

Agent-Based Modelling for freight Management

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Objectives

Create a model to improve the cost efficiency of transporting goods:

- Simulate a working port lead supply chain.
- Review simulation with real world data.
- Analyse the areas of lowest cost-to-action co-efficient

Introduction

The increases of global trade has created the need for large amounts of goods to be transported around the globe. This cargo, depending on its specific needs, can then be transported via land, sea or air. The bulk of which is transported inside intermodal containers, as they allow for the movement of goods between different transport types such as ship to rail or truck. However, the vast number of containers arriving and leaving UK ports has caused congestion the ports, bottlenecking at the exchange to different modes of transport. The ultimate controlling factors of the freight market is the commodity market, the trade between producers and consumers, combined with the way in which these interact and can be seen in Figure 1.

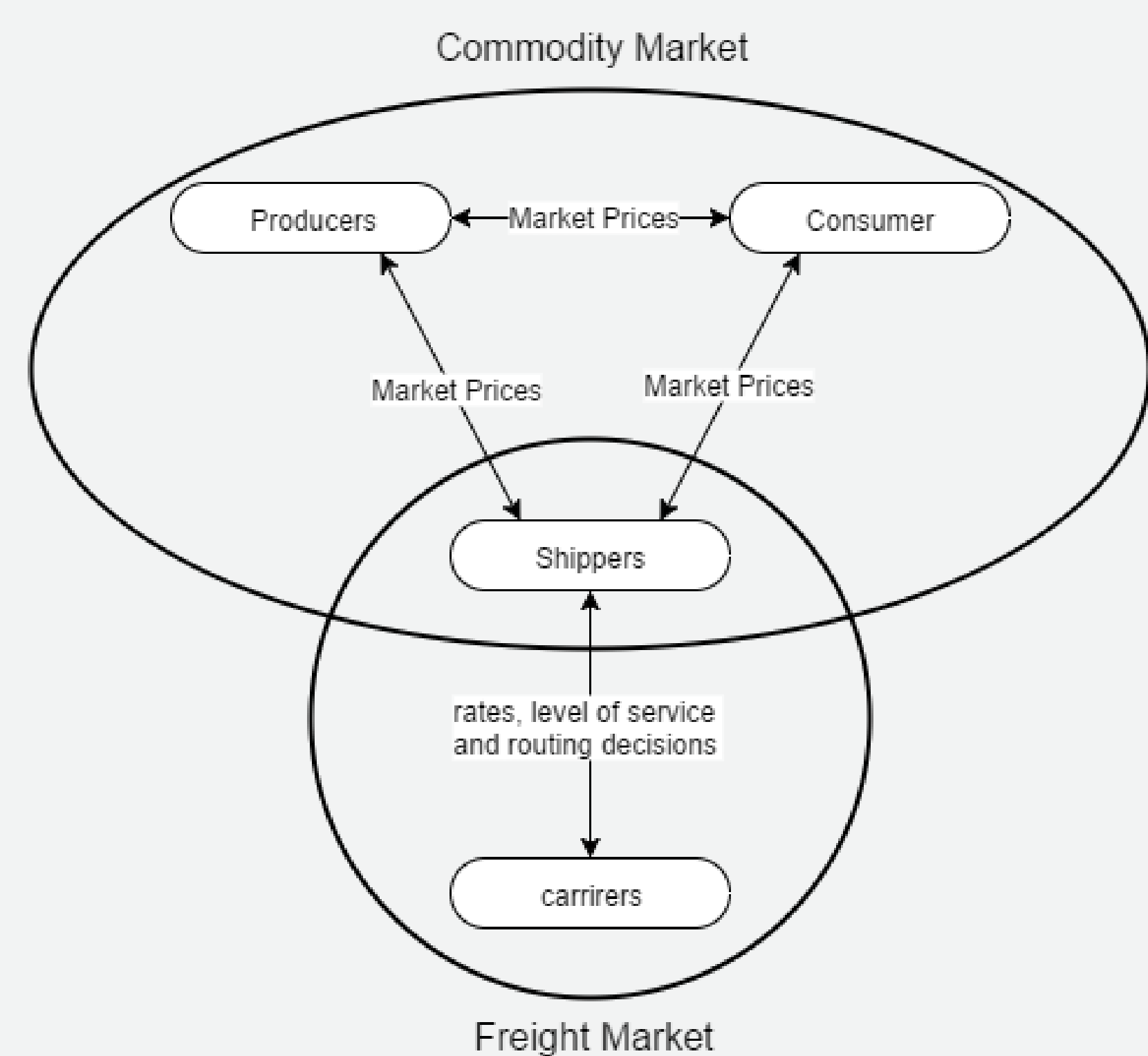


Figure 1: Supply Chain System: Adapted from P.T. Harker (1986)

