Full Time MSc in Logistics/Procurement and Supply Chain Management 2022/23

SIMULATION ELECTIVE ASSIGNMENT

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ZoomSheep Gifts – A Case Study

Background

ZoomSheep are an online printing and personalized gifts manufacturer. The company was born in 1999 out of two separate projects, one based in the UK and the second in France, the companies formally merged in 2006. Business for ZoomSheep has gone from strength to strength and the group now counts around 700 employees across four countries with one million customers across Europe, Australia, Canada and New Zealand. With 200 million photographs shipped a year plus a wide range of personalised gifts this is a substantial make to order business.

Figure 1: A selection of ZoomSheep T-shirt Products

The company has three facilities in France, Guernsey and London. This case study will focus on the personalised gifts operation in the London facility. The London facility produces about 1000 products divided into three main categories:

- Prints – including photos and posters.
- Bluemoon – which includes cards and calendars.
- Personalised Gifts – representing a large range of products, including: mugs, canvas framings, t-shirts, phone cases and tablet cases.

Each product can be personalised with a picture and a specific design. Products are then shipped from the facility to customers all over the world though local postal services. The UK facility sells to end customers through its website and to other businesses through its marketing department.

Customers place orders through the company website. During the ordering process the customer can choose between a number of different options for each basic product (e.g. t-shirts in different colours and sizes). They then have the opportunity to personalise the product with a personal picture. This means that the production process can only begin once the order has been placed. ZoomSheep stock standard components which are customised to customer requirements at the last moment.

In order to meet demand and guarantee high service levels the company holds stock at two locations, in a warehouse located next to the production plant and in multiple dedicated areas next to the production lines. These areas act as a buffer in order to directly feed the production process. Each component has an allocated area in the production facility. Currently lineside components are replenished regularly throughout the day by a dedicated team that operates between the warehouse and the production area. The whole process is managed manually and has proven successful for a long time. However, the growth of the company has made it necessary to expand the production operation into the area which currently houses the warehouse. The main warehouse will be moved to a separate building some distance from the factory. This will make replenishment more complex due to the physical distance. An efficient mechanism to control and coordinate replenishment will be required.

Since inventories in production play a vital role in helping to meet customer demand and maintain high service levels it is imperative that stock levels are maintained at an appropriate level. However, keeping inventory has both a space and a cost implication and a balance between these two factors is required. The company needs to determine suitable levels of inventory which will allow them to maintain appropriate customer service levels and to investigate suitable replenishment policies.

The study

Your task is to make a proposal for how ZoomSheep should stock and replenish their lineside inventory going forward. You will carry out a pilot study on an important product group – T-shirts (such as those shown if Figure 1). This study will use Monte Carlo simulation to investigate:

- How much stock to carry
- How to manage and control stock replenishment

Analysis of current operations shows that the production information system releases customer orders to production operators who then translate the demand for finished products into demand for standard components manually according to the quantities indicated in the BOM as described in figure 2:

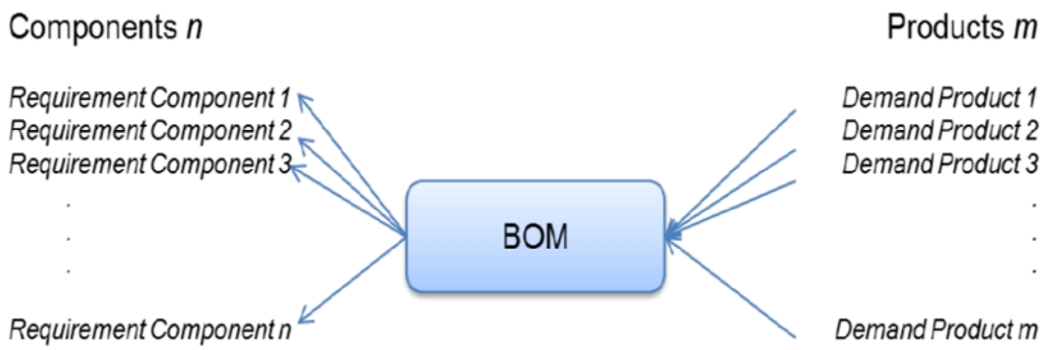

Figure 2: Assemble-to-order system with n components and m products.

