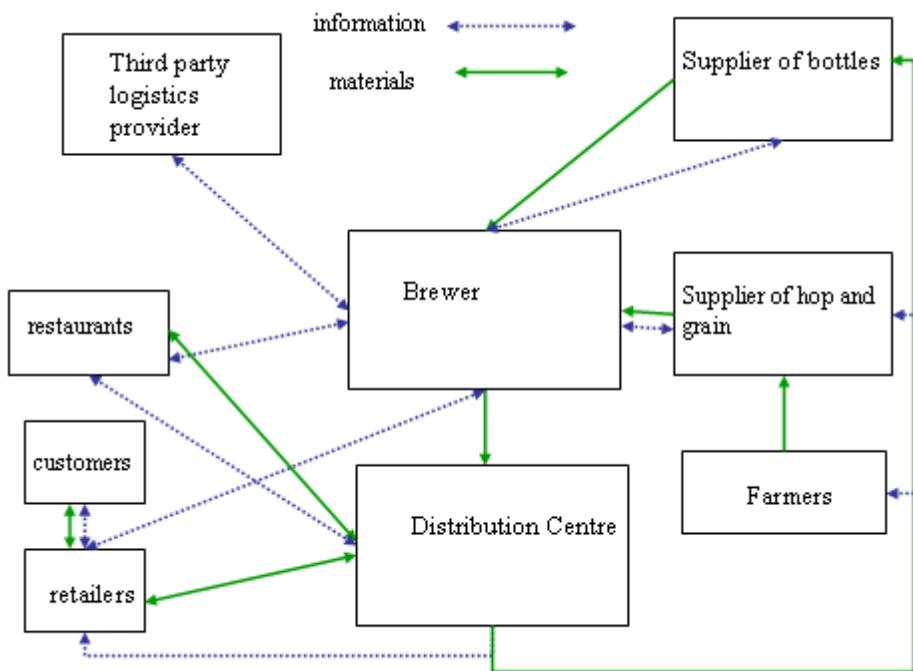


Answers
Exam Supply Chain Network Design (EBM040A05)
October 29, 2013

Questions 1,2,3,4,5: 75 credits

Exercise 1A

Draw a figure to describe this supply chain of organic beer. Indicate clearly all flows of materials and all flows of information. (5 credits)



Exercise 1B

It seems that you have insufficient information to start your design project.

a. Specify what information you need at least from the management of the beer brewer, potential suppliers and, potential 3PLs? Give a bullet list with questions and clearly indicate whom to ask for more information. (3 credits)

beer brewer

- demand The Netherlands; data production process; costs; factory opening hours

3PL

- costs; capacity trucks, number of trucks; warehouse locations; dedicated/non-dedicated; costs for value added operations

Suppliers

- lead times; capacity

And much more to think of.....

- b. What are 3 main performance measures you can use in your analyses and why? (2 credits)**

lead times to consumers (efficient and effective to supply at the right time)
 costs (for production as well as distribution)
 quality (organic components)

Exercise 1C

The table below gives the Dutch demand for bottles of beer in the past 6 years.

Year	Demand
1	34,000
2	31,000
3	27,000
4	24,000
5	36,000
6	?

- a. What is the forecasted demand for year 6 when using exponential smoothing with a smoothing constant of 0.6? Assume that the original forecast for year 4 was 29,000 bottles of beer. (5 credits)**

$$F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1});$$

$$F_5 = F_4 + 0.6(A_4 - F_4) = 29 + 0.6(24,000 - 29,000) = 26,000$$

$$F_6 = F_5 + 0.6(A_5 - F_5) = 26 + 0.6(36,000 - 26,000) = 32,000;$$

- b. Explain how you could translate this forecast for the Dutch market to a forecast for the demand in Belgium and Luxemburg. (2 credits)**

households, age groups, size of population, # retailers and restaurants

Exercise 1D

One of your colleagues performed extensive data analyses on the data provided by the beer brewer concerning the production process in the current factory.

