BWI
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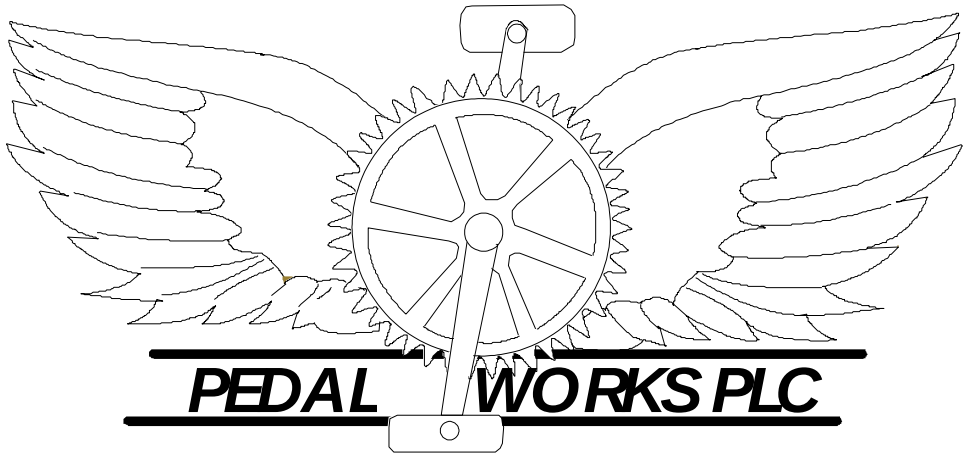
Demand Forecasting

Chapter 9 Case Study



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LOS II
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1. Introduction

General explanation of the issue

Successfully running a business always requires assumptions to be made about future developments. On a strategic level, for example, business trends, buying behaviour and competition behaviour must all be predicted. By doing this it is possible to derive certain goals for the business, taking general business goals into account, that will form the foundation for strategic business planning (planning horizon of 2 – 5 years).

At the operational level, these specifications are converted into the planning of concrete goals and actions. On this level, assumptions must be made about the market development of old and new products, capacity efficiency, etc. The aim of this planning should be to answer the following question:

What must be ready at what time and to what extent in order to optimally satisfy customers' wishes?

It is possible here to distinguish between long term and medium term planning. Long term planning is generally carried out on the level of product families over a long time horizon (1 – 2 years). This planning also serves as a foundation for the readying of the necessary capacity. Medium term planning determines what the concrete demand will be during the next few months. This demand must be calculated using forecasting methods "...when procurement time to cover demand is greater than time for delivery, i.e. the time allowed by the customer between ordering and delivery/purchase" (SCHÖNSLEBEN 2004). If reprocurement time is less than time for delivery, demand can be calculated from customer orders.

The level at which forecasting takes place (finished product, components or raw materials) is mainly dependent on the production environment. In a company producing for stock (Make to Stock) the finished products are forecast, and in a company producing to customer order (Make to Order) the necessary raw materials, bought-in parts and production capacities must be forecast. A third variant is a production environment in which products are principially assembled the same way but the products are only fitted after the customer has made the order (Assemble to Order). In this case, frequently used components are forecast.

In this case study we will look more closely at the application of various forecasting methods.

Object of the case study

The aims of the case study can be stated as the following 3 points:

- An overview of the various forecasting methods and their strengths and weaknesses.
- Recognition of the applicability of individual methods to different boundary conditions and courses of demand.
- Recognition of how important it is to differentiate between the results of a model and a reality generally deviating from these results.

Case study timetable

① Formation of groups with a maximum of 4 members. Sign-up lists for division into groups are given during the lecture.

② Students work on the case study as homework. Consultation periods to answer any questions will take place by arrangement.

③ Work on Exercise 4.6 will be done in the WebCT interactive learning environment. In the first lecture on 19.02.2014 you will receive a guide on how to set up the appropriate access yourself.

