CARISCA Centre for Applied Research and Innovation in Supply Chain – Africa

FACILITATING AND LEARNING MATERIAL FOR SUPPLY CHAIN DIGITALIZATION

Supply Chain Digitalization

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COURSE OVERVIEW

Supply chain digitalization creates opportunities for connecting disparate systems in the supply chain to enable communication within and across organizations to create a single source of truth for information. Digitized supply chains allow you to accurately visualize your upstream and downstream supply chain activities. They empower your procurement planning and sourcing and enable supply chain and logistics teams to collaborate, automate and effectively leverage data analytics to fulfill customer needs and improve decision making.

In this course, we will focus on existing and emerging digital technologies used in supply chain management. We will further explore how to create a digital supply chain network, as well as how analytics can be implemented to improve supply chain performance. Finally, we will cover how digitalization can be leveraged to enhance supply chain functions

LEARNING OUTCOMES

On completion of this course, students will be able to:

1. Demonstrate knowledge of the building blocks of the digital supply chain
2. Demonstrate knowledge of the digital supply chain network
3. Demonstrate skills in advanced analytics in Supply Chain Management
4. Demonstrate skills in leveraging the enablers for Supply Chain Functions

COURSE OUTLINE

MODULE 1: Building Blocks of the Digital Supply Chain

Session 1.1: Digital technologies in perspective

Session 1.2: Digital Supply Chain Pillars

Session 1.3: Application of these technologies in supply chain management

MODULE 2: Digital Supply Chain Network

Session 2.1: Linear supply chain network

Session 2.1: Digital supply chain network

Session 2.1: Digital capability in an enterprise

MODULE 3: Advanced Analytics in Supply Chain Management

Session 3.1: Big data and basics of advanced analytics

Session 3.1: Key enablers for building a successful implementation and utilization of analytics

Session 3.1: Roadmap for advanced analytics implementation

MODULE 4: Leverage Enablers for Supply Chain Functions

Session 4.1: Digital procurement

Session 4.2: Faster and smarter supply planning

Session 4.3: Logistics and digitalization

Session 4.4: Supply Chain Visibility: Connecting the Dots

HOW TO USE THIS DOCUMENT

The course is structured into four (4) learning outcomes (hereafter, modules). Each specifies what learners will know or be able to do as a result of a learning activity. Each module is made up of sessions expressed as knowledge or skills.

You are required to read and practice activities to gain the relevant knowledge and skills associated with each module. Some of the modules will require you to access extra readings and videos to assist in your learning. This material is prepared to encourage you to work independently and make decisions concerning how you might approach a task. Some of the modules have key concepts that will briefly explain relevant terminologies and concepts within their respective sections.

The next session shows the symbols (icons) that will be used frequently in this material. It also provides the meaning of the icons, so that any time you see an icon, you will understand what it means. Please feel free to ask your facilitator any questions you have as you read the material.

Module 1: Building Blocks of the Digital Supply Chain

Welcome to module one. In this module, we will examine nine digital technologies, some of which are already in use and others that are just starting to gain traction. We'll give a crucial review of these technologies, the much-desired advantages that come with using them, and the supply chain applications that can be made of them.

Session 1.1: Digital technologies in perspective

In this session, we will focus our discussion on answering two (2) questions: (1) What are digital technologies? and (2) what is the digital supply chain?

Digital Technologies

Digital technologies are present wherever we go, including our homes, workplaces, and the services we depend on to maintain our way of life. Imagining a world without digital technology is challenging.

Digital technologies include any electronic devices, automated systems, pieces of technology, and resources that create, process, or store data. Supply chains have used digital technology to boost efficiency in a number of company functions, including operations, procurement, shipping, manufacturing, finance, and auditing, among others.

Digital Supply Chain

The term "digital supply chains" describes the transformation of supply chains via the use of digital technology. Through automation and connectivity along the supply chain, a digital supply chain takes advantage of the knowledge and intelligence that are already built into physical things and combines it with internal and external data. A digital supply chain enables the use of intelligent processes, such as those that connect real-time inventory, customer product interactions, data from delivery services, and Internet of Things (IoT) technologies.

Watch this video on the digital supply chain: Digitization of Supply Chains

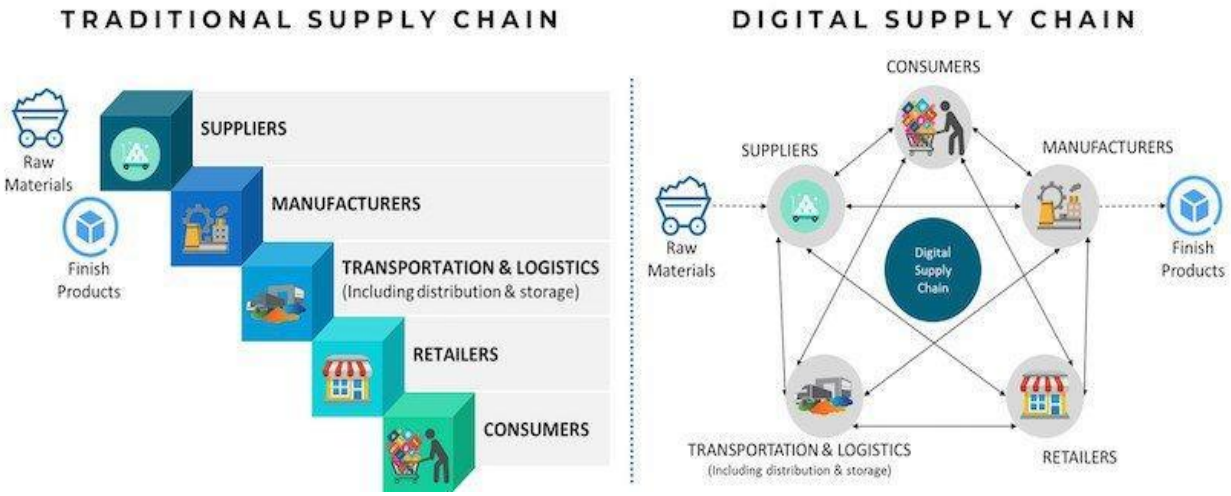


Figure 1.1: Comparing the traditional supply chain to the digital supply chain

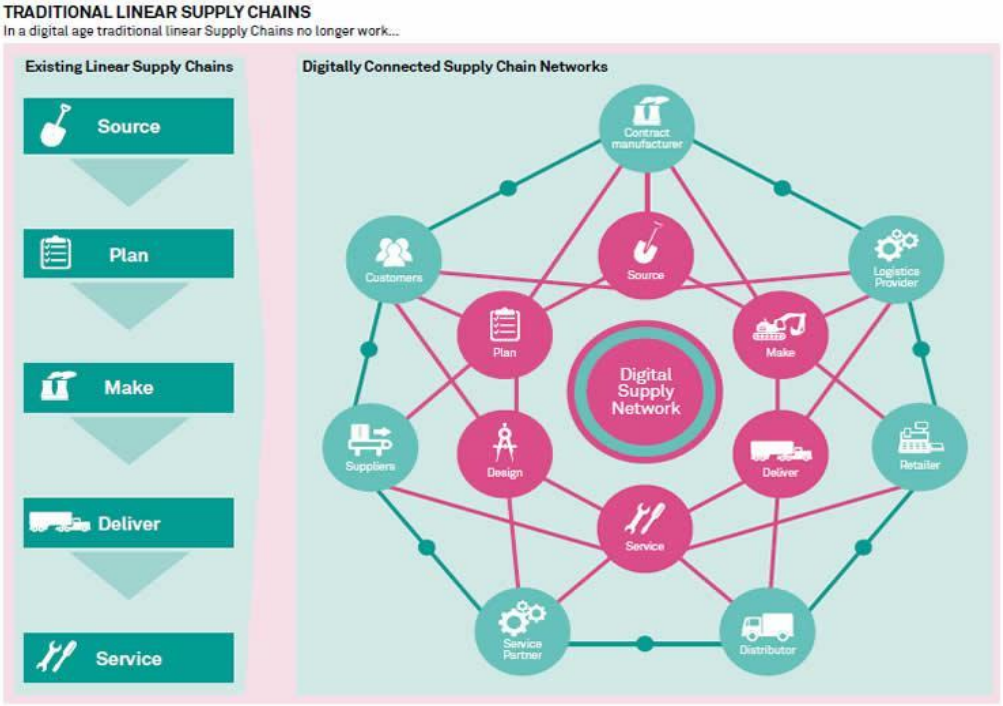


Figure 1.2: Digital Supply Network

Supply chain digitalization results in digital supply chain networks. "The transition to digital supply chains is an evolution rather than a revolution."

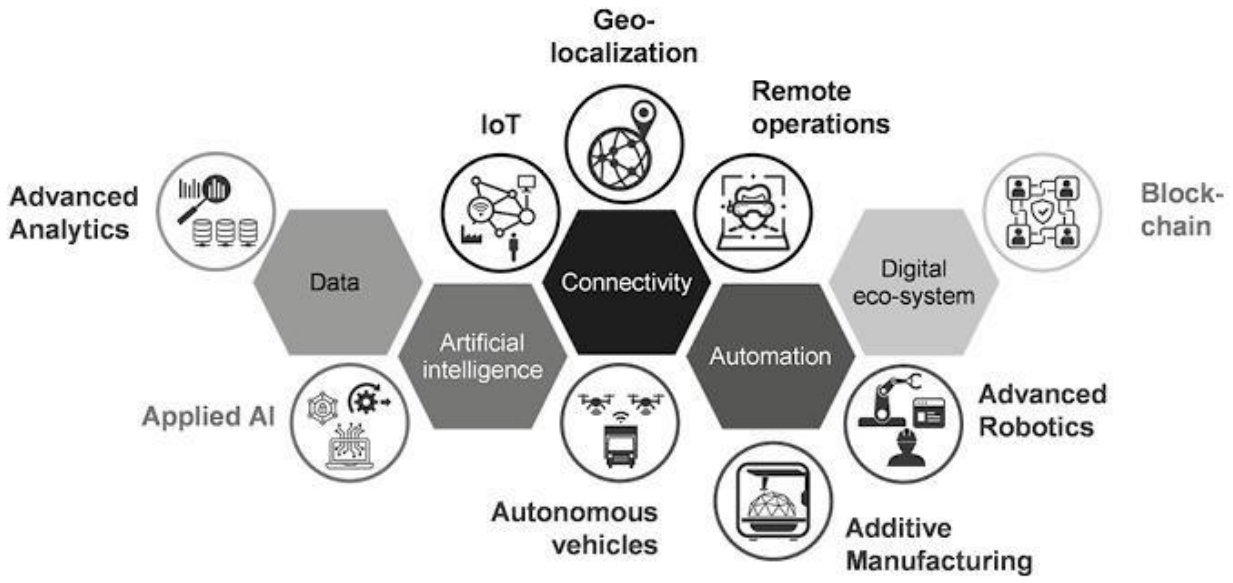


Figure 1.3: **Nine (9) Digital Technologies Relevant for Supply Chains**

Advanced Analytics

Advanced Analytics is what helps us to make sense of Big Data. It is an advancement of Business Intelligence (BI). Simply put, Advanced Analytics is a study and analysis tool that can help drive change and improvement in future company operations.

Advanced analytics is often used to make decisions regarding future events such as manufacturing capacity, raw material costs, future demand, avoiding sales losses, and optimizing inventory. It creates forecasts using what-if studies, data mining, machine learning, and other analytic tools.

