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# Raw Material Inventory Strategy for Make-to-Order Manufacturing

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# Agenda

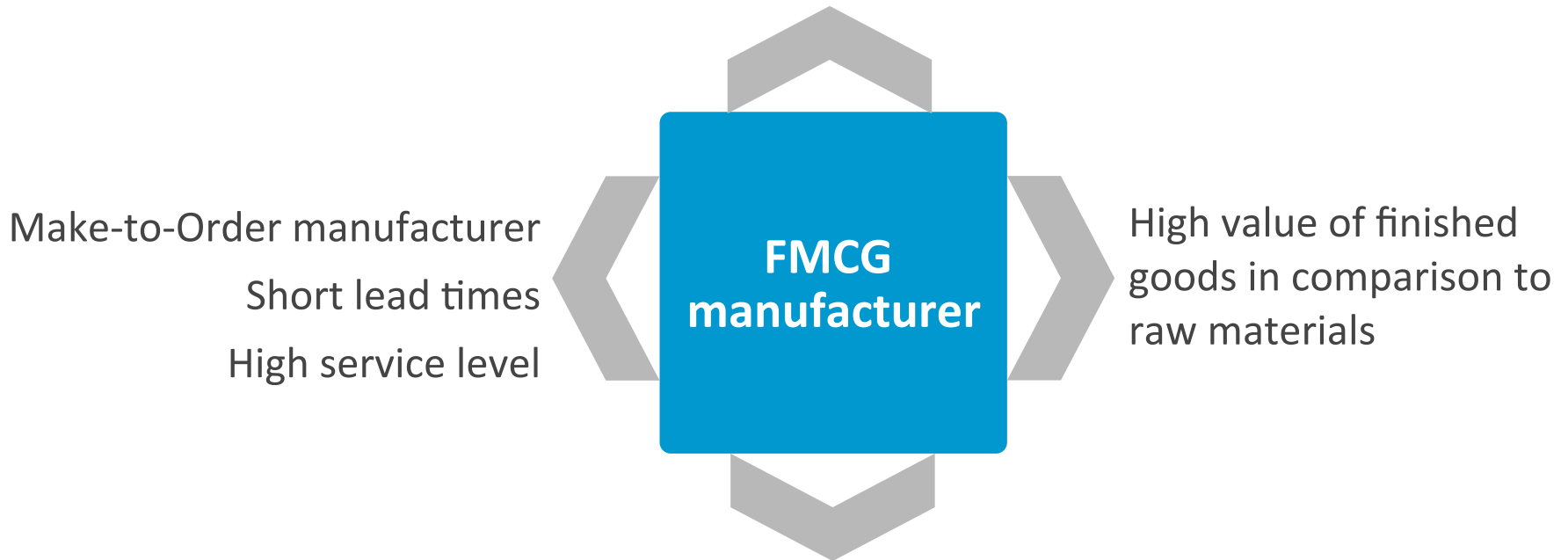
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- > Context
- > Current Structure
- > Approach
- > Results
- > Questions

# Context

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High growth rate sustained for the last decade  
The focus was market share



Legacy inventory policies untouched  
Have worked reasonably well

# Context contd.

## So why change inventory policies and why not do it the conventional way?

### Supplier service levels are variable

- > Supplier service levels (SSL) are variable and can greatly impact production
- > The actual quality of the raw material is the problem
- > Switching to another supplier not always practical

Can Inventory policy changes mitigate the effect of SSL decline?

