



## Traditional vs Digital Supply Chains

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**Abstract:** *This paper thoroughly describes traditional and digital supply chains and their key characteristics. Since digitization has had an impact on every single aspect of human life across the world, it is also transforming traditional into digital supply chains. The research domain is the explanation of traditional and digital supply chains and their comparison based on their stated differences. The methodological approach involves a comparative analysis of traditional and digital supply chains based on a literature review. The result of the paper is the identification of the specifics of digital supply chains and their importance for the company's business. The originality of the paper is ensured by a comparative analysis of the characteristics of traditional and digital supply chains, which are presented in the form of a table and described in the text. Possible limitations of the paper refer to the availability of relevant literature.*

## 1. INTRODUCTION

In the context of the global economy, demand fluctuates regularly, consumers are becoming increasingly discerning, and products and markets are growing more intricate. This complexity extends to supply chains (SCs) as well. As SCs become more complex, involving a larger number of participants and intricate business relationships, managing them becomes more challenging. Visibility and monitoring of product movements become difficult, leading to increased costs and other related issues. The existing business solutions, concepts, and supporting software are inadequate in addressing these challenges. The requirements set forth by the Industry 4.0 concept make it essential to transform conventional SCs into digital SCs.

The structure of this paper is as follows: following the introduction, the second section defines traditional SCs, outlining their objectives and the common challenges associated with them. The third section delves into the detailed explanation of digital SCs. The fourth section presents a comparative analysis of traditional and digital SCs based on predefined criteria. The paper concludes with final thoughts.

## 2. TRADITIONAL SUPPLY CHAINS

Traditional SCs involve turning raw materials into finished goods and products, as well as delivering products on time to end customers. They also represent the combination of key business processes thanks to which products and services are delivered from suppliers to end customers.

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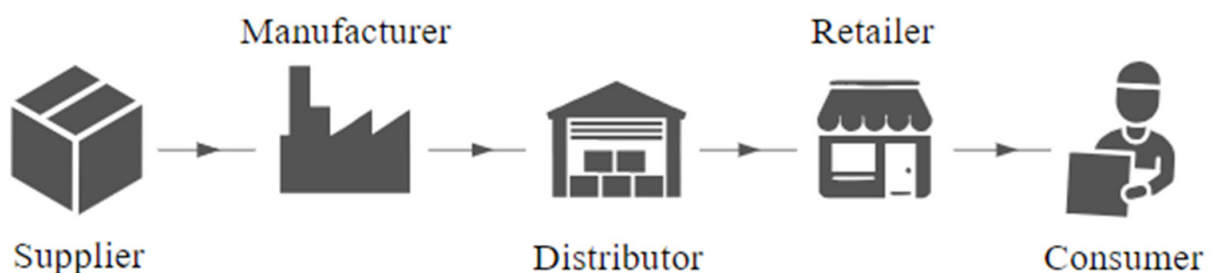
The goal of traditional SCs is to maximize profits, maximize operational performance, and develop better relationships between employees within companies. In a traditional SC, products move linearly and each link in the chain depends on the previous one. If an error occurs in a traditional SC, it can take days or even weeks to detect it, and a single error can lead to missed deadlines and customer dissatisfaction claim [Ayesh et al. \(2020\)](#). The phases of traditional SCs are ([DIGGIPACKS, 2023](#)):

1. Collection of raw materials - In this phase, all the raw materials needed in the production process are collected and the raw materials can be composed of one element or a group of elements;
2. Obtaining raw materials from suppliers - In this phase, raw materials are collected from suppliers, which cannot be obtained without them;
3. Production - In this phase, the production of products is carried out, after collecting raw materials and obtaining them from suppliers;
4. Distribution- In this phase, finished products are distributed to retailers or customers;
5. Consumption- This is the final stage where finished products are bought and consumed by retailers or customers.

Characteristics of traditional SCs according to [Ayesh et al. \(2020\)](#) are:

- Long delivery time;
- High transportation costs;
- Complex distribution networks;
- Dependence on economies of scale;
- Non-immediate consumer response;
- Managing demand uncertainty can be a complex task;
- Elevated inventory levels;
- Production is carried out far away from the places of product consumption;
- Generally not strict product quality control;
- Each participant in the SC works on demand forecasting;
- Employees at lower levels are not given enough importance.

