OUR VISION AT SOLVENTURE

Inventory Optimization as an essential part of your S&OP Process?

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SOLVENTURE

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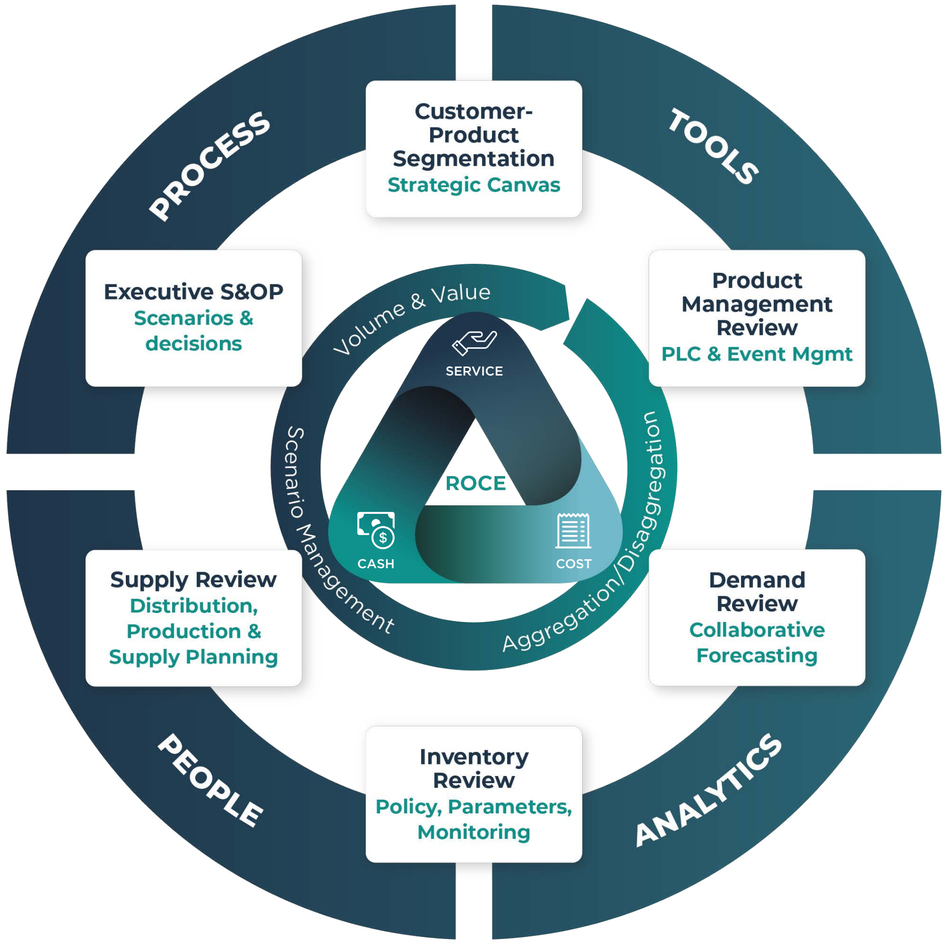
INVENTORY OPTIMIZATION AS AN ESSENTIAL PART OF YOUR S&OP

At Solventure we take pride in being experts in designing and implementing Sales and Operations Planning. Companies that have a good S&OP process can't imagine how to live without it. It is the key instrument for the CEO to navigate the business along the budget towards its strategic targets. For a summary of our vision on S&OP, we refer to our position paper "Sales and Operations Planning (S&OP)."

In this vision paper, we discuss how inventory, next to cost and service, has become a more important element of the S&OP equation. We will also provide answers on how we believe inventories can be put at a more effective use or basically how inventories can be reduced, while at the same time improving service and cost. We also refer to a separate vision paper on how we believe multi-echelon inventory optimization, as a more advanced form, is still an unexplored opportunity, for even many of the leading companies.

In the Gartner terminology, multi-echelon is a 'system of differentiation', an app which can be plugged in on a 'system of record'. In this vision paper, we describe the functionality a system of record should have.



