# Demand Forecasting with Real Case Analysis for Effective Retail Decision-Making

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## Abstract

Supply chain decisions involve different entities and activities such as sourcing of material, production of goods, and logistics. Through the efficient management of these activities, firms can gain a competitive edge by beig responsive in maximizing customer value and enhance its efficiency by minimizing operating costs. Inadequate management results in poor replenishment processes which can, in turn, lead to lack of product availability in stores, lost sales, or oversupply of products, etc.. Accurate demand forecasting plays a crucial role in reducing these problems by providing precise quantities required to order and store to satisfy the customer demands, reduce inventory and production costs, reduce safety stocks and transportation, and improve replenishment processes. However, demand forecasting for products, mainly perishable goods can be challenging for firms. Many companies, such as retailers, have struggles in accurately predicting future demand. Suppliers usually have a bulk shipment process that can cause inventory differences for the retailer's desires. Furthermore, without proper information sharing between a retailer and its suppliers, mismanagement of order quantities and production can occur. Recently, these problems are tackled through the adoption of collaboration models between supplier and retailer. More precisely, companies are encouraged to integrate inventory management models to order when required. The integrated model enhances the demand planning, inventory control and replenishment processes in the supply chain. Nonetheless, the investments in such methodologies are costly for both suppliers and retailers alike. Moreover, the benefits from implementing these models are not clear in monetary terms and are not widely discussed in the literature. This research aims to improve inventory management of a retailer located in the United Arab Emirates that is facing issues with its replenishment and forecasting processes. To achieve this purpose, forecasting models such as ARIMA, exponential smoothings and machine learning models such as Artificial Neural Networks (ANN) were built and tested for the highest accuracy. The results show that forecast models ARIMA and average of ARIMA and triple exponential smoothing achieve the best accuracy, i.e., the least forecasting error value. Implementing the forecast model needs coordination and collaboration between the supply chain entities. Therefore, collaborative planning, forecasting and replenishment collaborative, CPFR, was suggested for the retailer's supply chain through a specific framework. Finally, the benefits of the collaboration framework in terms of transportation costs were displayed using discrete-event simulation. Several scenarios and parameters were tested. Adopting the CPFR collaborative framework could reduce the transportation cost for some retail items by 42% evident in the simulation.

## Keywords
Demand forecasting, collaboration, supply chain management, CPFR, simulation of supply chain activities

## Biographies

**Dr. Dua Weraikat** is an assistant professor in RIT- Dubai. She has a Ph.D. degree in Industrial Engineering from Concordia University, Montreal, CA. Dr. Weraikat research interests lie in Operation Research, Green Supply Chain, Collaboration Mechanisms in Reverse Supply Chain for Perishable Products, and Coordination in Pharmaceutical Supply Chains. She has several publications in high-ranked journals in the field of Industrial Engineering.

**Safika Thasin** is a graduate of Rochester Institute of Technology, Dubai with a B.Sc. degree in Industrial Engineering. She was recently awarded Undergraduate Research Scholar Recognition Award for her contribution to the research conducted as her graduation project. Her prospects are to do a Master's in Logistics and Supply Chain Management.

**Caroline Zeidan** is an Industrial Engineering graduate from Rochester Institute of Technology. Her senior design project was a research on forecasting and supply chain management. Her prospects are to do a Master's in Programming to learn futher about artificial intelligence.

**Muhammed Ishtiaq** is a graudate from Rochester Institute of Technology, Dubai with a B.Sc. degree in Industrial Engineering and he completed his high school from the International School of Choueifat in 2015. He is currently enrolled in an internship program in Emerson Electric, where he applies his knowledge in the field of Manufacturing and learning everyday. He is also in the process of starting up a new e-commerce organization in the field of packaging services tackling consumer needs as-well as providing utmost sustainability.

**Dr. Adolf Acquaye** is an Associate Professor in Industrial Engineering at Rochester Institute of Technology, Dubai, UAE. Previously, he was a Reader in Sustainability at Kent Business School, University of Kent, UK. He is a Lead Author for the United Nations Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6), 2018-2021. He also previously acted as a Lead Author for the AR5 (2012-2014) and Contributing Author of the Technical Summary Report of the IPCC.

Dr Acquaye serves on the Editorial Board of Energies and has Guest Edited Special Issues in the Journal of Environmental Accounting and Management and Energies. He is the recipient of research funding awards from the European Commissions and The British Academy. He is widely published on his research, which cuts across sustainability issues and how these inform business practice and policy.