

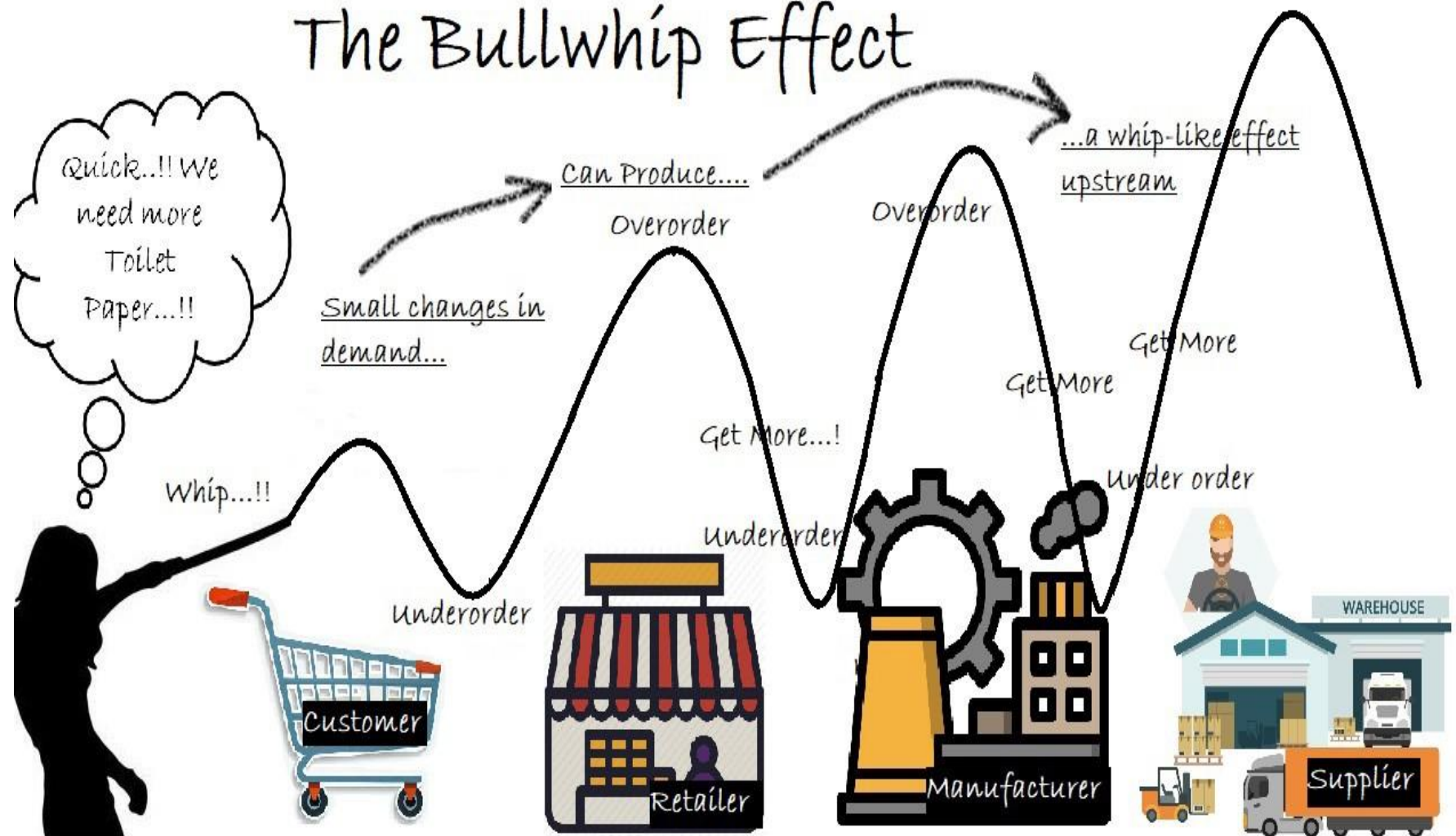
# Complexity in Supply Chains

**Systems Science- Group 4**  
**Vikram Khanzode (300198886)**  
**Yash Doshi (300218400)**

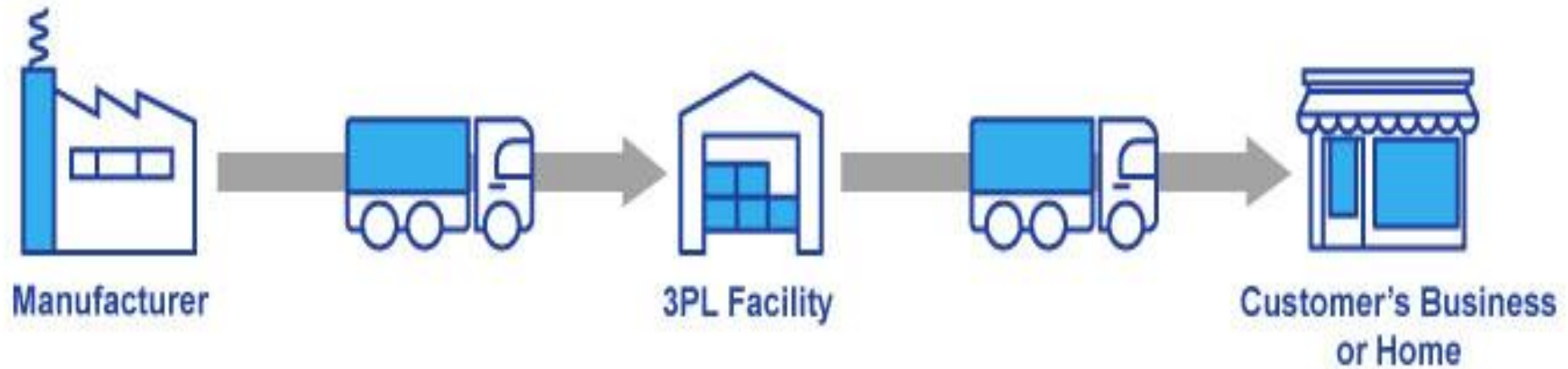




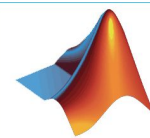
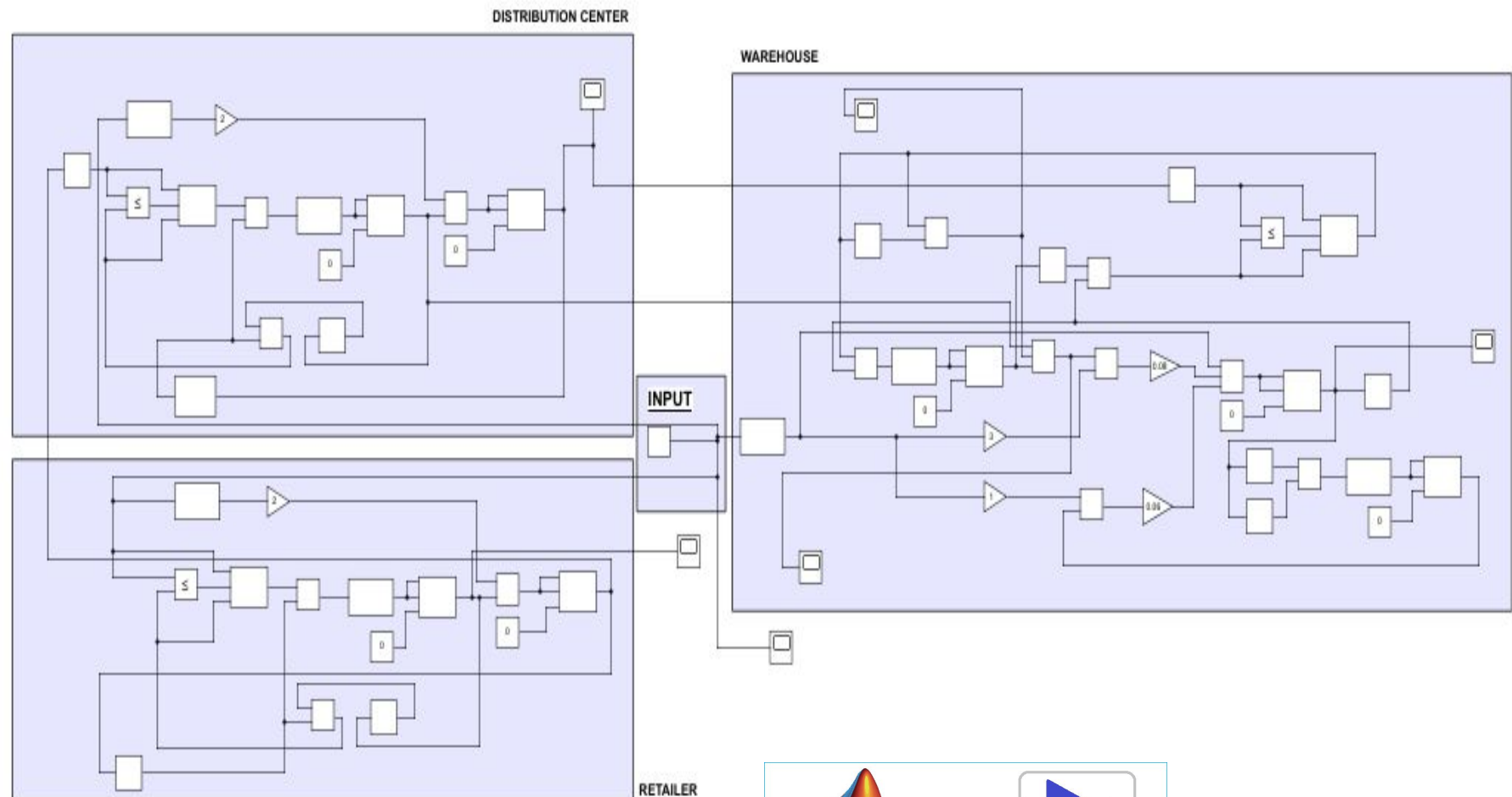
# The Bullwhip Effect