④ Preliminary discussion with the previously designated presentation groups and discussion group will take place on 07.04.2014 in WEV. Exact time will be communicated. These groups need to hand in their case study on this date.

⑤ Hand in the case study before the start of the lecture on 08.04.2014 for the rest of the groups

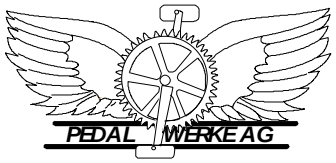
⑥ Presentation of the results in the lecture on 08.04.2014 by the presentation groups (**15 mins each**); discussion of the results particularly by the discussion group.

If you have any questions about this case study, please contact: Aldo Duchi (aduchi@ethz.ch) or Matthias Baldinger (mbaldinger@ethz.ch).

Position in the context of the lecture

- For this case study it will be assumed that you have read and understood Chapter 9 of the book “Integral Logistics Management”.

2. Starting situation



After finishing your degree you have obtained a position in the production planning department of Pedalworks PLC, a renowned manufacturer of bicycles. At Pedalworks PLC, standard products are produced to stock, as the customers (bicycle retailers) make large orders for these bicycles at irregular intervals.

Your department often has trouble with other parts of the company, as production is not adapted to meet demand. In some periods, hardly any customer orders are received, and the storage staff complain that too much warehouse space is being filled. In other periods, the sales department complains that many orders cannot be met because stock on hand has been exhausted and setup and production for a new batch takes too long.

Your boss has now given you the task of analysing the reasons for these problems and suggesting potential solutions. You soon notice that one of the main reasons is past planning of production figures for independent demand. It currently works as follows:

Based on shipping figures for the last month, the person in charge of your department produces a plan for the next four weeks. In addition, a sales forecast is provided. This is however largely ignored, because the person in charge is convinced that sales workers generally make estimates that are far too optimistic.

You now believe that the implementation of forecasting methods and the creation of a production plan based on these figures would deliver much better results. However, first you would like to obtain an overview of the various forecasting methods and the possibilities for their implementation. As your boss has a rather negative attitude to such methods, you then plan to convince him of your idea using an example calculation.

3. Forecasting methods

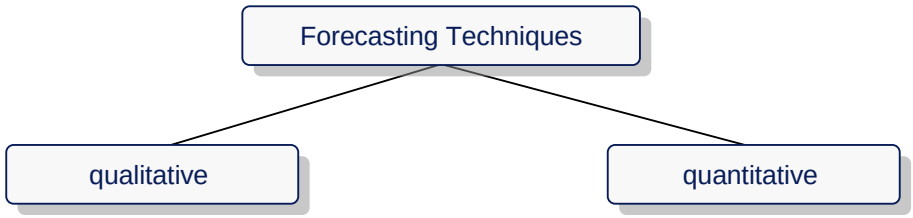
Contents

- Qualitative methods
- Quantitative methods
- Estimation of forecast error
- Implementing the methods

Qualitative and quantitative methods

A different division of forecast methods to that suggested by Prof. Schönsleben in the book “Integral Logistics Management” (fig. 9.1.2.1) is the division into qualitative and quantitative methods.

3.1. Give examples of each of the following methods:



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Estimation of forecast error

It can generally be said of any prognosis that it will most likely be wrong. Discrepancies between the forecast and the actual values are very difficult to avoid. However, there are differing reasons for these discrepancies. It may be possible to take corrective measures (e.g. when a change in the course of demand took place or false data were used), but in other cases we must accept these discrepancies (statistical discrepancies).

