CAROLYN L. CRAWFORD

UM76127BPR85311

Course Name: Analytical Techniques for Supply Chain Management

A Research Paper Presented to
The Academic Department
of the School of Business and Economics
In Partial Fulfilment of the Requirements
For the Degree of Master's in Procurement, Logistics and Supply Chain Management

ATLANTIC INTERNATIONAL UNIVERSITY

February 2022

Contents

1 Introduction – What is Analytical Technique in Supply Chain Management

History of Supply Chain Analytics

An analysis of the supply chain that has its roots in Frederick Taylor's work, published in 1911, "The Principles of Scientific Management", laid the foundation for modern fields of industrial engineering and supply chain management. Henry Ford used Taylor's techniques in creating a modern mixing line and supply chain that supports the most efficient production methods.

The invention of mainframe computers created the data processing work of IBM researcher Hans Peter Luhn, who some say coined the term “business intelligence” in his 1958 paper, “A Business Intelligence System.” His work has helped to establish the basis for the different types of data used in supply chain analysis.

In 1963, Bud Lalonde, a professor at Ohio State University, suggested that physical distribution management should be integrated with asset management, procurement and production into what he called business logistics. During this time, managing consultant Stafford Beer and others began exploring new ideas as a model for effective business information planning systems into an organized management team to improve business planning and performance. In the early 1980s, a growing field was known as "Management of Purchasing Options".

With the advent of the internet in the 1990s, people were looking at how it could be used in supply chain management. A pioneer in this area was British philosopher Kevin Ashton. He was a young product manager who had the task of solving the problem of keeping popular lipsticks on store shelves. Ashton, who would continue to receive the Auto-ID Center of the Massachusetts Institute of Technology that developed RFID and sensory technology, came up with the term Internet of Things to describe what supply chain management is all about.

Some researchers in the 1990s developed the CEP which was headed by David Luckham from Stanford University along with many others. CEP was able to capture incoming data from events in real-time which helped supply chain managers understand how low-level data was related to factory operations, which is the physical movements of products and services in the supply chain analytics tool.

An example of this is when data production processes could be abstracted to factory performance, which in turn could be abstracted into business events related to things like inventory levels.

Another creation in the supply chain analytics field was the advent of cloud computing, a new vehicle for delivering IT infrastructure, software and platforms as service.

The researchers speculated that by providing the basis for data processing across multiple sources, cloud computing has led to improvements in many types of analysis, including supply chain analysis. The advent of new data technologies has allowed businesses to capture data from different sources in one place, further refining the supply chain analysis to enable companies to integrate multiple types of data.

Robotic process automation has become popular in more recent years. The software that automates computer tasks previously performed by humans has become a powerful tool in improving business automation and the ability to integrate data into analytics.

Researches noted that Supply chain analytics is exactly what the name suggests: it helps enterprises to make sense of all the data that is being gathered from theirs warehouse to study and analyze patterns and generate insights into managing a successful supply chain. Lalonde reiterates that all supply chains provide a wealth of information that is gathered from its production site to the production and delivery of items to the consumer. He notes that it is most important to manage how that data will be used in order to better assist the appropriate parties so as to assist with order and production number projections for any or all future fulfilments required by the consumer.

The supply chain management approach also helps to automatically filter large amounts of data to help the organization improve forecasting, detect inefficiencies, respond better to customer needs, promote innovation and pursue effective ideas according to *IBM*.

There are many different types of analytical techniques that companies use in the market to analyze the large amount of information that is being gathered from normal day to day logistical functions. They include ***Descriptive Analytics, Predictive Analytics, Prescriptive Analytics and Cognitive Analytics***, which are referenced below.

Descriptive analytics

As its name implies, it provides an "eye on the machine" type service, with visibility across the supply chain process for internal and external data usage.

Predictive analytics

Assist organization to understand fully the likely outcomes and scenarios for its business.

Prescriptive analytics

This method is known as the problem solver! Analyses the data and solves the problem in a reduced time and effort while mitigating disruptions.

Cognitive analytics

Assists companies to deal with complex questions in a natural and holistically selective way.