A traditional SC is defined as an integrated production process in which suppliers deliver raw materials or semi-finished products to manufacturers, and then manufacture or assemble the semi-finished products into final products, and then the finished products are sent to distributors and retailers, and finally delivered to customers. In traditional SCs, the physical flow of products takes place from suppliers to customers, and the flow of information takes place from customers to suppliers claim [Deshmukh and Vasudevan \(2014\)](#). Figure 1 shows the structure of a traditional SC.



**Figure 1.** Traditional SC structure

Source: [SourceTrace, 2023](#)

The advantages of traditional SCs according to [Kadam et al. \(2017\)](#) are:

1. Striving to achieve profit maximization;
2. The focus is on the production and distribution of products;
3. Striving to achieve better relations between employees in the company.

Disadvantages of traditional SCs are ([LinkedIn, 2023](#)):

1. Weaker data updating in real-time;
2. Higher number of expected delays;
3. Difficulties in adapting to changing market conditions;
4. Increased inventory levels;
5. Detecting possible problems can be time-consuming, laborious, and unreliable.

### 3. DIGITAL SUPPLY CHAINS

A digital SC is characterized as a smart, value-oriented network that leverages cutting-edge technologies and analytical tools to generate business benefits. According to [Büyükožkan and Göçer \(2018\)](#), it can be defined as a customer-focused platform that efficiently harnesses real-time data from diverse sources. Utilizing digital technologies and data analysis, a digital SC makes informed decisions, optimizes performance, and swiftly adapts to evolving circumstances. It encompasses a series of processes that employ advanced digital technologies, enabling companies to enhance their decision-making regarding inventory requirements, product demand, and the interconnections between these factors. Digital SCs function more like networks. The configuration of digital SC is a network, rather than traditional linear SC. According to [Ageron et al. \(2020\)](#), it is a dynamic system that leverages information technology to integrate the SC activities for smooth material flows. The configuration for the digital SC depends upon the company's objectives and strategies. Digital SCs can provide real-time insight into the performance of each step in the chain. This visibility into supplier performance and customer needs allows the company to develop more relationships with more suppliers and better protects the company from disruptions when they occur states ([RECIPROCITY, 2023](#)). According to [Ye et al.\(2022\)](#) SC transparency and SC agility are two key factors that have helped companies achieve astonishing SC performance in the COVID-19 crisis. [Gupta et al. \(2020\)](#) stated that Industry 4.0 and digitalizing the SC offer executives the means to effectively manage complex environments and achieve mass customization with heightened speed, efficiency, and productivity. Within the SC, various points can contribute to wastage and inefficiencies. However, when companies collaborate closely and integrate their operations, it results in enhanced transparency and system safety. [Rasool et al. \(2021\)](#) proposed a set of metrics including operational efficiency, operational speed, error rate, system reliability, system flexibility, operational cost, on-time delivery, supplier relation, information availability, inventory level, return on investment, etc. for digital SC' performance measurement.

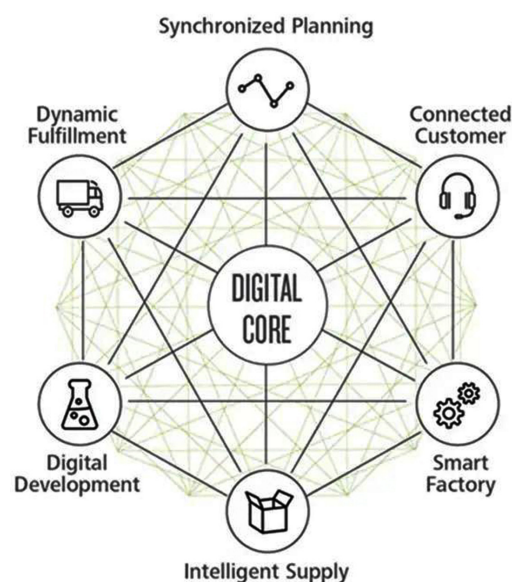
Figure 2 shows the structure of digital SCs.