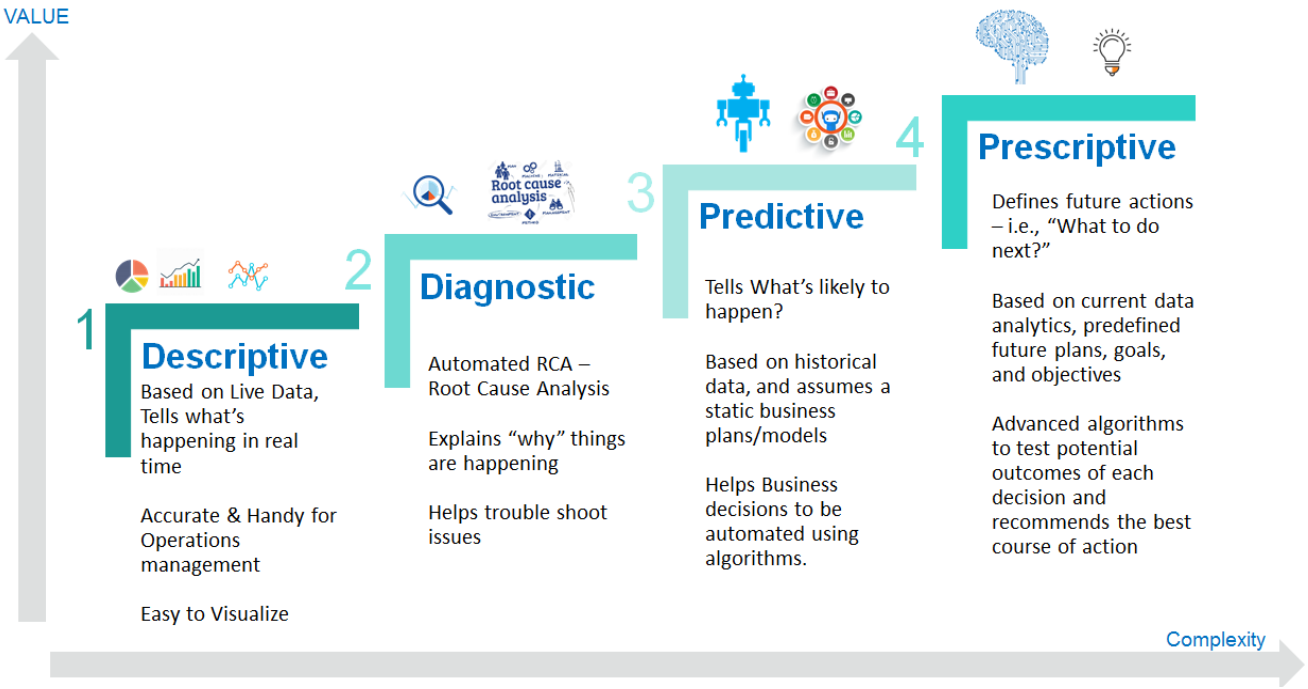


Figure 1.4: Advanced Analytics

Artificial Intelligence

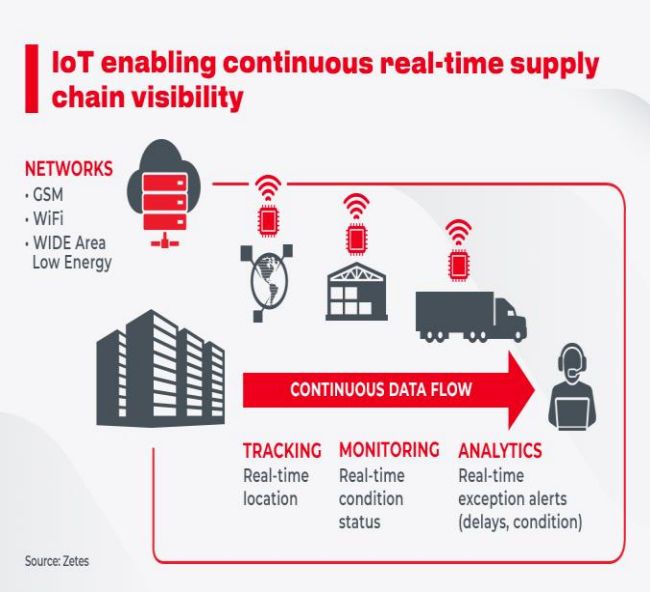
AI refers to systems that can comprehend, reason, learn, and interact. They employ Deep Learning, Machine Learning, and Neural Networks, among other techniques.

AI can be applied in the supply chain to improve efficiency, logistics, customer service, inventory management, and reduce operating costs, among other things.

They are most beneficial to businesses when they assist personnel in their activities and speed up procedures (reducing costs) or when they can provide superior insight (value creation).

Internet of Things (IoT)

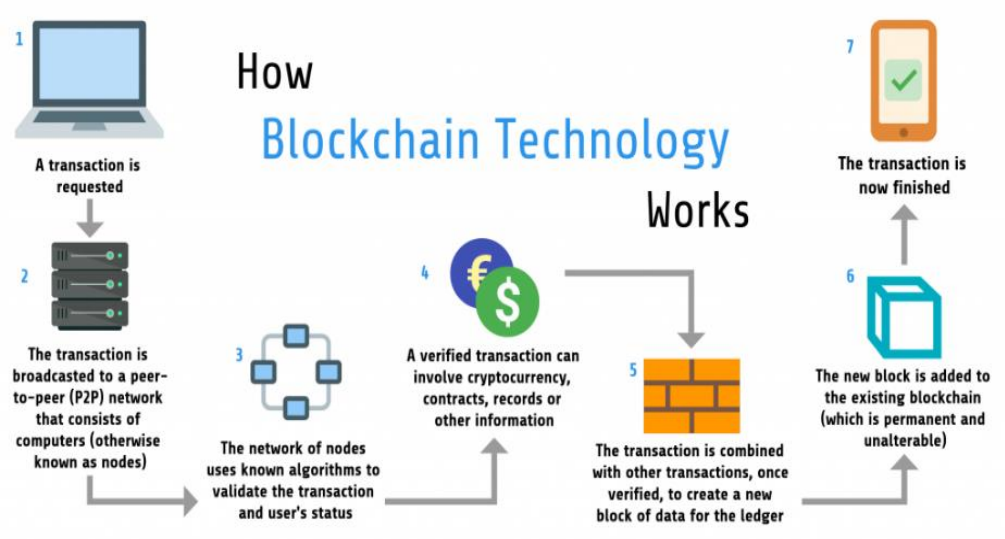
IoT is made up of objects that become "smart" after gateways are installed. These allow them to communicate with other systems directly via the Internet. Each smart object is given a unique identifier that may be used to verify its identity in the network.



(IoT) uses sensors to monitor its surroundings, such as location, temperature, light levels, and movement speed. RFID chips, smart gadgets, and mobile sensors are common examples of Internet of Things (IoT) technologies utilized in the supply chain.

Blockchain

Blockchain in basic terms: “I lend Paul GHC 20 and five friends see me doing so. Those five pals have become the blockchain.” It's essentially a publicly accessible database (those five pals) that keeps a constantly growing list of chronological transaction records (like adding links to a chain).



Because all previous transactions are kept in a ledger document that all users utilizing the blockchain have, the chain is infinite and never forgets.

Blockchain, for example, is particularly suited to verifying the validity of a shipment. It's a trustworthy, secure, quick, and cost-effective way to complete transactions like shipping documents, export documentation, or product tracking.

Autonomous Vehicles

The use of Zipline drones in Ghana, Rwanda, and Nigeria's health supply chains to transport emergency pharmaceuticals to rural and isolated regions

Robots are used in Amazon's smart warehouses. Humans and robots collaborate to sort and deliver packages to customers.

Walmart's usage of Zipline drones in parcel delivery to customers.

Other Digital Technologies

- **Additive Manufacturing:** The use of 3D printers to swiftly create prototypes.
- **Geo-localization** is a technology that identifies or estimates the real-world geographic location of remote objects using wireless detection via GPS, GSM, and Galileo-based positioning and sensors. The most prevalent application in the supply chain is real-time tracking of things such as ships and trucks.

- **Remote Operations**:The operation of a system or machine from a distance is referred to as remote operations. This is made possible by the use of augmented and virtual reality, as well as virtual telepresence systems, which eliminate the need for individuals to be present on-site. Without a physical trainer, this method is commonly utilized to train individuals in the supply chain.

- **Advanced Robotics** refers to computer-programmed machines that can interact with the actual environment using sensors such as touch, ultrasonic, or light. Advanced robotics has apparent supply chain applications in packaging, production, and process automation.

Session 1.2: Digital supply chain pillars

In this session, we will focus our discussion on what the digital supply chain pillars are.

Digital Supply Chain Pillars

Digital supply chain transformation necessitates a thorough grasp of the five building pieces (shown in figure 1.3) that underpin digital technologies and their applications. These construction blocks are interconnected and cannot be viewed separately. Analytics, for example, is heavily dependent on data, but also on connectivity and the digital environment, whereas autonomous driving is dependent on all of the building elements.

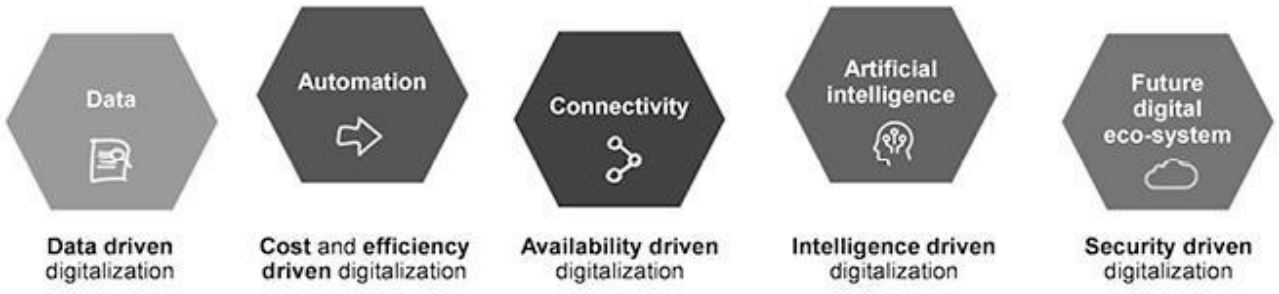


Figure 1.3: Digital supply chain pillars

The building blocks of supply chain are explain below:

DATA: Processes are becoming more data-driven as global supply networks become more complex. The basis for enhancing digital supply chains is the processing of structured and unstructured data.

AUTOMATION is used to describe the range of applications, from highly automated processes, affordable robots, to intelligent and self-directed systems, that carry out difficult tasks.

CONNECTIVITY refers to the use of wireless technologies, sensors, and geo-localization to connect people, processes, and things. Collaboration is aided by connectivity because it gives people more freedom over when, where, and how they work and access systems and information. In addition, it encourages the development of innovative working and teamwork practices like augmented and virtual reality.

ARTIFICIAL INTELLIGENCE is a branch of computer science that enables machines to sense and reason, allowing them to recognize patterns and make predictions. Machine learning is a subset of Artificial Intelligence (AI) that consists of algorithms that, when trained with relevant data, can improve their predictions.

FUTURE DIGITAL ECOSYSTEM should be designed to support not only present digital systems and technologies, but also upcoming technologies that will ease the flow of information and outcomes from future digital applications. The ecosystem must also be secure to guarantee that only the appropriate people and systems are present.