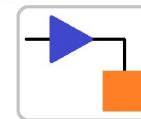
# THIRD PARTY LOGISTICS



# THIRD PARTY LOGISTICS MODEL



+

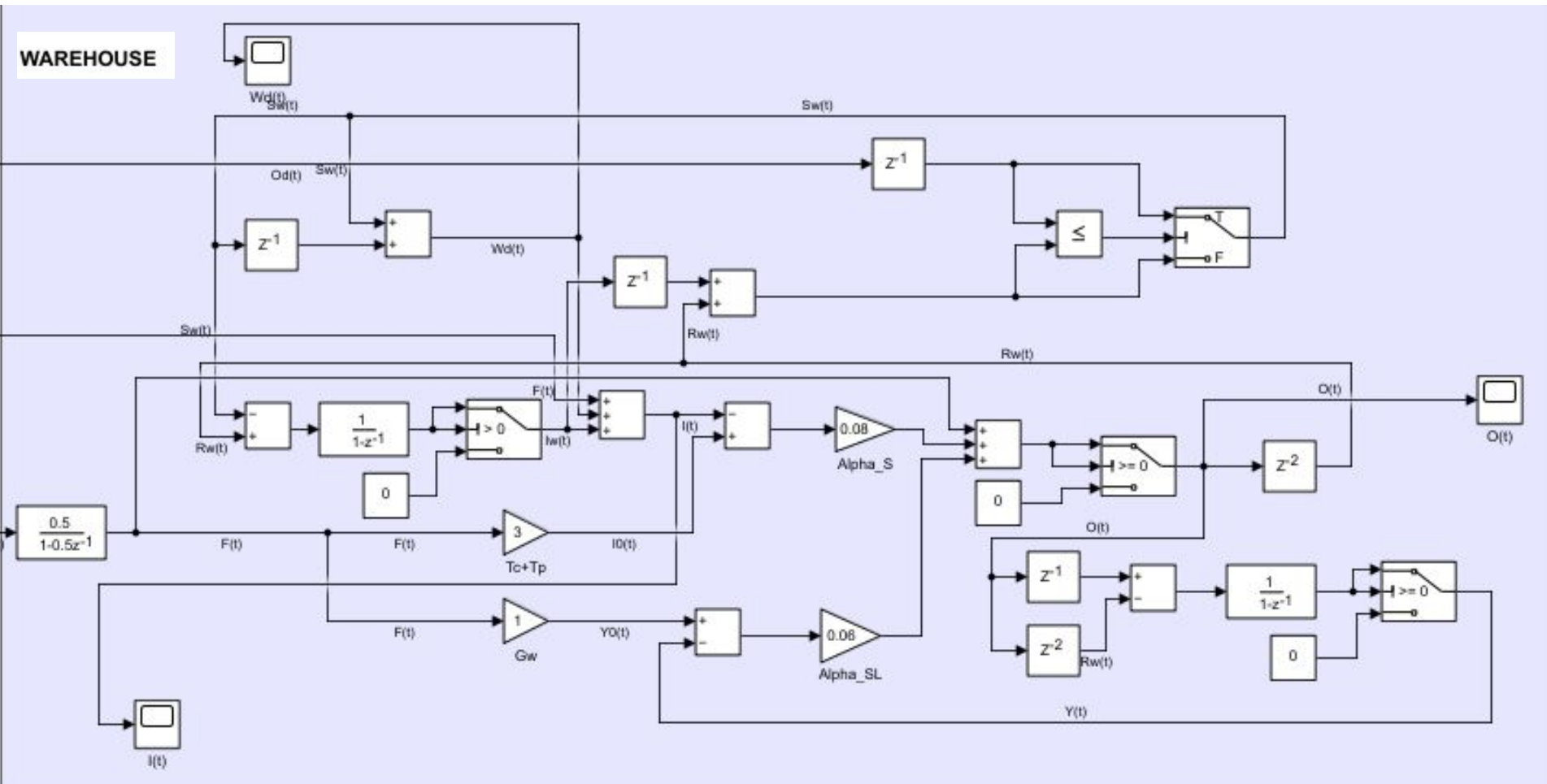


**MATLAB**  
**SIMULINK®**



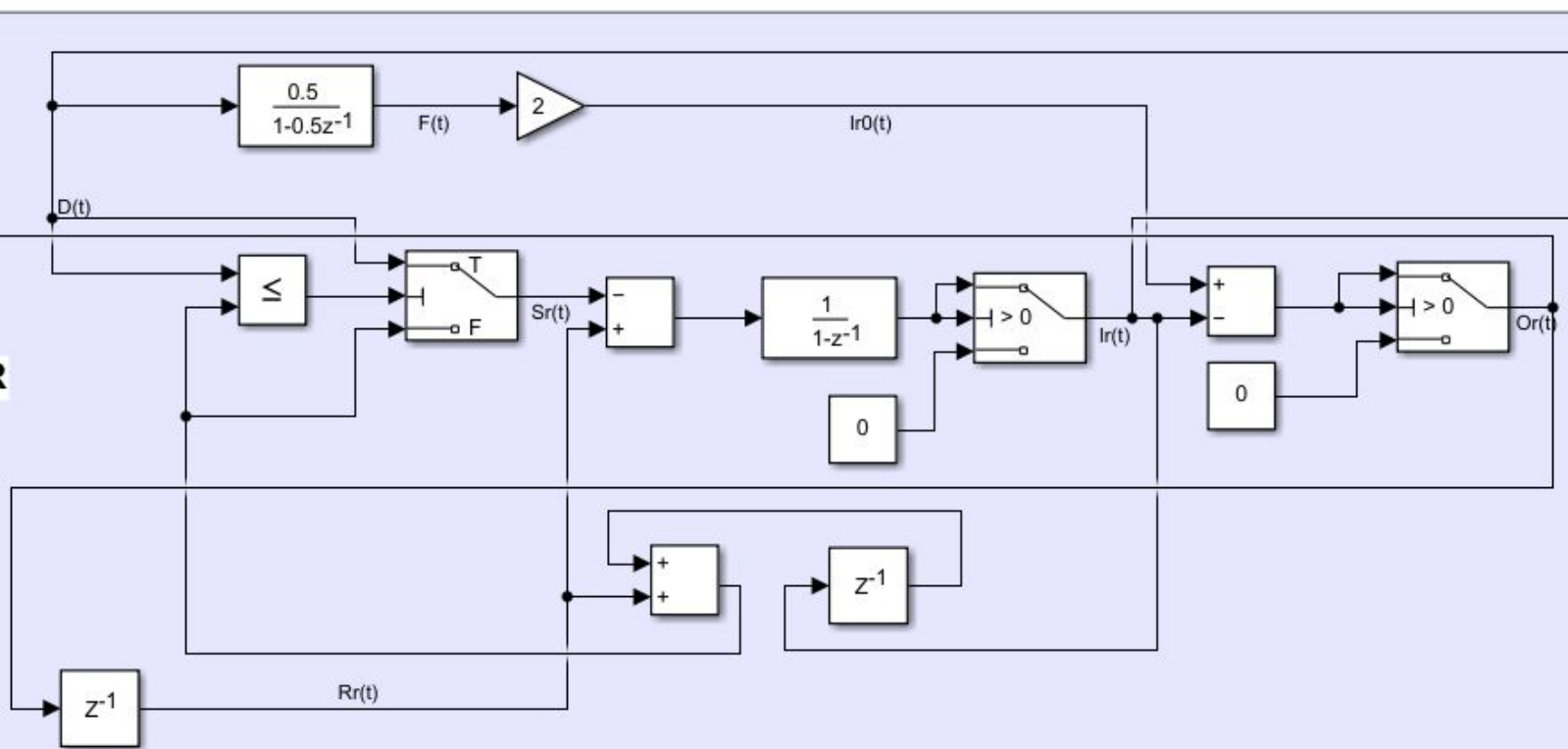
uOttawa

