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SUPPLY CHAIN MANAGEMENT

Textbook

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Models, key steps and different flows in supply chains, features of their centralization and transformation, supply chain performance measures, rules and regulations, drivers and metrics, as well as designing distribution networks and global supply chain networks were considered. Features of aggregate planning systems, sales and operations planning, business process management and coordination in a supply chain were outlined. Interconnections between digital markets and global supply chain, the role of marketing and online business in ensuring global supply chain, prerequisites for digitalization of the financial sector in global supply chains, and management of information transformation in the context of the financial sector digitalization were considered. Transportation in the supply chain and supply chain management in conditions of sustainable development were studied.

For higher education seekers studying in the fields of study 05 "Social and Behavioural Sciences", 07 "Management and Administration", 27 "Transport", 28 "Public Management and Administration" and 29 "International Relations".

CONTENT

PREFACE

The textbook "Supply Chain Management" is offered for higher education seekers studying in the in the fields of study 05 "Social and Behavioural Sciences", 07 "Management and Administration", 27 "Transport", 28 "Public Management and Administration" and 29 "International Relations".

The subject "Supply Chain Management" is a holistic business concept combining modern organisational principles and the capabilities of advanced information technologies in the formation and optimisation of logistics activities. Effective supply chain management is one of the key factors in maintaining and increasing the competitiveness of enterprises and products in existing and future markets. The purpose of the discipline is to develop special competencies in the formation, management and evaluation of the effectiveness of the supply chain.

The tasks of the discipline include the following: mastering the conceptual apparatus and theoretical foundations of supply chain management; familiarisation with the supply chain management methodology; acquiring skills in supply chain design and planning; familiarisation with the main business processes in supply chains; studying the basics of creating a single information space for supply chain participants; getting acquainted with the criteria for the quality and efficiency of supply chain functioning; acquiring the ability to coordinate relationships between supply chain participants and make decisions in the supply chain management.

As a result of studying under the programme, the higher education seekers should know: models and characteristics of types of networks and supply chains; principles of supply chain functioning, including business process models, basic management elements, features of solutions in the areas of supply, production, marketing and design of new products; methods and tools for assessing the effectiveness of the supply chain; features of production capacity management in supply chains; role of logistics in the strategic development of the supply chain; fea-

tures of supply chain design and achievement of competitive advantages. Higher education seekers should be able strategically and tactically plan the functioning of the supply chain, assess the impact of logistics on the performance of both the supply chain and its individual participants, and identify reserves for improving the economic efficiency of the designed and existing supply chains.

As a result of studying the discipline, the student should acquire the following competences: ability to solve complex tasks and problems in the field of supply chain management; ability to determine the effective structure of a competitive supply chain that generates value; skills of using information and communication technologies for searching, processing, analysing information from various sources and making decisions to build supply chains; ability to think abstractly and pragmatically identifying cause-effect relationships between phenomena and processes in supply chains; ability to identify risks of local and global supply chains, develop measures to prevent risk situations, and implement international supply chain security standards; ability to make informed strategic decisions on the formation of optimal supply chains.

The textbook contains 14 sections. Also, textbook contains tests, case studies and discussion questions, which should facilitate the practical mastering of the material and the ability to solve specific practical problems.

Contribution of the authors is as follows: A. Koldovskiy personally developed sections 11 and 12; V. Kolosok personally developed sections 3 and 4; A. Mostova personally developed sections 9 and 10; V. Drozdova personally developed sections 5 and 6; S. Lytvynenko personally developed preface, sections 1 and 13; N. Vitka personally developed sections 7 and 8; Y. Popova personally developed sections 2 and 14.

The authors express their sincere gratitude for the assistance in preparing the textbook for publication to collectives of the Air Transportation Management Department National Aviation University, as well as to professors A. Novikova and V. Yanovska. Authors of the textbook will be grateful for critical comments, recommendations and suggestions.

1. UNDERSTANDING THE SUPPLY CHAIN

1.1. MODELS AND KEY STEPS IN THE SUPPLY CHAIN

A supply chain is a network of individuals and companies involved in creating a product or service and delivering it to the consumer. The chain links start with the manufacturers of raw materials and end when the finished product is delivered to the final user [1].

Elements of the supply chain include producers, vendors, warehouses, transportation companies, distribution centres, and retailers. The supply chain functions cover product development, marketing, manufacturing operations, distribution, finance, and customer support. Effective supply chain management leads to reduced costs and an improved production cycle [1].

There are many types of supply chain models. The model that a company selects may depend on the way it is structured and its individual needs, as shown in Fig. 1.1 [1].

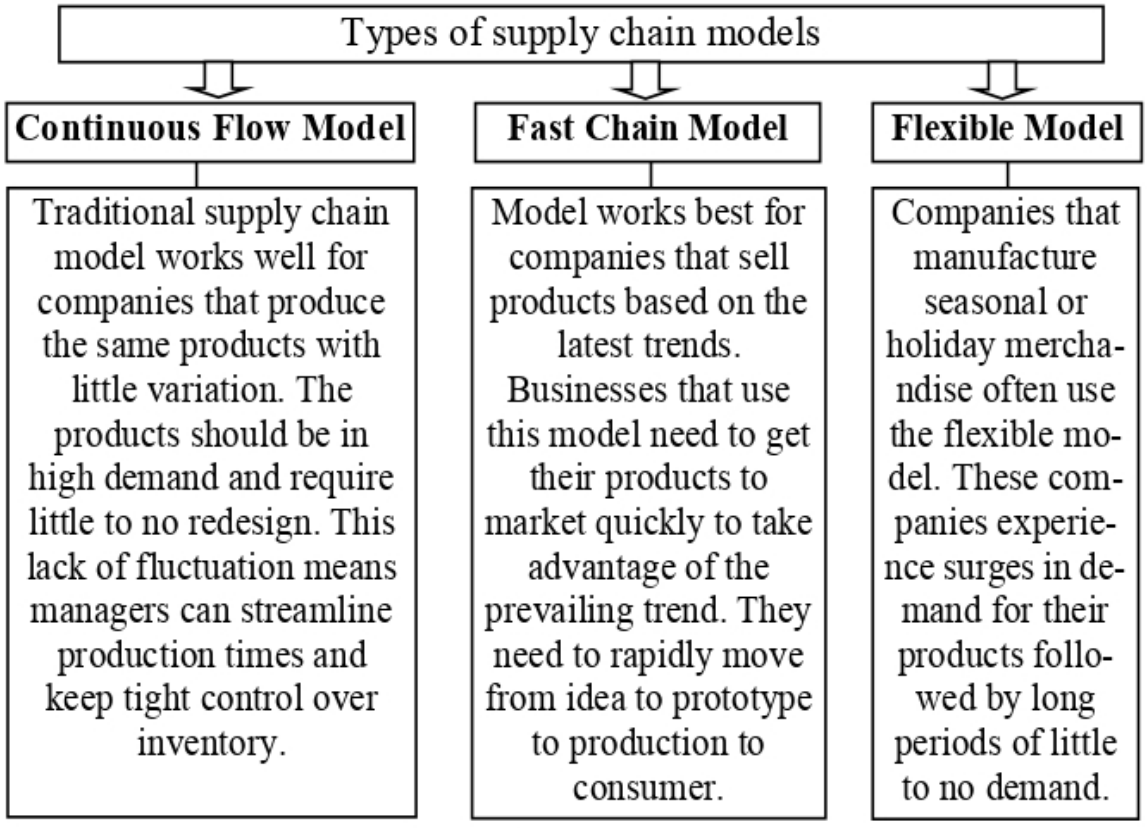


Fig. 1.1. Types of supply chain models [1]

The supply chain covers all the stages related to the delivery of a finished product or service to the consumer. Effective supply chain management can reduce a company's overall costs and increase its profitability. Failure of one link can disrupt the rest of the chain and become costly [1].

The supply chain is composed of interrelated components, each of which forms the finished product that customers purchase. Some types of supply chain stakeholders are shown in Fig. 1.2 [2].

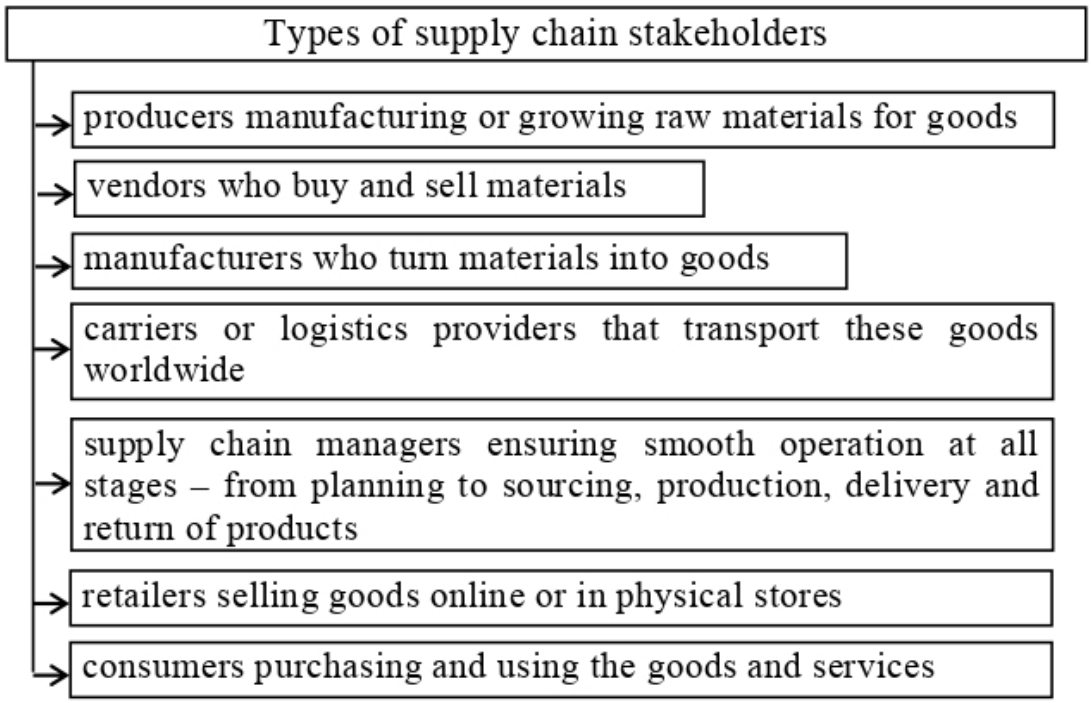


Fig. 1.2. Types of supply chain stakeholders [2]

Supply chain management (SCM) is the supervision and control of an organisation's operations to transform raw materials into finished products for sale to end customers. SCM ensures centralised control over the planning, design, production, inventory and distribution activities needed to manufacture and sell the company's products [1].

Five main spheres of supply chain vulnerability can be identified [2] as follows: planning and supplier networks; transport and logistics systems; financial resilience; product complexity; and organisational maturity. The key stages in the supply chain are given in Fig. 1.3 [1].

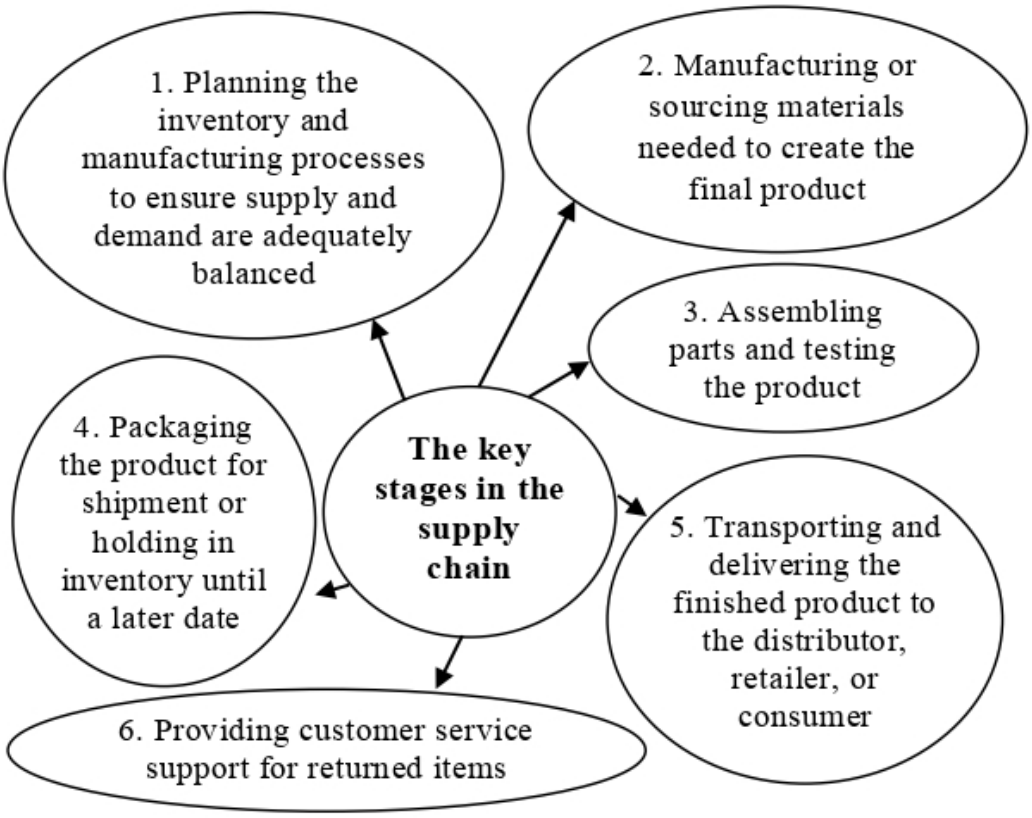


Fig. 1.3. Key stages in the supply chain [1]

McKinsey has grouped ***supply chain shocks into four distinct types*** based on their influence, timing and frequency of occurrence [2]:

Unanticipated catastrophes. Such events represent history-making occasions that cannot be predicted and result in trillion-dollar losses. Some examples included extreme terrorism and a massive cyber-attack.

Foreseeable catastrophes. Shocks in this group are related in scale to an unforeseen disaster, but they differ in that greater regularities and probabilities can determine overall readiness. Financial crises and global military conflicts are examples.

Unanticipated disruptions. Such events are severe and high-cost, but on a smaller scale as compared to catastrophes. Data breaches, product failures and workplace accidents can be considered examples.

Foreseeable disruptions. It is possible to spot some disruptions in advance, even before they happen. For example, trade disputes between China and the United States and the UK's exit from the European Union.

1.2. THE DIFFERENT FLOWS IN SUPPLY CHAIN

In supply chain management, there are 3 flows [3]: physical flow, information flow, and financial flow.

The physical flow of the supply chain (Fig. 1.4). It can be related to logistics, i.e. the transportation and storage of goods [3].

Fig. 1.4. The physical flow of the supply chain [3]

The problem with *information flow* is figuring out how to use it to forecast and envision the future (Fig. 1.5). Being able to determine what will take place in the future makes the work of supply chain teams easier. Furthermore, logistics also involves information flows, which means that ultimately the physical and information flows are tightly interconnected. For example, optimising logistics movements in a warehouse requires a wide flow of information to improve process and performance [3].

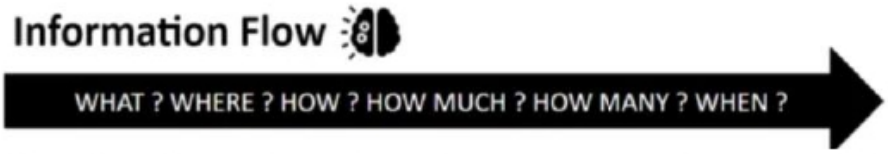


Fig. 1.5. The information flow of the supply chain [3]

The *financial flow of the supply chain* (Fig. 1.6). It can be viewed as information and, like all money transfers to partners, suppliers and sub-contractors, and also within the company [3].

Fig. 1.6. The financial flow of the supply chain [3]

Financial flow can be seen as a procurement strategy. In large enterprises, this flow is implemented in multiple currencies [3].

1.3. LONG-TERM UNCERTAINTY AND DEGREE OF CENTRALIZATION IN THE SUPPLY CHAIN

There are ***three essential measures that organisations should undertake when managing their supply chains*** to address long-term uncertainty and potential shocks [2]:

Firefighting. It includes short-term, daily actions to help uncover overlooked gaps in the supply chain.

Integrating and streamlining operations. It can be crucial to creating resilient supply chains: establishing a nerve centre to consolidate organisational reactions, modelling and planning for extreme supply and demand disruptions, and reassessing strategies for timely inventory supply.

Achieving structural resilience. It is easier to react quickly, but if the goal is long-term resilience.

Resilience is the ability to sustain, adjust and succeed in conditions of internal and external shocks, both known and unknown. In more specific terms, operational resilience, covering supply chains, means that businesses maintain reliable production capacities that can adapt to changes in demand and remain stable under disruptions without compromising quality [2].

In a recent study, McKinsey analysed the supply chain organisations of over 50 companies across a range of industries in Europe, Asia and the Americas. It asked about the strategic choices, organisational structures, management practices and work culture of their global supply chains, seeking to identify the decisions that correlate with their EBITDA performance. The findings may be surprising – and shed light on the structure of successful supply chain organisations [4].

The optimal organisational design is an ongoing discussion. Supply chain executives often consider organisational transformation under one of three circumstances: when the business structure changes, such as through mergers or acquisitions; when it is required by changes in operations, such as digitisation of processes or reconfiguring the supply chain; or when executives detect indications of inefficiency, like a new product launch taking too long to scale or decisions taken in cross-functional forums that cannot be effectively implemented in the field [4].

Supply chain organisational redesign usually begins with an analysis of competitors' organisational choices, followed by an attempt to imitate what seems to work well. A McKinsey study showed no correla-

tion between supply chain organisational archetypes and companies' bottom-line results [4].

A certain degree of centralisation has been a common practice in the design of supply chain organisation. In various industries, most companies tend to at least centralise a strategic supply chain function so that ownership and improvement of selected processes is shared across geographies, while local units retain control of execution (Fig. 1.7). Centralisation generally serves best for functions that improve, standardise or manage scarce resources across units [4].

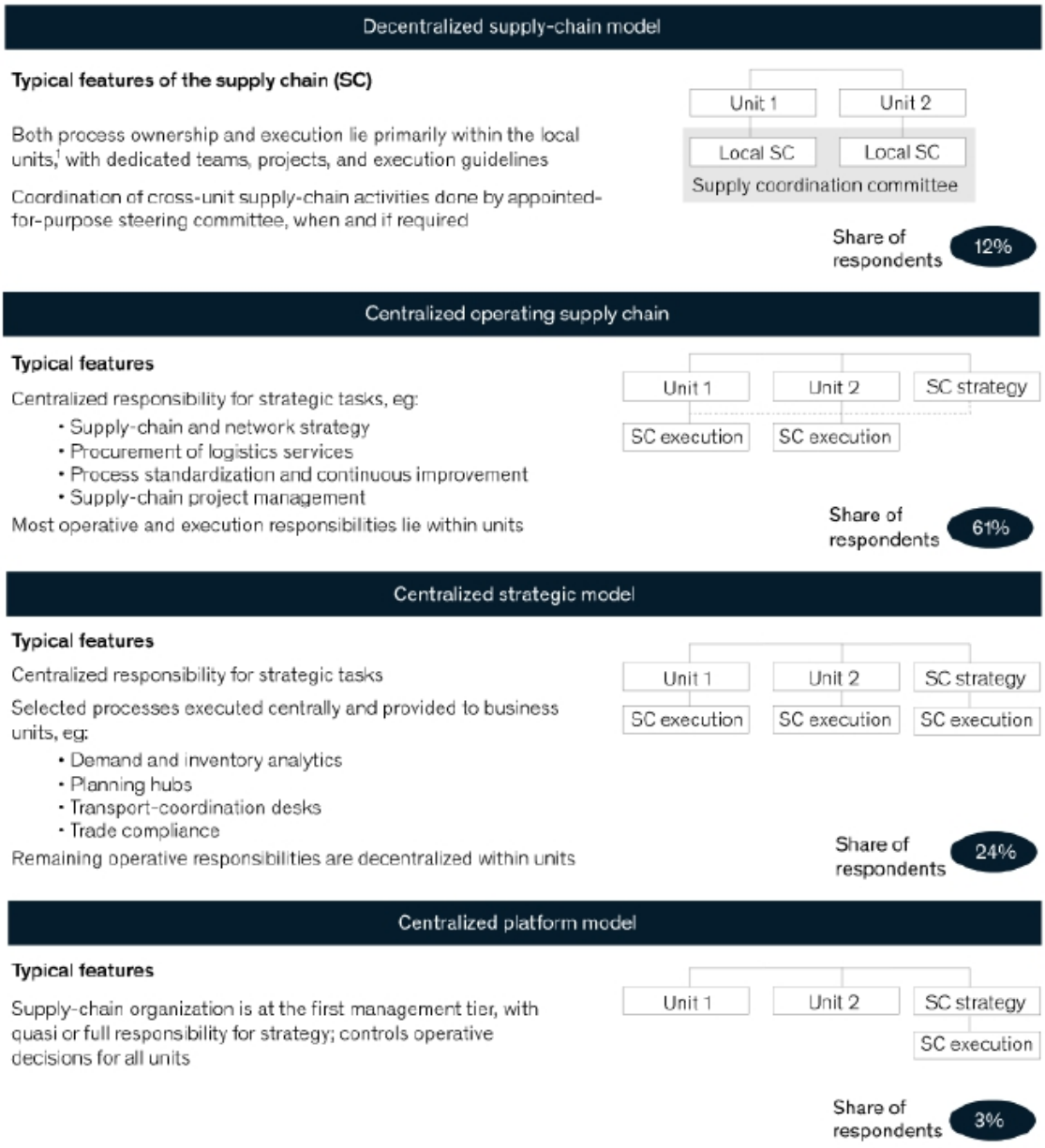


Fig. 1.7. Degree of centralization [4]

A McKinsey study has highlighted six organisational factors that correlate with EBITDA, which high-performing companies apply to address isolation and enhance cross-functional supply chain performance (Fig. 1.8) [4].

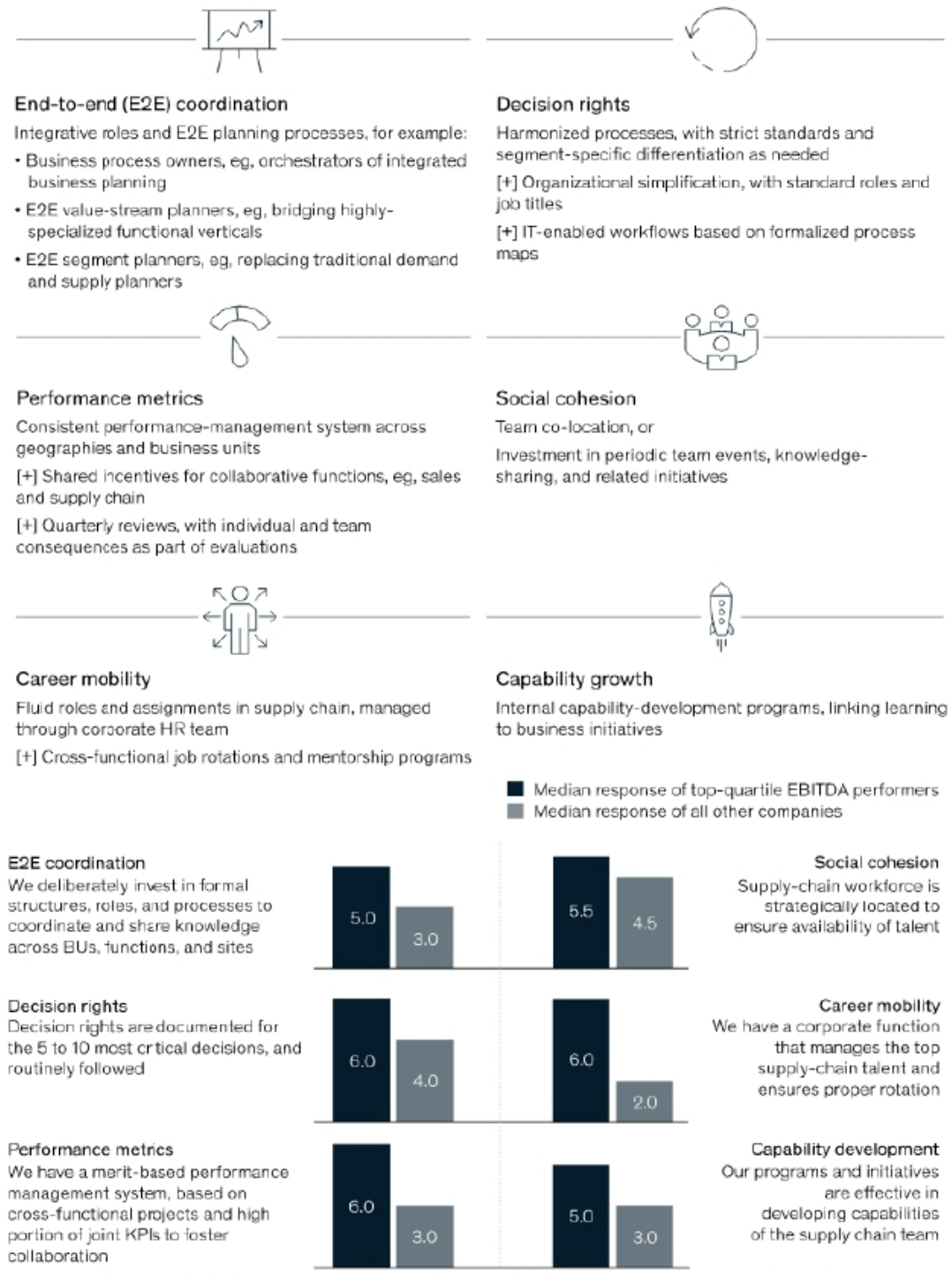


Fig. 1.8. McKinsey's six EBITDA-correlated market [4]

1.4. TRANSFORMATION OF THE SUPPLY CHAINS

There is a growing interest in sectors and industries that many software product managers used to ignore. A shift to a 'supply chain mindset' has begun. Forced isolation has brought attention to the global supply chain, ranging from food to energy and pharmaceuticals to the rest. Both their vital role in keeping the world running and the scale of these operations are gaining the interest of product managers. The supply chain of the 1990s is shown in Fig. 1.9 [5].

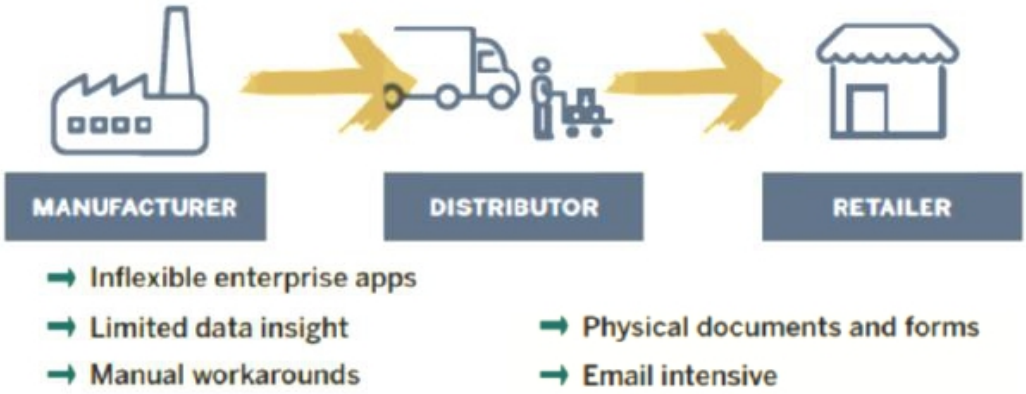


Fig. 1.9. The supply chain of the 1990s [5]

There is a desire to make changes, and great progress is being made, including through new technologies such as robotic process automation, blockchain and artificial intelligence/machine intelligence. The supply chain of the near (future) is shown in Fig. 1.10 [5].