COMPANIES ARE UNDER PRESSURE TO REDUCE INVENTORY

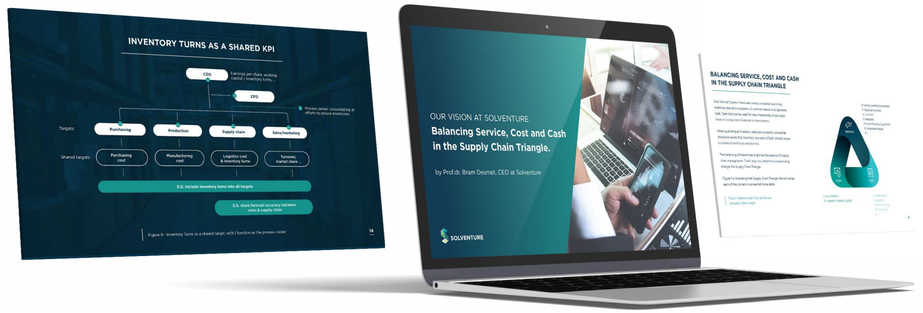
In our experience, the pressure on working capital has increased since the financial crisis. Working capital is composed of Accounts Payable, Accounts Receivable and Inventory. The Payables and Receivables are relatively easy to manage. You try to extend payment terms to suppliers, shorten those of customers, and improve discipline to collect due invoices.

Inventory is much more difficult. At the center of our S&OP framework you will find the Supply Chain Triangle. Reducing inventory is a balance between service, cost and inventory. I've heard CEO's telling their board "I can easily halve the inventory … but we'll be out of business in 2 years". A blind cut in inventories will have a negative impact on service towards the customer, and service is a driver for top-line.

The resulting service issues will also increase operational costs because of firefighting. We will break the optimal sequence in production and we will expedite orders trying to fight the service issues. We describe the delicate balancing act and how companies struggle with it in more detail in our vision paper "Balancing Service Cost and Cash in the Supply Chain Triangle".

The trick of 'escaping' the pressure in the triangle is to find ways to improve on all 3 dimensions at the same time: reduce inventory, while at the same time improving service and cost. Improved forecasting and improved supply planning are typical examples. In this vision paper we will show how inventory optimization is a third one in its own right.

White Paper: Balancing Service, Cost & Cash in the Supply Chain Triangle



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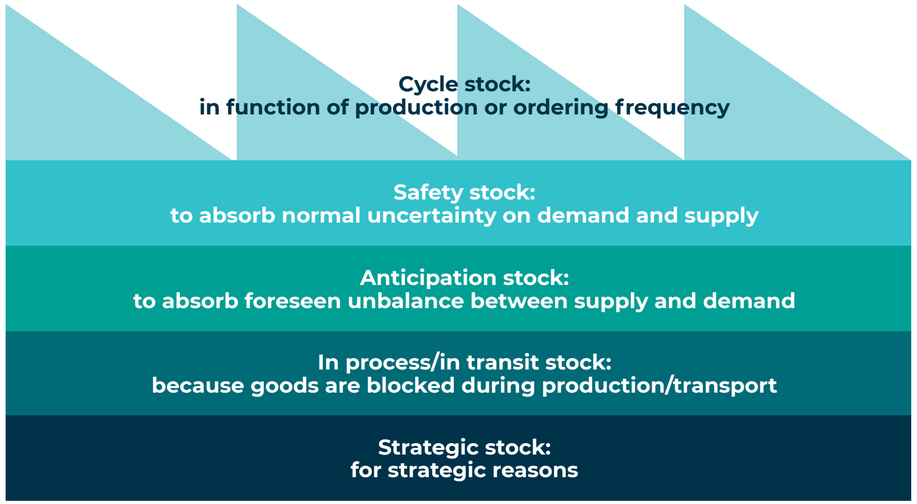
WHY DO WE NEED INVENTORY?

There are multiple reasons why we hold inventory. The 5 most common reasons are shown in the following graph.



Cycle stock results from the need to produce or order in batches. The lean philosophy works towards a 1-piece flow. As long as we're not there and are confronted with significant changeover or ordering cost, the EOQ principle teaches us it's more economical to produce in batches. If we produce once a month, the average cycle stock will be 2 weeks. If we produce once a week, the average cycle stock will be half a week. The EOQ shows us that optimal batch sizes go up when we are confronted with higher change-over/order costs or when the product cost goes down. They are primary drivers of the amount of cycle stock.

Safety stock is a buffer against uncertainty. It will typically look at the forecast error, the average lead time and the variance on that lead time. More advanced variants will look at factors like yield or quality loss. A second element in the safety stock is the service level. The service levels are typically converted into a k- or z-factor that defines how many times we will cover for the uncertainty. They are 2 separate things. We can have a product with low uncertainty but require a very high service level. We can have products with a high uncertainty but accept a low service level, for instance if there are multiple substitutes available.