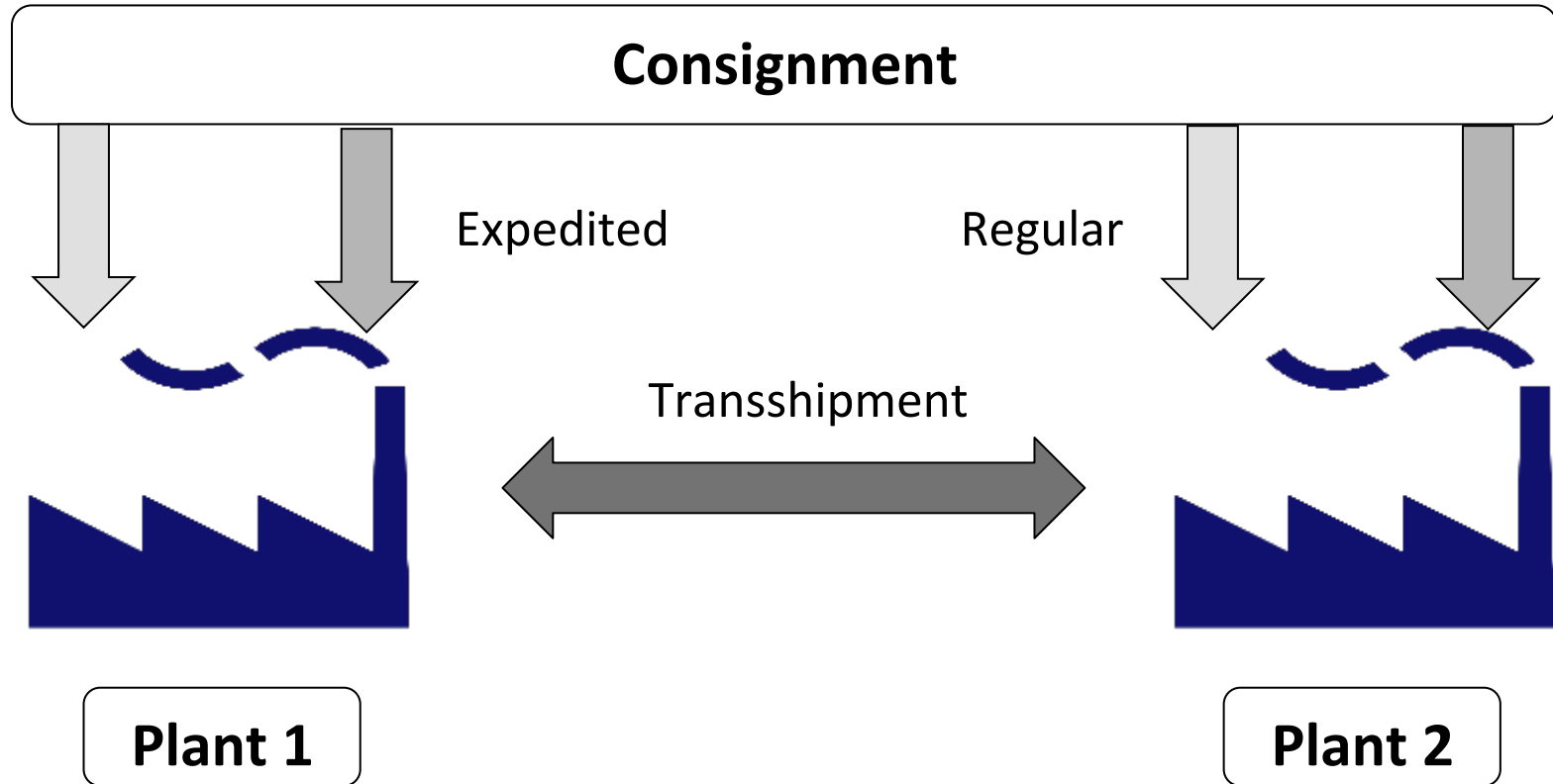
### Cost information not available

- > Traditional inventory policy determination requires cost and/or service level information
- > Trade-off information is needed in order to devise strategies
- > An evaluation tool is more appropriate to help understand policy change effects

Can a model for testing the effects of inventory policy changes be built without cost information?

# Current Structure

## Two echelon, centralized inventory management



# Current Structure contd.

## Demand

- > Make-to-Order and forecast errors limit demand visibility
- > Sudden spikes in demand can trigger the ordering cycle

## Replenishment

- > Decision based on days on hand (DOH)
- > Different shipments have different DOH levels

## QA & Backorders

- > Packaging allows limited inspection
- > Real check just before production
- > Backorders completed as soon as possible

## Transportation

- > Regular shipments preferred
- > Regular shipment cost is included in material costs

# Approach

## Understand current process

### Understand current process

- > The current processes are deeply embedded in organization
- > Improve the process for practical application

## Identify key metrics

### Identify key metrics

- > Key criteria is to meet production plan
- > Production Fill Rate (PFR) is the measure of adherence to production planning
- > In conjunction with shipments and inventory levels

## Find cost substitutes

### Find cost substitutes

- > Hard to put a cost to different shipments, inventory holding costs, etc.
- > Number of events give a better understanding to management

