



Aalto University
School of Science

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TU-A1300

Introduction to Industrial Engineering and Management: Supply chain management

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■ September 3, 2021, 11:00 AM GMT+3

Forget Finance. Supply-Chain Management Is the Pandemic Era's Must-Have MBA Degree

- The just-in-time inventory systems embraced by many businesses led to empty shelves and costly bottlenecks. That's put a rare spotlight on supply-chain programs, which are attracting more students.

By Matthew Boyle



▲ The container ship *Ever Given*, stuck in the Suez Canal in Egypt on March 27. PHOTOGRAPHER: GOKTURK1 OBSERVATION SATELLITE/GETTY IMAGES



Global Supply-Chain Problems Escalate, Threatening Economic Recovery

Component shortages, surging prices of raw materials and transportation backups compound the bottlenecks

Tinder was Covid, but underlying is a lot of structural reasons

BUSINESS | AUTOS & TRANSPORTATION | AUTOS INDUSTRY

Toyota to Cut Output as Chip Shortage Finally Catches Up to It

Car maker says it will cut production in Japan by 40% in September



Toyota's Motomachi plant is one of the factories set for suspension.

The UK's CO2 shortage was entirely predictable

The current CO2 shortage is a perfect storm of stretched supply chains and high prices. The government could have been more prepared



A”

How 'Chaos' In The Shipping Industry Is Choking The Economy

June 15, 2021 - 6:30 AM ET

GREG ROSALSKY



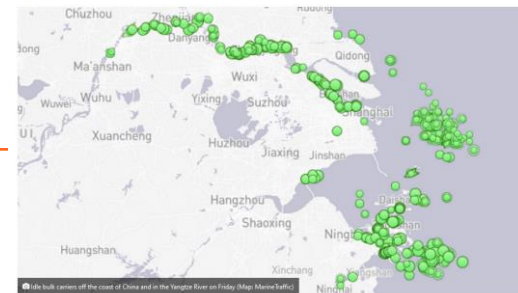
Justin Sullivan/Getty Images

China bulker pileup dwarfs California container-ship gridlock

COVID restrictions in China push dry bulk congestion to all-time high

Greg Miller, Senior Editor Friday, August 20, 2021

4 minutes read



3.10.2022

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Chip bullwhip 2020-2022

2020

2021

2022

Pandemic demand shock

- Cars ↓ EVs ↑
- Consumer electronics ↑

Shortages and lost sales

- Consumer electronics, appliances lead-times extend
- EVs and carmaker shortages

Capacity utilization increased

Semiconductor fab capacity utilization rate



Source: Suttle Economics, SIA, 2021.

Boom continues

- Cars ↑ EVs ↑
- Consumer electronics ↑

Shortages and lost sales

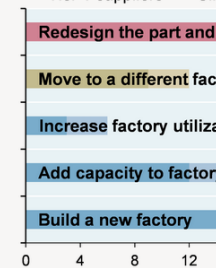
- Consumer electronics out-of-stock
- EVs and car shortages
- Appliances shortages

Capacity building investments

- Lead times for capacity >12 m
- Capacity utilization at max

Semiconductor shortage

■ Tier 1 suppliers ■ Sili

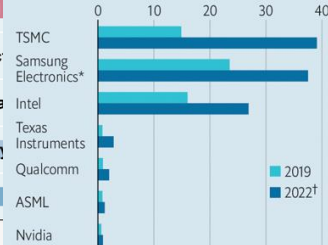


Source: Bain, June 2021, Dotte

Castles made of silicon

Selected semiconductor companies

Capital expenditures, \$bn



Source: Bloomberg *Not a pure semiconductor company †Forecast

Demand bust

- EVs strong ↑
- Consumer electronics ↓

Inventory build-up and obsolescence

- Commoditized products abundance
- Prices down, inventories up during global inflation
- Still shortages of specialized components

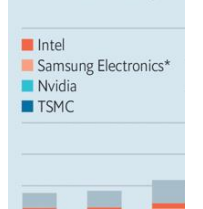
Capacity increase comes online

- Capacity utilization down
- Pressure to retire low-margin production

A peta flop

Semiconductor companies

Worldwide market capitalization, \$trn



Source: Bloomberg

Ford warns investors of an extra \$1 billion in supply chain costs during the third quarter

KEY POINTS

- * Ford Motor on Monday warned investors that the company expects to incur an extra \$1 billion in costs during the third quarter due to inflation and supply chain issues.
- * Ford said supply problems have resulted in gains shortages affecting roughly 40,000 to 45,000 vehicles, primarily high-margin trucks and SUVs that haven't been able to reach dealers.
- * The automaker reaffirmed its full-year guidance, saying it expects to deliver the vehicles to dealers in the fourth quarter.

Consumer retailers' bullwhip resulting in drastic waste

SPRING '22

FALL '22

Discount Stores Are Awash in Merchandise Thanks to Shipping Delays

Executives at discount stores including Ross, Burlington say supply-chain strains are leaving their buyers with lots of available merchandise



A shopper at a Ross Stores Inc. discount department store in
PHOTO: MARIO ANZUONI/REUTERS

Retailers Scrambling to Stow Inventories Are Turning to Transport Equipment

More truck trailers and shipping containers are being used as mobile warehouses, the latest sign of ad hoc adjustments in strained supply chains



Retailers and manufacturers continue to reset distribution operations on the fly to keep supply chains running amid transportation network disruption and difficulties forecasting demand
PHOTO: MICHAEL CIAGLO/BLOOMBERG NEWS

Nike's Inventory Glut Sends Stock Down the Most in 20 Years

Kim Bhushin

Fri, September 30, 2022 at 11:07 PM



Nike's inventory (Star Bucks) (Bloomberg News) (20-20-2022)

In this article

Nike Research

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Clothing retailers set for discount battle to clear inventory glut

US stores face large stockpiles and customers made wary by high inflation



Retail sales for clothing and accessory stores have remained largely flat for the past year, according to US Census Bureau data. © Bing Guan/Bloomberg

Lydia Tomlin in New York SEPTEMBER 19, 2022

US apparel retailers are preparing steep markdowns to clear shelves ahead of the critical holiday season, as inflation pushes consumers to pull back on discretionary spending and wait for deals.

Clothing stores are battling a glut of inventory and a split in spending habits, as lower-income shoppers put necessities including food and rent first while affluent consumers replace pandemic leisurewear with tailored office outfits and spend labor for going out.