The advantages of digital SCs according to ([RECIPROCITY, 2023](#)) are:

1. Improved visibility into SC performance - companies have real-time visibility into supplier performance, enabling them to pinpoint and address issues that could potentially lead to disruptions.;
2. Process automation - A digital SC eliminates the need for manual data entry and the reliance on phone calls to request updates; all required information is readily accessible, streamlining business processes, enhancing efficiency, boosting worker productivity, and

ultimately improving profitability; digital tools like sensors enable live inventory tracking throughout the SC;

3. Lower costs and faster innovation - a digital SC provides up-to-date information that helps manage and optimize processes such as raw material flows, forecasting, and resource planning, leading to lower costs; enhanced information sharing and collaboration lead to the identification of process bottlenecks, shortening the time to market for a new product and accelerating innovation;
4. Advanced Analytics - a digital SC can provide advanced analytics tools that visualize data, making it easier for users to learn from errors, predict outcomes, and enhance decision-making;
5. Enhanced planning - In a digital SC, shared and current data on quality and control empower companies to anticipate and proactively address issues before they escalate. Digital SC management simplifies the planning and management of all SC activities;
6. Reduced delivery times - digital SCs significantly minimize waiting times, enabling quicker and more efficient deliveries;
7. Improved financial management - With shorter lead times, digital SCs reduce financial requirements and enhance cash flow by reducing the capital tied up in excess inventory stored in warehouses;
8. Forward-looking Approach - Instead of merely reacting to events, digital SCs empower companies to anticipate future demands by collecting, analyzing, and sharing a wealth of data, enabling a more proactive approach to SC management.



**Figure 2.** Digital SC structure

Source: [RECIPROCITY, 2023](#)

Disadvantages of digital SCs according to ([CHRON, 2023](#)) are:

1. It takes time to implement digital technologies, as well as to train employees to learn to use them;
2. There is a risk of cyber attacks due to the exchange of large amounts of data in real-time;
3. If there is a power outage or network interruption, it can lead to serious disruptions in the entire SC, because information will be unavailable;
4. Implementation costs are high, as significant initial investments in digital technology are required.

The steps for transforming a traditional SC into a digital SC are (RECIPROCITY, 2023):

1. Evaluation of the traditional SC - the journey toward digitization should always commence with an assessment of the existing SC; this assessment entails examining the strengths, weaknesses, opportunities, and threats within the SC, identifying and analyzing current issues, risks, and potential complications;
2. Defining a digital strategy - collaboration and communication between companies and their SC partners are essential in defining the objectives of a digital SC; it's crucial to grasp the anticipated benefits to ensure that the new digital system aligns with the requirements of all stakeholders. Transitioning from a traditional SC to a modern, fully integrated digital one can be a complex endeavor, underscoring the importance of developing a well-defined strategy and implementation roadmap;
3. Conduction of a supplier analysis - an integral step in establishing a digital SC involves evaluating the maturity and readiness of suppliers, including their awareness of potential risks, to ensure alignment with digital initiatives;
4. Investing in digital opportunities - once goals, risks, expectations, and potential benefits are clearly defined, then investment in relevant digital opportunities follows; the right opportunities are critical to the success of companies;
5. Employee training - the successful adoption of digitization hinges on well-informed personnel who have received comprehensive training, ensuring their capability to effectively and efficiently manage new technologies.;
6. Performance analysis for continuous improvement - after the implementation of digitized systems and processes, it is imperative to regularly assess the performance of the digital SC; this assessment encompasses productivity, efficiency, return on investment, delivery times, and inventory; such analysis can help assess whether new systems are performing as expected and uncover opportunities for digitally driven optimization and growth.

Integration of Industry 4.0' concept trends and enablers, such as Internet of Things/Internet of Services, click and collect delivery, pick-up points, product-lifecycle management, radio-frequency identification, simulation tools, smart factories, etc. is generating an essential dimension in the transition of traditional SCs into digital SCs confirm Garay-Rondero et al. (2019).

According to Queiroz et al. (2019), transitioning from traditional to digital SCs, that is, SC digitalization necessitates a substantial integration of an organization's internal capabilities with those of its SC partners. Additionally, the resistance of employees to embracing these changes may manifest at different phases of the transformation, prompting managers to carefully weigh the expenses and potential risks linked to digitalization initiatives.

Digital SC facilitates strategic SC improvements by optimizing design processes, enhancing product quality, improving planning and inventory management, managing risks, fostering collaboration with suppliers, increasing operational efficiency, optimizing logistics, maximizing sales performance, and enhancing after-sales services stated Ageron et al. (2020).

