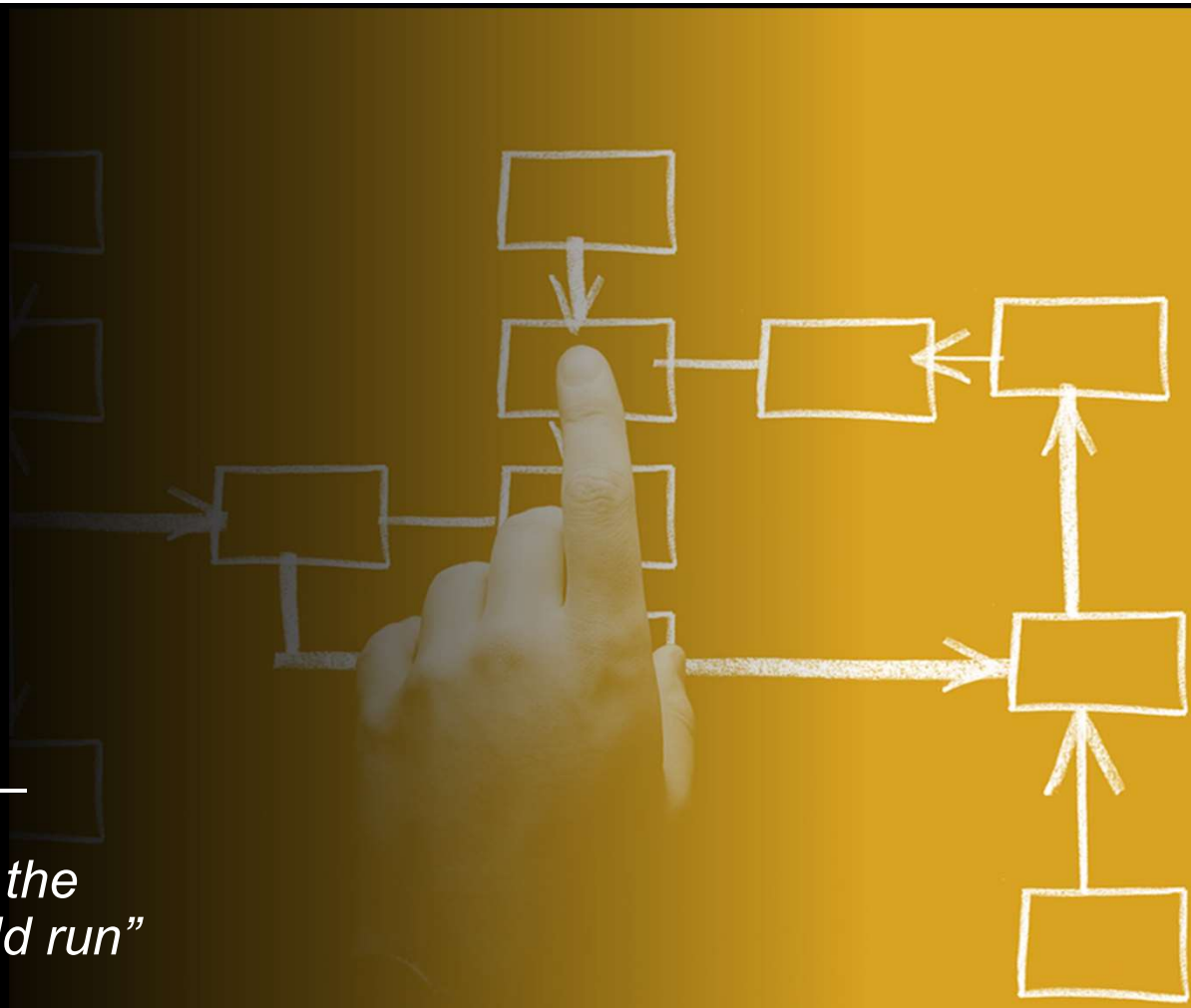
Operations Management **MLI21C617**



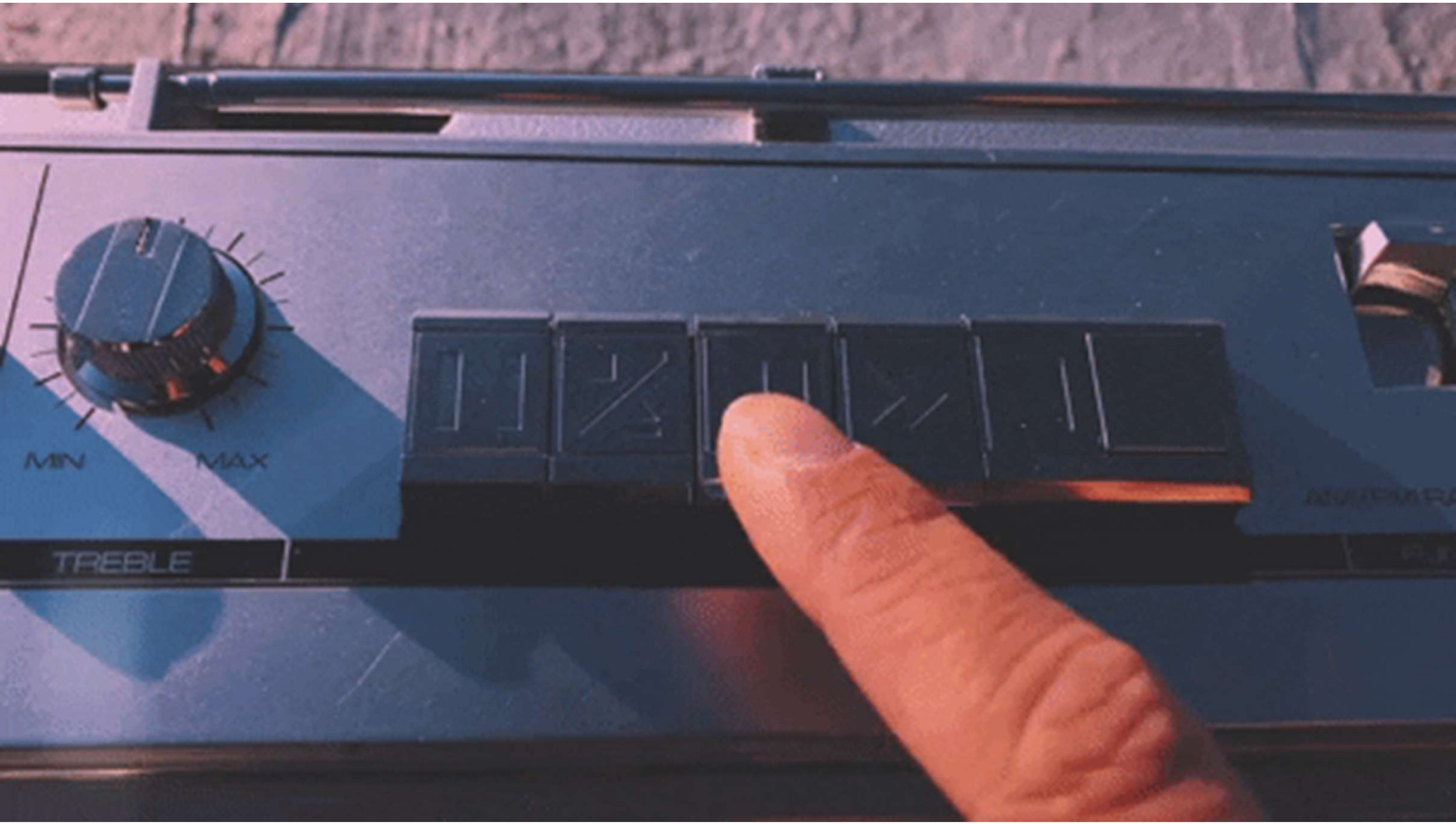
"Operations may not run the world, but it makes the world run"