Anticipation stock is typically the result from your supply planning process. I may build up stock to anticipate a seasonal peak, a tender or a shutdown. This type of planning decisions leads to so-called anticipation stock.

As long as we have lead times we will have inventory sitting on the production floor or sitting on trucks, trains or boats. We call this the work-in-process or transit stock.

Improving flow in production can reduce the work-in-process. Optimizing transport routes can reduce the stock in transit.

Strategic stock is carried to manage potential risks, e.g. an expected price increase or a shortage in a key raw material. As opposed to a plant shutdown these events are not sure. That makes the difference between anticipation and strategic stock. You can consider strategic stock more as a hedging and part of risk management in the supply chain.

There are many other reasons companies carry inventory. An example in retail is ‘presentation stock’. We may need 5 pieces at minimum to fill the shelves and make the product sell. This behaves like a Minimum Order Quantity at the supply side. All these are extra drivers for inventory. As a company it is important that you list your key inventory drivers. Adapt the classification to something that works for you.

I see many companies where inventories increase with 20-30% over a 2-3 month period without knowing the reason. The only way to explain is to look for and monitor the underlying drivers. If you decide to keep extra stock for strategic reasons, then document it accordingly in you inventory plan! If you decide to keep producing during a period of lower demand, document the according stock increase in your inventory plan. Show what you expect as inventory evolution and show which drivers take it up or down!

A PRACTICAL FRAMEWORK FOR INVENTORY OPTIMIZATION

Multiple aspects come into play when we want to optimize our inventory. In this vision paper we make abstraction of some of the more strategic questions like:

- the design of our global manufacturing-distribution footprint, for which we assume a network design exercise has been done and we have found the right trade-off between being close to the customer on the one hand and controlling shipping, warehousing and inventory costs on the other hand

- defining and controlling the size of the product portfolio, for which we assume we have defined our strategic positioning, and for which we assume we have a 'product management review' in place.

The figure on the next page summarizes our vision on how to optimize your inventory. You start by defining inventory policies, which are an input to defining the right inventory parameters. These are input to an inventory planning process, which interacts with your supply planning process. All of these are forward looking. We end by comparing the actual inventory versus the planned inventory, which provides the necessary triggers to keep the two aligned and as close as possible. In the next sections we will elaborate on each of these steps.

Inventory Policy

- MTS/MTO or Stock/Non-Stock
- Central/Decentral
- Reordering Policy:
  - “push”: DRP/MRP
  - “pull”: Reorderpoint, Min/Max, ...
- Target Service Levels:
  - ABC/XYZ

Inventory Parameters

- Single Echelon Optimisation
  - Lot Sizes in pcs, in days
  - Safety Stocks in pcs, in days
  - ReorderPoints, Min/Max in pcs, in days
- Allow overrides, e.g. contractual agreements
- Monthly updates

- Multi-Echelon Optimisation

Inventory Planning (1)

- Time-Dependent Safety
- Stocks & Lot Sizes = “Minimal Inventory”
- Show impact MOQs
- Define required “Strategic Stock”

Supply Planning

- Capacity Constrained Planning = defining “anticipation stock” and/or “leveling stock”

Inventory Planning (2)

- Show projected inventory in inventory layers
- Show cashflow impact (inventory increase & decrease)

Inventory Monitoring

- Inventory reporting
  - Actual vs Target: Inventory $ or €, Inventory Turns, Days of Inventory on hand
- Inventory balance:
  - Amount of $ or €, #SKU in:
    - overstock
    - understock
    - in balance
  - Rebalancing opportunities across DCs
- Slow moving & write-offs:
  - Slow moving and obsolete
  - Write-offs & risks

SETTING YOUR INVENTORY POLICY: MAKE-TO-STOCK/MAKE-TO-ORDER, OR STOCK/NON-STOCK

If you can avoid inventory, by working make-to-order instead of make-to-stock, go ahead and do so. The problem is that make-to-order increases the customer lead time, and sales may argument that a longer lead time, will reduce the customer interest and as such sales. So how do we define stock/non-stock or make-to-stock/make-to-order?

A common approach is to look at an ABC or ABC/XYZ classification. We try to avoid stock for slow movers, as they require more inventory and their inventory is at a higher risk of being written off. XYZ may look at cost of the product, for sure we try to avoid inventory for the expensive slow movers.

Though pragmatic, the approach does not account for the competitive landscape. If I'm the only supplier I can probably switch to non-stock without impacting sales volumes. If I'm in a highly competitive landscape no stock may mean no sales.