Supply chain management

Matching supply and demand: core challenge

Supply chain's
capacity

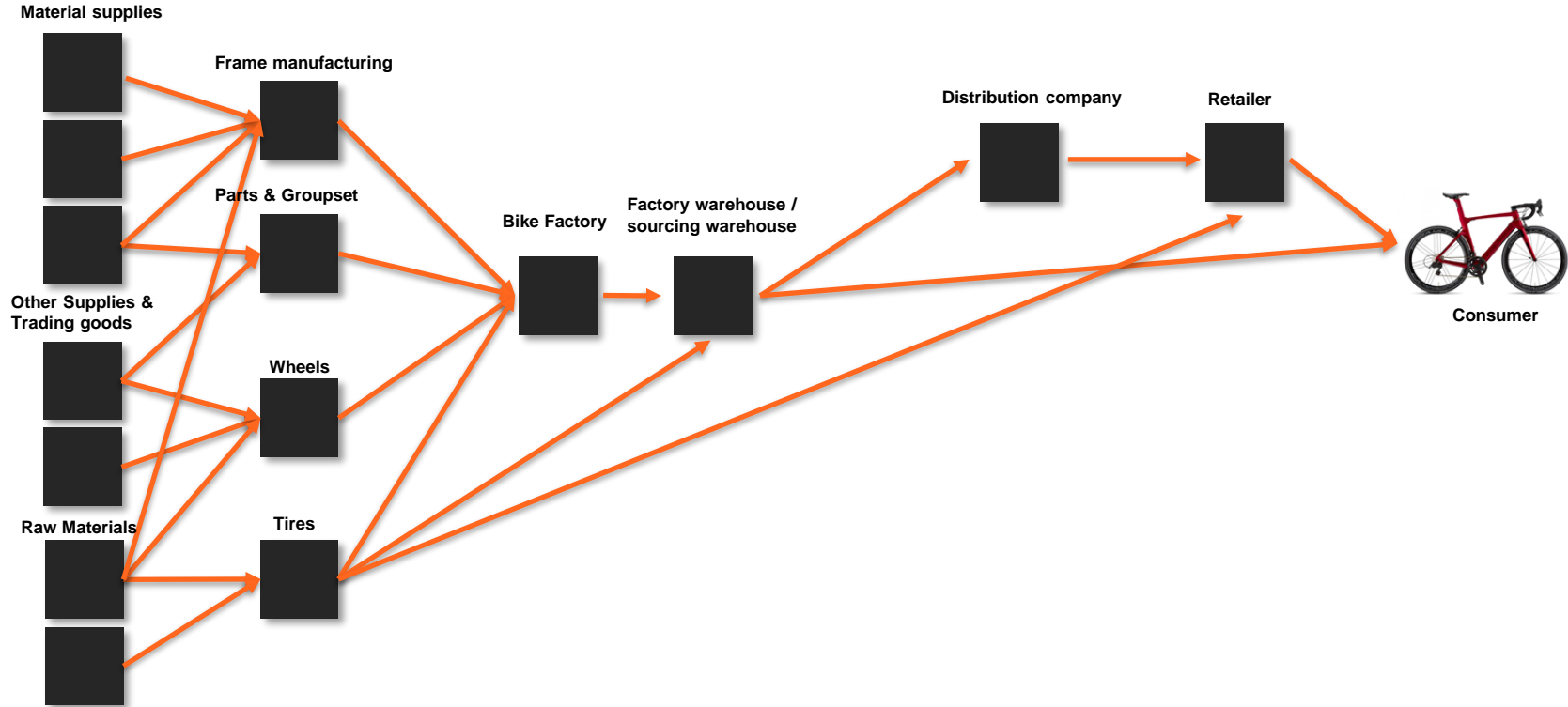
Oversupply:
Lost
investment

=

Undersupply:
Lost
revenue

Future
demand

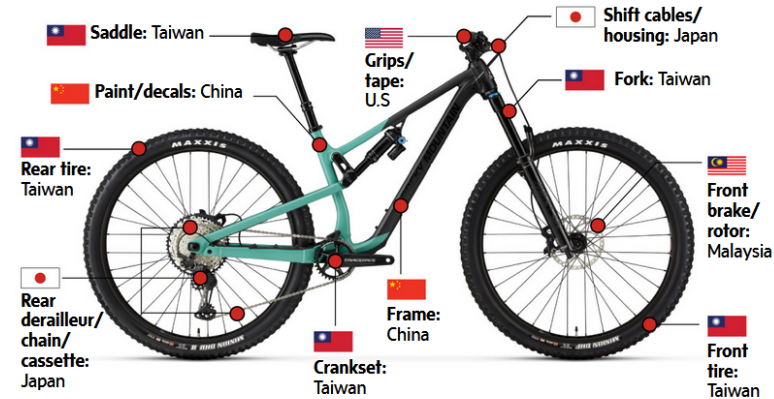
Supply chain consists of all the actors that are involved in the fulfillment of a customer request



Bike is a perfect example of complex nature of global production

The complicated modern bicycle

Fifty-one parts. Twenty-eight suppliers. Five countries. That's what it takes to build the Instinct Alloy 50 from North Vancouver's Rocky Mountain Bicycles, which retails at \$5,649. It's a complicated supply chain that tended to run smoothly – until COVID-19 came along.



Manufacturing notes

The frame is built in China, a powerhouse in bike manufacturing. The past couple years have been tough, however, owing to U.S. tariffs that targeted a variety of industries.

