Global Garment Bar Inventory Management System

IE3100R System Design Project

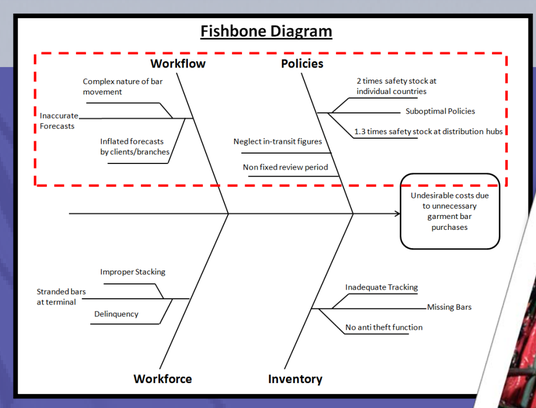
Company Background

American President Lines Limited (APL) is a container transportation and shipping company that serves more than 25,000 locations in 140 countries around the world. It is a wholly-owned subsidiary of Singapore-based Neptune Orient Lines (NOL), the largest shipping and logistics company listed on the Singapore Stock Exchange.

Problem Description

One business area of APL lies in the shipping of garments. Containers handling such loads are fitted with detachable installation known as garment bars that allow textiles to be transported unfolded on clothes hangers. The Equipment Management Department (EMD) manages inventory records, repositioning and purchasing of these bars.

In recent years, APL notices that costs associated with garment bars purchases are on the rise. This observed phenomenon can be attributed to inefficiencies of the current system classified under 4 main categories, namely 'Inventory', 'Policies', 'Workflow' and 'Workforce'. This project focuses on the problems of forecasts inaccuracy and sub-optimal policies with respect to bars repositioning and purchasing decisions.

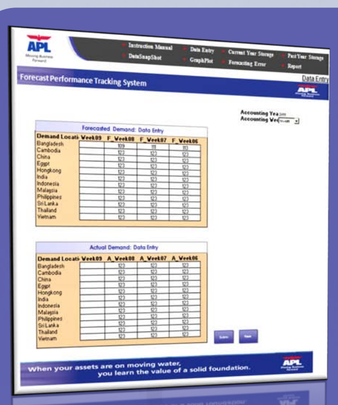


Forecasting Solutions

A straightforward solution is to simply monitor the forecast performance of individual demand locations over time. Performance measure such as cumulative sum tracking signal can be used to identify sources of inflated figures on a backward-looking basis.

A continuously updated confidence interval of demand forecast is provided to give the user an expected range of forecast demand for the next period.

Forecast Performance Tracking System

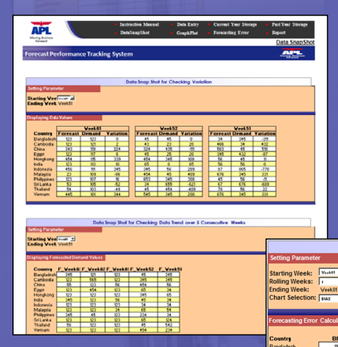


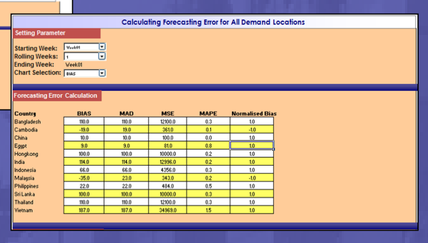
Deliverable 1: Microsoft Excel spreadsheet coded using Microsoft Visual Basic for Applications.

User enters past forecasted and actual demand data on a weekly basis.

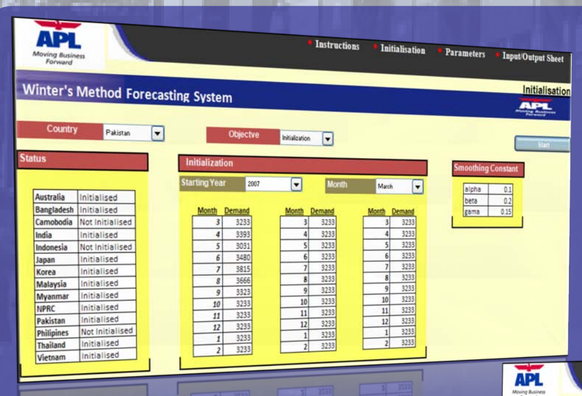
System records figures and allows them to be viewed under "Data Snap Shot" Panel.

