L1: Introduction

INSE6290 Quality in Supply Chain Design

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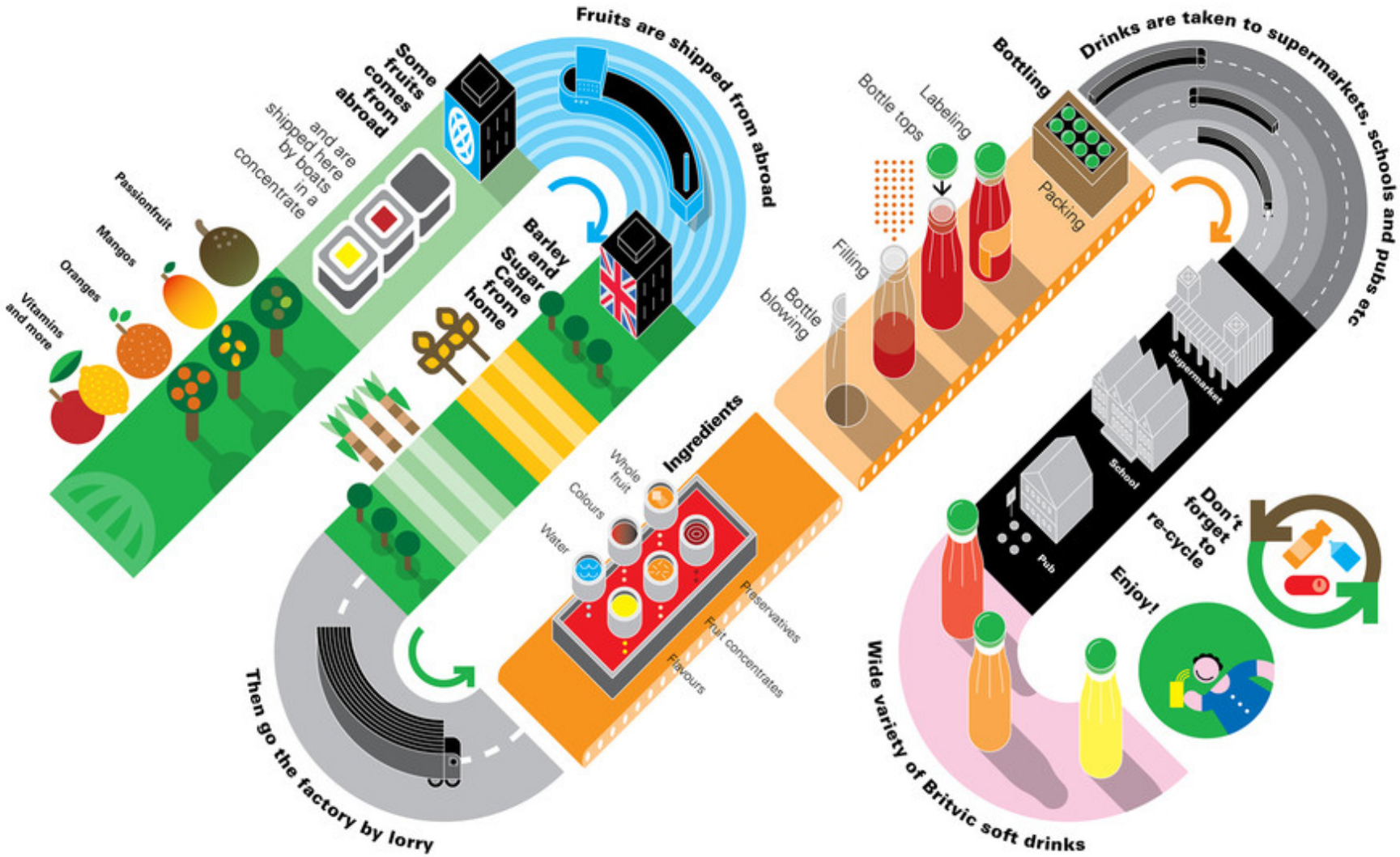
What is a supply chain?

