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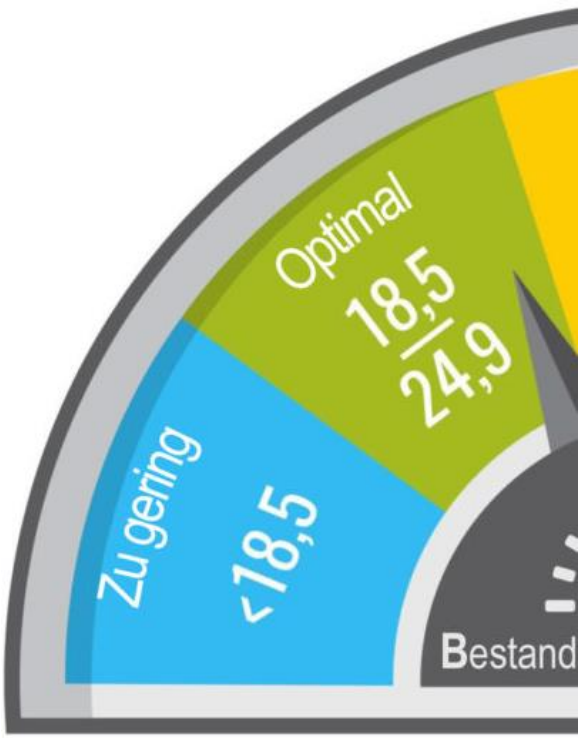
A guide to action.



Inventory Reduction with secured Service Levels

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A QUANTUM LEAP AHEAD

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Systematic inventory reduction with secured service levels - A guide to action

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Economic parameters suggest that the economy will struggle more in the coming months. So it may be time to take a look at the inventories again. These not only tie up a lot of capital that might be urgently needed elsewhere in the company in worse times, but also cause high running costs.

Whether production or trading companies, we are all faced with the dilemma of keeping at least some of our goods, production items or raw materials in stock in order to be able to supply customers or our own production or assembly with materials at short notice. On the one hand, you have to be able to deliver and on the other hand, you have to keep the stocks under control.

The solution to this dilemma of supply capability and inventory is often left to scheduling, logistics or supply chain management. However, it is a big mistake for entrepreneurs and managers not to be interested in the mechanisms of inventory management and thus not to understand the connections. Because the right positioning between supply capability and inventory is an entrepreneurial task whose execution can be delegated, but not the responsibility for it.

Those who understand the basic mechanisms and pay attention to a few sticking points can achieve the required service level with lower costs and inventories and, on the other hand, know what to invest in order to be able to deliver.

Delivery capability and inventory: not always a dilemma...

Experience and common sense say that a higher delivery capacity also requires a higher inventory. But this is only partly true. Let us therefore first take a look at the cybernetics of inventories.

An item stock is basically composed of the stock required to satisfy the so-called basic demand and the so-called safety stock. The basic requirement corresponds to the average material consumption during the replenishment period. The safety stock is intended to cushion fluctuations in demand, because in practice consumption per day is not constant.

There are four main parameters that determine how extreme the trade-off between service level and inventory is (Fig. 1):

- The fluctuation strength of the requirements on the stock-out side,
- the predictability of these needs,
- the required service level,
- the replenishment time to restock the item.

These parameters mainly affect the safety stock. Only the replenishment time also has an influence on the basic requirement. This is because it is proportional to the replenishment time: twice the replenishment time results in twice the basic requirement; halving the replenishment time results in half the basic requirement.

Under otherwise constant boundary conditions, the required inventory level increases as the service level increases. Unfortunately, it does not increase proportionally to the service level, but progressively. Especially in service level ranges beyond 93%, a small increase in the required service level can already trigger a flood of additional inventory. Beyond 98%, one must expect an explosion of inventory.

Mathematical consideration:

The higher the required service level, the more "standard deviations" of safety stock are required. The standard deviation is a measure of the variation in demand; the greater the variation, the higher the standard deviation. The standard deviation is given in the form of a number of pieces or tonnage of the item.

This sounds bad, but it does not necessarily have to be. How much stocks actually explode depends on the other influencing parameters listed above, the predictability of demand, the fluctuation of demand and the replenishment time.

Large fluctuations in demand that you cannot predict act as a propellant for your inventory explosion. Strong fluctuations in demand that you can foresee are much less critical. Logical, really, because if you know what demand is coming, you can be well prepared for it and do not need to maintain high safety stocks. Certain types of demand fluctuations can be well anticipated; seasonalities, for example. Unfortunately, a large proportion of demand fluctuations are purely chaotic. They can only be countered with correspondingly high safety stocks. At this point, experts are pinning great hopes on developments in artificial intelligence. However, the results so far are still very modest.