Lecturer: Misa Bakajic

Spring 2024

Password: Coquitlam

LECTURE 9 Beer Game Simulation


MIN
MAX
TREBLE

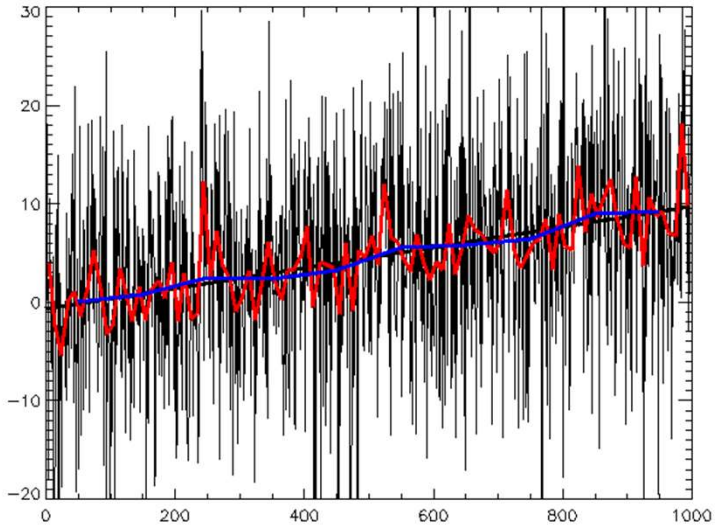
Recap

1. The supply network is a system of interdependent actors
2. Customers are a significant source of randomness
3. Transparency reduces variation in the supply chain

Signal VS Noise

Signal: meaningful information that you're trying to detect**.**

Noise: random or unwanted variation that interferes with the signal



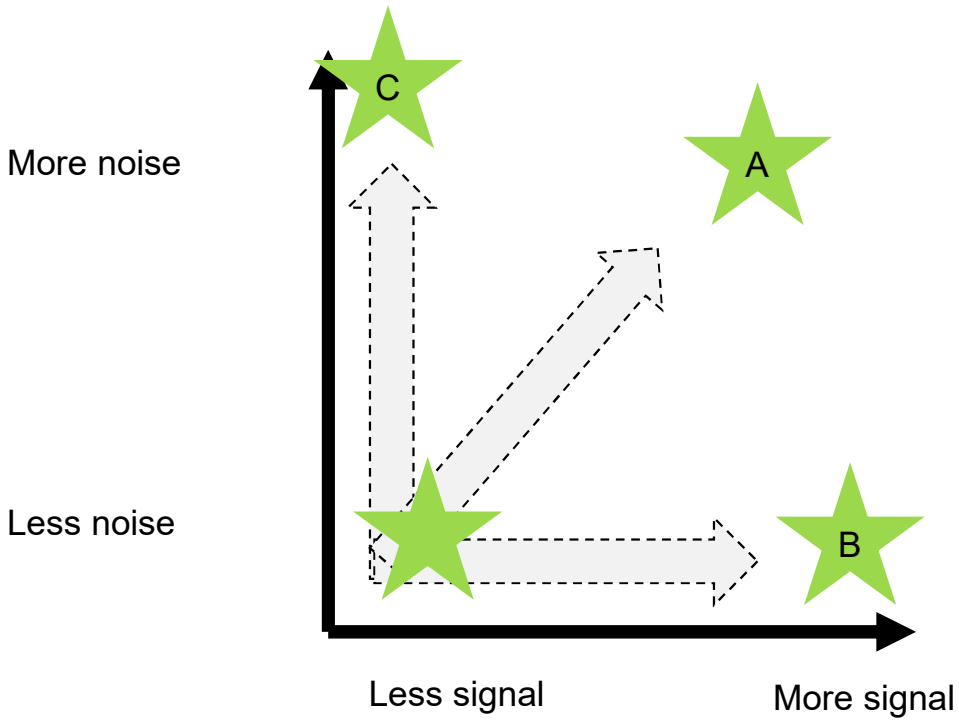
A!

Signal VS Noise applied to ordering

Signal: Actual sales data from retailers reflects true customer demand. This is a clear and accurate signal.

Noise: Fluctuations in individual retailer orders, like ordering in batches, inject "noise" into the system. This noise makes it difficult to understand the underlying customer demand.

Increasing the level of information



A. Beter than before but higher information volume still makes it challenging to understand situation in market.

B. Better than before. Higher useful information so easier to understand situation in market

C. Worse situation than before. Higher complexity of situation.

A!

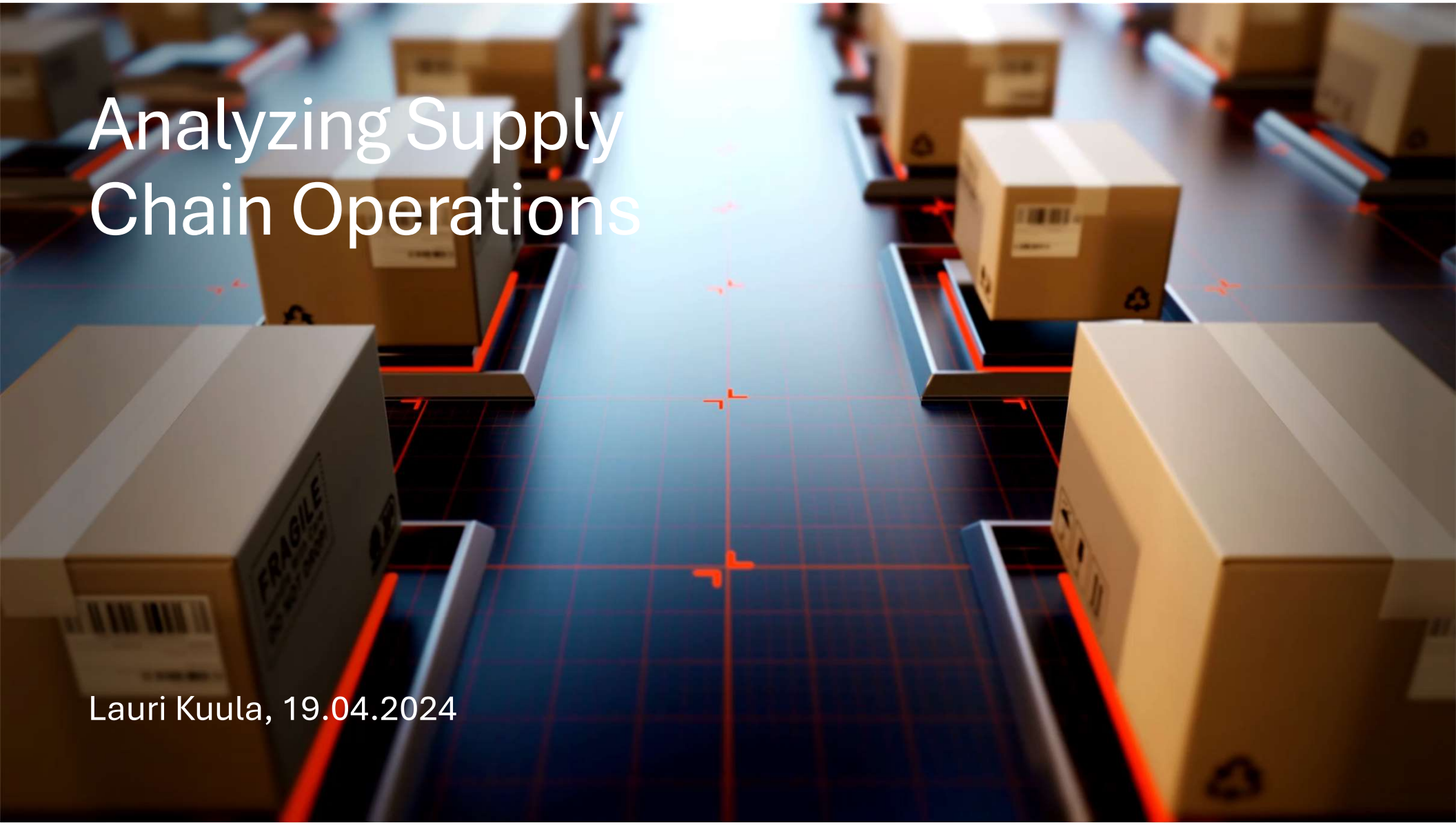
Individual Assignment 1 - Debriefing

Question 1 expected answer example

Bullwhip occurred due to small variations occurring at the start of the supply chain (Retailer) being amplified upstream. Increased order transparency could potentially reduce the bullwhip effect.