[1]

[1] https://s-media-cache-ak0.pinimg.com/736x/b8/63/7b/b8637b73027d18d5f8e3603c253851e1.jpg

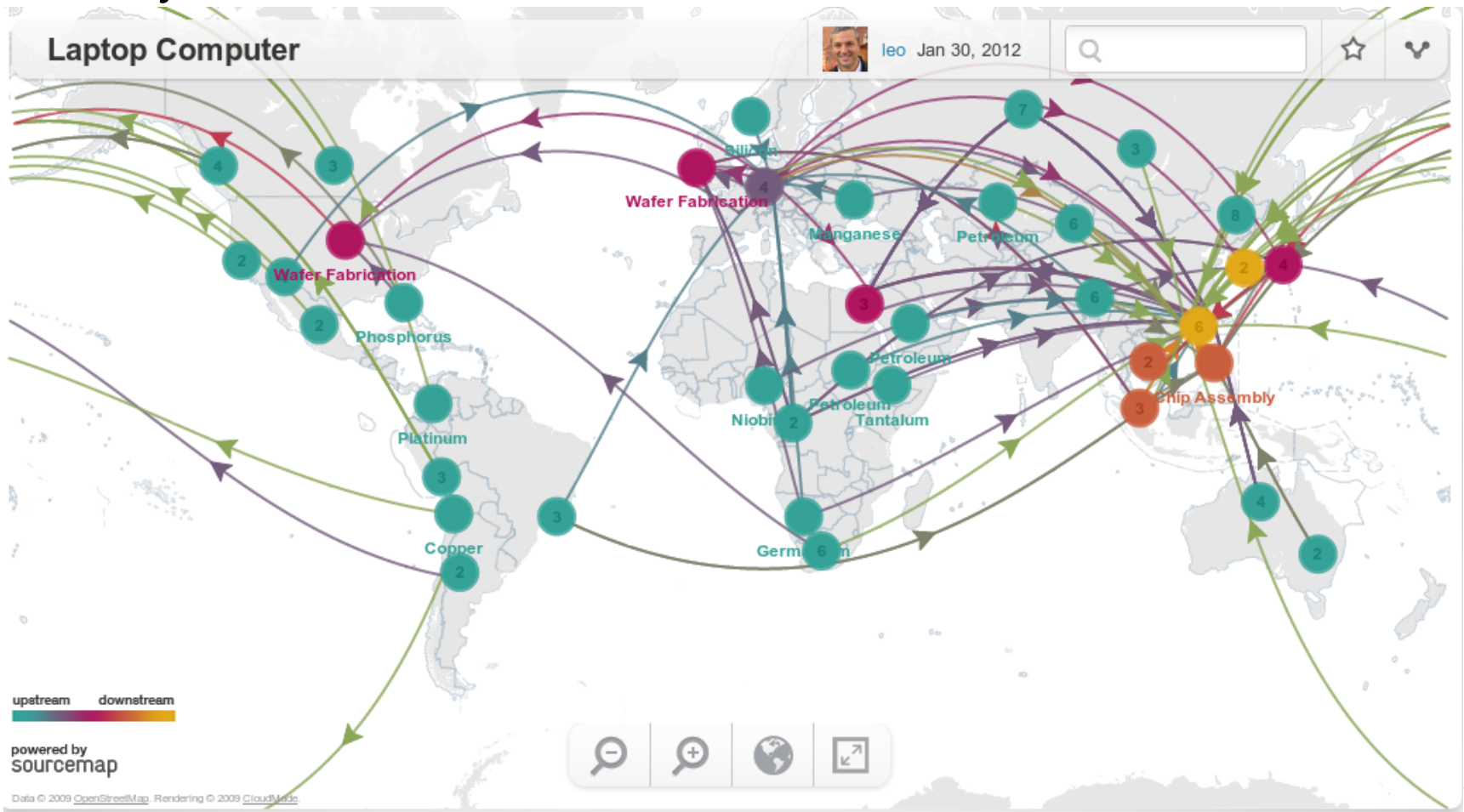
What is a supply?



[2] https://mohammadghaffar.blog.ryerson.ca/files/2010/08/debutart_peter-grundy_2855.jpg

Not really a chain

Actually a multi-chain!



[3]

[3] https://drawingbynumbers.org/sites/drawingbynumbers.org/files/Sourcemap.png

Why a (multi-)chain?