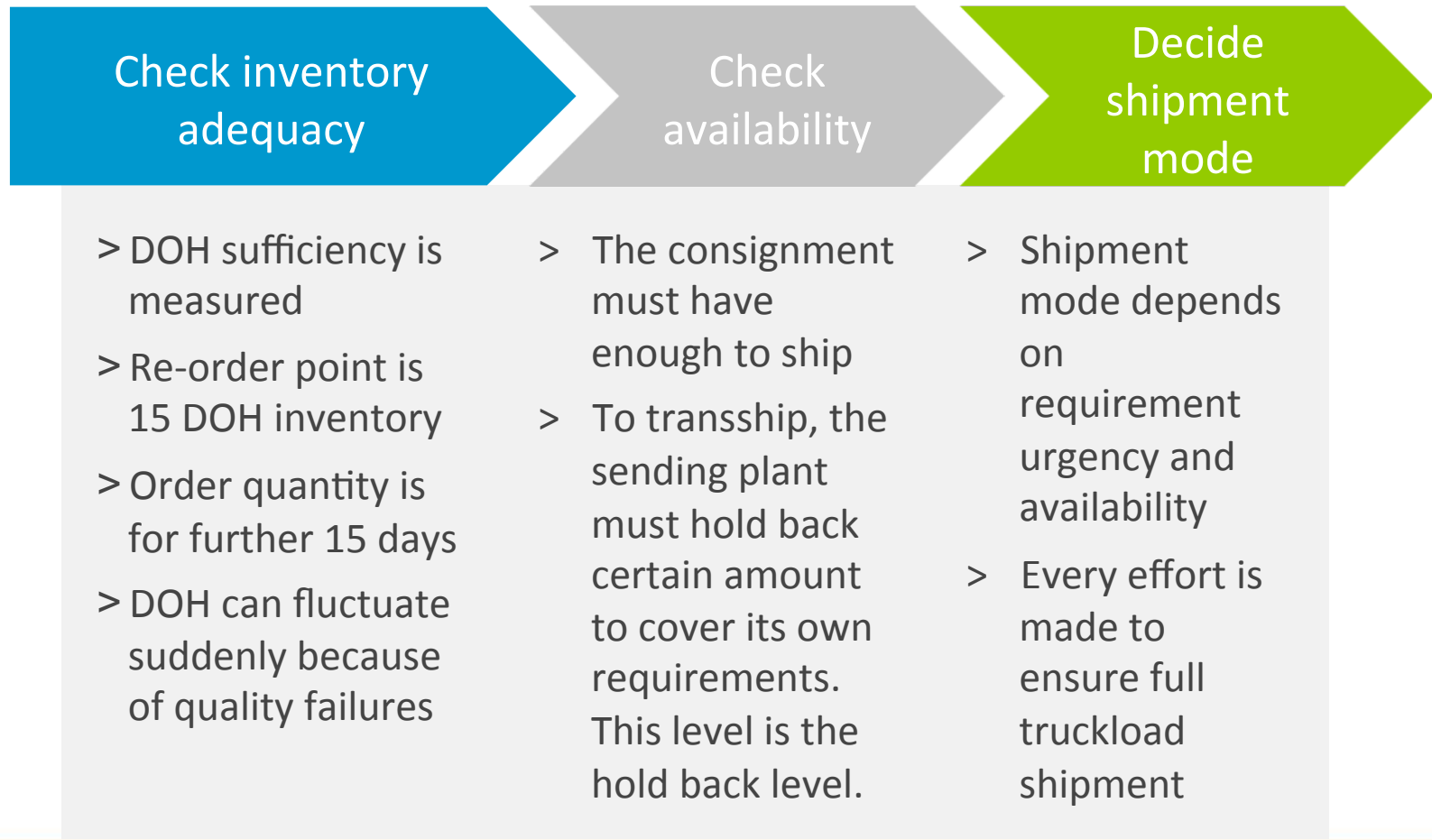
## Decide mathematical formulation

### Decide mathematical formulation

- > Numerical model or simulation model?
- > Flexibility and ease of future usage by sponsor main concerns

# Approach contd.

## Current process



# Approach contd.

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## Key metrics and cost factors

**1** Production Fill Rate = Production quantity fulfilled on time / Total production quantity

**2** Regular shipments = Number of regular shipments in a year

**3** Expedited shipments = Number of expedited shipments in a year

**4** Transshipments = Number of transshipments in a year

**5** Average inventory = Sum of daily starting inventory / 365

**Note: All metrics are averaged over two plants**

# Approach contd.

## Which model to use?

### Numerical Model

- > Provides the optimal solution
- > Harder to formulate
- > Without cost info, certain values cannot be deduced
- > Less flexible
- > Future changes can be difficult to add

### Simulation Model

- > Does not provide optimal solution but can be a good evaluation tool
- > Easier to implement
- > Can work with number of events instead of costs
- > Flexible, modifications easier to implement
- > Easy to use within sponsor organization

# Approach contd.

## Solution approach

- > The possible combinations of parameters under various inventory policies is extremely high
- > Need to reduce the number of combinations