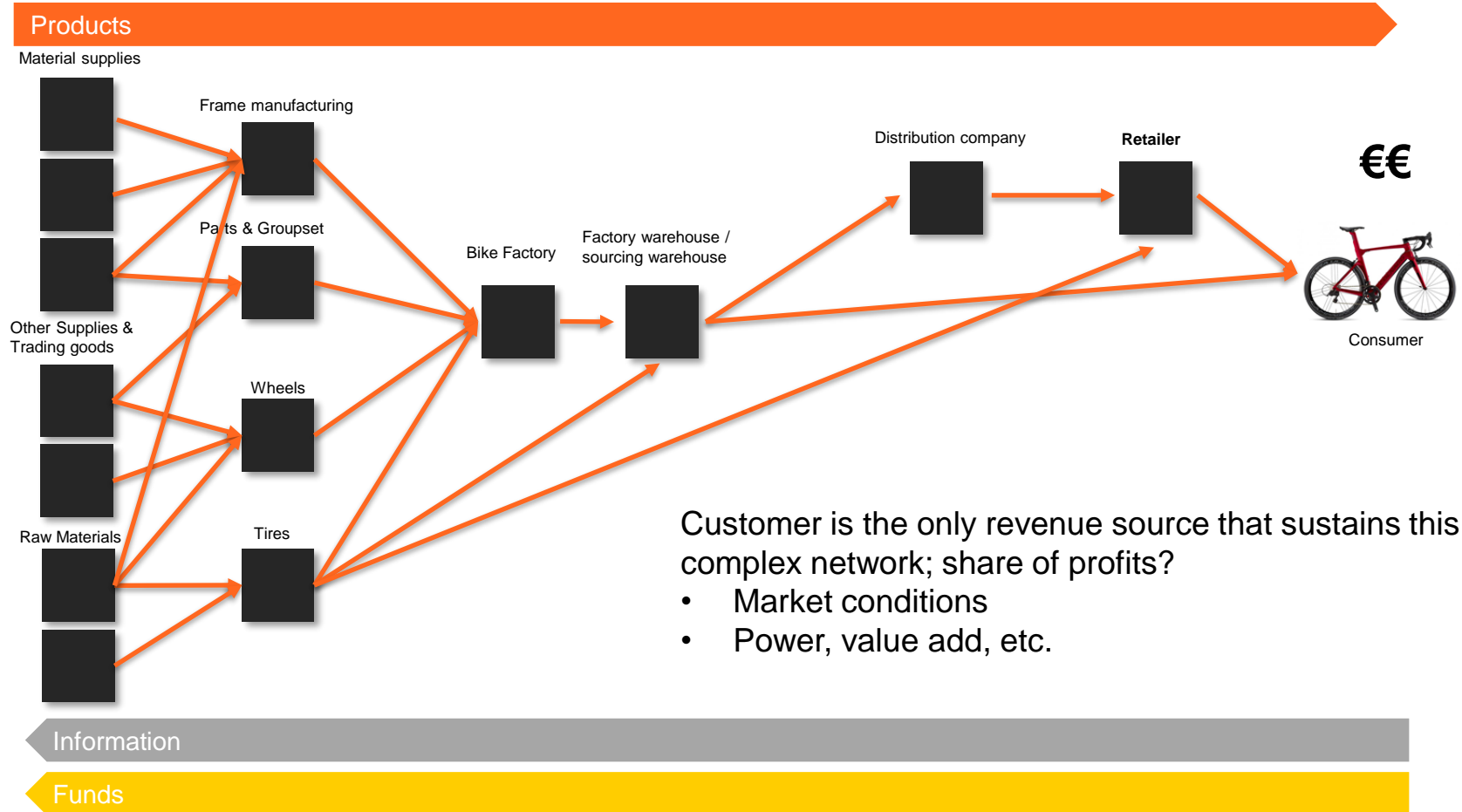
The grips are the only component from the U.S. Much like other industries, bike production has shifted overseas, with relatively little manufacturing and assembly in North America.

The rear derailleur is built in Japan by Shimano, the leader in market share for bicycle components.

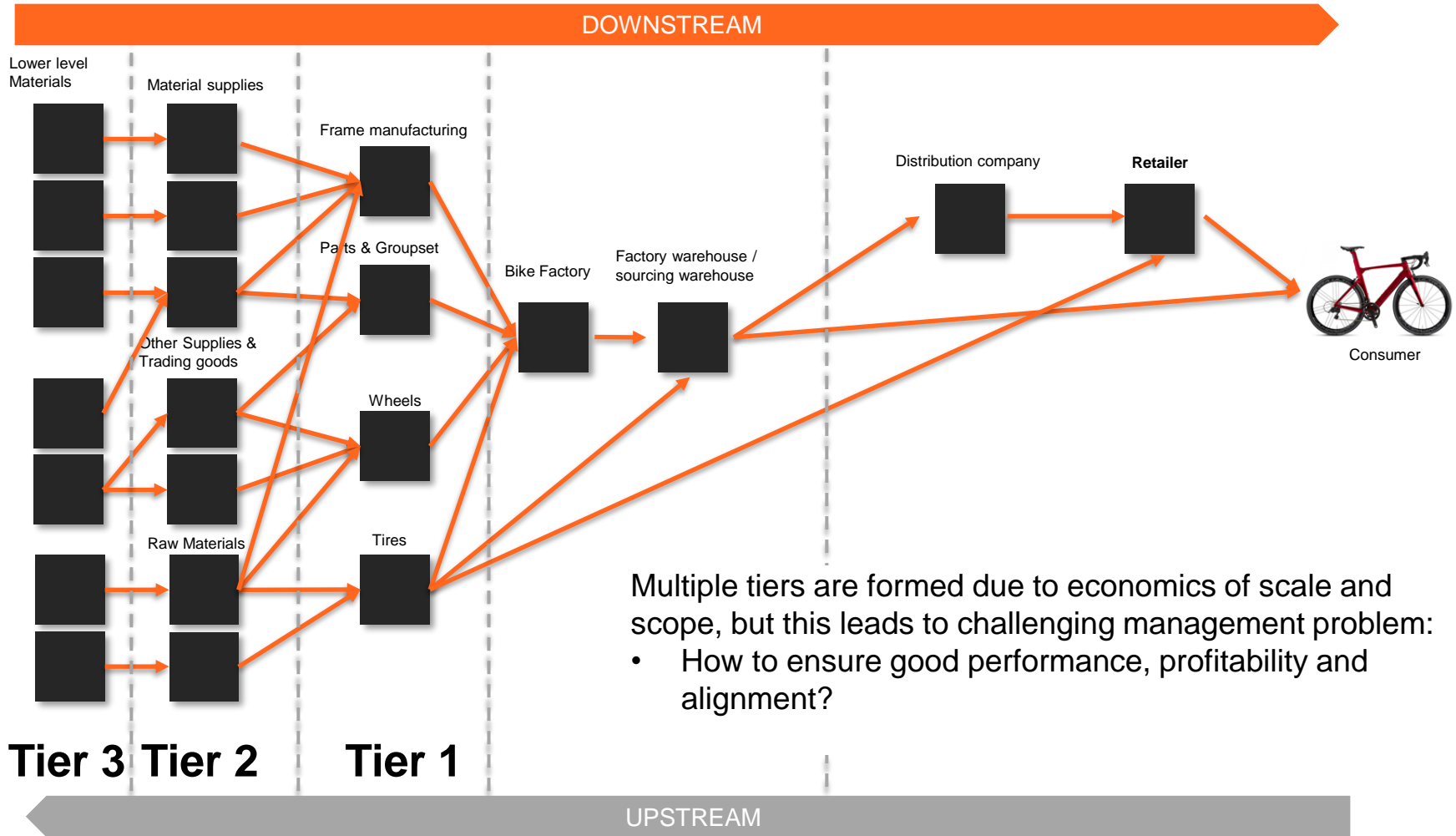
The fork is made in Taiwan, along with most of the parts on this particular bike. Taiwan has become a hub of high-end manufacturing.