Question 2 expected answer example

The answer depends. If we decide that the Retailers are not communicating with each other or with the Distributor than the bullwhip is probably worse. If there is some information sharing the bullwhip could be mitigated better.



Analyzing Supply Chain Operations

Lauri Kuula, 19.04.2024

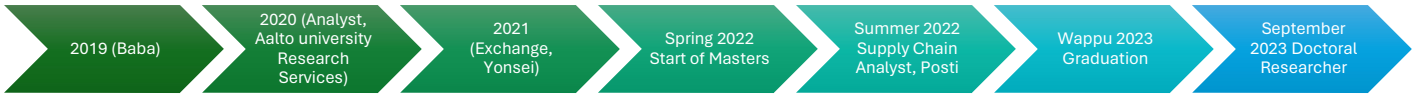
Agenda

- Introduction / Career
- ISM SCM Track
- Break
- Center of Gravity
- Break
- Mathematical Optimization Example

Who am I?

- **Baba 19**
- **Doctoral Researcher in Logistics**
  - HC Operations, Last-Mile Logistics

What I’ve been up to?



Supply Chain Analyst, Posti

- **Tactical / Strategic Postal volume forecasting**
  - Includes creating semi-automated forecasting processes
  - Directly influencing workforce allocation
- **Network and Transportation Modelling**
  - Using optimization and simulation tools (e.g., Coupa SCGx)
  - Example; where should our delivery start points be located?
- **Route Optimization Tool Management**
  - Updating, developing, and managing the main route optimization tool used by Posti

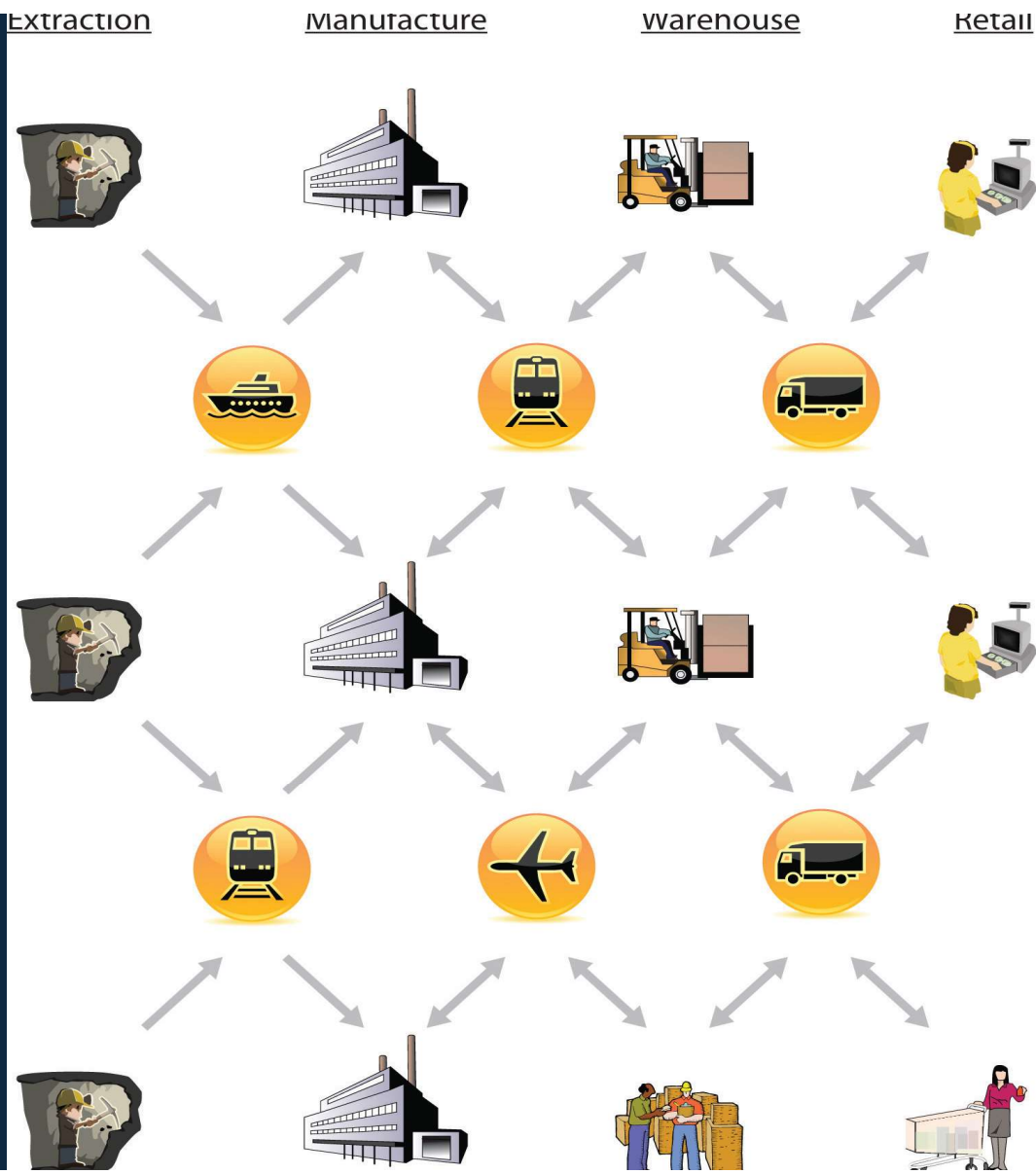
Doctoral Researcher, Aalto

- **Research interest in Social and Healthcare Service Delivery**
  - Efficient procurement practices for social and healthcare services
  - Resource management in healthcare operations
  - Social and healthcare service network

- **Additionally researching the environmental impact of last-mile parcel deliveries**
  - Are parcel lockers (and other pick-up points) more environmentally sustainable than home deliveries
    - Rather – When to select different last-mile delivery alternatives based on the environmental impact?

SCM specialization

Aalto University
School of Business



Fifth of all global CO2 emissions come from the supply chains of large multinational companies such as Total, BP and Coca Cola, study finds

- Report reveals the scope of big companies' power in climate change prevention

Cadbury faces fresh accusations of child labour on cocoa farms in Ghana

Climate change will disrupt supply chains much more than Covid — here's how businesses can prepare

Special Report UK's Leading Management Consultants

Supply chain bottlenecks: 'It's been nuts'

..."It's been absolutely nuts," says Brian Higgins, head of KPMG's U supply chain and operations practice....

Apple Inc

Apple forecasts up to $8bn hit from supply chain problems

...Apple executives warned that the group could sustain a hit of up to $8bn in the current quarter from headwinds including supply chain shortages and factory shutdowns in China, underscoring how the challenges...

DHL says supply chain must drive move to circular economy

January 26, 2022 • 5 mins

Supply chains + Add to myFT

Supply chain managers in demand as businesses hit by shortages

Supply chain traceability – the next revolution?

