Managing Uncertainty and Risk in the Supply Chain using Financial Engineering Instruments

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ABSTRACT

In the last few years we have seen a significant growth in the use of analytical tools in the design, modeling and analysis of existing and new financial products; these are typically dubbed Financial Engineering. These tools have focused on managing risk, optimizing portfolios and characterizing the trade-off between wealth and risk.

Our objective in this presentation is to illustrate that many of these financial instruments can be used in engineering systems to effectively manage risk and uncertainty. We focus on the application of financial instruments in supply chain management through the use of

- Real Options
- Portfolio Optimization
- Deviation measures such as Mean-Variance and Conditional-Value-at-Risk
- Utility theory and concepts

All these instruments have been applied in financial environments but to a great extent not to engineering systems in general and supply chain and logistics in particular. Our objective in this talk is to illustrate that financial engineering instruments can be used in engineering systems and supply chains to manage risk, to price the cost of flexibility or to evaluate product postponement strategies. Below we describe two examples:

Example 1: Reduce procurement cost and risk using a portfolio approach for supply contracts:

Traditionally, buyers have focused on long-term contracts for many of their purchasing needs. Recently, some manufacturers have started looking at more flexible, i.e., option, contracts for non-strategic components, which enable them to buy from a variety of suppliers. This example illustrates how a portfolio of supply contracts that involve the use of real options, can help reduce procurement costs and risk in the supply chain.

Example 2: Applying deviation measures and utility theory to manage inventory and pricing strategies

Traditional inventory control and pricing strategies focus on deriving policies or solutions for maximizing the expected total profit, or equivalently, minimizing the expected total cost over a planning horizon. We describe a broad framework for incorporating risk in inventory and pricing strategies using concepts such as mean-variance, conditional-variance-at risk as well the utility of wealth.

Finally, it is important to emphasize the challenges of supply chain and engineering system problems compared to traditional financial models. Indeed, in finance, portfolio and investment decisions can be reversed in the sense that investors can sell whatever asset they hold at any time; in manufacturing, however, once inventories are ordered, or produced, they are written off at a high cost, i.e., sold at a low salvage value, since the components are engineered for a particular manufacturer. This difference requires modifying financial engineering tools to engineering systems and supply chain problems.