Applying cognitive technologies

A more form of advance supply chain methodology. It helps to understand the reason, human interaction at a maximum speed. It is an advanced technology that can go through large amounts of data to assist to make improvements on the methods they currently use.

2 Justification of Research – Why an Analytical Approach

A company's supply chain is the most important face of the business for both its internal achievements and for its customers. The better the company perform this analytical approach and practices, the better it is in protecting its reputation and stability in the market.

In "*The Thinking Supply Chain*," Simon Ellis of IDC identifies five "Cs" of functional analysis of the future delivery chain. Important features of supply chain efficiency include:

- **Connected**

Being able to gather and use date from social media sites and the internet at large, while using traditional data is what sets corporations apart.

- **Collaborative**

Being able to collaborate with a wide range of suppliers to enhance product demands and delivery while utilizing the most up-to-date technology.

- **Cyber-aware**

All supply chain must strengthen its systems from cyber-intrusions of all sorts, which should be an enterprise-wide concern.

- **Cognitively enabled**

Using the AI platform to its greatest advantage where the modern supply chain's control tower by collating, coordinating, and conducting decisions and actions across the chain. Businesses are now using automated and self-learning technology to improve process flow and efficiency.

- **Comprehensive**

All processes must be done in real time using real data collected. This is a more comprehensive approach that will provide insight to how your system is working.

3 Evolution of Supply Chain Analytics

In the past, supply chain analytics was restricted mostly to statistical analysis and quantifiable performance indicators for planning and forecasting. Statistics was stored in spreadsheets that came from diverse participants and customer's review within the supply chain.

By the 1900s, industries had adopted the Electronic Statistics Interchange (EDI) and Enterprise Resource Planning (ERP) systems to compile and exchange information data between supply chain partners. These programs provide easy ways to use statistics to analyze, without assisting businesses in designing, planning, and forecasting. In the 2000s, businesses began to turn to commercial intelligence and predictable toll solutions. These solutions have helped industries maintain an in-depth knowledge of how their supply chain networks perform, how to make major decisions and how to improve their networks.

The challenge nowadays concerns how industries ca best use the enormous amounts of statistics produced in their supply chain networks. As late as 2017, a ordinary supply chain had permission to produce 50 times more statistics that just five years earlier. However, less than a quarter of this information was being analyzed. Further, while more or less than 20% of all supply chain statistics is structured and can be easily analyzed, 80% of supply chain statistics is unstructured or dismal at that. Today's organizations are looking for ways to best analyze this type of data.

The challenge nowadays concerns how industries can best use the enormous amounts of statistics produced in their provide chain networks. As lately as 2017, an ordinary provide chain had perm ision to 50 times more statistics than just five years earlier. However, less than a quarter of this in formation was being analyzed. Further, while 20% of all provide chain statistics is structured and can be easily analyzed, 80% of provide chain statistics is unstructured or dismal data. Today's or ganizations are seeing for ways to best analyze this type of data.

Recent studies are not pointing to the use of cognitive technology and artificial intelligence as the "future" in the supply chain analytics. Artificial Intelligence will go beyond just retaining information and process automation. The software will be able to think, reason, and learn as humans do or in a human like manner. This solution can process tremendous amounts of data and information – both structured and unstructured data and assist with providing summaries and analyses of the information at that time.

It was estimated that by the time 2020 came around that 50% of all business software will incorporate some cognitive computing functions. This system will provide a powerful platform that will interpret the data from across systems and sources. This will allow businesses to analyze supply chain data and intelligence in real time. Paired with other emerging technologies such as blockchain, businesses will now be able to properly forecast and predict events in the future.