November 2022 | FEATURE | BOARDROOM INTELLIGENCE

Supply Chain Analytics Market Statistics - 2027

The global supply chain analytics market size was valued at $4.53 billion in 2019, and is projected to reach $16.82 billion by 2027, growing at a CAGR of 17.9% from 2020 to 2027. Supply chain analytics targets to improve operational efficiency and effectiveness by enabling data-driven decisions at strategic, operational, and tactical levels. It incorporates virtually the complete value chain including sourcing, manufacturing, distribution, and logistics. Supply chain analytics helps in increasing

A THE BIG SUPPLY CHAIN TALENT SHORTAGE

A Tech 'Golden Age' Awaits Supply Chains Limping Out of the Pandemic

- Investors injecting $9 billion a quarter into logistics tech

Supply Chain Management is part of ISM MSc programme

- **Information and Service Management – MSc programme where student can choose to specialize in 1 or more areas:**
  - Supply chain management
  - Information Systems Science
  - Business Analytics

Also the MSc in Business Analytics contains a specialization area in SCM

SCM courses on offer

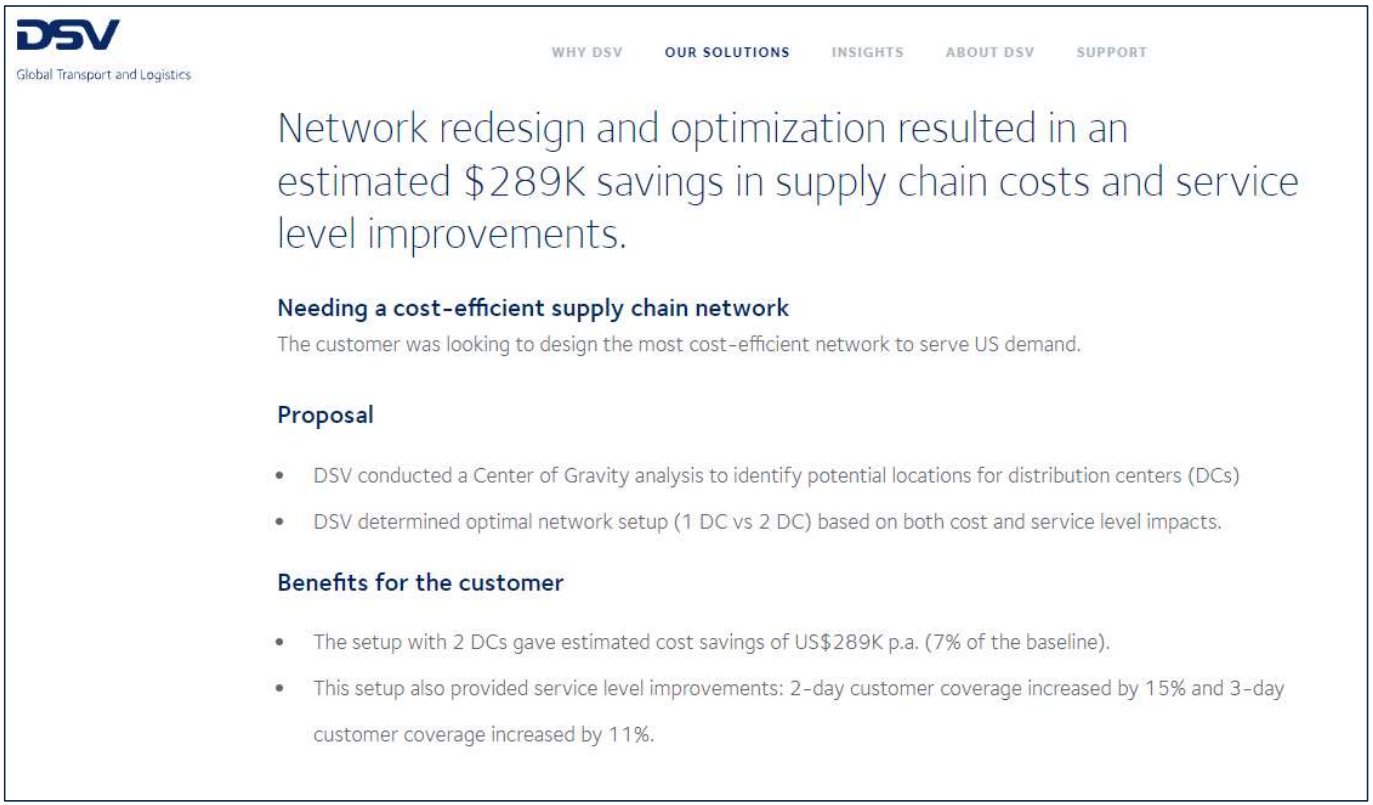
Sustainable Supply Chains	One of the 2/3 core programme studies courses (offered now in 1st period)
Operations and Supply Chain Analytics	New course!
Quality and Performance Management	
Procurement and Strategic Sourcing	
Revenue Management and Demand Analytics	New course!
Coordination of Supply Chains	Recommended close to MSc thesis writing
Capstone: Future-proofing supply chains	New course! Recommended towards end of your studies. Real-case-based course, practice consulting

Name	Short description of course content	Teacher	Period
Sustainable Supply Chains	The course is intended to provide an overall understanding of the triple bottom line i.e. economic, environmental and social sustainability in the context of supply chains. Students will understand the various ways in which environmental and social sustainability strategies and practices and circular economy approaches can be incorporated into different stages of a supply chain, and how these will impact supply chain performance. The course will also provide insights on the challenges and solutions related to the implementation issues in supply chain sustainability for organizations and industries.	Katri Kauppi	1st
Operations and Supply Chain Analytics	The course will include an overview of analytics for business operations and supply chains; data-driven decision-making for capacity and inventory management; optimization in logistics; and supply chain design, with applications from e.g., retail and manufacturing.	Heikki Peura	2nd
Procurement and Strategic Sourcing	The course topics include sourcing strategy and procurement/sourcing impact on performance, purchasing category strategies and management, cost and spend analysis, supplier selection, outsourcing, supplier relationship management, purchasing organization and processes as well as sourcing of services.	Seongtae Kim	2nd
Quality and Performance Management	The main concepts and topics of the course include definitions of quality and performance management, total quality management, lean, six sigma, statistical process control, and different quality certificates. Those who pass the course will also receive Lean Six Sigma Yellow Belt certification.	Markku Kuula	3rd

Name	Short description of course content	Teacher	Period
CAPSTONE: Future-proofing supply chains	This course helps understand major external challenges, opportunities and risks to supply chains in the future. Key megatrends to be included are for example climate change, geopolitical issues and digitalization. Students work in groups on a real-life case assignment, presenting to the company in the end	Katri Kauppi	3rd
Revenue Management and Demand Analytics	The course will cover demand analytics and forecasting as well as revenue management and price optimization, including the process of identifying problems where employing analytics is appropriate, translating problems into models, and interpreting the results. The topics covered will include, for example, statistical and optimization models applied to settings in e.g., transportation, hospitality, retail, media, and energy.	Heikki Peura	4th
Coordination of Supply Chains	Main topics of the course are supply chain integration and coordination as well as collaboration models. This will cover the value of information, supply chain optimization, flexibility principles, contracting and incentive alignment.	Gautam Basu	5th

Center of Gravity

Centre of gravity method



DSV
Global Transport and Logistics

WHY DSV OUR SOLUTIONS INSIGHTS ABOUT DSV SUPPORT

Network redesign and optimization resulted in an estimated $289K savings in supply chain costs and service level improvements.

Needing a cost-efficient supply chain network

The customer was looking to design the most cost-efficient network to serve US demand.

