WHITE PAPER

Planning and Optimisation in a Lean Manufacturing Environment

EXECUTIVE SUMMARY

In order to increase shareholder value, recent trends in operations have led companies to introduce Lean Manufacturing practices. The stated goals are to increase manufacturing flexibility and reduce cumulative manufacturing lead-times, allowing companies to increase customer service/response by producing products when requested by the customer, while still reducing enterprise-wide inventories. This in turn increases Return on Assets by having a positive impact on revenue and profits, while reducing assets (inventory).

This sounds straightforward, but it's not. Companies now face new challenges and choices regarding the manufacturing or assembly of finished goods. Which finished goods should they make-to-stock (MTS) vs. assemble-to-order (ATO)? Which sub-assemblies/components should they stock to prepare for final assembly? How much stock of these sub-assemblies/components should they hold to maintain a high level of customer service? What's the resulting Finished Goods Service Level? How can they forecast raw component requirements?

The key to managing a hybrid MTS-ATO environment is accurate planning and stocking of these sub-assemblies. This entails optimal:

- Forecasting the demand pattern of raw component requirements
- Calculation of sub-assembly/components stocking levels to hit target Finished Goods customer service levels

GAINS performs this by 'intelligently' aggregating all finished goods history, allowing the software to forecast the requirements for stocked sub-assemblies. In turn, GAINS calculates the optimal replenishment of Raw Components, ensuring companies meet their target service levels. GAINS also determines optimal sub-assembly inventory levels, taking into account the number of Finished Goods any given sub-assembly is needed as a component ('where-used density').

MINIMIZING INVENTORY INVESTMENT WHILE ACHIEVING TARGET SERVICE LEVELS IN A HYBRID MTS-ATO ENVIRONMENT

To increase ROA, companies need to increase revenues and profits. This means winning the battle for customers through better service. And better service usually involves:

- More product categories and choices
- Faster delivery dates

However, stocking all possible finished good combinations inflates inventory numbers and is a drag on companies' cash position. This begs a question: at what level of the Bill-Of-Material (BOM) should they stock? Both the beginning and end of the assembly process will create "ripples" throughout the Supply Chain.

Companies will need to reschedule manufacturing to profitably utilise production assets when components are missing. Once components finally arrive, companies will have to expedite the manufacturing of demanded finished goods.

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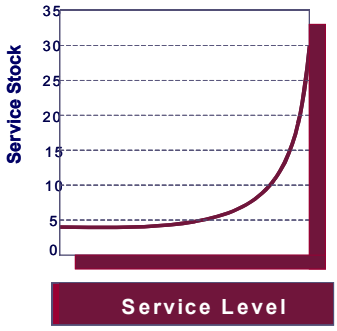
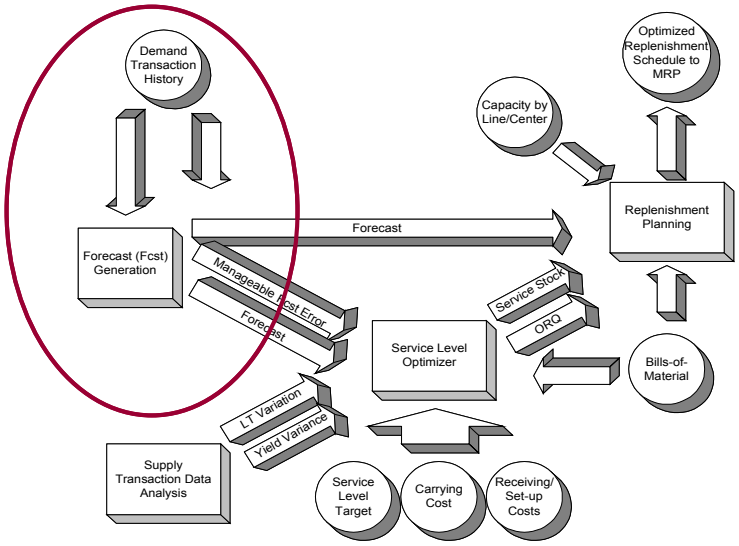
- **Lost sales due to lower than expected Service Levels** – Even with extensive expediting, sub-optimal management of a Lean Manufacturing Supply Chain has a negative impact on on-time shipments to customers. This eventually affects revenues.
- **Excess inventory at the Raw Component** – When companies do not have an effective tool to help them optimally determine Inventory Policy, or in response to excessive expediting, Safety Stock levels of Raw Components can be excessive. This leads to excess inventory, often resulting in obsolete inventory.