A more in depth analysis can be made via various graph plots and forecasting performance measures.





Winter's Method Forecasting System

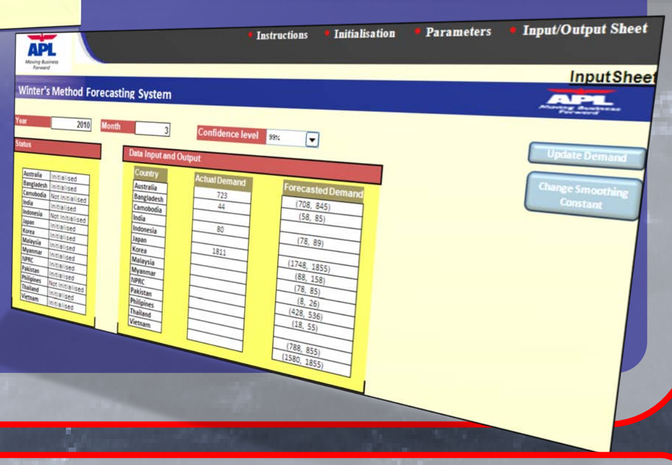


Deliverable 2: Microsoft Excel spreadsheet coded using Microsoft Visual Basic for Applications.

User initializes system using at least 3 years worth of historical demand records.

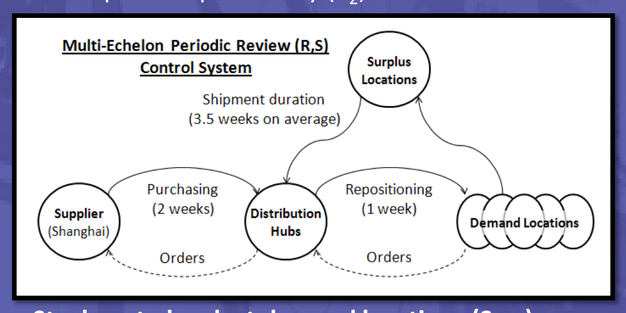
User updates system by entering forecasted and actual demand of demand locations.

System generates forecast confidence interval based on desired confidence level provided by the user.



Proposed Inventory Management Policy

The global garment bar shipping network was simulated as a multi-echelon inventory model. Recommended policies changes were based on decision rule for periodic review (R,S) control system with specified probability (P_2) of demand satisfied directly from shelf.



Stock up to level at demand locations ($S_{t(dl)}$)

$$S_{t(dl)} = E(X_{t+1}) + \text{Safety Stock}_{(dl)}$$

$$\text{Safety Stock}_{(dl)} = k \times \sigma_1$$

Given $G_u(k) = \frac{X_{t+1}}{\sigma_1}(1 - P_2)$, where $G_u(k) = \int_k^{\infty}(u-k)\frac{1}{\sqrt{2\pi}}\exp(-\frac{u^2}{2})du$

Stock up to level at distribution hub($S_{t(hub)}$)

$$S_{t(hub)} = E(X_{t+2}) + E(X_{t+3}) + \text{Safety Stock}_{(hub)}$$

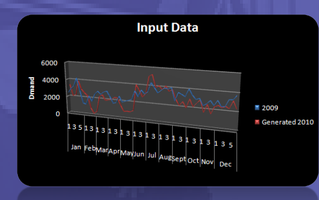
$$\text{Safety Stock}_{hub} = k \times \sqrt{\sigma_2^2 + \sigma_3^2}$$

Given $G_u(k) = \frac{X_{t+2} + X_{t+3}}{\sqrt{\sigma_2^2 + \sigma_3^2}}(1 - P_2)$, where $G_u(k) = \int_k^{\infty}(u-k)\frac{1}{\sqrt{2\pi}}\exp(-\frac{u^2}{2})du$

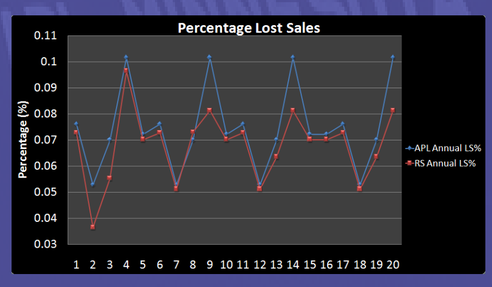
Comparison of Alternatives using Simulation

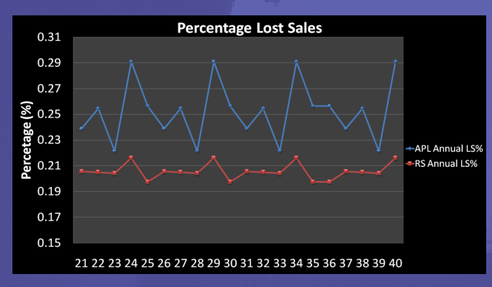
Weekly demand for 2010 of 9 demand locations was generated using input modeling. 40 test cases of 50 replications each were simulated.