The approach also disregards margin. If the cost of the product is 100 and I can sell it at 400, then writing of 3 pieces is equal to losing 1 sale because of not having inventory. Higher margins allow for more inventory.

From these experiences we have developed a model which compares a Make-To-Stock situation and a Make-To-Order situation on the following two characteristics:

- What is the lost margin in % if we switch from Make-To-Stock to Make-To-Order:
  - this depends on the competitive situation, cfr. Above
  - and on the lead time for Make-To-Stock versus Make-To-Order

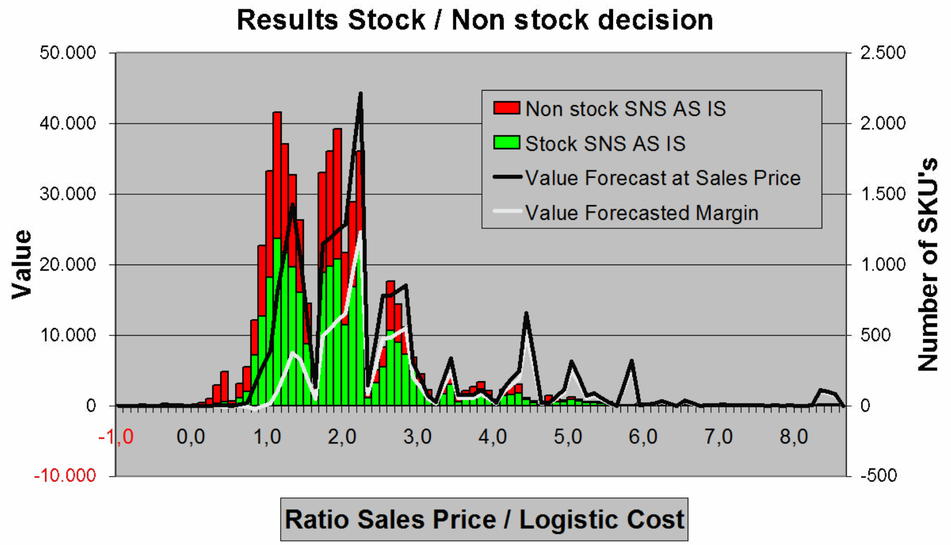
- What is the gain in inventory cost if we switch from Make-To-Stock to Make-To-Order

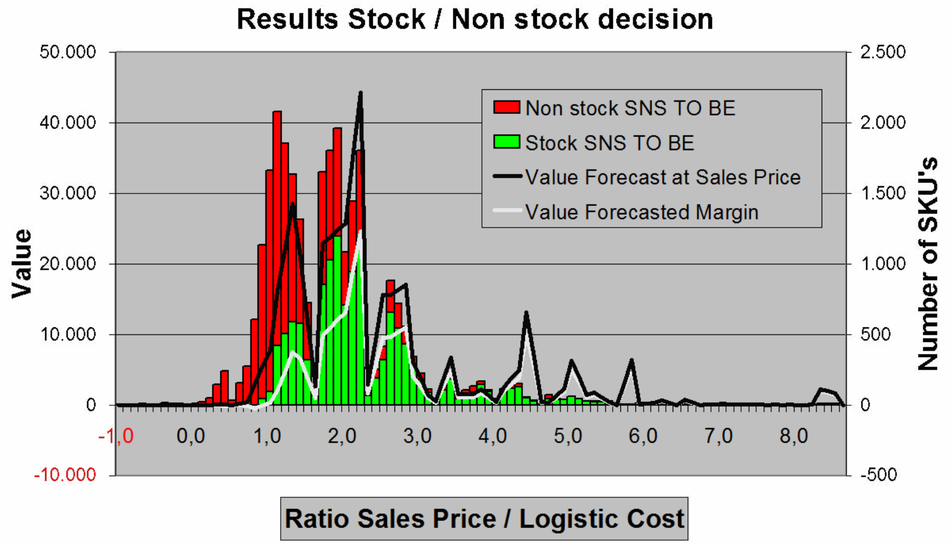
As products mature and come near the end of the life cycle we see that volumes decrease, because of price competition margins decrease even faster, while we need to keep more inventory (in days) to come to the same service level. This will push end-of-life items towards a non-stock situation, taking into account the competitive situation (the % of lost margin when switching to MTO) and the margin of the product.