The brakes are made in Malaysia, also by Shimano. Malaysia is a valuable manufacturing centre, due to its membership in a Trans-Pacific trade deal Canada has also joined

Product, information and money flows need to be coordinated to make the supply chain work



Multiple tiers and complex structure makes supply chain management a challenging task



Best supply chain design is product and business model dependent

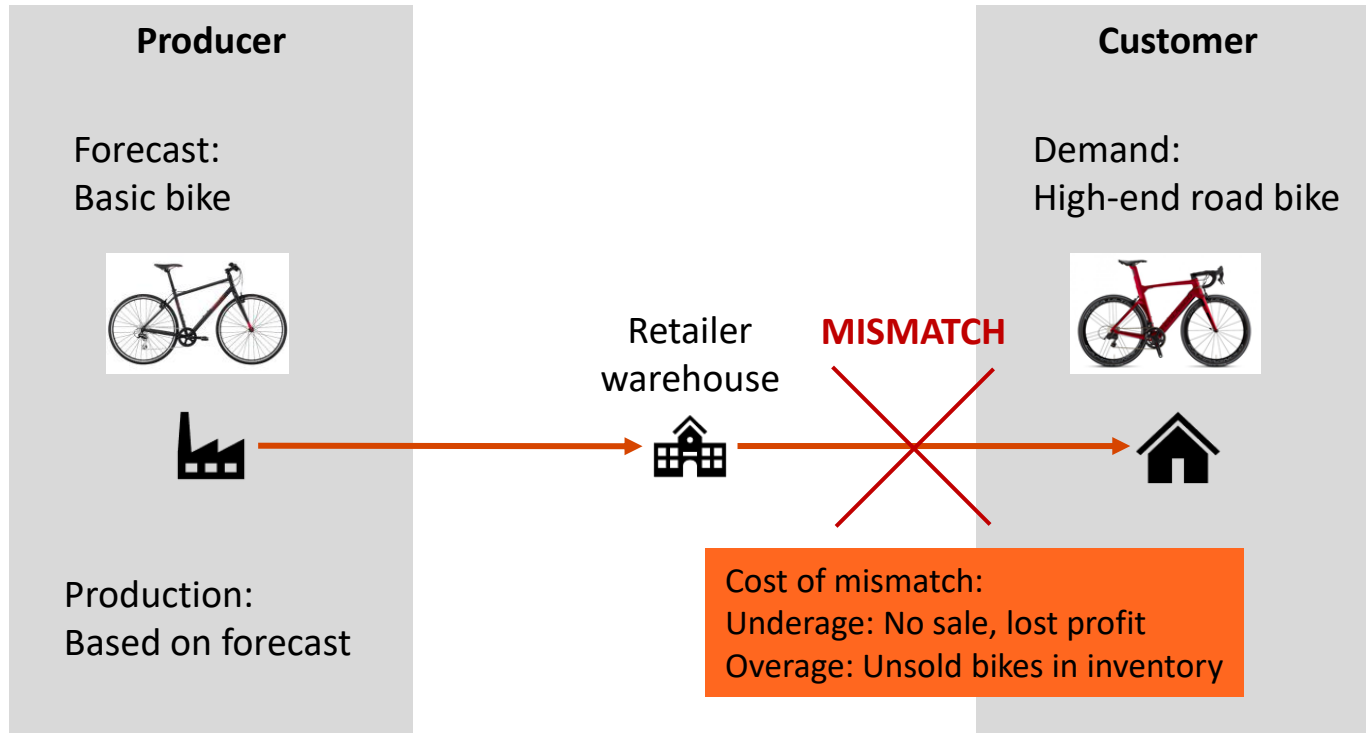
**Standard, low margin,
high volume**



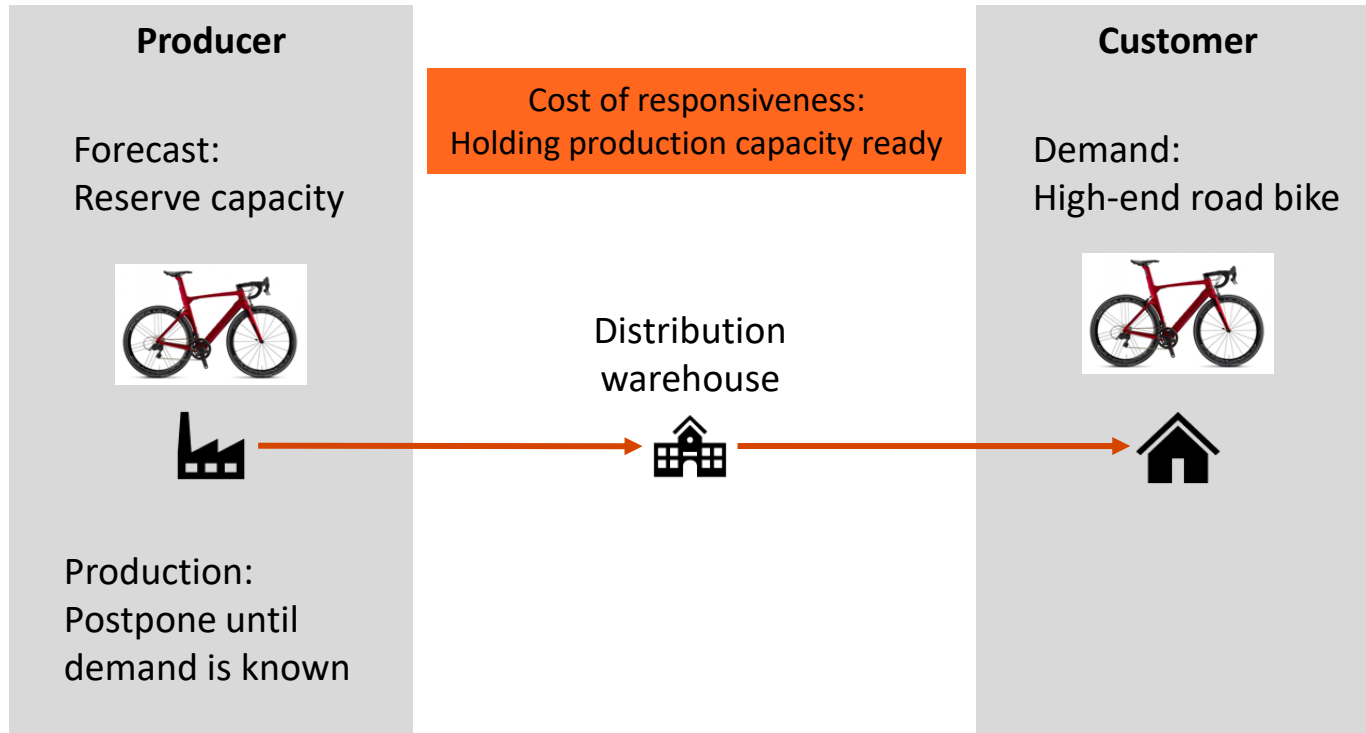
**Specialized, high margin,
very low volume**