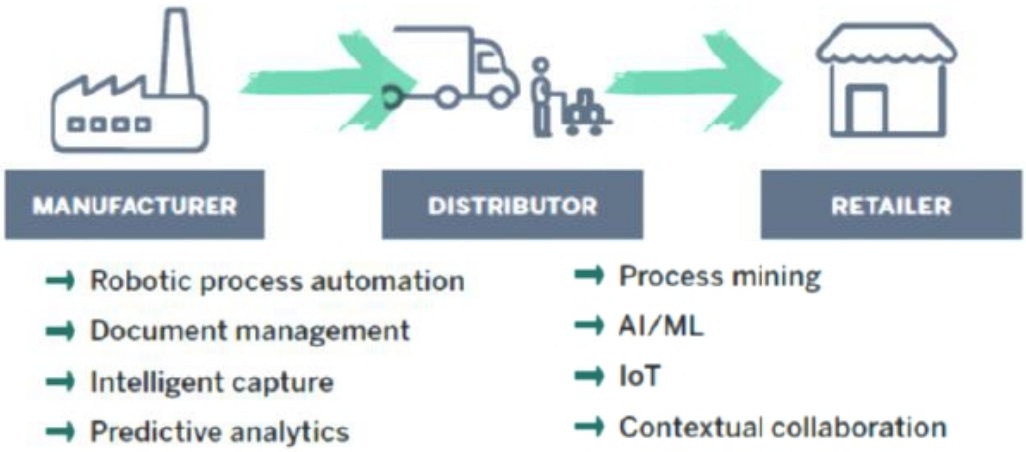


Fig. 1.10 The supply chain of the near (future) [5]

The 20th century saw companies start investing in improving the efficiency of their supply chains. With the development of technology, new opportunities for supply chain optimization have emerged. Nowadays, companies are more often acknowledging that a well-designed and well-managed supply chain can be a pivotal factor in driving business value. Equipped with more reliable and accessible data, as well as with advanced capabilities such as artificial intelligence (AI), machine learning, robotics, self-driving vehicles, connected devices and next-generation networks, many companies are embracing the opportunity to go digital and radically transform their supply chains

Although the specific objectives of a company may differ depending on the industry, the overall goal remains the same: to optimize the supply chain so that it supports the company's strategic goals. For many businesses, supply chain transformation entails not only the introduction of new software and tools, but also a change in mindset that requires the design of new processes, personnel roles, and organizational models [6].

Supply chain transformation strategy to optimize end-to-end supply chain performance needs vision, leadership and tenacity. It also needs roadmaps, best practices and real-world supply chain transformation examples to make the vision a reality. Supply chain and demand-driven transformation is shown in Fig. 1.11 [7].

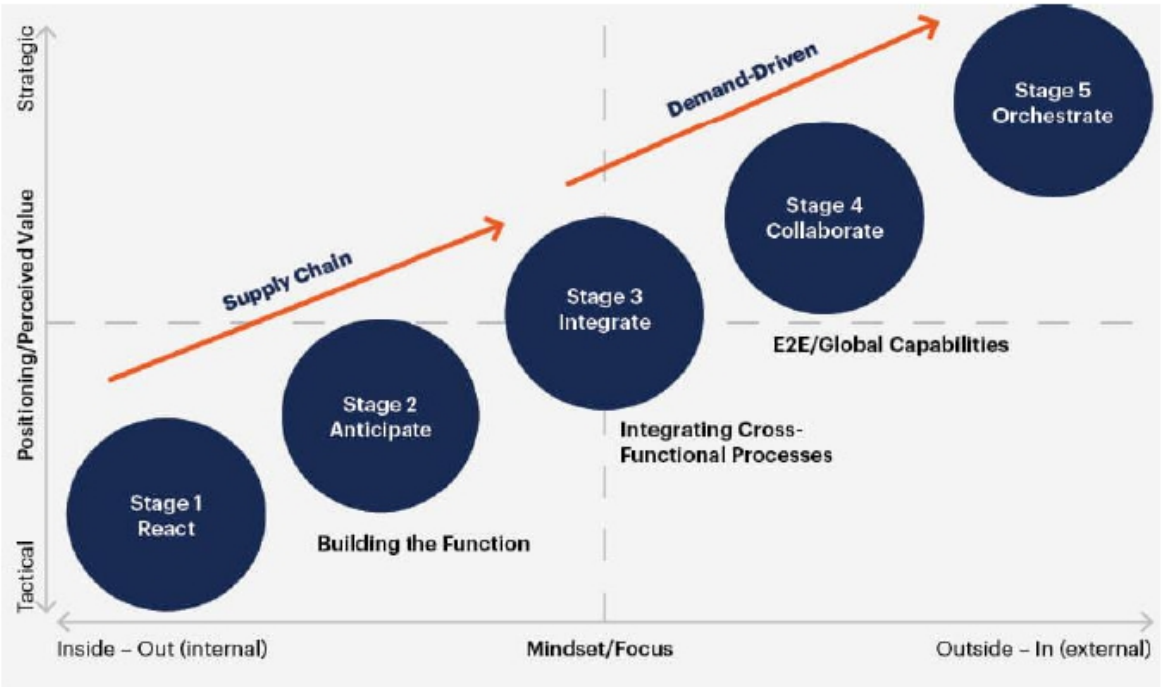


Fig. 1.11. Supply chain and demand-driven transformation [7]

1.5. THE DIFFERENCE BETWEEN PROCUREMENT AND SUPPLY CHAIN MANAGEMENT

The process through which organizations locate and purchase the goods and services necessary to operate is called procurement. It includes everything from determining needs, finding suppliers, negotiating prices, and providing on-time delivery. However, it's not solely a question of buying goods, but also of getting the best value, establishing sound supplier relationships, and matching procurement with business goals. The main procurement activities are summarized in Table 1.1 [8].

Table 1.1

Key activities involved in procurement [8]

Indicator	Detailing
Need Identification	Before any purchases are made, it's crucial to determine what the organization requires. This could be in response to a shortage, a new project, or regular operational needs.
Supplier Research	Once you know what you need, it's time to find out who can provide it. This involves researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation.
Supplier Negotiation	This step involves hashing out the terms of the purchase, from price and quantity to delivery timelines and payment terms.
Purchase Order Issuance	After negotiations, a formal document, known as a purchase order, is issued to the supplier, detailing the specifics of what's being bought
Delivery and Inspection	Once the goods or services arrive, they are inspected to ensure they meet the stipulated requirements and quality standards.
Invoice Processing and Payment	After confirming the delivery and quality of goods or services, the procurement team processes the supplier's invoice and ensures timely payment.
Supplier Relationship Management	Procurement isn't a one-off activity. Maintaining healthy, long-term relationships with suppliers can lead to better terms, discounts, and improved collaboration in the future.
Contract Management	For longer-term or larger-scale purchases, managing contracts becomes essential. This involves monitoring contract performance, ensuring compliance, and renegotiating terms as necessary.
Risk Management	This is about anticipating potential problems, like supply chain disruptions, and putting measures in place to mitigate them.
Review and Analysis	Regularly analysing procurement processes can uncover inefficiencies, saving the organization time and money. This could involve reviewing supplier performance, assessing the effectiveness of internal processes, or looking for cost-saving opportunities.

The role of procurement in an organization is shown in Fig. 1.12 [8].

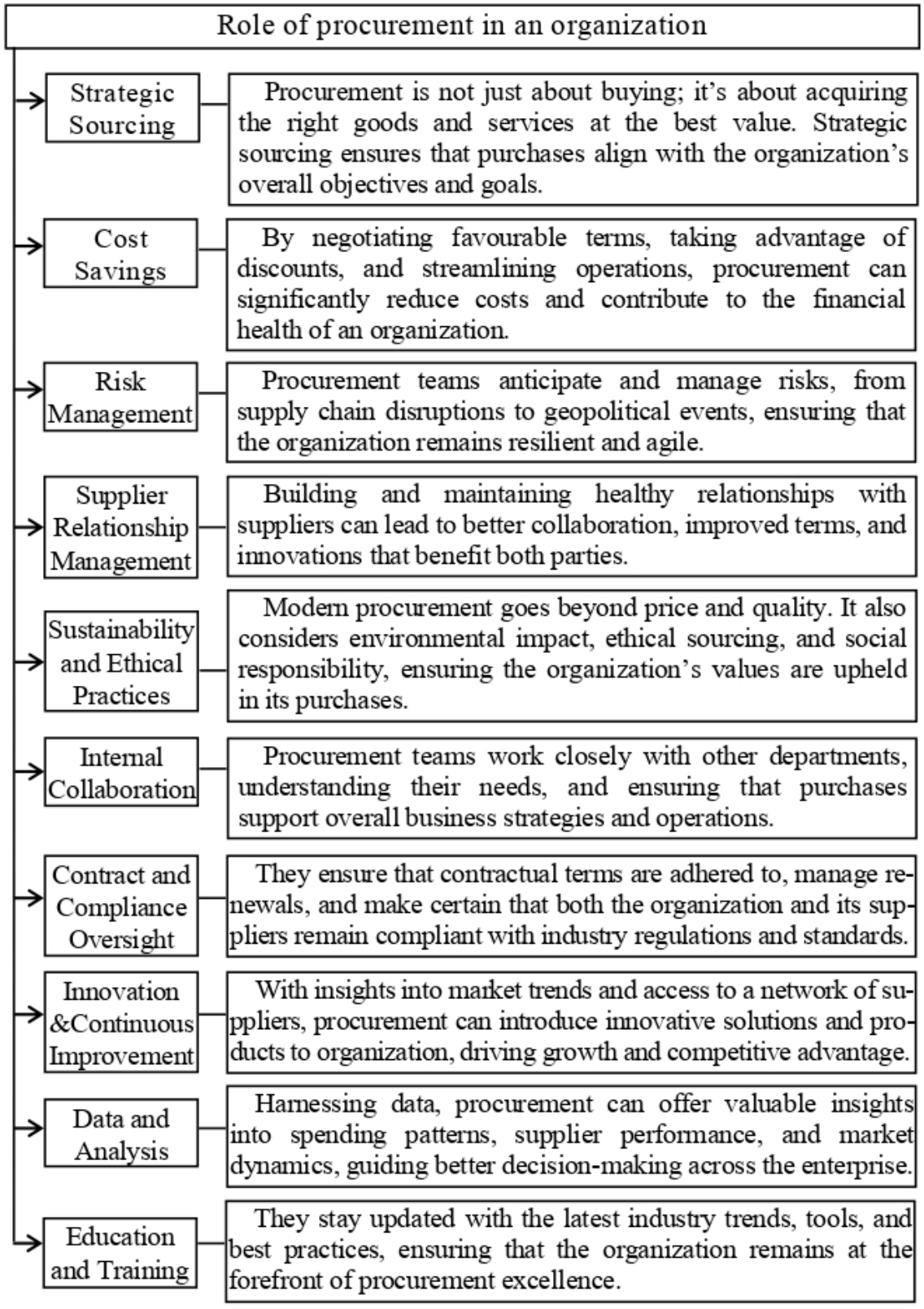


Fig. 1.12. The role of procurement in an organization [8]

Understanding the difference between procurement and supply chain in the modern logistics world allows a company to take advantage of the benefits and efficiencies of both terms and ensure a well-organized supply chain. It's easy to get the two terms confused, but they are not interchangeable, and thus it is crucial to recognize the difference between them [9].

At its simplest, procurement in the context of supply chain management is the process of purchasing the goods a business requires to fulfil its business model. For a firm to be profitable, the cost of a product or service procurement should be less than the amount for which it is sold, excluding processing and selling costs [9].

When managing supply chains, it is important to keep in mind that procurement is just one part of the process. Supply chains might also be involved in functions that lead to the moving and distributing of goods, including market research, quality control, and customer service [9].

The only thing that remains constant in the continuously changing field of procurement and supply chain management (SCM) is change. Nowadays, professionals are not only required to negotiate contracts and manage suppliers, but also to keep up with the relentless pace of technological advancement, adjust to new roles in the ecosystem, and uphold the principles of sustainable and ethical business practices. Also, there are forces that will shape the future of procurement and SCM [8].

During the digital era, technologies have become the backbone of progressive procurement and supply chain strategies. Technology advancements have not only dramatically changed the way procurement professionals fulfil their roles, but have also transformed the entire supply chain ecosystem. The integration of procurement and supply chain management (SCM) is critical to efficiency and remaining competitive. When procurement is aligned with SCM, companies are able to improve operations, drive innovation, and quickly respond to emerging market trends and customer demands. Strategic approach, advanced technology, and a team with expertise in both areas are required for successful integration. It requires cooperation between departments to enable procurement to target cost-effectiveness and value across the supply chain. Implementing new technologies and investing in staff development are core aspects of the strategy [8].

Discussion questions

1. What is a supply chain?
2. What are the components of the supply chain?
3. Describe the supply chain models.
4. What are the types of stakeholders in the supply chain?
5. What are the features of supply chain management?
6. In what areas are the vulnerabilities of supply chains most often observed?
7. What are the types of shocks in the supply chain according to the McKinsey classification?
8. Characterize the physical flow in the supply chain.
9. What are the features of information flow in the supply chain?
10. What characterizes the financial flow in the supply chain?
11. What are the three steps that an organization should take to deal with long-term uncertainty and possible shocks?
12. What are the features of supply chain centralization?
13. What are the six organizational factors related to EBITDA identified by McKinsey?
14. What is the difference between the supply chain in 1990 and the current or near future supply chain?
15. Describe the strategy of supply chain transformation.
16. What are the main activities related to procurement?
17. Describe the role of procurement in the organization.
18. What are the opportunities provided by understanding the difference between purchasing and supply chain in the modern logistics world?
19. What is the role of technology in the formation of progressive procurement and supply chain strategies?
20. What are the benefits of integrating procurement and supply chain management?

Cases

1. Having chosen a company, theoretically justify the choice of supply chain model for it.
2. Identify the stakeholders in the selected company and determine what their interests are.
3. In the selected company, identify the weaknesses of the supply chain and how they are manifested.

4. For the selected company, determine the feasibility of centralising the supply chain and justify your choice.

5. Determine the extent to which the company you have chosen meets current supply chain principles and those of the near future.

6. Identify the features of procurement in your chosen logistics company.

7. Determine what modern technologies the chosen company uses to develop progressive procurement and supply chain strategies.

8. Determine the level of integration of procurement and supply chain management in the selected company.

Tests

1. Continuous flow model is:

a) a traditional supply chain model working well for companies that produce the same products with little variation;

b) a model working best for companies selling products based on the latest trends;

c) a model for companies manufacturing seasonal or holiday merchandise;

d) there is no correct answer.

2. Fast chain model is:

a) a model for companies manufacturing seasonal or holiday merchandise;

b) a model working best for companies that sell products based on the latest trends;

c) a traditional supply chain model working well for companies that produce the same products with little variation;

d) there is no correct answer.

3. Flexible model is:

a) a model working best for companies selling products based on the latest trends;

b) a model for companies manufacturing seasonal or holiday merchandise;

c) traditional supply chain model works well for companies that produce the same products with little variation;

d) there is no correct answer.

4. The key steps in the supply chain do not include:

a) planning the inventory and manufacturing processes to ensure supply and demand are adequately balanced;

b) assembling parts and testing the product;

c) transporting and delivering the start product to the distributor, retailer, or consumer;

d) there is no correct answer.

5. Unanticipated catastrophes from McKinsey's classification supply chain shocks are:

a) larger patterns and probabilities that can guide general preparedness;

b) historically remarkable events that can't be anticipated and lead to trillions of dollars in losses;

c) serious and costly events, but smaller in scale than catastrophes;

d) there is no correct answer.

6. Foreseeable catastrophes from McKinsey's classification supply chain shocks are:

a) serious and costly events, but smaller in scale than catastrophes;

b) historically remarkable events that can't be anticipated and lead to trillions of dollars in losses;

c) larger patterns and probabilities that can guide general preparedness;

d) there is no correct answer.

7. Unanticipated disruptions from McKinsey classification supply chain shocks are:

a) serious and costly events, but smaller in scale than catastrophes;

b) disruptions that can be spotted in advance of their arrival;

c) larger patterns and probabilities that can guide general preparedness;

d) there is no correct answer.

8. Foreseeable disruptions from McKinsey's classification supply chain shocks are:

a) larger patterns and probabilities that can guide general preparedness;

b) disruptions that can be spotted in advance of their arrival;

c) serious and costly events, but smaller in scale than catastrophes;

d) there is no correct answer.

9. Firefighting as a supply chain management tool in the face of long-term uncertainty and possible shocks:

a) can be critical to building resilient supply chains: creating a nerve centre to consolidate organizational responses, simulating and planning for extreme supply and demand disruptions and reevaluating just-in-time inventory strategies;

b) includes short-term, day-to-day actions that can help identify previously overlooked supply chain gaps;

c) implies a rapid response, which is easier to achieve, but if long-term resilience is the goal;

d) there is no correct answer.

10. Achieving structural resilience as a supply chain management tool in the face of long-term uncertainty and possible shocks:

a) includes short-term, day-to-day actions that can help identify previously overlooked supply chain gaps;

b) can be critical to building resilient supply chains: creating a nerve centre to consolidate organizational responses, simulating and planning for extreme supply and demand disruptions and reevaluating just-in-time inventory strategies;

c) implies quick responses, which are easier to accomplish, but if long-term resilience is the goal;

d) there is no correct answer.

11. Integrating and streamlining operations as a supply chain management tool in the face of long-term uncertainty and possible shocks:

a) can be critical to building resilient supply chains creating a nerve centre to consolidate organizational responses, simulating and planning for extreme supply and demand disruptions and reevaluating just-in-time inventory strategies;

b) implies quick responses, which are easier to accomplish, but if long-term resilience is the goal;

c) includes short-term, day-to-day actions that can help identify previously overlooked supply chain gaps;

d) there is no correct answer.

12. Supplier research in key activities involved in procurement is:

a) hashing out the terms of the purchase, from price and quantity to delivery timelines and payment terms;

b) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

c) activity after the arrival of goods or services, when they are tested for compliance with established requirements and quality standards;

d) there is no correct answer.

13. Supplier negotiation in key activities involved in procurement is:

a) hashing out the terms of the purchase, from price and quantity to delivery timelines and payment terms;

b) activity after the arrival of goods or services, when they are inspected to ensure they meet the stipulated requirements and quality standards;

c) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

d) there is no correct answer.

14. Delivery and inspection in key activities involved in procurement is:

a) activity after the arrival of goods or services, when they are tested to ensure they meet the stipulated requirements and quality standards;

b) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

c) hashing out the terms of the purchase, from price and quantity to delivery timelines and payment terms;

d) there is no correct answer.

15. Contract management in key activities involved in procurement is:

a) monitoring contract performance, ensuring compliance, and renegotiating terms as necessary;

b) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

c) reviewing supplier performance, assessing the effectiveness of internal processes, or looking for cost-saving opportunities;

d) there is no correct answer.

16. Risk Management in key activities involved in procurement is:

a) monitoring contract performance, ensuring compliance, and renegotiating terms as necessary;

b) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

c) anticipating potential problems, like supply chain disruptions, and putting measures in place to mitigate them;

d) there is no correct answer.

17. Review and analysis in key activities involved in procurement is:

a) monitoring contract performance, ensuring compliance, and renegotiating terms as necessary;

b) researching and evaluating potential suppliers based on factors like price, quality, reliability, and reputation;

c) reviewing supplier performance, assessing the effectiveness of internal processes, or looking for cost-saving opportunities;

d) there is no correct answer.

18. Strategic sourcing in role of procurement in an organization:

a) involves teams anticipating and managing risks, from supply chain disruptions to geopolitical events, ensuring the organisation is resilient and agile;

b) ensures that purchases align with the organization's overall objectives and goals;

c) includes negotiating favourable terms, taking advantage of discounts, and streamlining operations, procurement can significantly reduce costs and contribute to the financial health of an organization;

d) there is no correct answer.

19. Cost savings in role of procurement in an organization:

a) includes negotiating favourable terms, taking advantage of discounts, and streamlining operations, procurement can significantly reduce costs and contribute to the financial health of an organization;

b) ensures that purchases align with the organization's overall objectives and goals;

c) involves teams anticipating and managing risks, from supply chain disruptions to geopolitical events, ensuring the organisation is resilient and agile;

d) there is no correct answer.

20. Risk management in role of procurement in an organization:

a) involves negotiating favourable terms, taking advantage of discounts, and streamlining operations, procurement can significantly reduce costs and contribute to the financial health of an organization;

b) includes teams anticipating and managing risks, from supply chain disruptions to geopolitical events, ensuring the organisation is resilient and agile;

c) ensures that purchases align with the organization's overall objectives and goals;

d) there is no correct answer.

21. Supplier relationship management in role of procurement in an organization:

a) provides for procurement teams working closely with other departments, understanding their needs, and ensuring that purchases support overall business strategies and operations;

b) considers the environmental impact, procurement ethics and social responsibility, ensuring that procurement activities are in line with the organisation's values;

c) includes building and maintaining healthy relationships with suppliers leading to better collaboration, improved terms, and innovations that benefit both parties;

d) there is no correct answer.

22. Sustainability and ethical practices in role of procurement in an organization:

a) ensures that procurement teams work closely with other departments, understanding their needs, and ensuring that purchases support overall business strategies and operations;

b) includes building and maintaining healthy relationships with suppliers leading to better collaboration, improved terms, and innovations that benefit both parties;

c) considers environmental impact, ethical sourcing, and social responsibility, ensuring the organization's values are upheld in its purchases;

d) there is no correct answer.

23. Internal collaboration in role of procurement in an organization:

a) includes building and maintaining healthy relationships with suppliers can lead to better collaboration, improved terms, and innovations that benefit both parties;

b) considers environmental impact, ethical sourcing, and social responsibility, ensuring the organization's values are upheld in its purchases;

c) provides for procurement teams working closely with other departments, understanding their needs, and ensuring that purchases support overall business strategies and operations;

d) there is no correct answer.

24. Contract and compliance oversight in role of procurement in an organization:

a) can introduce innovative solutions and products to organization, driving growth and competitive advantage;

b) ensures that contractual terms are adhered to, manages renewals, and makes certain that both the organization and its suppliers remain compliant with industry regulations and standards;

c) provides for staying updated with the latest industry trends, tools, and best practices, ensuring that the organization remains at the forefront of procurement excellence;

d) there is no correct answer.

25. Innovation and continuous improvement in role of procurement in an organization:

a) can introduce innovative solutions and products to organization, driving growth and competitive advantage;

b) provides for staying updated with the latest industry trends, tools, and best practices, ensuring that the organization remains at the forefront of procurement excellence;

c) ensures compliance with contractual terms, manages contract renewals and verifies that the organisation and its suppliers adhere to industry norms and standards;

d) there is no correct answer.

26. Data and Analysis in role of procurement in an organization:

a) can introduce innovative solutions and products to organization, driving growth and competitive advantage;

b) provides continuous exposure to the latest industry trends, tools and best practices, ensuring that the organisation remains at the forefront of procurement best practice;

c) can offer valuable insights into spending patterns, supplier performance, and market dynamics, guiding better decision-making across the enterprise;

d) there is no correct answer.

27. Education and Training in role of procurement in an organization:

a) can offer valuable insights into spending patterns, supplier performance, and market dynamics, guiding better decision-making across the enterprise;

b) keeps the organisation up-to-date with the latest industry trends, tools and best practices to ensure it remains at the forefront of procurement excellence;

c) can introduce innovative solutions and products to organization, driving growth and competitive advantage;

d) there is no correct answer.

28. In the simplest form, procurement in relation to supply chain management is:

a) the process of acquiring the goods business needs to fulfil its company model;

b) the process of selling the goods business needs to fulfil its company model;

c) the audit process the goods business needs to fulfil its company model;

d) there is no correct answer.

29. Integrating procurement and supply chain management (SCM) is essential for:

a) audit process;

b) efficiency and staying competitive;

c) process of selling;

d) there is no correct answer.

30. Successful integration requires:

a) a skilled team;

b) a strategic approach;

c) an advanced technology;

d) all answers are correct.

2. SUPPLY CHAIN PERFORMANCE

2.1. SUPPLY CHAIN PERFORMANCE MEASURES

In the current global economy, the business landscape is shifting from the performance of individual companies to the performance of supply chains. Supply chain performance is the activities of the advanced supply chain aimed at meeting end-user requirements, including the availability of products, timely delivery and all required inventory and capacity in the supply chain to ensure this performance in an efficient manner. Supply chain performance extends beyond the boundaries of the company, as it includes basic raw materials, components, parts and finished products, as well as distribution via multiple channels to the end customer. It also transcends traditional functional organisational lines like procurement, production, distribution, marketing and sales, and R&D [10].

To succeed in the changing environment, supply chains need to continuously improve. This requires performance indicators, or metrics, that support global supply chain performance improvement, versus company- or function-specific (siloed) metrics that hinder improvement across the chain [10].

For supply chain integration, companies need to focus on two performance dimensions – multi-functional and multi-company. Supply chains cover many functions within an entire company, so it is important that performance measures do not have a narrow focus. One-dimensional metrics as capacity utilisation, inventory turnover or material costs will result in a partial picture of the company's performance. Excellent performance at one point in the chain will not be enough for a supply chain to succeed if the rest of it does not perform up to par. The supply chain is as strong as its weakest link [10].

The evolution of performance metrics for supply chains is shown in Fig. 2.1 It visualises the bi-directional evolution of integrated supply chain performance. Businesses should shift from unidimensional to multidimensional metrics, and from a single-enterprise focus to a multi-enterprise focus. Companies employing multidimensional performance metrics need to acknowledge that not all dimensions are of equal importance and trade-offs are required. Recognising the trade-offs and, consequently, knowing how to prioritise and set targets is vital [10].