As far back as 1776, Adam Smith noticed something fundamental.

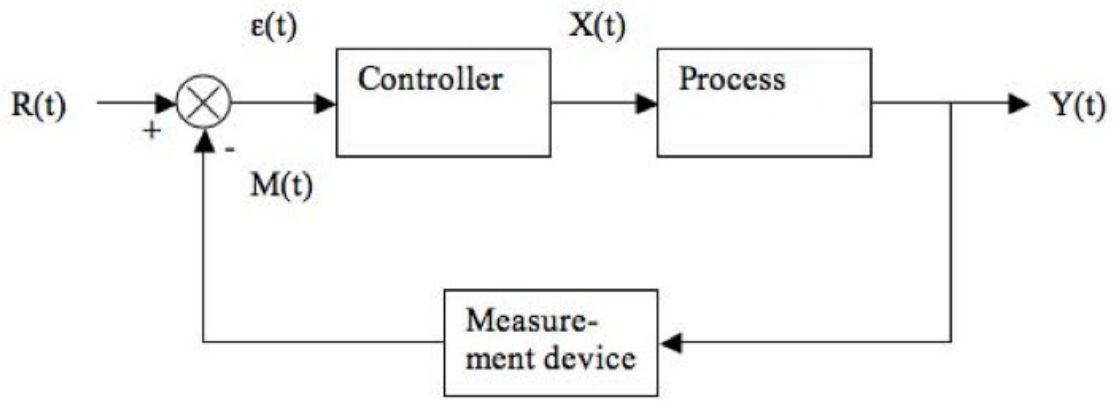
[4]

[5]

[4] https://ozgurzan.files.wordpress.com/2011/01/adam-smith.jpg
[5] http://study.com/cimages/multimages/16/Divison_of_labor.jpg

How do we model it?

- This is engineering (a precise science).
- A supply chain is a system with inputs and outputs.
- Block diagram in control theory:



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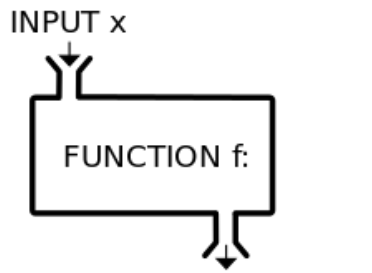
[6] https://controls.engin.umich.edu/wiki/images/5/5b/BlockDiagram2.jpg

This system is made of components

- A system is made of interconnected components. (Each component is also a system.)
- Each component maps inputs (variables) to outputs (variables). It is a function.



[7]

- The variables have time indices to model evolution over time.
- Examples of inputs: quantity of raw materials, decisions, demand, state variable, etc.
- Examples of outputs: quantity of finished products, revenue, etc.
- Example: inventory or queue management.

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[7] https://upload.wikimedia.org/wikipedia/commons/thumb/3/3b/Function_machine2.svg/220px-Function_machine2.svg.png

What do we mean by Design?

- Putting components together, connecting them.
- Choosing the values of the decisions (variables): Decision-making.
- E.g., how many employees to hire, how much to charge for each hot dog, etc.

[8]

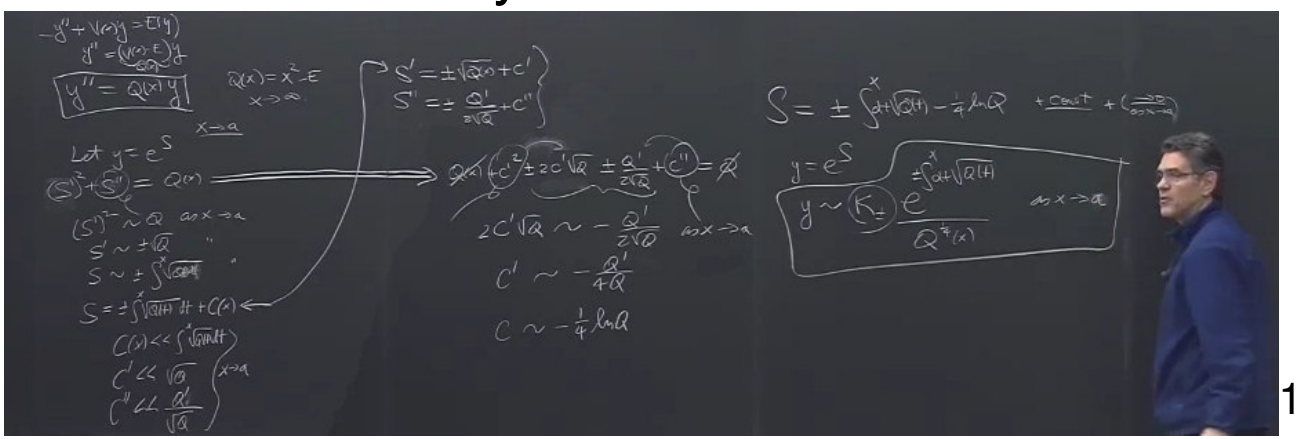
[8] http://canadianimmigrant.ca/wordpress/wp-content/uploads/lemonade_stand.jpg