In addition to fluctuations in demand and the predictability of demand, the replenishment time also plays a role in the required level of safety stock. Common sense already tells us that the longer the replenishment time, the larger the safety stock must be. After all, the longer it takes to respond to growing demand, the greater the uncertainty about how demand will develop. However, the correlation between the required safety stock and the replenishment time is disproportionately low. Doubling the replenishment time does not require twice as much safety stock. Again, this is logical on closer inspection. During a longer period of time, higher requirements in one period and lower requirements during another can partly balance each other out.

It is nice that an extension of the replacement time does not have such a drastic effect on safety stocks. But beware, if you shorten the replenishment time, the game turns around. If you manage to halve the replenishment time, this does not mean that the safety stocks are also halved. In this case, they are only reduced disproportionately. The shorter the replenishment time, the smaller the possibility that higher demand in one period will be offset by lower demand in another period.

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Mathematical consideration:

Specifically, the safety stock changes according to the square root of the quotient of the two replacement times considered. If the replenishment lead time is doubled, the required safety stock increases by only approx. 140% (square root of 2). If it is possible to halve the replenishment lead time, the safety stock drops to approx. 71% (root of 0.5).

The risks of good delivery performance for profitability

Once the cybernetics of inventory are understood, it is clear where the risks of high service level (93% or higher) lie in terms of efficient stocking and management. For items with high demand volatility, high service level leads to high safety stock levels.

These not only tie up a lot of capital, but also entail a high risk that part of the stock will lose its value:

- Items may exceed their best before date,
- Articles can become technically obsolete,
- Items must be written off for accounting reasons.

A special situation can arise when you are required to keep items with a short shelf life and high fluctuation in demand highly available. You then need high safety stocks that drive up the stock ranges, if necessary even beyond the permitted storage period of the item. This can lead to the continuous destruction of stocks that have exceeded their expiry date. Beyond ecological criteria, the following applies in such cases: If you cannot pass these costs on to the sales price, you should reduce the service level!

If you take a look at your stocked product portfolio, you will probably notice that you are confronted with highly fluctuating demand for some of your items, while another, usually smaller part, shows a more even demand. With a so-called XYZ analysis, you can transparently divide your items into three classes according to the size of the demand fluctuations. X-items have low demand fluctuations and Z-items have high demand fluctuations. Y-items are in between.

Mathematical consideration:

All items with a coefficient of variation lower than 0.5 are classically considered X-items, all with a value up to 1 are Y-items and all above are Z-items.

You have probably already divided your articles into A, B and C classes. Normally, A-items generate the first 80% of turnover, B-items generate another 15% and the last 5% are generated by the C-items. You can now assign each of your stock items to an ABC and an XYZ class. This ABC/XYZ

portfolio helps you a lot in the economic design of your stocks. You can use it to balance stock levels (and costs) and turnover importance against each other.

On the one hand, you should try to reduce the service level for items with highly fluctuating demand (Z-items) in order to keep stocks at an economic level. On the other hand, items with high turnover importance (A-items) should be kept more deliverable than C-items. In the ABC/XYZ portfolio, one tries to "distribute" the service level across the nine portfolio fields in such a way that one strives for a very high service level for AX items, which decreases towards the AY field and AZ field.

Also, as the contribution of the articles to the total turnover of the company decreases, one generally reduces the service level. So a BX item also already has less service level than an AX item, but more than a CX item.

For those who want to sail higher on the technological wind:

With corresponding optimisation algorithms, this distribution of service level can be determined automatically depending on the permitted total stock. The optimisation also works the other way round:

- *Depending on a required overall service level, the inventories in the portfolio fields are balanced in such a way that the overall service level is achieved with the lowest possible overall inventory.*

As you can see, a lot can be done. However, the statistical mechanisms behind the cybernetics of inventory cannot be tricked. Unfortunately, it is not possible to achieve maximum service level with minimum inventory. High service level does not hurt with every article. For a whole series of articles, however, you have to decide between a high stock level and a high service level.

High delivery capacity is not always necessary

Sales usually demand high service level for finished goods. This leads to the fear of missing out on sales if you are not ready to deliver: If your sales department cannot deliver, customers will go to the competition. The connection between service level and loss of sales is actually only so consistent in the case of commodities that are available on every street corner. Put it to the test and ask your sales department (or yourself) what happens if an item is not available. In the B2B sector, nothing happens in extreme cases because you can simply send the missing quantity with the next delivery. In the B2C sector, a delivery takes a little longer if a component is missing. In the long run, unreliable delivery drives away customers, but if it remains a rare experience for the customer, it does not break the world. With a few basic values, it is even possible to estimate the level of an item's economic service level.