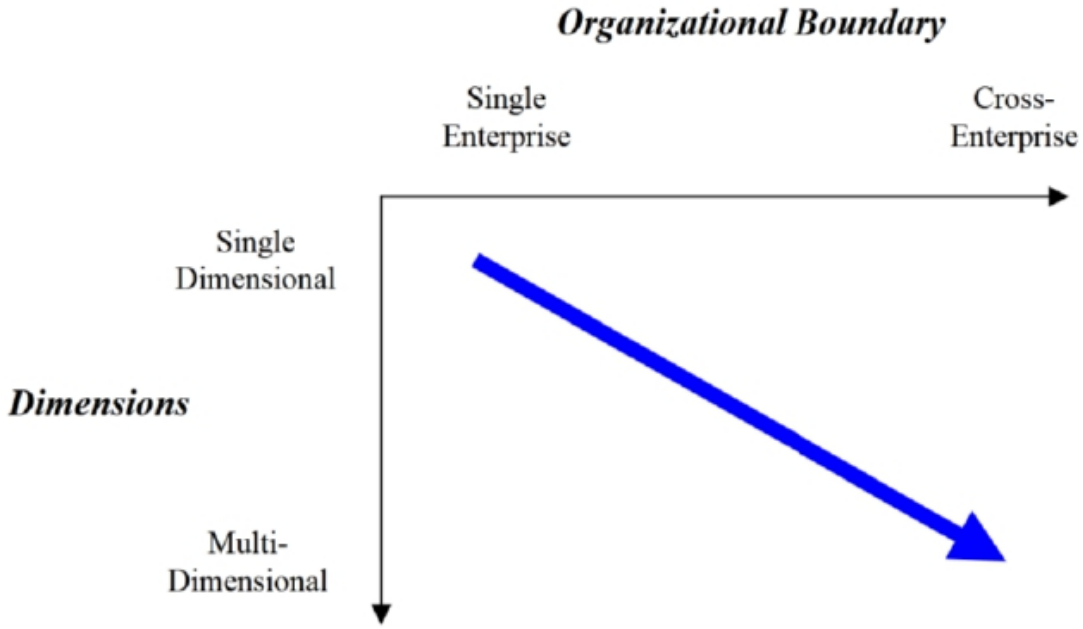


Fig. 2.1. Evolution of performance measures for supply chains [10]

Various types of indicators have been introduced to assess multiple activities in supply chains and logistics. Deciding which type of indicator to use can be difficult, and it can be risky to simply focus on a single area. For instance, concentrating only on cost management may improve one aspect but not the overall supply chain performance. An adaptation of the model proposed by Edward Frasel (2001) is more holistic and includes quality, time, finance and productivity indicators [11; 12].

Supply chain management performance measures (matrix by function) are shown in Table 2.1 [11].

The National Supply Chain Assessment (NSCA 2.0) provides an automated tool for conducting an on-the-spot evaluation of national public health supply chains or individual components of such chains in the context of developing countries. The NSCA 2.0 offers a structured framework that enables the collection and analysis of data in a standardised, objective manner, making it possible to compare results between countries and over time. The NSCA 2.0 consists of three main components: a mapping of the public health supply chain; a diagnostic tool of the Capacity Maturity Model (CMM), and key performance indicators (KPIs). The CMM indicators measure the existing capacity and maturity potential of the system to provide the required services in terms of available infrastructure, governance strategies and mechanisms, systems and processes, and human resources capacity and training [13].

Table 2.1

Supply chain management performance measures (matrix by function) [11]

	Quality Indicators	Response Time Indicators	Cost/Financial Indicators	Productivity Indicators
Product Selection/ Forecasting/Procurement	Product Section Based on National Essential Medicines List	Lead Time for Contract/Purchase Order Issue	% Markup on Products in Cost Recovery System (Profit Margin)	Average number of Orders Processed Per Full-Time Equivalent (FTE) in Procurement
	Forecast Accuracy	Lead Time for Contract Award	% of Average International Reference Price Paid	% of Purchase Orders/Contracts Issued as Emergency Orders
	% of Procured Products Registered in Country		Ratio of Unit Prices Paid Through an Emergency Procurement vs. Competitive Bidding Process	
	% of Products that Undergo Quality Testing		Fixed Order Cost	
	% of Procured Products that Meet Stringent Regulatory Authority (SRA) or WHO Standards			
	Commitment to Established Procurement Plan			
	% of Contracts Issued as Framework Contracts			
Supplier/Sourcing (from purchaser's perspective)	Order Compliance	On-Time Delivery	Total Supply Cost	Supplier Fill Rate
	% of Orders with Products on Back Order	Supplier Lead-Time Variability		
	Shipping Accuracy			

Table 2.1 (End)

	Quality Indicators	Response Time Indicators	Cost/Financial Indicators	Productivity Indicators
Warehousing/Storage	Inventory Accuracy Rate	Warehouse Order Processing Time	Total Warehousing Cost	Storage Space Utilization
	Put-Away Accuracy	Customs Clearance Cycle	Value of Product Damaged in the Warehouse	Units Moved Per Person Hour
	Picking Accuracy Rate	Put-Away Time		% of Storage Space Dedicated for Handling
	Warehouse Accident Rate			
	Defined Security Measures			
Inventory Mgmt/LMIS Customer Response	Stockout Rate	Order Entry Time	Inventory Holding Cost	Inventory Turnover Rate
	Order Fill Rate	Order Turnaround Time	Value of Unusable Stock	Inventory Velocity
	Inventory Accuracy Rate	Order Lead Time	Value of Unaccounted Stock	% of Orders Placed Through Electronic Ordering System
	Stocked According to Plan		Average Response Cost	Facility Reporting Rates
	Adequate Shelf Life			
	Stock Wastage Due to Expiration or Damage			
	Plan in Place for Predictable Change in Demand			
	Order Entry Accuracy			
	Invoice Accuracy			
Distribution/Transport	On-Time Arrivals	Average Delivery Time	Total Transportation Cost	Vehicle Use Availability
	% of Shipments Where Quantity Dispatched Equals Quantity Received	Average Vehicle Loading/Unloading Time	Average Transportation Cost Per Kilometer/Volume/Weight	Container Capacity Utilization
	% of Shipments Arriving in Good Condition	Vehicle Turnaround Time	Ratio of Transportation Cost to Value of Product	Fleet Yield
	Kilometers Between Accidents			Average Number of Stops Per Route
	Time Between Accidents			

The phases are divided into sub-sections or subtopics comprising areas including: project management; key processes for sampling, training, data collection, cleaning and analysis; key tools for re-reporting and dissemination of results; and relevant tools and resources. The components of NODC 2.0 are shown in Fig. 2.2 [13].

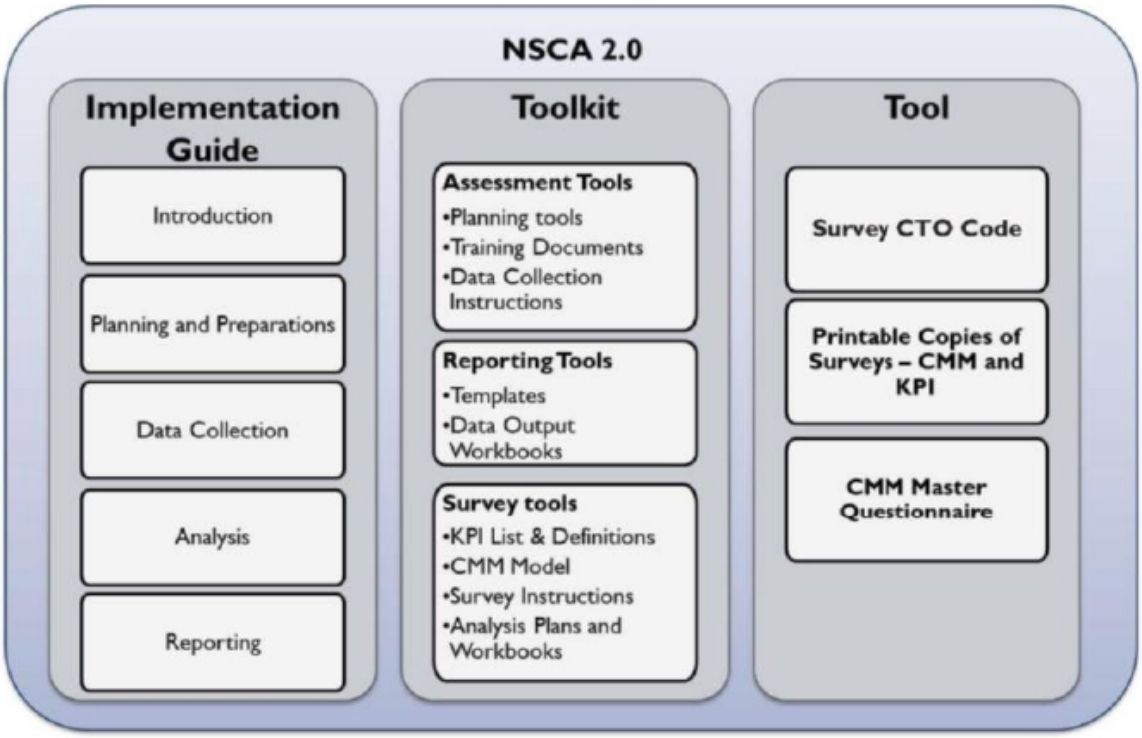


Fig. 2.2. The components of NSCA 2.0 [13]

The NSCA 2.0 approach encourages ownership and involvement of the country's leadership from the preliminary planning stage. It is designed to be a collaborative effort involving local policy makers, public health supply chain managers, donors and other stakeholders. The leadership team should collaborate in setting the goals, objectives and desired outcomes of the evaluation according to local needs and plans. This practice also provides the leadership team with a clear understanding of the evaluation process [13].

2.2. SUPPLY CHAIN RULES AND REGULATIONS

The rules and regulations of the supply chain are a new frontier in supply chain management. In this fast-changing landscape, companies must refocus from cost management to compliance with new supply chain regulations [14].

International Trade Regulations. In fact, more than 76% of global trade is accounted for by transactions within global supply chains in accordance with the International Trade Administration data. **Supply chain rules** contain import and export restrictions, customs procedures, and trade agreements that regulate the movement of goods throughout the world. Consequently, these rules are highly influential in disrupting or reorienting the world's trade patterns [14].

ESG (Environmental, Social, and Governance) Standards. The supply chain obviously makes a significant impact on the environment. However, it's not just a matter of the environment, as the supply chain also carries a large social responsibility. About 450 million people are employed in it around the world. Among other things, this social aspect concerns human rights, labour standards and child labour. Disregarding ESG compliance can result in serious implications, such as environmental damage, loss of reputation and even legal sanctions [14].

Product Safety and Quality Regulations. The supply chain should also comply with product safety and quality regulations to ensure that products meet the required standards. These regulations include certification, labelling, health and safety, testing, as well as with regard to legal requirements for product quality and safety [14].

Data Privacy and Security Regulations. Driven by rapidly expanding digitalisation, data privacy and security regulations are becoming essential for supply chains. Businesses should limit data sharing with external partners, reinforce access controls, conduct audits and risk assessments, combat cyber risks, and comply with regulations such as the GDPR to protect sensitive information [14].

Anti-corruption and Bribery Regulations. Supply chain corruption is an ongoing problem that potentially can cost businesses both reputation and money. Obviously, customers and suppliers need to implement anti-bribery policies and procedures, together with good practices such as due diligence, anti-corruption policies and special practices for company representatives. Hence, companies should have internal compliance systems in place and should consider the risks throughout the supply chain [14].

Seven key Supply Chain laws by M. Graska [15] represent supply chain discipline that leads to solving difficult supply chain issues.

1. *Law of Demand*. The question is one of how both independent and dependent demand influence the business operations of a company and therefore its supply chain. The more a company improves its knowledge

and control over demand management, the more capable and flexible its supply chain can become.

2. *Law of Paradox*. Supply chain resources are limited. A business must balance the benefits of an efficient supply chain with the ability to respond to customer demands. The following choices define the supply chain model.

3. *Law of Metrics*. It includes aspects that set the company's direction, define expectations, and assess improvements.

4. *Law of People*. This includes determining whether the right people are in place to make the right decisions at the right time. They should be trained, developed and enabled to excel. People take decisions that move the company ahead, not machines.

5. *Law of Variability*. Supply chain variability increases as a company's products and information move up the supply chain. It is a key to recognising issues in the supply chain.

6. *Law of Optimization*. Solving individual problems in isolation only creates other problems in other parts of the supply chain. When solving problems, one must look at the supply chain as a whole.

7. *Law of Contingency*. Planning is important, execution is even better, but things can happen.

2.3. SUPPLY CHAIN PERFORMANCE

Customer centricity and product complexity, coupled with shorter product lifecycles, enhanced digitalisation and increased collaboration between partners, are putting greater demands on supply chain performance management. These changes are driven by customer demands and new technologies that have already transformed traditional supply chains [16].

Modern material planners, customer order managers, and professionals external to supply chain are able to prioritise their day-to-day operations with ease using cross-functional supply chain information. But there are different sides to the trade-off. On the one hand, new technologies enable companies to better and more efficiently coordinate and manage the whole network. Value chain analysis to detect deviations and irregularities has improved and is based on a larger amount of information compared to the past. The disruption of supply chains by digitalization and new technologies from traditional supply chain is shown in Fig. 2.3 [16].

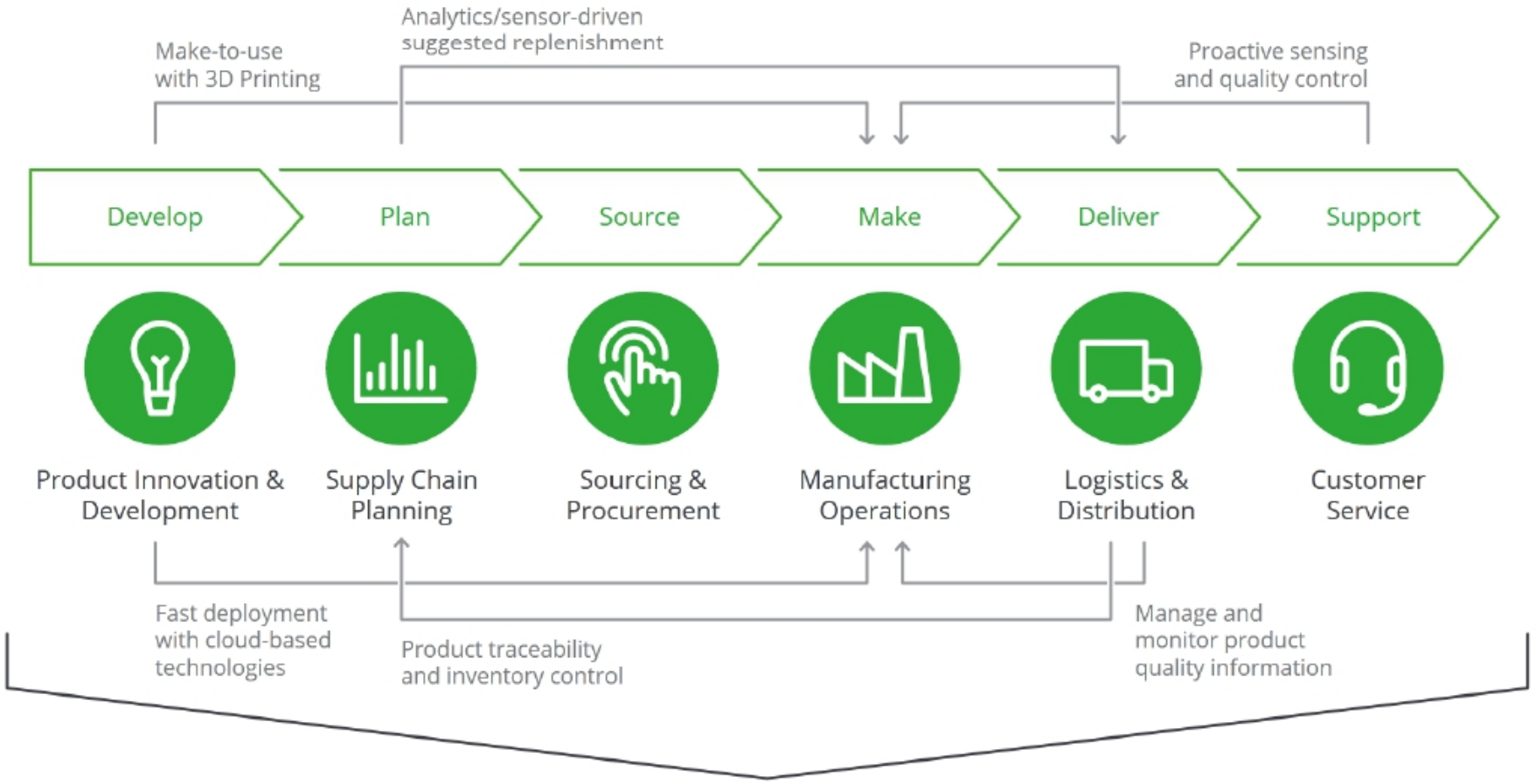


Fig. 2.3. Disruption of supply chains by digitalization and new technologies from traditional supply chain [16]

The disruption of supply chains by digitalization and new technologies from digital supply networks is shown in Fig. 2.4 [16].

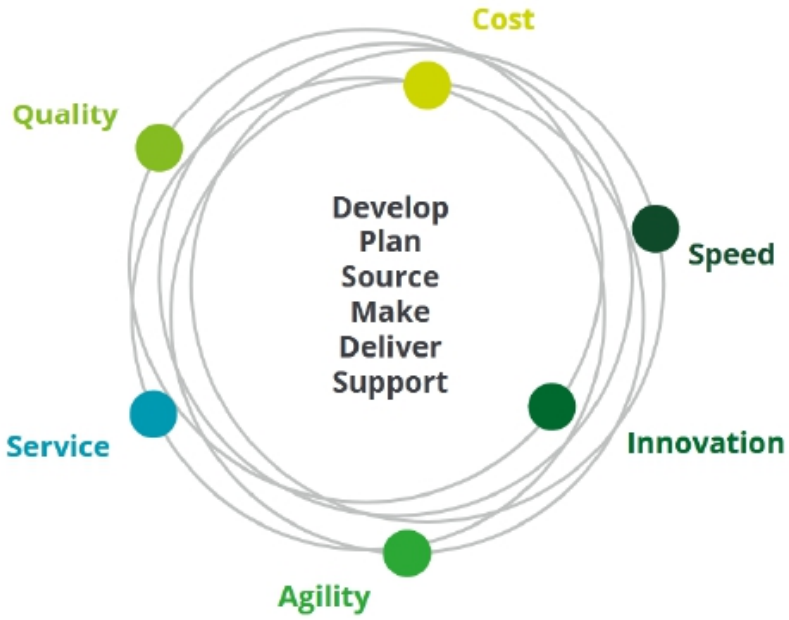


Fig. 2.4. Disruption of supply chains by digitalization and new technologies from digital supply networks [16]

Supply chains consist of flows of products, information and capital. The way they are managed significantly affects a company's competitiveness and profitability. Appropriate alignment with business strategy is critical to achieving high overall performance. Supply chain performance management is a holistic approach to improving the efficiency and effectiveness of all supply chain processes [16].

Key elements to be considered are [16]:

- Supply Chain Strategy.
- Organization.
- Planning.
- Management.
- Control Activities.

The combined elements bridge the gap between business decision makers and IT systems for measuring performance with data structures and reporting tools [16].

Optimizing the end-to-end value chain with the help of an integrated solution is shown in Fig. 2.5 [16].

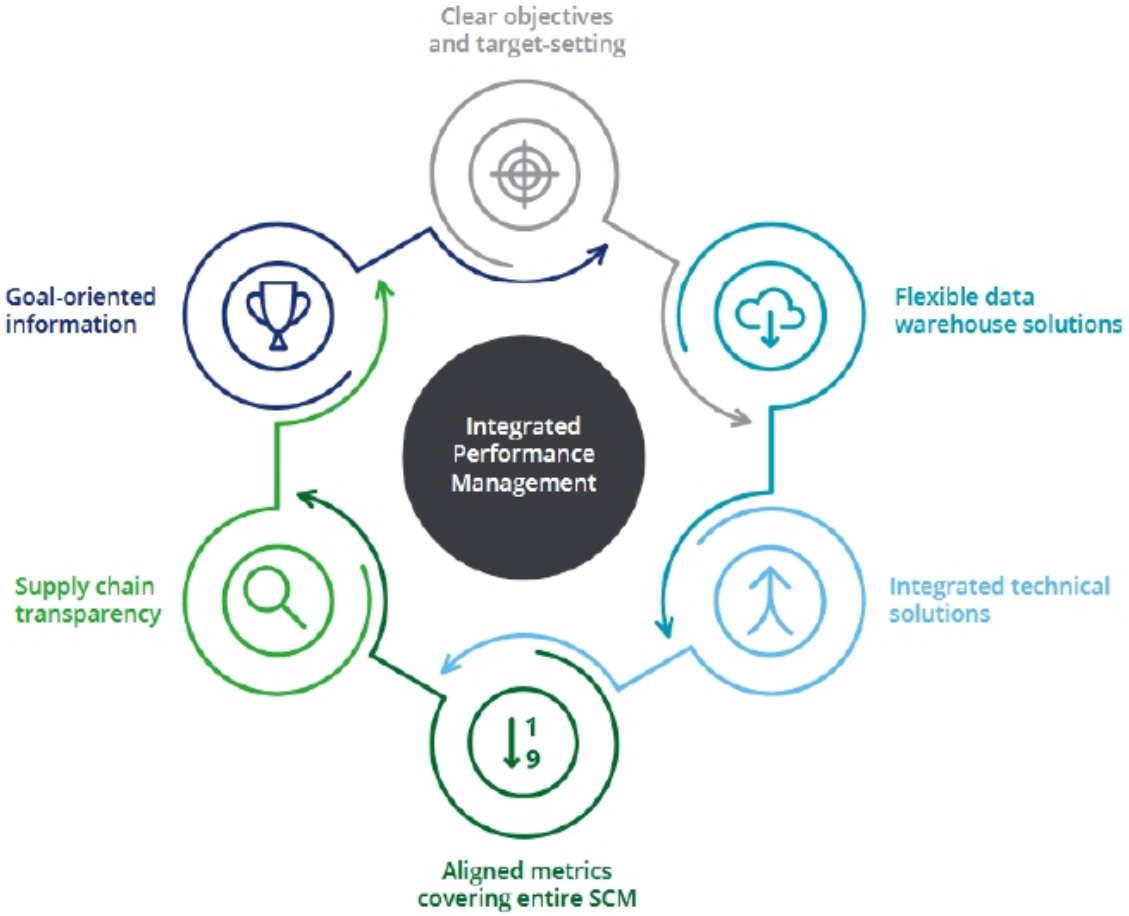


Fig. 2.5. Optimizing the end-to-end value chain with the help of an integrated solution [16]

A successful performance management approach aims to provide a comprehensive and consistent view of all relevant information about the supply chain and its supporting activities. Key performance indicators (KPIs) are designed to structure the required information across different dimensions, including customer service, costs and assets. Conceptually, KPIs are consistent across all levels of the reporting hierarchy and are accessible as needed [16].

Subsequent auxiliary metrics provide a deeper insight into the root causes to detect irregularities. For most companies, though, the reality differs. A lot of companies have introduced supply chain performance measurement systems that only focus on a limited number of aspects. The majority of systems are siloed, static, with retrospective metrics that are often not complete. Root cause analysis is limited to aggregating data, which leads to a lack of detail, or is just impossible for insufficient

information. A cross-cutting perspective is commonly not taken, and an integrated performance measurement concept is not in place [16].

Leading performance management solutions use shared metrics to allow integration across functions, for instance, finished goods inventory is shared between production and sales. Key performance indicators can be shared with key supply chain partners to optimise the end-to-end value chain and manage trade-offs. There are advanced dashboard solutions that visualise a complete set of supply chain information at a glance [16].

The four differentiators in supply chain performance management are shown in Fig. 2.6 [16].

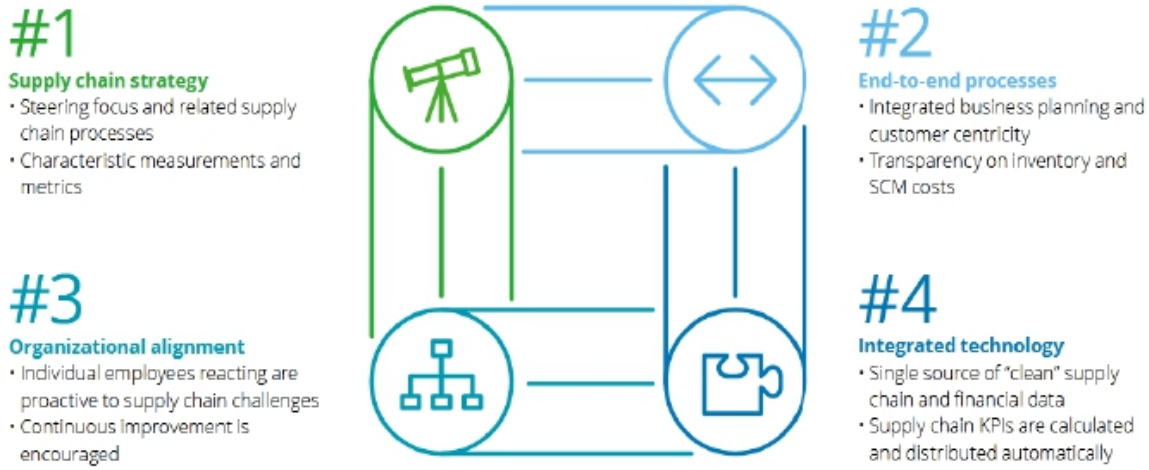


Fig. 2.6. The four differentiators in supply chain performance management [16]

A large number of companies are exploring the potential of emerging technologies enabled by Industry 4.0 and are carrying out pilot studies. Transparency of information and the interaction of machines and people are key factors that are taking supply chains and their efficiency to new levels. Consequently, supply chain performance management is progressively transforming with quicker access to information and better ways to obtain insights [16].

Maturity levels of performance management in supply chain and operations are shown in Fig. 2.7 [16]. There are a lot of companies that have already introduced strong supply chain performance management and are constantly upgrading their capabilities [16].

Emerging	Developing	Defined	Advanced	Leading
• Informal operational performance metrics • Local functional metrics and functional accountability • Executive incentives aligned with functional objectives	• Standardized performance metrics within business units • Local functional metrics with shared accountability	• Trend analysis of performance measures • Regional functional metrics with shared accountability • Executive incentives based on regional cross-functional performance • Tools available to track key KPI's	• Standardized metrics with formal target-setting process • Regional process and functional metrics with shared accountability • Cross-business metrics aligned to support enterprise objectives	• Optimized trade-offs in performance measures from conflicting objectives • Global process metrics with shared accountability • Executive incentives aligned on global cross-functional performance • Targets evaluated formally on a regular basis, and form the basis for continuous improvement
Developing Supply Chains			**Leading Supply Chains**	

Fig. 2.7. Maturity levels of performance management in supply chain and operations

Discussion questions

1. What are the peculiarities of ensuring supply chain efficiency at the present stage?

2. What is needed for continuous improvement of supply chains?

3. Describe the evolution of performance indicators for supply chains.

4. What is characteristic of the bi-directional evolution of integrated supply chain activities?

5. What are the features of supply chain management performance indicators in the matrix by function?

6. What does NSCA 2.0 provide?

7. What do the capability maturity model (CMM) diagnostic indicators assess?

8. What does the NSCA 2.0 approach contribute to?

9. What are the features of ESG standards?

10. What are the characteristics of the Product Safety and Quality Regulations?

11. What are the peculiarities of the Data Privacy and Security Regulations?

12. Describe the seven key laws of the supply chain according to M. Graska.

13. How does information about the cross-functional supply chain allow to prioritise daily operations?

14. How does supply chain disruption due to digitalisation and new technologies differ from the traditional supply chain?

