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Integration of demand forecasts in ABC-XYZ analysis: practical investigation at an industrial company

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## REFLECTIVE PRACTICE

# Integration of demand forecasts in ABC-XYZ analysis: practical investigation at an industrial company

Integration of  
demand  
forecasts

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### Abstract

**Purpose** – Item classification based on ABC-XYZ analysis is of high importance for strategic supply and inventory control. It is common to perform the analysis with past consumption data. In this context, the purpose of this study is to test the hypothesis that an integration of demand forecasts can improve the performance of item classification, in particular the performance of ABC-XYZ analysis.

**Design/methodology/approach** – For the study, real data of an industrial enterprise in the mechanical engineering sector (focal company) were analyzed and evaluated.

**Findings** – The study shows that a comprehensive data analysis of the focal company can recommend a specific implementation of the ABC-XYZ classification. In contrast to the classic method of making the ABC-XYZ analysis based on consumption data only, the approach developed in this paper offers considerable advantages. These are quantifiable in respect to an assumed optimal reference classification.

**Originality/value** – The evaluation of the results is very promising and applicable to other branches besides mechanical engineering.

**Keywords** ABC-XYZ analysis, Purchasing, Inventory control, Demand forecasting, Item classification, Mathematical analysis

**Paper type** Case study

### Processes of classification

The classification of items is very important to manufacturing logistics of industrial enterprises. It supports the stock management and helps to realize potentials. Additionally, a classification of items can assist determining the material planning strategy of the different items (Bruckner and von Wrede, 1998). There are many different possibilities to classify items, which can be applied depending on the objective. Main techniques include the ABC analysis (ranking the items according to the annual turnover) and the XYZ analysis (analysis of the usage regularity) as well as further alternatives, which can be found in (Bruckner and von Wrede, 1998; Wiendahl and Nyhuis, 2002). The characteristic which is used to classify the items with the ABC



analysis is the periodic turnover. It is determined as the product of: the cost of a unit and its consumption rate within a certain period. If characterizing the items by classes A, B and C the ideal Pareto principle can be found with comparably few, however valuable A-items and numerous but inexpensive C-items (Jung, 2006).

The XYZ analysis distinguishes between items according to their fluctuations in consumption. Classes become summarized as follows (Errasti *et al.*, 2010; Wassermann, 2001):

- X: some extent constant consumption, fluctuations are rather rate.
- Y: stronger fluctuations in consumption, usually for trend-moderate or seasonal reasons.
- Z: completely irregular consumption.

For the XYZ analysis the feature characteristic of statistic measurement is the coefficient of variation (Hoppe, 2005; Schönsleben, 2007), which is the ratio of the standard deviation of item consumption over a certain period and the average consumption. Due to it is broad application spectrum the ABC analysis is regularly applied as the primary analysis and supported by the XYZ analysis (Hoppe, 2005; Schönsleben, 2007; Reese and Geisel, 1997; Reiner and Trcka, 2004). Hence the classification matrix (AX, BX, CX, AY, BY, CY, AZ, BZ, CZ) evolves.

One of the advantages of these analyses is the integration of items with similar characteristics to process them with the same material planning parameters. Since the demand of an item over the past cycles is crucial for its classification it is important to perform the item classification with consistently defined standards in periodic intervals to include possible changes promptly. Gudehus (2006) advises to perform the classification monthly, quarterly or at least yearly, depending on the industrial branch.

### **Procedure of the ABC-XYZ analysis based on data of an industrial company**

This study determines if the consideration of the future sales volume through a demand forecast improves the quality of the ABC-XYZ analysis. Future trends can have a direct impact on the classification and the classification can be improved by considering them, instead of only influencing the classification retrospectively. For our study, real data of an industrial enterprise in the mechanical engineering sector (focal company) is analyzed and evaluated. Factual item consumption data and demand forecasts from the previous years are considered. After reassessing the total amount of items due to discontinued parts and new additions, a total of 15,000 actively dispatched items is available.

The ABC analysis of the items is based on the turnover of the previous twelve months. The parameters of the classification were set in consultation with field experts:

- A-items: 0-80 percent of the accumulated consumption value.
- B-items: 80-95 percent of the accumulated consumption value.
- C-items: 95-100 percent of the accumulated consumption value.

For the XYZ analysis the following framework is set: the considered period of time is set to twelve months and material consumption is aggregated on a monthly basis. The

critical values of the coefficient of variation, which is an indicator for the stability of consumption, are classified as following in consultation with field experts:

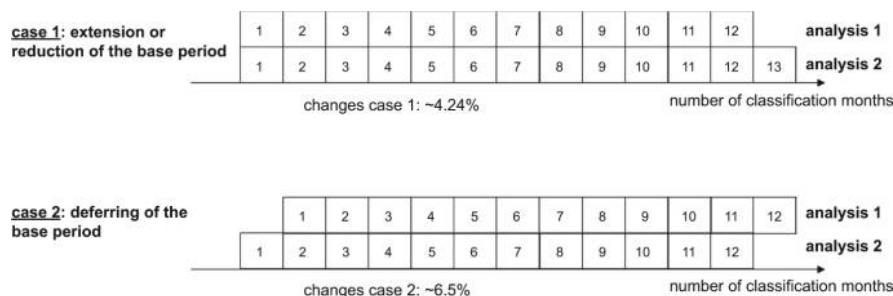
- X-items: coefficient of variation  $< 0.5$ .
- Y-items: coefficient of variation between 0.5 and 1.
- Z-items: coefficient of variation  $> 1$ .