Part of the production system consists of three stages. A product arrives at the production system every 4.9 minutes to be processed. Each product must visit all three stages. Products first go to process 1 which consists of 3 employees working in parallel. An employee can process a product in 9.3 minutes. Next, the product goes to process 2, where 2 parallel operating machines are available. A machine at process 2 needs 7.8 minutes per product. Finally, the product goes to a checking station. The checking station is manned by one person (a different person than the employees at process 1), who needs 5.6 minutes per product for a quality check.

a. **What is the departure rate of this system? (3 credits)**

calculate design capacities per process

Arrivals: $60/4.9 = 12.24$ products/hour

process 1: $3 * 60/9.3 = 19.35$ products/hour

process 2: $2 * 60/7.8 = 15.38$ products/hour

process 3: $60/5.6 = 10.71$ products/hour

Design capacity of process 3 is lowest and therefore departure rate equals design capacity of process 3

b. **In another part of the process a labeling machine is used. Why is it better to use a continuous empirical distribution than a discrete empirical distribution to represent the processing times of this machine? (2 credits)**

all values are valid

c. Suppose that the processing time is always higher than 5 minutes, and that the average processing time is 7 minutes. Assume that all possible values are equally likely to be selected. Give the distribution, which is suitable for this model (including parameters). Show your calculations. (3 credits).

Uniform(5,9) minutes

Exercise 2 Supply Chain Modelling (15 credits)

x_{1A} : amount shipped from factory 1 to warehouse A

x_{1B} : amount shipped from factory 1 to warehouse B

x_{1C} : amount shipped from factory 1 to warehouse C

x_{1D} : amount shipped from factory 1 to warehouse D

x_{2A} : amount shipped from factory 2 to warehouse A

x_{2B} : amount shipped from factory 2 to warehouse B

x_{2C} : amount shipped from factory 2 to warehouse C

x_{2D} : amount shipped from factory 2 to warehouse D

all variables integer, and ≥ 0

$$\text{Min } Z = 15x_{1A} + 13x_{1B} + 13x_{1C} + 10x_{1D} + 9x_{2A} + 11x_{2B} + 12x_{2C} + 16x_{2D}$$

(minimize costs)

$$\text{ST: } 1) \quad x_{1A} + x_{1B} + x_{1C} + x_{1D} \leq 500$$

(no more than maximum capacity factory 1 can be shipped)

$$2) \quad x_{2A} + x_{2B} + x_{2C} + x_{2D} \leq 900$$

(no more than maximum capacity factory 2 can be shipped)

$$A) \quad x_{1A} + x_{2A} = 300 \text{ (demand of warehouse A needs to be met)}$$

$$B) \quad x_{1B} + x_{2B} = 200 \text{ (demand of warehouse B needs to be met)}$$

$$C) \quad x_{1C} + x_{2C} = 400 \text{ (demand of warehouse C needs to be met)}$$

$$D) \quad x_{1D} + x_{2D} = 200 \text{ (demand of warehouse D needs to be met)}$$

Dummy variables and related constraints could also have been formulated to compensate for the difference in total demand and requirements. In that case equations 1 and 2 have an equal sign.

b.

Total Cost	\$11,700
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Factory #1 will have idle time only 200 out of 500 are used.

Exercise 3 Facility location (10 credits)

question A.

Step 1: First, you need to calculate the number of trucks required. Namely, costs are calculated per truck and not per yeans

City	Coordinates (x,y)	Forecast monthly demand jeans	Number of trucks
Amsterdam	(-10,15)	5250	3
Delft	(-18,-18)	2600	2
Rotterdam	(-20,-20)	4200	3
Groningen	(30, 45)	2400	2
Zwolle	(25,40)	900	1

Step 2: Total number of trucks = 11

$$\text{Step 3: } X = (-10*3 + -18*2 + -20*3 + 30*2 + 25*1)/11 = -3.7$$

$$Y = (15*3 + -18*2 + -20*3 + 45*2 + 40*1)/11 = 7.2$$

question B.

sending 1 truck to Delft, sending 2 trucks to Rotterdam and sending 1 truck to both Delft and Rotterdam;

sending 1 truck to Groningen and sending 1 truck to both Groningen and Zwolle

Number of trucks can be decreased with 2.

Instead of 11 trucks we need 9 trucks. The weighted distance also will decrease due to the fact that less trucks visit the stores. Most demand is in the western part of the country, % decrease of trucks is larger in northern part of country than in western part. As a result, only a small shift in the centre of gravity is expected.

Exercise 4 Distribution strategies (10 credits)

Earnings per day = $(0.08*50*500)/365 = \text{€}5.48$.

To wait 5 days: $5*5.48 = \text{€}27.40$ in foregone earnings.

To wait 7 days: $\text{€}38.36$ in foregone earnings.

To wait 10 days: $\text{€}4.80$ in foregone earnings

To wait 14 days: $\text{€}6.72$ in foregone earnings.

Overnight shipment (delivery tomorrow, 5 day wait for payment): $\text{€}100$ expense + $\text{€}27.40$ forgone earnings = $\text{€}127.40$ total relevant costs for Fencepost.

