

TU-A1300

Introduction to Industrial Engineering and Management

Week 5 Pre-lecture Reading

Being a part of a supply chain

Have you ever wondered how a product in a store ended there? You may have looked up the manufacturer or the country it is manufactured, but have you ever wondered what the steps it takes to get the product from the manufacturer to you are. Take, for example, a backpack from nearby sporting store. It is likely to have been shipped to the store by truck from the central warehouse of the sporting store. To the central warehouse, it has been delivered from the brand owner's own central warehouse or regional distribution warehouse as land or sea freight. To the brand's central warehouse, it has been shipped from the manufacturer's warehouse. The factory has purchased the fabrics, zippers, ribbons, and other supplies needed to make the backpack from its own supply partners, which get the parts from factories, possibly through multiple warehouses in various modes of transport. Component factories, in turn, buy the raw materials needed to manufacture them. This goes on from the source of raw materials to the mines and plantations. The supply chain consists of all these actors and operations from the source of raw materials to the end-user. The supply chain is usually viewed from the perspective of one of the parties in the supply chain, such as the manufacturing plant. In this case, the supply chain can be divided upstream, which refers to the supply chain from the source of raw materials to the company in question, and downstream, which refers to the supply chain from that company to the end-user.

The supply chain can be considered consisting of three flows: information flow, material flow and cash flow. All of these must work seamlessly to make the products available to end customers. The information flow includes e.g. order, demand, availability, and product information. Information generally goes upstream, from customers to suppliers. The information flow initiates and directs the material flow, which is the movement of products and materials between and within the supply chain parties and generally flows from upstream to downstream. The third flow is cash flow, which consists of the payments for products, materials and transportation in the supply chain.

There are five basic processes in the supply chain: the planning process, the procurement process, the manufacturing process, the delivery process, and the possible return process. These are linked in such a way that the supplier's delivery process is linked to the buyer's procurement process. The planning process guides all other processes and it is central to the functioning of a supply chain.

Supply chain planning process has well defined but challenging goals: maximizing product availability for customers, minimizing inventories and ensuring that delivery promises to the customers are fulfilled. The planning process is challenged by three underlying phenomena. Firstly, there are many uncertainties in the supply chain which leads to faulty demand and supply figures. Demand nor supply cannot be predicted with 100% accuracy. Secondly, supply chains form systems with numerous interdependencies. A small change in one part of the supply chain can then have a major impact on another part of the supply chain. An example of this is the so-called Bullwhip-effect small fluctuations in demand down the supply chain are reflected in larger and larger fluctuations in demand upstream. This is caused by time delays in the flow of information and material between the different stages of the supply chain, as well as by various human behavioural factors.

Supply chain planning can be divided into three parts. Long-term planning creates the basic prerequisites for ensuring availability. The decisions include for instance the location of factories and warehouses, the procurement of strategic resources and capacity, developing the necessary production technology and planning long-term procurement. Medium-term planning balances supply and demand by reserving and adjusting capacity and by managing demand. Medium-term planning results in concrete sales, production and procurement plans. Short-term planning focuses on precise allocation of resources, fine-tuning of capacity and scheduling of deliveries and orders.

The planning is based on demand forecasts, which serve as a starting point for the process of balancing supply and demand. Demand forecasting starts with identifying and understanding demand fluctuations that are specific to the product or product group being forecasted. These fluctuations are made up of four components: trend, cyclical, seasonal, and random fluctuation. The trend indicates a long-term change. Cyclicity, in turn, is the long-long term fluctuations in the broader economy. Seasonal fluctuation typically refers to fluctuations in demand during the year, such as the Christmas and summer seasons. Random fluctuation, in turn, is the "noise" in demand for which there is no clearly identifiable reason.

When forecasting demand, it is also essential to consider the impact of external factors on operations. For example, how the entry of a new competitor or changes in competitors' pricing affects the demand. It is also important to consider how a company's own business decisions, such as changes in product portfolio and sales campaigns, impacts demand. The demand figures serve as a common planning basis for all operations - procurement, production, sales and distribution. The aim is for all parties to base their actions on the same demand forecasts, i.e. "One set of numbers" principle.

There are three different approaches to forecasting demand: qualitative, causal and a method based on time series. In a qualitative approach, the forecasts are based on the views of experts. Qualitative forecasting is done by looking at several external factors and the effects of the company's own decisions, but the process is laborious and prone to distortions. Sales forecasts are often too optimistic and production forecasts are often over-cautious.

Using causal techniques, the demand is derived from one or more of the better-known factors. For example, the demand for building supplies can be based on information on building permits granted on the start of construction. This type of cause-and-effect analysis is the most reliable way of forecasting. The difficulty is to find things which affect demand. And it should always be remembered that correlation does not imply causation. For example, a clear correlation can be seen between ice cream consumption and drowning, but drowning is unlikely to be the result of ice cream consumption. With large information sets, correlation prediction can be improved through machine learning.

The chronological method is based on the assumption that the future will somehow repeat the past. The trend-, cyclical-, seasonal-, and random fluctuation are derived from past data. Based on this, the appropriate prediction technique is selected and the parameters are set. The strength of the time series method is that it can be automated. In the short term, the method generally

produces good predictions, but the weakness is that it cannot predict future turning points.

Several methods can be combined to produce a demand forecast. When using qualitative and causal methods one must almost invariably have information on demand history. The forecasts produced by the time series method, in turn, can be adjusted with qualitative methods.

Predictions made by any method are almost never completely correct. Therefore, it is important to pay attention to the quality and accuracy of the prediction. Forecast accuracy is measured by metrics based on the difference between forecasted and actual demand. As with production quality management, forecast quality management is based on the need to live with the error caused by natural fluctuations in demand. Similarly, the forecast should be able to account for systematic fluctuations and fluctuations due to foreseeable events.