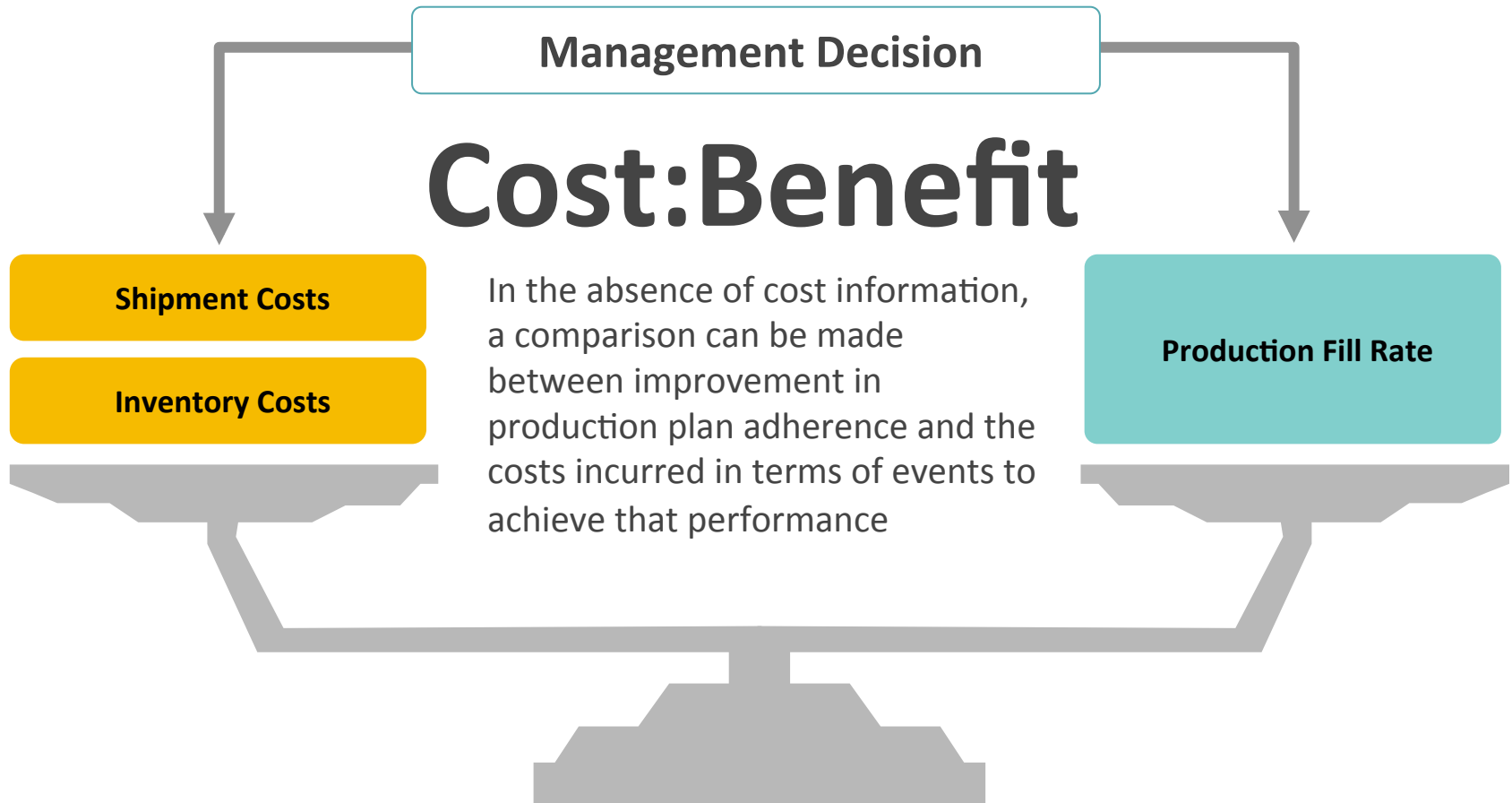
### Phase-1

- > Decide the transshipment hold back level
- > Test this hold back level at different SSL and standard deviations of demand
- > Fix the chosen value for the use in next phase