15. Describe the disruption of supply chains through digitalisation and new technologies from digital supply chains.

16. What are the features of optimising the end-to-end value chain using an integrated solution?

17. What makes it possible to combine the elements of supply chain performance management?

18. What is the goal of a successful supply chain performance management approach?

19. What are the four distinctions in supply chain performance management?

20. What are the maturity levels of performance management in supply chain and operations?

Cases

1. Select a company and determine the most appropriate supply chain management performance indicators for it.

2. Assess the company's compliance with ESG standards.

3. Determine the degree of compliance with the Safety and Product Quality Rules in the selected company.

4. For the selected company, determine the level of compliance with Data Privacy and Security Regulations.

5. Assess the potential for supply chain disruption due to digitalisation and new technologies from the traditional supply chain for the selected company.

6. For the selected company, determine the best approach to managing supply chain performance.

7. Set key performance indicators for your chosen logistics company.

8. Determine the maturity level of supply chain and operations performance management for the selected company.

Tests

1. In the modern economy, the key is:

a) the productivity of an individual company;

b) the efficiency of the supply chain;

c) the efficiency of countries;

d) there is no correct answer.

2. Satisfaction of end-user requirements in the supply chain includes:

a) product availability and timely delivery;

b) all the necessary inventory and capacity in the supply chain to deliver this performance in an efficient manner;

c) margin effect;

d) there is no correct answer.

3. Supply Chain Performance crosses company boundaries since it includes:

a) basic materials and components;

b) subassemblies and finished products;

c) distribution through various channels to the end customer;

d) all answers are correct.

4. Companies must focus on two dimensions of performance to ensure supply chain integration:

a) multi-functional and multi-company;

b) multi-functional and multi-product;

c) multi-product and multi-company;

d) there is no correct answer.

5. The supply chain is only as strong as its:

a) strong link;

b) weakest link;

c) another link;

d) there is no correct answer.

6. Businesses need to migrate from:

a) single-dimensional measures to multi-dimensional ones, and from a single-enterprise focus to a cross-enterprise focus;

b) multi-dimensional ones to single-dimensional measures, and from a single-enterprise focus to a cross-enterprise focus;

c) single-dimensional measures to multi-dimensional ones, and from a cross-enterprise focus to a single-enterprise focus;

d) there is no correct answer.

7. The National Supply Chain Assessment (NSCA 2.0) is:

a) an automated tool designed to conduct a point in time assessment of international public health supply chains, or selected components of such supply chains, in a developing region context;

b) an automated tool designed to conduct a point in time assessment of national public health supply chains, or selected components of such supply chains, in a developing country context;

c) an automated tool designed to conduct a point in time assessment of international non-public health supply chains, or selected components of such supply chains, in a developing region context;

d) there is no correct answer.

8. NSCA 2.0 consists of the following key elements:

a) public health supply chain mapping;

b) key performance indicators (KPIs);

c) a capability maturity model (CMM) diagnostic tool;

d) all answers are correct.

9. Supply Chain Management Performance Measures (matrix by function) include:

a) project management;

b) key processes for sampling, training, data collection, cleaning and analysis;

c) the main vehicles for reporting and disseminating findings, and related tools and resources;

d) all answers are correct.

10. ESG Standards include:

a) social standards;

b) environmental standards;

c) governance standards;

d) all answers are correct.

11. Product Safety and Quality Regulations cover:

a) certifications and labels;

b) governance;

c) health, safety and testing;

d) there is no correct answer.

12. From Data Privacy and Security Regulations companies must:

a) limit data sharing with outside partners;

b) tighten access controls, do audits and risk assessments;

c) deal with cyber risks and follow rules;

d) all answers are correct.

13. The best practices of Anti-corruption and Bribery Regulations include:

a) due diligence and anti-corruption policies;

b) specific practices for company representatives;

c) limit data sharing with outside partners;

d) there is no correct answer.

14. Law of Demand from Seven key Supply Chain laws by M. Graska is:

a) a company needs to balance the pull of being an efficient supply chain with customer responsiveness;

b) the more a company refines their knowledge and controls of demand management the more efficient and responsive the supply chain becomes;

c) give company direction, set expectations and measure improvement;

d) there is no correct answer.

15. Law of Paradox from Seven key Supply Chain laws by M. Graska is:

a) a company needs to balance the pull of being an efficient supply chain with customer responsiveness;

b) give company direction, set expectations and measure improvement;

c) the more a company refines their knowledge and controls of demand management the more efficient and responsive the supply chain becomes;

d) there is no correct answer.

16. Law of Metrics from Seven key Supply Chain laws by M. Graska is:

a) the more a company refines their knowledge and controls of demand management the more efficient and responsive the supply chain becomes;

b) a company needs to balance the pull of being an efficient supply chain with customer responsiveness;

c) give company direction, set expectations and measure improvement;

d) there is no correct answer.

17. Law of Variability from Seven key Supply Chain laws by M. Graska is:

a) amplifies as a company's product and information move up the supply chain;

b) the supply chain needs to be considered in its entirety when dealing with problems;

c) planning is great, execution is even better, but stuff happens;

d) there is no correct answer.

18. Law of Optimization from Seven key Supply Chain laws by M. Graska is:

a) amplifies as a company's product and information move up the supply chain;

b) the supply chain needs to be considered in its entirety when dealing with problems;

c) give company direction, set expectations and measure improvement;

d) there is no correct answer.

19. Law of Contingency from Seven key Supply Chain laws by M. Graska is:

a) planning is great, execution is even better, but stuff happens;

b) a company needs to balance the pull of being an efficient supply chain with customer responsiveness;

c) give company direction, set expectations and measure improvement;

d) there is no correct answer.

20. Increase performance management demands on supply chains means:

a) customer focus and product complexity paired with shortened product lifecycles;

b) country focus;

c) increasing digitalization and closer cooperation between partners:

d) there is no correct answer.

21. With the help of new technologies, companies can:

a) coordinate and manage their entire network poorly and less effectively;

b) coordinate and manage their entire network better and more efficiently;

c) coordinate and manage the entire network in a poorer and more costly way;

d) there is no correct answer.

22. Supply chain performance management is:

a) a unified approach to improve the effectiveness and non-efficiency of all supply chain processes;

b) a unified approach to improve the effectiveness and efficiency of all supply chain processes;

c) a unified approach to improve the non-effectiveness and non-efficiency of all supply chain processes;

d) there is no correct answer.

23. Key elements to be considered in supply chain performance management include:

a) supply chain strategy and organization;

b) planning and management.

c) control activities;

d) all answers are correct.

24. The purpose of a successful performance management approach is:

a) to give a complete and well-balanced view of all relevant supply chain information and underlying activities;

b) to give a complete and non-balanced view of all relevant supply chain information and underlying activities;

c) to give a complete and non-balanced view of supply chain information and underlying activities;

d) there is no correct answer.

25. Key performance indicators (KPIs) are intended to:

a) structure the desired information in different dimensions such as customer service, costs, and assets;

b) structure the non-desired information in different dimensions such as customer service, costs, and assets;

c) structure the desired information in non-different dimensions such as customer service, costs, and assets;

d) there is no correct answer.

26. Ideally, KPIs should be aligned across the reporting with:

a) non-hierarchy levels;

b) hierarchy levels;

c) economy levels;

d) there is no correct answer.

27. Further supporting metrics allow:

a) deep dives into root causes to identify irregularities;

b) superficial dives into root causes to identify irregularities;

c) superficial dives into peripheral causes to identify irregularities;

d) there is no correct answer.

28. Most companies have implemented supply chain performance measurement systems solely focusing on:

a) an unlimited number of considerations;

b) a limited number of considerations;

c) superficial dives into root causes to identify irregularities;

d) there is no correct answer.

29. Most systems implemented supply chain performance are:

a) isolated and static;

b) with metrics that are backward-looking and often not holistic;

c) with metrics that are backward-looking and often holistic;

d) there is no correct answer.

30. Leading performance management solutions utilize joint metrics to ensure:

a) not holistic principles;

b) isolated and static principles;

c) the integration of all functions;

d) all answers are correct.

31. Can key performance indicators be communicated to key supply chain partners using an overall perspective to optimize the end-to-end value chain and to manage trade-offs?

a) yes;

b) rather yes;

c) rather no;

d) no.

32. Solutions with dashboards exist for:

a) visualizing a comprehensive suite of supply chain information at a single glance;

b) non-visualizing a comprehensive suite of supply chain information at a single glance;

c) visualizing a limited suite of supply chain information at a single glance;

d) there is no correct answer.

33. Key drivers that take supply chains and their performance to the next level are as follows:

a) information transparency;

b) information visualization;

c) interoperability of machines and people;

d) there is no correct answer.

34. As a result, supply chain performance management is gradually evolving due to:

a) faster access to information;

b) information visualization;

c) new ways of gaining insights;

d) there is no correct answer.

3. SUPPLY CHAIN DRIVERS AND METRICS

3.1. FINANCIAL MEASURES AND DRIVERS OF THE SUPPLY CHAIN PERFORMANCE

Logistics factors such as facilities, inventory and transformation, as well as cross-functional factors including information, sourcing and pricing, define any supply chain's performance [17].

From the perspective of shareholders, return on equity (ROE) is a key aggregate indicator of a company's performance [17; 18].

$$ROE = \frac{Net\ Income}{Average\ Shareholder\ Equity} \tag{3.1}$$

While ROE measures the return on investment generated by a company's shareholders, return on assets (ROA) measures the profit generated for every dollar invested in assets by a company [17; 18].

$$ROA = \frac{Earnings\ before\ Interest}{Average\ Total\ Assets} = \tag{3.2}$$

$$= \frac{Net\ Income + [Interest\ Expense \times (1 - Tax\ Rate)]}{Average\ Total\ Assets}$$

An important ratio that determines financial leverage is accounts payable turnover (APT) [17; 18].

Another useful metric is the cash-to-cash (C2C) cycle, which roughly measures the average amount of time from when cash enters the process as cost to when it returns as collected revenue [17; 18].

$$APT = \frac{Cost\ of\ Goods\ Sold}{Accounts\ Payable} \tag{3.3}$$

Return on equity (ROE) and return on assets (ROA) of Amazon.com Inc. from 2005-2023 are shown in Fig. 3.1 [19; 20].

Two important metrics, however, are not reflected in a company's financial statements: markdowns and lost sales. Markdowns are the discounts needed to persuade customers to purchase excess inventory. Lost sales are customer sales that did not take place due to the lack of goods that the customer was willing to buy [17].

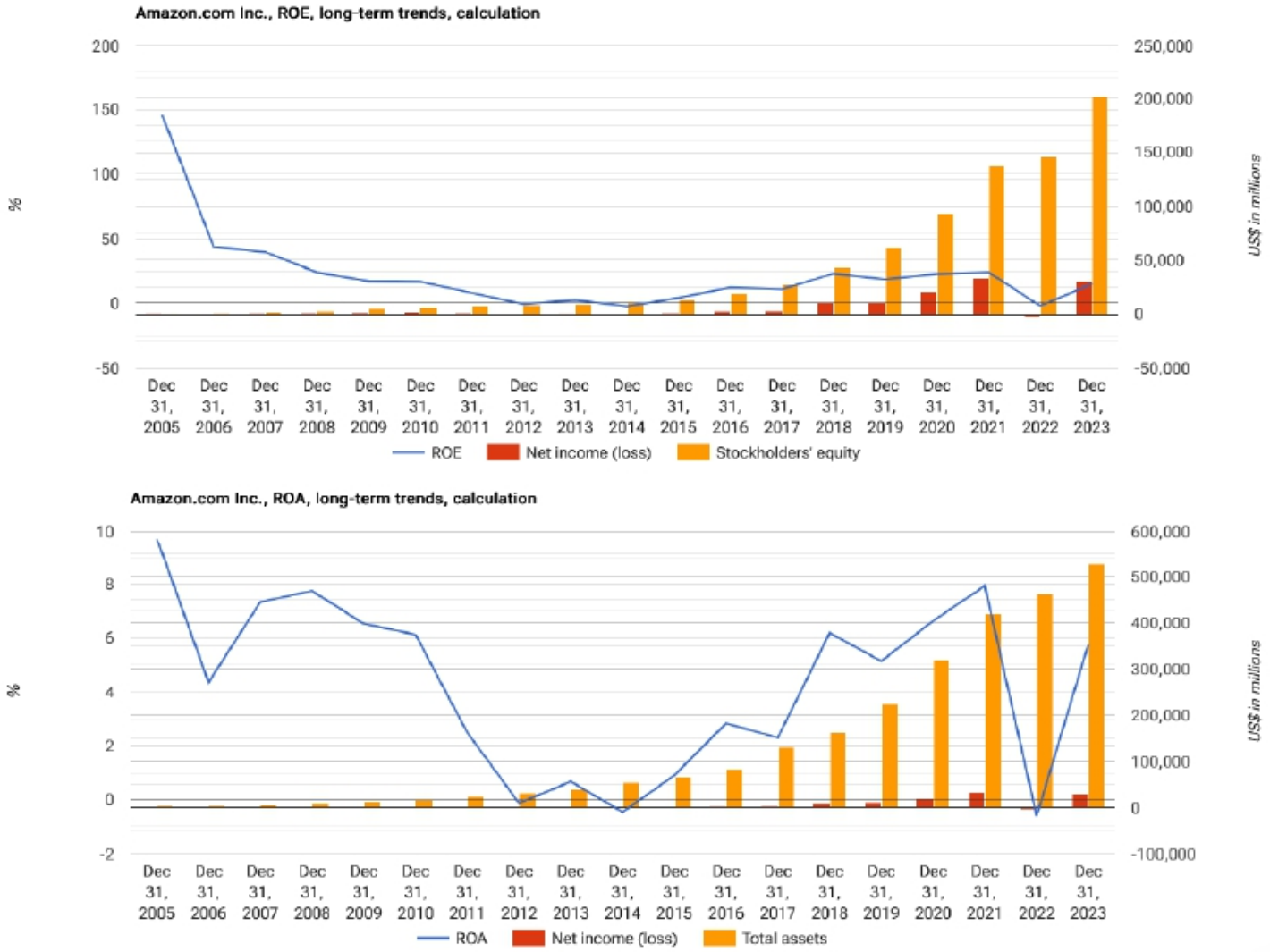


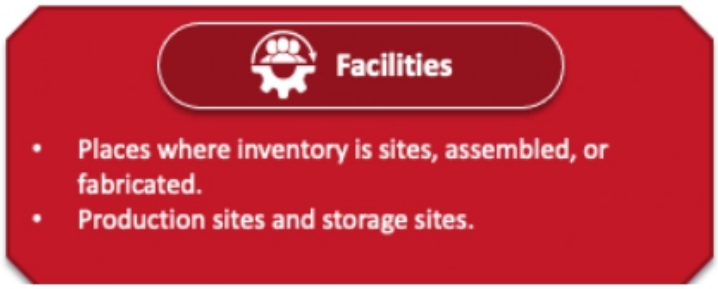
Fig. 3.1. Return on equity (ROE) and return on assets (ROA) of Amazon.com Inc. from 2005-2023 [19; 20]

Financial ratios, or financial metrics, represent tools for assessing a company's financial performance. They give an insight into a company's financial position, profitability, and operational efficiency. Financial metrics are obtained from a company's financial statements – balance sheet, income statement, and cash flow statement. These indicators are more than just numbers, they reveal a company's story. They can show whether a company is managing its assets effectively, is profitable, and if it is likely to meet its financial obligations. Additionally, they can also provide a picture of a company's future growth prospects and its risk profile [21].

That said, financial indicators are not universal. Across industries, financial characteristics differ, and thus the same indicator may have different meanings in the various sectors. For example, a high debt-to-equity ratio would be a red flag in the technology sector, but it could be considered acceptable in the utilities sector, given that it is capital-intensive and often reliant on borrowed funds [21].

It is necessary to structure the factors or drivers to obtain the required level of responsiveness with the lowest possible costs, improving the supply chain surplus and the company's financial performance. Initially, each driver should be determined and its impact on the supply chain performance should be considered [17]:

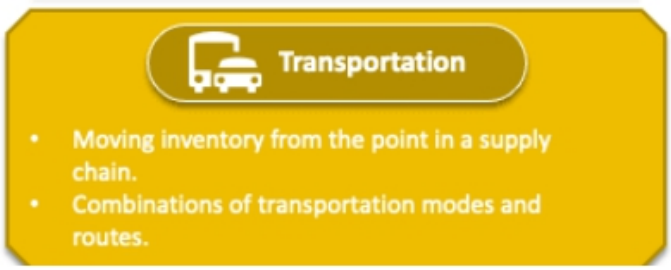
1. *Facilities* refer to the actual physical locations in the supply chain network in which products are stocked, assembled, or manufactured. Production and warehousing facilities are the two main types available. Making decisions on the role, location, capacity, and flexibility of facilities has a major impact on supply chain performance.



2. *Inventories* include all raw materials, work-in-progress and finished goods in the supply chain. Inventories owned by the company are reported in

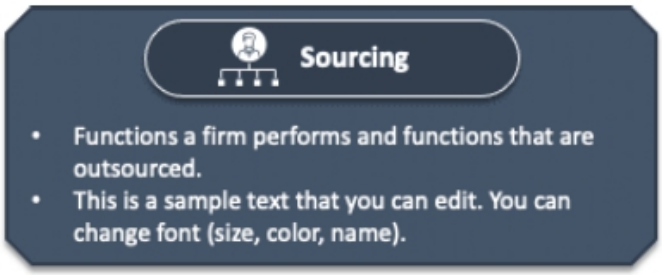
the report under "Assets".

3. *Transportation* means moving inventory from one point to another in the supply chain. Transportation can be performed through many combined modes and routes, each of which has its own performance features.

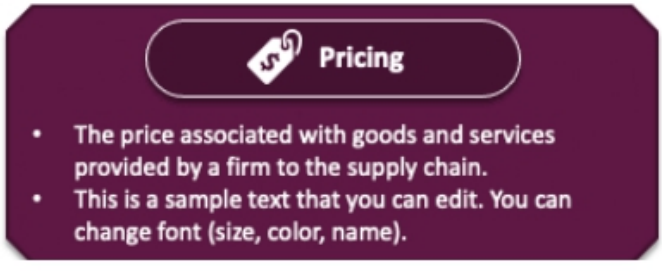


4. *Information* comprises data and analytics related to production facilities, inventory, transportation, costs, prices, and customers across the supply chain. Information represents possibly the greatest driver of supply chain performance, as it directly impacts all the other drivers.

5. *Sourcing* is the selection of a supplier to carry out a specific activity in the supply chain, i.e. manufacturing, storage, transportation, or information management. At the strategic level, such decisions define which functions a company should retain, and which should be outsourced.



6. *Pricing* specifies the amount a company will charge for goods and services it provides in the supply chain. Pricing influences the customer's behaviour of buying a product or service, impacting demand and supply chain performance.



Supply chain efficiency has been the top priority for many businesses for a long time, but now it is competing directly with the need for rapid response. Companies are facing volatile environment, disruptive supply

chains and rising costs. In many cases, suggestions to increase productivity and reduce costs have been put on hold in favour of a supply chain that can adapt to unpredictable market fluctuations and changes in customer needs [22].

Drivers including inventory, transportation, sourcing, information, and pricing converge to identify supply chain performance. According to the company and its financial goals, businesses can develop and manage these factors to achieve an optimal balance between efficiency and responsiveness. Consequently, to ensure this balance is maintained, a company should evaluate the performance of its supply chain drivers, as this will also allow it to know how and when it has achieved strategic alignment [23].

3.2. FRAMEWORK FOR STRUCTURING DRIVERS

A visual scheme of supply chain decision-making is shown in Fig. 3.2. Most companies start with a competitive strategy followed by a supply chain strategy. The supply chain strategy defines the way the supply chain should operate in terms of efficiency and responsiveness. The supply chain should use the three logistics factors and the three cross-functional factors to achieve the level of performance required by the supply chain strategy and generate maximum supply chain profit. While this framework is usually considered from a top-down perspective, in many cases an examination of the six factors can point to whether a change in supply chain strategy and potentially even competitive strategy is needed [17].

In addition, financial measures do not consider non-financial drivers that can impact a company's performance, including the quality of management, competitive positions and industry trends. For that reason, they should be combined with other types of analysis, particularly strategic analysis and industry analysis. Benchmarking financial performance across industries can be both an art and a science. This involves not only financial knowledge and analytical skills, but an awareness of the industry environment and good judgement. Despite its complexities and limitations, such analysis will provide valuable insights and assist in making reasonable decisions [21].

A framework for structuring drivers is shown in Fig. 3.3 [24].

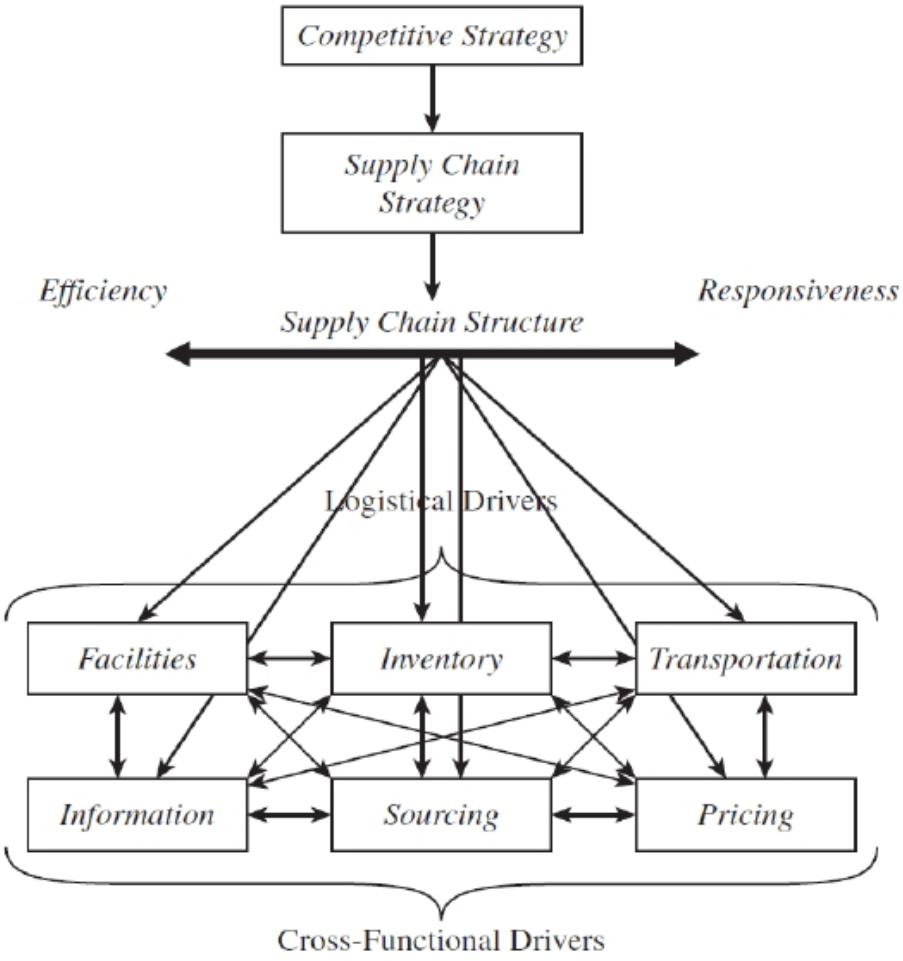


Fig. 3.2. Supply chain decision-making framework [17]

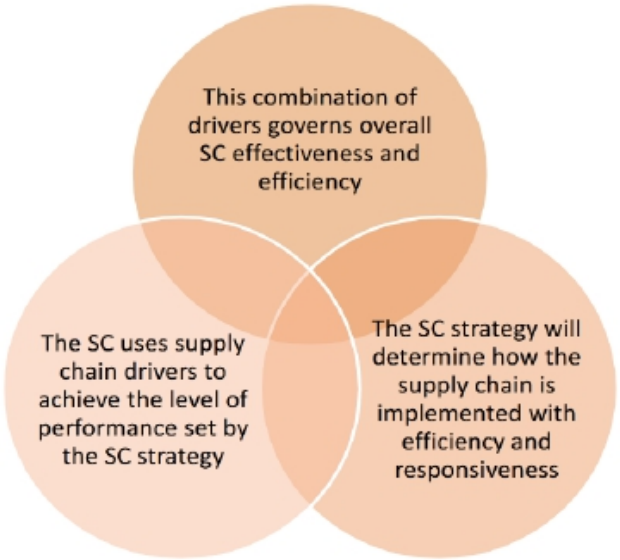


Fig. 3.3. A framework for structuring drivers in the supply chain [24]

3.3. E-BUSINESS SUPPLY CHAINS DRIVERS, METRICS, AND ERP INTEGRATION

Contrary to e-supply chains (e-SCs), traditional supply chain design initiatives are typically considered top-down processes, similar to the classic waterfall model from systems engineering. Studying the six driving factors, as well as the corresponding indicators and related measures, indicates the need for steadier relationships with partners. The emergence of globalisation and the internet radically changed paradigms. As a result, supply chain leaders need to adapt their strategies and align with the six drivers of traditional supply chains (Table 3.1) for high levels of responsiveness and minimising logistics costs across the supply chain [25].

Table 3.1

Drivers, metrics, and measures of traditional supply chains [25; 26]

Driver Type	Drivers	Metrics	Measures
• Logistical	• Facilities	• Design capacity • Effective capacity • Capacity cushion • Utilization • Efficiency • Product variability	• Production per unit • Production cycle time • Flow time • Flow time efficiency • Production service level • Average batch volume
• Logistical	• Inventory	• Inventory cycle • Safety stock • Product availability • Obsolescence	• Average inventory • Inventory turns • Average replenishment lot size • Rate of obsolete inventory
• Logistical	• Transportation	• Network design • Shipment • Transportation mode selection process	• Inbound cost per period • Outbound cost per period • Inbound average shipment size • Outbound average shipment size • Volume per mode
• Cross-functional	• Information	• Demand forecasting accuracy • Process design type (push vs. pull) • Sharing and coordination • Availability • Accessibility • Enabling technology (ERP, EDI, RFID, and SCM) • Encryption	• Mean absolute deviation (MAD) • Mean squared error (MSE) • Forecasting horizon • Frequency of update • Information velocity • Transactions per users per enabling technology • Reliability of enabling technologies
• Cross-functional	• Sourcing	• In-house/outsource rate • Supplier selection • Purchasing/Procurement • Quality of supply	• Average purchasing price • Purchasing range • On-time deliveries to total deliveries • Receipts defect rate (RDD)
• Cross-functional	• Pricing	• Price menu • Profit	• Range of sale price • Average sale price • Incremental fixed/variable cost per unit

The driving forces behind traditional supply chains are facilities, transport, inventory, information, sourcing and pricing. They can be categorised as logistics or cross-functional performance drivers [26]. In contrast to traditional supply chains, the drivers of e-SC performance are an adjusted organisational structure that provides effective management of relationships between network partners, management criteria, and critical e-SC activities [27].