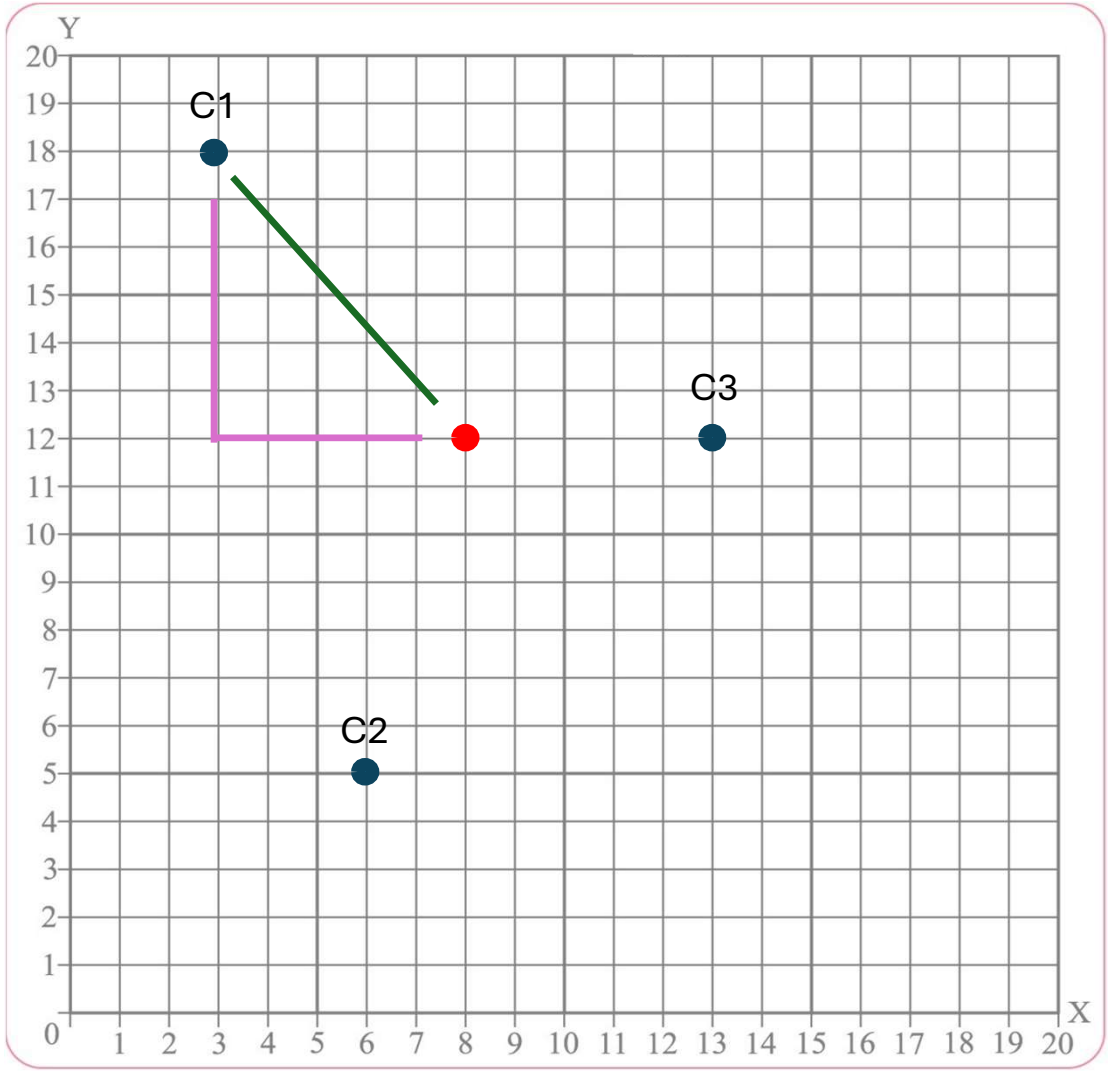
Proposal

- DSV conducted a Center of Gravity analysis to identify potential locations for distribution centers (DCs)
- DSV determined optimal network setup (1 DC vs 2 DC) based on both cost and service level impacts.

Benefits for the customer

- The setup with 2 DCs gave estimated cost savings of US$289K p.a. (7% of the baseline).
- This setup also provided service level improvements: 2-day customer coverage increased by 15% and 3-day customer coverage increased by 11%.

https://www.dsv.com/en-us/our-solutions/supply-chain-innovation/cases/extra-distribution-centre



Distance Measures

Euclidian distance is the straight-line distance or shortest path possible between points.

di = distance between customer **i** and proposed facility
xi = x-coordinate of customer **i**
yi = y-coordinate of customer **I**
x* = x-coordinate of proposed facility
y* = y-coordinate of proposed facility

$$di = \sqrt{(xi - x*)^2 + (yi - y*)^2}$$

$$\boldsymbol{d1 = \sqrt{(3 - 8)^2 + (18 - 12)^2} = 7{,}81\ km}$$

Rectilinear distance measures distance between two points with a series of 90 degree turns (as along city blocks).

$$di = |xi - x*| + |yi - y*|$$

$$\boldsymbol{d1 = |3 - 8| + |18 - 12| = 11{,}00\ km}$$

Calculating a Load-Distance Score

- Often knowing only the distance is not enough
- Suppose that a firm is seeking a new location and wants to select a site that minimizes the distance that a loads, particular larger ones, must travel to and from the site.
- Depending on the industry "a load" may be a shipment from suppliers, shipment to customer, or even people moving between locations.
- The idea is to minimize the **load-distance score**, by choosing a location that ensures large loads go on short distances.
- It could be easier to think of loads as weights

Load distance = sum (load* distance)

