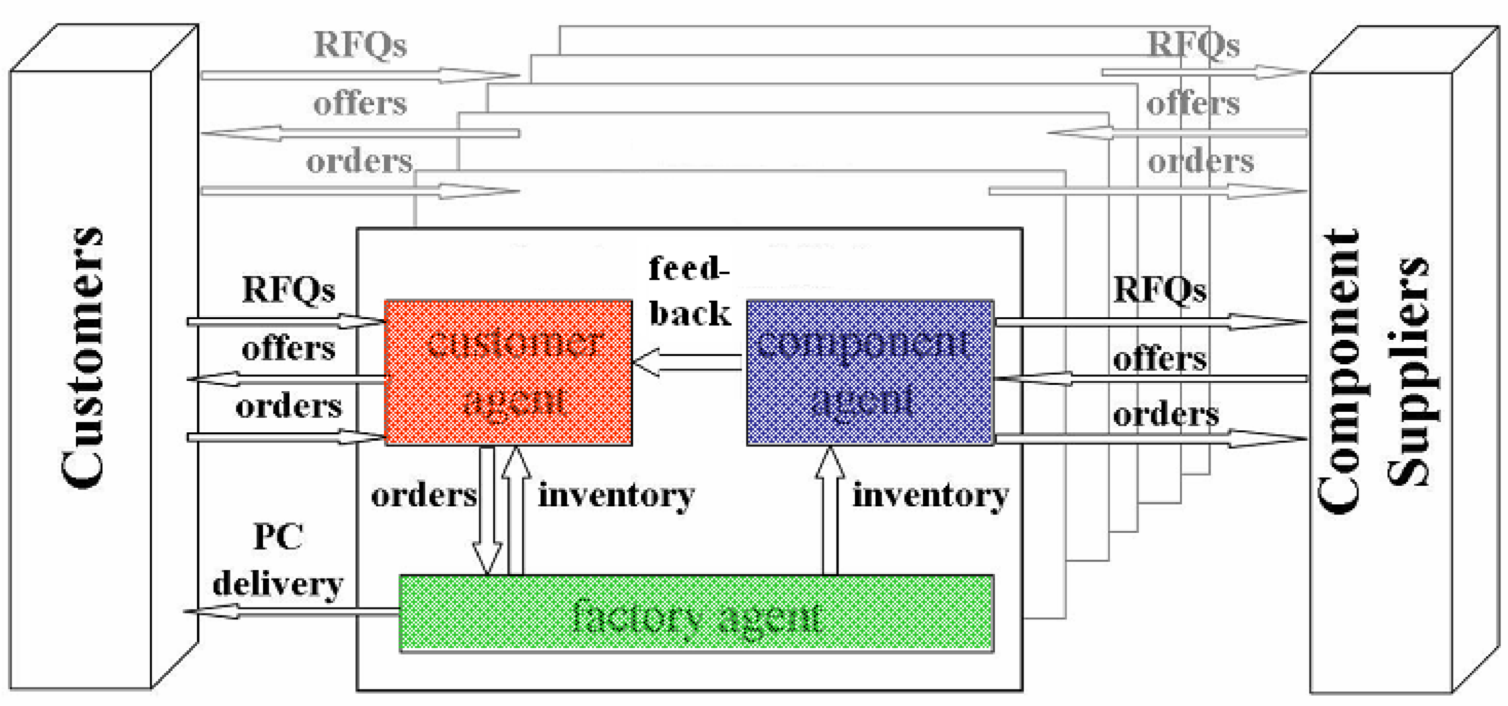

Figure 1 Supply chain Management Model of Trading Agent Competition

❑ **Supply Model** related to Component Suppliers and the Component Agent. The aim is to minimize the costs of components needed for building the products (PCs). The solution is to procure the purchases on as low prices as possible.

❑ **Demand Model** related to Customers and the Customer Agent. The aim is to maximize the profit. The solution is to maximize number of PCs sold with as high prices as possible.

Optimal Strategies for Supply Model

❑ **Component Procurement Problem**

- ❑ For a given procurement period of *D* days, revenue *p, k* available RFQs and maximum quantity *W* to collect.
- ❑ When and how many to buy?

❑ **Solution**

- ❑ Multiple-Choice Knapsack Problem (MCKP) model for Components Procurement Problem
- ❑ For each RFQ's quantity *w* and due date *d* are specified

$$\text{maximize} \quad \sum_{i=1}^{k} \sum_{j \in N_i} p_{ij} x_{ij}$$

$$\text{subject to} \quad \left\{ \begin{array}{l} \sum_{i=1}^{k} \sum_{j \in N_i} w_{ij} x_{ij} \le W \\ \sum_{j \in N_i} x_{ij} = 1 \\ x_{ij} \in \{0,1\}, \forall i \in \{1,\ldots,k\}, \forall j \in N_i \end{array} \right.$$

- ❑ Solution indexes with value *x* equal to 1 indicate the selected due dates *d*

Optimal Strategies for Demand Model

❑ **Daily Demand Predictor:** Smoothed average number of RFQs sent for PCs in three market segments over the number of historical games.