Session 1.3: Application of the digital technologies in supply chain management

In this session, we will focus our discussion on how these digital technologies can be applied to supply chain management.

What are the digital applications for SCM ?

The idea that data is one of the most important assets a corporation can have is gaining traction. This is most likely why Advanced Analytics is receiving far more attention than the other eight technologies.
Companies recognize the benefits of growing it across their whole supply network. This is why there is a clear link between the Internet of Things (IoT), glocalization, and Advanced Analytics, as they collect data that Advanced Analytics feeds off of.
The extent of broad and complete adoption of the nine core technologies is startling, with just 5% claiming to have fully deployed analytics throughout all functions and the supply chain.

Despite its current limited use, AI will see tremendous growth through 2025. This, together with Advanced Analytics, will have an impact on all aspects of supply chains, paving the path for faster and more informed decision making that can then be implemented using the new technology.

Watch the videos below on the applications of some of these digital technologies in SCM:
Applications of IoT in Supply Chain Management
Data Analytics In Supply Chain Management
44 - Big Data Analytics in Supply Chain Management
Applying AI in the Supply Chain
How will Artificial Intelligence Change Supply Chain Management?
Blockchain in Supply Chain Management? Applications, Advantages, Examples and Trends | AIMS UK
Blockchain for Supply Chain Transparency & Traceability - Simardeep
Location Intelligence for supply chain and logistics
Supply Chain Automation and the Next Level of Supply Chain Robotics
Enabling the autonomous supply chain with IoT, AI and Blockchain

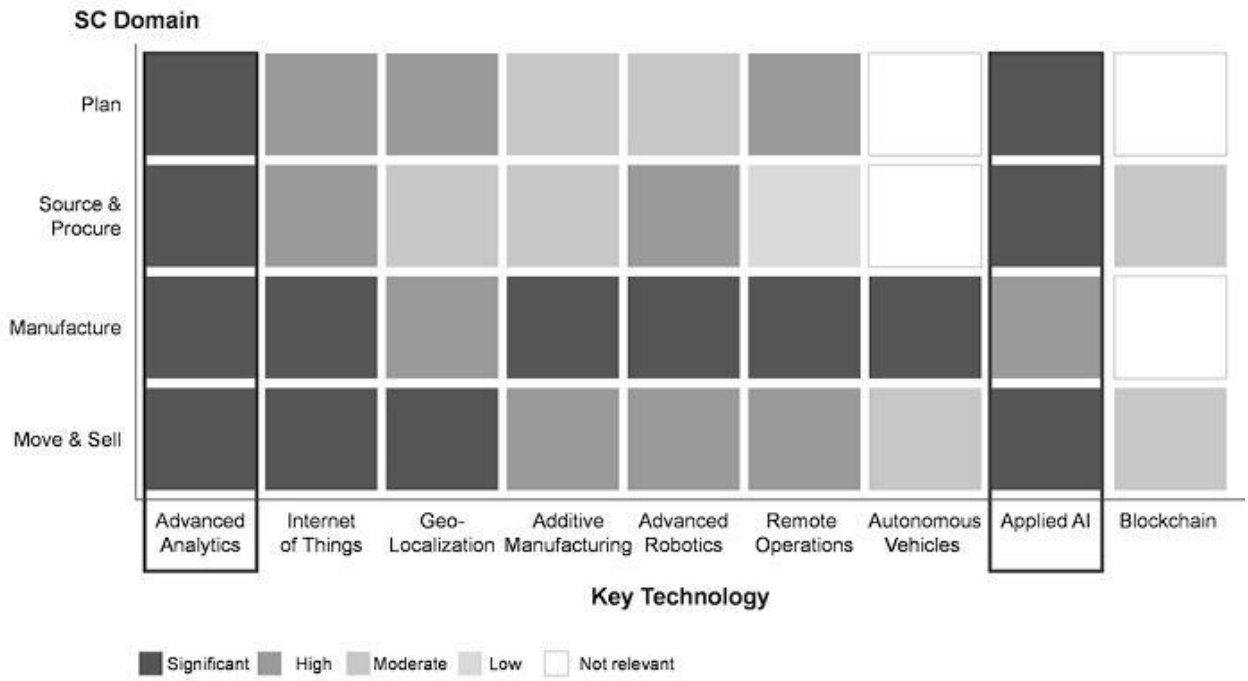


Figure 1.6: Use of the 9 Digital Technologies in Supply Chain

Congratulations! You have completed the first module!!!

Self-Assessment Questions

We have come to the end of this module. I recommend you take this practice exercise to improve your knowledge of the building blocks of the digital supply chain. This is meant to help you determine how well you have understood this module. Now assess yourself with the questions below:

5. Elaborate on at least four (4) digital technologies discussed in this module.
6. Write a one page summary of how each of the aforementioned digital technologies is being used in SCM.

Module 2: Digital Supply Chain Networks

Welcome to module 2. This module is developed to help you understand the linear supply chain and the drivers behind the shift from the linear supply chain to the DSN of the future. You will also learn about the digital disrupters accelerating the transition to DSN and the six fundamental integrated capabilities a mature DSN must have.

Session 2.1: The linear supply chain

In this session, we will focus our discussion on answering two (2) questions – (1) what is the linear supply chain? (2) How is the linear supply chain model transformed to a Digital Supply Network(DSN)?

The Linear Supply Chain

Traditional supply chain management planning is often based on historical data and the premise that the past may be used to anticipate the future to some extent. Planning is done ahead of time, and teams scramble when disruptions or unexpected events occur.

Collaboration occurs on a predefined foundation that is difficult to change, and market shifts necessitate lengthy and sometimes painful adaptations. Pre-optimization and scenario-based knowledge are heavily used in execution.

If unexpected developments or opportunities arise, financial resources and time are needed to alter the direction. Even the most responsive supply systems are primarily reactive to demand shifts.

While it is widely acknowledged that speed is one of the most important components in a successful supply chain, the sequential nature of the activities, as well as the large number of sometimes weakly connected partners, limit the potential for agility.

Figure 2.1: The linear supply chain

How is the linear supply chain model transforming to a Digital Supply Network (DSN)?

Supply chain management (SCM) is an essential component of any business since it manages the flow of products or services intended to meet the needs of the end consumer. SCM does this by overseeing a five-step process that includes acquiring raw materials, manufacturing goods, moving products closer to customers, delivering the final product to the customer, and servicing the product.

With today's technologically sophisticated consumer demands, the old supply chain approach of create, plan, source, make, deliver, and support must evolve to one of interconnected information flows and improved capabilities.

This integrated model is made possible by new technological breakthroughs and can serve as a one-stop shop for today's changing corporate climate.

The Digital Transformation of Supply Chain

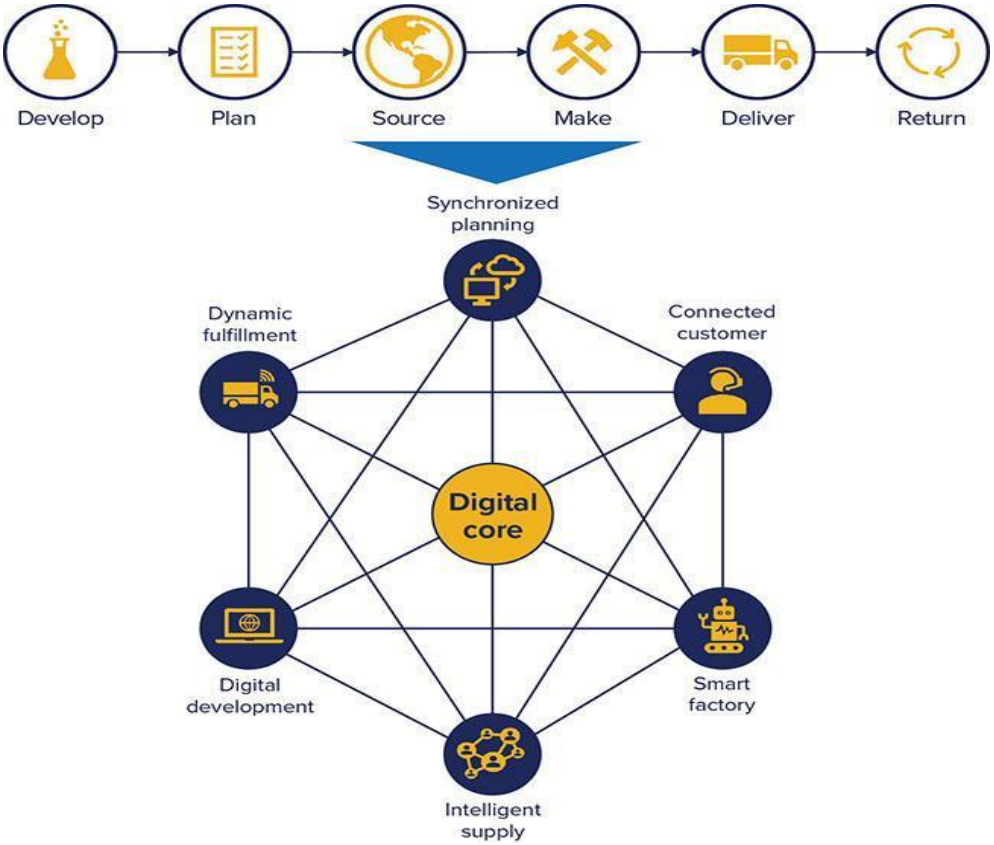


Figure 2.2: The Linear Supply Chain Model Evolving to a Digital Supply Network, DSN

Session 2.2: What is the Digital Supply Network (DSN)?

In this session, we will focus our discussion on what a DSN is and identify the differences between the linear supply chain and the DSN.

What is a Digital Supply Network (DSN)?

Convergence of technologies, new technological developments, large amounts of data, and the widespread use of increasingly smaller, cheaper, and mobile devices in personal and organizational contexts all contribute to disruption and the potential for tremendous opportunities for organizing and managing supply chains.

Without a doubt, the successful adoption and deployment of enabling digital technologies can result in benefits and value addition. However, the true benefits and full potential will accrue to

those organizations that leverage ongoing technological developments to reimagine business models, products and services, and end-to-end value chains to generate maximum value for customers, organizations, employees, partners, and societies.

DSN is thus the epitome of a managerial thinking centered on redesigning supply chain structure and management, attaining an always-on, always-connected, real-time, adaptive, and smart digital network. Figure 2.3 depicts a basic DSN model in which all parties are members of the same connected network. Throughout the network, product, money, and information flow fluidly and in real time. Customers are tightly linked and integrated into the network. Suppliers are also constantly connected and exchange data in real time. The network design is adaptable. The entire system works together to serve the consumer while increasing the value of the entire network.