The next 2 graphs compare a ‘typical’ stock/non-stock policy with the ‘margin-driven’ stock/non-stock policy. The graphs show the turnover in value (lines) and the number of SKUs (bar charts) for different ratios of the sales price versus the logistics price. If that ratio is less than 1, we have negative margin products, if the ratio is 2, we sell at double the cost price.

In the second graph you can see that combinations with a negative margin are automatically forced to non-stock, whereas some of the higher margin products are suggested make-to-stock compared to the current situation.

In general, a margin driven make-to-stock/make-to-order or stock/non-stock decision will improve the margin generated on the invested capital, financially speaking the return on capital, or more freely the bang-for-the-buck. It is also an effective means in challenging marketing and sales whether they make the best possible use of the capital invested in the inventory.





SETTING YOUR INVENTORY POLICY: CENTRAL/DECENTRAL

Many distribution networks have both central Distribution Centres (DCs) and regional DCs. Applying Make-To-Stock/Make-To-Order to the Regional DCs turns into a Central/Decentral decision. Again, balancing the lost margin with the gain in inventory cost will show, per regional DC, whether the stock should be kept on decentral level, or only at the central level.

Instead of using the margin-based model, we again see that companies commonly use an ABC classification to decide on whether to centralize the stock. As above, that does not account for the competitive situation nor the margin of the product. As such, here too, we advise to use the margin-based model.

SETTING YOUR INVENTORY POLICY: REORDERING POLICY: PUSH VERSUS PULL

Multiple definitions exist of what is push versus pull. We use the following one, which is the closest to the lean philosophy. A ‘pull’ model is triggered by ‘actual consumption’. A ‘push’ system is based on forecast.

A typical ‘pull’ model is a reorder point system which tells “we order a lot size if the on hand + on order is less than or equal to the reorder point”. If there is no consumption, there will be no ordering. Another typical system, often used in production, is a Kanban system. We order a new container, if a container has been consumed. A container can be any type of unit of replenishment, a pallet or a kind of bin. The container forms a closed loop system, which ensures a constant WIP, a so-called CONWIP system.

While the lean philosophy advocates everything should be pull and forecast should be banished, that assumption is impractical. If you have seasonal products, or working with promos, you’ll have to forecast ups and downs in demand far enough in advance, to be able to buy raw materials, produce any intermediates and finished products in time.

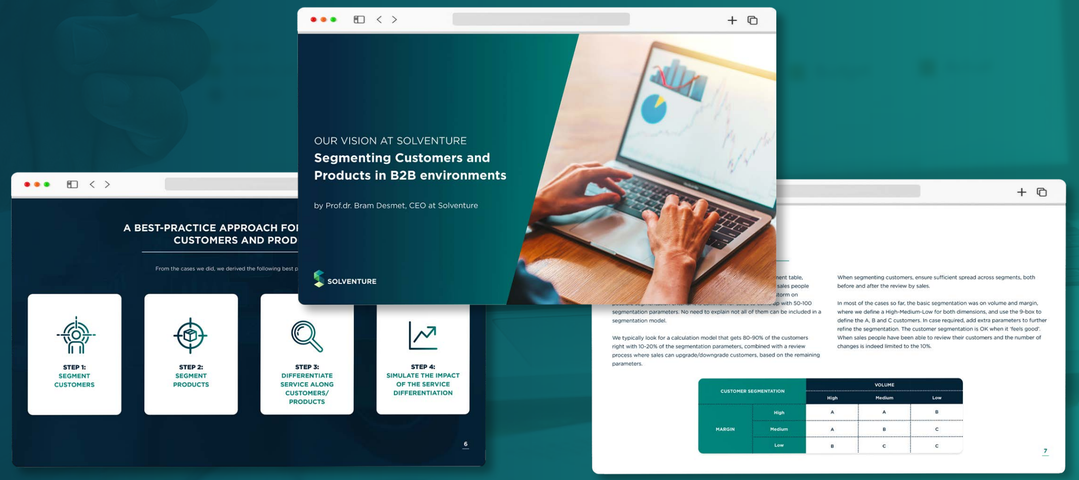
What we have used in practice is the following rule. Measure the ‘demand stability’ using the ‘coefficient of variation’ (standard deviation divided by the average demand). If the coefficient of variation is less than 25%, then you should question the added value of forecasting. Changes in the forecast may add, instead of reducing the variability. For stable demand products, a pull system may be more effective than a push system. Combining push and pull is a challenge for most major ERP systems. If you decide to do so, look for a tool that can accommodate both.

