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"World Best-In-Class" Enterprise Using Aera

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Abstract
This article is about a real life case study about implementing BI (Business Intelligence) automation at a major Dow Jones 50 company using Aera. The article also describes about how we can implement similar automation at any organization which when added with cognitive intelligence will lead the enterprise towards "world best-in-class" status. It also describes about the approach to be taken to implement the same at any area or level of organization to be the "nirvana" of business. The BI automation is achieved by mapping the planner's or business analyst's mind with a decision tree logic and implementing them in Aera using business rules. The cognitive layer on the top of it will identify the problem areas proactively before it occurs and learn from it's mistakes making the process closed loop and will move the KPI needle slowly towards the end goal and even exceeding it in the future.

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I. Introduction

Current state supply planning activities that are outside the ERP or planning systems are manual with many decision points and subject to errors or inaccuracies. This paper describes possible options available for companies in today's world to automate such tasks via. automation. It also describes about scenarios where we take this approach one step further by using AI or machine learning to predict events in supply chain and thus improving the KPI's leading to projected **drastic improvements** in bottom-line costs and customer service.

II. Description

The current used case describes about a company that had issues with both stock-outs and excess inventory. This was leading to scenarios where **no** on-hand stock was available for key customer's causing delays in shipments and resultant poor customer service. The excess inventory for certain SKU's on the other hand was locking precious capital and leading to inefficiencies in the supply chain. The supply planner's were using the data from the ERP/Planning systems to analyse and solve these issues off-line which was further reviewed in the S&OP meeting but still the company was facing problems with inventory.

Aera solved the problem in two ways by automating the complex decisions taken by the planner's using business rules and second by providing an Artificial Intelligence (AI) layer to learn from the human decisions to avoid similar issues in the future. The first step was to map the human mind of the planner by defining a step by step process of the decision taken by them to avoid the stock-out's at a distribution center (DC). This was done after identifying the SKU's that were flagged for "overselling" or stock-outs by comparing the forecast against the sales orders using certain thresholds. Similarly, SKU's where flagged for "underselling" or excess inventory scenario and recommendations were made to cancel extra incoming inventory. After determining the customer priority using the flags the supply response skill was executed for SKU/locations only where the projected inventory was negative in the current week or the future 7 weeks horizon. The amount of deficit and the dates were used to determine the requirement quantity and requirement dates that were the drivers for the logic. For example if the project inventory goes negative in week 3 for the next 2 consecutive weeks then the negative quantity in the last bucket i.e. week 5 was identified as the requirement quantity that was due in week 2 (considering 1 week lead time to deliver to the customer across the board after availability of the stock at the DC).

The figure 1 below explains the high-level decision tree for stock-out or "overselling" scenario via. the execution of the following steps in Aera:

(1) Manage Orders: The total requirement quantity was first checked at the delivering DC against available on-hand inventory otherwise Step 2 was executed.
(2) Branch Orders: The feasibility of transferring stock from an alternate DC was then checked as a part of this used case. Multiple conditions where checked within this scenario to see first if the stock available at the

alternate is greater than equal to the requirement quantity, the transfer of stock does not make the projected inventory negative in any buckets at the alternate DC, etc.

(3) Move SO/SO Line: If inventory transfer failed then additional checks were made to see if the change of the delivering plant to alternate DC by shipping directly from that plant will be feasible. The key check here was to determine if the lead time to ship directly from the alternate DC for the sales order selected was less than the requirement date if the above condition had failed in step 2 above.

(4) Expedite Production: If the move to alternate DC failed then the next option to move in the firmed external supply orders from the manufacturing plants or the other DC's (called stock transfer orders in SAP) was considered. The order searching logic involved moving the order furthest in the horizon first and only if the quantity was greater than the requirement quantity. The logic also clubbed multiple supply orders until the requirement quantity was satisfied at the requirement date.