How do we make decisions?

- You have to convince your boss.
- Divination, intuition.

[9]

- Mathematical analysis.



[10]

[9] HarryPoter

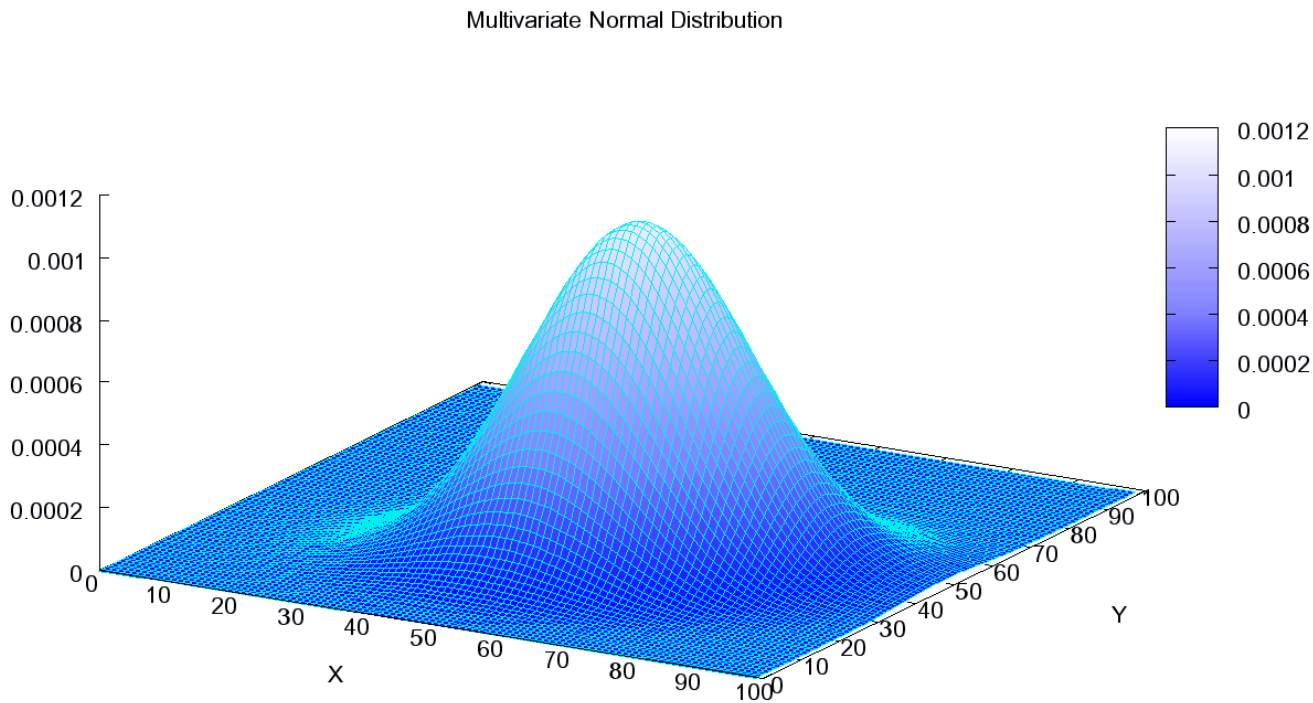
[10] http://www.numericana.com/fame/bender-wkb.jpg

Which approach do we take in this course?