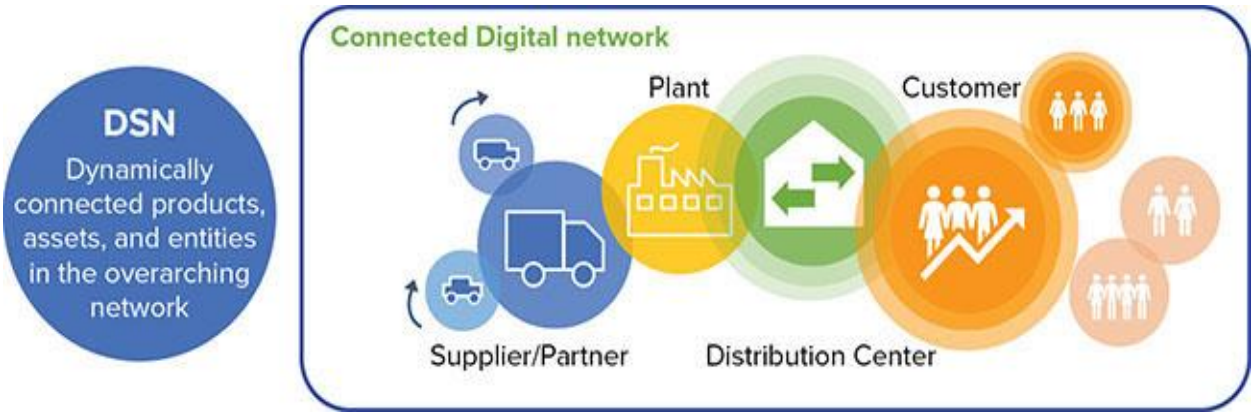


Figure 2.3: Representation of a Digital Supply Network

A digital supply network (DSN) can be broadly defined as a unified set of digitally empowered supply chain capabilities fueled by an interconnected flow of data, as displayed in Figure 2.4. At the center of a DSN is a digital core that simultaneously orchestrates six different supply chain capabilities**.**

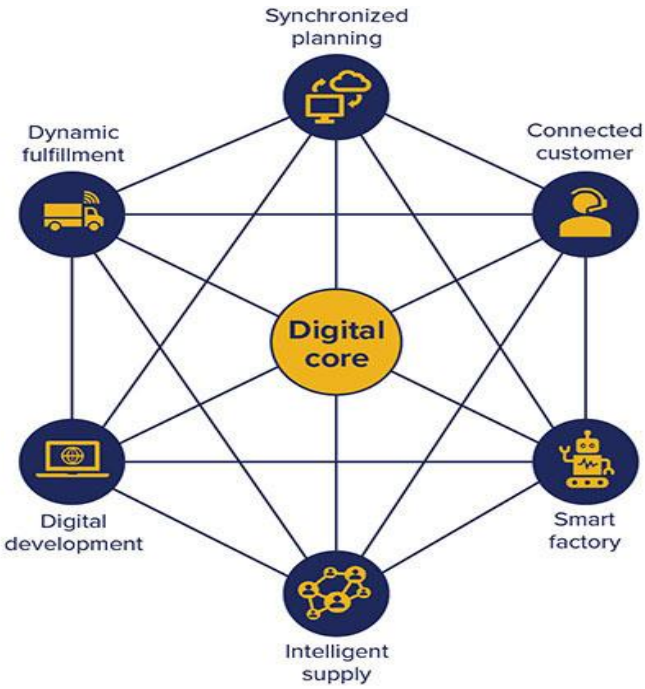


Figure 2.3: The DSN Model

What are the differences between the linear supply chain and the DSN?

Data and information from all six supply network capabilities are stored, distributed, and analyzed in the digital core. The DSN model, enabled by new and disruptive technologies, produces the following results, which distinguish DSN from the traditional linear supply chain:

1. **END-TO-END TRANSPARENCY** allowing visibility across the entire supply chain
2. **HIGH LEVELS OF AGILITY** driving flexible and proactive reaction of supply network levers
3. **CONNECTED ENVIRONMENT** enhancing cross-functional collaboration across all partners and functions
4. **RESOURCE OPTIMIZATION** promoting a cohesive environment for humans and machines
5. **HOLISTIC DECISION MAKING** promoting optimal network efficiency, reduced cost, and increased revenue

These features enable businesses to fully use their supply networks and reduce traditional resource, time, and space limitations. This can result in better operational efficiency and effectiveness, as well as new revenue prospects.

Session 2.3: What are the capabilities of a DSN in an enterprise?

In this session, we will discuss the six fundamental integrated capabilities a mature DSN must have, identify the key digital disciplines that are indicative for successful DSNs and the digital twin concept in a DSN.

What are the six fundamental integrated capabilities a mature DSN must have?

DIGITAL DEVELOPMENT. This capability uses technology to envision, create, and launch items into production, assuring cross-functional collaboration across the product lifecycle and enhancing design efficiency to develop high-quality products.

Automation also enables faster product introductions while minimizing environmental effect throughout development through process efficiency and digital technology.

SYNCHRONIZED PLANNING. This capability aligns strategic business objectives with financial goals and operational plans across various functions within the business. This helps to effectively anticipate customer demand and optimize inventory in the overall network.

This capability allows companies to sense exceptions across the supply network to enable on-time demand fulfillment.

INTELLIGENT SUPPLY. This capability helps companies more effectively collaborate with strategic partners and improve the customer and supplier experiences by adopting advanced electronic platforms for requisitions and invoices.

It also helps anticipate supply risks to proactively optimize end-to-end operations. Technologies such as machine learning and artificial intelligence (AI) can be used to predict cost fluctuations and select sourcing strategies to optimize costs.

SMART FACTORY. This capability uses a calculated balance of human intelligence and machine intelligence to drive improvements in business performance and worker safety based on production and demand data.

It helps in making informed trade-off decisions to identify opportunities to improve performance standards and ensure compliance in real time, improving product quality.

DYNAMIC FULFILLMENT. This is an interconnected and cross-enterprise capability that enables companies to deliver the right product to the right customer at the right time, enhancing customer experience.

It also helps enable intelligent customer order management, improving customer experience and reducing obsolescence costs. It can reduce start-up costs and increase risk resilience as well.

CONNECTED CUSTOMER. This capability allows companies to move from traditional transaction-based relationships to seamless customer engagement throughout the entire customer lifecycle.

This results in better anticipation of customer needs, enriching the customer experience. It also enables faster resolution of issues and identification of customer consumption patterns.

The Digital Core

The digital core that resides at the center of DSN integrates all the fundamental capabilities and ultimately drives the DSN.

What are the Key Digital Disciplines for Successful Digital Supply Chain Network ?

There are four key digital disciplines (Figure 2.4) that are indicative for successful DSNs. These disciplines are only achieved when all six DSN capabilities are interconnected and operate collectively as a network, orchestrated through a digital core.

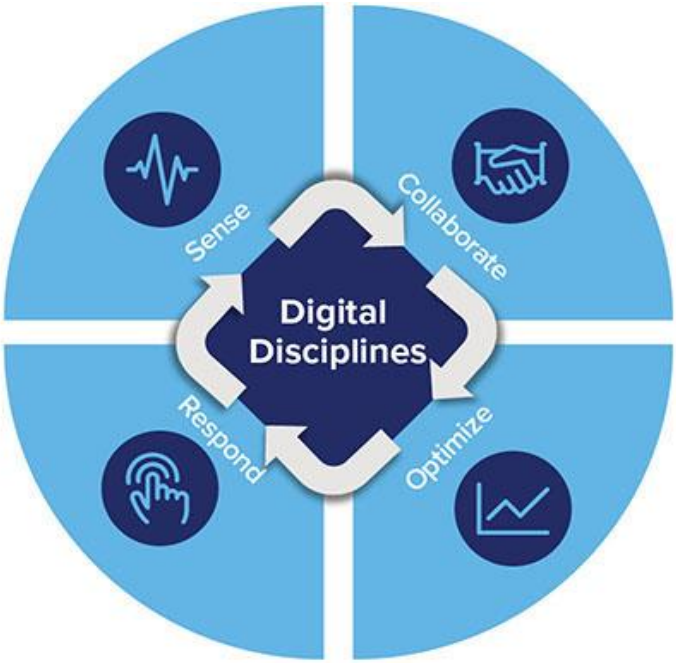


Figure 2.4: Digital Disciplines

SENSE. Rather than approaching the supply chain in a linear manner, DSNs scan the network pulse to find and evaluate relationships between all nodes. Historically, demand was the primary sensor activity in the supply chain.

Sensing has evolved into a much broader discipline that encompasses essential variables like supplier performance, customer sentiment, industrial performance, and staff satisfaction.

COLLABORATE. Supply chains exist to facilitate trusted transactions between trading partners. While customers and suppliers have traditionally interacted, DSNs enable concurrent and transparent involvement across numerous network nodes.

One example of new collaboration capabilities is emerging supply chain control tower technologies that leverage sophisticated chat-based problem-solving technology to combine numerous persons, data types, and communication channels.

OPTIMIZE. The goal of gathering and analyzing data from DSN nodes is to ultimately optimize the supply network in both the short and long term.

Previously, operations research departments were a step away from operations, but advanced optimization skills are now built in the platforms used by supply chain experts on a daily basis.

RESPOND. After sensing a situation, collaborating with stakeholders, and deciding on the optimal solution, the enterprise must execute the plan. This means connecting the digital to the physical world.

Supply network professionals can convert a plan into a series of orders, work instructions, or other activities that initiate operations on the actual goods, software, or service with the click of a button.

Introducing the Digital Capabilities Model

What is the Digital Twins Concept in Digital Supply Chain Networks?

DSN introduces the notion of a digital representation of the physical reality of a supply network, which is referred to as the digital twin.

A digital twin is essentially defined as a digital clone that mimics the traits, properties, and behavior of a physical object or process, allowing a business to simulate activities in a digital world without conducting or investing in a physical action.

Traditional supply chains must develop a physical-to-digital-to-physical loop in order to transfer an organization into the digital age (Figure 2.5).

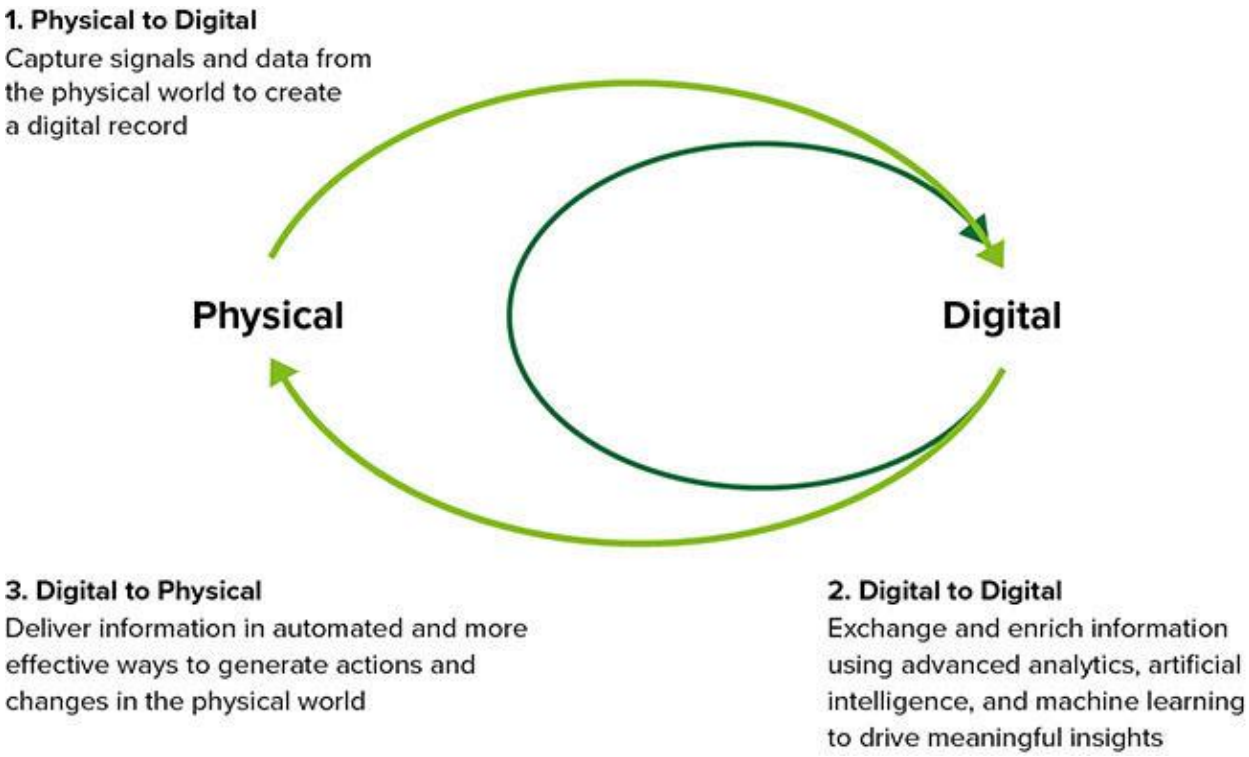


Figure 2.5: The Physical-to-Digital-to-Physical Loop

This loop begins with data generated by the digital twin and manages its evolution from the physical to the digital realm, followed by action that returns to the physical world. This loop is divided into three important components that, when combined, provide a source of continual value creation in a digital organization.