Focus on efficiency: Mismatches between demand and supply are inevitable

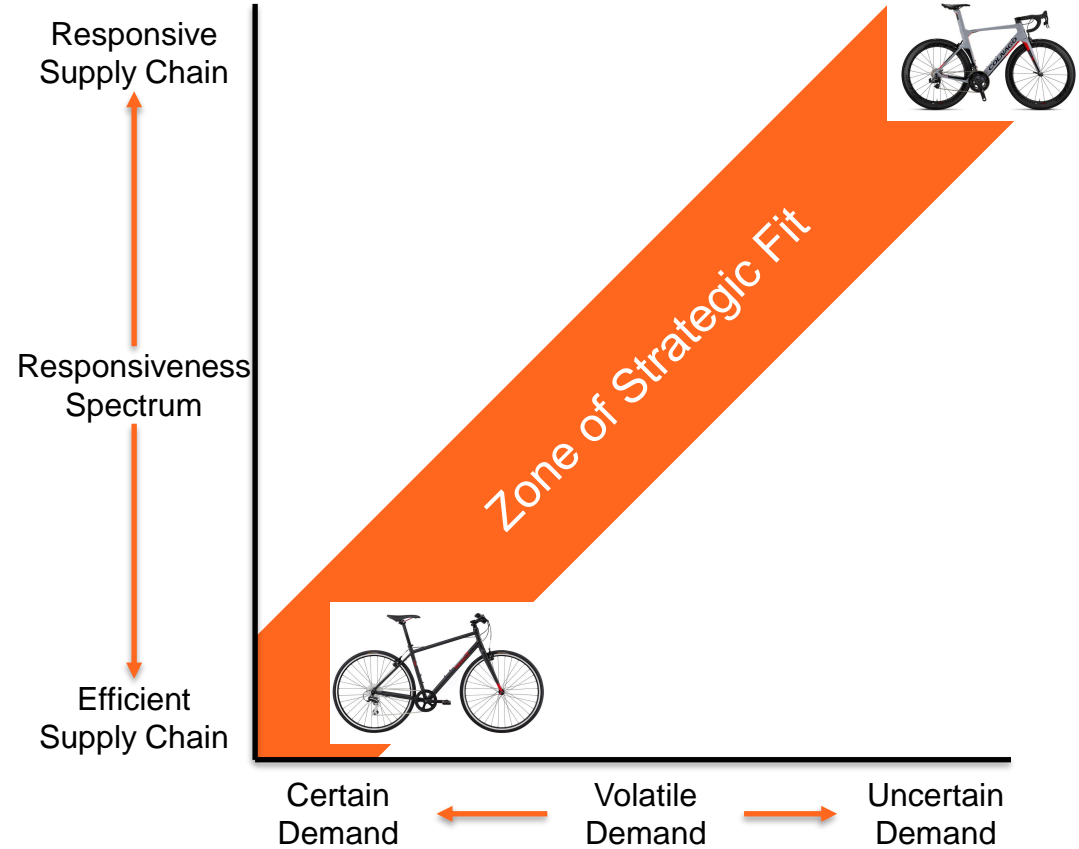


Responsiveness is an antidote: wait until you know what customer wants



Strategic fit and scope

- Supply chain is a company network that is designed for supplying a product
- **From customer value to supply chain strategy:**
 1. **Customer and supply uncertainty**
 2. **Supply chain capabilities**
 3. **Achieving strategic fit**
- Cost efficiency versus flexibility and speed
- Mismatch minimization and profit maximization is the goal



Planning has a critical role in management of supply chains

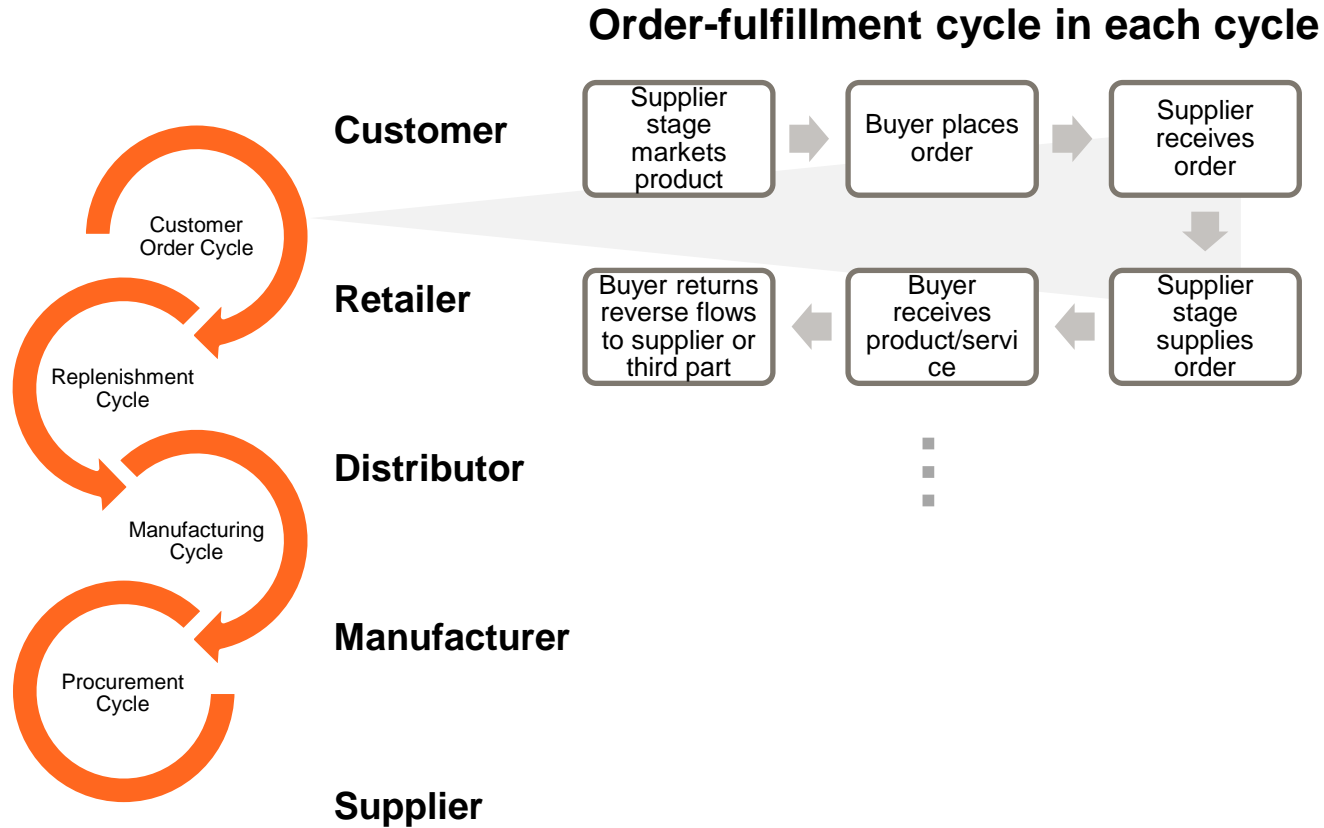
Supply Chain Management means design, management and operation of supply- and distribution network. It includes the processes and information flows between companies in the chain.