The market is what it is. What can still be done to reduce stocks?

Another look at the cybernetics of inventories shows us some further possibilities beyond the differentiation of the degree of service level in order to reduce inventories through scheduling measures.

Reduction of the replacement time

We have already mentioned that the reduction of the replenishment time has a positive effect on stocks. The stock required to cover basic needs is reduced proportionally to the replenishment time. The safety stock decreases disproportionately, but it also decreases.

In our consulting projects, we regularly experience that replenishment times are by no means as unchangeable as is often expected. It therefore makes sense to check whether the replenishment times of articles that are regularly procured or produced can be changed.

Sometimes it already helps to ask once whether a shorter delivery time would not be feasible, because the maintenance of replenishment lead times is often not as accurate as it would make sense. Suppliers, but also the company's own production, rarely complain if the customer accepts a longer replenishment lead time as a given.

The time needed for the subsequent delivery of an item, whether from the company's own production or from a supplier, is often less dependent on the actual production time than on the waiting and idle times until production or the next production step can be started. In such cases, it helps to consider what can be done to shorten waiting and idle times. Discussions can be...

- Raw material releases so that the supplier does not have to procure the required raw material when an item is ordered,
- Pre-production to an intermediate storage stage, from which many different product variants are manufactured,
- Adapt technical specifications.

Amazing effects sometimes arise when you have the leeway to discuss the required product specification with suppliers. Small changes to the technical specifications sometimes make it possible to significantly shorten the manufacturing processes and thus also the lead times.

Reduction of the mounting time

Reducing the so-called mating time is also an effective means of stock reduction. It only affects the basic stock, i.e. the stock that is required to cover the basic demand. But even in cases where the replenishment time cannot be shortened, it is still possible to turn the tying-up time. The term "procurement time" refers to the period of time for which material is expected to be available for a purchase order or a production order. An example makes the situation clear:

With a replenishment time of 10 working days and an average consumption of 50 pieces per day, the basic requirement and thus the basic stock is 500 pieces. If you replenish material every 10 days, then you order with a lot size of 500 pieces each time. In this case, the stocking time is 10 days, as is the replenishment time. You could also decide to stock up for only 5 days at a time, i.e. replenish every 5 days. In this case, you would order 250 pieces every 5 days, which would be delivered after 10 days. Before the first order is delivered, the second order is already placed.

In both cases, the average stock is half the order lot size + the safety stock. In the first case this would be 250 pieces, in the second only 125 pieces, both plus safety stock. The total stock has not been halved because the safety stock base remains the same in both cases. If this base is very high, the effect may be small. For items with a low safety stock, however, this lever has a drastic effect.

Reduction of the minimum lot size

Sometimes you do not get as far as you would like with the reduction of the stocking time because the supplier or your own production insists on a minimum lot size. Then it is no use if you only want to supply yourself with material for a short period of time, but the minimum lot size forces you to purchase quantities that cover your needs for a much longer period of time.

An inventory reduction initiative should also shake things up here and check whether the minimum lot sizes cannot also be turned. Reasons for minimum lot sizes in production are mostly set-up times. If the set-up of a plant is time-consuming and takes a long time, then production would also like to be allowed to manufacture longer for reasons of efficiency and thus deliver larger production batches. In such cases, projects to reduce set-up times can help to lower inventories in the value chain.

Steady demand

More even demand leads to lower fluctuations in demand and these automatically lead to lower safety stocks with the same service level. For this reason, it is also worthwhile to think about this lever. In the B2C sector, the possibilities are rather limited unless you find starting points to motivate the customer to wait for his order if necessary. Sometimes it can make sense and be economical to give the customer a discount for being patient. In the B2B segment, it is easier to find starting points, because fluctuations in demand for articles do not always result from corresponding fluctuations in demand on the customer side. In some cases, evenly distributed requirements are combined into large order batches. The overlapping of large order lots from different customers ultimately leads to strong fluctuations in demand for an article.

If your customers order in-stock items from you, it might make sense to reduce your own minimum order quantities to motivate customers to order smaller quantities more frequently. When added up across all customers, this can reduce the running costs for safety stock more than it increases freight costs. This is especially true if the customer orders several other parts from you, so that the number of deliveries does not necessarily have to increase, but only the number of delivery items. To illustrate a simple example: instead of delivering product A in a large batch size one week and product B the following week, product A and product B could also be delivered every week, then in halved batch sizes.

Beyond the dispositive measures mentioned above, there are also a number of organisational measures in the cooperation with suppliers that can help you to reduce inventories. Two of them should be mentioned here: Consignment stock and vendor managed inventory.