Watch this video to have a better understanding of the digital twin;What is Digital Twin? How does it work?

Congratulations! You have completed module 2!!!

Self-Assessment Questions

We have come to the end of this module. I recommend you take this practice exercise to improve your knowledge on the digital supply network. This is meant to help you determine how well you have understood this module. Now assess yourself with the questions below:

1. Describe the Digital Supply Network (DSN) model.
2. What are the fundamental capabilities a mature DSN must have?

Module 3: Advanced Analytics in Supply Chain Management

Welcome to module three. In this module, we will examine big data and the basics of advanced analytics, identify the key enablers for building successful implementations and utilizations of analytics and examine the roadmap for a successful implementation of advanced analytics.

Session 3.1: Big Data and Basics of Advanced Analytics

In this session, we will focus our discussion on answering three (3) questions – (1) what is big data? (2) what is advanced analytics, and (3) what are the evolutionary steps of advanced analytics?

What is big data?

When we talk about Big Data, the word is frequently understood in terms of data quantity. This knowledge, however, is considerably too restricted. According to a recent study, the successful use of digital applications in the supply chain is contingent on the right and context-specific use of data.

Big Data refers to a vast number of both organized and unstructured data that is complex and exceedingly difficult to manage using typical databases and software tools. The 5-V model has five characteristics: Variety (data types), Velocity (data creation and processing speed), Volume (data size), Veracity (data dependability and trust), and Value

VARIETY. Refers to the range of possible input data sources, which includes regular internal sources, historical data, machine data, or completely new data such as current weather conditions, as well as completely new data sources such as social media material and even video footage.

VOLUME. Refers to the quantity of data, with a special focus on storage capabilities as a limiting factor. For example, it is estimated that every day, 2.3 trillion gigabytes of data are produced.

VELOCITY. Refers to the ever-increasing need for rapid data processing. If batch processing was sufficient in the past (time intervals, e. g. always updating the previous day's data overnight), the demands concerning processing speed become much higher. The subsequent steps are near-time (smaller time intervals), real-time (within milliseconds) and data streaming (instant analysis of data flows).

VERACITY. Refers to the significance of data quality and the amount of trust in specific data sources' reliability.

VALUE. Refers to the process of using big data to find significant, as of yet untapped insights that may then be used to help decision-making.

The 5-V model, as a fundamental model, aids in making a clear and traceable connection between the data. The data can be perfectly customized for the intended purpose thanks to the analysis and categorization.

What is advanced analytics?

Beyond business intelligence, advanced analytics is the next level of data analysis (BI). It is the (semi-)autonomous analysis of data for knowledge acquisition, outcome prediction, and formulation of suggestions for decisions. It makes use of methods including text and data mining, machine learning, pattern matching, forecasting, visualization, sentiment analysis, network and cluster analysis, multivariate statistics, graph analysis, simulation, complex event processing, and neural networks.

Future company processes can benefit from change and improvement brought about by advanced analytics. More specifically, it refers to the methods for analyzing Big Data with sophisticated tools and methodologies, usually beyond those of traditional BI. It is employed to produce predictions, offer recommendations, and enhance business planning.

What are the evolutionary steps of advanced analytics?

Advanced Analytics encompasses multiple stages of development that reflect the level of data maturity for input/output as well as the additional value. In both directions, we make a distinction between three main stages in this way. We make a distinction between "information," "knowledge," or information put into context, and "wisdom," which refers to the process of arriving at conclusions or suggestions for decisions based on knowledge.

We must also consider time as a consideration while arranging the four maturity levels into this framework. **Diagnostic analytics** analyzes the recent past and the present, as opposed to **Descriptive analytics**, which analyzes the history. Findings from **Predictive analytics** are already projected for the near future, whereas **Prescriptive analytics** offers advice for the future. To go toward Advanced Analytics, these systems must be modified.

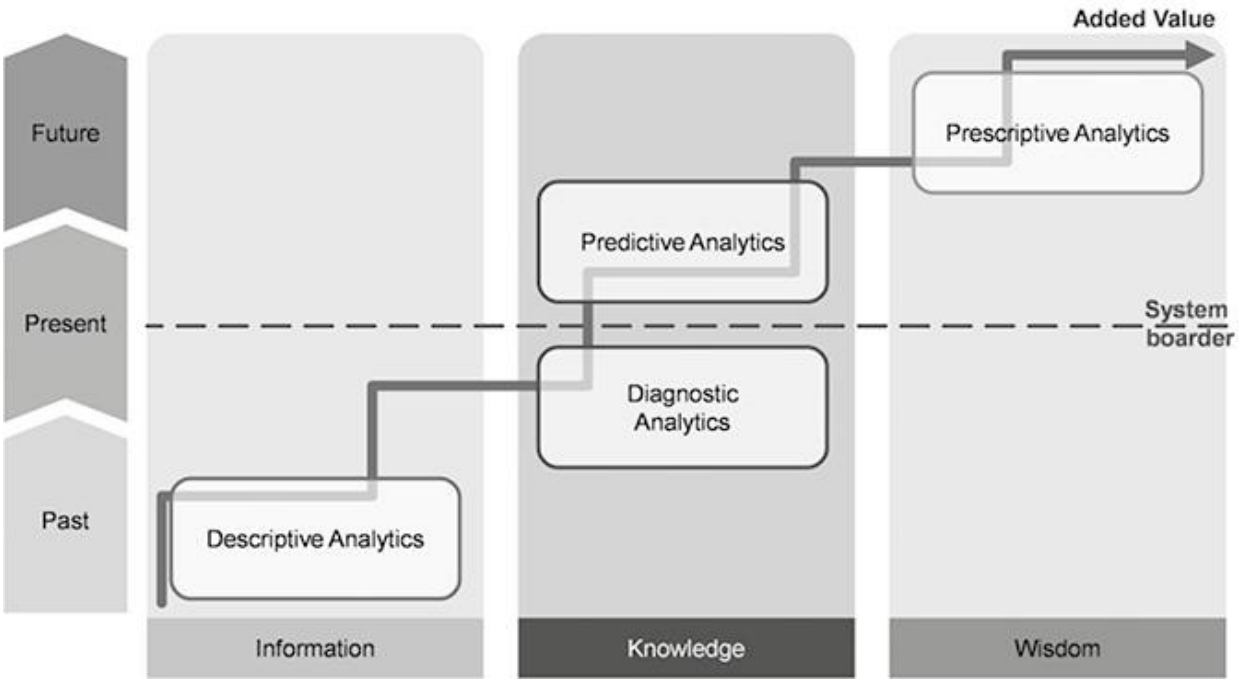


Figure 3.1: Advanced Analytics evolution steps

As of today, Advanced Analytics begins with Predictive Analytics and peaks in Prescriptive Analytics because in these two stages at least semi-autonomous usage and evaluation of data takes place. Therefore, we would like to dive deeper into these two forms of Advanced Analytics.

PREDICTIVE ANALYTICS. Predictive Analytics uses various detection and analyzing methods, such as data mining or machine learning, to uncover trends and patterns of behavior that may be extrapolated and predicted from a data set. The ultimate goal is to develop new business-relevant knowledge by making cross-functional predictions in shorter time periods (e.g., daily instead of monthly). In business, for example, Predictive Analytics is used to evaluate transactional data and identify business risks and opportunities at an early stage. Recent findings reveal that the trend in Predictive Analytics applications is toward enhanced user-friendliness and the ability to create faster and shorter studies.

PRESCRIPTIVE ANALYTICS. Prescriptive Analytics is the most recent stage of development in Advanced Analytics. Automated recommendations represent technical development. They are created with consideration to future actions, are based on study of the expected future, and use generated information to visualize a decision-tree including every decision possibility. To be more specific, Prescriptive Analytics uses prior results and applies various additional technological approaches such as Artificial Intelligence, optimization algorithms, and expert systems in a probabilistic context to provide adaptive, automated, constrained, time-dependent, and optimal decisions.

Watch the video below to understand supply chain analytics better:

The Basics of Supply Chain Analytics

Session 3.2: Key enablers for building successful implementations and utilization of analytics

In this session, we will focus our discussion mainly on what exactly is needed to enable the effective and efficient use of advanced analytics.

There are three key enablers that are necessary to successfully utilize Advanced Analytics within a project or across an entire organization: data, methods and people (Figure 3.2).

Figure 3.2: Key Enabler Building Blocks- Data, Methods and People

DATA. The total amount of existing data is rising over the years. However, the fact that the number and variability of publicly and privately available data sources are constantly increasing, is much more important (see Chapter 3.2 on Supply Chain Planning for detailed information). Four types of data need to be differentiated:

- Structured data: put together into a database-like predetermined depository. The discrete aspect of structured data, which permits retrieval of the information it contains, is a distinguishing characteristic (singular or combinations of data).

- Semi-structured data: Not arranged in a formatted repository, but contains associated information, such as metadata tagging, that makes it easier to process and analyze the data.
- Unstructured data: Various different forms of data which do not fit either into databases nor contain a related, specialized form of data structure like metadata tagging.
- Mixed data: Not easily assignable and may include a combination of the three aforementioned data kinds.

METHODS. Having a structured approach can facilitate the implementation of Advanced Analytics and help to achieve strived-for benefits. One of the most implemented processes is the CRISP-DM (CRoss-Industry Standard Process for Data Mining) model. The process is made up of six phases, as shown in Figure 8. It's important to note that the phases shouldn't necessarily be seen as strictly consecutive steps. Quite often, switching back and forth between phases is required.