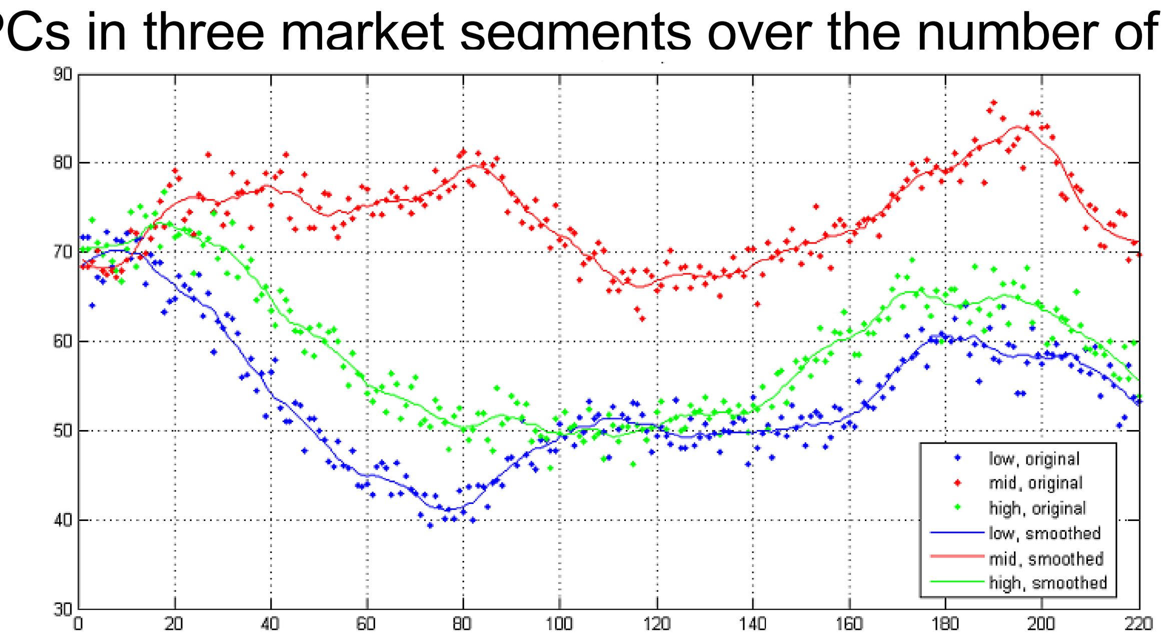

Figure 2 Smoothed average number of RFQs sent for PCs in low, mid and high market segment over 220 days. Stavitzky-Golay used as the smoothing method.

The proposed formula computes quantity of component *c* demanded on day *d*

$$N_d^c = w_c \times q \times \frac{Q_d}{n}$$

❑ **Feedback Mechanism:** Demand Model is linked with Supply Model by adapting the GA solver for MCKP Component Procurement to the market demand. Re- designed *swap mutation* employs the proposed percentage spread formula.

$$s_d^c = \frac{N_d^c - N_d^c}{\max_{i \in D} N_i^c - \min_{i \in D} N_i^c} \times 100\,\%$$

Experiments & Discussion

Supply Model

❑ GA for MCKP Component Procurement Problems was tested on two types of randomly generated uncorrelated data-instances in sizes of (k=10, n=10) and (k=10, n=100) within the ranges of R=100 and R=1000.