### Improvement of the ABC analysis through forecast integration verified with practical data

Before forecast data can be implemented in the ABC analysis, the effect of the length of the base period in respect to the quality of the classification is evaluated. Therefore an ABC analysis is made in 2007 as well as in 2008 (with an interval of 12 months). The results of the analyses are compared in terms of the disposition of items in classes. The comparison shows that the items were classified identically in only 60 percent of the cases. If in the practical example the ABC-XYZ analysis was made only once a year; in the end of 2007, shortly before performing the second item classification, approximately 40 percent of all items would not be in the right category in terms of item consumption.

Since two consecutive ABC-XYZ analyses made annually have a weak correlation, it is being tested whether an adjustment of the base period by one month influences the result of the ABC-XYZ analysis. The monthly deviation of the classification is indicated in percent. It expresses the proportion of the items, which are not classified in the same category in two consecutive ABC-XYZ analyses, with the base period of the analysis differing one month. In the process two cases are distinct: on the one hand (case 1) the monthly deviation of the classification results could be caused by extension and/or reduction of the base period. In this case the addition or subtraction of a month results in a mean proportion of “class changes” of is 4.24 percent. On the other hand (case 2) the monthly variation of the ABC-XYZ analysis is determined by deferring the base period by one month. In this case the analyzed data shows a mean monthly deviation of 6.5 percent (Figure 1).

The considerable deviation makes clear that an annual ABC-XYZ analysis is not sufficient. Since the practical example indicates that adding or subtracting a month to/from the base period and/or deferring the base period by a month explicitly changes the result (4.24 percent or rather 6.5 percent), it seems appropriate to make the ABC-XYZ analysis monthly. A shorter interval is not reasonable due to the main data collection and analysis effort. And with respect to the focal company the number of customer orders will not change the results significantly within a shorter period.

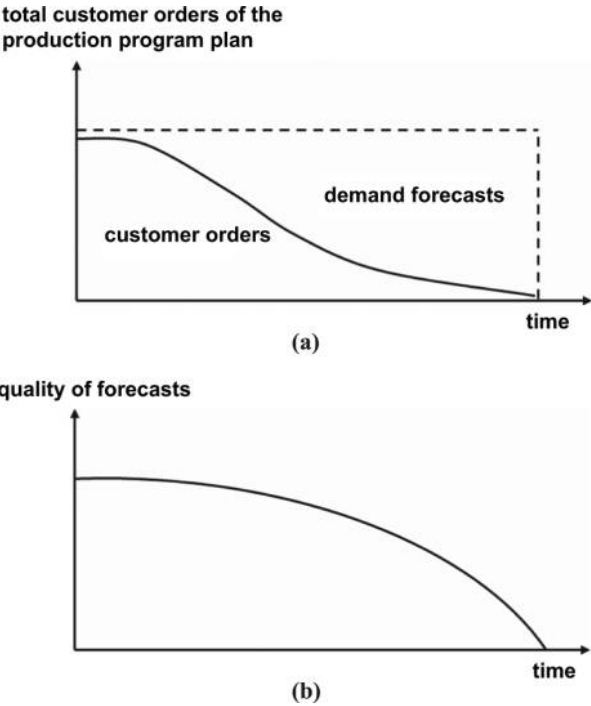


**Figure 1.**  
Monthly deviation of the  
classification results by  
extending or reducing and  
deferring the base period

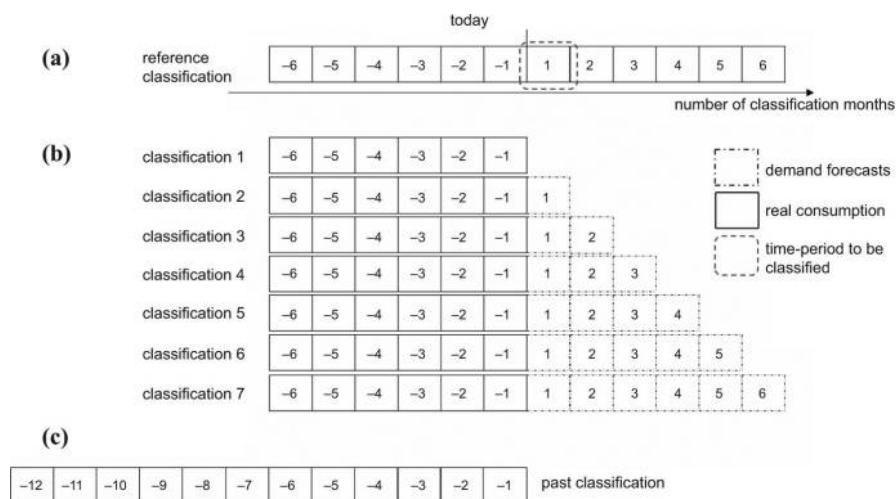
Furthermore, due to continuous changes in the item consumption it is preferable to use a classification period which includes an equal share of past months and upcoming months. This way it shall be guaranteed that both the consumption fluctuations of the past and the future trends (forecasts) are incorporated in the ABC-XYZ classification.