Delivery day after tomorrow shipment (7 day wait for payment): $\text{€}80 + \text{€}38.36 = \text{€}123.36$

Three day delivery (10 day wait for payment): $\text{€}80 + \text{€}4.80 = \text{€}84.80$

Five day shipment (14 day wait for payment): $\text{€}75 + \text{€}6.72 = \text{€}81.72$

Exercise 5 Transportation networks and Vehicle Routing (15 credits)

a.

node 1: route = {1,2,4,5,7,6,8,3,1} with length of 37.9

node 4: route = {4,5,7,6,8,1,2,3,4} with length of 31.9

so select node 4

b.

costs = 100 + 3.30*# km up to 5 + 2 (if arc distance > 5)

From node <i>i</i> /To node <i>j</i>	1	2	3	4	5	6	7	8
1	-	=100+2.2*3.3 = 107.26	118.5	113.2	116.5	118.5	111.88	111.88
2	107.26	-	113.53	111.88	118.5	118.5	116.5	118.5
3	118.5	113.53	-	110.56	118.5	118.5	118.5	118.5
4	113.2	111.88	110.56	-	109.9	118.5	111.88	118.5
5	116.5	118.5	118.5	109.9	-	111.88	106.6	118.5
6	118.5	118.5	118.5	118.5	111.88	-	111.88	118.5
7	111.88	116.5	119.9	111.88	106.6	111.88	-	113.2
8	111.88	118.5	118.5	118.5	118.5	118.5	113.2	-

still node 4

Exam SCND – module information systems

This part of the exam is related to the (simplified) supply chain of flowers in The Netherlands, as far as this supply chain uses auctions. These auctions belong to one company, Flora Holland, which actually has 5 locations, viz.:

- Aalsmeer (3 auction rooms, 14 clocks)
- Naaldwijk (4 auction rooms, 11 clocks)
- Rijnsburg (1 auction room, 7 clocks)
- Bleiswijk (1 auction rooms, 3 clocks)
- Eelde (1 auction rooms, 3 clocks).

Farmers who produce flowers (“growers”) are members of exactly one auction. they send their flowers in roller containers to the auction to which they belong. Each roller container, which can be moved manually, contains a batch of identical flowers. A shipment consists of a number of batches.

At the auction, each batch is sold via a clock to a customer (trader). Traders buy flowers at several auctions: they are registered as allowed traders if they rent space at the auction, where they receive and temporarily store their purchases.

The auction keeps track of agreed prices and settles the payments. Therefore, traders do not have direct contact with customers.

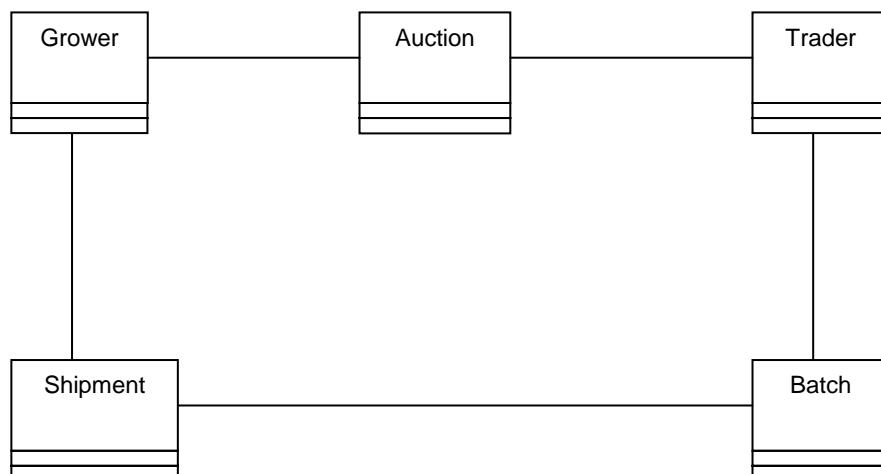
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Exercise 1 – belonging to syllabus Part I and first practical