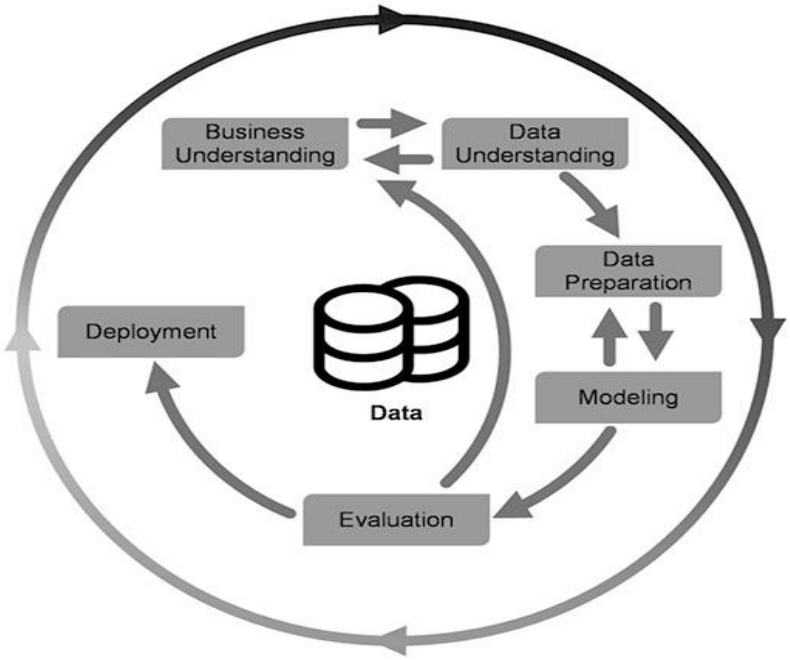


Figure 3.3: Cross Industry Standard Process for Data Mining (CRISP-DM)

Phase 1: "Business Understanding" begins with the definition of goals and requirements. The purpose is to separate those tasks with the greatest potential from the total sum of various tasks to be completed. In addition, a rough idea of how to approach the tasks should be developed.

Phase 2: “Data Understanding” involves gathering data or checking the availability of data. This helps determine possible problems regarding data quality.

Phase 3: “Data Preparation” involves construction of the final data set for modeling.

Phase 4: “Modeling” is the application of suitable data mining methods.

Phase 5: “Evaluation” of models to select that which best meets the requirements. This is where there needs to be a thorough comparison of the task and data in question. If the data turns out not to be suitable, re-assessing phase 1 may be necessary.

Phase 6: “Deployment”—This is where results are prepared and presented. If required: integration of the model into the customer’s decision-making procedure. Data preparation should not be underestimated. Often, this is one of the most time-consuming steps in data mining and Advanced Analytics projects.

As the technology advances over time, so do the models. The evolution of the CRISP framework is known as ASUM-DM. There are two major differences we want to highlight.

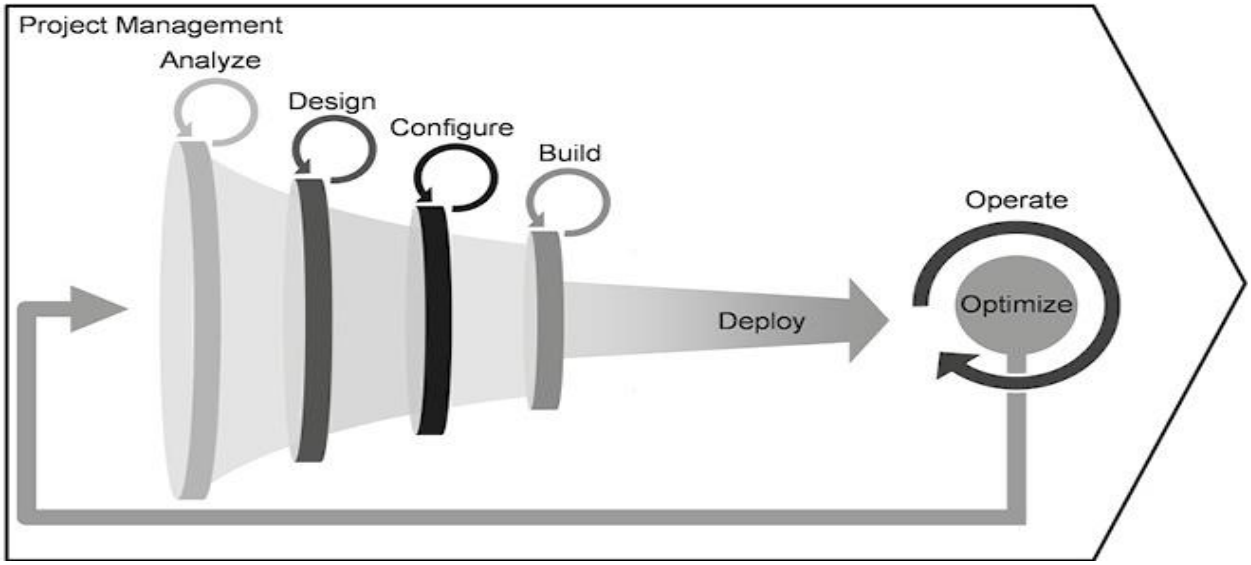


Figure 3.4: Analytics Solutions Unified Method for Data Mining (ASUM-DM)

The ASUM model contains the same “Deployment” step as the CRISP model but is followed by “Operating and Optimizing.” Nowadays, this often translates to additional costs and effort, e. g. development and maintenance of an infrastructure for the analysis of large data streams.

But not everything about the new model is better. Some data scientists see potential for improvement at ASUM-DM.

PEOPLE. As with any transformation project, empowering and enabling your staff to comprehend and utilize analytics is essential for changes to be accepted. Through suitable training, employees need to comprehend what needs to be done and how it should be done. As a result, it's crucial that they have a clear awareness of their options—both for the business and for themselves. It is also essential to comprehend how analytics data might be applied to enhance operations and simplify lives. The choice to adopt advanced analytics will probably be made by the leadership, though frequently without giving the implications further down the hierarchy enough thought.

Finding the ideal data scientist is essential for applying advanced analytics in your business or for a specific project. Understanding the source of the data and what may be accomplished using it is crucial for the data scientist. The data scientist ought to have experience creating data products. The skill set of a data scientist should include machine learning, statistics, and probability theory. The capacity to conduct experiments and employ scientific methods should also be included in the skill set. The data scientist must also comprehend the data and be able to interpret it, at least to a certain extent.

There are three types of work in Advanced Analytics projects: building visuals and dashboards, building databases and modeling data.

Session 3.3: Roadmap for advanced analytics implementation

Careful planning is the name of the game when it comes to successfully completing an Advanced Analytics project. In this session, we aim to understand the steps involved in doing so.

It is always very important to have a structured approach, such as defined in the ASUM processes. It is also very important for the client and the team to have common goals, based on a clear understanding of the client's requirements and expectations. Also, managing the client's expectations (e. g. if expectations are unrealistic) is crucial. Before you begin analyzing, you need first obtain a thorough comprehension of a high-quality database.
Always make sure that competent and experienced data scientists are accessible to work on the project. They demand a comprehensive grasp of the project's business case, assuming one exists. A smart data scientist may suggest uses that others have not considered.
The following stage is to thoroughly grasp the present database procedures and tools. Always employ the most recent technology and applications, and implement the best Advanced Analytics solution for each unique scenario.

Finally, it is critical to empower your employees. They will be using the tool and will have a clear understanding of what has to be done and how the results may be used meaningfully.

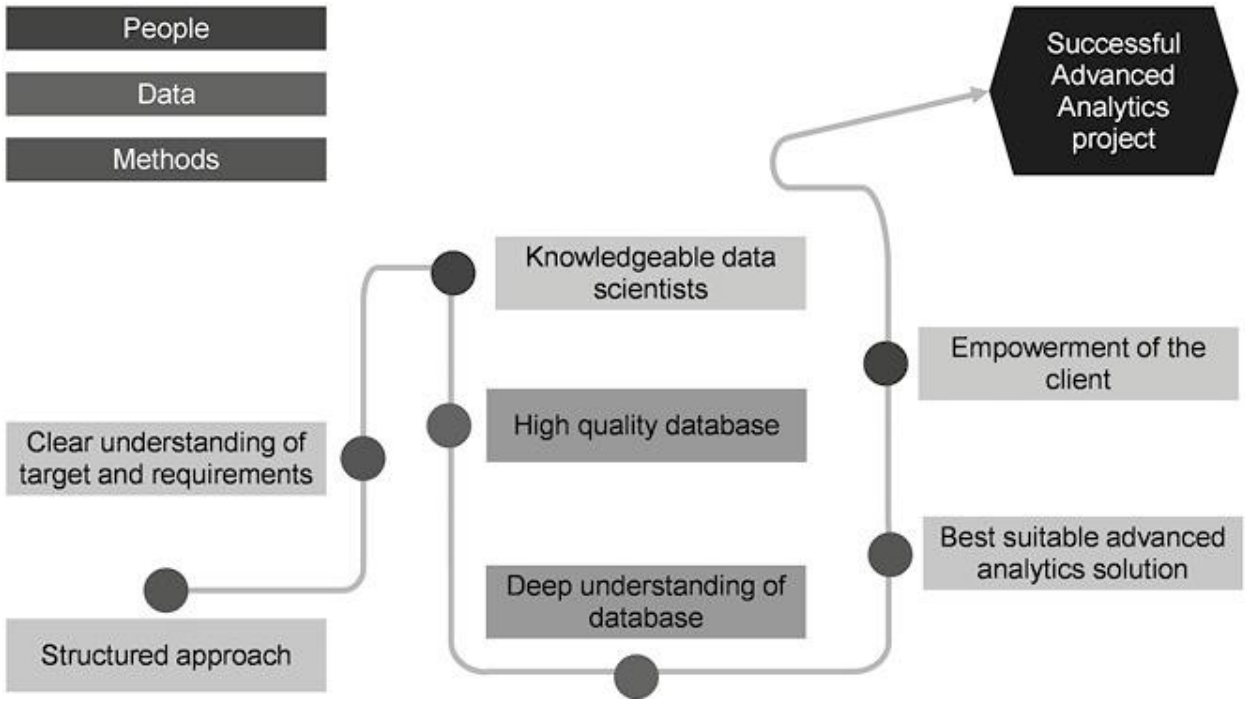


Figure 3.5: Roadmap to successful Advanced Analytics implementation

Congratulations! You have completed module 3!!!

Self-Assessment Questions

We have come to the end of this module. I recommend you take this practice exercise to improve your knowledge of advanced analytics in supply chain management. This is meant to help you determine how well you have understood this module. Now assess yourself with the questions below:

1. What is Advanced Analytics?.
2. What are the types of analytics? Discuss.

Module 4: Leveraging enablers for supply chain functions

Welcome to module three. In this module, we will examine nine digital technologies, some of which are already in use and others that are just starting to gain traction. We'll give a crucial review of these technologies, the much desired advantages that come with using them, and the supply chain applications that can be made of them.

Session 4.1: Digital Procurement: a Key Driver to Performance Improvement

In this session, we will focus our discussion on answering two (2) questions – (1) what is digital procurement? and (2) What are the evolving capability and roles of digital procurement?

What is digital Procurement?

All procurement professionals agree that digitalization must now be prioritized. There are only a few cases where strong arguments are still required to justify a budget investment in digital procurement technology.

Overall, the extent to which digital technologies are employed for procurement varies greatly—the discrepancies are due to their varied digital maturity levels and current IT environments.

A digital supply chain for procurement is one in which the fundamental operations are digitalized from start to finish (E2E), from plan-to-strategy (P2S) to source-to-contract (S2C) and all the way to purchase-to-pay (P2P) (P2P). Digitalization extends beyond internal E2E procurement..

What are the evolving capabilities and roles of digital procurement?