# WAREHOUSE



# RETAILER

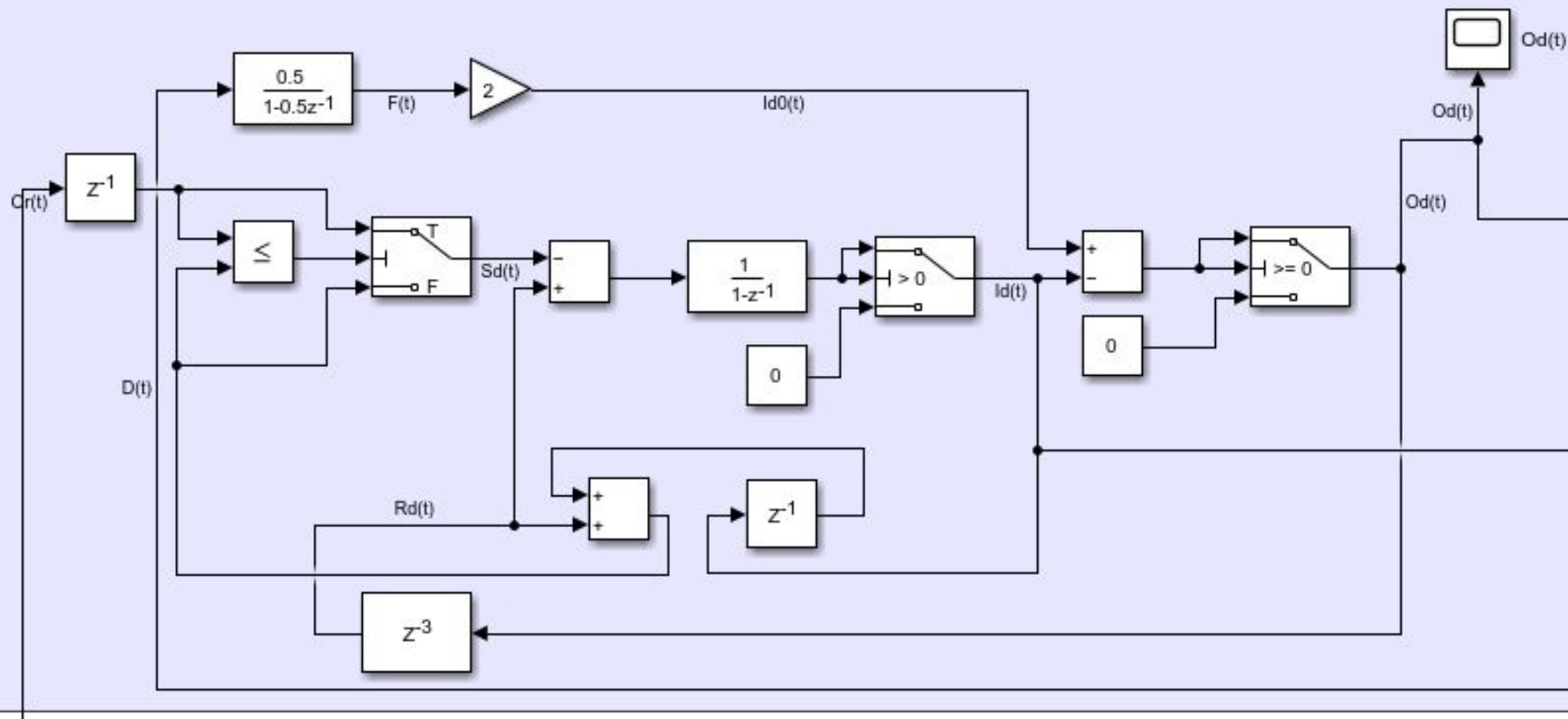
RETAILER





# DISTRIBUTION CENTER

## DISTRIBUTION CENTER





# VARIABLES OF INTEREST

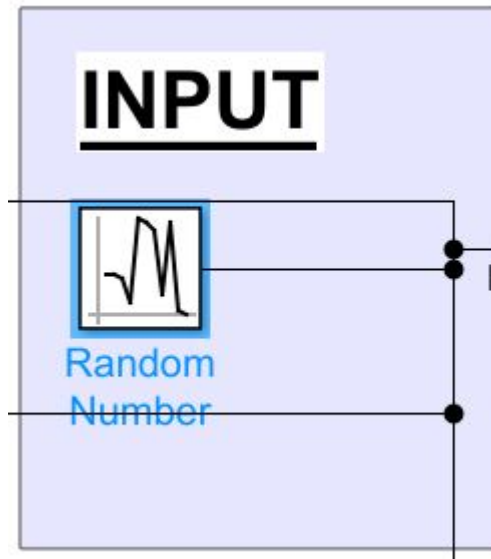
**$D(t)$**  : The actual demand at time  $t$

**$O(t)$**  : Warehouse-distribution center system's order amount at time  $t$

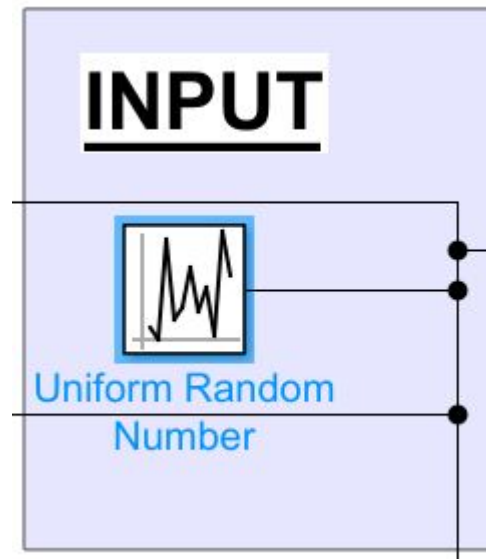
**$I(t)$**  : Warehouse-distribution center system's inventory level at time  $t$