- Mathematical modeling, theory of decision-making
- Connections to industry, state-of-the-art

How to make good decisions?

- Give performance guarantees on the decisions.
- E.g., among all possible decisions, x^* maximizes the profit function f.



[11] https://upload.wikimedia.org/wikipedia/commons/5/57/Multivariate_Gaussian.png

Where does supply chain theory come from?

Scientific approach to decision making:

- Fourier (1800s): formulated linear optimization problem.
- Kantorovich (1900s): encountered linear optimization problem for economic planning in USSR.
- WW2: transportation, scheduling, allocation of resources with constraints.
- George Dantzig (1947): solving linear optimization problems quickly for military activities.

Where is it used today?

- Petroleum industry: scheduling refineries, routing tanker ships.
- Airlines: scheduling planes, crews, pricing tickets
- Transportation: routing
- Lumber: managing forests
- Government: policies, regulations
- Customer service: managing queues

Supply chain decision are common sense

- Inventory management at home

[12]

[12] http://www.forrent.com/blog/wp-content/uploads/2012/02/Fridge-1.jpg

Supply chain decision are common sense

- Combined shipping

[13]

[13] Amazon

Where is it used?

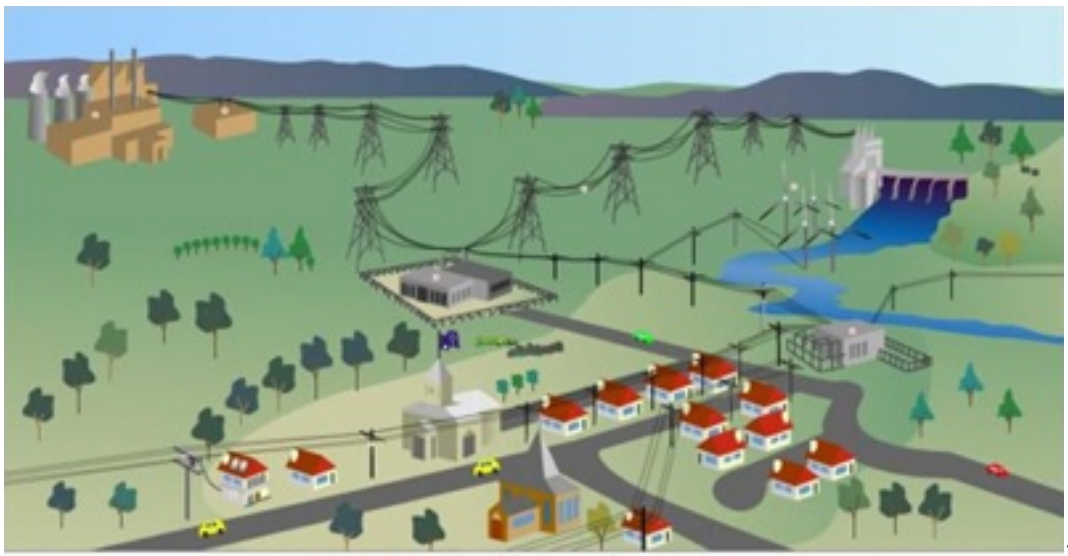
- Games

[14]

[14] Starcraft

Where is it used?

