OPIM 3104 - Calvert -- Spring 2022: PRACTICE Student 34

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Week 20

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Supply Chain Performance

$ 1,674	163 / 170 = 95.8%	106 units	10/20 weeks
Total Cost	Retailer On-time sales	Average Total Stock	With backorders

At each stage, a performant supply-chain :

- Shouldn't have too many backorders - they drive penalities and lost sales.
- Shouldn't have too much stock - this increases storage costs, immobilized assets and obsolescence risk.

In this simulation our main focus is to keep **the sum of both costs - all stages combined** as low as possible.

Individual Performance - Fill rate vs. Cost

The capacity to fulfill the clients needs can be illustrated by the 'Fill rate' (% of units shipped on time).
We may target a more reasonable Fill rate (97% for example) if this helps reduce significally supply-chain costs.

Retailer MegaCorp

163 / 170 = 95.8%

Units sold on time

-$91

Cost

Wholesaler

154 / 169 = 91.1%

Units sold on time

-$220

Cost

Distributor

153 / 198 = 77.2%

Units sold on time

-$506

Cost

Manufacturer

229 / 366 = 62.5%

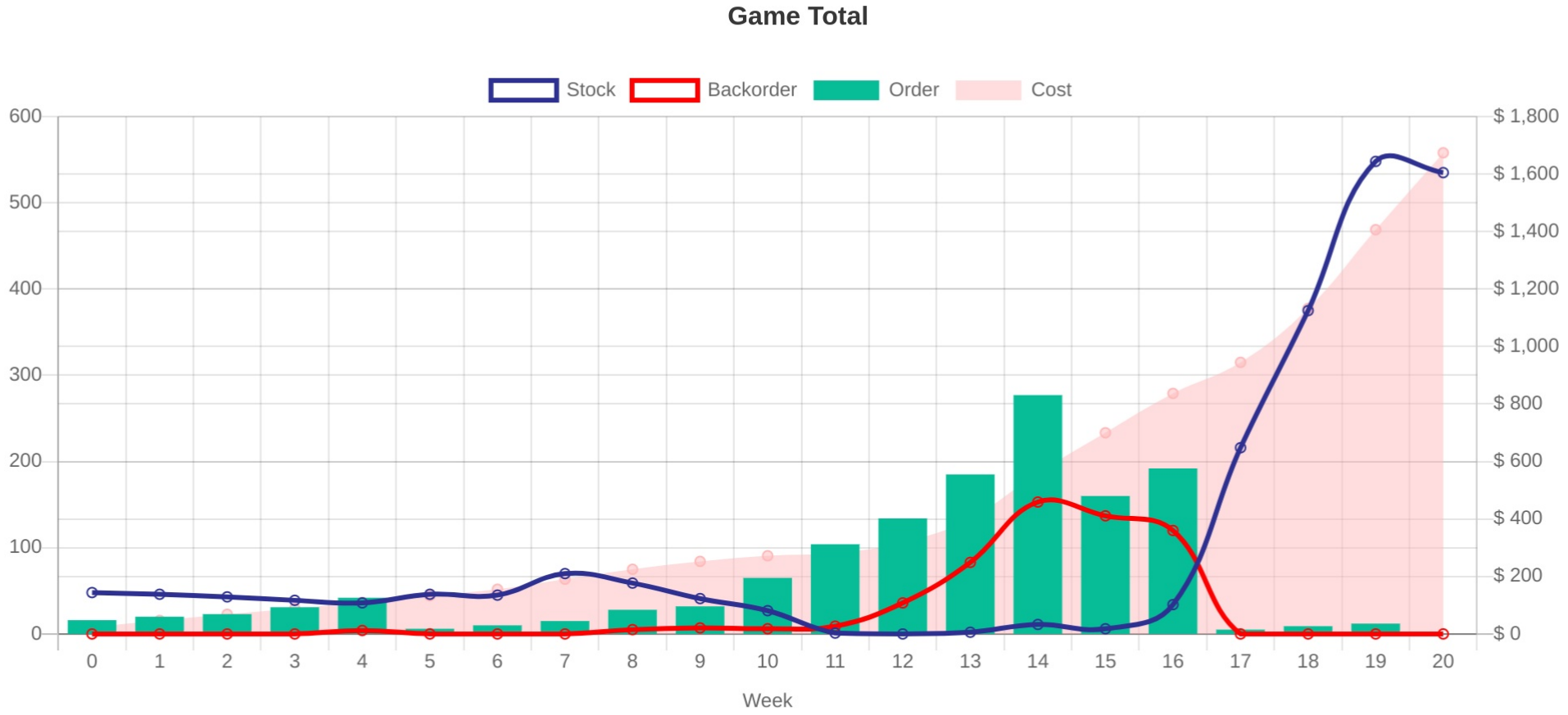
Units sold on time

-$858

Cost

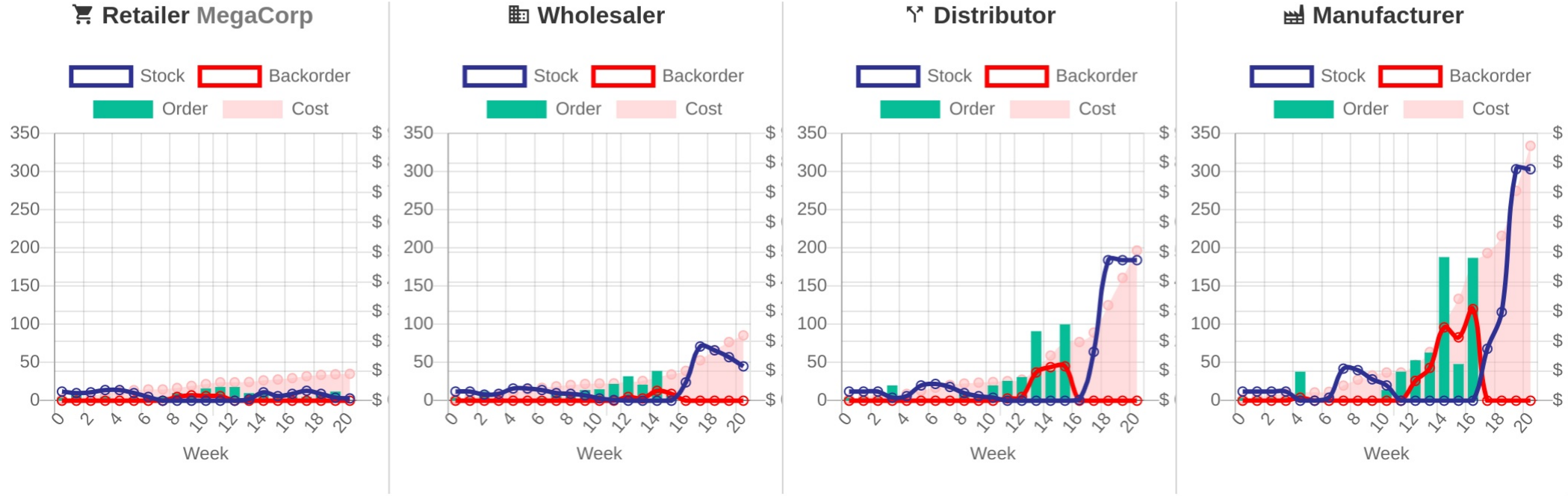
Supply Chain evolution

See below the evolution of key metrics throughout the game, all stages combined.