SETTING YOUR INVENTORY POLICY: TARGET SERVICE LEVELS ABC/XYZ

We see that many companies still use the same service level for all products and customers. Our approach to S&OP starts with a customer/product segmentation. This can give crucial input on how to differentiate service levels. We refer to our vision paper on segmentation for how to approach this.

If you have not yet done a full customer/product segmentation, an ABC/XYZ classification may be a good alternative and starting point. The idea is that you want to have lower service levels for slow moving products. Customers know your market as good as you do. They know which are the fast and the slow movers. They will accept a lower service level on slow moving products, where they will not accept stock-outs for fast moving products. From your side, it's easier to score service with a cheaper product compared to a more expensive product. If you have a stock out, you don't want it to be on the nuts and the bolts, you want it to be on that expensive engine! While ABC/XYZ is not accounting for differences in customers, for differences in strategic fit, it is a good starting point. Remember to differentiate service levels, it will again help in increasing the margin generated on the invested capital.

White Paper: Customer-Product Segmentation in S&OP



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CALCULATING YOUR INVENTORY PARAMETERS

The graph on page 16 shows that many companies still use very simplistic policies to define their inventory parameters. When it comes to safety stocks, we just put 2 weeks or 1 month of safety stock for all items. 1 step further is to apply an ABC/XYZ classification and for instance to put some more safety stock on the cheaper items, versus less on the more expensive items, and to put some more on the slower mover items, as they require higher coverage to give a comparable service level.

A first real optimization step is to calculate your safety stocks using a stochastic model. The simplest and most known formula is $SS = k.\sqrt{L}.\sigma_d$. Safety stock should account for the uncertainty over the lead time. More advanced versions account for forecast error, average lead time, lead time reliability, quantity reliability … The k-factor is linked to the service level and defines 'how good we want to protect ourselves against the uncertainty'. It's a separate decision. We can have a product with low uncertainty, but it requires a very high service level. We can also have a product with high uncertainty but allow a low service level because there are substitutes, e.g. a 2l instead of a 1l packaging.

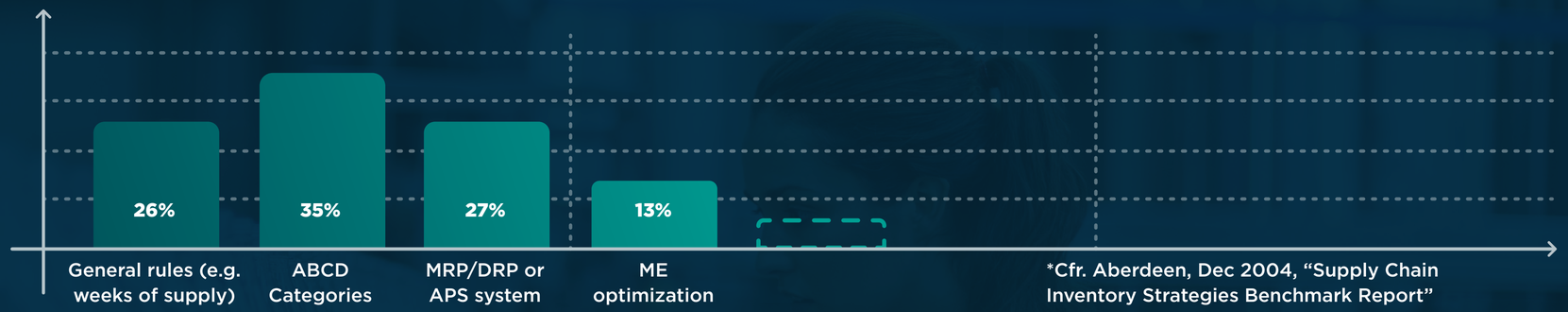
Applying this type of safety stock formula typically reduces the safety stock while increasing the service level. If we carry 1 month for all items, it means for some items we are carrying too much, for others we're not carrying enough. When applying a safety stock calculation, we will typically put less safety stock for the fast movers and put more for the slow movers. The redistribution of the safety stock will positively affect the service level. If we reduce from 1 month to 2 weeks for a fast mover, it will have a big impact. 2 weeks of demand on a fast mover is huge. From that perspective we will not only redistribute the safety stock but it will also be reduced. We typically see a 20-30% reduction.