**$I_r(t)$**  : Retailer's inventory level at time  $t$

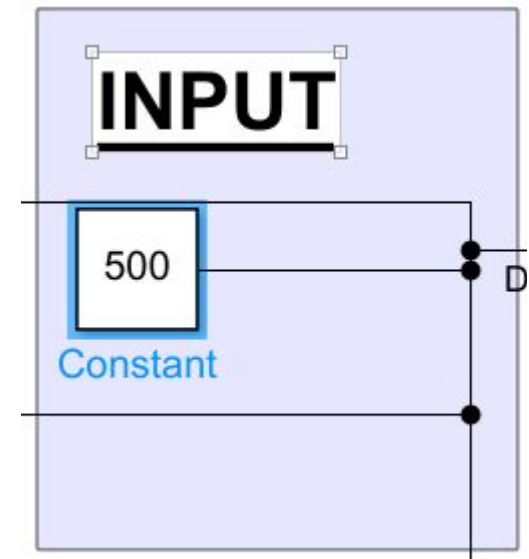
# DEMAND INPUTS $D(t)$



**Random  
Normally Distributed  
Mean = 500  
Variance = 100**



**Random  
Uniformly Distributed  
Max = 550  
Min = 450**

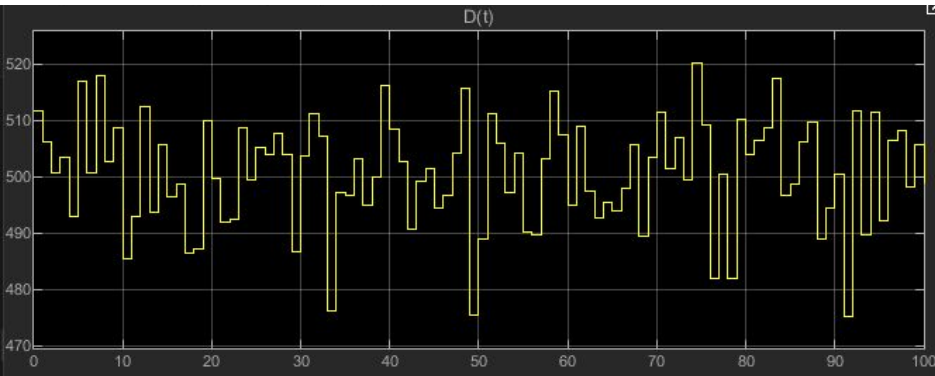


**Fixed Constant  
500**

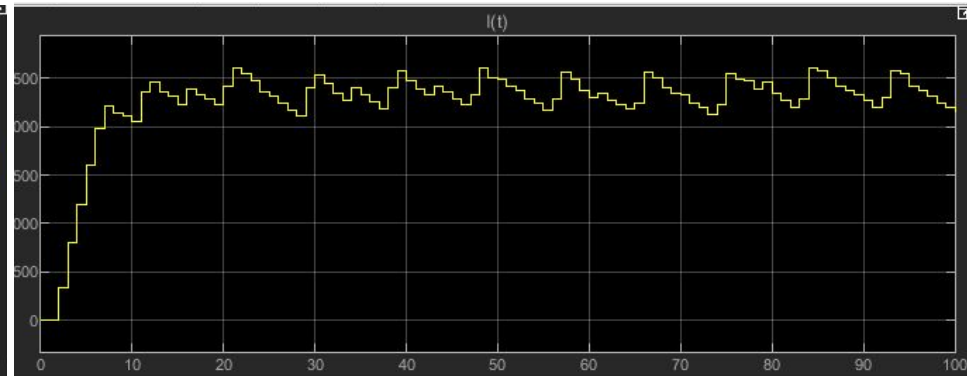
# Random Normally Distributed Demand

Mean = 500 ; Variance = 100