The future duties of procurement managers and purchasers as well as the characteristics of those who hold these positions will alter as a result of digitalization, shifting market demands, and changes in the procurement process. Traditional jobs in procurement, such as category managers, strategic buys, tactical buyers, and operational buyers, may alter or even vanish. As a result of changes to the business, it is necessary to create new roles and competencies. More specialized procurement jobs, such those requiring data scientists, market analysts, skilled negotiators, and cost-value analysts, may even be required.

Strategic buyers.

Category buyers and procurement managers will devote more effort to analyzing market trends and opportunities and strategically evaluating them.

Strategic buyers and sourcing managers will be freed from the administrative responsibilities that come with setting up and managing sourcing processes, which they currently bear.

Instead, they will concentrate on creating value by participating in decision-making, considering strategic and commercial opportunities, assessing benefits and risks, and contract negotiation as part of a multidisciplinary team that is in charge of managing the entire sourcing process.

New intelligent software will assist the strategic buyer in this latter role by assisting with contractual decisions, legal exchanges, and the final formalization of the contract.

Supplier relationship management

Supplier relationship management (SRM), which will also fall under the task portfolio of the strategic buyers, will become an increasingly significant duty linked to the strategic improvement of contract lifecycle management. Value generation will shift away from today's traditional commercial levers and toward more sustainable advancements in managing suppliers and their own supply chains. Leveraging innovations that have been started and made possible by strategic suppliers will likewise produce value.

Sustainability.

Sustainability must be completely embraced by procurement managers in the future. Sustainability will become an equally important issue to take into account, but buyers currently primarily focus on cost, delivery reliability, and quality as the main factors influencing decision-making in the supply chain. Suppliers will need to adhere to sustainability's ecological, social, and economic considerations. In order to see opportunities and limitations and agree on contract and partnership designs that produce sustainability benefits, buyers will need to be able to deal with these new needs. To reflect these new criteria and aims, KPI metrics need to be improved.

Tactical and operational buyers.

Companies are aiming to shift capacity and resources away from operational and administrative duties and into more value-adding roles and processes in order to increase procurement efficiency. Modern operational buyers must develop their abilities in order to advance into more strategic roles or at the very least be able to support the new digital means and processes since digitalization intends to simplify or even automate such jobs and processes. As a result, the value proposition for procurement is changing, and as a result, the nature of the roles from negotiator to cost manager to value advisor to strategic business partner must also evolve (Figure 4.1).

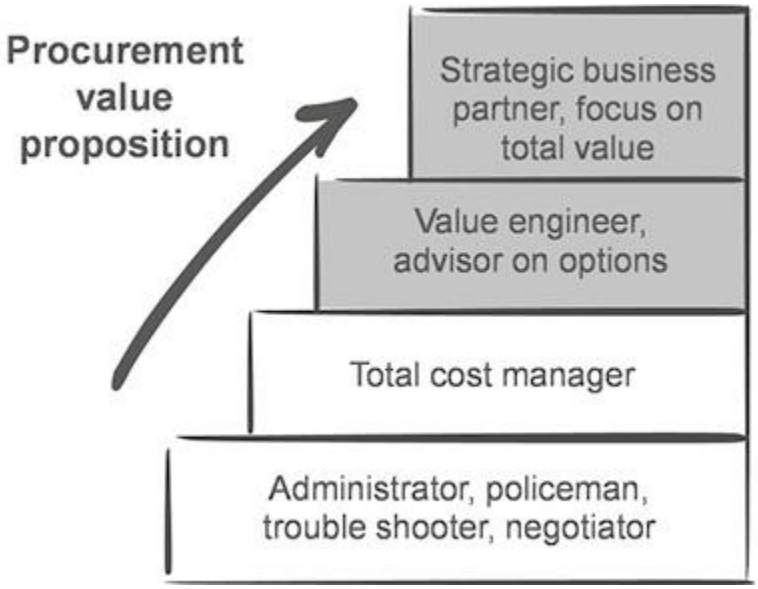


Figure 4.1: Evolution of procurement's value proposition and the roles within

Session 4.2: Faster and smarter supply chain planning

In this session, we will focus our discussion on answering three (3) questions – (1) what does the future of supply chain planning look like?, (2) What is the evolution of supply chain planning? and (3) what is required to achieve this step into the future?

What does the future of supply chain planning look like?

Planning as a strategy for managing inventories was often embraced far earlier by businesses with a larger make-to-stock footprint. As a result, they have been able to reduce supply chain costs and increase customer satisfaction while also benefiting from the advantages of accurate planning.

The availability and volume of relevant point-of-sale data are simply higher and simpler to get in consumer-oriented businesses, which puts a bigger emphasis on planning.

In order to align needs, achieve stringent timelines, and satisfy escalating consumer expectations, there is a lot of interaction required with other supply chain operations. There are many different tool options available to help with this project. Modern planning systems may already be available or being upgraded by more advanced businesses.

What is the evolution of supply chain planning?

The concept of supply chain planning evolved from sales and operations planning during the 1990s where companies gained tangible business benefits in improved customer service and reduced inventories. The planning process was used to facilitate growth and sustained profitability. Tools were put to use to plan and optimize inventory and improve service levels.

However, one gap remained. Planning is and was always a strictly sequential process where demand triggered a demand review process and the finalized demand figures flowed into supply planning and later into production planning and sequencing. This led to a situation where the time from demand trigger to finalized production plan could be as long as two to three weeks. Clearly in a fast-moving world with volatile markets and high customer expectations this is too long and could lead to inadequate and incorrect plans that result in high inventory or stockouts.

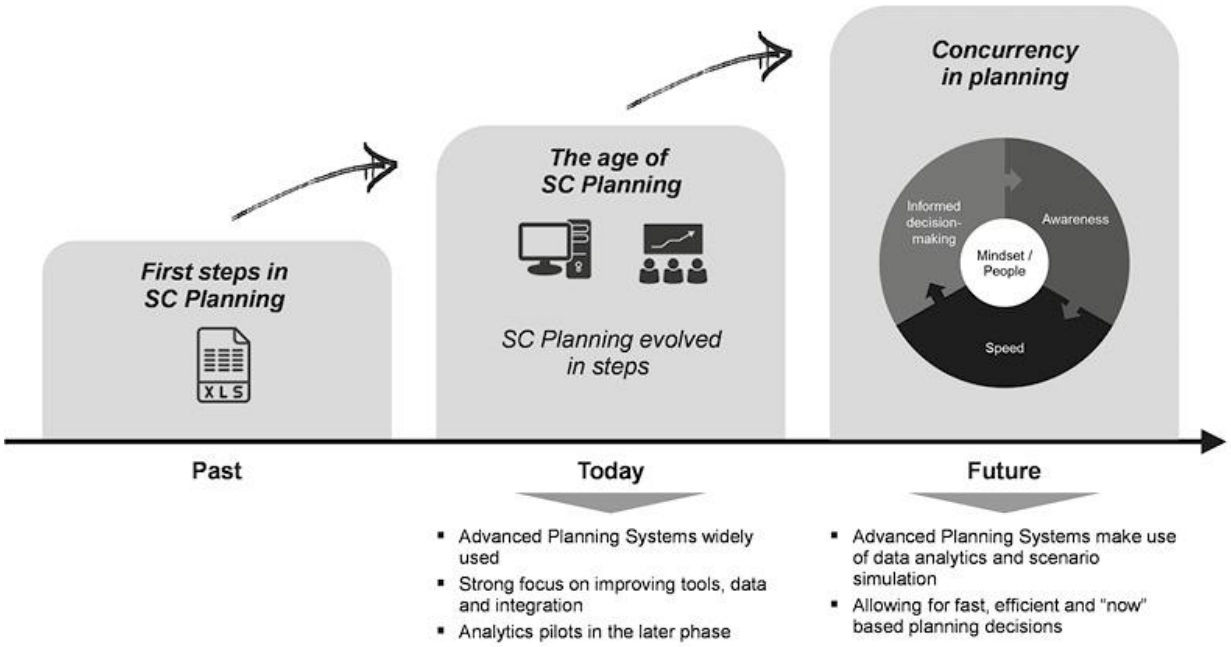


Figure 4.2: Evolution of supply chain planning

Watch the video below on supply chain planning:

Supply Chain Planning 2025+

What is required to achieve this step into the future?

In essence, the focus is not so much on reducing planning costs, reducing the number of planners, or even on delivering round-the-clock support, but on providing competitive advantages by improving customer focused KPIs such as service levels, shortening lead times at competitive prices, as well as creating more time for value-added tasks by planning staff.

To generate this leap in efficiency and speed at the same time it is necessary to combine a number of capabilities in supply chain planning, as shown in the diagram below.

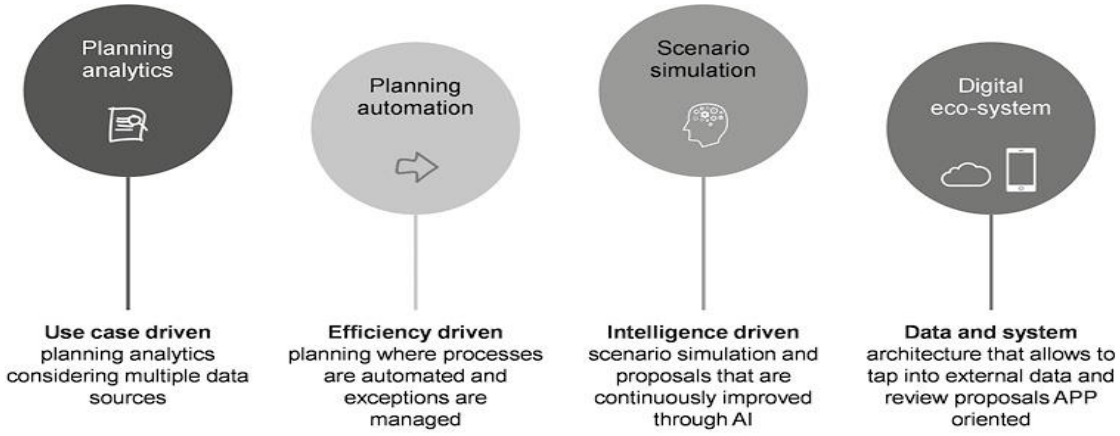


Figure 4.3: Future digital capabilities in supply chain planning

PLANNING ANALYTICS is Advanced Analytics applied to planning. The basis of this is its ability to consider internal and external data sources for demand or transportation planning, and also to consider analytics capabilities in production planning.

PLANNING AUTOMATION drives and supports speed but processes need to be integrated and automated in order to make concurrent planning a reality. Tool providers are supporting this step with ready-to-use or configure-to-use systems, depending on the specific business needs.

SCENARIO SIMULATION and proposals that are continuously improved through AI.

DIGITAL ECOSYSTEM, such as mobile connectivity, is the architecture that allows access to external data and review proposals that are APP-oriented.

The combination of these elements paired with adapted roles and organizational design will bring improved plans that drive the supply chain and the ability of many people to simultaneously review scenario plans across different time horizons at different levels of detail, comment on them, and achieve the goal of a fast-paced and reactive supply chain.

The digitalization of logistics offers numerous advantages. In this session, we aim to discuss these advantages and their limitations, and identify some business models with their value added services that can be digitalized.

Advantages of digitalizing logistics

Logistics is becoming a key competitive differentiator as an operational discipline. Process improvement, automation, and sustainability (green logistics) concerns have taken center stage in recent years. It is digitization in our time. The digitization of logistics has many benefits. By automating routine tasks, many logistics service providers have already been able to drastically lower personnel expenses in their transport logistics or warehouses.