Stages Evolution

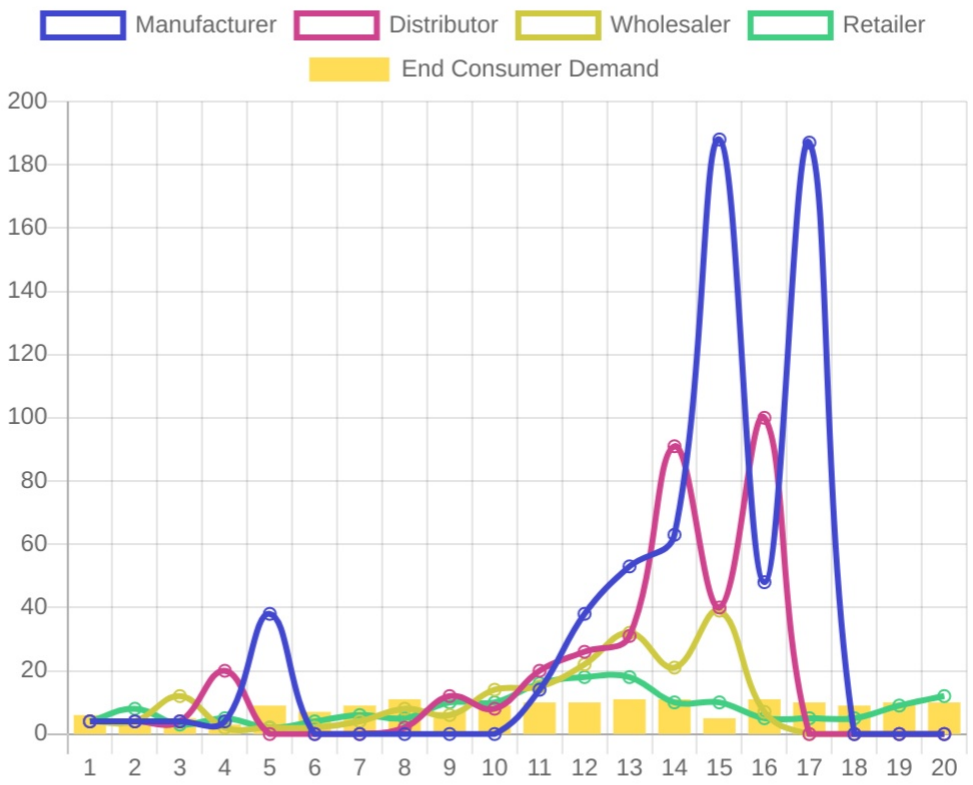
Find below the comparison of profiles of the different roles in the chain.



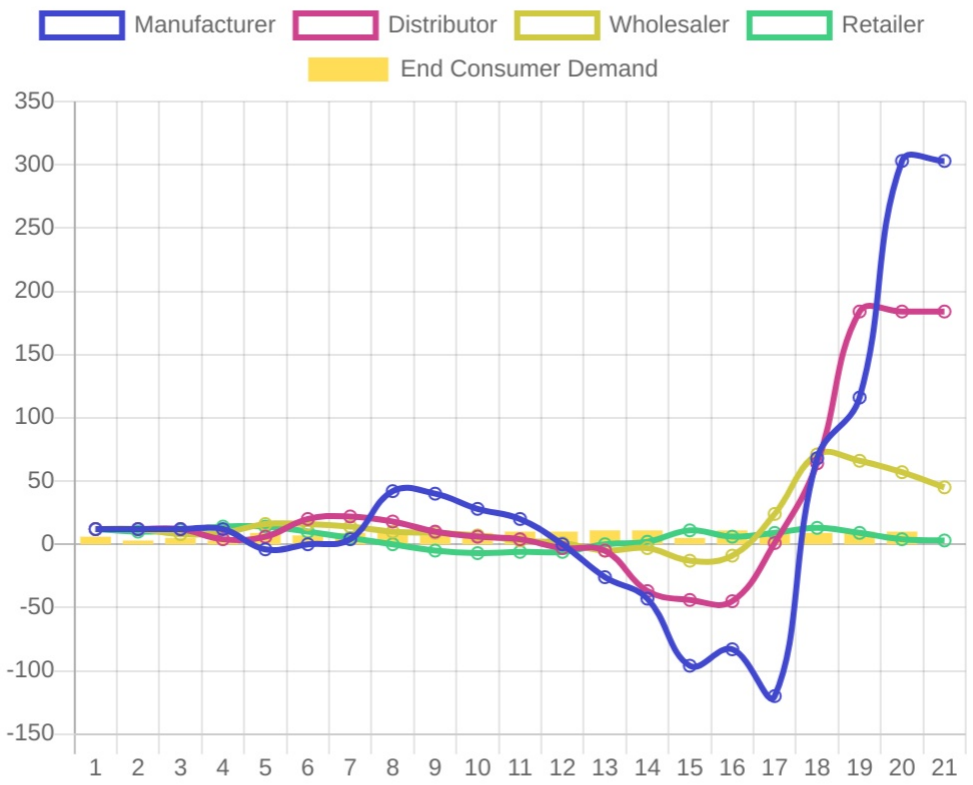
Response to Demand

The graphs below compare the end consumer demand to the response of the industrial partners : orders and stock.
Do you see a gap between the input signal and the reaction inside the supply-chain system ?

Orders vs. End Consumer Demand



Stock/Backorders vs. End Consumer Demand



We often see supply-chains alternate between phases of over-stock and out-of-stock.
The amplitude of variations increase as we move upstream from retailer to manufacturer.
This phenomenon is called the **Bullwhip effect**.