#### 4. COMPARATIVE ANALYSIS OF TRADITIONAL AND DIGITAL SCS

The differences between traditional and digital SCs are shown in Table 1 (LinkedIn, 2023; Oracle, 2023; RECIPROCITY, 2023):

1. Traditional SCs are rigid, following predefined rules and historical data, whereas digital SCs operate in real-time, exhibit dynamic behavior, and can adjust to evolving situations.;

2. Traditional SCs follow a linear model, whereas digital SCs function as interconnected networks;
3. In contrast to traditional SCs that frequently use isolated systems, digital SCs seamlessly integrate data from both information technology systems and operational technology;
4. In a traditional SC, detecting potential problems and predicting potential effects can take a lot of effort. Most companies should conduct regular assessments of the SC resilience of their most critical suppliers. In a digital SC, on the other hand, the sharing of quality and control data with suppliers allows companies to predict issues and take proactive measures without the need for extensive upfront planning.
5. In traditional SCs, employees make decisions based on input from machines, while in digital SCs, machines make decisions, with employees supervision;
6. Traditional SC primarily concentrate on production and logistics, whereas digital SCs have a broader focus, addressing overall customer requirements and striving to enhance the overall value of the product delivered to customers, rather than solely emphasizing distribution aspects;
7. Traditional SC has no strategy to improve the value of the finished product. In contrast, companies operating within a digital SC create value for the end customer's product;
8. Traditional SCs allow companies to progress more slowly than digital SCs;
9. Traditional SC does not use any logistics management tool, while digital SC uses logistics management tools to ensure safe delivery of goods;
10. Unlike traditional SCs, where delivery times are significantly slower, digital SCs are much faster. New approaches to product distribution in the digital SC can reduce the delivery time for many products to just a few hours;
11. Digital SCs are more flexible than traditional. Real-time SC planning means that companies can respond more flexibly to changing demands or supply situations. Through the reduction of planning cycles, digital SCs facilitate a more continuous and agile planning process, enabling quicker responses to changing demands or constraints;
12. Unlike traditional SCs, digital SCs allow customers to choose offers that exactly match their needs;
13. Digital SCs are more accurate because they provide real-time transparency throughout the SC;
14. Unlike traditional SCs, digital SCs are more efficient. Automating physical tasks and planning means increasing efficiency along the SC. For example, in a digital SC, robots handle materials throughout the warehousing process, from receiving and unloading, to putting away materials, to picking, packing, and shipping;
15. Unlike traditional SCs, digital SCs are more environmentally conscious;
16. Different from traditional SC, digital SC enables more efficient management of the storage of goods and continuous monitoring of inventory levels with the help of sensors or other advanced technologies;
17. Compared to traditional SCs, a key characteristic of digital SCs is innovation, so they are always open to change.

**Table 1.** Traditional and digital SC – a comparison

	<b>Traditional SC</b>	<b>Digital SC</b>
1.	Static	Dynamic
2.	Linear	Networks
3.	Reliance on standalone systems	Non-reliance on standalone systems
4.	Detecting a problem requires a lot of effort	Problem anticipation without complex planning
5.	Employees make decisions based on input from machines	Machines make decisions with employees' supervision

6.	Focus on production and supply only	Focus is also on customer needs
7.	Non-defined improvement strategy for value of the finished product	Defined improvement strategy for value of the finished product
8.	Slow progress of the company	Fast progress of the company
9.	Logistics management tools are not used	Logistics management tools are used
10.	Slower delivery time	Faster delivery time
11.	Less flexibility	Greater flexibility
12.	Standard product range	Personalized products (offers)
13.	Lower accuracy	Higher accuracy
14.	Lower efficiency	Higher efficiency
15.	Environmental negligence	Environmentally conscious
16.	Lower efficiency in goods storage management	Greater efficiency in goods storage management
17.	No innovation	Innovation

Source: Own research

## 5. CONCLUSION

Traditional and digital SCs are presented and explained in detail in this paper. Although traditional SCs are much simpler than digital SCs, they have their advantages. The focus is on maximizing profits and establishing better relations between employees. Contrary to the linear structure of traditional SCs, digital SCs have a network structure. Real-time data providing and visibility are the digital SC's best features.

A conducted comparative analysis of traditional and digital SCs is the result of this paper. In comparison to traditional SCs, digital SCs are more flexible, accurate and efficient. Digital SCs welcome innovations, while traditional SCs hold on to familiar things. While traditional SCs focus only on production and supply, the main focus of digital SCs is customers. Thus, digital SCs offer more personalized and customized products to their customers. A big advantage of digital SCs is their environmental awareness.

In the end, it can be concluded that digital SCs are a better choice for companies' business because they are faster, more flexible, innovative, proactive, environmentally friendly, and if companies have the opportunity, they should implement digital SCs.

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