(5) Launch Orders: If all the above options failed the last option was to create an unfirmed external supply order or stock transfer requisition from the manufacturing plant to the delivering DC. Manufacturing capacity constraints at the manufacturing plants were not considered while creating the order as it was assumed infinite (will be incorporated in the next release).

Similar to overselling flag the "underselling" flag determined the SKU's for which the total orders were less than the demand forecast and exceeds the threshold to trigger the following scenario below:

(1) Cancel Orders: This used case determined the SKU's that had excess inventory and provided recommendations to cancel all in-coming supply or stock transport orders from the manufacturing plants or other DC's.

Recommendations were generated in Aera using Cognitive Workbench (CWB) as the front-end tool for each of the 6 used cases at different levels of data aggregation. The recommendations provided actionable context for users to take decisions on them as to whether to accept/reject the same. Users had to enter the rejection code for rejected recommendations including any comments in the UI. An audit trail was also generated in the backend for each action taken on each of the recommendations at the appropriate level of data aggregation. The recommendations where set to refresh once a day that was planned to be increased to x 4 times to match with the near real-time sales order updates.

The results from the used cases "Branch Orders" and "Launch Orders" were selected to be feed back to the execution ERP system to create unfirmed supply recommendations or stock transport requisitions. Also, the used case "Expedite Production" results were sent via. e-mail notification to the planner to take action on the date changes to the firmed manufacturing supply. The FRP or the fill-rate percentage (@ SKU/DC and DC level) KPI was measured to monitor the performance of the supply response skill for the next few quarters.

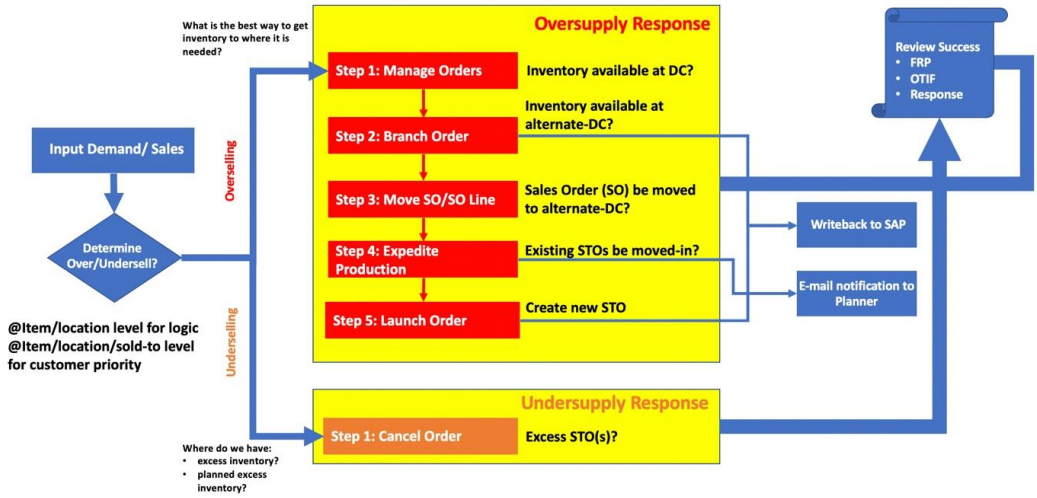

Figure 1: Supply response architecture for automation

III. Methodology

The above supply response used case using Aera was implemented using the following 5 tier approach:

1. Understand,
2. Recommend,
3. Predict,
4. Act, and
5. Improve.

Understand: This steps defines the crawling and harmonization of the source data to build the base structure for the supply response skill.

Recommend: Any transformations applied to the base structure from above to generate the recommendations and displaying it in the UI is part of the "Recommend" step.

