Natnicha Khumwan 2007: Sensitivity Analysis of the Bullwhip Effect in a Three-Level Supply Chain with Stochastic Demands and Lead Times. Master of Engineering (Industrial Engineering), Major Field: Industrial Engineering, Department of Industrial Engineering. Thesis Advisor: Assistant Professor Juta Pichitlamken, Ph.D. 62 pages.

In a real-world supply chain (SC), when each party manages its organization without any coordination to the others, the so-called "Bullwhip Effect" (BWE) happens; variances of ordering patterns move up the SC from retailers, to distributors, to manufacturers, and then to suppliers. Our goal is to determine what SC factors significantly contribute to the BWE. We develop a three-level SC simulation model with stochastic demands and lead times where periodic order-up-to level inventory policy is used. We build our model in Arena (Rockwell Software). Our model consists of two retailers, a distributor and a supplier. Customers, with random demands, purchase goods only from retailers. A supplier has an infinite supply. No backorder is allowed, and unfilled demands are lost. We use 2^6 factorial design where factors are: mean of demands, standard deviation of demands, mean of lead times, standard deviation of lead times, time between inventory reviews, and multiple of lot sizes. Other key performance indicators include time-average inventory, average time in system of goods, stock-out fraction of time, and fraction of lost sales. The ANOVA results show that high levels of standard deviation of demands, mean of lead times, standard deviation of lead times, and time between inventory reviews increase the extent of the BWE. On the other hand, the lower in mean of demands and multiple of lot sizes increase the BWE. The results for other key performance indicators are shown inside of the paper.

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