Martinsuo et al., 2016, p. 279

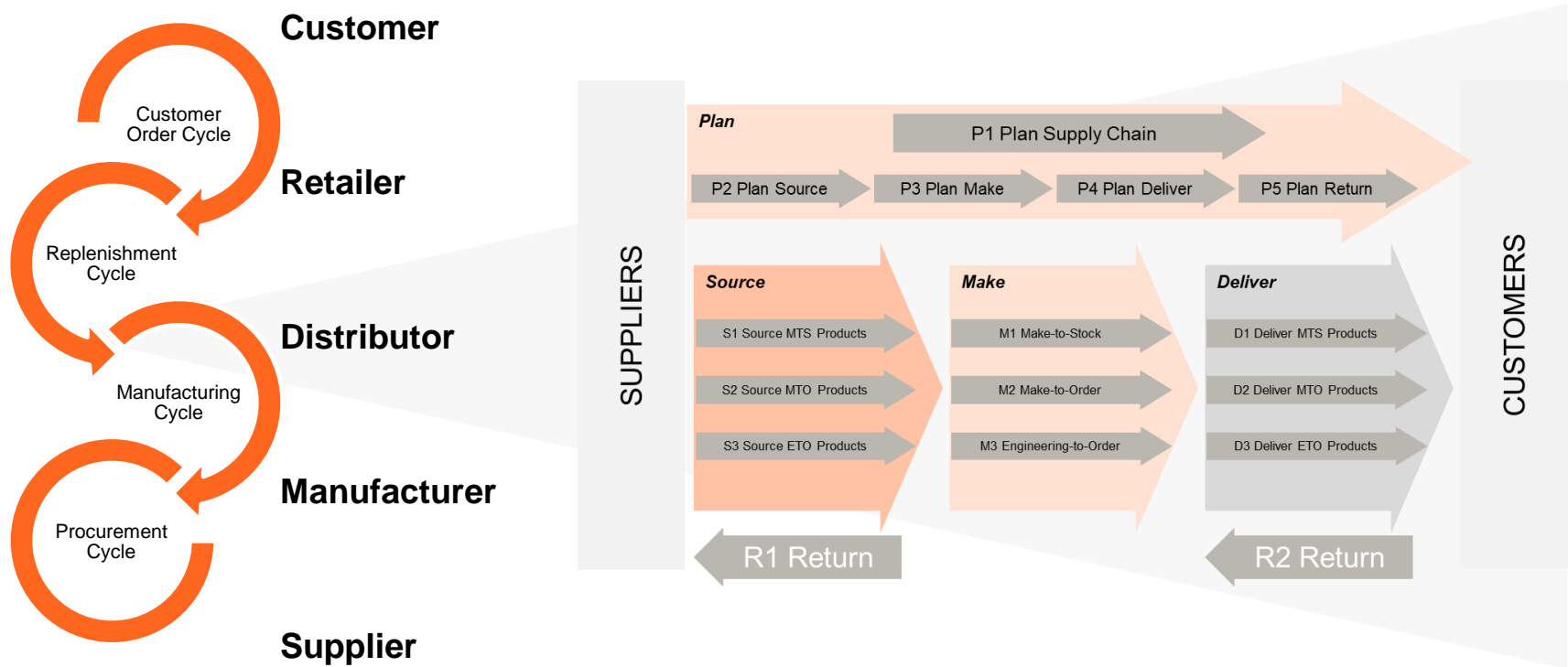
Goal: Maximal customer value, minimum waste, beneficial for all parties.

Condition: Flow is planned and managed so that right products and information are in a right place at the right time, and the correct information is available to everyone. **Swift, Even flow**

Cycle view of supply chain

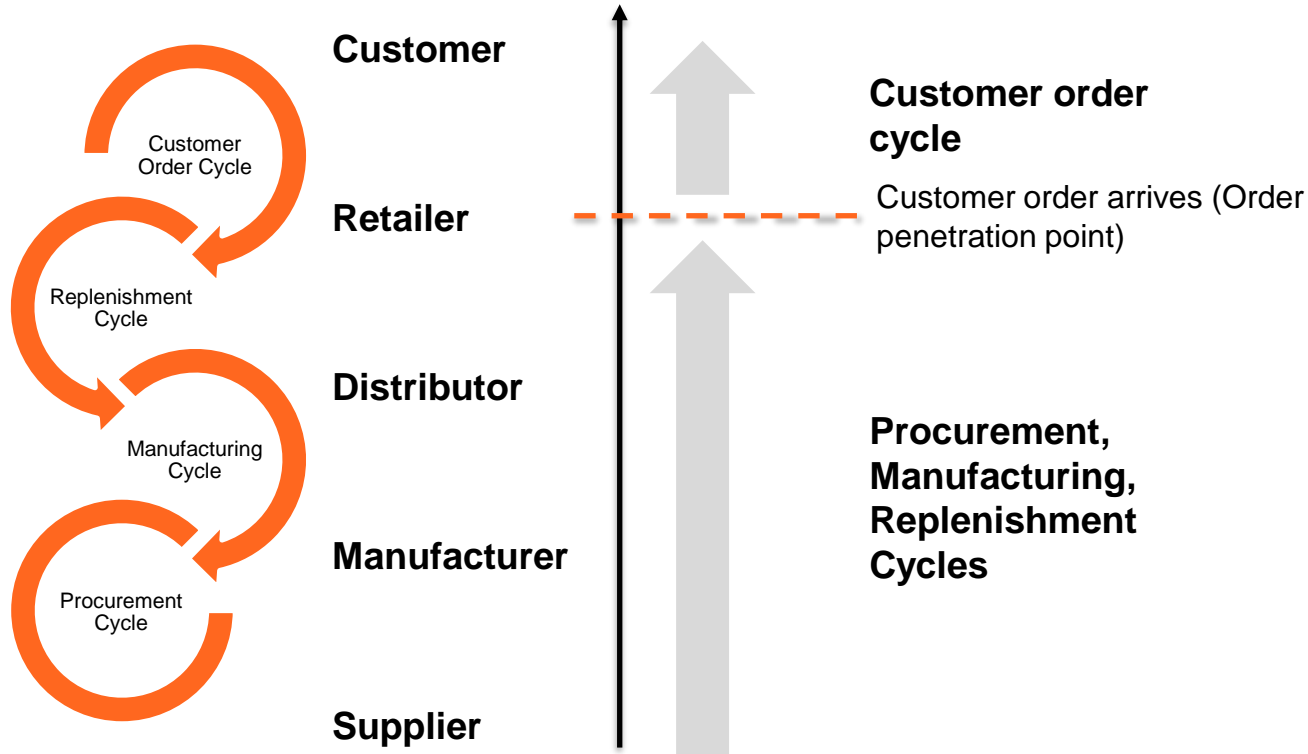


Process view of supply chain – Supply Chain Operations Reference model (SCOR)



Push/Pull view of the supply chain

Where to place OPP for our two bikes?