### Phase-2

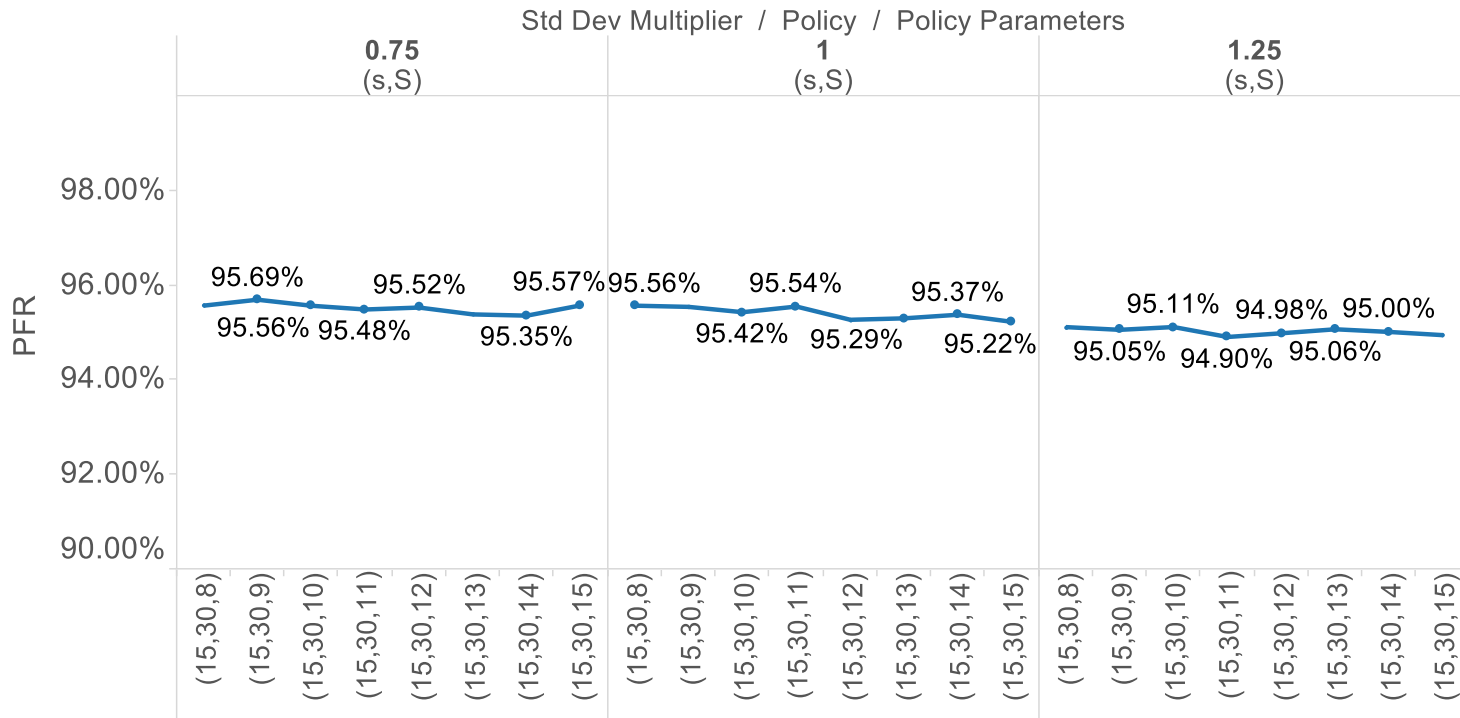
- > With the assigned hold back level, simulate for different combinations of the re-order point and re-order quantity  $(R,Q)$   $(s,S)$
- > Record the results in terms of events
- > Check the sensitivity of the different policies for various SSL and standard deviations of demand