A consignment warehouse is a warehouse that is typically located in the vicinity of a customer or on the customer's premises. The decisive factor here is that the goods remain the property of the supplier until they are removed. For you as a customer, the consignment warehouse has the advantage that the stocks contained there do not go on your capital commitment. On the other hand, all other warehousing costs are generally incurred on your side. For the insurance of the stocks, for the obsolescence risk, you assume the responsibility and it is also your storage capacity, your storage technology and your storage personnel that are used.

So from a cost point of view, a consignment warehouse solution is not always advantageous for you as a customer. What about when you as a supplier are forced by your customers to maintain consignment warehouses? From a cost point of view, this can definitely be an advantage if you manage to do without further stocks of these articles for this customer on your side in the company.

What remains is the capital commitment

But this can also be adjusted in the negotiations with your customers. Strictly speaking, it is not decisive whether capital is tied up in the form of stocks or in the form of receivables from customers. A consignment warehouse with a stock range and thus a capital commitment of three months and immediate payment of the withdrawn quantities by the customer is no worse than material deliveries that are invoiced directly but paid by the customer only after a period of 90 days. Therefore, when setting up a consignment warehouse, try to negotiate short payment periods with your customer.

A Vendor Managed Inventory (VMI) concept is often understood as a further development of the consignment warehouse concept. Strictly speaking, it is a mechanism that can be operated in combination with a consignment warehouse, but also without a consignment warehouse. The basic idea of VMI is that the supplier replenishes the stocks of his articles in the customer's warehouse himself. For this purpose, a minimum stock level and a maximum stock level are usually set for each article, between which the stock of the article must range. It is up to the supplier to decide when exactly to replenish the stock; the only decisive factor is to keep the stock between the two limits.

Although a VMI mechanism means additional effort for the supplier in terms of item disposition, it can have a positive effect on stocks. This is because VMI allows you to decouple from your customers' often stochastic ordering mechanisms. We often find that suppliers do not (or cannot) manufacture items that they regularly supply to customers on a customer-order basis and therefore place them in stock in order to be able to respond to customers' orders sufficiently quickly.

In such cases, you can benefit from a VMI concept because the decoupling from the order triggering by the customer makes it possible to stabilise replenishment. This allows you not only to reduce your delivery stocks to suppliers, but also to reduce demand fluctuations possibly even in the entire supply and production chain, which can lead to lower safety stocks in the entire chain.

Finally, focus on technology!

How can effective inventory management be implemented in practice? Not the way it is still done in many companies today: by hand!

We discuss Industry 4.0 and talk about the need to increase labour productivity and the lack of staff everywhere. Yet many companies still tinker with their inventories by hand. Most companies do use an ERP system or an enterprise resource planning system, but these systems are often only used as expensive typewriters in material planning. To achieve effective inventory management, it is important to understand that people are one of the biggest inventory drivers in the company.

On the one hand, there is the scheduler who is required to keep her stocks low, but who also experiences immediate pressure when some of the items she schedules "go dry". A lack of material stocks usually leads to hectic efforts to bring in the required material as quickly as possible. Excessive stocks, on the other hand, relax the day's work and are far less likely to lead to unpleasant conversations. One cannot blame the dispatchers for preferring to "play it safe". The effect is even more pronounced if the management does not clearly support the desired inventory reduction and gives the scheduling department a free hand. In a project, a managing director once said:

"As experts, please tell us which service level levels we should set for our articles, for me it is only important that we are always ready to deliver!" Such thinking reliably leads to inventory increases. As a manager, you must be clear that non-deliverability must be endured. 98% service level, for example, explicitly means that 2% of the required quantity should specifically not be delivered on time; simply because this would be too expensive! I therefore like to make it clear to planners that I do not see their task in achieving 98% service level, but in ensuring that 2% of the requirements are not immediately available.

In the final analysis, a person cannot completely detach himself from his emotions when making planning decisions. You can only achieve strategic calm instead of operational hecticness in material planning if you rely more on the planning algorithms of your IT systems. People should only intervene in the planning system's planning proposals if they have additional information that has not been included in the planning system's planning proposal. A prerequisite for this principle of action, however, is that the item master data and the parameters of the algorithms are set correctly and that your planning system has the right algorithms. Today, there are proven mechanisms for updating article master data continuously, mostly automatically and with little effort. The only keyword here is "scheduling rules".

I would like to go into a little more detail about the challenges of forecasting and safety stock algorithms, because these are not considered in most ERP or merchandise management systems, which can have a serious negative impact on stock and service level. To understand these challenges, we need to take another short trip into statistics.