Planning is critical part of supply chain management; Decision lead time

Why we need planning?

Everything is uncertain

- Demand, Capacity, Material availability, Costs, Prices

Long time delays in complex chains

- Between supply chain steps
- Within process steps between tasks
- Decision lead time = From decision to delivery

Structures are rigid

- Adaption to changes takes time
- Structure, processes and liabilities

Tasks are interdependent

- Delivery of the final product is dependent of all of the production, sourcing, deliveries and inventories upstream

Planning in 3 time-horizons

Strategy & Design – Long term

- Obtaining strategic resources and capacity to meet long-term demand
- Choice of strategic locations depending on the markets
- Development and utilization of production process technology
- Planning long delivery components

Sales & Operations planning – Medium term

- Balancing supply and demand
- Sales, production and purchasing plans

Control and Schedule operation – Short term

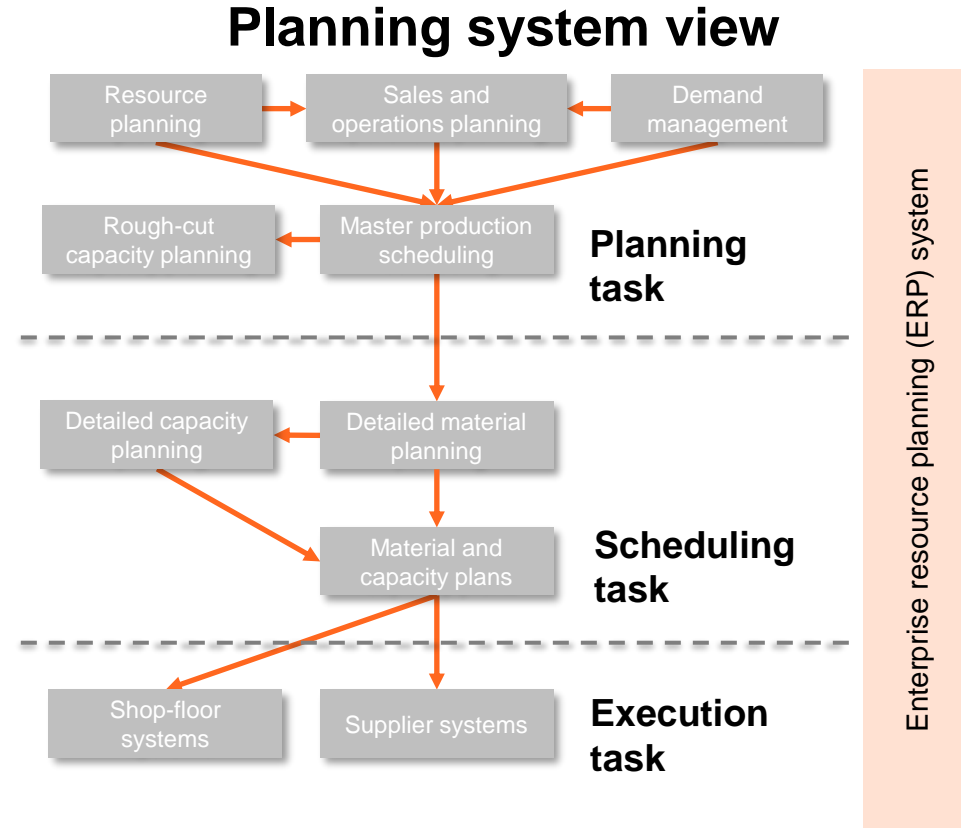
- Shop-floor resource allocation
- Short-term scheduling
- Managing exceptions

Planning process for supply chain

From **forecasting** demand to **adjusting capacity**, to **scheduling** actions

Targets:

- Maximize sales – availability of prod/service to customer
- Minimize costs and tied-up capital
- Hold up the customer service agreements



Inflexibilities and delays in SC: Forecasting is a critical task

Good forecasting

- “One set of numbers”
- Robust with predictable error
- No bias (systematic errors)

Characteristics of forecasts

- Always wrong
- Longer horizon, larger error
- Aggregate forecasts are more accurate

Types of methods

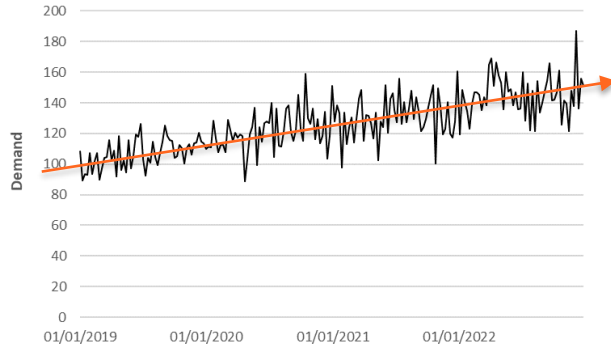
- Qualitative
- Time series
- Causal
- Simulation

Important data

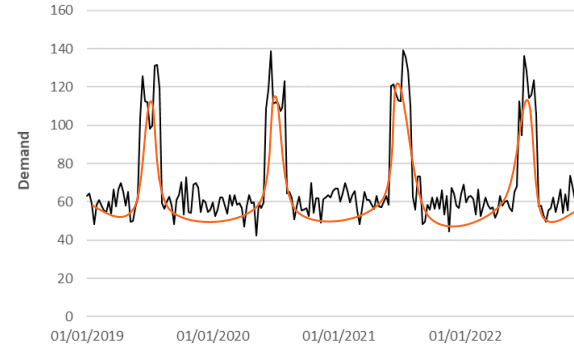
- Past demand
- Lead times
- Planned marketing
- Planned pricing
- Competitive actions
- Important external factors