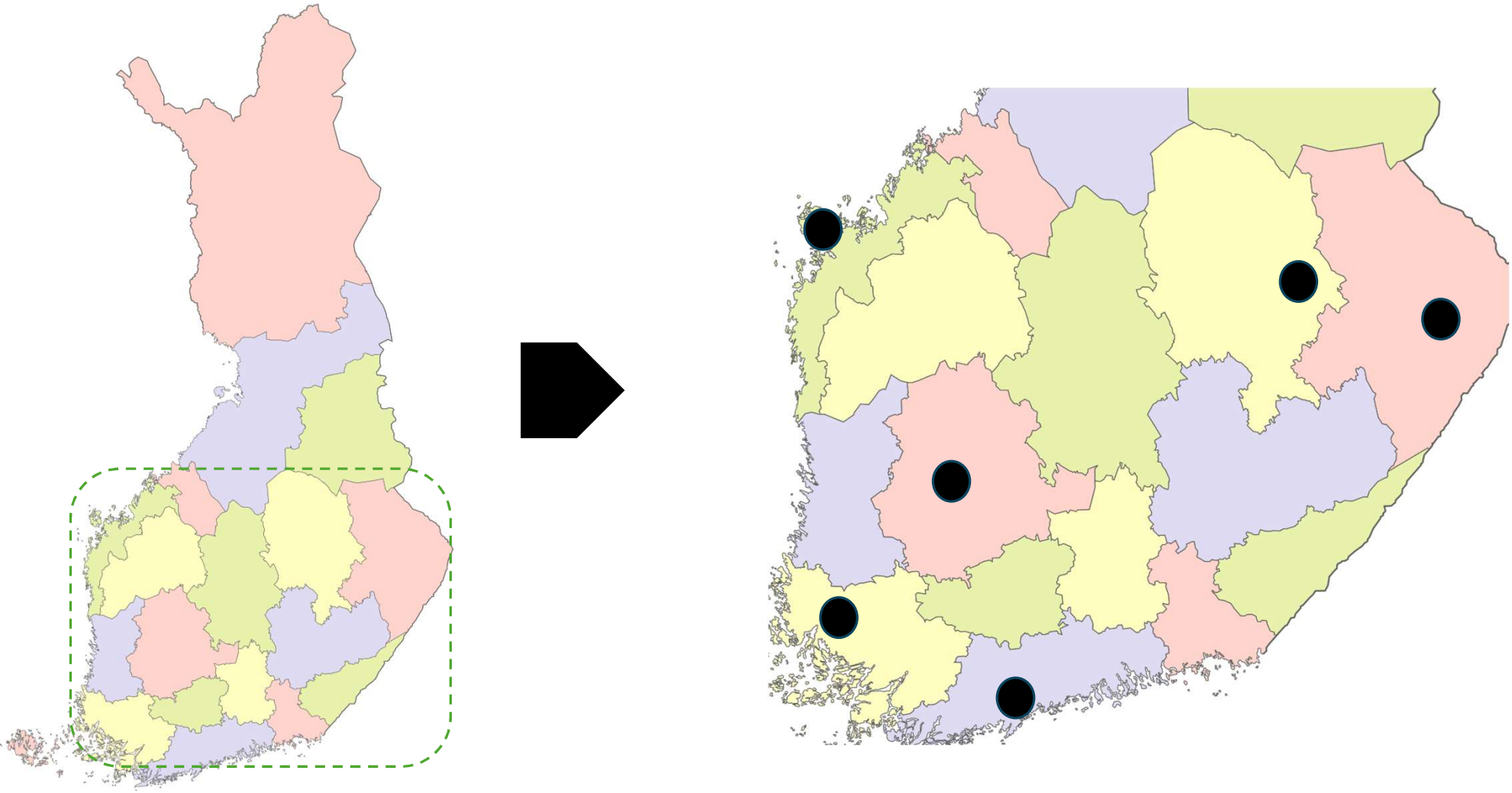
Centre of gravity method

- COG is a good starting point to evaluate locations in the target area using the load-distance method.
- First step is to determine the x- and y- coordinates of different locations on the graph (*longitude/latitude can also be used*)
- COG methods is used to determine the x and y coordinate of a location that incorporates distance between nodes and the corresponding load score.

x* = sum of (all loads X x-coordinates) / sum of (loads)

y* = sum of (all loads X y-coordinates) / sum of (loads)

$$x* = \frac{\sum lx}{\sum l} \quad y* = \frac{\sum ly}{\sum l}$$



KL0

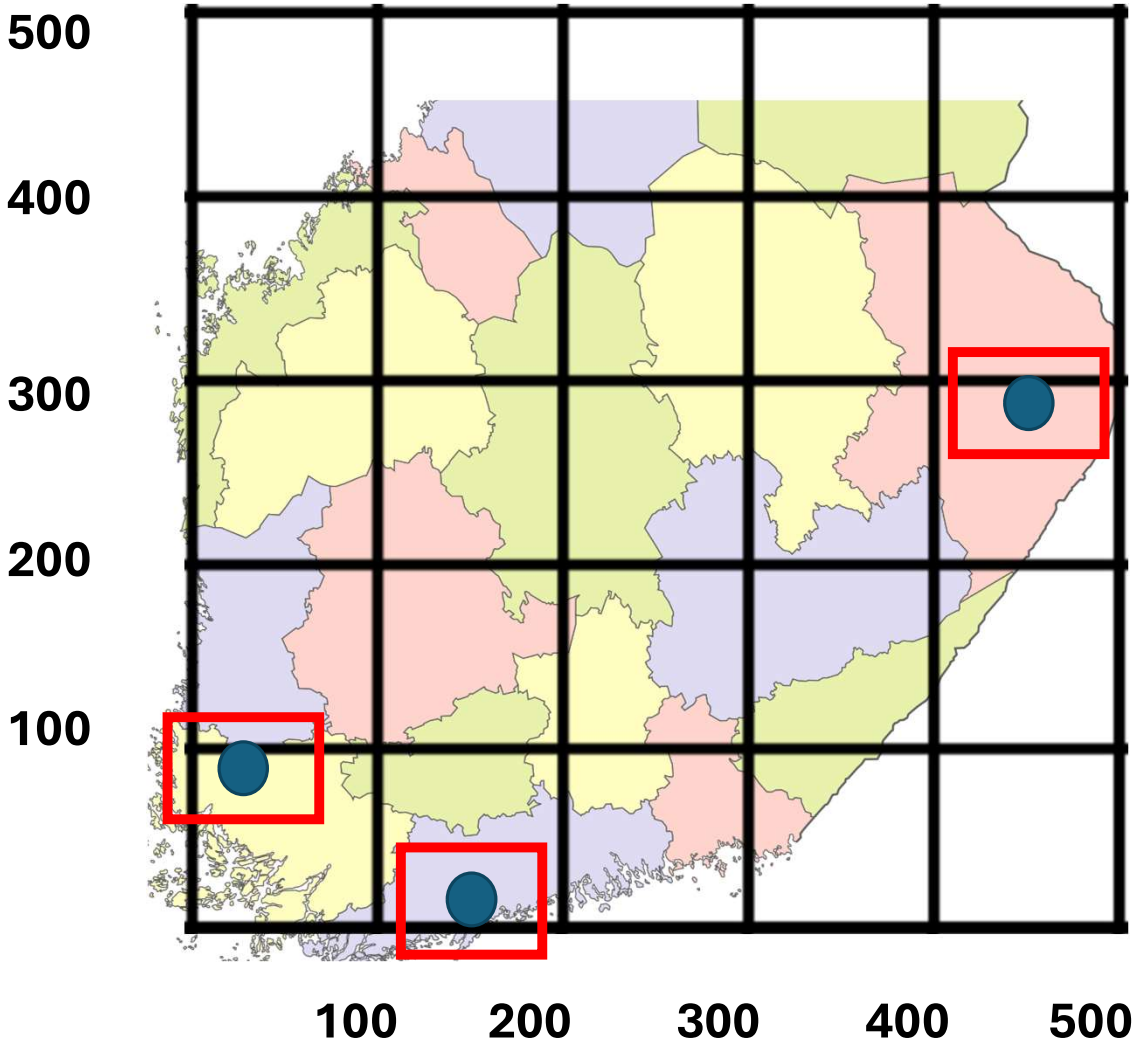
Customer location	Tons shipped	X/Y Coordinate
1. Helsinki	10	x_1 / y_1
2. Turku	30	x_2 / y_2
3. Joensuu	100	x_3 / y_3