Supply Chain

The supply chain can be broken into two markets the commodity market and the Freight market. Firstly, the Commodity market is formed from the flow of goods via the transactions between Consumers and Producers Simchi-Levi (2005). Once established, a Producer sends a list of transactions to a Shipper for delivery. Secondly, the Freight market is formed from the exchange of contracts between Shippers and Carriers. The Shipper on receiving multiple transaction list from different Producers, contacts appropriate Carriers to have the good physically transported to there destinations, this is what forms the vehicle flow Roorda et al. (2010).

Commodity Market

The Commodity Market is the trade between producer and consumers that results in a Commodity Flow:

- Producers are actors that specialise in the conversion of raw materials into products.
- Consumers are the purchasers of these products, and can have many forms e.g. Suppliers, retailers

Freight Market

The Freight Market encompasses the interaction between the shippers and carriers:

- Carriers are the logistic service providers, directly organising the movement of vehicles.
- Shippers utilize the services provided by the Carriers.

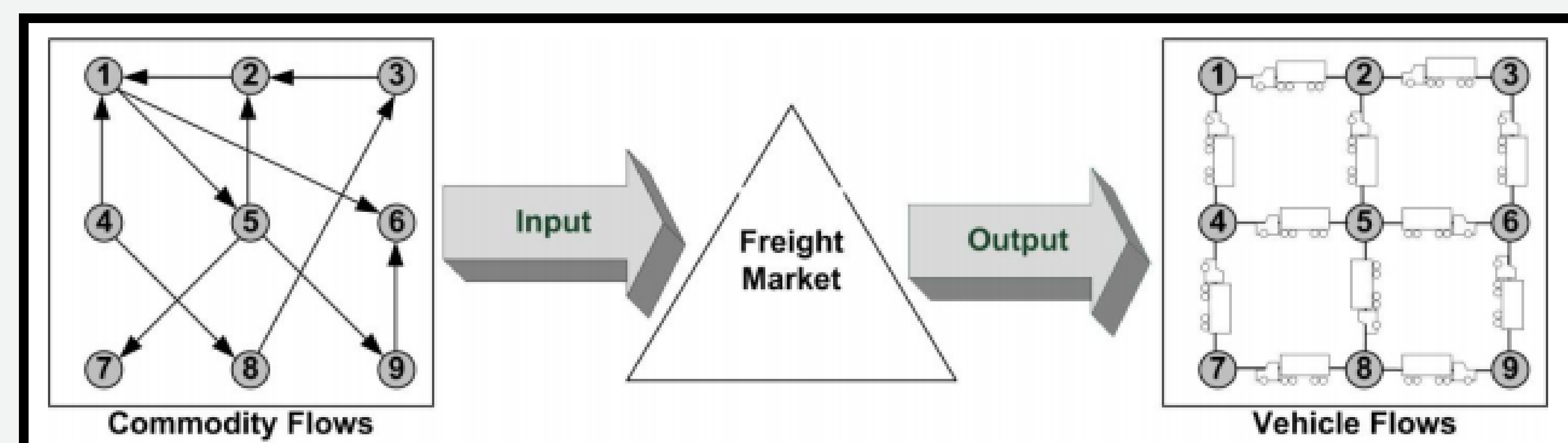


Figure 2: Interaction between the Commodity and Freight markets. Adapted from Cavalcante (2013)

Methods

Modelling using aggregate market data is well established in the economic literature, particularly in the area of macroeconomics. There are two main ways in which to model using only aggregate data, Analytical and Agent-based modelling.

Analytical Approach: Is a top-down model that relies heavily on the formation of Nash equilibrium points. As such these systems tend to require simplified assumptions.

Agent-Based Approach: Is a bottom-up simulation that models the markets on micro scale agent interaction. These systems allow for the identification of Nash equilibrium points for their output.