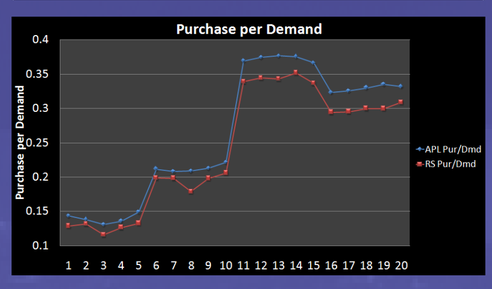
	Test Case							
	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to 30	31 to 35	36 to 40
Demand (set)	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5
% Yield Loss	0	10-20	30-40	10-40	0	10-20	30-40	10-40
Positive Forecast Bias	Yes	Yes	Yes	Yes	No	No	No	No

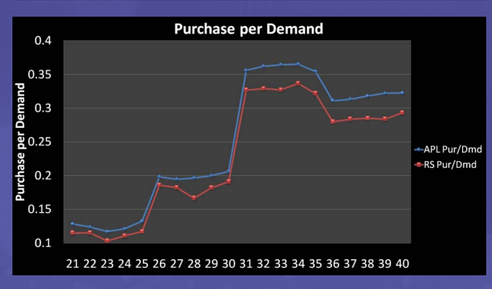


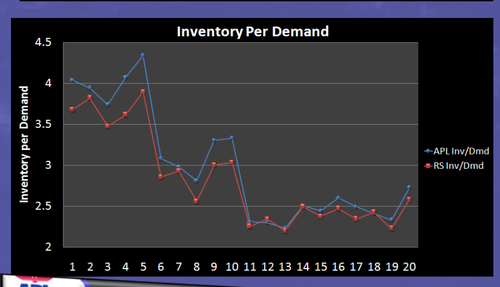
A P_2 comparable to APL's existing policy was employed. Proposed (R,S) control system consistently outperformed current system across all 3 performance measures.

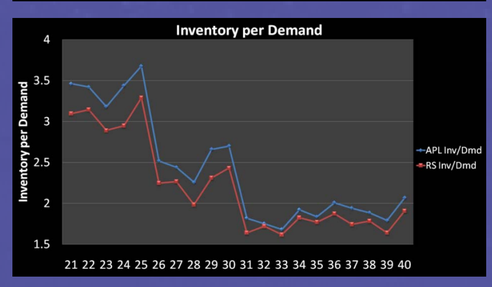


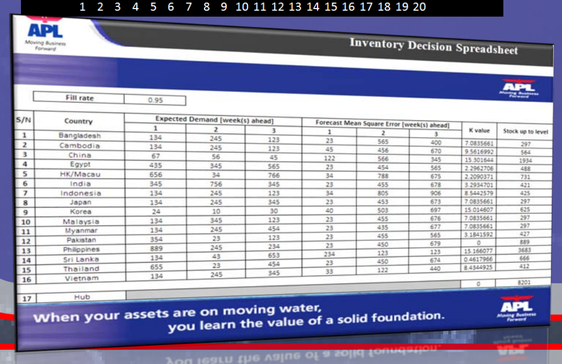












Deliverable 3: User enters forecasts, forecast mean squared errors and desired fill rate. Inventory decision spreadsheet calculates stock-up-to levels for individual demand locations and distribution hubs.

Recommendations & Conclusion

The Forecast Performance Tracking System enables EMD to identify inflated forecasts made by branch offices, while the Winter's Method Forecasting System serves to provide EMD with their own independent forecasts. Both aim to eradicate the problem of inflated forecasts.

The proposed Periodic Review (R,S) Control System is also found to be more cost efficient than the existing policy.

These solutions result in less bar purchases and a more efficient garment bar inventory.

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