3.2. How can statistical discrepancies be determined?

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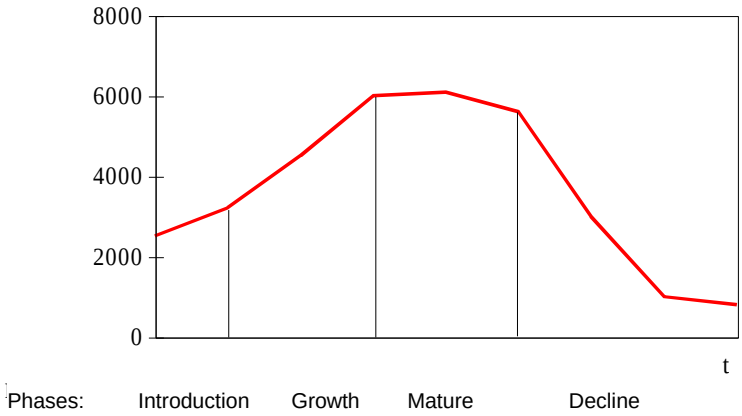
Implementing the methods

It is also possible to use prognostic methods to determine which stage of the product life cycle the product is currently in!



3.3. Which methods are suitable for each phase?

Phases:	**Methods:**
Introduction	.....
	.....
Growth	.....
	.....
Mature	.....
	.....
Decline	.....
	.....

3.4. What additional external factors influence the course of demand and should be included in the forecast?

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3.5. Can you think of applications for forecasting methods in daily life?

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4. Example: Pedalworks PLC

Making a forecast

- Define goals
- Provide and prepare time series and characteristic forecast quantities
- Select techniques
- Carry out forecast
- Check forecast

When **defining goals** it must first be determined **what** is being forecast and **why** the forecast is being made. This includes determining planning levels (strategic, operational) and the aggregation class (product families, single products, for a production line, for a whole factory etc.).

Next the necessary **time series and characteristic forecast quantities** must be **provided and prepared**. Forecast quantities include the length of periods, length of the planning horizon and the planning interval for the forecast.

In the next step, **techniques** suited to the course of demand and the data available must be **selected**.

The **forecast** is then **carried out**. This step consists of the calculation of forecast values and a qualitative evaluation of these values.

Finally, the **forecast** must be **checked**. To what degree do forecast values correspond to the values actually found? Are deviations in a particular direction visible? Must the forecast be adapted or changed?

Process for Pedalworks PLC

- graphical course
- moving average and exp. smoothing, determine n and α
- calculate forecast error
- determine characteristic forecast quantities
- suggest methods for other courses of demand

You would now like to find suitable forecasting methods for various products and courses of demand. In your company a powerful computer system is available and the sales department have been keeping statistics on the number of orders per product and period for about the last three years. This gives you the idea that the implementation of quantitative forecasting methods could be a successful approach.

You therefore obtain figures for the demand for replacement parts since the year 2004 for the product “Bicycle Fork GA-M-536” from the sales department (see Table 1). This is a fork used in various bicycle models.

4.1. To get a first impression of the course of demand, the values should be illustrated using a graph. State the formulae for the calculation of forecast values in words.

moving average: ….....

.....

1st order exponential smoothing:.....

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4.2. Your predecessor has already calculated the forecast values for the previous year using a spreadsheet program. To do this he chose to use the moving average method and 1st order exponential smoothing. Unfortunately he forgot to tell you what values were used for α and n. Using the data you have, calculate the smoothing factor used, α, and the number of periods included, n.

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4.3. For what value of α for given n from Exercise 4.2 would both forecasting methods produce comparable results? Compare them using the interactive learning environment (Derivation and Justification).

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4.4. Since your predecessor left at the end of July, the values for August, September and October have been left uncalculated for a long time. Your task is therefore now to fill in the values for this period retrospectively (these can best be calculated using Excel Table 1!)

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4.5. Now calculate the required forecast values for the next months and enter the forecast error (σ, MAD) for November 2005 ($MAD_{October}$ (November)). Take the $MAD_{January}$ (February) = 30, as your starting value, and make the appropriate justified assumptions if necessary. (These can best be calculated in Excel!)) What values would you provide for December and January (target figures)?

	November	December	January
moving average	.....	.....	.....
forecast error σ	.....		
1st order exponential smoothing	.....	.....	.....
forecast error (MAD)	.....		