Proposal

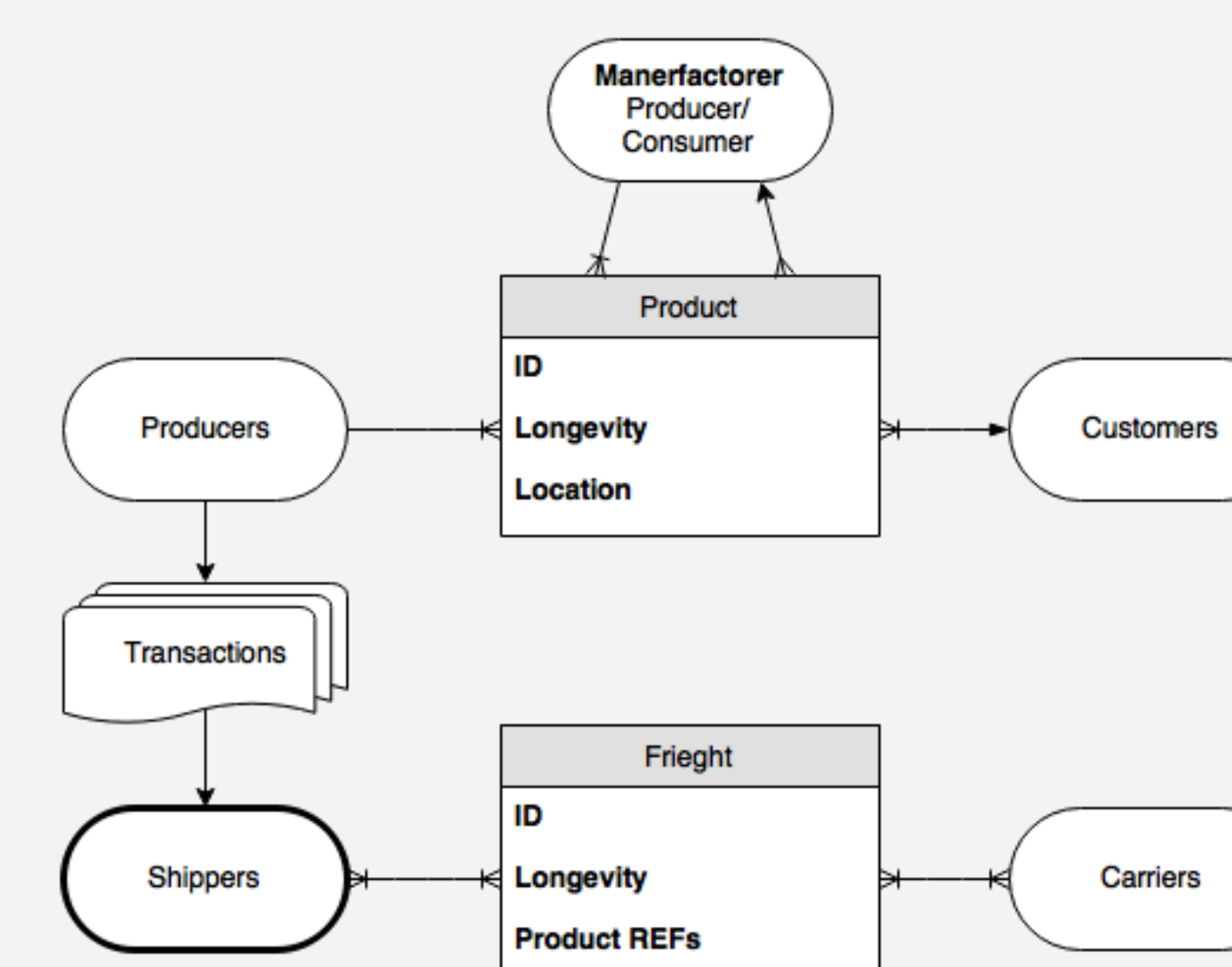


Figure 3: Basic Proposed system

In relation from Figure 3, the utilisation of agent-based models and multi-agent systems to aid the exploration of freight management for a localised area such as Yorkshire or the UK. This system will be modelled on many intercommunicating layers, to allow different levels of agent complexity within the system.

Conclusion

With the increase in port based freight traffic more strain is placed upon the ports distribution systems for freight containers. Methods to successfully deal with this incoming workload must be found to reduce wasted time of congested ports. agent-based models will be used to help simulate the systems involved in an attempt to first identify the bottlenecks of freight transport, and second to find solutions for these issues.

References

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