As we can calculate safety stocks we can also calculate optimal production or replenishment lot sizes. We see here as well that companies may have something like an ABC or at best an ABC/XYZ classification to define the optimal lot sizes or production/replenishment frequencies. There is a wide range of methods available to calculate lot sizes. The Economic Order Quantity is the most basic model. More advanced methods like the Wagner Within algorithm all build on the same theme. If I switch from producing once per month to once per week, my inventory costs will go down, but my ordering and change-over costs will go up.

The EOQ and its more advanced variants try to optimize this. Applying an EOQ-like logic will trigger cheaper products to be produced in bigger batches where more expensive products are being produced more often. Calculating lot sizes instead of applying a general rule will reduce inventory and at the same time reduce ordering and change-over costs.

Safety stocks and lot sizes can be calculated in pieces, converted in a coverage, and are the crucial inputs to calculate Reorder points, Order-up-to-levels, Min/Max, … Whatever policy you may be using, these are the key ingredients to calculate your inventory parameters.

Where are companies today?



How do we move forward?	Single Echelon Optimization	Multi Echelon Optimization **Intra** Company	Multi Echelon Optimization **Inter** Company
What will it bring in inventory reduction?	**20 - 30% reduction**	**20 - 30% reduction**	**20 - 30% reduction**
What is it about?	› Get familiar with stochastic safety stock optimization from a people, process and systems perspective › Measure and gather necessary data › Define and measure Service Levels	› Get familiar with multi-echelon optimization from a people, process and systems perspective › Understand, implement & harvest ME benefits	› Extend the multi-echelon optimization to your suppliers and customers › Typical first step: integrate dealers › First mover advantage is critical

We have written a separate vision paper on how we believe multi-echelon inventory optimization is still a huge opportunity for a lot of companies. Looking at safety stocks it is common for companies to have safety stocks at the different steps, or so-called echelons, across the supply chain.

We require a high service level on the raw materials and components, we require a high service level from the intermediates, a high service level at the central DC and a high service level at the regional DC.

In regrouping the supply chain uncertainties on the customer facing echelon, we can significantly reduce the safety stock in the supply chain. When looking at lot sizes, the synchronization of lot sizes across the supply chain can at the same time reduce inventory and ordering/change-over costs.

The results of multi-echelon are often counter-intuitive but rewarding. Review our vision paper on multi-echelon for a more detailed discussion on how multi-echelon works and what it can mean for your company.

After the single or multi-echelon calculation, you want the planner to be able to apply overrides. Maybe there is a contractual agreement with the customer to keep at minimum 20 days of safety stock. There could also be good reasons to deviate from the proposed lot sizes.

Where the calculations are clear about the ideal size, you should always allow the planner to define overrides to account for specific constraints.

PLANNING YOUR INVENTORY

Next step in the inventory journey is to make the safety stocks and lot sizes time-dependent. Expressing the safety stock and lot sizes into weeks and mapping it to the forecast will give a time-dependent view on safety stocks and lot sizes.

For instance, for seasonal items, the safety stocks will go up towards the high season and will be lower in the low season. This also creates questions like how to avoid a bull-whip? If my forecast goes from 100 to 200, my production goes from 100 to 200. If my safety stock covers 1 month, my safety stock should go from 100 to 200 as well … so my total production goes from 100 to 300?

Smoothing the safety stock by taking an average of 2-3 periods is common in avoiding a bull-whip.

The safety stock plus half a lot size is in fact the minimal inventory you can carry. In practice there are multiple reasons why, at least temporarily you will carry more inventory. Some reasons will really be the result of your supply planning process:

- ‘anticipation’ stock: if we do upfront production to anticipate a shutdown, or a peak exceeding the capacity (e.g. a seasonal peak, a promo or a project or tender)

- ‘levelling’ stock: we may decide to keep running at full capacity when demand is low, assuming we will sell of the resulting inventory later in the year, management may decide so to keep the efficiency up and the cost down, we are supporting the EBIT by creating more inventory on the balance sheet

Bullwhip Effect

The bullwhip effect is a supply chain phenomenon describing how small fluctuations in demand at the retail level can cause progressively larger fluctuations in demand at the wholesale, distributor, manufacturer and raw material supplier levels.

Some reasons are an input to the supply planning process:

- ‘strategic stock’: I may decide to build up extra inventory because I expect a shortage in the market, this is ‘uncertain’ but I’m willing to take the bet, this is an input to the supply planning process
- ‘tender/project stock’: I may decide to start building inventory for a tender or a project, even if I’m not certain I will get the deal, again this is an input to the supply planning process

So step 1 is making the safety and cycle stocks time-dependent, then we add extra stock requirements such as ‘strategic stock’ or ‘tender/project stock’. The supply planning process will add other stocks like ‘anticipation stock’ or ‘levelling stock’.