THE KEY DECISION: SETTING SERVICE LEVELS AT THE COMPONENT LEVEL



Graph 1



Graph 2

Service Level is one of the key drivers of Inventory Parameter Calculation (see graph 1).
GRA consultants, using the GAINS software tool, have developed a methodology to help companies "hit" target finished goods service levels while controlling their inventory. The solution seems simple: hold a 'balanced' level of inventory of the lowest stocked sub-assembly. Yet this entails one major challenge and one key decision. The challenge is component forecasting. The key decision is optimally setting stocked sub-assembly Service Levels in GAINS.

- **Component Forecasting** – As all planners and inventory managers know, the first step in calculating Inventory Parameters involves forecasting (see GAINS Flow diagram Graph 2). Yet how do you forecast the demand for a component when this component is used in both MTS **and** ATO finished goods with ATO items NOT having enough demand to be forecasted accurately? Solution: GAINS will aggregate and 'roll-up' as independent demand, the history for all finished goods that use this sub-assembly.
- **Determining optimal Service Level of the sub-assembly** – The fill-rate or availability of the stocked sub-assembly is the key behind the overall on-time shipment rate of the finished goods. Since the stocked sub-assembly is used as a component in several finished goods, GAINS takes two main factors into account when calculating the sub-assembly service level:
- **Higher Customer Service Levels** – Identifying sub-assemblies to stock and their optimal inventory levels will reduce delivery time to customers and will ensure product availability. Higher Customer Service levels could lead to increase in revenue.
- **Reduction in inventory** – Holding optimal inventory will reduce Raw Materials inventory levels. An added impact will be a more balanced inventory.

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TRADITIONAL APPROACHES

The most used approaches to deal with MTS-ATO environments are using BOM Planning Bills and maintaining a Fixed-time supply of components. These approaches are static and do not permit companies to react to environment changes. Companies also typically suffer from both chronic shortages of components, and overstocked Finished Goods.

Bill-of-Material Planning Bills

Because of fundamental problems with Planning Bill methodology, companies will suffer from chronic overstocked situations and expediting. The main reasons are:

- **Inaccurate forecasting**: Planning Bills assume aggregate-level forecasts. SKU or SKUL-level demand plans are derived using historical percentage distribution of demand.
    - This methodology cannot pick up and react to recent product-specific trends without a high level of market awareness and manual effort on the part of planners
    - Furthermore, Planning Bills assume Moving Average or Exponential Smoothing forecasting models. What if the demand for an item is highly seasonal or sporadic? GAINS, thanks to SKUL-level forecasting, will generate and grass-roots forecast that can then be aggregated into different groups.
- **Static calculation of buffer or safety stock**: Safety Stock or Service Stock levels can only be calculated using forecast error and other errors in the supply chain. Planning bills because of the top-down approach cannot calculate forecast errors. Furthermore, safety stock values are typically static numbers that are very infrequently re-evaluated or modified. GAINS will calculate SKUL-level Service Stock values that will change given a change in the forecast and the related error in the plan.

Fixed-time supply of components

Using manually-derived 'Broad brush' policy and rules, by class, to determine what the Fixed-Time supply of components across all items should be will not result has different demand patterns and cost factors, a "one-size-fits-all" policy is inadequate.

- Companies are de facto using a Moving Average forecast. Moving Average forecasts have limited capacity to take trends or seasonality into account
- Furthermore, how should companies determine what that appropriate time-supply should be? Should it be five days or 30 days?

COMPONENT "WHERE-USED" DENSITY IMPACT ON SERVICE LEVEL DETERMINATION

"Where-Used" density reflects the quantity of Finished Goods that use a specific component. Or, in how many Bill-Of-Materials does a component appear? A component that is used in the assembly of a high number of Finished Goods has a high "Where-Used" density. The higher the "Where-Used" density, the higher component-level Service Levels need to be to hit the target Service Level of **ALL** Finished Goods using that component.

Illustration: Target Finished Good Service Level = 90%

- Scenario 1: High "Where-Used" density
    - Component is used in 15 Finished Goods
    - Resulting Component Service Level: **99.3%**
- Scenario 2: Low "Where-Used" density
    - Component is used in 5 Finished Goods
    - Resulting Component Service Level: **98%**

CONCLUSION – ENVIRONMENTS WHERE GAINS MTS-ATO LOGIC IS APPLICABLE

- Long cumulative lead times due to overseas sourcing of raw components combined with a shorter final-assembly or manufacturing lead time
- Large or increasing product portfolio, due to additional options, features, modules of Finished Goods (e.g. color schemes and coatings)

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