- Electricity networks



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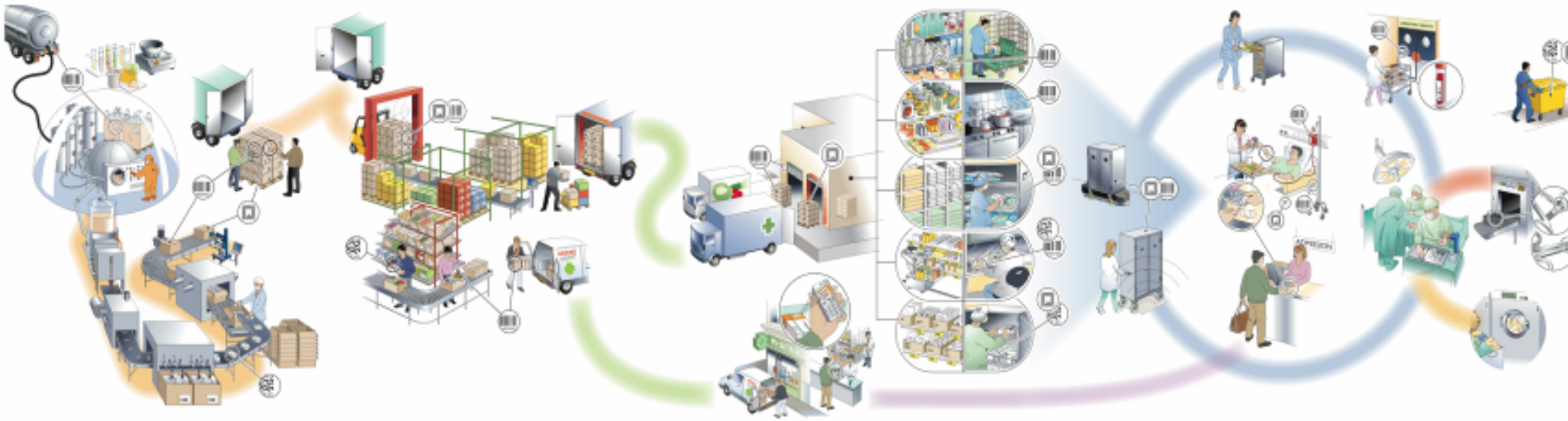
[15] http://kk.org/mt-files/thetechnium-mt/Electricity_Network.jpg

[16] https://upload.wikimedia.org/wikipedia/commons/d/d7/Kuwait_Water_Towers.jpg

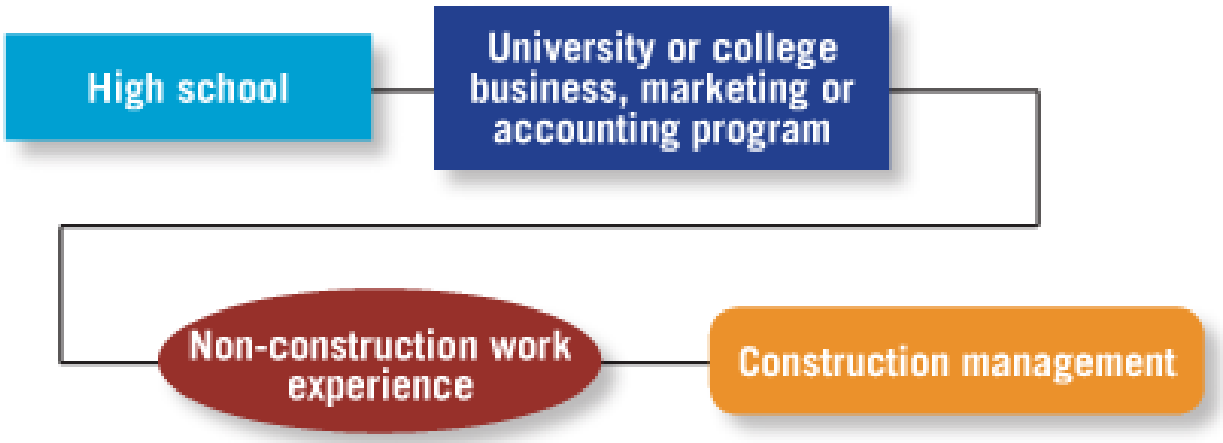
Where is it used?

- Hospitals



[17] http://www.gs1.org/sites/default/files/docs/healthcare/Healthcare_supply_chain.png

Is this course part of a supply chain?



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- What are the inputs?
- What are the outputs?

[18] http://www.careersinconstruction.ca/sites/cic/files/images/career_paths/management_path_08-en.png

Is this course part of a supply chain?