1. Most businesses combine digitalization with an improved delivery reliability objective. In order to do this, digitalization provides a number of levers, including more transparency, improved predictability, better planning, efficient risk management, and more individualized services. Additionally, modern IT enables businesses to be more responsive, flexible, and agile in their processes and thereby respond quicker and more precisely to consumer and market requirements.

2. Control and reduction of logistics process complexity. Digitalization enhances networking and comprehensive automation. It improves transparency and makes it easier for individuals involved in a supply chain to interact. Data becomes extensively available to all parties concerned by connecting the various participants and company-wide IT-based collaboration. Additional information and insights are generated as a result of this, such as the capacity to identify supply chain hazards at an early stage. An better, in-depth understanding of the entire process is a necessary prerequisite for producing new, inventive concepts.

3. Cost reduction is achieved by increased efficiency, error prevention, risk mitigation, automation, and sound decision-making based on comprehensive information. Simultaneously, new services like data analysis and interpretation increase client pleasure. New business domains and sales opportunities can be formed on this basis.

Limitations of digitalizing logistics

1. Experience has shown that some of the systems are not yet fully built and so generate mistakes. The subsequent troubleshooting may negate the savings that were supposed to be inherent in employing the technology in the first place.

2. Every failure in the complicated logistical chain causes significant damage as soon as it occurs. As a result, systems must be redundantly constructed, durable, and properly safeguarded from external effects. The reliability and efficiency of the logistics chain must be reconciled when considering if and to what degree such preventive measures should be employed.

Business models with value-added services

We are already seeing logistics service providers offer data and document management throughout the logistics chain in addition to freight transport or warehousing and handling. Value-added services associated with this can include, for example, targeted data evaluation and the provision of recommendations for action planning, efficient resource use, transportation bundling, logistics chain networking, or the improvement of logistics performance indicators for the respective customers.
The new digital business models should be built to fully capitalize on the potential of digitalization when combined with powerful IT. A few of these new business models and value-added services are addressed more below.

Blockchain

Blockchain technology has applications in logistics and is anticipated to lower transportation-related expenses. It aids in tracing the lineage of supplied components and can track every shipment's movement. By eliminating the need for brokers, attorneys, and other third parties, smart contracts that are supported by blockchain technology can save expenses. Based on self-executing contracts between unidentified parties with terms that have been recorded in the ledgers, smart contracts can manage cargo flows.

Automatic storage systems and autonomous warehouses

Logistics operations require clear tracking and visibility of the commodities. The tracking of items and location management are supported by digital solutions. RFID-based location management is already well established. The focus of digital solutions is shifting to the tracking of things that cannot be labeled with RFID tags.

Autonomous vehicles

Internal logistics has long used autonomous, driverless cars, which have excelled in many respects. The completely automated container terminals, which are already successfully running in several ports throughout the world, are notable examples. Automation can enhance safety and efficiency in addition to autonomous driving by giving forklift drivers the best support possible. The detection of obstacles (like people) and coalition avoidance in warehouses are two examples of smart solutions. It was demonstrated that the forklifts' speed may be increased by 15% without compromising the workers' safety.

Geofencing or geo-localization in logistics

Anyone who uses their smartphone to hire a cab can track the car's current location in real time and anticipate the arrival time with a high degree of accuracy. However, new application areas have also been made possible by technological advancements. Particularly when it comes to the issue of the last mile, time-window delivery and same-day delivery are popular topics.

Future role of IT in Logistics

The integration of all parties involved in a value chain and the mapping of all corporate business operations into fully integrated IT workflows provide the biggest obstacles to the digitization of logistics. Logistics professionals should embrace IT and its projected leadership position in the industry because it may significantly boost competitiveness. The examples below illustrate how IT is becoming significant in logistics.

- **Gains in transparency**
  The ability to process and evaluate mass data in the shortest possible time and the automatic recognition of recurring patterns using learning algorithms make it possible to obtain new information from data that has been collected from a variety of sources.
- **Gains in reliability**
  Using telematics, transponders, RFID chips, and sensors, it is possible to compare local reality and process progress better and faster at the planning and control level. This avoids errors, rectifies malfunctions more quickly, and draws the right conclusions from the past.
- **Gains in efficiency**
  Logistics provides numerous control and decision-relevant data and information in real time.

Session 4.4: Supply Chain Visibility: Connecting the Dots

In this session, we will focus our discussion mainly on the changing nature of SC visibility, the barriers to SC visibility and how SC visibility creates value

The changing nature of supply chain visibility

Though the concept of supply chain visibility (SCV) is not new, its applications have evolved over time. For instance, rather than being a regulated entity contained within a warehouse's four walls, the supply chain is an integrated network of partners. Today, the procedure is far more complicated and involves a network of resources dispersed across numerous institutions and places throughout the globe (see Figure 4.4). Visibility is made more difficult by this complexity, and a few years ago, the idea of complete supply chain visibility could have seemed like a pipe dream. However, this is altering, and the majority of businesses are pursuing some level of supply chain insight in order to stay current and offer customers a smooth experience.Maybe it's not full visibility, but it’s the beginning.

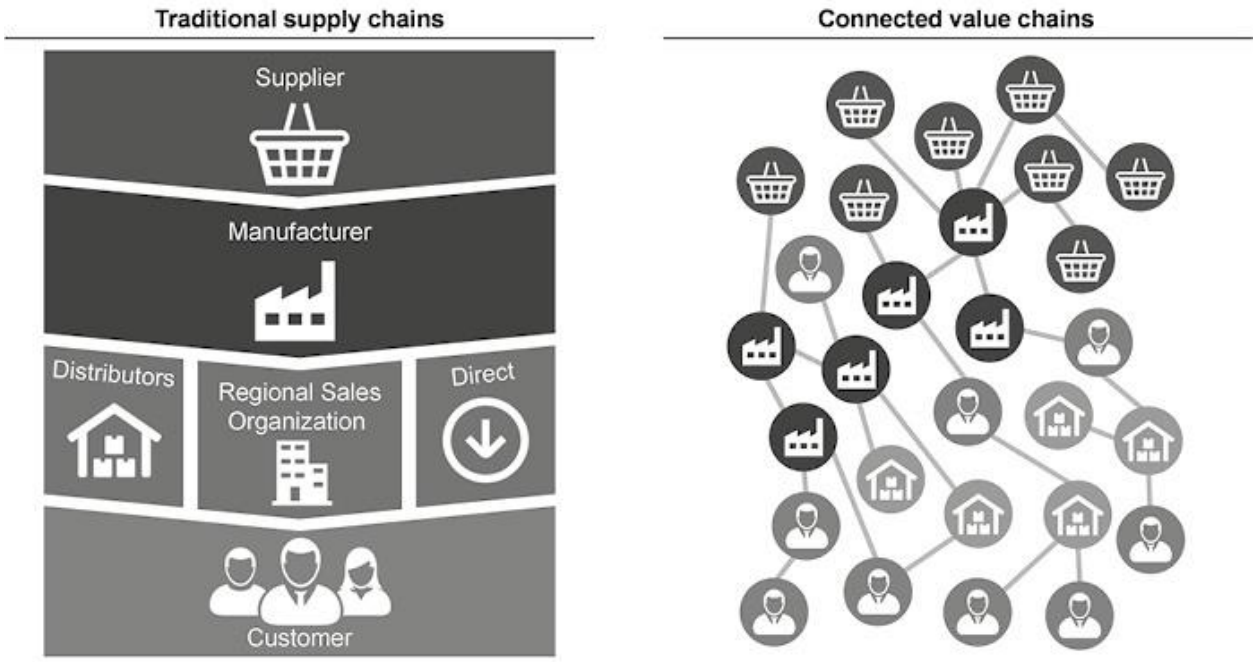


Figure 4.4: Network of Resources

The barriers to SC visibility

Visibility programs can be targeted at any part of the supply chain, from supplier compliance to consumer demand sensing, but it's not that simple. Of course, there are a lot of obstacles in the road, which makes it challenging to achieve supply chain transparency. Several of these are discussed below;

The increasing complexity of supply chain management

The global operations of many firms inevitably increase business complexity. If suppliers are dispersed over the globe, it stands to reason that suppliers also have suppliers, resulting in an N-Tier Supply Chain. As a result, there are more connections, ecosystems, and data needed to ensure transparency along the entire supply chain. This results in a problem with data harmonization since information like part numbers, drawings and specifications, sources of origin and destinations, and sources of data are stored not just in one system but in several. Traditional enterprise resource planning (ERP) is not designed to handle this kind of information management difficulty.
Hence, there is complete consensus that having good visibility along the supply chain is indispensable to tracking supplier network activity precisely and accomplishing short and accurate lead times to customers, but the very nature of these widespread and complex supply chains makes visibility hard to achieve.

Customers changing demands unexpectedly

The greater number of choices customers have today is another barrier to visibility. When customers have more options, they get used to demanding shorter and more flexible lead times, and in turn, they’re less tolerant of mistakes and late deliveries. This means that you, as the supplier, need a viable, effective supply chain with a steady and stable flow of data.

Accelerating market volatility and intensified response times

The increased number of options available to clients nowadays is another barrier to visibility. Customers are less tolerant of mistakes and late deliveries when they have more options. As a result, as a provider, you require a robust, effective supply chain with a consistent and constant flow of data.

Complexity of IT Systems

While information technology can assist supply chain managers in solving many problems, the inherent complexity of it can offer new challenges. Because IT systems are frequently fragmented and heterogeneous, they muddy the waters instead of providing global inventory transparency. However, openness is critical in evaluating whether a reorder is required or whether a stock-out issue exists. The conclusion is that if you want to see continued growth in your company, investing in a cloud-based system is not only advantageous now but also vitally important in the future.

Compliance with regulatory requirements

Tools for supply chain visibility make it easier to monitor the ever-shifting world of compliance and laws. When it comes to addressing various trade agreements and tariffs, this is especially important for firms that operate internationally. Furthermore, supply chain visibility technologies help business executives anticipate and adapt to changing legislation in their sector.

How visibility creates value

Supply chain visibility creates value in a number of different ways, including increased revenues, decreased operating expenses, and more efficient inventory management. Exactly how it does that is summarized below.

- Forecasts improve and lead to fewer instances of stock-outs as a result of increased demand visibility.
- Supply chain planning is aided by improved visibility, which helps avoid shortages.
- Decision-making can be aided by scenario simulations, which can also optimize product supply, increase availability, and improve customer happiness, all of which will probably increase income.
- Depending on the industry sector, increased visibility can boost revenue by 1–3%.

While increased visibility into the supply chain can boost revenues, a lack of visibility can result in costs along the supply chain.

- Unexpected demand changes result in more frequent changes in production campaigns, which in turn result in higher production costs and inefficiencies.

- Missing raw materials may result in unplanned production downtimes meaning extra costs can be incurred for rushed orders and express deliveries.
- There are higher logistics costs for express deliveries of incoming and outgoing goods to customers to meet promised delivery dates
- Volatility can be decreased so that capacity levels can be raised and procedures can be improved.

Enhanced Visibility in the Supply Chain World

Congratulations! You have completed the last module!

Self-Assessment Questions

We have come to the end of this module. I recommend you take this practice exercise to improve your knowledge on leveraging enablers for supply chain functions. This is meant to help you determine how well you have understood this module. Now assess yourself with the questions in the link below:

1. What is supply chain visibility?.
2. What is digital procurement?
3. How does supply chain visibility create value?