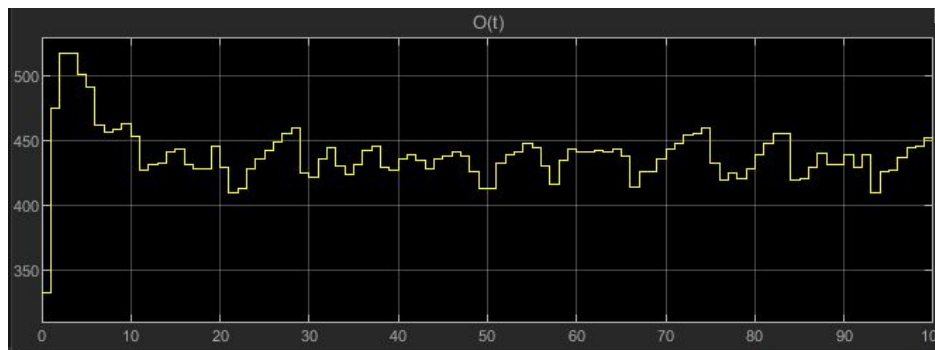
$D(t)$



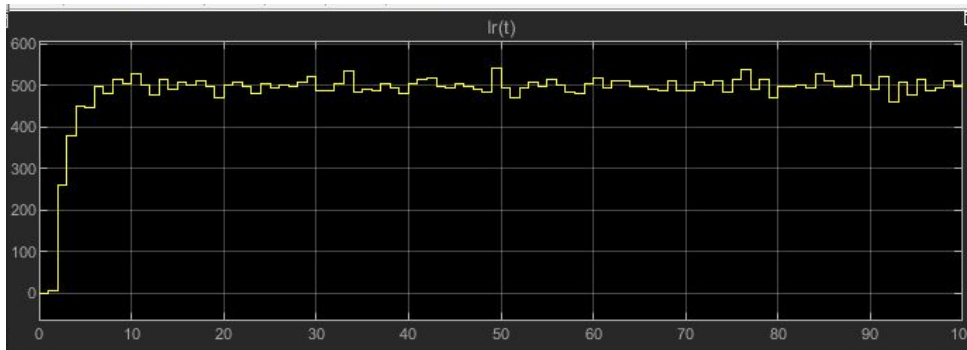
$I(t)$



$O(t)$



$I_r(t)$

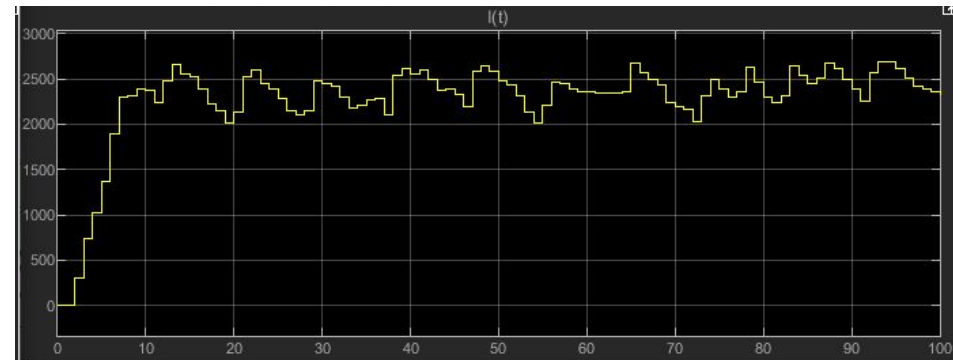
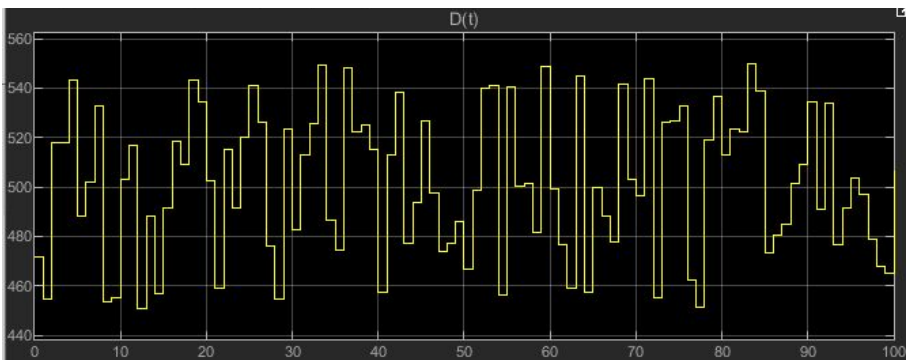


# Random Uniformly Distributed Demand

Maximum = 550 ; Minimum = 450

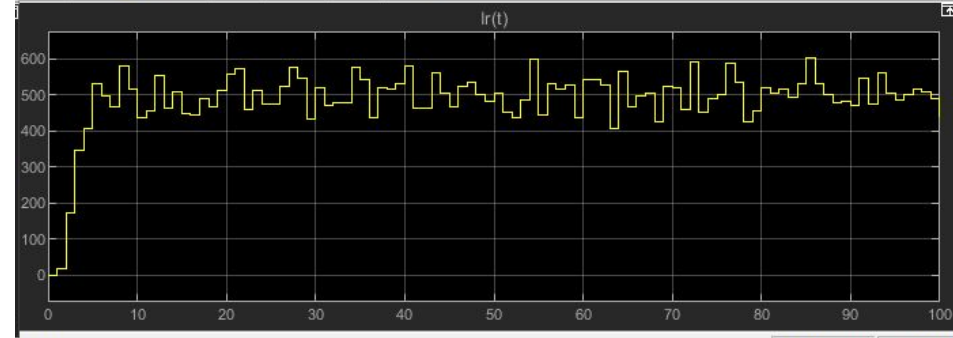
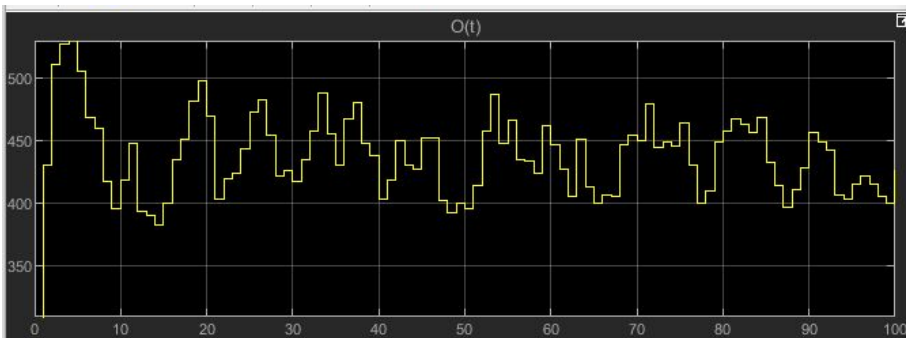
$D(t)$