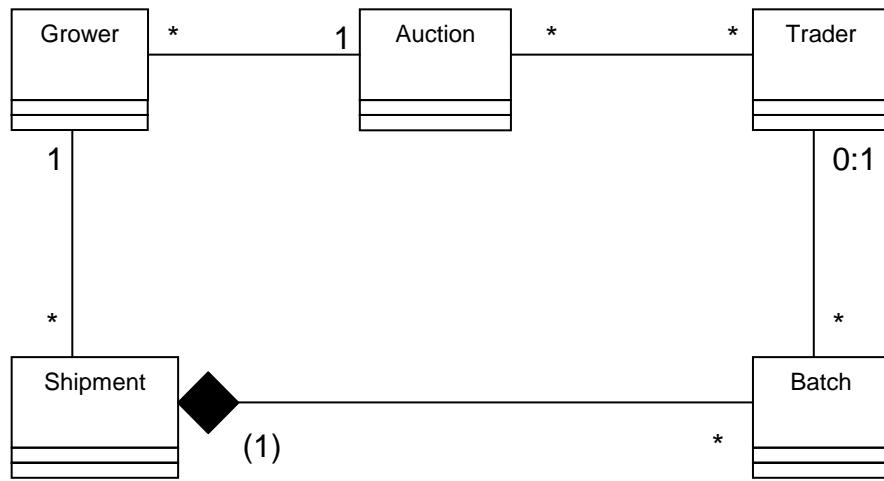
Below, you will find a part of a UML class diagram for Flora Holland.

Question 1.1 (15 minutes)

In this diagram, there are no cardinalities shown. Please add the cardinalities. Also, if you believe that it is useful to add somewhere a composition or aggregation relationship, please draw the symbol in the diagram.



Answer:



Question 1.2 (5 minutes)

Please draw below the table which corresponds to the class Auctions. You should include at least three attributes.

Name	No Clocks	No Auction Rooms
Aalsmeer	3	14
Naaldwijk	4	11
Rijnsburg	1	7
Bleiswijk	1	3
Eelde	1	3

Question 1.3 (5 minutes)

Please list attributes necessary for the class Shipments and for the class Batch.

Attributes of Shipments

Necessary:

- Shipment ID
- Grower
- Date
- Number of batches

Other possibilities:

- Transporter
- Timing (hour of arrival)

Attributes of Batch

Necessary:

- Batch ID
- Shipment ID
- Type of flowers
- Trader ID
- Agreed Price

Other possibilities:

- Roller Container ID
- Expiration date
- Auction Room
- Time of passing the clock
- Clock number

Exercise 2 – belonging to syllabus Part II

The following messages are exchanged by EDI between the auctions and their business partners:

1. From grower to auction: shipment advice, including the batches in the shipment
2. From auction to grower: notification of shipment arrival, with all batches present
3. From auction to grower: batch sold at which price
4. From auction to grower: notification of payment by auction to grower
5. From auction to trader: batch sold at which price,
6. From auction to trader: batch delivered, together with invoice
7. From trader to auction: notification of acceptance of delivery by auction
8. From trader to auction: notification of payment from trader to auction

Extension

The situation is going to be extended, and the question below refers to the extended situation. The extension is concerned with the following: Flora Holland agrees that growers connected to an auction open a trading website for e-business. This allows traders to buy batches of flowers from growers directly, before the growers have shipped their flowers to the auction. If a deal has been obtained, the website of the grower sends an EDI message to the trader, about the transaction which was closed. This message is not visible for the auction. However, the auction still has to be informed, as we will see.

In case of e-business, the physical flow of flowers still goes via the auction, but not via the clock in the auction. The reason is, that there is anyway a cross-docking function necessary, where growers can ship their flowers to and where traders can efficiently collect their purchased goods. Accordingly, the physical goodsflow hardly changes (except for the goodsflow within the auction building). Also in this situation, the auction will keep its services related to payment.

Question 2.1. (2 minutes)

Which of the above messages (numbered 1-8) will continue to be used in case of e-business?

Question 2.2. (3 minutes)

Which of the above messages (1-8) will no longer be used? What new messages will be needed in which the auction is involved?

Not needed:

3, 5

NB: many students stated that messages related to finance were no longer necessary, but this is clearly wrong in the light of the last sentence above question 2.1 ("Also in this situation, the auction will keep its services related to payment. ")

New messages in which the auction is involved:

- From grower to auction: which batch sold to which trader for which price
- From trader to auction: which batch sold from which grower for which price

Question 2.3. (10 minutes)

Is there in the new situation a need for a change in business processes? Please describe such a change if you deem this necessary

Yes, several business processes change:

- When shipments arrive at the auction, batches which are sold should be treated differently as compared with unsold batches
- In case of e-business trade, the auction does not have a proof from the trader that the deal has been closed. Therefore, such a message is needed (see above under new messages)
- When both the two new messages are not consistent, the auction needs to start a new process for reconciliation.