Variability

You must have felt it was a challenge to cope with a changing and uncertain demand.
Small variabilities in the final consumer orders may have big impacts on the industrial chain.

11 units
Biggest order of the final consumer

vs. 188 units
Biggest order by the Manufacturer in week 14

8.3 units
Average weekly consumer demand

vs. 17.1 units
Average weekly supply-chain orders

2.6 units
Standard deviation of consumer demand

vs. 25.5 units
Standard deviation of supply-chain orders

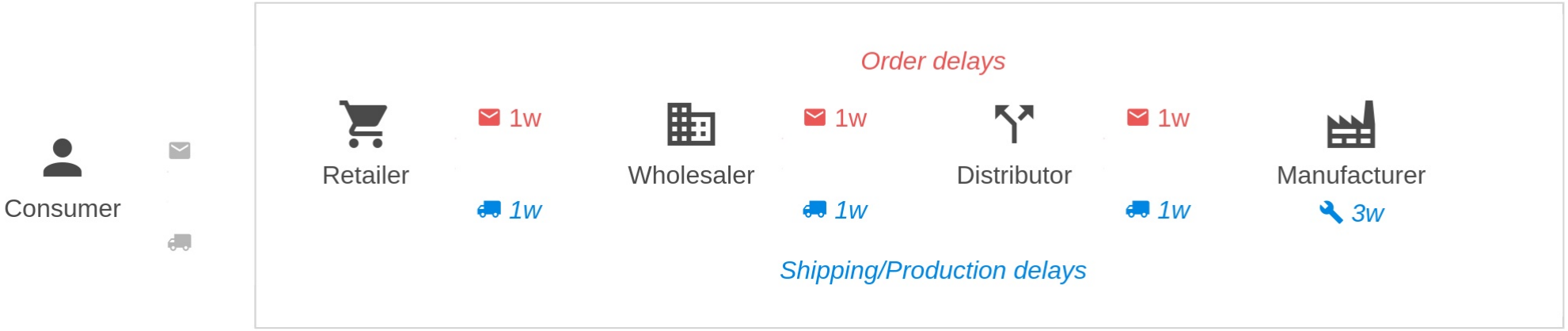
32%
Coef. of variation (StDev / Mean) of consumer demand

vs. 128%
Coefficient of variation of supply-chain orders

Lead times

In our example, each node adds lead times for both information and material flows.
It results in an end-to-end supply chain which is **9 weeks** long from *Retailer* to *Manufacturer* .
The more delays in the system, the bigger the variability and amplification of information, which leads to distorted and delayed material flows.

Very few managers are aware of the long trajectories that their order must complete before being fulfilled. We tend to expect the goods to arrive with the next truck.
But in reality the system structure makes each delivery to the consumer the result of a demand signal sent at least 9 weeks ago!



*Total lead time: **9 weeks**.*

To go further

The best supply-chains manage fluctuations of the demand in a smooth way : they are reactive, agile and sustainable 👌

A few questions to stimulate your thinking...

Which parameters may have an influence on the Bullwhip effect ?

- Lead times make supply-chains less reactive to changes of demand. This also increases the tendency to 'secure' stock and order more than needed.
- The number of stages in the chain has a negative impact. Each level tries to avoid backorders and secure their own stock, which creates tension in the chain.
- Batch sizes and Minimum Order Quantities (MOQ) reduce costs (thanks to economies of scale) - but reduce flexibility.
- The lack of visibility on the stocks/demand make it impossible to anticipate production. When industrials master their whole supply-chain's capacity, they can take better stock decisions.

How could a different supply network improve performance ?

- Reducing the number of stages would be quite beneficial. Some industrials choose a 'direct to consumer' strategy, which reduces time-to-market, allows unifed IT-systems and access to all the data.
- Having alternative sources of supply can reduce risk and improve reactivity. In the same sense, a factory having flexible production lines can smooth its productions depending on demand.
- In product development, making use of generic components can reduce their variability and obsolescence risk. Industrials should try to design products with a late differentiation (ex: using the same bottles for different beer brands).

Cite a few innovations that might reduce the Bullwhip effect

- ERPs are now deployed to the cloud. This improves visibility and access to standardized information in the whole chain.
- E-commerce distribution reduces the number of intermediates : products are available faster and for the whole world.
- New production methods such as 3D-printing allow more flexibility and late customization.
- Artificial Intelligence and 'Demand Sensing' techniques can boost forecast quality, stock decision-makings and reactivity.