

# Inventory Policies across Product's Lifecycle

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**Summary:** To stay ahead in competition, firms are constantly coming up with more and more innovative products and this process has resulted in high inventory levels across different stages of these products' life cycle. To address this problem, firms are looking at ways to reduce their inventory levels and the overall associated costs. Our thesis reviews the extant literature to find optimum policies for different stages of a product's lifecycle and then calculates the different parameters such as inventory holding costs and order costs. We compare these parameters with those calculated using company inventory policies. After analyzing the results, we make recommendations to the company about what factors they must take into account when considering any inventory policy and which policy to use for different stages of the product lifecycle.



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## KEY INSIGHTS

- As the product moves from one stage to another, different inventory policies are required at different stages (i.e. Introduction, growth, maturity and decline) of a product's lifecycle.
- X, Y, Z categorization is a good method to segregate the different SKUs, as this method uses Coefficient of Variance (COV) to segregate these SKUs into different categories. However, sometimes one SKU which is in the decline phase will be in the same category as the SKU which is in the growth phase, if their COVs fall within the range of a particular category. This would not be recommended as the SKU in the growth stage requires more attention than the SKU in decline stage because of the different demand characteristics.

## Introduction

Having been founded in the 19<sup>th</sup> century, "Chem Corp" is presently one of the largest producers of both specialty and commodity chemicals in the world. It operates more than 100 production, research and development facilities globally either through joint ventures or wholly owned units. It operates in numerous markets by business segmentation such as Agriculture, Automotive & Transportation, Chemicals, Construction, Semi-Conductor and Apparel. Recent downturn in the oil and gas industry had a noticeable impact on the global economic growth

and most notably on Chem Corp's sales. Also, the competition within the specialty and the commodity chemicals across a range of industries has intensified over the past few years forcing all chemical companies including Chem Corp to constantly come up with more and more innovative products. This process has forced most of these products/SKUs to go through the different stages within its product's lifecycle. As these SKUs go through different stages, there is variability in demand and lead time. In such a scenario, Chem Corp wants to reevaluate its inventory management system and ensure that it

is maintaining the optimum inventory levels in each stage of its product lifecycle.

## Methodology

The main purpose of this research is to satisfy the following goals:

1. To establish that different inventory policies are required for different stages of a product's lifecycle and propose those policies
2. To understand the nature of the demand for company products by segmentation of various SKUs based on sales order data.
3. To do a comparison between overall costs using the company's policies and that using recommended policies.

A brief summary of the research methodology will be narrated in the figure 1, and further explained in this chapter.

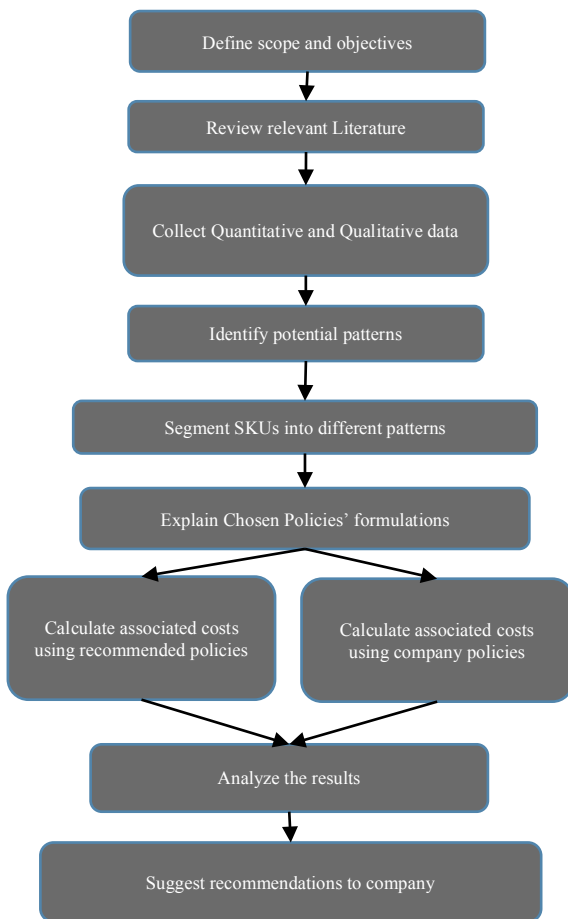
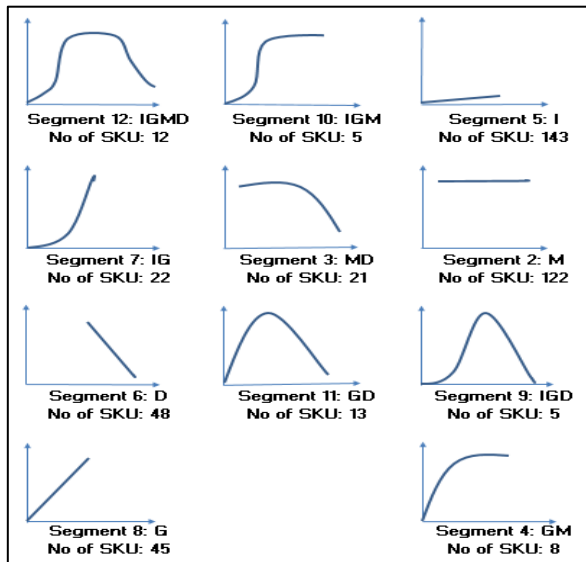