Predict: Data science transformations applied over the recommendations so that prediction of the recommendations can happen for future events (as differentiated from the present state event for the above step). The crawled data, recommendations and the associated user actions history is input to the data science layer and future predications for stock-outs and excess inventory is generated. Basically, this layer runs advanced algorithms to predict the future dates in the 7-week horizon **where the inventory is going to go negative and the expected quantity of deficit** as a part of the "Artificial Intelligence" learnings. The system is also expected to learn from the further user actions and actual data to predict with better accuracy. "Predict" has not been implemented yet but is part of the future development after the initial phase of KPI monitoring meets the target.

Act: The predicted results that have been approved by the user is fed to the source system to automate the manual process of creation of the supply orders by the planner. Currently this is semi-automated as the approved recommendations are loaded into SAP via. a flat file load post review by the planners. With the fully functional "Predict" phase the output of the recommendations are fed to the source systems directly to act on the predicted recommendations. This closes the loop and makes the system "touchless" as except for certain manual review steps the system adjusts after each write back and the prediction get's even better.

Improve: This phase defines the future state as opposed to the current state for all the above where the continuous cycle of learning by the AI engine leads to further improvements in the FRP as an iterative process. The system also keeps learning and takes proactive measures to avoid stock-outs and excess inventory making the FRP closer to 100% target and in ideal case eliminating them completely and even exceeding the measure (shipped qty greater than order quantity only remaining in the calculation).

Figure 2 below shows the maturity of the Aera supply response skill from it's basic recommendation state and limited write back to future state of best in class. This idea state called "Nirvana" of business is when the associated measures exceed their targets for e.g. the FRP > 100%, which means only over-shipments are remaining in the equation (shipments greater than order quantity). All the inventory deficits in the supply chain are being proactively acted upon before they actually occur, and customer's orders are satisfied on-time and in full.

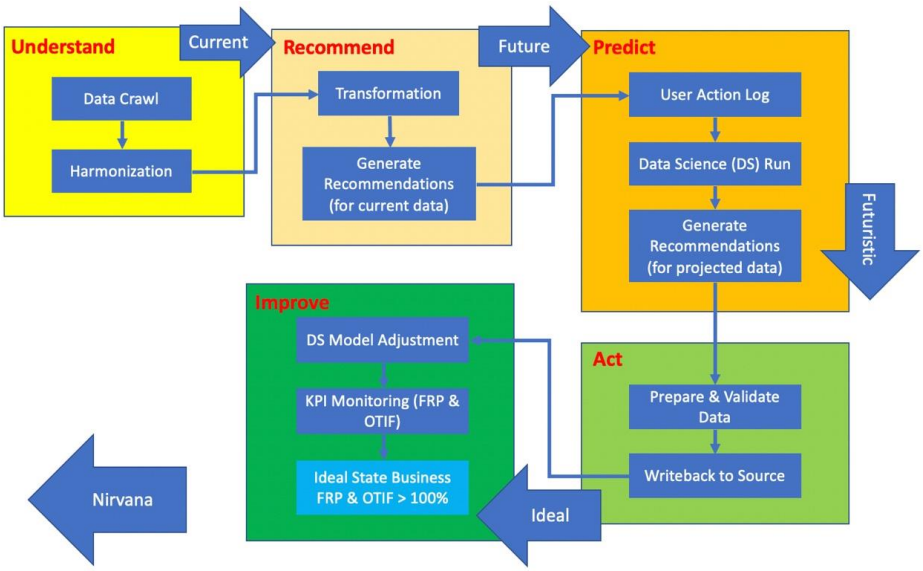

Figure 2: Maturity of Aera skill from reporting to recommendation to "best in class" supply chain

IV. Conclusion

This paper shows that automation of any element of the supply chain is possible using set business rules in Aera which executed in conjunction with data science (AI or ML) creates a self-autonomous and best in quality business. Businesses can save not only substantial money but also add efficiencies back in their value chain and can be the best in their area of expertise by implementing this proven methodology. This concept could easily be extended to forecasting, procurement, logistics and other areas of the supply chain or functions thus making the enterprise "world best-in-class".

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