To realize that, demand forecasts or rather data about planed consumption rates are necessary. Starting on a reference date, these are determined and regularly updated over a specific period in respect to the production program plan. In the practical example, the demand forecasts include existing customer orders as well as statistically forecasted sales volumes of the focal company. The proportion of real customer orders decreases with the progressing planning period (Figure 2a). In the practical example this is a major reason for the decreasing quality of the forecasts, whose qualitative characteristics are presented in Figure 2b.

To analyze the deviation of the ABC-XYZ classifications based on consumption forecasts from the actually optimal reference classification (Figure 3a) an item classification based on real data is made. Afterwards the found optimal reference classification is compared to classifications, which are partially based on available forecasts. The aim is to find amount of additional forecast periods which leads to the least deviation from the optimal classification. For this purpose seven additional material classifications are made. The base periods include the six previous months (months  $-1$  to  $-6$ ) as well as an increasing number of consumption-forecast-periods (months  $+0$  to  $+6$ ) (Figure 3b).



**Figure 2.**  
A (top): splitting of  
production program plan  
into customer orders and  
demand forecasts; B  
(bottom): process of the  
quality of forecasts

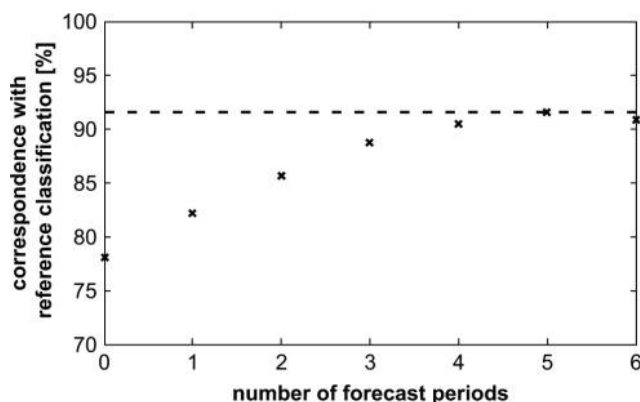


**Figure 3.**  
Comparison of the  
reference classification  
with the  
ABC-XYZ-classification  
including demand  
forecasts

Afterwards each of the seven ABC-XYZ classifications is compared to the reference classification regarding the disposition of items in the same class. The comparison shows that classification 1, whose respective time horizon only involves the previous six months, however no consumption forecasts, has a relatively low correspondence of 78 percent with the reference classification. The other classifications, which consider demand forecasts, have a higher correspondence with the reference classification, with five incorporated consumption months being the highest result (92 percent). In contrast, despite having the same number of periods as the reference classification with six consumption months and six consumption-forecast-periods, the conformance of classification 7 (Figure 3b) decreases due to the poor forecasting quality (Figure 4).

## Results

The evaluation of the data at hand shows that the material classification according to Figure 4 leads to a higher correspondence in terms of items remaining in the same class



**Figure 4.**  
Correspondence of seven  
ABC-XYZ-classifications  
considering different  
consumption-forecast-  
periods with the reference  
classification

compared to other alternatives. The decreasing correspondence in classification 7 is caused by poor forecasting quality since a demand forecast on more than six months results in a strong decrease of reliable customer orders for the focal company.

Utilizing demand forecasts for the ABC-XYZ classification proves to be advantageous in the practical example. The evaluation of consumption data and forecast data determines that a material classification based on six previous consumption months and five succeeding demand forecast months has a correspondence of 92 percent with the reference classification suggested by experts (Figure 3a). Compared to the reference classification, an ABC-XYZ classification based on the previous twelve months, which is often recommended in technical literature and in praxis, only has a correspondence of 75 percent of items remaining in the same class (Figure 3c).

### Final summary and discussion

Summing up it is evident, that a comprehensive data analysis of the focal company can recommend a specific implementation of the ABC-XYZ classification. On the one hand it makes sense to repeat the ABC-XYZ analysis on a monthly basis due to the high dynamics in terms of consumption consistency of items. On the other hand the consideration of consumption forecasts proves to be beneficial since future trends have a greater influence on the classification quality than forecasting errors. In contrast to the classic method of making the ABC-XYZ analysis based on consumption data only, the developed approach in this paper offers considerable advantages. These are quantifiable in respect to an assumed optimal reference classification, with the classic approach having a correspondence of 75 percent and the developed approach reaching a correspondence of 92 percent.

The evaluation of the results is very promising and applicable to other branches besides mechanical engineering. For that purpose a preliminary screening of the item consumption dynamics is highly important to determine the adequate time intervals between item classification. In addition, the forecasting quality has to be analyzed to choose the quantity of subsequent months suitable for integration in the classification. Afterwards the accuracy of the item classification should be considerably improvable.

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