Figure 1: Research Methodology

1. The scope, objective and background is already defined in the introduction part.

2. Literature review was done to find out articles that dealt with the concept of a product life cycle and how the demand characteristics varied across each of these stages. Further research was conducted to find out any articles that proposed any inventory policies either for each of these different stages of the product life cycle or for different demand characteristics.
3. Interview was conducted with key personnel from different business units to understand the following variables such as demand characteristics of the different chemical products, and Also, demand data for different SKUs was requested for analysis and we received 65 months of sales order data for 754 different SKUs.
4. Based on literature review, potential lifecycle patterns were identified. For e.g. one pattern will represent a SKU going through all four stages of its product life cycle and another pattern will have another SKU going through only one stage of its product lifecycle.
5. Out of 754 SKUs, 310 were eliminated from further analysis as they had less than 6 data points. The remaining 444 SKUs were further segmented using the following methodology:
  - a) Normalization: This process was carried out to ensure that all the SKU's sales data fell in the same range, as there was lot of variation of demand across different SKUs.
  - b) Derivatives: First order derivate was used to find out when one SKU transitioned from one stage/phase to another.
  - c) Graphical visualization: The graphs of both the raw sales data and the first derivative was used to find out the different transition points when an SKU moved from one phase to another.
  - d) Aggregation: Sum of 12 months sales data was also used to further collaborate the results.
6. Based on the segmentation methodology applied above, the SKUs were placed into the different patterns as shown in the figure 2.



I – Introduction                      M – Maturity  
 G – Growth                              D – Decline

Figure 2: The Historical Sales Order Data's Patterns

- Based on literature review, formulations of the recommended policies (R,s,Q) and (R,S) were further explained.
- Associated costs such as inventory holding and order costs were calculated using both the company and the recommended policies. Comparison of these costs were made.
- Based on the analysis of the calculations and other important parameters such as setup costs, recommendation were made to the company

## Result and Finding

### The Impact of Inventory Policy

From our analysis, we recommend the following inventory management practises for each stage:

- Introduction Stage: Make To Order
- Growth Stage: (R, s, nQ) policy
- Mature Stage: (R, S) policy
- Decline Stage: (R, S) policy

The difference between our recommended policies and Chem Corp's policies is only during the mature and declien stage.

### Chem Corp Product's Demand Nature

We segment the five years historical sales order data and identified the top five segments which is with the highest number of SKUs as in Figure 5. In this percentage calculation, segment with less than six data points is excluded. Based on the historical

data we received 444 SKUs are clearly assign to the rest of twelve segments. From the twelve segments, the top five segments are I 32.21%, M 27.48%, G 10.81%, D 10.14% and IG 4.95%. Based on the five years segmentation result, Chem Corp products' demand nature that consists of highest percentage only single stage which is potentially shows that their product's lifecycle usually might take five years and above.

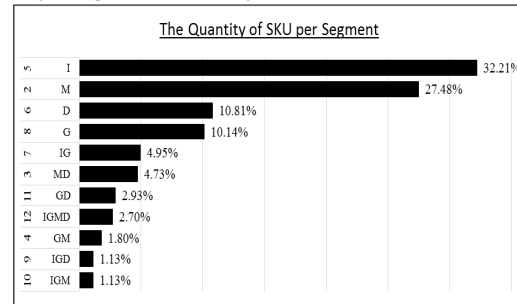


Figure 5 – The Quantity of SKU for Each Segment in percentage

### Chem Corp Inventory Management's Insight

Chem Corp managed its inventory with using Low, Medium, and High categorization after new product stage. The company is not using product lifecycle management but manages its inventory with using Low, Medium, and High based on COV as presented in Table 1. The COV method used in managing the inventory gives a clear and fixed figure, which is easy to identify between the Low, Medium, and High. However, this method does not differentiate between the Growth and Decline stage which could be an area of improvement or the weakness of this method as mentioned by Sabol Andrija (2013) each stage of the product's lifecycle have different characteristics. Thus, these two stages should be managed differently.

Categories	Characteristics	Forecasting	Reference
New Product	<ol style="list-style-type: none"> <li>In research stage</li> <li>Uncertain in product finalization</li> </ol>	<ol style="list-style-type: none"> <li>No inventory management tool used</li> <li>MTO</li> </ol>	<ol style="list-style-type: none"> <li>Global Business Analytics Division</li> </ol>
X	<ol style="list-style-type: none"> <li>The demand is more stable</li> <li>Has less variation</li> <li><math>COV_x &lt; 0.4</math></li> </ol>	<ol style="list-style-type: none"> <li>Statistical forecasting is used as it is more reliable.</li> <li>Economies of scale used for production</li> </ol>	<ol style="list-style-type: none"> <li>Supply Chain Asia Pacific.</li> <li>Global Supply Chain Strategy Development</li> </ol>
Y	<ol style="list-style-type: none"> <li>Intermediate variation</li> <li><math>COV</math> is intermediate between that of X and Y</li> <li><math>0.4 \leq COV_y \leq 1.3</math></li> </ol>	<ol style="list-style-type: none"> <li>S&amp;OP meeting on regular basic.</li> <li>All the different departments present their own forecasts.</li> </ol>	<ol style="list-style-type: none"> <li>Global Business Analytics Division</li> </ol>
Z	<ol style="list-style-type: none"> <li>Has highest variation in demand</li> <li><math>COV</math> is highest among the X, Y, Z</li> <li><math>COV_z &gt; 1.3</math></li> </ol>	<ol style="list-style-type: none"> <li>Planner selects the most accurate forecast from SAP ERP for MPS.</li> </ol>	

Table 1: Chem Corp Inventory Management

## Conclusion

The demand characteristics of the product changes when a product moves across different stages in its life cycle. Better understanding of the product's nature and characteristics at each stage will help improve the efficiency of inventory management. We propose to use the total costs calculation as a comparison between our recommended policy and the company policy. We used the cost calculations to find out which policy has the lower total costs.

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