$$x* = \frac{\sum lx}{\sum l} \qquad y* = \frac{\sum ly}{\sum l}$$

$\sum l$ = 10 + 30 +100 = 140

$\sum lx$= 10(x_1) + 30(x_2) + 100(x_3) =

$\sum ly$= 10(y_1) + 30(y_2) + 100(y_3) =



Slide 29

KL0 Tähän excel template, valitaan koordinaatit yhdessä luokan kesken

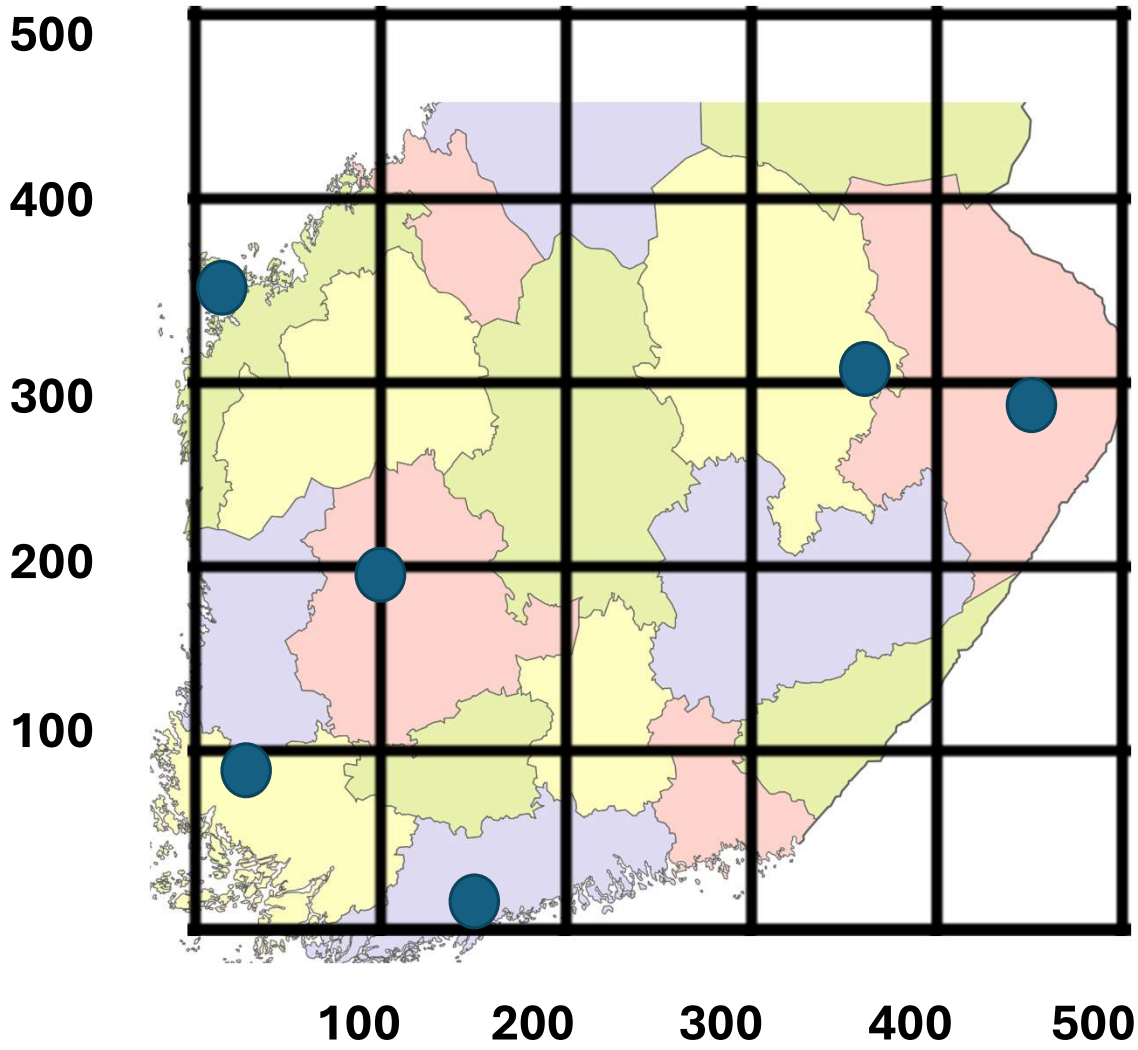
Kuula Lauri, 2024-04-16T11:49:16.307

Student Exercise

KL0

Customer location	Tons shipped	X/Y Coordinate
Turku	35	30, 80
Vaasa	50	25, 350
Tampere	30	100, 200
Helsinki	25	150, 20
Kuopio	70	370, 310
Joensuu	80	450, 290

$$x* = \frac{\sum lx}{\sum l} \qquad y* = \frac{\sum ly}{\sum l}$$



Slide 31

KL0 This one calculated by students, then together
Kuula Lauri, 2024-04-16T11:23:41.190

KL0 0 Ota koordinaatit valmiiksi esiin
Kuula Lauri, 2024-04-16T11:48:59.134

Customer location	Tons shipped	X/Y Coordinate
Turku	35	30, 80
Vaasa	50	25, 350
Tampere	30	100, 200
Helsinki	25	150, 20
Kuopio	70	370, 310
Joensuu	80	450, 290

$$x* = \frac{\sum lx}{\sum l} \qquad y* = \frac{\sum ly}{\sum l}$$

$\sum l$ = 35+50+30+25+70+80 = 290

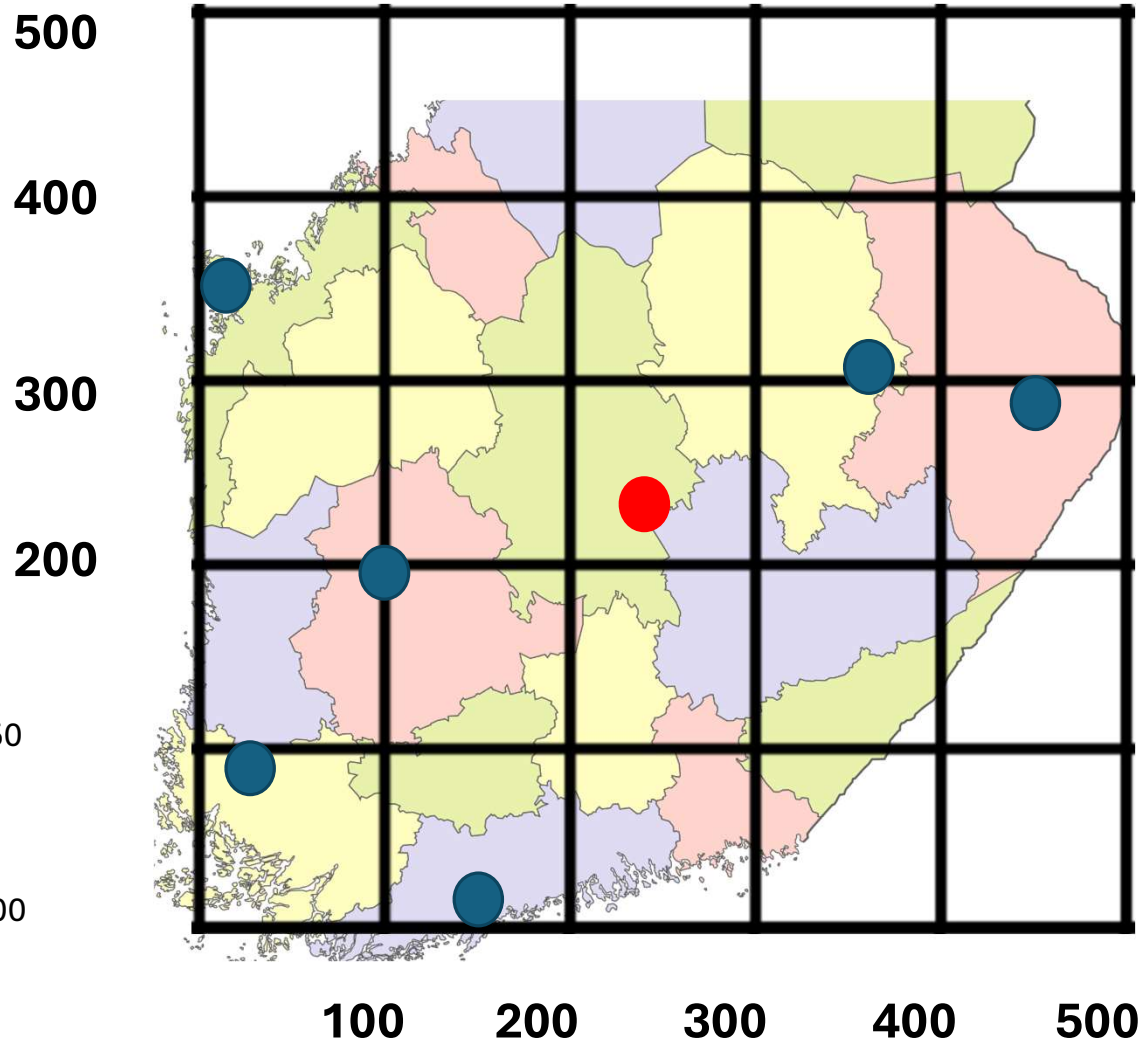
$\sum lx$= 35(30)+50(25)+30(100)+25(150)+70(370)+80(450) = 70650