4 General Analysis - Why is Supply Chain Analytics Important?

According to research, supply chain statistics can help make the decision-making process smarter, faster, and more efficient. Benefits include the ability to: (i) Cost reduction and gene enhancement (ii) Access to comprehensive data for continuous integrated planning and real-time visibility of various data that performs efficiency and potential data (iii) Better understanding of risk. by identifying known risks and helping to predict future risks by identifying patterns and trends throughout the supply chain (iv) Increasing accuracy in planning and analyzing customer data, supply chain statistics can help business better predict future demand. Helps the organization decide which products can be reduced if they are not for profit or understand what the customer needs will be after the first order (v) Obtain a supply chain where companies use supply chain statistics to monitor warehouse, partner responses and customer needs. better informed decisions (vi) Prepare for the future by providing advanced supply chain management statistics. Advanced statistics can process both formal and informal data, giving organizations the upper hand by ensuring that warnings arrive on time, in order to make informed decisions. Advanced statistics can also build correlation patterns between different sources to provide risk-reduction warnings with minimal cost and the impact of slower recovery.

As AI-like technologies are more common in supply chain analysis, companies may see an explosion of additional benefits. Information that has not been processed due to limitations of native language data can now be analyzed in real time. AI can read, understand, and quickly integrate data from a variety of sources, monsters, and systems. It can then provide real-time analysis based on data interpretation. Companies will have more supply chain intelligence. She can work well and avoid distractions - while supporting new business models.

5 Types of Inventory Control Systems

Whether Big Data or General Data, Statistics empowers companies to use their data to drive decisions and actions to better manage their supply chain. These decisions can be strategic and / or strategic and provide the ability to improve real-time performance of supply chains and warehouses. Big data analysis in the performance and provision of comprehensive data use to identify models that drive comprehension, decisions, and actions. Regular data analysis empowers companies to use their data to drive decisions and actions. Companies far and wide have been able to use both functions to effectively manage their investment in the cost of managing warehouses around the world. Asset management is very important in a management and planning system that allows suppliers / suppliers to see better when inventory levels are very low.

Asset management helps companies determine what and how much stock they should order at any given time. It tracks inventory from the purchase to the sale of goods. The practice identifies and responds to trends to ensure that there is always enough stock to fulfil customer orders and a proper shortage warning. Once sold, inventory becomes revenue. Prior to the sale, inventory (although reported as an asset on the balance sheet) includes cash. Therefore, more stocks are costly and reduce cash flow.

One measure of good inventory management is inventory profit. Accounting rate, inventory profit shows how often stocks are traded over time. A business does not want more stock than sales. Poor stock exchanges can lead to death, or to stocks that can be sold.

Inventory Management Challenges

The main challenges of inventory management is having too much inventory and you can sell it, not having enough supplies to fill orders, and not understanding what items you have in the inventory and where to find them. Other obstacles include:

- **Getting Accurate Stock Details:**
  Make sure your stock details are as accurate as possible.

- **Poor Processes:**
  Make sure processes are current and up to date.

- **Changing Customer Demand:**
  Monitor customer demands making sure you are keeping up with your customer's needs.

- **Using Warehouse Space Well:**
  Make sure staff are properly trained in maximizing the use of storage space.

Inventory is often referred to as stock market: Managers often use the term "stock on hand" to refer to products such as commodities and household goods. In all industries, "inventory" generally refers to stored goods and equipment and components used in production. Some people also say that the word "stock" is widely used in the U.K. reference to inventory. Although there is a difference between the two, inventory and stock names are often changed.

Types of Inventories?

There are 12 different types of inventories: consumables, ongoing (WIP), finished goods, inventory, security stock, packaging materials, cycle inventory, service inventory, transportation, theory, overruns and storage, repairs, and operation (MRO). Some people do not see MRO as a form of invention.

Inventory Management Techniques and Terms

Some asset management strategies use formulas and analytics for stock planning. Others rely on procedures. All methods aim to improve accuracy. The methods a company uses depend on its needs and stock.

Here's a summary of them:

- **ABC Analysis:**
  This method works by identifying the most and least popular types of stock.

- **Batch Tracking:**
  This method groups similar items to track expiration dates and trace defective items.

- **Bulk Shipments:**
  This route looks for items that are not packed by suppliers who load them directly into ships or trucks. It includes the purchase, storage, and shipping of goods in bulk.

- **Consignment:**
  When you become accustomed to shipping goods, your business will not pay its supplier until a particular product is sold. That provider also keeps a list of names until your company sells it.

- **Cross-Docking:**
  Using this method, you will deliver the goods directly from the supplier truck to the delivery truck. Storage is complete.