Thus, critical activities can be considered as logistics factors. Organisational structure and management criteria can be seen as cross-functional factors in the e-SC factor equation. Information influences are influenced by all supply chain factors. It enables logistics and cross-functional processes related to supply chain performance drivers [25].

Information serves as a key factor in both traditional and e-supply chains, as it connects all the factors [26].

Customer demand information, for instance, provides the input for the aggregate plan that sets production capacity. The production capacity and capability determine the scheduling rules for individual products or groups of similar products. During this planning phase, the main strategies for meeting demand are developed, either by pursuing demand or levelling capacity strategy [25].

At any point in the supply chain, two-way information flows are crucial. Being a key performance driver, information creates the preconditions for potential efficiency increases in logistics and cross-functional processes both within and across the supply chain. Information serves as a cross-functional driving force in the supply chain [26].

As shown in Table 3.2, information represents the primary driver of both traditional and e-SCs. An enabling technology like ERP, Electronic Data Interchange (EDI), Radio Frequency Identification (RFID) and SCM software is commonly used in all supply chains. For e-supply chains, technology enabling is a given. It allows organisations to collect, store, process and distribute information throughout and within the supply chain [25; 26].

In terms of the variables relevant to measuring effective e-SC, a study with a greater emphasis on the relationship between the factors of e-SC effectiveness may allow for limited (or even excessive) intervention to provide more precise causal relationships and a better understanding of the core construct [25].

Table 3.2

e-SC metrics and their accompanying measures [25; 27]

Driver Type	Drivers	Metrics	Measures
• Logistical	• Adapted organizational culture	• Web-enabled service	• Data access time • System response time • Data transmission speed between business-to-business applications • Number of system verification steps • Traffic volume per page and/or site
• Cross-functional	• Managerial criteria	• Transaction reliability	• Number of transaction errors • Number of backlog transactions • Number of partners accessing the system • Cost per transaction • ERP interface cycle time
• Cross-functional	• Managerial criteria	• Cost	• Administrative cost
• Cross-functional	• Critical activities	• Time	• Administrative time • Number of stages in the purchasing cycle • Purchasing lead time • Procurement cycle time • Procurement response time
• Logistical	• Adapted organizational culture	• E-Response	• Reliability of mail service • Completed number of transactions per period (day, week, or month) • Pending number of transactions per period (day, week, or month)
• Cross-functional	• Adapted organizational culture	• E-Invoice process	• Number of steps involved • Dispute resolution completion time
• Logistical	• Adapted organizational culture	• E-Payment	• Payment time • Reconciliation time
• Cross-functional	• Managerial criteria	• E-Document	• Data accuracy • Data reliability

A longitudinal field experiment on this issue may also provide more insight into the factors that influence the performance of e-SCs. A follow-up study could also aim to test the hypothesis of the quality of the advanced technologies used in e-SCs and their impact on efficiency and responsiveness [25].

3.4. DETAILING DRIVERS OF SUPPLY CHAIN PERFORMANCE

Companies can improve their response time by adding more facilities, increasing their flexibility, or increasing their capacity. However, all of these actions have a cost. More facilities will increase costs for facility maintenance and inventory but will reduce transport costs and shorten the time to response. Improving facility flexibility or capacity results in higher facility costs, but lower inventory costs and shorter response times [17].

The *inventory* is created in the supply chain due to a mismatch between supply and demand. Such discrepancies are intentional in certain production operations, like steel manufacturing, where it is economically advantageous to produce products in large quantities, which are then accumulated and stored for later sale. The mismatch is also purposeful in the retail sector, where inventories are maintained in expectation of potential future demand or when retailers stock up to anticipate a jump in sales during the holiday season. In these cases, inventory is maintained to lower costs or improve the availability of goods [17].

Inventory influences the assets available, costs incurred and responsiveness of the supply chain. Having high inventory levels in the apparel supply chain increases response time, but also makes the chain sensitive to markdowns, resulting in lower profit margins. Inventory also significantly affects the material's flow time in the supply chain. Material flow time refers to the time that takes between the moment a material entering the supply chain and the moment it leaves it. For a supply chain, throughput means the speed at which sales are made [17].

Successful levelling requires a thorough analysis, as reducing inventory levels can lead to shortages, unsatisfied demand and lost profit opportunities [22].

Moving goods via *transportation* between different points in the supply chain influences responsiveness and efficiency. Speedier transportation costs more but enables more responsiveness in the supply chain. Consequently, the supply chain can have smaller inventories and limited facilities. Choosing the appropriate transportation option enables a firm to adapt the location of its facilities and inventory so as to determine the proper balance between responsiveness and efficiency. A company offering high-value goods like medical devices may use fast transportation for rapid response and centralise its facilities and inventory to reduce costs. Conversely, a company selling low-cost, high-demand goods such as house electric appliances can keep a significant amount of inventory near the customer and use low-cost modes of transport such as sea, rail and full trucks to resupply these inventories from production facilities based in low-cost countries [17].

For example, FedEx and UPS are companies offering high levels of last-mile delivery responsiveness, utilising express shipping methods to deliver goods as quickly as 48 hours. Transportation efficiencies can be

gained by transporting goods in large quantities less frequently by bulk carriers such as ships or rail. Although bulk carriers are an excellent option when the aim is to ensure large volumes and reduce costs, this approach compromises speed and flexibility. Employing a centralised distribution centre instead of a few individual locations would be another option to increase efficiency and cut costs, yet again, this would result in a loss of delivery speed and response time [22].

High-quality information has the potential to enhance the utilisation of supply chain assets and improve the coordination of supply chain flows to increase efficiency and cut costs. For example, Seven-Eleven in Japan leverages information to increase availability of products and reduce inventory. At Walmart, information on shipments from suppliers is used to enable cross-warehousing and reduce inventory and transport costs [17].

While information sharing allows the supply chain to serve customer needs more effectively and at a lower cost, it can be a mistake to assume that more information is always better. As the amount of information in a supply chain increases, the complexity and costs of the infrastructure and subsequent analysis required increase in an exponential manner. However, the marginal value of the information provided by the exchange decreases with the amount of information available. Therefore, it is important to assess the minimum amount of information required to achieve the intended goals [17].

By centralising all internal supply chain data in one place, supply chain planning software using advanced AI-based analysis can also identify inefficiencies and optimise operations to improve efficiency [22].

Sourcing comprises a complex of business processes needed to acquire goods and services. Managers should initially decide on whether each task will be fulfilled by a responsive or efficient source, and then determine whether the source will be internal or external. The sourcing decision needs to be made with the goal of maximising the amount of overall surplus that can be distributed throughout the supply chain. Outsourcing to a third party makes sense if the third party increases the supply chain surplus to a greater extent than the firm can do on its own. Conversely, the company should retain the supply chain function internally if the third party is unable to increase the supply chain surplus or if the risk related to outsourcing is substantial [17].

Pricing is a process through which a company decides on how much to charge customers for its goods and services. Pricing influences the customer segments that are willing to purchase a product, as well as customer expectations. This has direct impact on the supply chain regarding the level of response required, as well as the demand profile that the supply chain is trying to meet. Pricing is also a tool to be used to align supply and demand, particularly when the supply chain is not highly flexible. Offering short-term discounts may allow to address oversupply or reduce seasonal spikes in demand by shifting some of the demand to future periods. Pricing directly impacts revenues, but can influence production costs and inventory as well, based on its impact on consumer demand. The manager should monitor pricing-related metrics [17].

For example, in menu pricing, each metric should be monitored individually for each menu segment [17]:

• Profit margin represents profit as a percentage of revenue. To optimize pricing, a company should study a wide range of profit margin indicators, such as margin type (gross, net, etc.), scope (product item, product line, division, company), customer type, etc.

• Days sales outstanding captures the average time between the point of sale and the point of cash collection.

• Incremental fixed costs per order represents additional costs that are unrelated to the order size. These include retooling costs at the factory or order processing or transport costs that do not depend on the size of the batch at the mail-order firm.

• Incremental variable costs per unit represent additional costs that depend on the order size. These include the cost of collection from a mail-order firm or variable manufacturing costs at a factory.

• Average selling price measures the average price at which a transaction in the supply chain was completed during a certain period. The average is calculated by weighting the price by the quantity sold at that price.

• Average order size captures the average quantity of goods per order. The average selling price, order size, incremental fixed costs per order, and incremental variable costs per unit are used to measure the input from supply chain activities.

• Selling price range indicates the maximum and minimum selling price per unit over a specified period.

• Periodic sales range estimates the maximum and minimum number of products sold per period (day/week/month) over a defined period. It aims to understand any sales-price correlation, as well as any potential opportunity to change sales by changing the price in time.

Discussion questions

1. What is ROE?
2. How is ROA calculated?
3. Characterise the APT indicator.
4. What are the features of Return on equity (ROE) of Amazon.com Inc. for 2005-2023?
5. What are the features of Return on assets (ROA) of Amazon.com Inc. for 2005-2023?
6. What are two important indicators that are not part of a firm's financial statements?
7. What drivers affect the efficiency of the supply chain?
8. What is the current competition for supply chain efficiency?
9. What are the features of the decision-making structure in the supply chain?
10. What determines the need to change the supply chain strategy and, potentially, even the competitive strategy?
11. Why is it important to combine different types of analysis?
12. Describe the Framework for Structuring Drivers.
13. Characterise the drivers, indicators and measures of traditional supply chains.
14. How do e-SC metrics and their accompanying measures differ from traditional drivers?
15. How does the increase in the number of objects affect supply chain management?
16. When is it advisable to accumulate inventory?
17. What are the advantages and disadvantages of high inventory levels in the supply chain?
18. Describe supply chain capacity.
19. What are the threats posed by inventory shortages?
20. What is the level of response to the last mile delivery provided by FedEx and UPS?

21. What opportunities does the correct use of information provide to leading logistics operators?

22. What are the benefits of effective pricing in supply chain management?

Cases

1. Select the company and determine the ROE.
2. Calculate the ROA for the selected company.
3. Determine APT for the selected company.
4. For the selected company, determine the efficiency of the supply chain.
5. Assess the features of the decision-making structure in the supply chain for the selected company.
6. For the selected company, identify a need for supply chain strategy change.
7. Identify the capacity of the supply chain.
8. Determine the feasibility of accumulating inventory for the selected company.
9. Assess the level of last-mile delivery response for the selected company.
10. Determine the appropriate use of information for the selected company.

Tests

1. Three logistical drivers are:

a) facilities, inventory and transformation;

b) information, sourcing, and pricing that determine the performance of any supply chain;

c) facilities, inventory and sourcing;

d) there is no correct answer.

2. Three cross-functional drivers are:

a) information, sourcing, and facilities that determine the performance of any supply chain;

b) information, sourcing, and pricing that determine the performance of any supply chain;

c) facilities, inventory and transformation;

d) there is no correct answer.

3. Markdowns are:

a) customer sales that did not materialize because of the absence of products the customer wanted to buy;

b) discounts required to convince customers to buy excess inventory;

c) customer sales that did not materialize because of the absence of products the customer did not wanted to buy;

d) there is no correct answer.

4. Lost sales are:

a) customer sales that did not materialize because of the absence of products the customer wanted to buy;

b) customer sales that did not materialize because of the absence of products the customer did not wanted to buy;

c) discounts required to convince customers to buy excess inventory;

d) there is no correct answer.

5. Financial metrics:

a) provide a snapshot of a company's political health, profitability, and operational efficiency;

b) provide a long-term of a company's financial health, profitability, and operational efficiency;

c) provide a snapshot of a company's financial health, profitability, and operational efficiency;

d) there is no correct answer.

6. Financial metrics are derived from the following financial statements of the company:

a) the balance sheet, specific fuel consumption, and cash flow statement;

b) the balance sheet, income statement, and cash flow statement;

c) the balance sheet, income statement, and employee reports;

d) there is no correct answer.

7. Are financial metrics one-size-fits-all?

a) yes;

b) no;

c) rather yes;

d) there is no correct answer.

8. Facilities are:

a) all raw materials, work in process, and finished goods within a supply chain;

b) the actual physical locations in the supply chain network where product is stored, assembled, or fabricated;

c) moving inventory from point to point in the supply chain;

d) there is no correct answer.

9. Inventory is:

a) all raw materials, work in process, and finished goods within a supply chain;

b) moving inventory from point to point in the supply chain;

c) the actual physical locations in the supply chain network where product is stored, assembled, or fabricated;

d) there is no correct answer.

10. Transportation is:

a) moving inventory from point to point in the supply chain;

b) all raw materials, work in process, and finished goods within a supply chain;

c) the actual physical locations in the supply chain network where product is stored, assembled, or fabricated;

d) there is no correct answer.

11. Information is:

a) the choice of who will perform a particular supply chain activity, such as production, storage, transportation, or the management of information;

b) analysis how much a firm will charge for the goods and services that it makes available in the supply chain;

c) data and analysis concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain;

d) there is no correct answer.

12. Sourcing is:

a) the choice of who will perform a particular supply chain activity, such as production, storage, transportation, or the management of information;

b) data and analysis concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain;

c) analysis how much a firm will charge for the goods and services that it makes available in the supply chain;

d) there is no correct answer.

13. Pricing is:

a) analysis how much a firm will charge for the goods and services that it makes available in the supply chain;

b) data and analysis concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain;

c) the choice of who will perform a particular supply chain activity, such as production, storage, transportation, or the management of information;

d) there is no correct answer.

14. The two major types of facilities are:

a) sales sites and storage sites;

b) production sites and storage sites;

c) sales sites and systems sites;

d) there is no correct answer.

15. The inventory belonging to a firm is reported under:

a) liabilities;

b) assets;

c) resources;

d) there is no correct answer.

16. Potentially the biggest driver of performance in the supply chain because it directly affects each of the other drivers is:

a) information;

b) sourcing;

c) transportation;

d) there is no correct answer.

17. Which supply chain is now becoming the most efficient:

a) supply chain that can increase productivity;

b) supply chain that can lower costs;

c) supply chain that can accommodate unexpected fluctuations in the market and changes in customer preferences;

d) there is no correct answer.

18. The supply chain strategy determines how the supply chain should perform:

a) with respect to efficiency and responsiveness;

b) with respect to non-efficiency and responsiveness;

c) with respect to efficiency and systematise;

d) there is no correct answer.

19. Non-financial factors that can affect company's performance are:

a) management quality;

b) competitive position;
c) industry trends;
d) all answers are correct.

20. Traditional supply chain design initiatives are generally viewed as:
a) bottom to top processes;
b) top to bottom processes;
c) reverse processes;
d) there is no correct answer.

21. The examination of the six drivers, along with their corresponding metrics and accompanying measures, reveals:
a) the need for more stable relationships with partners;
b) the need for more partners;
c) the need for more competitors;
d) there is no correct answer.

22. Factors that affect e-SC performance are:
a) the adapted organizational structure, which effectively manages relationships among network partners, the managerial criteria, and the e-SC critical activities;
b) the non-adapted organizational structure, which non-effectively manages relationships among network partners, the managerial criteria, and the e-SC critical activities;
c) the adapted organizational structure, which effectively manages relationships among network competitors, the managerial criteria, and the e-SC non-critical activities;
d) there is no correct answer.

23. Key driver of both traditional and e-SCs because it serves as the connector to all drivers is:
a) sourcing;
b) information;
c) inventory;
d) there is no correct answer.

24. As a leading performance driver, information sets the stage for:
a) potential productivity gains for both logistical and system processes within, across, and throughout the outside supply chain;
b) potential productivity gains for both logistical and cross-functional processes within, across, and throughout the entire supply chain;

c) potential non-productivity gains for both logistical and stochastic processes within, across, and throughout the outside supply chain;

d) there is no correct answer.

25. All supply chains often rely on enabling technology such as:

a) Enterprise resource planning (ERP) and electronic data interchange (EDI);

b) radio frequency identification (RFID) and System Capital Management (SCM) software;

c) Public relations (PR);

d) there is no correct answer.

26. Firms can increase responsiveness:

a) by increasing the number of facilities, making them less flexible or increasing capacity;

b) by increasing the number of facilities, making them more flexible or increasing capacity;

c) by increasing the number of problems, making them more flexible or increasing capacity;

d) there is no correct answer.

27. Increasing the facility flexibility or capacity increases facility costs but:

a) decreases inventory profits and response time;

b) decreases inventory profits and increase response time;

c) decreases inventory costs and response time;

d) there is no correct answer.

28. Inventory affects in:

a) the assets held;

b) the costs incurred;

c) responsiveness provided in the supply chain;

d) all answers are correct.

29. Material flow time is:

a) the time that elapses between the point at which material enters the supply chain to the point at which it exits;

b) the time that elapses between the point at which material enters the supply chain to the point at which it is utilised;

c) the time that elapses between the point at which material disappears the supply chain to the point at which it is utilised;

d) there is no correct answer.

30. Faster transportation is more expensive but allows a supply chain to be:

a) cheaper;

b) more responsive;

c) more reliable;

d) there is no correct answer.

31. A firm selling high-value items use rapid transportation to be:

a) responsive while centralizing its facilities and inventory to lower cost;

b) responsive while decentralizing its facilities and inventory to lower cost;

c) responsive while decentralizing its facilities and inventory to higher cost;

d) there is no correct answer.

32. Transportation efficiency can be achieved:

a) by moving products in larger batches by aircrafts;

b) by moving products in larger batches by bulk carriers, such as ships or railroads;

c) by moving products in larger batches by pipelines;

d) there is no correct answer.

33. Using a centralized distribution centre instead of multiple separate locations is:

a) way to improve efficiency and save on costs, but sacrificing delivery speed and responsiveness;

b) a way to increase efficiency and save on profits, but sacrificing delivery speed and efficiency;

c) way to improve non-efficiency and save on profits, but sacrificing delivery speed and responsiveness;

d) there is no correct answer.

34. The marginal value provided by the information shared:

a) diminishes;

b) increases;

c) remains unchanged;

d) there is no correct answer.

35. Supply chain planning software that uses advanced AI-based analysis can:

a) highlight efficacies and non-optimize for efficiency;

b) highlight inefficacies and optimize for efficiency;

c) highlight efficacies and optimize for efficiency;

d) there is no correct answer.

36. Outsourcing to a third party is meaningful if:

a) the third party reduces the supply chain surplus less than the firm can on its own;

b) the third party reduces the supply chain surplus more than the firm can on its own;

c) the third party raises the supply chain surplus more than the firm can on its own;

d) there is no correct answer.

37. Pricing is:

a) a lever that can be used to match supply and demand, especially when the supply chain is not very flexible;

b) a lever that can be used to pricing match, especially when the supply chain is not very flexible;

c) a lever that can be used to pricing match, especially when the supply chain is very flexible;

d) there is no correct answer.

38. Short-term discounts can be used to:

a) eliminate supply surpluses or decrease seasonal demand spikes by moving some of the demand forward;

b) eliminate supply deficit or increase seasonal demand spikes by moving some of the demand forward;

c) eliminate supply surpluses or increase seasonal demand spikes by moving some of the demand forward;

d) there is no correct answer.

39. Profit margin measures:

a) the average time between when a sale is made and when the cash is collected;

b) the incremental costs that are independent of the size of the order;

c) profit as a percentage of revenue;

d) there is no correct answer.

40. Days sales outstanding measures:

a) profit as a percentage of revenue;

b) the incremental costs that are independent of the size of the order;

c) the average time between when a sale is made and when the cash is collected;

d) there is no correct answer.

41. Incremental fixed cost per order measures:

a) the average time between when a sale is made and when the cash is collected;

b) profit as a percentage of revenue;

c) the incremental costs that are independent of the size of the order;

d) there is no correct answer.

42. Average order size measures:

a) the average quantity per order;

b) the maximum and the minimum of sale price per unit over a specified time horizon;

c) the maximum and minimum of the quantity sold per period (day/week/month) during a specified time horizon;

d) there is no correct answer.

43. Range of sale price measures:

a) the maximum and minimum of the quantity sold per period (day/week/month) during a specified time horizon;

b) the maximum and the minimum of sale price per unit over a specified time horizon;

c) the average quantity per order;

d) there is no correct answer.

44. Range of periodic sales measures:

a) the average quantity per order;

b) the maximum and the minimum of sale price per unit over a specified time horizon;

c) the maximum and minimum of the quantity sold per period (day/week/month) during a specified time horizon;

d) there is no correct answer.

45. Range of periodic sales measures:

a) the average quantity per order;

b) the incremental costs that vary with the size of the order;

c) the average price at which a supply chain activity was performed in a given period;

d) there is no correct answer.

4. DESIGNING DISTRIBUTION NETWORKS AND NETWORK DESIGN IN THE SUPPLY CHAIN

4.1. DESIGNING DISTRIBUTION NETWORKS

Distribution involves the actions performed to move and store goods from the supplier step to the customer step in the supply chain. Distribution takes place between each pair of supply chain stages. Raw materials and components move from suppliers to producers, while finished goods are transported from the producer to the end consumer. Distribution plays a key role in a company's profitability, as it directly influences both supply chain cost and customer value [17].

The process of designing a distribution network consists of two major stages. The first stage visualises the overall structure of the supply chain network. At this stage, the number of stages in the supply chain and the role of each stage are determined. In the second stage, the overall structure is mapped into locations and their capabilities, throughput and demand distribution. The appropriate distribution network can be used to meet a wide range of supply chain objectives, including low costs and high response times. For this reason, companies in one industry usually choose different distribution networks [17].

Established distribution network should cover such aspects as [28]:

a. Maximizes the customer service.

b. Minimizes the logistical costs.

c. Maximizes flexibility.

d. Maximises reliability to minimise risks when conditions change.

Deliverables to establish the distribution network are as follows [28]:

1. *Best distribution network* means recommending the overall best distribution network, given the cost and service level, from warehouse to customer.

2. *Alternative networks*. Given a predicted volume, different conceptual alternative networks are assessed in terms of transport costs, warehousing costs, inventory holding costs and service levels.

3. *Supporting analysis*. A full supporting analysis, covering factors for planning, demand factors, supply/demand maps, risk analysis, market analysis, local opportunities, etc., is provided.

4. *Visible improvements.* With data analysis and project progress, any potential opportunities for distribution network improvements will be communicated upon discovery.

5. *Implementation of the recommended distribution network*. Planning and implementation management tasks to avoid business interruption encompass detailed project planning, tender management and implementation management.

The four main criteria, quantitative and qualitative, of each concept are shown in Fig. 4.1 [28].

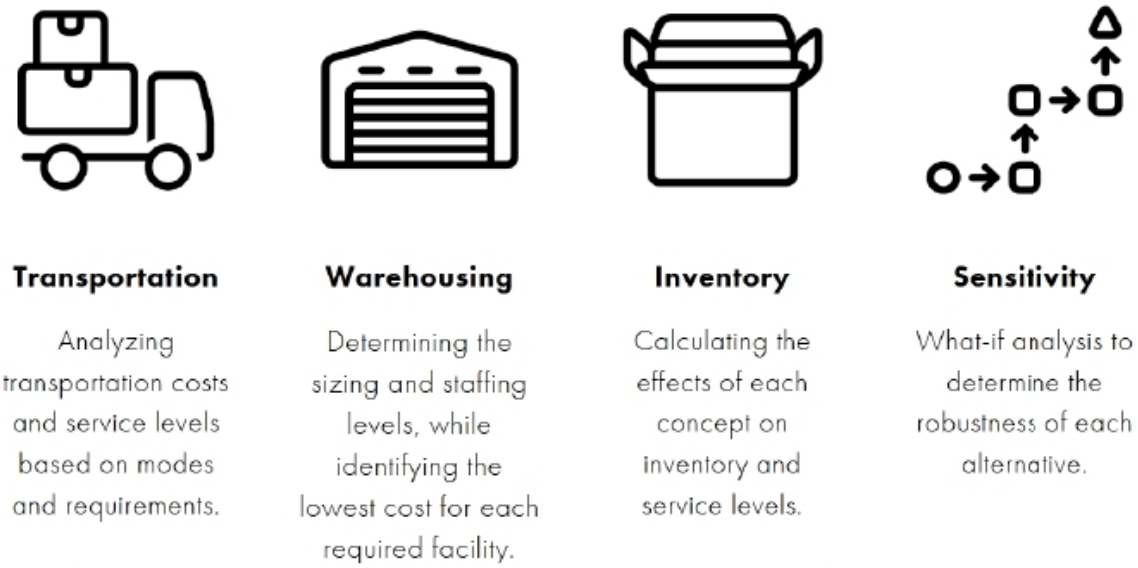


Fig. 4.1. The four main quantitative and qualitative criteria [28]

Planning factors for designing distribution networks process are shown in Fig. 4.2 [28].

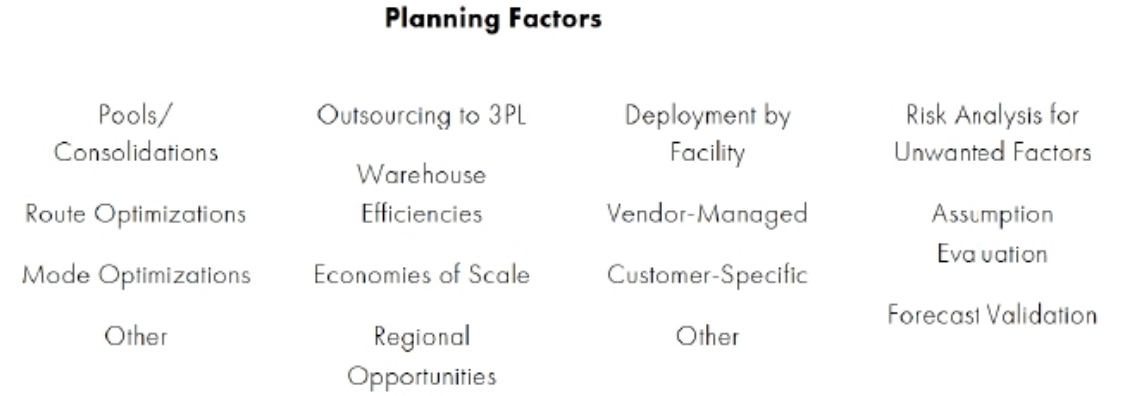


Fig. 4.2. Planning factors for designing distribution networks process [28]

Designing distribution networks process is provided in Fig. 4.3 [28].