You will simulate the operation of this system. In order to help you do this you have been provided with an Excel deterministic base case model, this is given in the "ZoomSheep deterministic model.xlsx" on the "Simulation" worksheet. The deterministic model is based on the following logic:

- For each product, *k*, where *k = (1,m)* the system simulates customer demand by picking random values from a defined probability distribution.
- The demand for the product k is translated into component requirements according to the quantities specified in the BOM.
- For each iteration the model simulates demand for the k products and then calculates the total requirements for *i*, *i = (1,n)* components.

The output of the model is the the daily total requirement for each component. You will need to use this to determine the stock level and replenishment proposal.

Demand

The t-shirt group contains 78 products across a range of types (men, women, and children), colours and sizes. Demand for the t-shirt product group has already been analysed and the products classified into 5 groups based on their demand, these are given in Table 1.

Demand group	Meaning	Approximate average daily demand	Number of products
A	Fast moving	7	2
B	Medium moving – 1	4	5
C	Medium moving – 2	3	12
D	Slow moving - 1	1	43
E	Slow moving - 2	0	16

Table 1: T-shirt Demand Classification

The deterministic model presents each end product, with its average daily demand and demand classification along with the associated bill of material. Each product has the following components:

- A plain uncustomised t-shirt
- Ink for customisation
- A size label
- An envelope for delivery
- A packaging label

The output of the deterministic model is then the gross requirement for standard components on an average day.

In order to take account of the probabilistic nature of demand the deterministic model needs to be converted into a Monte Carlo simulation. Data has been collected for the products in groups A & B, this is given in the "data" sheet of the Excel model file. You can use this data to determine an appropriate distribution to model the demand for these products. For groups C, D and E the following assumptions can be made, based on a previous analysis of the data:

Group C products should be modelled using an Exponential distribution with $\beta = 3$
Group D products should be modelled using a Poisson distribution with $\lambda = 1$
Group E products should be modelled using a Poisson distribution with $\lambda = 0.5$

Replenishment information:

Once you have run the Monte Carlo simulation you will need to use the output to recommend stock levels and a replenishment strategy. The following replenishment information will help you to do this:

- A box of t-shirts contains 12 t-shirts or t-shirts can be replenished individually
- A box of labels contains 50 labels – labels can only be replenished in full boxes
- A carton of shipping envelopes contains 25 envelopes – shipping envelopes can only be replenished in full cartons.
- A roll of shipping labels contains 100 labels – labels can only be replenished in full rolls.
- A drum of printing ink contains 1 litre – printing ink can only be replenished in full drums.
- ZoomSheep would like to maintain 90% component availability.

It is envisaged that a replenishment order made on one day will be available lineside at the beginning of the following day. In shift replenishment will no longer be available.

Your task

- Using the information provided, convert the deterministic model to a Monte Carlo simulation using @Risk.
- Run the model for an appropriate number of iterations – remember to consider the accuracy and validity of your results.
- Collect a set of relevant model outputs and carry out a comparative analysis of your results.

Your overall aim is to make the following recommendations:

- How much stock of each component (or group of components if appropriate) should be kept at lineside?
- How should replenishment of the lineside stock be managed and replenished going forward in the context that immediate replenishment from the warehouse is no longer possible (i.e. how often should stock be replenished and how big should each replenishment be?)?

Prepare a short report (maximum 1200 words) describing your approach, presenting your results (figures, tables, etc.) and analysing your findings.

You are also required to submit **one Excel workbook** containing your working model/s and tabulated results. Marks will be awarded based on the model efficiency and ease of use of your simulation (i.e. the model must be user-friendly, easy to understand and simple to run – you should consider that the model you are building is a decision support tool that could be used by ZoomSheep staff to plan lineside stockholding and replenishment going forward).

Marks will be awarded according to the following mark scheme:

1. Description of the method used and logic
    a. Description of model set-up (5 marks)
    b. Justification of your simulation approach (5 marks)
    c. Justification for number of runs and level of accuracy used (5 marks)
    d. Summary of your Conceptual model accompanied by a Conceptual Model Flow chart (5 marks)
2. Analysis of simulation results
    a. Monte Carlo simulation output (5 marks)
    b. Appropriate presentation and analysis of simulation results (including use of charts) (20 marks)
    c. Discussion of the results including recommendations for stock levels and replenishment policy for each component or group of components (15 marks)
3. Simulation Model
    a. Model design (15)
    b. Ease of use and efficiency (15)
    c. Instructions (10)

Acknowledgment: This case was developed based in large part on the MSc thesis of Valentina Passariello (2014)