- **Demand Forecasting:**
  This analyses and predict customer demand.

- **Dropshipping:**
  In this practice, the supplier ships items directly from its warehouse to the customer.

- **Economic Order Quantity (EOQ):**
  his formula accurately indicates how much assets a company should order in order to reduce holdings and other costs.

- **FIFO and LIFO:**
  First entry, first exit (FIFO) means you move the oldest stock first. Lastly, the first issue (LIFO) looks at the fact that prices are constantly rising, so the newly purchased listing is very expensive and thus the first sale.

- **Just-In-Time Inventory (JIT):**
  Companies are using this approach in an effort to keep stock levels as low as possible before replenishing

- **Lean Manufacturing:**
  This approach focuses on removing waste and anything that does not contribute to the value of the customer in the production process.

- **Materials Requirements Planning (MRP):**
  This system handles planning, scheduling, and inventory control for manufacturing.

- **Minimum Order Quantity:**
  A company that relies on a small amount of order will order smaller inventory prices from retailers each way to keep costs down.

- **Reorder Point Formula:**
  Businesses use this formula to determine the minimum amount of stock they should have before ordering an order, and then manage their list accordingly.

- **Perpetual Inventory Management:**
  This technique entails recording stock sales and usage in real-time.

- **Safety Stock:**
  The ethos of inventory management prioritizing security stocks will ensure that there is always additional stock set aside in the event the company is unable to complete those items.

- **Six Sigma:**
  This is a data-based method for removing waste from businesses as it relates to inventory.

- **Lean Six Sigma:**
  This method combines lean management and Six Sigma practices to remove waste and raise efficiency.

How to Choose an Inventory Management System?

Choosing an asset management system is a matter of identifying the features that your business needs. Do you need to track stock movements and stocks, or organize inventory and track styles, or both?

When exploring the system, remember to consider three key factors: the task of real-time scheduling, data analysis tools and near real-time data reporting.

6 Actualization/Conclusion

The mathematical solutions provided for the challenges the supply chain managers face are clearly explained below.

• Moving to Smart Logistics to improve Supply chain visibility.

• Managing flexibility in demand and asset management.

• Reducing cost fluctuations by improving screening and planning activities.

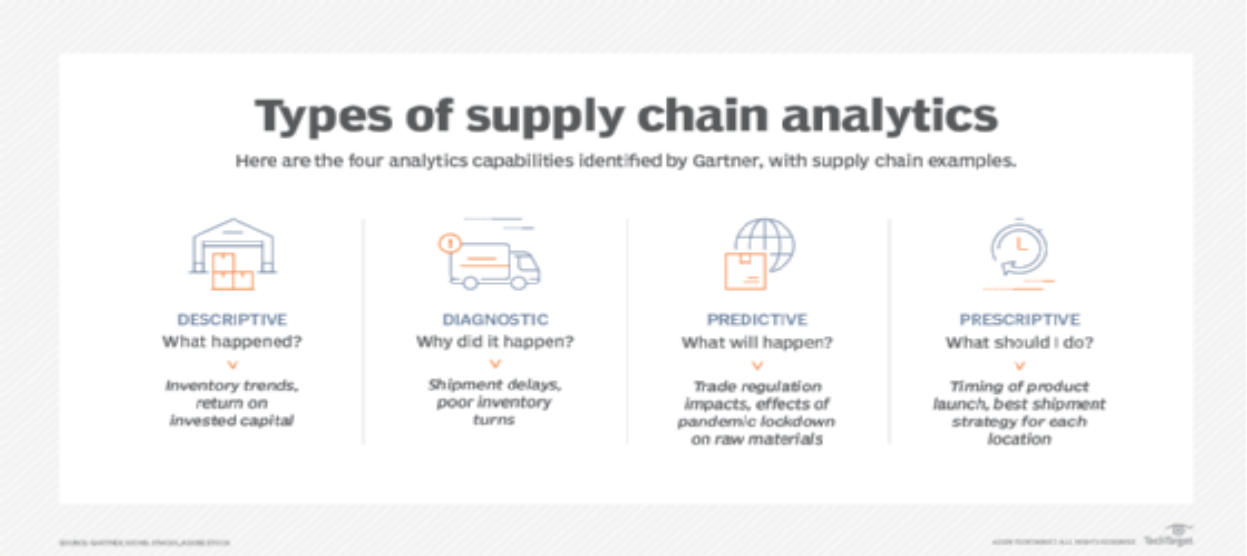
Big data combines past sales trends with forecasting technology to provide asset managers with guidelines on how much to expect. This helps to significantly reduce costs so that the supply chain can order enough goods to stock on the shelves without having to order too much and waste products.