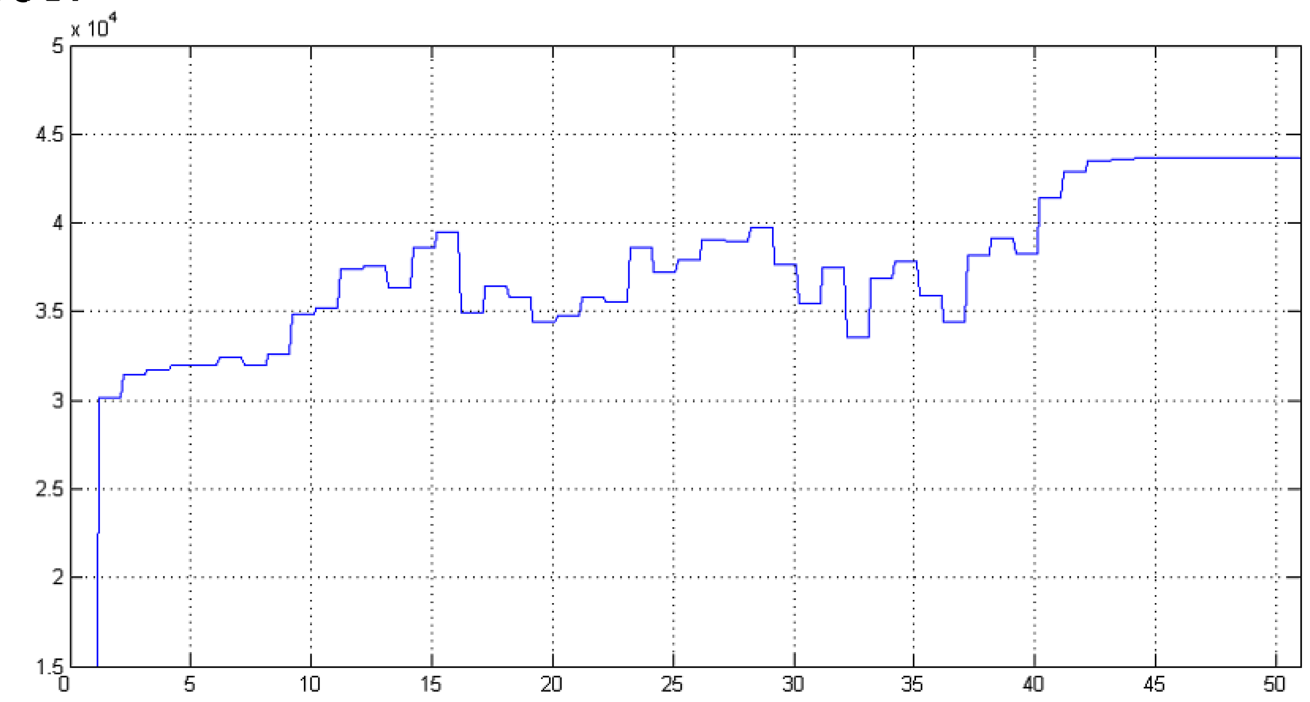

Figure 3 Fitness function over generation for [k=10, n=10, R=100, pop size=10]

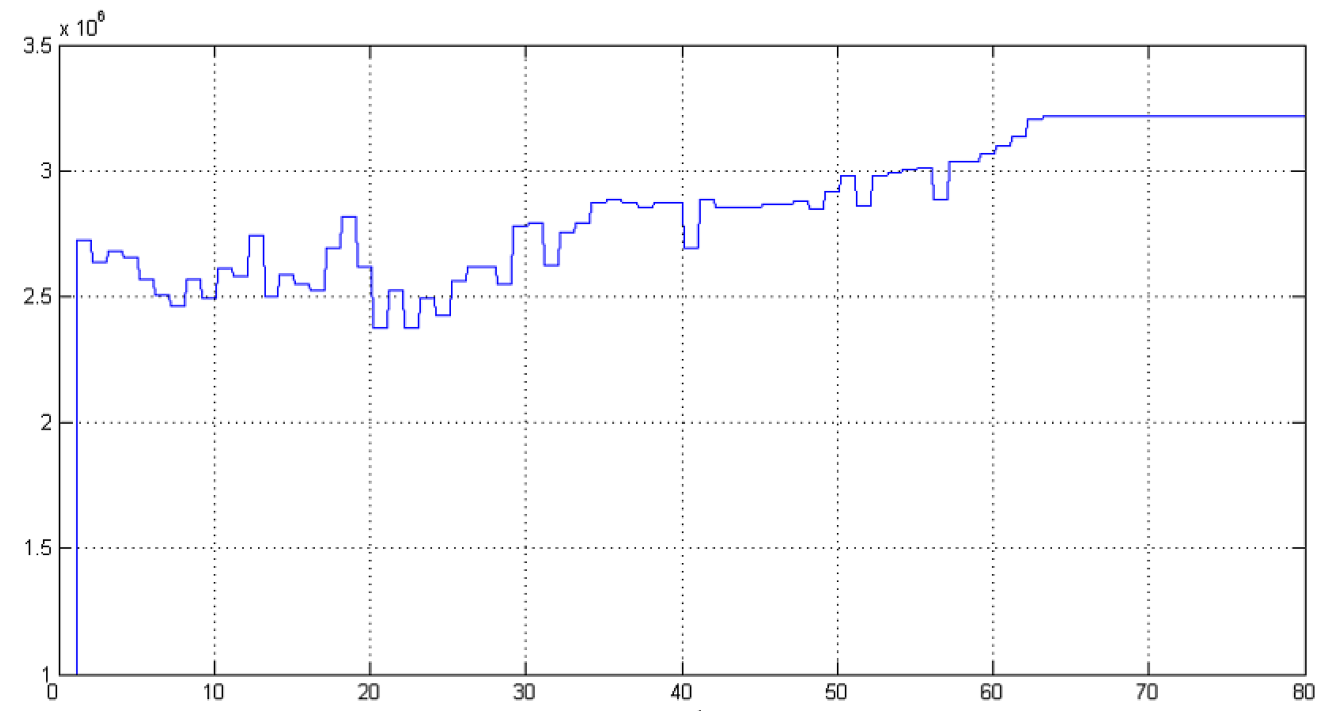

Figure 4 Fitness function over generation for [k=10, n=10, R=1000, pop size=10]

❑ Component Procurement Problem was solved by the implementation of simplex method. Table 1 presents the percentage gap between the best result returned by GA for MCKP and the best result returned by the implementation.