Why your ERP system leads to incorrect forecasts and safety stocks

You have probably heard of the Gaussian normal distribution. In very simplified terms, this describes the way in which measured values of recurring events are distributed symmetrically around their mean value. In nature, practically all measured values are normally distributed. If you measure the

heights of the adult population, you can determine an average height. Around this mean value, the size of individual persons fluctuates in such a way that a large proportion of persons lie closely around the mean value, while there are only a small number of extremely large and extremely small people. This normal distribution principle applies to many values in nature.

Unfortunately, this law of normal distribution only applies to a limited extent to the market demand for an item. Unfortunately, most items do not have a normally distributed demand. However, all classical forecasting methods and methods for determining safety stocks assume that demand is "normally distributed". If one applies the corresponding formulas to infer future anticipated market demand from past sales or stock withdrawals, calculation errors occur. Forecast values and safety stocks are shown either too high or too low. As a result, you either hold more stock than necessary and thus arrive at a service level that is higher than desired, or you have too little stock and thus do not achieve the required service level. As a result, you are struggling with overstocks of some items and are not able to deliver enough of others. Does this sound familiar?

You can easily check yourself whether the demand for your articles is normally distributed or not: Determine the mean value and the median for the articles from the monthly consumption quantities of the last 12 or 24 months and compare the two characteristic values per article with each other. If the mean and median are different, there is no normally distributed demand. If median and mean coincide, there may be a normally distributed demand, but not necessarily.

How to deal with the problem of missing normal distribution in forecasting and safety stock determination? For certain articles the errors are small, here the classical methods are sufficient. In the suggested recalculation, you may have noticed that for regular items (X-items) there are no large deviations between median and mean, but for Y- and Z-items there are. For X-articles, the classical methods are therefore more sufficient.

For the more irregular items, however, one should use so-called "distribution-free procedures". These procedures are especially important for the so critical safety stock determination. Unfortunately, they are not offered in the ERP systems I know, but only in selected special systems for sales forecasting. They are too complicated for the forecasting world in Excel.

Sometimes a provisional solution can help you, which is not provided by most ERP systems either, but can be managed by spreadsheet, the "forecast bias". The forecast bias describes whether a forecast regularly delivers too large or too small forecast values. If your forecast is always a little too low, you need to increase the forecast values by a correction value or decrease them the other way round. The forecast bias only helps you with the forecast values, not with the so important safety stocks.

The mechanism of simulative forecast determination goes one step further than distribution-free methods. This mechanism is also reserved for special systems. Let us therefore conclude by taking a look at such special systems.

Additional software for sales forecasting, safety stock determination and inventory management can pay off quickly

ERP systems are generalist systems. They must provide support for a wide range of tasks. It is therefore not surprising that only the larger providers have the resources to deal with special topics and provide special solutions for specific tasks. Often these solutions are also very expensive. For example, there is a wide range of special additional programmes for demand forecasting, material planning and inventory management.

In general, four groups of add-on systems can be distinguished: The first group consists of systems that are only designed for a specific ERP system. These systems usually run "in" the corresponding ERP system. They thus offer close integration, but at the expense of flexibility and solution depth.

The second group comprises low-end systems. They are inexpensive, but offer only very limited functionality. The target group for these systems are small businesses that are forced to compromise on functionality because they feel they cannot afford more expensive, more powerful systems. This group of add-on systems only makes sense for very simple ERP or merchandise management systems, as their performance hardly goes beyond what more powerful ERP systems themselves bring. However, the user interface of these add-on systems is more user-friendly than that of many ERP systems.

A third group of additional systems for material planning includes high-end systems that are often intended for large corporations in special industries and are extremely high in price.

Ultimately, there is a group of systems that are geared towards medium-sized businesses. In this group of systems, most companies find the best price/performance ratio for their problem. The scope and depth of services of the established systems in this market are high, but there are also significant differences in price and performance. The functional scope of these systems mostly also meets the requirements of large-scale industry. However, the providers are themselves medium-sized and do not have sales structures as required for corporate customers. Medium-sized user companies can communicate with these system providers on an equal footing, which is an advantage that should not be underestimated when introducing the system and providing ongoing support.

Another software programme besides the ERP system?

From my perspective, a clear recommendation based on economic considerations: Efficient supplementary systems that meet the requirements described above can already pay off from an average portfolio size of one million euros. From an inventory of 5 million, it is actually inexcusable to forego the effect of these systems, because otherwise you will continuously lose money and tie up unnecessary capital. Because every million in unnecessary inventory quickly costs you 190,000 to 300,000€ in lost earnings per year!