C14 Supply Chain Management - Taylor ED 3.4

Taylor ED (Enterprise Dynamics) is an object-oriented simulator for discrete processes. Processes, stations, entities, and also control of any kind are represented by *atoms* (objects). The *4Dscript Language* is the interface through which all Taylor ED functionality is controlled. It is used to define atom functionality, to create, run and analyse models, to define model logic, to control Taylor ED from outside, etc.

Model: The four factories (atoms *Fabrik*) store finished products in (built-in) storages. If an order is to be fulfilled the needed amount of products is taken from there and placed into dispatching units (atoms *Verteiler*), where they stay for the duration of the transport time. Then the products enter the distributor (atom *Distributor*) they were ordered from. Depending on the wholesalers' orders, products are then routed to the wholesalers (atom *Wholesaler*).

Fig. 1: Graphical model layout in Taylor ED 3.4

An event-based approach was used for simulating this supply chain. After initialisation, a timer triggers the distributors' order event each 24 hours. The order event checks the storages of the factory and – if the amount needed is available – the ordered products are moved to atom *Verteiler*; parts of code see below.

```
repeat(12,do(
  v:=count,
  if(cell(v,1,c)>0,do(
    if(v<7,do(
       sets(atombyname([produktion1],model)),
       c.prod:=1),do( ……
    if(content(out(v,s))>=cell(v,1,c),do(
       sets(out(v,s)), …..repeat(cell(v,1,c),do(
  sddb([tz],dist(att(6,c),c.prod),first(s)),
     setcell(v,1,cell(v,1,c)-1,c),
     moveatom(first(s),atombyname(concat
       ([verteiler_],string(att(6,c))),model))
    ))))))),createevent(86400,c,20)
```

Task a: Simple Supply Chain. This simple strategy (fixed orders per day) results in increasing stock for each distributor (fig. 2); storage costs become higher as the storage becomes fuller. The table shows costs and delivered products for distributor D_1.

Task a	min	max	mean	dev
C	30352 €	37983 €	34517 €	1440,14
N	200	257	225	12,59
R	119 €	185 €	154 €	14,6

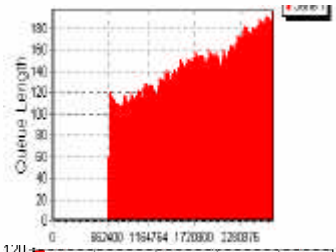

Fig. 2: Stock over Time (sec) of Distributor D_1 – Simple Order Strategy

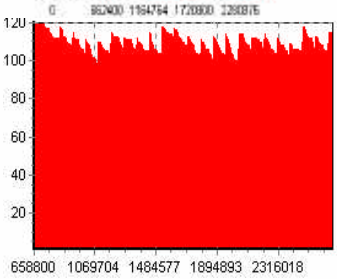

Fig. 3: Stock over Time (sec) of Distributor D_1 – On Demand Order Strategy

Task b: On Demand Order Strategy. The distributors record the wholesalers' orders during 24 hours, no matter if the order was fulfilled or not, and order this amount from the factories at next order event. The event code (left) is slightly extended. Result of the strategy: costs for distributors decrease, while stock stays almost constant (fig. 3, table).

Task b	min	max	mean	dev
C	25765 €	30901 €	28206 €	1195,35
N	196	257	227	13,28
R	119 €	185 €	154 €	14,6

Task c: Minimal Supply Time – Order Strategy. When ordering, the distributor tries to order at the factory with minimal supply lead time. The order event code (left) is extend by finding the factory with minimal supply lead time:

```
if(content(out(v,s))>=cell(v,1,c), ……
do(c.time:=min(c.time,dist(att(6,c),count)))),..
if(c.time<c.old_time,c.bestell_nr:=count))),
if(c.bestell_nr>0,do(…….
sets(out(v,atombyname(concat([produktion],
string(c.bestell_nr)),model))),
```

Simulation again shows a decrease of costs as the transport time goes down (table below)

Task c	min	max	mean	dev
C	22883 €	27307 €	25416 €	998,95
N	194	255	224	12,94
R	97 €	134 €	113 €	4,4

Comparison of the strategies (table below) shows, that the strategy with minimal supply time is the best also wrt deviations. Evaluation of the 100 runs was performed in EXCEL using Taylor's interface atoms.

	C_{mean}	C_{dev}	N_{mean}	N_{dev}	R_{mean}	R_{dev}
T. a	34517 €	1440,14	225	12,59	154 €	14,6
T. b	28206 €	1195,35	227	13,28	150 €	11,49
T. c	25416 €	998,95	224	12,94	113 €	4,4

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