Components in a forecast

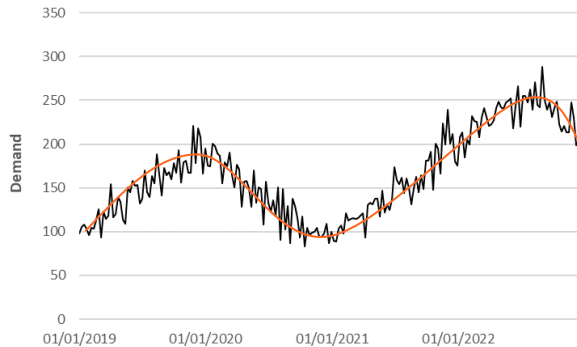
Trend



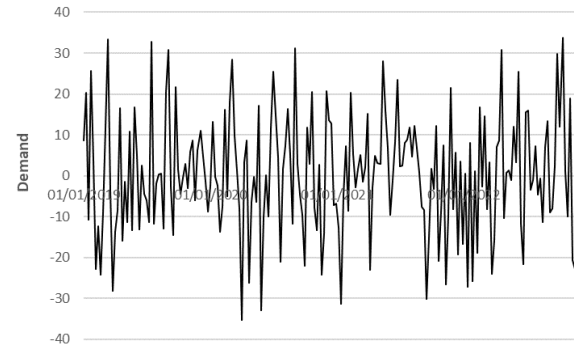
Seasonality



Cyclical

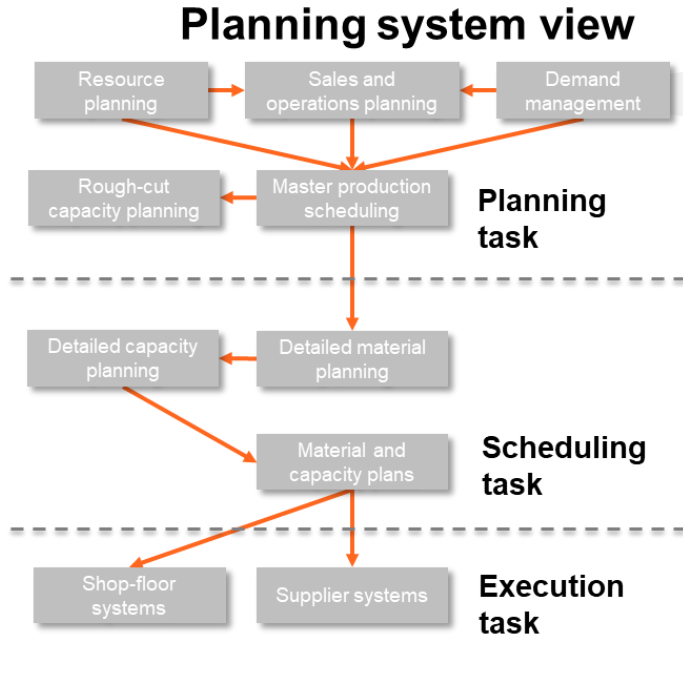


Random variation



From a forecast to an aggregate plan

Cross functional planning effort



Demand-supply balancing = Sales & Operations planning (S&OP)

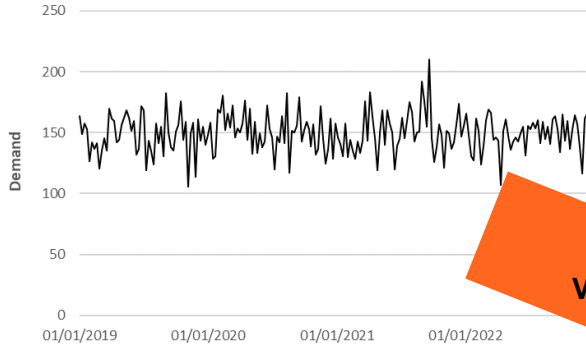
Supply constraint: You can **only** sell what is available for supply
Demand constraint: You should **only** produce what you are able to sell

Supply chain integration by SOP:

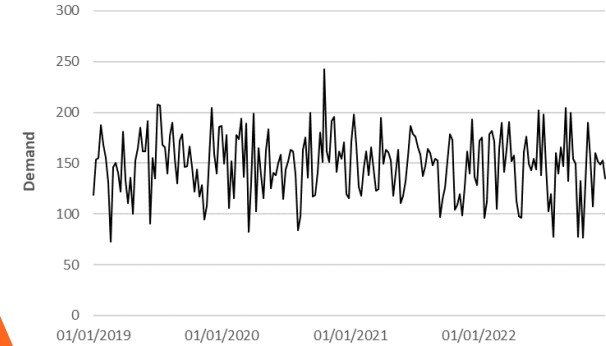
- Evaluate potential demand and commit “one set of numbers)
- Identify supply constraints and bottlenecks
- Create a common plan that the entire supply chain is capable and committed to execute

Supply chain coordination: Bull-whip effect

Customer sales at Retailer

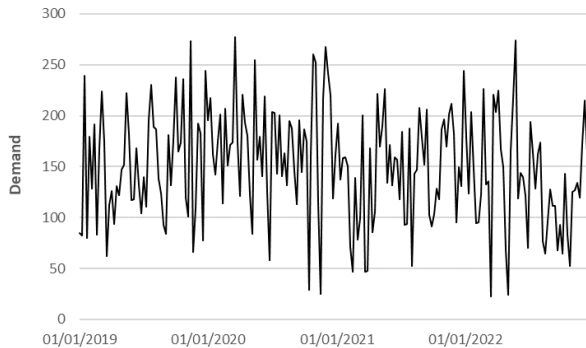


Retailer's Orders to Wholesaler

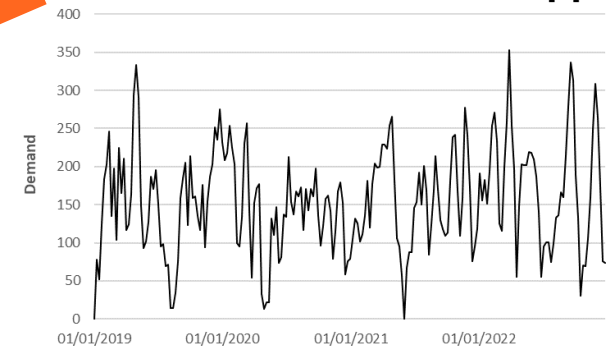


Volatility propagates upstream, why?

Wholesaler's Orders to Manufacturer



Manufacturer's Orders with Supplier



Reasons and mitigation strategies for bullwhip

- **Incentives misaligned**
 - Local optimization
 - Sales force incentives
- **Information distortion and delays**
 - Forecast driven operations
 - No information sharing
- **Operational inflexibilities**
 - Large production lots
 - Long lead times
- **Rationing and shortage gaming**
- **Pricing misaligned**
 - Quantity discounts
- **Aligning goals and incentives**
- **Pricing schemes for coordination**
- **Information accuracy and visibility**
- **Collaborative planning and forecasting (S&OP)**
- **Reduce lot sizes and lead times**

Summary of supply chain management lecture

Supply chain management means design, management and operation of supply- and distribution network. It includes the processes and information flows between companies in the chain.

Martinsuo et al., 2016, p. 279

Goal: Maximize value, minimize waste, beneficial for all parties

Challenge: Complex system of multiple levels and parties, massive number of decision parameters, visibility, conflicting interests, local vs. global optimization

Enabler: Swift even flow

Means: Planning processes for the management of the whole, systemic view, alignment of different levels to overall goals