# Results



# Results contd.

## Phase-1 Fix hold back level

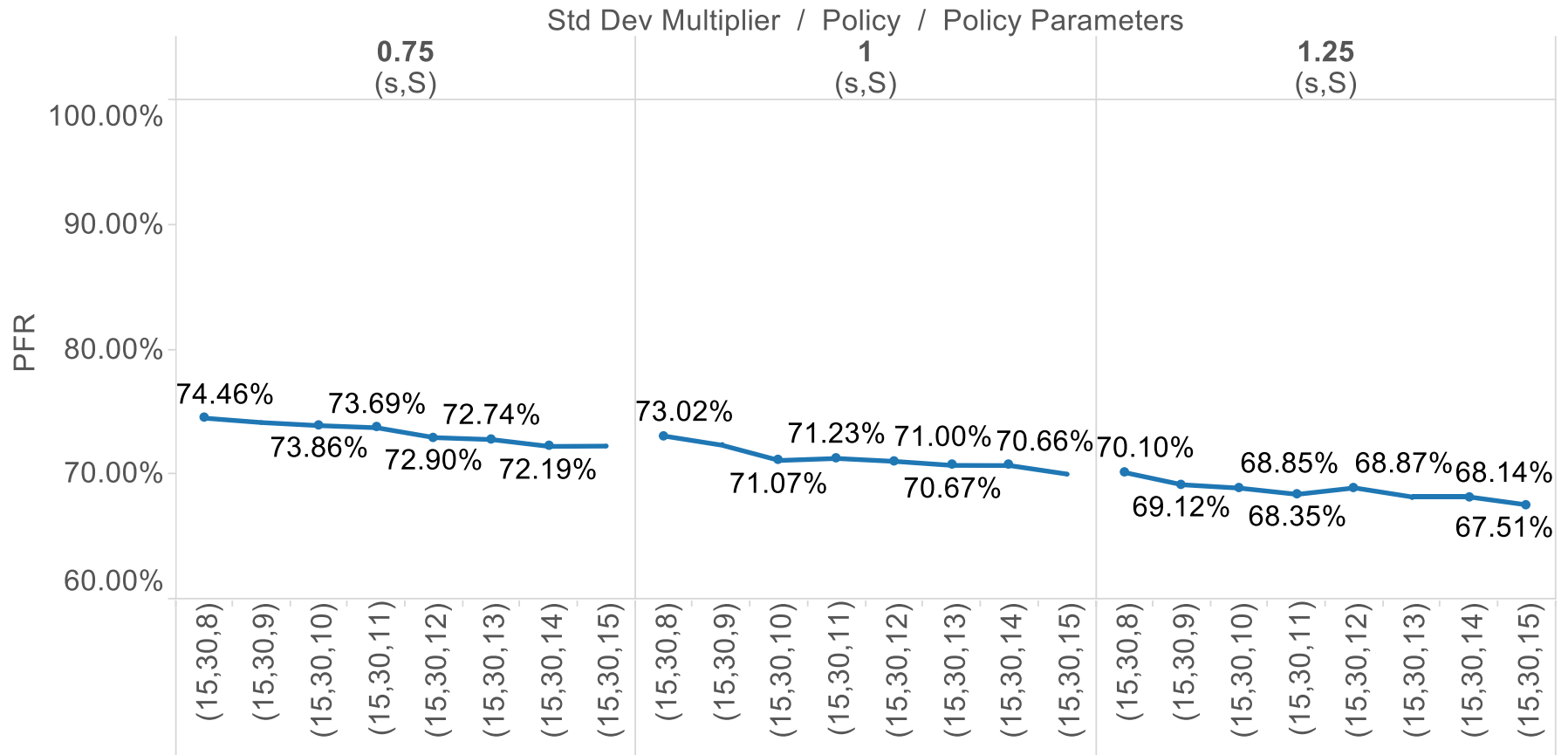


### Hold back level

- > Current value of 15 can be improved
- > Lower hold back levels enable more transshipments, especially with low SSL
- > Better distribution of raw materials
- > Improves the PFR slightly and generally gives better results

**SSL = 97%**

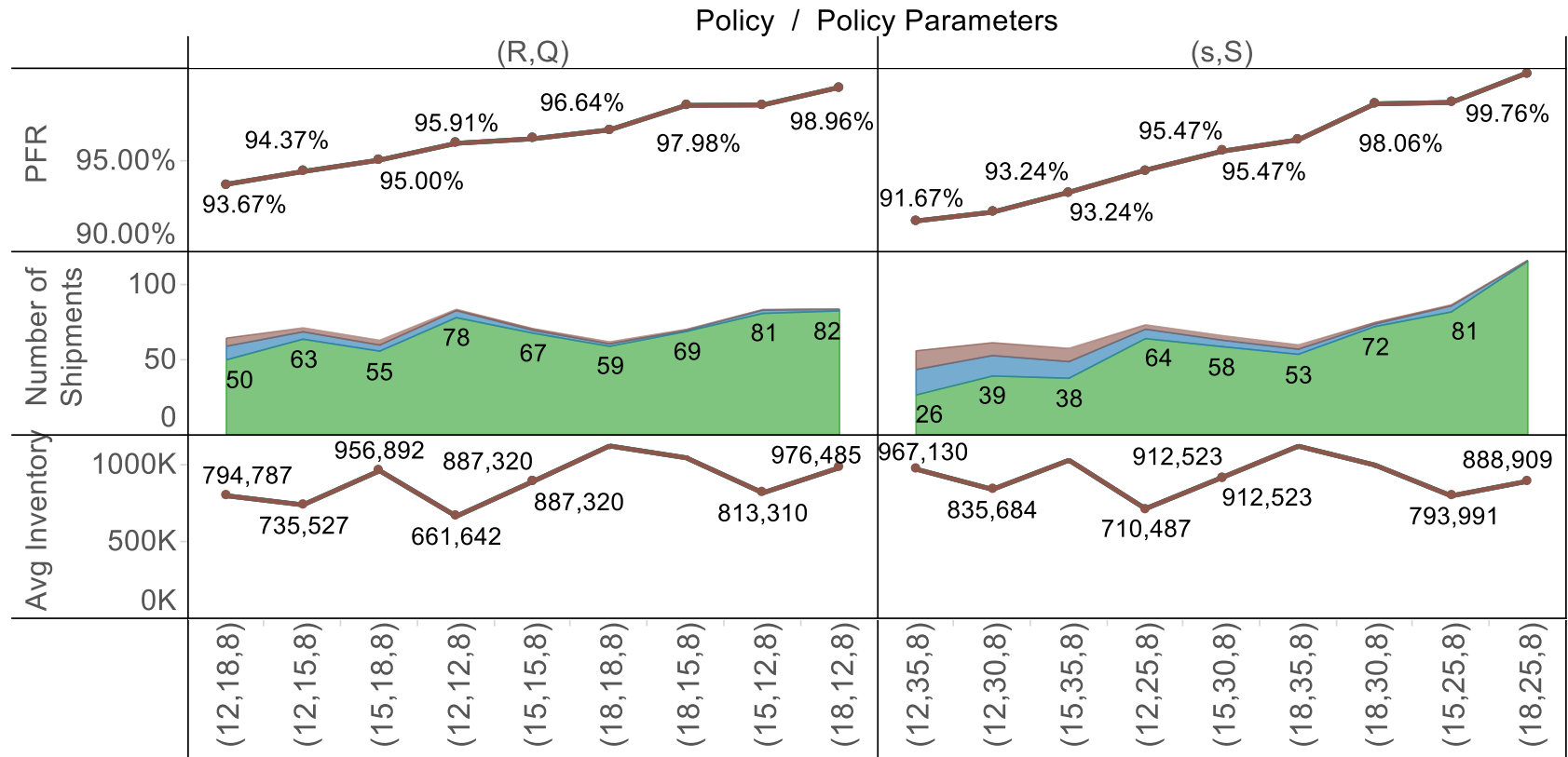
# Results contd.



