

# A Comparative Study of Bullwhip Effect in a Multi-Echelon Forward-Reverse Supply Chain

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## SUMMARY

Along with the forward supply chain organization needs to consider the impact of reverse logistics due to social awareness, environmental benefits and economic advantages. An important observation in a supply chain management, known as the bullwhip effect, refers to the phenomenon where orders to the supplier tend to have larger variance than sales to the buyer (e.g., demand distortion), and the distortion propagates upstream in an amplified form (e.g., variance amplification) (cf. [1]). The quality and quantity of used products return to the collection points are uncertain in the reverse channel. Because of this, the systematic distortion is inevitable and bullwhip effect may occur at retailer, distribution and manufacturer level. In this paper, first, we propose a system dynamics framework for a multi-echelon integrated forward-reverse supply chain network. Then, in the simulation study, we analyze the order variation at both the retailer and distributor level and compare the bullwhip effects of different logistics participants over time between the traditional forward supply chain and the integrated forward-reverse supply chain. Also, in the proposed model, a sensitivity analysis is performed to examine the impact of inventory adjustment time, cover time and collection rate of used products on the order variance and bullwhip effect.

**Keywords:** Reverse Supply Chain, Bullwhip Effect, Simulation, System Dynamics, Return Rate, Inventory Cover Time.

**AMS Classification:** 37M05, 90C31, 90B50

## References

- [1] HAU L LEE, V PADMANABHAN, AND SEUNGJIN WHANG (1997). The Bullwhip Effect In Supply Chains. *Sloan Management Review* **38**(3), 93–102.

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