Inventory Dynamics In Supply Chain Networks

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What in this work?

To explore the inventory dynamics in supply chain systems with complex network configurations and complicated communication mechanism and inventory policies, we propose:

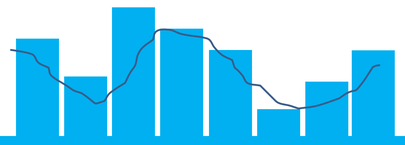
- *An agent-based model that simulates the operation of a general network supply chain system with multiple players, including supplier, distributor, and retailer.*
- *A HubNet model that allows human clients to experience the inventory dynamics and peer competition in the simulation.*

Why study this?

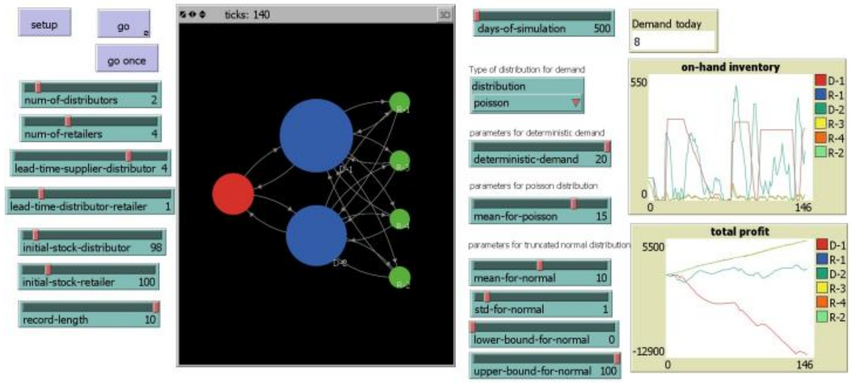
Due to the uncertainty of demands in the marketplace, the inventory profile in the supply chain system tends to be highly dynamic, which makes the inventory management very difficult.

Traditional approach to study the inventory dynamics was via statistical methods and probability tools. However, this approach is prohibitive for supply chain systems with complex network configuration and abundant features. However, agent-based modeling provides a solution.

In this work, we try to incorporate the major factors that affect the inventory dynamics and the economic performance of the supply chain system, namely supply delays, ordering policies, allocation rules, sourcing preferences.

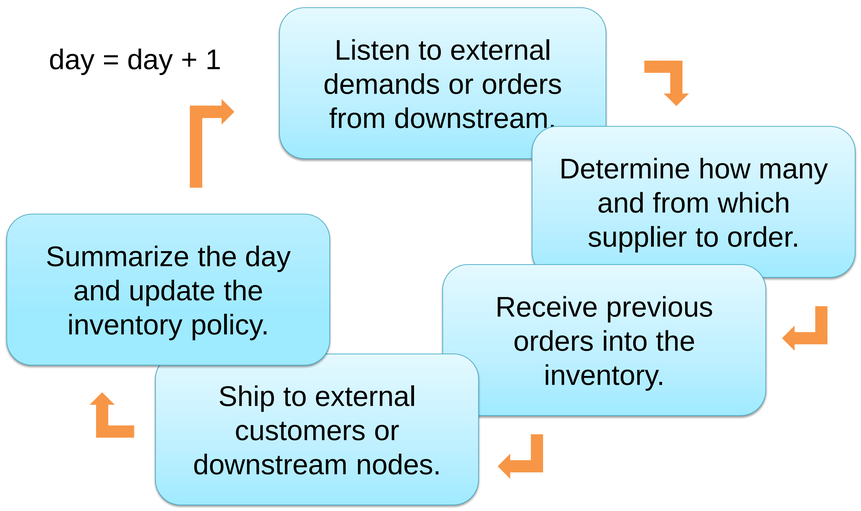


What models look like?



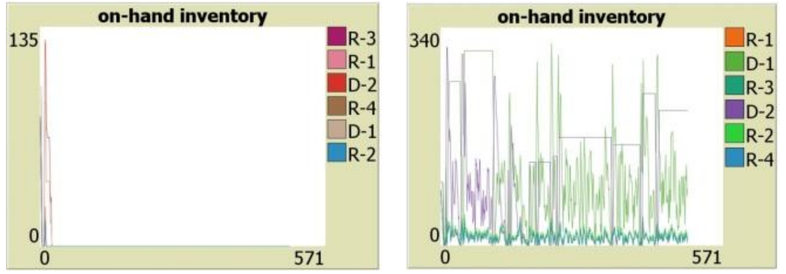
- A supply chain system with three echelons: supplier, distributor and retailer.
- Adjacent players connected by demand links and supply links.
- Sliders to adjust network configuration, supply delays, demand generation mechanisms, etc.
- Plots showing the on-hand stock level and profit for all players

How agents act?



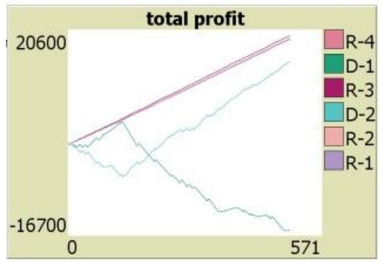
What we observe?

Constant demands vs. Uncertain demands



Steady inventory vs. Fluctuating inventory

- Inventory profile in the supply chain system tends to be highly fluctuating under uncertain external demands.
- Amplitude of fluctuation would propagate from downstream to upstream.



Player's attitude towards risks

Safety stock level: higher or lower?

- Higher safety stock level guarantees better customer services.
- Higher safety stock level helps to keep customers and win the competition in the long run.

This work is done at Northwestern University.
All models are coded in NetLogo.