$I(t)$



$O(t)$

$I_r(t)$

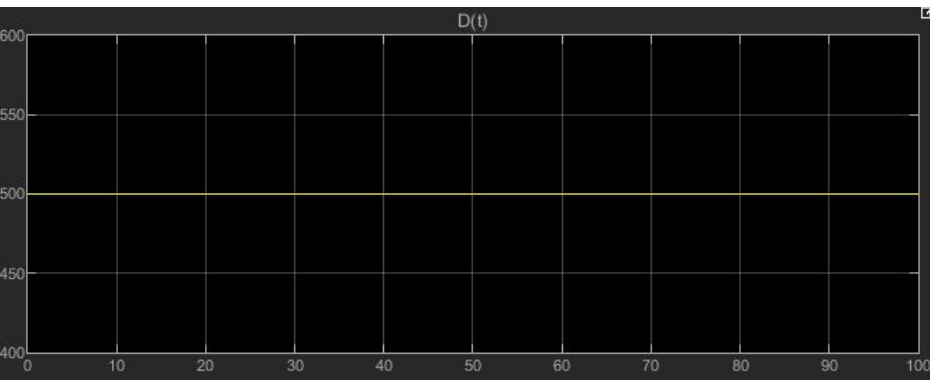




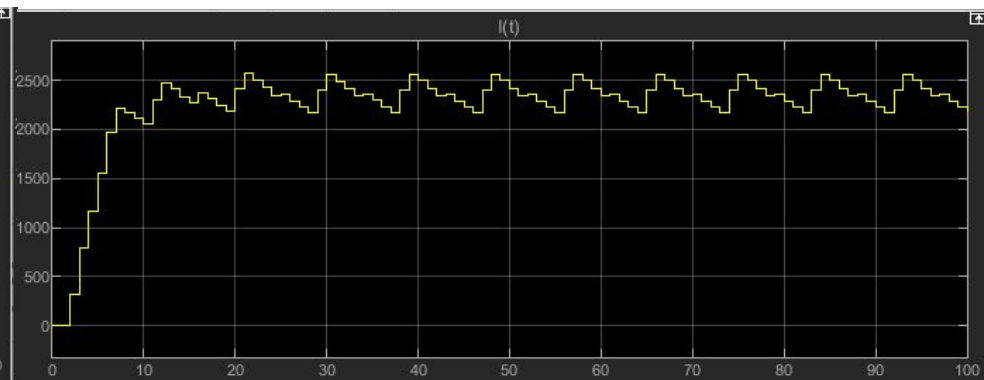
# Fixed Constant Demand

Value = 500

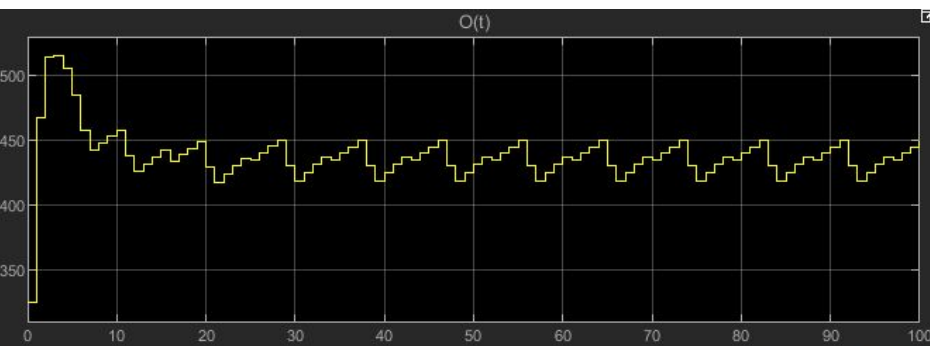
$D(t)$



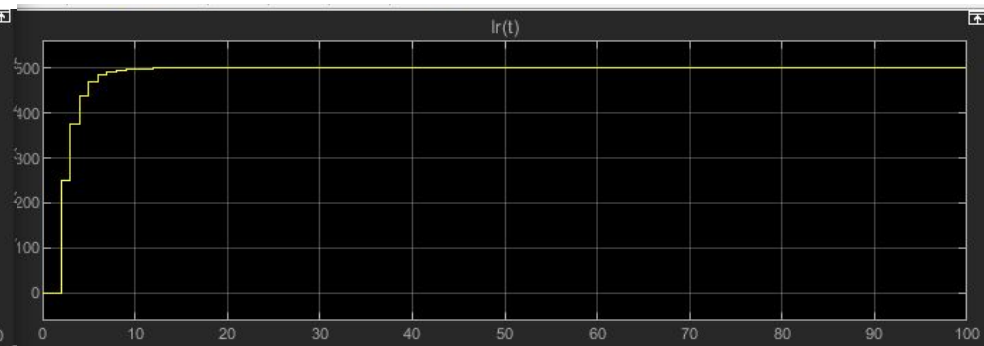
$I(t)$



$O(t)$



$I_r(t)$



## **CONCLUSION**

- **Third Party Logistics Inventory Model keeps the retailers' inventory level stable.**
- **There is more volatility in the case of uniformly distributed random demand than in the cases of normally distributed random demand and that of fixed constant demand.**

## References

- [1] S. Raaidi, I. Bouhaddou, A. Benghabrit, "Is Supply Chain a complex system?," MATEC Web Conf., 200 00018, (2018), [DOI: 10.1051/mateconf/201820000018](https://doi.org/10.1051/mateconf/201820000018)
- [2] S. Kuttappa, "The Supply Chain Bullwhip Effect," Dec 12, 2020, RentHop, <https://www.renthop.com/blog/2020/12/covid-19-vaccine-availability-supply-chain-bullwhip-effect/>
- [3] Alvarez, R., 2020. *Types of Logistics Providers Explained in Plain English*. [online] ShipLilly. Available at: <https://www.shiplilly.com/blog/types-of-logistics-providers-explained-in-plain-english/> [Accessed 9 April 2022].
- [4] Zusheng Zhang, Xu Wang, Qianqian Guo, Zhenrui Li, Yingbo Wu, "Simulation and Analysis of the Complex Behavior of Supply Chain Inventory System Based on Third-Party Logistics Management Inventory Model with No Accumulating of Unsatisfied Demand", *Complexity*, vol. 2019, Article ID 3194093, 18 pages, 2019. <https://doi.org/10.1155/2019/3194093>

# THANK YOU