Not only does detailed access, improved flow, and increased visibility from real-time data better equip organizations to stay afloat, it also helps businesses plan ahead for challenges or disruptions before they occur.

Supply chain analytics statistics refer to the processes used by organizations to gain insight into and extract significant amounts of data related to the purchase, processing and distribution of assets. Supply chain analytics analysis is an important aspect of supply chain management (SCM).

The supply chain analysis analytics has been around for over 100 years, but statistical models, data infrastructure, and applications that support these statistics have come a long way. Mathematical models developed with better mathematical techniques, model prediction and machine learning. The data infrastructure has changed with cloud infrastructure, complex event processing (CEP) and internet of things. Applications have grown to provide insight into all aspects of traditional applications such as ERP, warehouse management, logistics and business asset management.

An important goal in selecting supply chain analytics software to improve prediction and efficiency and more responsive to customer needs. For example, forecasting analyzes in the sales terminal data stored in the demand signal area can help an entity anticipate consumer demand, which may lead to cost savings in the listing list and faster delivery. Gaining the analysis of the supply chain needs to bring together information on all immature purchases and expanded the production, distribution and after-market services. This is based on the effective integration between multiple SCMs and supply chain manufacturing platforms that form the standard corporate supply chain. The goal of such a combination is the appearance of a supply chain: the ability to view asset data at all stages of a supply chain.



Supply Chain Analytics Software

Supply chain analytics software is usually available in two ways: embedded in supply chain software, or alternatively, dedicated business intelligence and analytics tool that can access supply chain data. Many ERP vendors offer feature-based analysis features, as do vendors of specialized SCM software. Some IT services create software models that can be customized and integrated with the company's business processes.

Some ERP and SCM vendors have started using CEP in their forums to get real-time analysis of supply chain. Many ERP and SCM vendors have one-to-one combinations, but none standard. However, the Supply Chain Operations Reference (SCOR) model provides general metrics to compare the performance of supply chains with benchmarks in the industry.

Ideally, supply chain analytics software will be used throughout the series, but in practice it usually focuses on the less important aspects of operations, such as demand planning, production, supply chain management or transportation management. For example, supply chain financial calculations can help identify major costs or opportunities to improve operating costs; Payment statistics can help identify the best suppliers and provide early warning of budget delays at certain cost levels; and transportation statistics software can predict the weather effect on shipping.

How supply chain analytics works

Supply chain analytics statistics bring together data from all different applications, infrastructure, third-party resources and emerging technologies such as IoT to improve decision-making in all strategic, strategic and operational processes that shape supply chain management. Supply chain analytics statistics help harmonize supply chain planning with performance by improving the real-time visibility of these processes and their impact on customers and the larger goal. Increased visibility can also increase flexibility in the supply chain network by helping decision makers better evaluate transactions between cost and customer service.

The process of creating supply chain statistics usually begins with data scientists who understand a particular part of the business, such as factors related to cash flow, inventory, waste and service levels. These experts look at possible connections between different data elements to create a speculative model that enhances the output of a supply chain. They test diversity until they have a solid model.

The mathematical models of the supply chain achieve a certain level of success invested in data engineer production with a focus on measurement and performance. Data scientists, data engineers and business users work together to refine how this data analysis is presented and applied in practice. Supply chain models are developed over time by combining the performance of data analysis models in production and the value of the business it delivers.

Features of supply chain analytics

Supply chain analytics software usually includes the following features:

• Data view. Ability to cut and sell data from different angles to improve comprehension and comprehension.