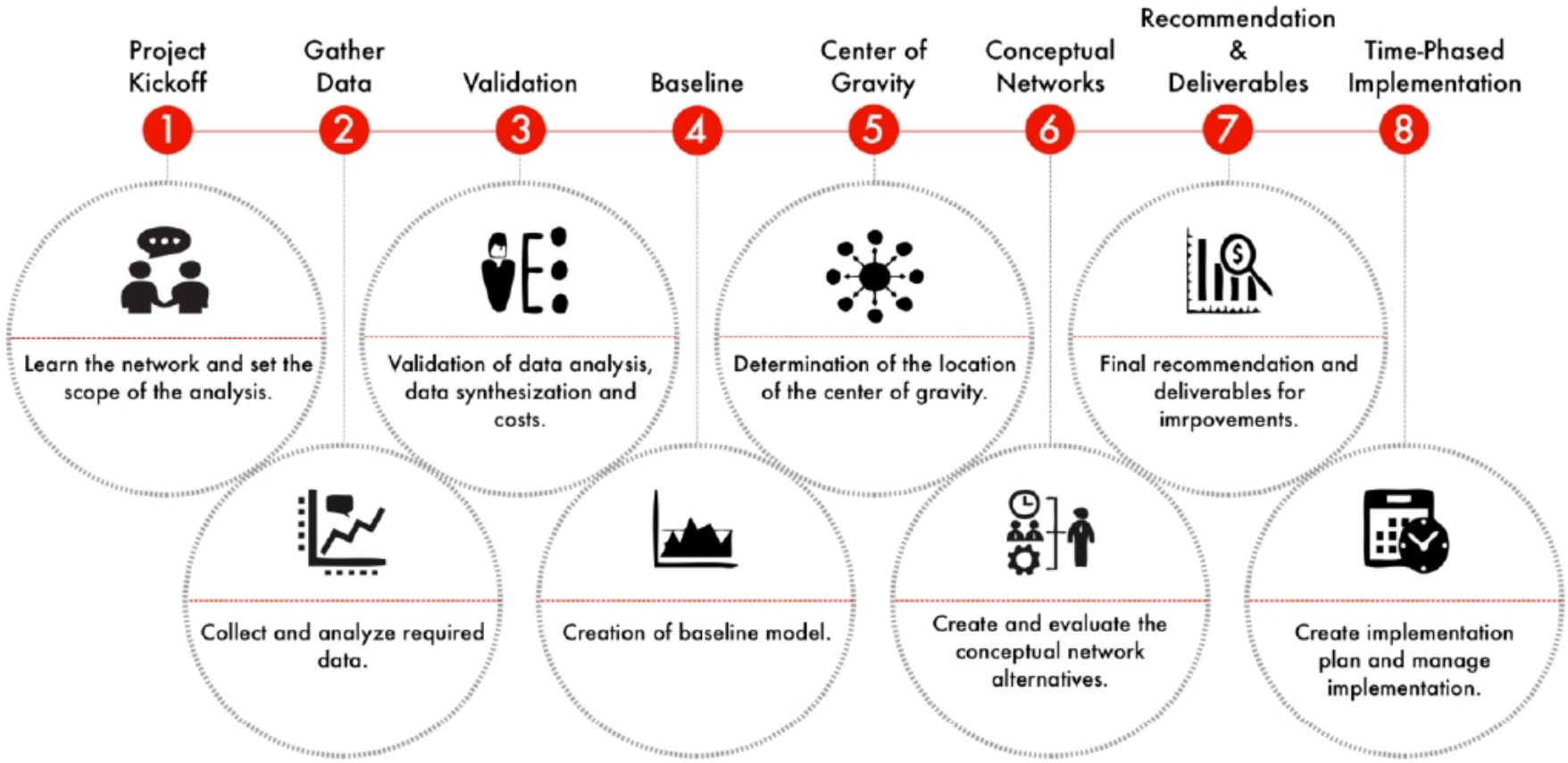


Fig. 4.3. Designing distribution networks process [28]

Distribution networks evolve over time when a business enlarges and seeks to capture more customers. As such, they must be designed in a way that can be optimised for the long term. Satisfaction of customer demand is crucial in determining the ideal and efficient distribution network and supply chain. Meeting overall customer demand requires low costs and the right level of service. To achieve this, strategic planning and specialised supply chain management and planning are needed [29].

Distribution networks are designed with all key factors affecting service quality and costs considered. Customer location is one of the key factors in distribution and supply chain modelling. Companies should map out where their customers are located to find a distribution structure that operates efficiently, at low cost, and does not have a significant impact on the price of the product for the end user. The customer's location allows for logistics planning. Another key factor is the number and frequency of orders. It is very important for a business to know how often consumers buy a product and what purchasing volumes are associated with that product. This helps with inventory management [29].

Transport costs and the transport mode required can also be key factors in developing a distribution model. Defining the frequency of orders and the customer's location helps to choose the most suitable transport mode, as well as the costs associated with the required transport modes and vehicles. Warehousing plays an important role in creating an efficient distribution network. A company should decide on the ideal warehouse location, size, accessibility and costs to make the right choice that will best meet distribution needs and provide overall customer satisfaction. In the case of goods being exported or imported, it is also essential for businesses to determine the entry points. Among other key factors are the location of plants and suppliers, along with service requirements [29].

he problem of designing a distribution network in a supply chain system may involve the location of production plants and distribution warehouses and developing the best strategy for product distribution from plants to warehouses and from warehouses to consumers, as described in [30]. The goal is to choose the optimal number, location and capacity of plants and warehouses to establish and operate with the aim of satisfying customer demand while minimising the total distribution network costs. In contrast to most previous studies, this study enables consideration of several levels of capacity available for warehouses and factories. A computational study is presented to examine the value of coordinating production and distribution

planning. A mixed-integer programming model was developed with the proposal of an efficient heuristic procedure for solving this problem for a supply chain system.

While customer value is influenced by many factors, it is important to consider the metrics that are affected by the distribution network structure: responsiveness, product mix, product availability, customer experience, time to market, visibility of orders and returnability [17].

In option shown in Fig. 4.4, product is shipped directly from the manufacturer to the end customer, bypassing the retailer (who takes the order and initiates the delivery request). This option is also referred to as *dropshipping* [17].

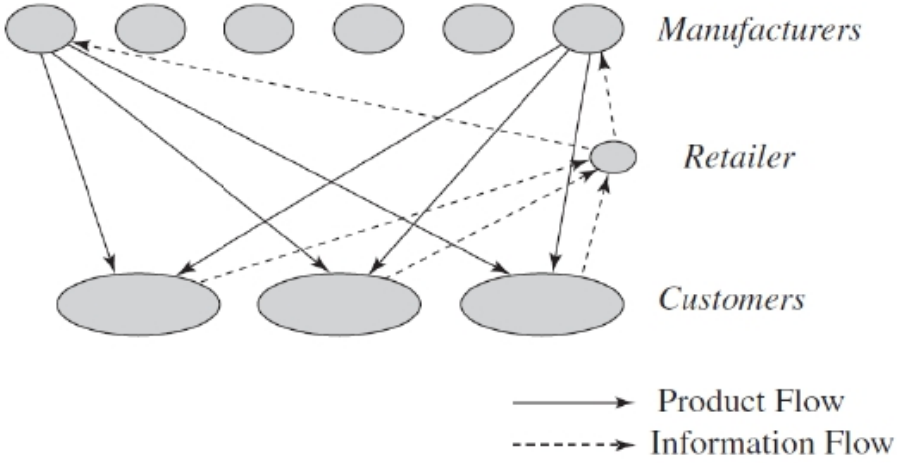


Fig. 4.4. Manufacturer storage with direct shipping [17]

Contrary to pure dropshipping, in which each product in an order is shipped directly from the manufacturer to the end user, in-transit merging combines parts of an order originating from different locations so that the customer receives a single delivery (Fig. 4.5) [17].

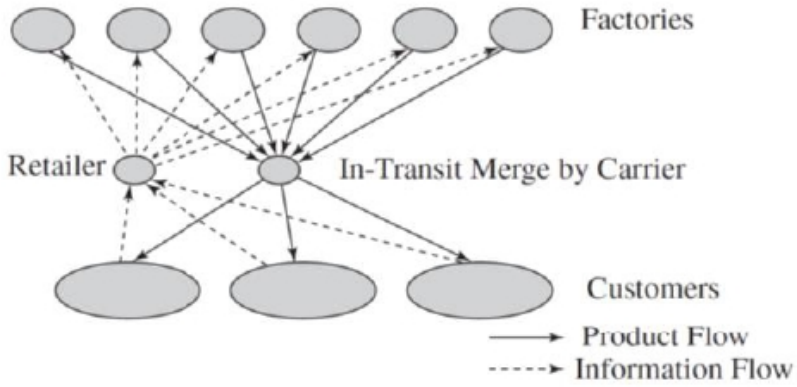


Fig. 4.5. In-transit merge network [17]

In the option shown in Fig. 4.6, stocks are stored not by producers in factories but by distributors/retailers in intermediate warehouses, and package carriers move the products from the midpoint to the final consumer [17].

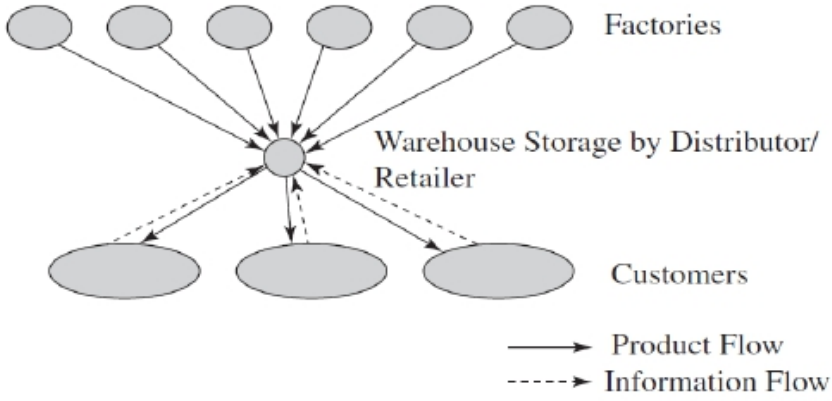


Fig. 4.6. Distributor storage with carrier delivery [17]

Last-mile delivery means that the distributor/retailer delivers the goods directly to the customer's home instead of using a courier service (Fig. 4.7). For example, the automotive parts industry is one of those where last-mile distribution warehouses are the dominant model. For dealers, it is too expensive to keep all spare parts in stock. Last-mile distribution warehousing requires higher inventory levels compared to other options (except for retail stores) due to lower aggregation levels [17].

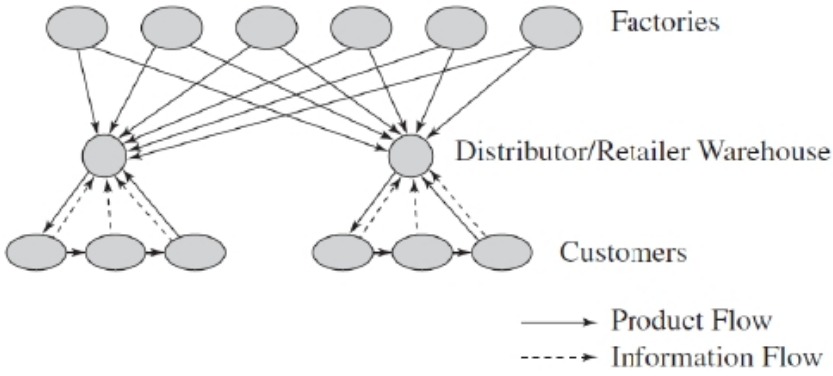


Fig. 4.7. Distributor Storage with Last-Mile Delivery [17]

Storage in the manufacturer's or distributor's warehouse with the customer's pickup option available is shown in Fig. 4.8. This approach keeps inventory at the manufacturer's or distributor's warehouse, but allows customers to place their orders online or by phone and then come to designated pickup locations to collect their goods [17].

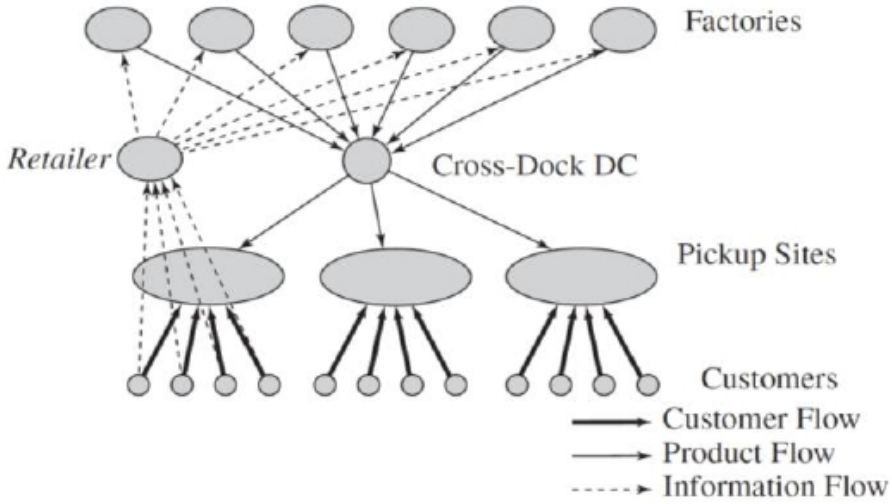


Fig. 4.8. Manufacturer or distributor warehouse storage with consumer pickup [17]

Visibility of the order is of utmost importance for customers pickups. The customer should be notified of the arrival of the order and it should be easily identifiable once the customer comes to collect it [17].

4.2. NETWORK DESIGN IN THE SUPPLY CHAIN

A supply chain network design is understood as a working model that outlines the overall structure of a supply chain to estimate the time and cost required to take goods to market. It helps businesses detect inefficiencies and potential risks in the supply chain. The model can also be used to run 'what-if' scenarios to optimise operations for cost reduction, service improvement and operational efficiency [31].

Supply chain analysis and design have become increasingly popular in recent years, as it is recognised that they are effective in dealing with the fast-paced changes and emerging challenges faced by businesses worldwide. Despite this, many companies still do not consider supply chain design as a basic process and instead view it as a one-off or ad hoc approach to each individual project. Examples of the networked supply chain design model include identifying bottlenecks in the supply chain and finding ways to improve processes throughout it, which is critical in modern conditions. In this way, tech-savvy businesses can apply a dynamic supply chain model to ensure that their supply chains meet and exceed business expectations in the long term [31].

Understanding supply chain risks and minimising their impact are top priorities for businesses today. But it can be a challenging and tricky task,

particularly in an environment of prevailing uncertainty. Supply chain risks can have a significant impact on a company's financial performance and operational efficiency. Companies need to be informed about different types of supply chain risks and implement strategies to address them. Equipped with proper strategies and tools, companies can effectively manage these risks and enable their supply chains to stay sound and safe [32].

Supply chain network design refers to the planning and implementation of supply chain operations in the optimal way to achieve long-term benefits. Organisations need to focus on planning in the certain areas when creating an effective supply chain network design (Fig. 4.9) [33].

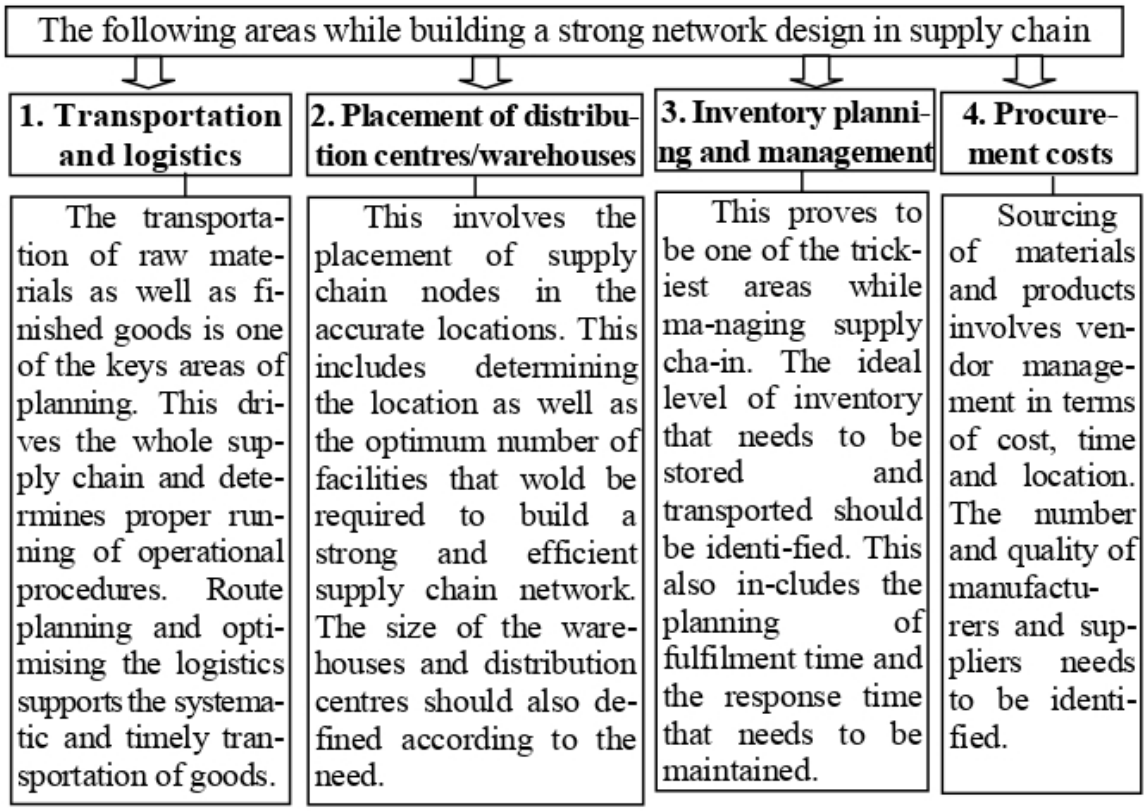


Fig. 4.9. Key areas while building a strong network design in the supply chain [33]

The rapid change in consumer choices and preferences, combined with the uncertainty in demands, increases the importance of pre-designing the network engaged in the supply chain. In the e- commerce, delivery within 24 hours or the next day becomes a common demand. Delayed delivery or unavailability of goods can simply cause a customer to choose another brand [33].

Benefits of a strong supply chain network design are as follows [33]:

1. Supply chain network design brings great benefits to businesses in the long-term. An efficient supply chain can lead to higher levels of customer satisfaction. This can provide significant advantage in channels such as e-commerce and online retail.

2. The cost of operations can be controlled and tracked. A successful network design will allow you to balance costs and revenues to generate profit.

3. Operations can be optimised as much as possible, and resources can be applied in their most efficient way.

4. A proper network design has the potential to build a strong competitive advantage for a business. A high-performance supply chain has become a challenging goal for many companies. Businesses that get supply chain management right can grow to become leaders in their industries.

The supply chain network design aims to maximise the company's profit by meeting customer needs with respect to demand and responsiveness. Decisions about the global network design are taken in four stages, as shown in Fig. 4.10 [17].

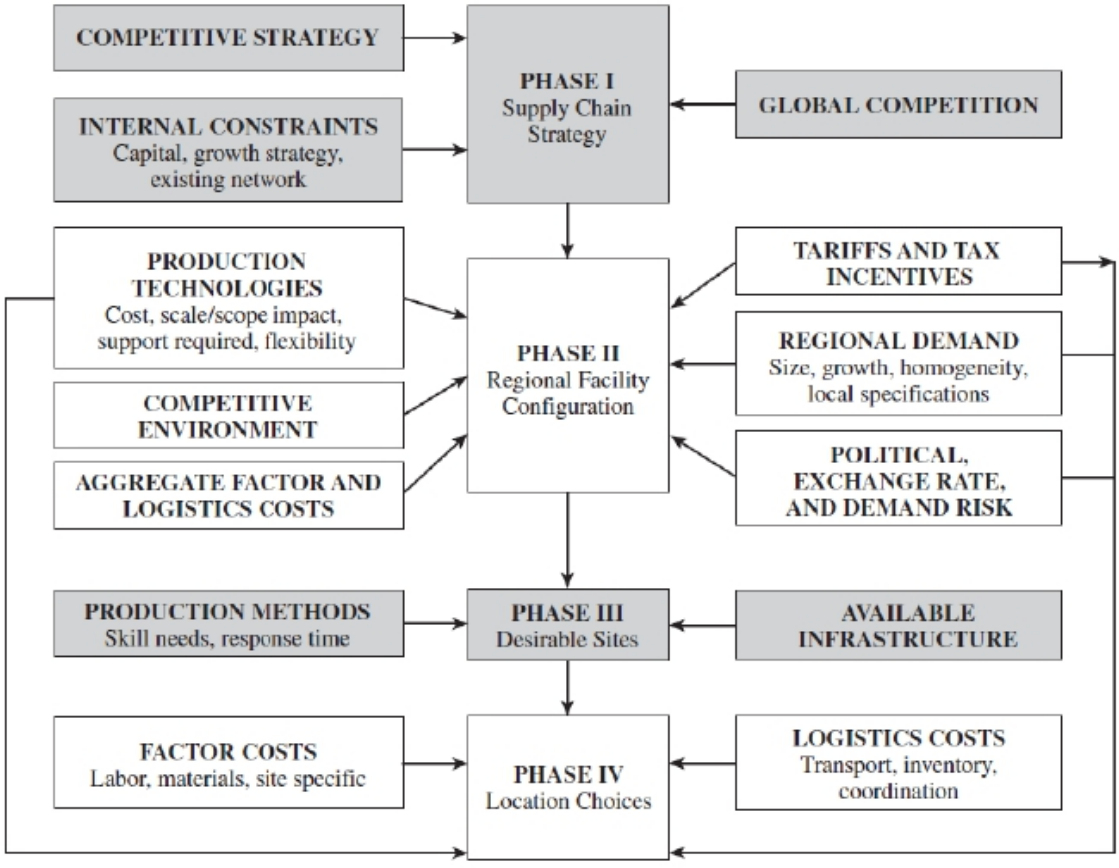


Fig. 4.10. Framework for network design decisions [17]

Phase I: Define a supply chain strategy/design. The purpose of the initial network design stage is to determine the overall structure of the company's supply chain. It involves defining stages of the supply chain and deciding whether each supply chain function will be performed in-house or outsourced. Phase I begins by clearly defining the company's competitive strategy as the set of customer needs to be met by the supply chain [17].

Phase II: Determine the regional configuration of facilities. The purpose here is to map out the regions where the facilities will be located, their possible roles and estimated capacity. Phase II analysis begins with a demand forecast by country or region [17].

Phase III: Select a set of desirable potential sites. The Phase III objective is to choose a preferred set of potential sites in each region where facilities should be located. Site selection should be based on an analysis of the infrastructure availability to meet the desired production methodologies [17].

Phase IV: Location choices. The Phase IV involves selecting the exact location among potential sites and allocating capacity to each facility. The network is supposed to maximise overall profits, taking into account the expected margins and demand in each market, different logistics and operating costs, as well as taxes and tariffs in each location [17].

Location-Allocation Models. Location-allocation models are intended to estimate the most appropriate location for one or a group of facilities to meet a specific demand. This demand is usually represented as a distribution of discrete points that may have equal or different values. The model can be viewed from two different perspectives (Fig. 4.11) [34; 35]:

- *Location*: the most suitable location(s) considering the demand distribution. Suitability is usually the result of minimising transport costs, often using distance as a proxy.

- *Allocation*: the most appropriate allocation of flows from distribution points to demand points. In terms of location, suitability is usually the result of minimising transport costs. Some demand points may not be suitable for service.

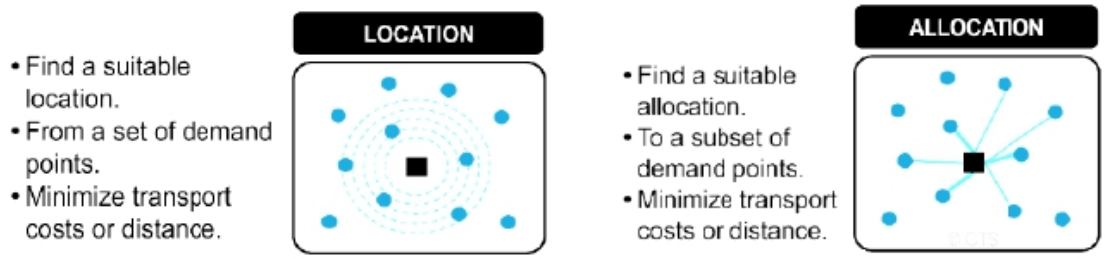


Fig. 4.11. Location-allocation models [34; 35]

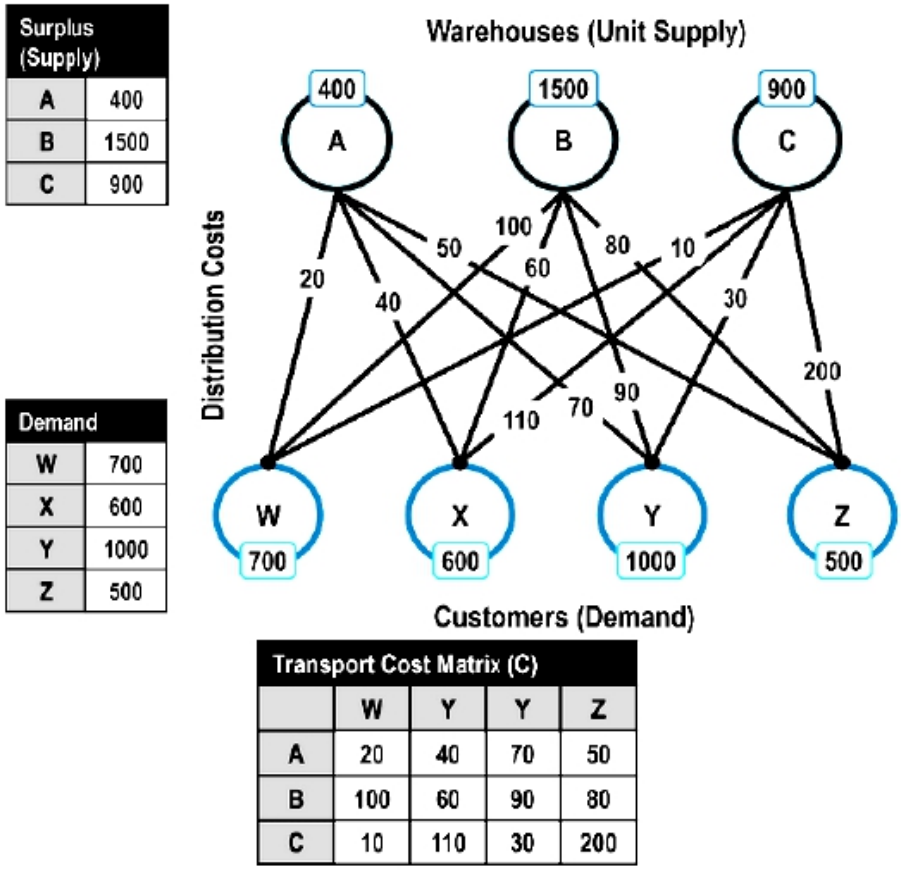
Linear programming is meant to minimise an objective linear function subject to constraints and has a wide range of applications. For transport problems, it includes an allocation considering multiple origins and destinations to optimise the solution by minimising transport costs with fixed demand, origins and destinations. It takes into account linear transport costs, known surplus (origins), demand (destinations) and possible routes. Thus, linear programming is relevant to logistics because it allows for the estimation of an optimal distribution system to assist in establishing or improving an existing distribution system. The linear programming formulation for a distribution problem is basically expressed as follows [34; 35]:

$$\begin{aligned} &Min: \sum_{a} \sum_{b} g(Q(a,b)) \\ &Subject\ to: \\ &Q(a,b) \geq 0 \end{aligned} \tag{4.1}$$

Where *Q(a,b)* is the traffic between origin *a* and destination *b*, and *g* is a cost function. So, *g(Q(a,b))* is the transport cost related to traffic *Q(a,b)*. This equation aims to minimise the sum of transport costs for each pair of origin and destination points. The traffic of each pair must be superior or equal to 0 (rule of non-negativity) [34; 35].