Table 1 Percentage gap between GA and the simplex implementation

Problem size		R	gap[%]
k	n		
10	10	100	58
10	10	1000	59
10	100	100	64

Demand Model

❑ GA for MCKP Component Procurement with and without Feedback mechanism were compared on uncorrelated data instances in size of k=10, n=10 and range of R=100.

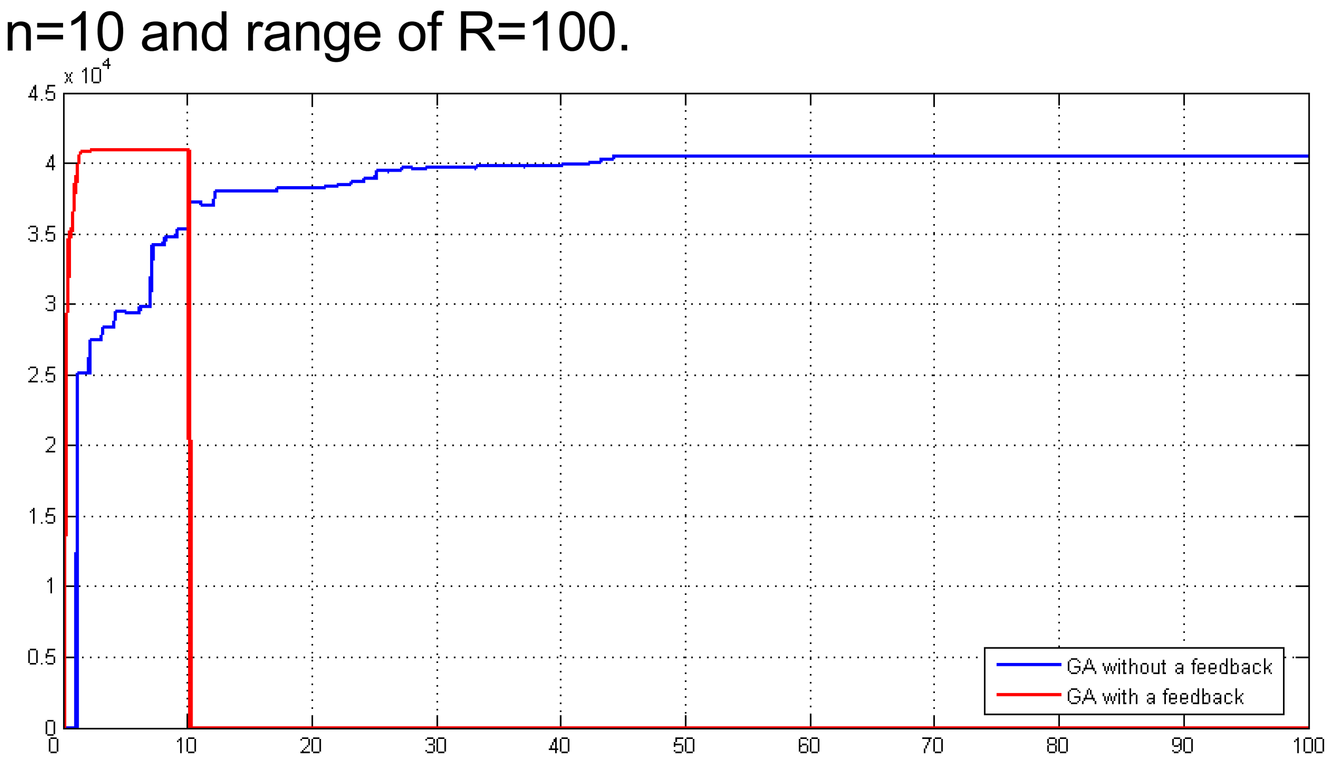

Figure 5 GA solver for MCKP with (red) and without (blue) Feedback mechanism. Fitness function over generation for [k=10, n=10, R=100, pop size=10]

❑ GA biases fitness function value towards higher values over the search space.

❑ Feedback mechanism and re-designed GA operators converge over the same search space quicker and more efficient than standard GA. New swap mutation allows to find more unique and feasible individuals.