$\sum l$ = 35+50+30+25+70+80 = 290

$\sum ly$= 35(80)+50(350)+30(200)+25(20)+70(310)+80(290) = 71700

X= 70650 / 290 = 244

Y= 71700 / 290 = 247



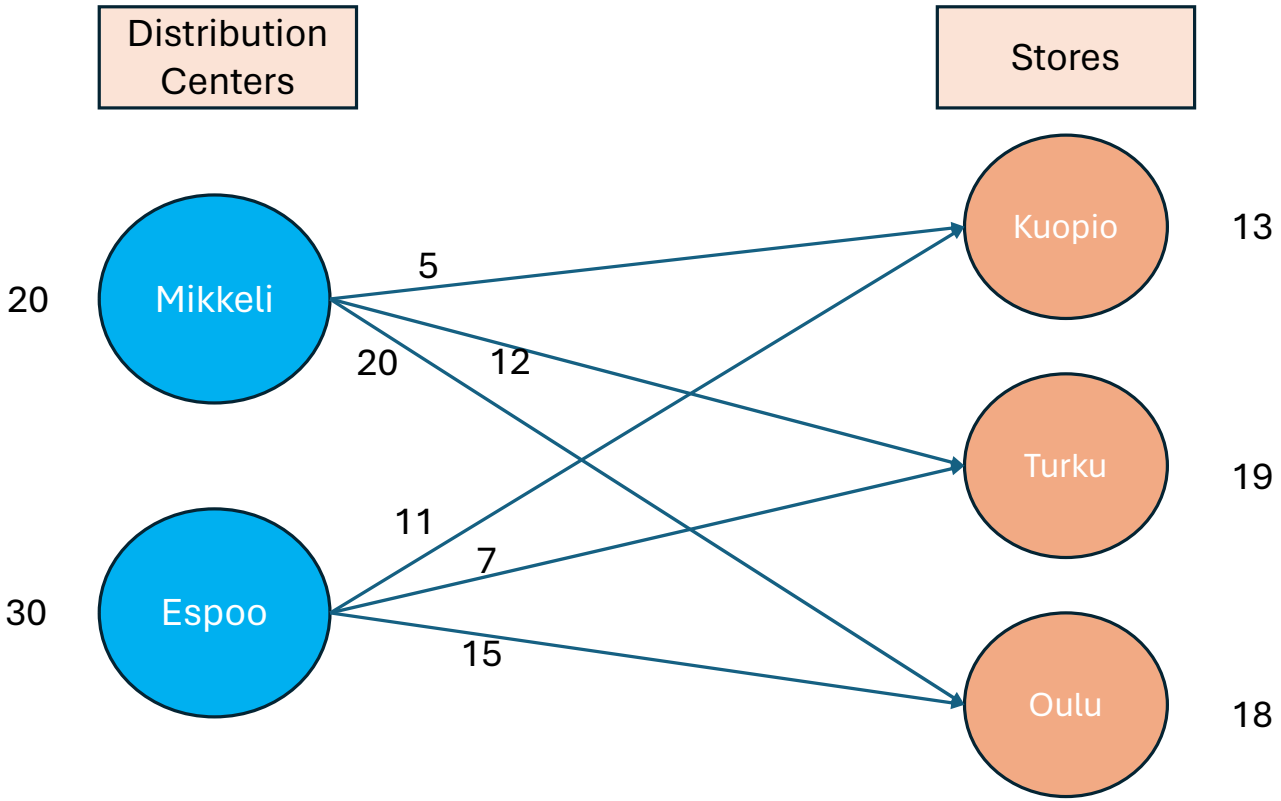
Mathematical Optimization Examples

Optimization

- Goal of optimization is to minimize or maximize an objective function
  - Objective function can be cost (money, emissions, etc.) or profit

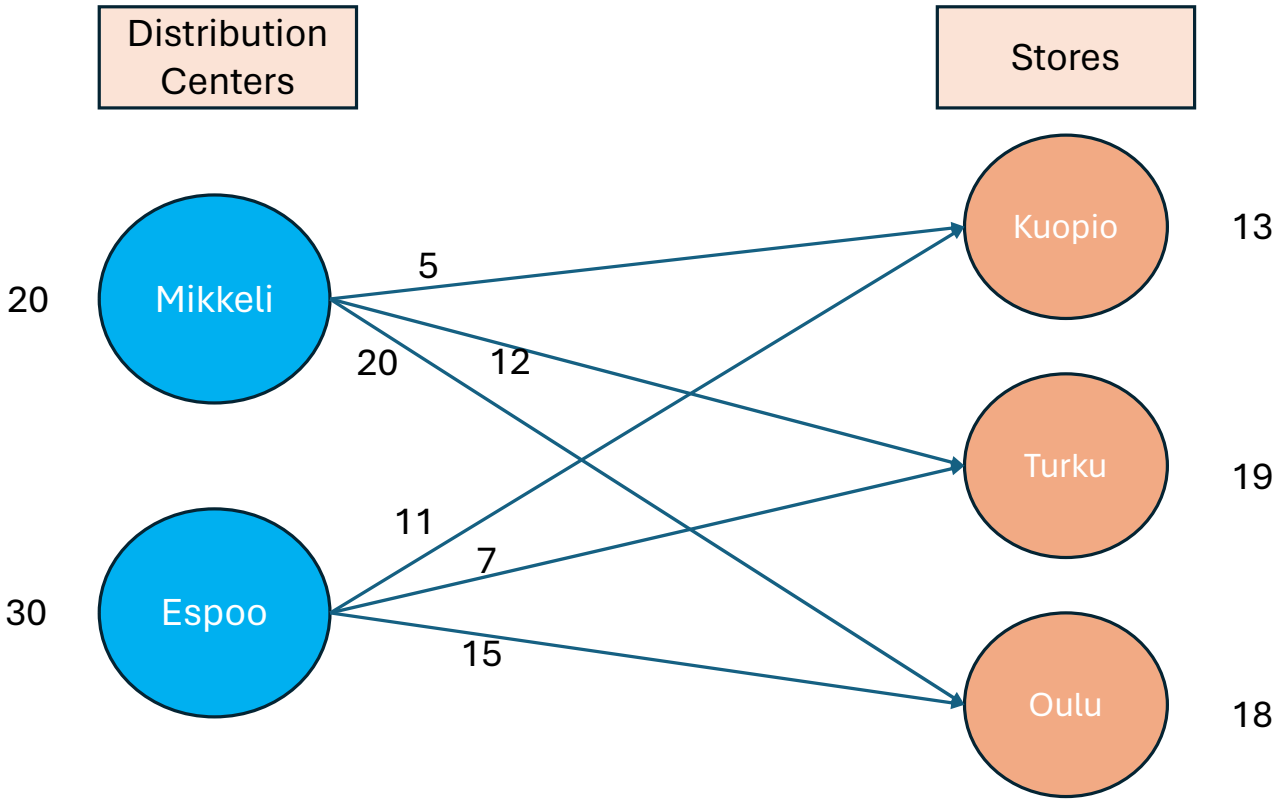
- Often used in logistics network and/or transportation design
  - However, same principle applies to many other things, such as manufacturing, pricing, etc.

Distribution problem (Delivery)



Goal = Minimize transportation costs

Distribution problem (Delivery)



Goal = Minimize transportation costs

"Leg"	Cost
MLI-Kuopio	5
MLI-Turku	12
MLI-Oulu	20
Espoo-Kuopio	11
Espoo-Turku	7
Espoo-Oulu	15

“Leg”	Units
MLI-Kuopio	13
MLI-Turku	7
MLI-Oulu	**0**
Espoo-Kuopio	**0**
Espoo-Turku	12
Espoo-Oulu	18

Minimal cost with this supply and demand would be 503 – no transportation between MLI-Oulu and Espoo-Kuopio Required

Learn More: Operations and Supply Chain Analytics

Feel free to reach out to me

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LinkedIn: https://www.linkedin.com/in/lauri-kuula/

Kiitos
aalto.fi