A supply chain manager is considering a distribution system between warehouses (A, B, and C) and customers (W, X, Y, and Z) and is looking to minimise global transport costs. The first question relates to the creation of *supply and demand matrices* where the number of units produced and consumed is the same, which implies market equilibrium. Any additional unit produced will not be transported because there is no additional demand for it, and any additional demand will not be transported because there is no additional supply for it. The *transport cost matrix* (C) in dollars per unit transported between warehouses and customers is also available. Formulation of the distribution problem is shown in Fig. 4.12 [34; 35].

For instance, it costs $20 to transport 1 unit from warehouse *A* to customer *W*. In Fig. 4.12, each warehouse and customer are a node, and each transport cost pair is a vector. With the data provided, linear programming can find an allocation with minimal transport cost. Also, this problem can be solved using the "Solver" add-in in Excel. Using heuristic method relatively simple problems (matrix of about 5 by 5) can be solved [34; 35].



Transport Cost Matrix (C)				
	W	Y	Y	Z
A	20	40	70	50
B	100	60	90	80
C	10	110	30	200

Fig. 4.12. Formulation of the distribution problem [34; 35]

The first step is to *order the transport costs* for each cell by beginning with the lowest, which has a rank of 1, to the highest. The same rank is assigned to cells having equal costs. The result is a *cost ranking matrix* (*R*). In this matrix, one need to take the cell with the lowest transport cost. In this case, it is the *C-W* cell ($10 per unit). Next, one should select the largest possible number of units in this cell and subtract this number from the number of surplus and needs in the corresponding row and column. Then the same procedure must be continued in order of rank until all surpluses are used and all requests are satisfied (the origin and destination points are 0). The result is the *allocation matrix* (*A*), representing the flows between the warehouses and the customers. Finally, the transport costs for this task must be calculated by multiplying the flow of each cell in the allocation matrix by the corresponding unit cost in the transport cost matrix (*C*A*). The total transport cost of this allocation is equal to $153,000 [34; 35].

Initial allocation is shown in Fig. 4.13. The *estimation costs matrix* (E) must be built to find if this allocation is the least cost distribution. This process takes place in stages [34; 35].

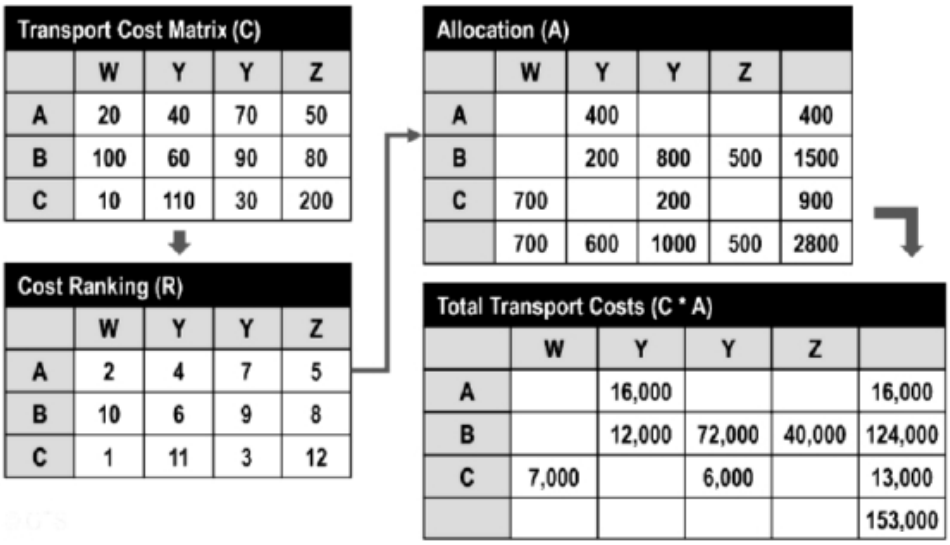


Fig. 4.13. Initial allocation [34; 35]

The outcome is a *new traffic allocation matrix* (*A'*) and its associated *transport cost matrix* (*C*A'*). New allocation is shown in Fig. 4.14 [34; 35].

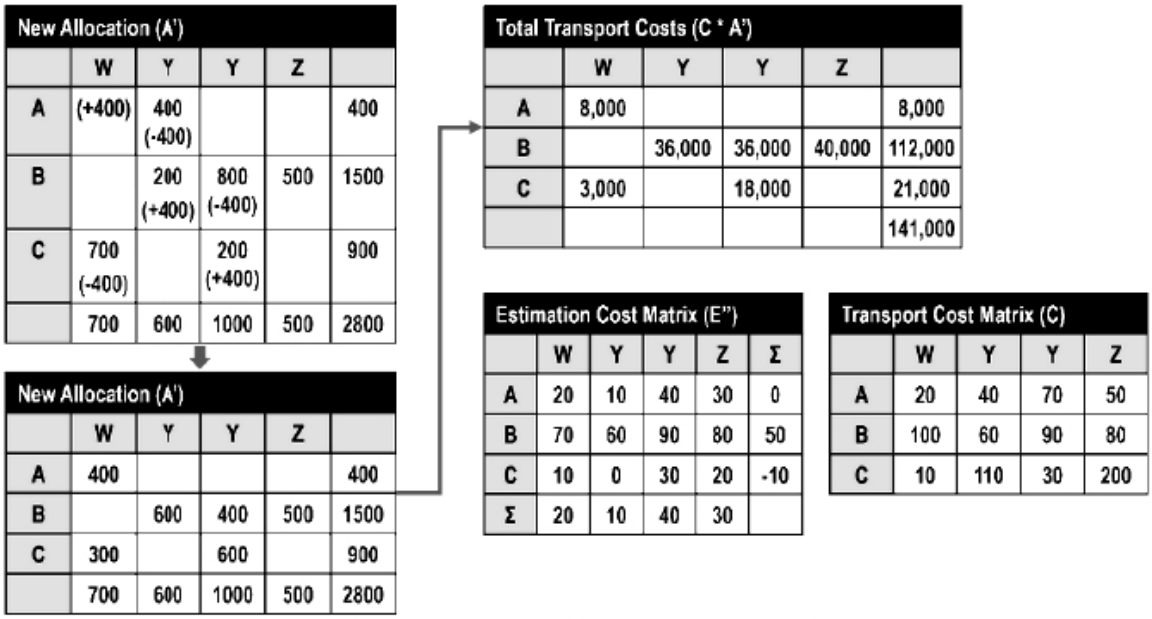
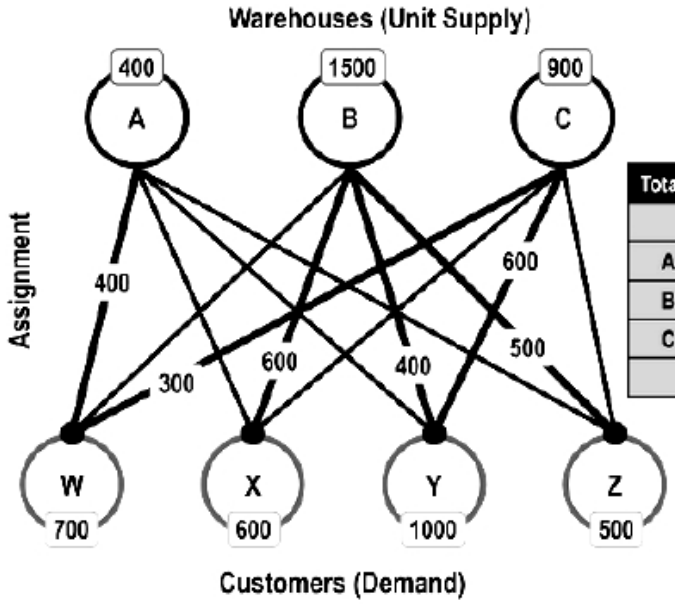


Fig. 4.14. New allocation [34; 35]

Solution to the distribution problem is shown in Fig. 4.15. The transport cost of this new allocation amounted to $141,000, which is lower than the initial figure of $153,000. To confirm if this is the optimal cost, the estimation costs matrix is again generated (*E"*). No cell in this matrix has estimation costs higher than real costs. So, the solution is optimal ($141,000 is the minimal cost) [34; 35].

Transport Cost Matrix (C)				
	W	Y	Y	Z
A	20	40	70	50
B	100	60	90	80
C	10	110	30	200

New Allocation (A')					
	W	Y	Y	Z	
A	400				400
B		600	400	500	1500
C	300		600		900
	700	600	1000	500	2800



Total Transport Costs (C * A')					
	W	Y	Y	Z	
A	8,000				8,000
B		36,000	36,000	40,000	112,000
C	3,000		18,000		21,000
					141,000

Fig. 4.15. Solution to the distribution problem [34; 35]

Discussion questions

1. What are the peculiarities of designing distribution networks?
2. Characterise the process of designing a distribution network.
3. What is needed to create a distribution network?
4. What is the first stage of the distribution network design process?
5. What are the features of the second stage of the distribution network design process?
6. What are the results for creating a distribution network?
7. What are the four main criteria, quantitative and qualitative, for designing distribution networks?
8. What are the planning factors of the distribution network design process?
9. Describe the process of designing distribution networks.
10. How is long-term optimisation ensured?
11. Why are transport costs and the required mode of transport important factors in building a distribution model?

12. What are the most relevant problems of designing a distribution network in a supply chain system?

13. What is drop-shipping?

14. Characterise the in-transit merge network.

15. What are the features of distributor storage with carrier delivery?

16. What are the main characteristics of distributor storage with last-mile delivery?

17. Describe manufacturer or distributor warehouse storage with consumer pickup.

18. What are the features of network design in the supply chain?

19. Describe the areas in building a strong network design in the supply chain.

20. What are the benefits of a strong network design in the supply chain?

21. What are the four stages that make up a global network design decision?

22. Characterise the location-distribution models.

Cases

1. Identify the features of distribution network design for the option chosen by you.

2. Characterise the stage of the distribution network design process for the selected option.

3. For the selected option, critically evaluate the results for the creation of a distribution network.

4. Choose the quantitative and qualitative criteria of designing distribution networks for the selected option.

5. For the selected option, determine how long-term optimisation will be ensured.

6. Identify the problems of designing a distribution network in a supply chain system for the selected option.

7. Determine the relevance of using drop-shipping for the selected option.

8. Using the location-distribution model, carry out calculations for the option you have chosen.

Tests

1. Key driver of the overall profitability of a firm is:

a) service;

b) distribution;
c) flexibility;
d) there is no correct answer.

2. Raw materials and components are moved:
a) from manufacturer to the end consumer;
b) from suppliers to manufacturers;
c) from suppliers to the end consumer;
d) there is no correct answer.

3. Finished products are moved:
a) from suppliers to manufacturers;
b) from manufacturer to the end consumer;
c) from suppliers to the end consumer;
d) there is no correct answer.

4. Distribution network can be used to achieve a variety of supply chain objectives:
a) ranging from high to low cost responsiveness;
b) ranging from low cost to high responsiveness;
c) ranging from low cost to high cost responsiveness;
d) there is no correct answer.

5. Companies in the same industry most often select:
a) different distribution networks;
b) similar distribution networks;
c) unprofitable distribution networks;
d) there is no correct answer.

6. A recommendation of the overall best distribution network is based on:
a) cost and service level, from warehouse to customers;
b) transportation costs, warehousing costs, inventory carrying costs and service performance levels;
c) bid management;;
d) there is no correct answer.

7. At forecast volume, various conceptual alternative networks are evaluated based on:
a) implementation management;
b) transportation costs, warehousing costs, inventory carrying costs and service performance levels;

c) cost and service level, from warehouse to customers;

d) there is no correct answer.

8. Tasks planning and managing the implementation distribution network include:

a) project detail planning;

b) bid management;

c) implementation management;

d) all answers are correct.

9. Distribution networks transform over time as:

a) businesses expand and aim to reach less consumers;

b) businesses are shrinking and aim to reach more consumers;

c) businesses expand and aim to reach more consumers;

d) there is no correct answer.

10. Satisfying overall customer demand must be done at:

a) low costs and required service levels;

b) high costs and required service levels;

c) high costs and insufficient service levels;

d) there is no correct answer.

11. Most important drivers for distribution and supply chain modelling are:

a) customer location;

b) high costs;

c) order quantity and frequency;

d) there is no correct answer.

12. Determining the order frequencies and the location of consumers:

a) aids in selecting the right type of transport needed, and the costs associated with the transportation modes and vehicles required;

b) the proper selection is made to best suit the distribution needs and ensure overall customer satisfaction;

c) exported or imported, it is also important for the businesses to identify points of entry;

d) there is no correct answer.

13. The business must determine the ideal warehouse locations, size, ease of access, and costs, to ensure the following:

a) the right type of transport needed and the costs associated with the transportation modes and vehicles required;

b) exported or imported, it is also important for the businesses to identify points of entry;

c) the proper selection is made to best suit the distribution needs and ensure overall customer satisfaction;

d) there is no correct answer.

14. The supply chain network design is defined as:

a) a working model that delineates the costs structure of a supply chain to assess the time and costs required to bring goods to the market;

b) a working model that delineates the overall framework of a supply chain to assess the time and costs required to bring goods to the market;

c) a working model that delineates the profits structure of a supply chain to assess the time and costs required to bring goods to the market;

d) there is no correct answer.

15. Tech-savvy businesses leverage the following:

a) a dynamic supply chain model to ensure that their supply chains deliver and exceed business expectations long into the future;

b) a static supply chain model to ensure that their supply chains deliver and exceed business expectations long into the future;

c) a linear insatiable supply chain model to ensure that their supply chains deliver and exceed business expectations long into the future;

d) there is no correct answer.

16. Supply chain network design as a whole is:

a) the planning and implementation of supply chain operations in the non-optimal way for long term benefits;

b) the planning and implementation of supply chain operations in the most optimum way for long term loses;

c) the planning and implementation of supply chain operations in the most optimum way for long term benefits;

d) there is no correct answer.

17. The network design in supply chain holds huge advantages in the longer , especially for businesses in the distribution channels:

a) e-commerce;

b) trade;

c) online-retail;

d) there is no correct answer.

18. Network design may help in:
a) balancing the cost and revenue in order to generate profits;
b) trade;
c) satisfying customer needs in terms of demand and responsiveness;
d) there is no correct answer.

19. Location is:
a) the most suitable location(s) considering the demand distribution;
b) the most unsuitable location(s) considering the demand distribution;
c) the most suitable location(s) considering the propose distribution;
d) there is no correct answer.

20. Allocation is:
a) the most suitable allocation of flows from points of distribution to points of propose;
b) the most suitable allocation of flows from points of distribution to points of demand;
c) the most unsuitable allocation of flows from points of distribution to points of demand;
d) there is no correct answer.

21. For transportation problems linear programming involves:
a) an allocation that considers several origins and destinations to optimize a solution by minimizing with fixed demand, origins, and destinations;
b) an allocation that considers several origins and destinations to not optimize a solution by maximising with fixed demand, origins, and destinations;
c) an allocation that considers several origins and destinations to optimize a solution by maximising with fixed demand, origins, and destinations;
d) there is no correct answer.

22. Suitability is commonly the outcome of:
a) maximising transportation costs, often using distance as a proxy;
b) minimizing transportation costs, often using distance as a proxy;
c) optimizing transportation costs, often using distance as a proxy;
d) there is no correct answer.

23. Location-allocation models are designed to:
a) assess the most suitable location for a middle or public of facilities to serve a defined demand;

b) assess the most suitable location for a single or group of facilities to serve a defined demand;

c) assess the most suitable location for a ring or complex of facilities to serve a defined demand;

d) there is no correct answer.

24. Any additional unit being produced would not be transported because:

a) there is no additional demand;

b) there is no additional supply;

c) there is no additional propose;

d) there is no correct answer.

25. Any additional demand will not be transported because:

a) there is no additional demand;

b) there is no additional supply;

c) there is no additional propose;

d) there is no correct answer.

26. The estimation costs matrix built to:

a) find if this allocation is the most cost distribution;

b) find if this allocation is the least cost distribution;

c) find if this allocation is the least revenue distribution;

d) there is no correct answer.

27. To confirm the optimal cost:

a) the estimation costs matrix is generated;

b) the estimation profits matrix is generated;

c) the estimation benefits matrix is generated;

d) there is no correct answer.

28. Estimation costs is:

a) sometimes higher than real costs;

b) not higher than real costs;

c) always higher than real costs;

d) there is no correct answer.

5. DESIGNING GLOBAL SUPPLY CHAIN NETWORKS

5.1. THE IMPACT OF GLOBALIZATION AND TRANSNATIONALIZATION ON SUPPLY CHAIN NETWORKS

Increasing globalisation has created great opportunities but also heightened risks for supply chain development. Globalisation calls for determining the risk sources for global supply chains, developing risk management strategies, elaborating methodologies applied to assess decisions on network design in an environment of uncertainty, and displaying of how it improves global supply chain decisions [17].

Companies are finding it possible to increase revenues and reduce costs at the same time due to intensification of globalisation processes. Emerging markets accounted for more than a third of the leading companies' sales growth, generating profit margins on par with those in developed markets [17]. Clothing and consumer electronics are examples of industries where globalisation has provided considerable benefits for cutting costs. In consumer electronics, the emphasis is on small-size, lightweight, high-value products being comparatively easy and cost-effective to transport. Businesses have benefited from significant economies of scale by concentrating the manufacturing of standardised electronic parts in one location to be used in a wide range of products worldwide. Clothing production is highly labour intensive, and the goods are relatively light and inexpensive to ship. Businesses have taken advantage of globalisation by relocating a large part of their apparel production to countries with low labour costs, notably China [17].

However, it should be noted that the globalisation advantages frequently involve considerable added risks. Being able to introduce appropriate risk reduction measures into supply chain design is what determines the success of global supply chains and those that fail [17].

Global supply chain management covers all the processes involved in the product life cycle, starting with its concept, through distribution to the final point of sale. The goal of global supply chain management is to improve the productivity of every point in the lifecycle, eliminate inefficiencies and ensure timely and uninterrupted delivery of products [37].

In the survey, the results of which are shown in Table 5.1, respondents classified risks in global supply chains and identified the drivers of these risks. Over a third said they were impacted by natural disasters, fuel price fluctuations and supply chain partners [17; 36].

Table 5.1

Results of Accenture Survey on sources of risk that affect global supply chain performance [17; 36]

Risk Factors	Percentage of Supply Chains Affected
Natural disasters	35
Shortage of skilled resources	24
Geopolitical uncertainty	20
Terrorist infiltration of cargo	13
Volatility of fuel prices	37
Currency fluctuation	29
Port operations/custom delays	23
Customer/consumer preference shifts	23
Performance of supply chain partners	38
Logistics capacity/complexity	33
Forecasting/planning accuracy	30
Supplier planning/communication issues	27
Inflexible supply chain technology	21

Businesses with highly efficient supply chains generate higher revenues compared to average logistics companies. CEOs need to figure out solutions to reshape global supply chain management while adapting to evolving customer demands [37].

In the management of a food company, supply chain management is a vital aspect of running a business, and forecasting demand can be a very difficult task. Any CEO will have experienced the bullwhip effect, meaning the ups and downs of consumer demand that hit a raw material supplier hard. With strong supply chain management software, managers are able to access a continuous real-time data stream. They can use this data to forecast demand more effectively and respond quickly to changing customer needs. In doing so, challenges including the bullwhip effect can be addressed [37].

The globalised industry is experiencing a major change in paradigm, moving from locally based operations to extensive global supply chain networks. As the manufacturing sector scales up to embrace and harness the potential of intertwined supply chain networks covering the globe, the following trends are emerging [38]:

Access to Multiple Markets. Producers can reach multiple and large markets worldwide. Optimised global supply chains enable them to reach consumers in various regions, broaden their market coverage and expand their customer base.

Risk Management and Resilience. A global supply chain network ensures inbuilt resilience. Supplier and production location diversity allows reducing the risks related to geopolitical issues, natural disasters or other disruptions in a particular region.

Strategic Inventory Allocation. Strategic inventory deployment around the world gives producers the ability to react quickly to changes in demand. As a result, orders are fulfilled on time, lead times are reduced, and overall customer satisfaction is improved.

Regulatory Compliance and Market Access. A strong global supply chain network enables producers to successfully navigate the regulatory environment, enhancing market access and facilitating international trade.

Economies of Scale. Mass production and multi-market distribution help to reduce unit costs and boost profitability. For the future of manufacturing, the capacity to manage and optimise global networks is integrally linked to the ability to innovate, be efficient and competitive within a global context.

5.2. RISK MANAGEMENT IN GLOBAL SUPPLY CHAINS

Modern global supply chains are exposed to more risk factors compared to local supply chains in the past. Such risks cover supply disruptions, delivery delays, demand volatility, price changes and exchange rate fluctuations [17].

Having access to real-time supply chain data, timely analytics, and back-up planning allows managers to seamlessly address supply chain risks, which means they can anticipate emergencies and disruptions that could lead to negative consequences for the whole business. [37].

By integrating Internet of Things (IoT) solutions, businesses can increase transparency and get better control over their operations. Telematics devices enable companies to minimise risks related to delays, product loss, product quality events, and other issues that may occur during transportation or managing inventory. Furthermore, IoT can be applied to detect supply chain management weaknesses through machine learning, cryptographic monitoring of equipment, and other methods to mitigate the effects of unforeseen malicious events [37].

Global supply chains are becoming increasingly sophisticated and essential for many companies to maintain their competitiveness. This

interconnected and complex nature of transboundary supply chains exposes them to numerous risks, among them cybersecurity threats, delays, unexpected events such as COVID-19, and numerous other negative impacts. Fortunately, new global supply chain technologies can significantly increase the transparency of the entire chain, providing greater flexibility and resilience [37].

An efficient supply chain network structure may be important in addressing supply chain risks. For example, the availability of multiple suppliers reduces the risk of supply disruptions from one supplier. The supply chain risks that should be considered when designing a network are summarised in Table 5.2 [17; 39].

Table 5.2

Supply chain risks to be considered during network design [17; 39]

Category	Risk Drivers
Disruptions	Natural disaster, war, terrorism
	Labor disputes
	Supplier bankruptcy
Delays	High capacity utilization at supply source
	Inflexibility of supply source
	Poor quality or yield at supply source
Systems risk	Information infrastructure breakdown
	System integration or extent of systems being networked
Forecast risk	Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base
	Information distortion
Intellectual property risk	Vertical integration of supply chain
	Global outsourcing and markets
Procurement risk	Exchange rate risk
	Price of inputs
	Fraction purchased from a single source
	Industrywide capacity utilization
Receivables risk	Number of customers
	Financial strength of customers
Inventory risk	Rate of product obsolescence
	Inventory holding cost
	Product value
	Demand and supply uncertainty
Capacity risk	Cost of capacity
	Capacity flexibility

It is crucial to design individual risk mitigation strategies when designing the network to ensure a proper balance between the number of risks addressed and the cost increases. Some individual risk mitigation strategies are presented in Table 5.3 [17; 39].

Table 5.3

Individual risk mitigation strategies during SC network design [17; 39]

Risk Mitigation Strategy	Tailored Strategies
Increase capacity	Focus on low-cost, decentralized capacity for predictable demand. Build centralized capacity for unpredictable demand. Increase decentralization as cost of capacity drops.
Get redundant suppliers	More redundant supply for high-volume products, less redundancy for low-volume products. Centralize redundancy for low-volume products in a few flexible suppliers.
Increase responsiveness	Favor cost over responsiveness for commodity products. Favor responsiveness over cost for short–life cycle products.
Increase inventory	Decentralize inventory of predictable, lower-value products. Centralize inventory of less predictable, higher-value products.
Increase flexibility	Favor cost over flexibility for predictable, high-volume products. Favor flexibility for unpredictable, low-volume products. Centralize flexibility in a few locations if it is expensive.
Pool or aggregate demand	Increase aggregation as unpredictability grows.
Increase source capability	Prefer capability over cost for high-value, high-risk products. Favor cost over capability for low-value commodity products. Centralize high capability in flexible source if possible.

Flexibility is essential in coping with the various risks and uncertainties that a global supply chain encounters. Flexibility comes in three broad categories – new product flexibility, product mix flexibility and volume flexibility [17].

New product flexibility is the ability of a company to bring new products to market quickly. New product flexibility is vital in a fast-changing, highly competitive environment with advancing technology and rapid shifts in consumer demand [17].

Product mix flexibility means the ability to manufacture diverse products in a short time frame. It is crucial in a market where demand for specific products is small or extremely volatile, raw material supplies are unstable and technology is advancing rapidly [17].

Volume flexibility is the ability of an enterprise to run profitably at different production levels. It is important in cyclical industries to have volume flexibility [17].

5.3. GLOBAL SUPPLY CHAIN STRATEGY

When deciding how to design a global supply chain in terms of uncertainty, managers should consider the insights that will assist with making improved network design decisions, as shown in Fig. 5.1 [17].

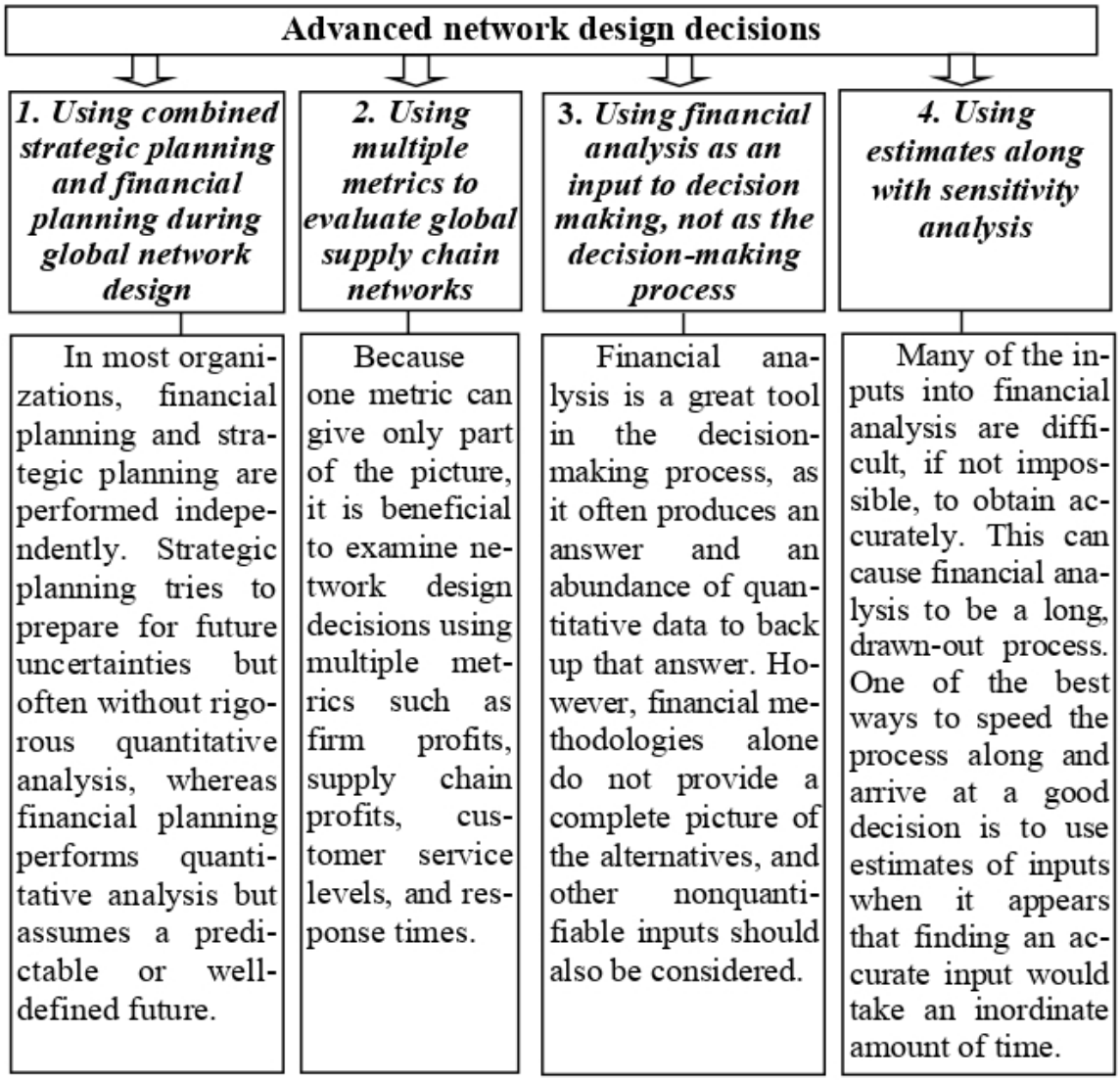


Fig. 5.1. Advances supply chain network design decisions [17]

The global economy refers to the phase in which multiple types of global supply chain strategies exist, such as multinational companies, global corporations, and local companies [40].