At the end of the ‘inventory planning’ it is key that we can:

- Show the projected inventory over the next 3-18 months
- Show the delta in inventory and the resulting cash consumption
- Explain why the inventory is going up and down by showing the different inventory layers: safety stocks, cycle stocks, anticipation stocks, levelling stocks, strategic stocks, tender/project stocks …

Many companies lack visibility on how inventories are expected to evolve and what are the underlying drivers. As companies have become more cash aware this is not sustainable. We strongly recommend installing an inventory planning process!

MONITORING AND CONTROLLING YOUR ACTUAL INVENTORY

There are multiple reasons why the actual inventory will deviate from the plan. You have sold less than expected, production produced more than agreed, quality turns out better than on average, returns were higher than expected, and the only way to keep up is to install a good monitoring and control process.

“Which inventory KPI’s do I need” is an often heard and read question. There are no real secrets here. Companies follow their inventory in days of supply or turns, in value, in total or per region/ product group. Most companies report on Slow Moving and Obsolete (SLOB) as slow movers turn into write-offs and finance is obliged to carry strict rules on how this is dealt with.

In general, we have to recommend the reporting of the ‘inventory balance’. Looking at a region/ product group, my total days in inventory will tell me if I’m right on target, however, some products may be out of stock, some in safety stock, some in overstock and some in balance. Reporting on the ‘inventory balance’ is a complimentary metric to the ‘inventory days’. It is like measuring the ‘bias’ and the ‘accuracy’ of the forecast. The Mean Percentage Error measures the over or under forecast. On the product group level, the MPE may be zero but the MAPE may be 50% meaning we’re on average 50% off! We need to do the same for the inventory!

Another opportunity is to identify rebalancing opportunities within the network. It may be ‘understocked’ in 1 location and ‘overstocked’ in another. Balancing the cost of transhipping with the risk of a recall or write-off can improve the cost/inventory balance in the network!

IN SUMMARY

In general, we can say that in many companies we have seen the pressure on inventory increase. In contrast, a lot of those companies are still missing a proper inventory management process.

It all starts with setting the right inventory policies. What is our MTS/MTO or Stock/Non-Stock policy? How do we balance the generated margin with the cost of the inventory? For the MTS items, many companies are stuck in simplistic inventory policies. Some have moved on to calculating safety stock and lot sizes but in general there remains a huge opportunity in optimizing your inventory. Inventory optimization helps in improving service, while reducing cost and inventories.

The parameters are input to a planning process. There are multiple reasons we temporarily hold more inventory than what we minimally need: in anticipation of a shutdown, because we want to level the production, for strategic reasons, for projects or tenders ...

Getting to grips with your inventory requires that you plan the inventory ups and downs, and show which layers are affecting your cash flow the most.

Last but not least, there are multiple reasons why the actual inventory will be different from the plan. Demand may be lower than expected, we have produced more than we planned, and there were more returns than on average ... A close monitoring of the total inventory but also the inventory balance is essential in mastering your inventory situation.

Companies that have followed our inventory framework have easily reduced their inventories with 30-50%. Depending on the size of your company, appointing an inventory manager and giving him the responsibility to get the process running may be required to make it all happen.

ABOUT THE AUTHOR

Bram Desmet - CEO | Professor | Author
As CEO, since 2009 Bram has led the Solventure Group to transform organization's sales & operations planning processes into a competitive advantage using his innovative Supply Chain Triangle® and Strategy-Driven approach.

As an adjuct professor at both Vlerick Business School and Peking University, Bram bridges the gap between academia and industry practice.

As an author, he has encapsulated his experiences into elegant and practical frameworks in his books, Supply Chain Strategy and Financial Metrics and The Strategy-Driven Supply Chain, evangelizing strategic thinking for cohesive alignment of strategy, supply chain, and finance within organizations across all sectors. Bram is also founder of The Strategy-Driven Supply Chain Institute.

ABOUT SOLVENTURE

As Solventure we proud ourselves of being experts in designing and implementing Strategy-Driven S&OP. We do that through a unique combination of people, processes, tools and analytics. Solventure is Arkieva's, OMP's and Kinaxis's implementation partner.

Check us at www.solventuregroup.com or contact us at contact@solventure.eu for more info.