4.6. Check your values in the interactive learning environment! For this purpose you will find the program “Demand Forecast” among the materials for case study 9. Compare forecast curves with different parameter values for α or n. What do you notice? Are the parameters optimally set for this case example? What method and parameter settings would you suggest?

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4.7. In the calculations made so far, the values used for the length of the statistical period, the length of the planning horizon and the planning interval have already been given implicitly. State each value and describe in words what these values mean.

Length of statistical period.....

.....

Length of planning horizon…….....

.....

Planning interval .....

.....

In order to be able to suggest suitable forecast methods for other courses of demand, print out three more courses of demand (see following graph).

4.8. What forecast methods would you suggest for:

“Three-tone horn” demand course:…….

“Hose” demand course:…….

“Tyre” demand course:……

Appendix

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2004 demand: N_t	129	138	190	216	155	155	112	86	112	224	250	207	1974
2005 demand: N_t	164	147	155	224	216	190	121	103	129	207			1656
2005 forecast: $P_{t-1}(t)$ 1st order exp. smooth. Start value: P_{Dec} (Jan) = 210	210	196	181	173	188	196	194						
2005 forecast: $P_{t-1}(t)$ Moving Average	227	207	173	155	175	198	210						

: Enter forecast retrospectively : Calculate forecast

: Target figures

Table 1: **Course of demand and currently available forecast values for the bicycle fork** (Note on notation: $P_{t-1}(t)$ is the forecast value for the period t, determined at the end of period t-1)

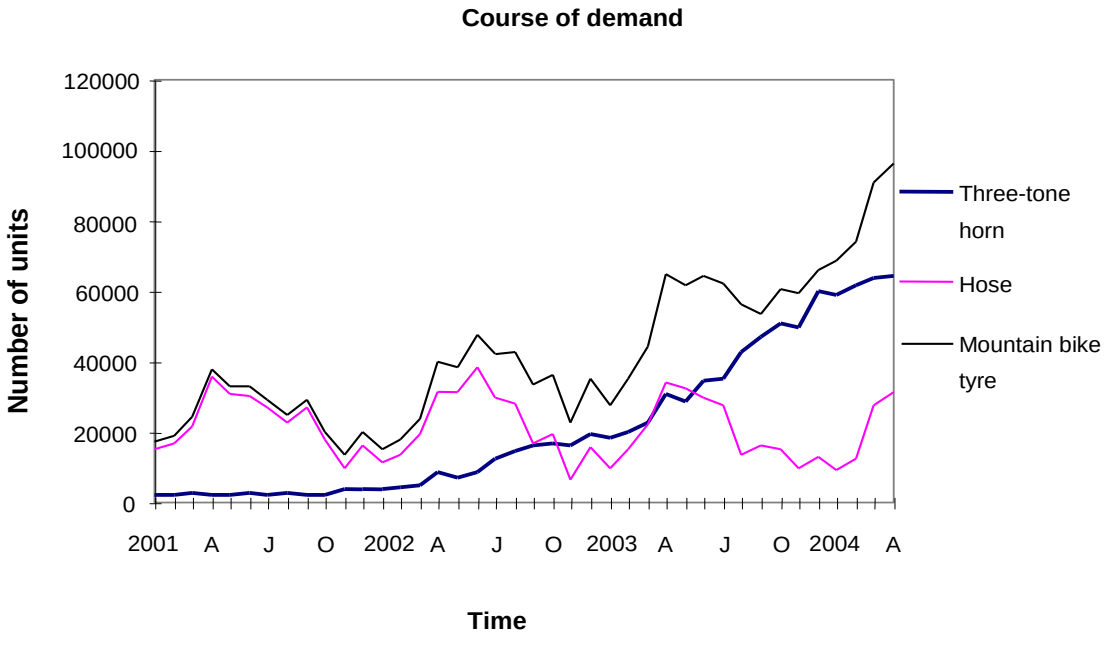

Figure 1: Course of demand for three more bicycle components