**SSL = 91%**

# Results contd.

## Phase-2 Vary inventory policy specifics and record events



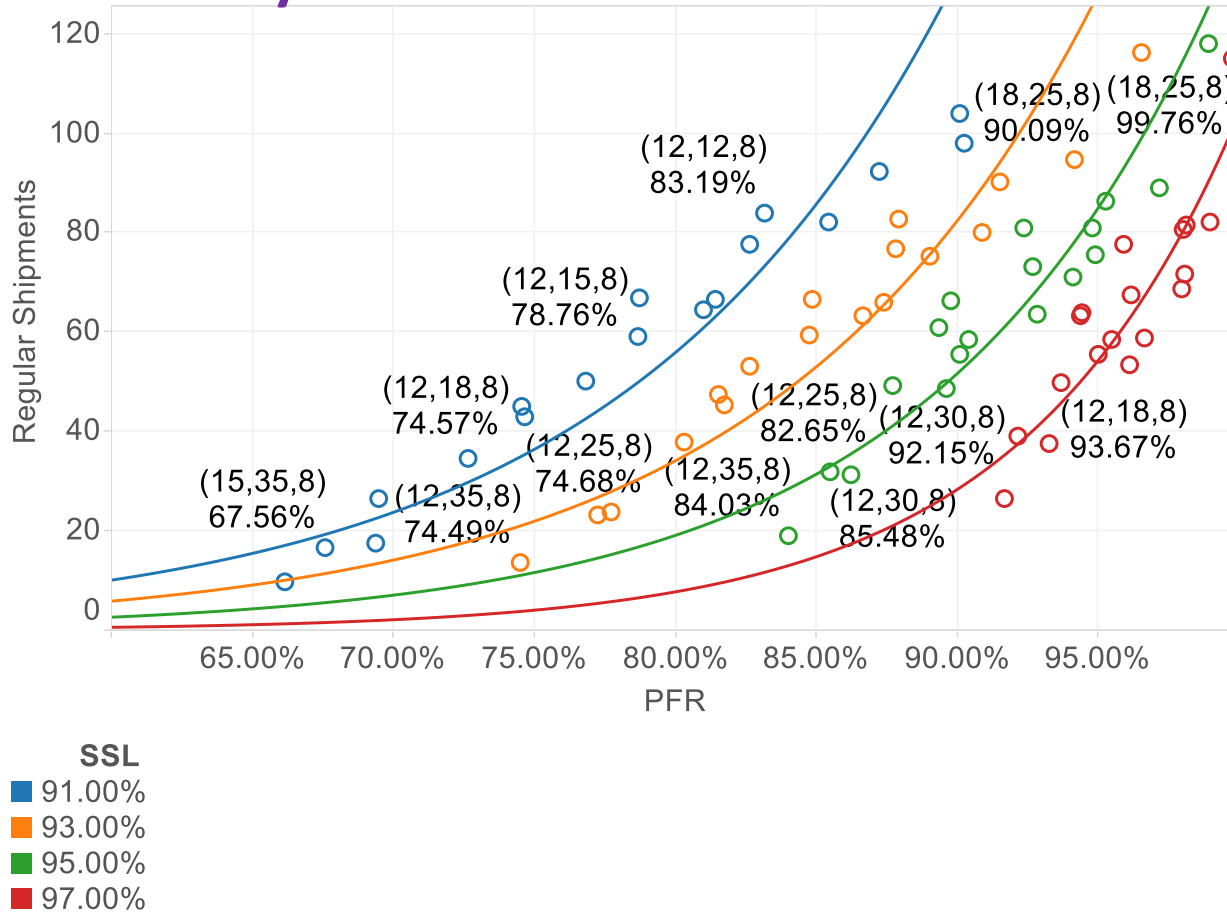
### Shipment Type

- Transshipments
- Expedited Shipments
- Regular Shipments

**SSL = 97%**

# Results contd.

## Sensitivity Checks - SSL

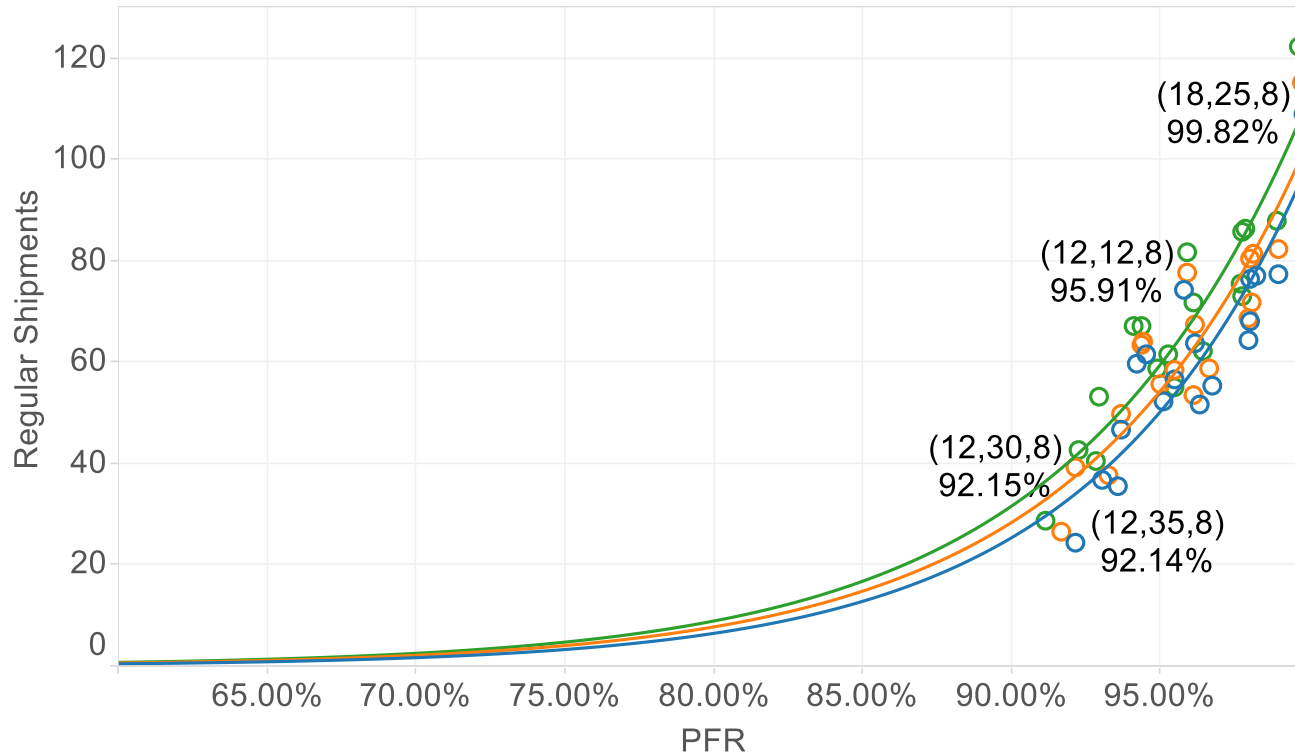


### Sensitivity to SSL changes

- > PFR is highly sensitive to SSL
- > A 2 percentage points reduction in SSL can have up to 5 percentage points reduction in PFR
- > The number of shipments will need to be much higher to meet the old PFR requirements

# Results contd.

## Sensitivity Checks – standard deviation



Std Dev Multiplier

■ 0.75

■ 1

■ 1.25

**SSL = 97%**

**Sensitivity to standard deviation changes**

- > PFR is comparatively stable to standard deviation changes
- > Same policy can be applicable over a wide range of SKUs

# Results contd.

## Can inventory policies offset SSL decline?

No, but it can help mitigate the damage. To a certain extent, PFR can be recovered.

## What to do immediately?

Reduce the hold back level for transshipment. This will help the PFR improve slightly.

## The current system not good enough?

The current system places large order constraints on the consignment which then needs to be replenished itself.

## Results

- Increase reorder point
- Reduce reorder quantity
- Increase frequency of shipments
- Analyze event-based tradeoffs

## Long term recommendations?

Increase the re-order point and decrease the order quantity. This will improve PFR but will increase costs elsewhere.

## Change the supplier?

To overcome the drop in PFR due to low SSL, the ultimate solution is to find a better supplier

## Can't change supplier?

Incentivize the supplier to increase the SSL. It will probably be money well spent.

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# Thank You!