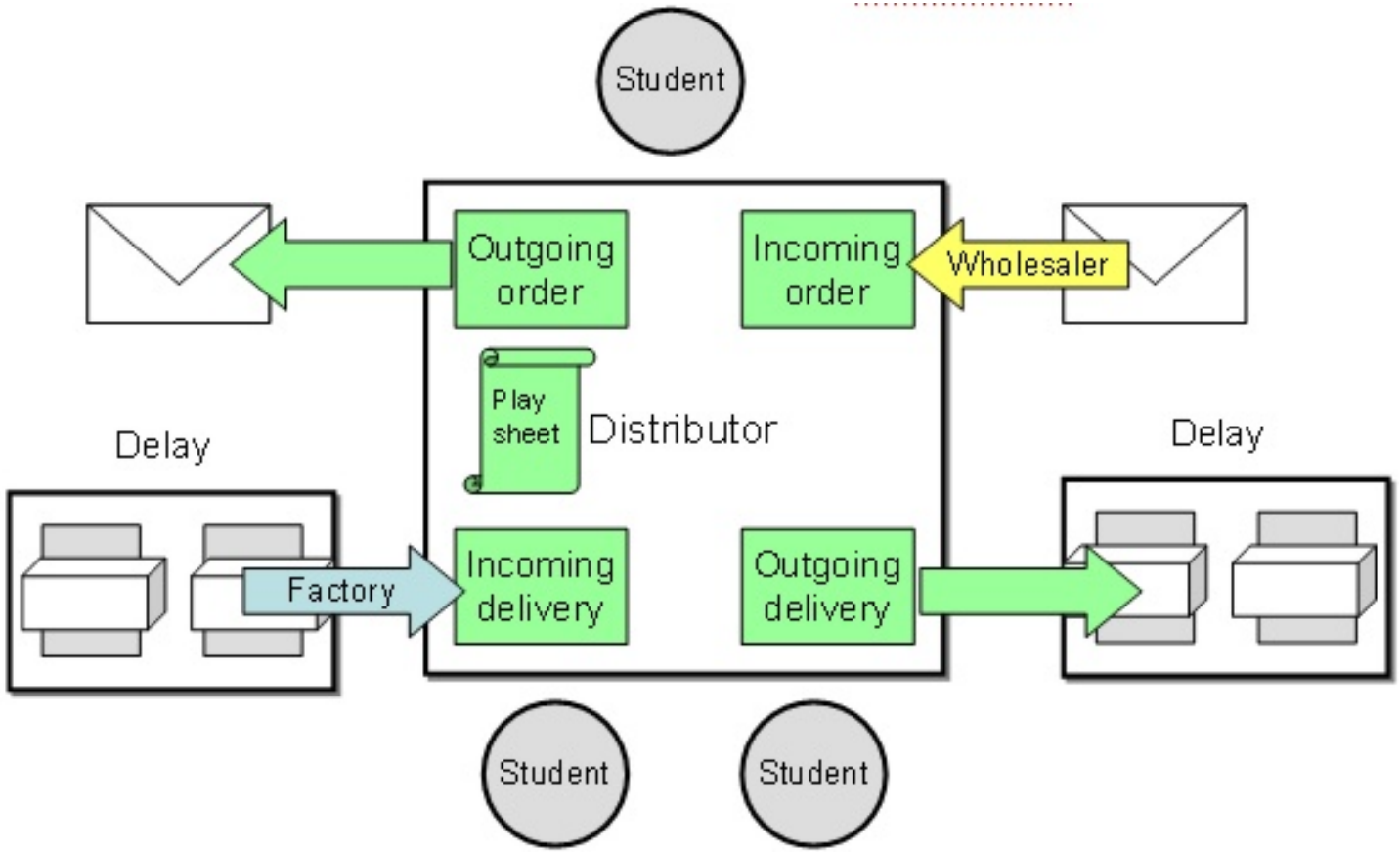
- What are the inputs?
  - Mathematical maturity
  - Hard work (Hint: this is not an easy course)
- What are the outputs?
  - A grade (ranking)
  - Entry on CV, recommendation letter (top 5%)
  - Internship opportunities
  - Job after graduation, start your own business

Where does supply chain fit?

- Logistics
- Operations research
- Optimization
- Markov decision problems
- Control theory

Time for a game

- Beer game



[19] http://www.beergame.org/materials

Course outline

- Uncertainty
- Inventory
- Queues
- Optimization
- Markov decision problems
- Risk
- Network flow
- Game theory
- Other topics