• Stream processing. Gaining insight from the many data stream generated, for example, IoT, applications, weather reports and third-party data.

• Communication integration. Using emotional data from social feeds to improve planning needs.

• Indigenous language processing. Extract and edit random data embedded in documents, media and data feeds.

• Local intelligence. Gain insights from local data to understand and improve distribution.

• Digital twin supply chain. Data processing is a comprehensive model of a distributed chain that is distributed to different types of users in order to improve predictable analysis and instructions.

• Graph database. Organizing data into interactive features that make it easier to communicate, identify patterns and improve tracking of products, suppliers and services.

Another way to break down supply chain type statistics is their function and function. The consulting company Supply Chain Insights, for example, classifies supply chain statistics into the following activities:

- Workflow
- Decision support
- Collaboration
- Unstructured text mining
- Structured data management

In this model, different types of statistics are provided as part of an ongoing process to improve supply chain management.

For example, a company may use informal text mining to convert raw data from contracts, social media feeds and news reports into organized supply chain data. This improved, more organized data can help automate and improve workflow, like earning processes for pay. Data in digital workflow is much easier to capture than data from manual workflow, thus increasing the available data for decision support systems. Better decision-making support can enhance collaboration across a variety of departments such as asset management and warehouse management or between supply chain partners.

Other technologies emerge as ways to develop speculative models produced by supply chain analysis. For example, organizations are beginning to use the mining process to analyze how they conduct business processes. This type of process calculation can be used to create the digital twin of an organization that can help identify automatic supply chain opportunities across all acquisitions, manufacturing, asset and financial transactions. Improved statistics can help business users to ask questions about the business in simple language, with short answers. Graph statistics can shed light on the relationship between businesses in the supply chain, such as how changes in the Phase 3 provider may affect phase 1 providers.

Uses of Supply Chain Analytics

Sales and operational planning uses supply chain statistics to match producer's supply and demand by producing systems that align with day-to-day operations and business strategies. Supply chain analytics statistics are also used to perform the following:

Improve risk management – identify the risk and know the causes of it by analyzing patterns and trends.

Increase planning accuracy - analyze customer data and identify factors to increase and decrease all fulfillment issues.

Improve order management – consolidate all the information received to assess warehouse level to better make predictions.

Streamline procurement - organize and analyze spending across departments to improve contract negotiations and identify opportunities for discounts or alternative sources; and

Increase working capital - improve models to determine the inventory levels required to ensure service goals with minimal capital investment.

Future trends of supply chain analytics

Supply chain analytics statistics will continue to evolve in line with the emergence of statistical models, data structures and infrastructure, and the ability to integrate data across all application silo. Over time, improved statistics will lead to independent supply chains that can handle and respond to changes, much like self-driving cars that start operating today. In addition, the development of IoT, CEP and broadcast infrastructure will allow businesses to gain instant understanding from larger data sources. AI strategies will continue to improve people's ability to produce more accurate and useful prediction information that can be embedded in the workflow.

Other technologies expected to play a big role in supply chain analytics and management include the following:

Blockchain

Blockchain infrastructure and technology promises to improve visibility and tracking across all layers of the supply chain. These same structures can drive companies to use smart contracts to create, manage and perform operations.

Graph analytics

As predicted to use more than half of all business applications over a decade, graph statistics will help chain managers better analyze the links of various businesses in the supply chain.

Hyperautomation

The technology that supports hyperautomation will speed up supply chain automation through process mining analytics to identify automation candidates, automate production and manage these automated processes.

7. References

Ellis, S. (2017) "The Thinking Supply Chain"

Hans, Luhn, P. (1958) "A Business Intelligence System"

Taylor, F. (1911) "The Principles of Scientific Management"

https://www.asite.com/blogs/what-is-supply-chain-management

https://www.ibm.com/topics/supply-chain-analytics

https://www.linkedin.com/pulse/four-levels-analytics-supply-chain-risk-management-edith-simchi-levi/

https://www.netsuite.com/portal/resource/articles/inventory-management/inventory-management.shtml

https://www.youtube.com/watch?v=fhsgpAxGa0w

https://www.youtube.com/watch?v=KdU9xBqsFWc