The drivers of the global economy encompass global market conditions, technological, global costs, political and macroeconomic factors. These drivers are usually viewed directly in terms of competition. For

instance, intensified international competition increases the difficulty of operating in the domestic market [40].

Different types of ***Supply Chain Models*** can affect a company's supply chain management [40]:

The continuous flow model is the optimal option for industries and firms operating in a stable manner. Stability is important for this model since it is required by both parties, i.e. the producer and the customer.

The fast chain is most appropriate for businesses requiring fast turnaround times. It is perfect for fashion companies that need to respond swiftly to market trends.

The efficient chain model is a good option for companies operating in the production industry or requiring a high degree of automation.

The agile model is suitable for companies operating in the technology industry or requiring a high level of personalisation and adaptability.

The individually configured model is the optimal option for companies requiring a high degree of customization. It is appropriate for companies operating in the automotive industry or for companies requiring a high personalisation level.

The flexible model is suitable for companies that need a high adaptability. It is good for companies in the healthcare sector or requiring a high responsiveness level.

The best and the strongest organizations survive due to the carefully designed ***Global Supply Chain Strategy***. The Oracle suggests some tactics to achieve better SCM [37; 41]:

1. *Make detailed demand forecasts to better understand the market and respond to changes instantly.* Accurate forecasting and contingency planning ensure a complete picture of business processes and prompt response to disturbances such as natural disasters, political disruptions, supplier communication issues, etc. that can cause production and logistics operations to be affected. Leaders can adjust pricing and promotional strategies to respond to demand, launch new products faster, speed up revenue streams, or increase margins for a trending product with an undersupplied market. The most important thing is to be prepared to use unforeseen events to an advantage and address negative consequences so that the company remains successful and at the leading edge. As advanced technologies such as blockchain, the Internet of Things, and robots develop, supply chains are becoming more sustainable, flexible, transparent, and manageable.

2. *Create an agile supply chain with precise planning and integrated solutions*. With business leaders equipped with better insight and the ability to instantly adjust to changing demand and risks, building supply chains that respond to continuously changing industry trends is the next step. To ensure SCM's agility, companies must use flexible planning tools and adapt operations on an ongoing basis. The latest model of global supply chain management takes into account new developments and reacts quickly to them, which minimizes disruptions to the entire network. The integration of the advanced technologies, such as autonomous vehicles, interconnected warehousing and inventory management devices, smart contracts on the blockchain, and AI-powered drones, gives businesses superior transparency, improved chain-wide collaboration, easier forecasting of sourcing and delivery related issues, just-in-time manufacturing, real-time tracking of shipments, efficient warehousing, and improved decision-making.

3. *Align product development with supply and manufacturing operations to speed up successful innovation*. Implementing innovations enables companies to remain competitive. To succeed, however, products should be developed cost-effectively, in the right place and at the appropriate time. Product management has to be optimised with suppliers, producers and transport processes. The current budget must be thoroughly analysed to maintain a full-cycle business in balance. In addition, product innovation and competitiveness are intertwined with the selection and support of suppliers and technologies. By controlling the information, people, operations, and decisions related to the product lifecycle, a company is able to lead the industry.

4. *Facilitate the implementation of green initiatives as part of global supply chain management to improve the company's image and business in whole*. Following a socially and environmentally responsible approach, organisations build a better reputation, gain strong competitive advantages, improve manufacturing and supplier relations, and increase employee engagement. Sustainability initiatives in SCM have the potential to create numerous opportunities. It is essential for managers to incorporate a green focus into SCM as an integral part of logistics. Implementing green practices will enhance supply chain processes, from cost-efficient alternative energy sources to improving the company's image.

Then, CEOs must deal with wasteful energy consumption and ensure real-time visibility. Doing so will help reduce carbon footprints, ensure responsible use of energy sources, minimise waste through recycling and optimal routing. Companies can stay in business and ahead of the competition by consistently improving by conducting regular reviews, audits, and learning new skills. By performing regular compliance audits and benchmarking best practices, a firm is able to ensure sustainability in its supply chain.

5. *Ensure a regular supply of products that can be easily predicted*. Businesses cannot meet required service levels without a steady supply of goods. This can result in significant losses and, even more seriously, supply disruptions. Responsible managers should therefore improve operational performance to guarantee that the supply chain runs smoothly. Thanks to robust SCM software, all of the company's production processes can be synchronised and integrated with demand planning activities.

The real-world examples of supply chain management strategies are shown in Fig. 5.2. They clearly demonstrate how different successful companies implement customised supply chain management strategies to improve efficiency, customer satisfaction and build competitive advantage, proving the vital role of supply chain management in achieving business success [42].

The benefits of a resilient supply chain strategy. The warehouse automation industry continues to emphasise the importance of a well-designed supply chain strategy for a reason. Following are the key benefits of a sustainable supply chain strategy [42]:

Benefit 1: Increased agility. This allows companies to respond quickly to disruptions, ensuring uninterrupted operations and customer service, essential for building trust and maintaining customer satisfaction.

Benefit 2: Enhanced risk management. Detecting potential risks and vulnerabilities in the supply chain helps companies develop effective risk minimisation strategies, reducing the exposure to disruption and protecting against major operational failures.

Benefit 3: Competitive advantage. A resistant supply chain assures that a business can keep up or even improve delivery times and product availability in times of difficulty, providing a strong advantage over competitors struggling to deal with the same issues. Investing in a resilient

supply chain strategy therefore serves as not only a way to protect a business from unpredictable challenges, but also to ensure that it is well positioned in a competitive marketplace, ensuring long-term sustainability and growth.

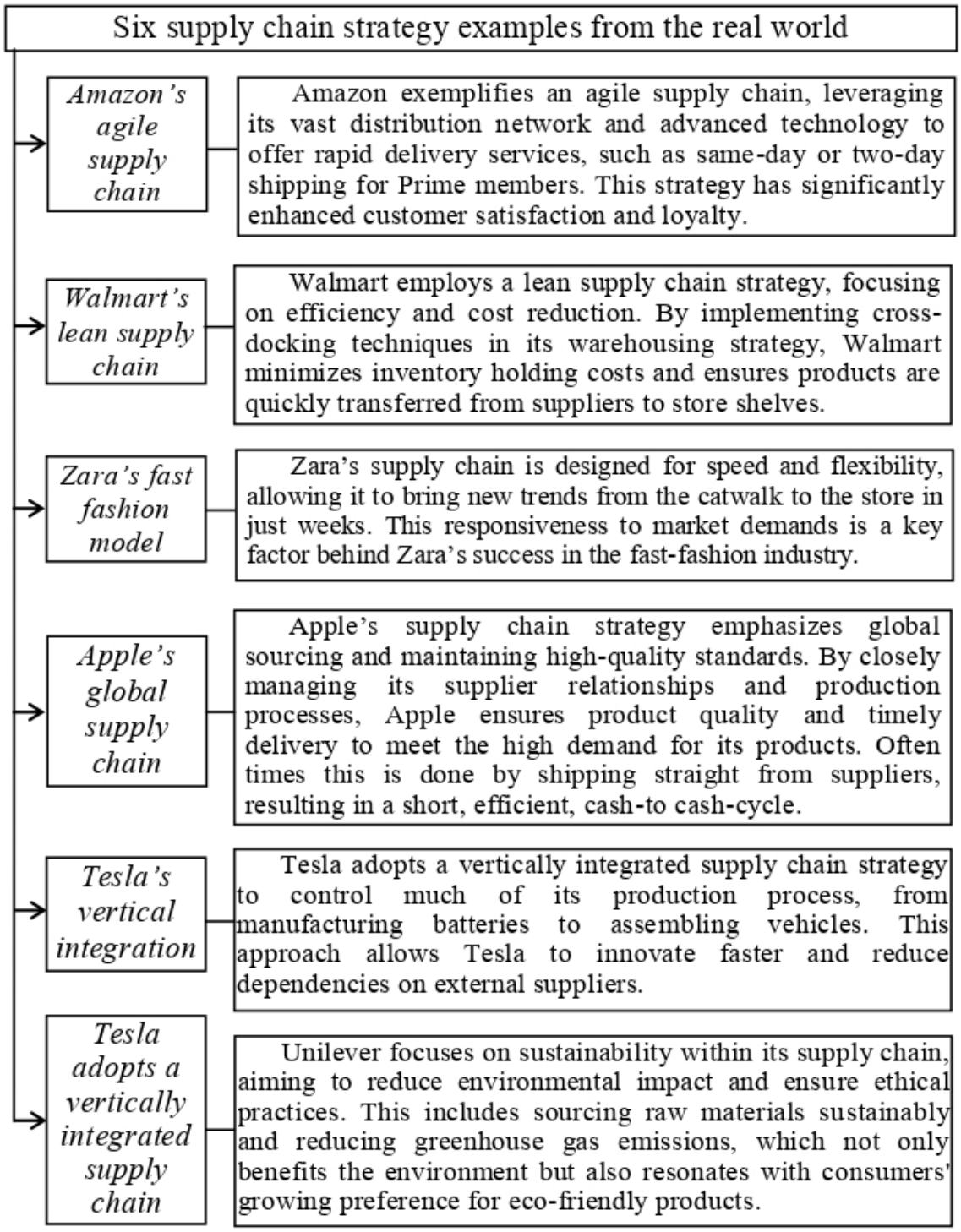


Fig. 5.2. Real-world examples of supply chain management strategies [42]

5.4. EUROPEAN TECHNOLOGY PLATFORM FOR LOGISTICS

Within ALICE, the European Technology Platform for Logistics, a working group is dedicated to the coordination and cooperation between stakeholders in global supply chains. Coordinating and collaborating relates to vertical and horizontal synergies along and across the various supply chains, respectively. Supply chain coordination refers to the synchronisation and dynamic updating of logistics and transport plans for different transport modes and participants (producers, retailers, logistics providers, carriers, terminal operators, etc.) [43].

For ALICE, one of the core components outlined as a vision to deliver this improvement is the concept of the Physical Internet (PI). The PI envisages the creation of an open global logistics system based on physical, digital and operational interconnectivity, by encapsulating goods, developing interfaces and protocols, to transport, store, sell, deliver and use physical objects globally in a way that is cost-effective, environmentally and socially efficient and sustainable [43].

There are five distinct areas that ALICE has pinpointed that require specific analysis and addressing for further study and innovation to achieve its mission. These areas are as follows [43]:

- Sustainable and secure supply chains.
- Corridors, hubs and synchromodality.
- Information systems for interconnected logistics.
- Global supply network coordination and collaboration.
- Urban logistics.

In the coming decade, the shift from the currently independent supply chains, in which transport and logistics resources are not shared or available to different cargoes and shippers, to open global networks, which make resources compatible, accessible and interconnected, is a key development. This will allow the introduction of innovative cargo management practices in two main spheres [43]:

- Cooperation in the supply chain is aimed at maximum utilisation of resources, namely vehicles and infrastructure capacity, aligning demand from different shippers with available transport and logistics services from different modes and service providers. It is also referred to as horizontal cooperation. It involves several companies operating at the same level of the supply chain and performing the same logistics functions.

• Coordination of the supply chain involves the provision of door-to-door services by synchronising and dynamically updating logistics and transport plans for multiple transport modes and participants (retailers, logistics providers, carriers, etc.). Such a practice is called vertical cooperation. It is described and defined in the Roadmap 'Corridors, Hubs and Synchronicity'.

Coordination and cooperation have the potential to create synergies in the use of resources across global supply chains, bringing considerable efficiency and sustainability benefits. It will be a major advancement towards the physical internet, leading ultimately to open global supply chains operating as one, with full vertical coordination and horizontal collaboration up and down supply chains that are currently managed individually. The relationship between the roadmaps is shown in Fig. 5.3 [43].

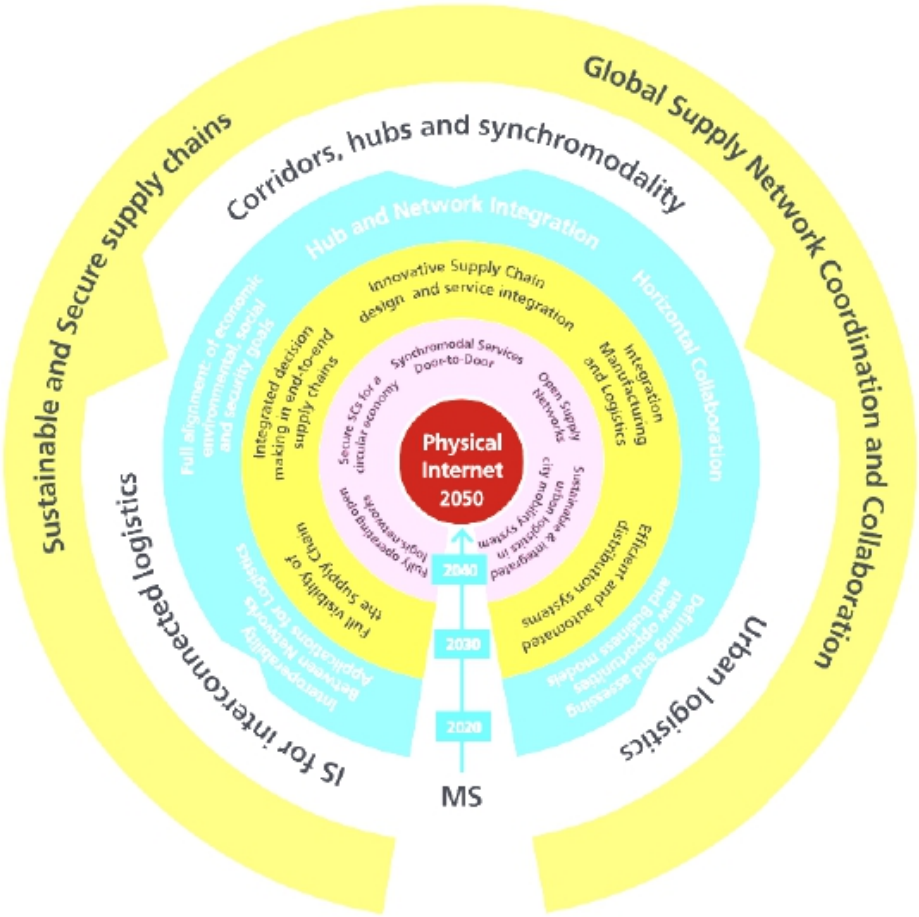


Fig. 5.3. Interrelation between roadmaps

Collaborative supply network design key elements are shown in Table 5.3 [43].

Table 5.3

Collaborative supply network design key elements [43]

RESEARCH CHALLENGES	INNOVATIONS AND EXPECTED RESULTS	BARRIERS TO OVERCOME	EXPECTED SECONDARY IMPACTS	EXPECTED PRIMARY IMPACT
Strategic collaborative logistic network design	Business models and creation of a databank for match-making on macro level to find possible collaboration partners. Tooling for network analysis of typology and characteristics of logistic flows, taking into account affinity in products and processes, raw materials, bill of material, functionalities, handling and transport units, packaging materials, etc.	Exchange of sensitive data. Sharing supply chain with partners. New business models. Legal agreements. Antitrust rules.	+ Asset utilization. + Load factors. + Transport routes optimization. - Empty Kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Tactical planning and execution of collaborative networks	Collaborative planning and tools for daily optimization of collaborative networks, maximizing shared and complementary resources usage. Approaches and tools for supply chain execution and event management enabling users to manage operations in the physical internet, exploiting internet-of-things and big data availability.	Sharing responsibilities. Choice of common logistic service provider. Sharing goals. Gain sharing mechanisms.	+ Asset utilisation. + Load factors. + Transport routes optimisation. - Empty kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Resilience capabilities and risk management of collaborative networks	Methods and tools to ensure risk management and development of resilience capabilities in collaborative supply networks, including definition of quantitative metrics for the assessment of network risk and resilience.	Exchange of confidential data. Agreements on insurance, etc...	+ Reliability of transport schedules. + Perfect order fulfilment. - Risk factor reduction. + Supply Chain Adaptability and Flexibility.	+ Customer satisfaction. - Cargo lost to theft or damage. - Total supply chain costs.
Business models and change management for collaborative services	Proven business models and change management approaches for traditional carriers, forwarders and other services providers to develop new services in open collaborative networks.	Mental shift of participants. Cultural fit of collaborating companies.	+ Load factors. + Asset utilization. + Reliability of transport schedules. + Perfect order fulfilment. + Decoupling logistics intensity from GDP. - Empty kilometres.	+ Customer satisfaction. - Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Cargo lost to theft or damage. - Supply chain costs.

The goal is to ensure that resources are utilised to the maximum extent possible by sharing information across an open supply chain (multiple control centres), aligning forecast demand and inventory allocation plans with the availability of logistics services. This will promote several efficiency-focused management approaches, including supplier-led inventory management models [43].

Supply network coordination key elements are given in Table 5.4 [43].

Table 5.4

Supply network coordination key elements

RESEARCH CHALLENGES	INNOVATIONS AND EXPECTED RESULTS	BARRIERS TO OVERCOME	EXPECTED SECONDARY IMPACTS	EXPECTED PRIMARY IMPACT
Coordinated planning of supply chain and logistic services	Supply chain planning methods and tools integrated with transport and logistics services planning, covering the entire door-to-door chain.	Data sharing. Interconnection of IT platforms. Shared warehouses.	+ Load factors. + % Synchromodal. + Asset utilization. + Supply Chain Visibility. + Reliability of transport schedules. + Transport actors using automatic data exchange. - Empty Kilometres. - Waiting time in terminals.	+ Customer satisfaction. - Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Synchronization and dynamic update of logistics operations in open networks	Tools for autonomous coordination based on the internet-of-things (automated reporting, self-controlled sub-systems). Governance models and cases to bridge gap between technological research and innovation.	Data availability and reliability. Governance of common systems.	+ Volume flexibility (Time to +/- capacity). + % Synchromodal. + Supply Chain Visibility. + Reliability of transport schedules. + Transport routes optimization. - Risk factor.	+ Customer satisfaction. + Return on assets and working capital. - Total supply chain costs.
Overcoming data-sharing barriers in collaborative networks	Approaches and policies to enable wide scale adoption of data-sharing solutions. Governance models to bridge gap between research and innovation in logistics data sharing, supported by proven and demonstrable business cases.	Data sharing. Interconnection of IT platforms.	+ Supply Chain Visibility. + Transport actors using automatic data exchange. + Cargo and logistics units integrated in the automatic data exchange.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.

An integration and synchronisation of transport/supply chain logistics with the production, sales and distribution planning of companies should aim to facilitate the seamless coordination of value chains by producers, distributors, logistics providers and retailers [43].

Discussion questions

1. What opportunities does globalisation provide for supply chains?
2. Characterise the risks in global supply chains.
3. What are the ways to transform the global supply chain?
4. What is the nature of demand forecasting in the global supply chain?
5. What are the features of access to various markets in the global supply chain?
6. What are the prerequisites for reducing risks and ensuring sustainability in the global supply chain?
7. What are the features of strategic inventory allocation in global supply chain management?
8. What are the features of regulatory compliance and market access in global supply chain management?
9. Characterise the economies of scale in global supply chain management.
10. What supply chain risks should be considered when designing a global supply chain?
11. What are the individual risk mitigation strategies for designing a global supply chain?
12. What are the best solutions when designing a global supply chain?
13. What are the types of supply chain models that can affect the global supply chain?
14. Describe the tactics to achieve better global supply chain management from Oracle.
15. What are some examples of strategy in the global supply chain from the real business world?
16. What are the benefits of a sustainable strategy in the global supply chain?
17. Characterise the European Technology Platform for Logistics.
18. What is the relationship between the roadmaps in ALICE?
19. What are the key elements of designing a collaborative supply chain network?
20. Describe the key elements of supply chain coordination.

Cases

1. Identify the characteristics of the risks for the global supply chain option chosen by you.

2. For your chosen option, forecast demand in the global supply chain.

3. Critically evaluate the prerequisites for risk mitigation and sustainability in the global supply chain for the option you have selected.

4. For the chosen option, select the quantitative and qualitative designing of distribution networks.

5. Determine the possibility of economies of scale for the selected option.

6. For the chosen option, evaluate the possibility of applying individual risk mitigation strategies in the distribution network design.

7. Identify the current type of supply chain model for the company you have selected.

8. Evaluate tactics to achieve better global supply chain management for the selected company.

9. Is it possible to realise the benefits of a sustainable strategy in the global supply chain for the company you have chosen?

Tests

1. Globalization offers companies opportunities to:

a) simultaneously increase revenues and decrease costs;

b) simultaneously equalize revenues and decrease costs;

c) simultaneously reduce revenues and decrease costs;

d) there is no correct answer.

2. More than a third of the top companies' sales growth was from:

a) deteriorating markets;

b) developing markets;

c) developed markets;

d) there is no correct answer.

3. Industries for which globalization has offered significant cost reduction opportunities:

a) apparel;

b) technique;

c) consumer electronics;

d) there is no correct answer.

4. In an era of globalization, the world industry is undergoing a paradigm shift, transitioning from:

a) localized operations to expansive global supply chain networks;

b) global operations to expansive global supply chain networks;
c) global operations to localized supply chain networks;
d) there is no correct answer.

5. A well-optimized global supply chain allows for:
a) reaching consumers in different regions;
b) expanding market reach;
c) diversifying customer bases;
d) all answers are correct.

6. A global supply chain network provides:
a) built-on resilience;
b) built-in resilience;
c) built-off resilience;
d) there is no correct answer.

7. Strategic placement of inventory across global locations enables manufacturers to:
a) respond swiftly to supply fluctuations;
b) respond swiftly to demand fluctuations;
c) respond swiftly to system fluctuations;
d) there is no correct answer.

8. Diversifying suppliers and manufacturing locations helps mitigate risks associated with:
a) geopolitical events;
b) natural disasters or other disruptions in a specific region;
c) implementation management;
d) all answers are correct.

9. A well-designed global supply chain network allows manufacturers to:
a) navigate regulatory landscapes effectively;
b) facilitating market access and trade;
c) systemise public relations;
d) there is no correct answer.

10. Bulk production and distribution across diverse markets contribute to:
a) high per-unit costs and improved overall profitability;
b) lower per-unit costs and improved overall profitability;
c) high per-unit costs and improved public profitability;
d) there is no correct answer.

11. Global supply chains today are subject to risk ____ factors than localized supply chains of the past:

a) less;

b) more;

c) few;

d) there is no correct answer.

12. The following helps managers run impeccable supply chain risk management:

a) access to real-time supply chain data;

b) on-time analytics;

c) backup planning;

d) all answers are correct.

13. By implementing the Internet of Things (IoT) solutions, companies get:

a) improved transparency;

b) system operation activities;

c) gain more control over operational activities;

d) there is no correct answer.

14. Telematics devices can help companies mitigate such risks as:

a) product losses;

b) events that compromise the quality of goods;

c) other concerns that arise during transportation or inventory management;

d) all answers are correct.

15. Good network design can play:

a) an insufficient role in mitigating supply chain risk;

b) a role in mitigating supply chain risk;

c) a significant role in mitigating supply chain risk;

d) there is no correct answer.

16. Flexibility can be divided into categories:

a) new product flexibility;

b) mix flexibility;

c) volume flexibility;

d) all answers are correct.

17. New product flexibility refers to:

a) a firm's ability to operate profitably at different levels of output;

b) a firm's ability to introduce new products into the market at a rapid rate;

c) the ability to produce a variety of products within a short period of time;

d) there is no correct answer.

18. Mix flexibility refers to:

a) a firm's ability to operate profitably at different levels of output;

b) the ability to produce a variety of products within a short period of time;

c) a firm's ability to introduce new products into the market at a rapid rate;

d) there is no correct answer.

19. Volume flexibility refers to:

a) a firm's ability to operate profitably at different levels of output;

b) a firm's ability to introduce new products into the market at a rapid rate;

c) the ability to produce a variety of products within a short period of time;

d) there is no correct answer.

20. The global economy is a stage where different types of global supply chains strategy perform, such as:

a) multinational companies;

b) global companies and domestic companies;

c) non-local companies;

d) there is no correct answer.

21. The forces shaping the global economy include:

a) the global market;

b) technological and global cost;

c) political and macroeconomic forces;

d) all answers are correct.

22. Increased foreign competition makes competing in the local market:

a) more challenging;

b) less challenging;

c) more problematic;

d) there is no correct answer.

23. Enhanced adaptability:

a) empowers identifying potential risks and weaknesses within the supply chain allows companies to devise effective mitigation strategies, minimizing the impact of disruptions and safeguarding against significant operational setbacks;

b) empowers businesses to swiftly navigate through disruptions, guaranteeing continuous operations and service delivery to customers, which is crucial for maintaining trust and satisfaction;

c) ensures that a business can maintain, or even improve, delivery times and product availability during challenges, offering a significant edge over competitors who might be struggling to cope with similar issues;

d) there is no correct answer.

24. Improved risk management:

a) empowers identifying potential risks and weaknesses within the supply chain allows companies to devise effective mitigation strategies, minimizing the impact of disruptions and safeguarding against significant operational setbacks;

b) ensures that a business can maintain, or even improve, delivery times and product availability during challenges, offering a significant edge over competitors who might be struggling to cope with similar issues;

c) empowers businesses to swiftly navigate through disruptions, guaranteeing continuous operations and service delivery to customers, which is crucial for maintaining trust and satisfaction;

d) there is no correct answer.

25. Competitive advantage:

a) ensures that a business can maintain, or even improve, delivery times and product availability during challenges, offering a significant edge over competitors who might be struggling to cope with similar issues;

b) empowers identifying potential risks and weaknesses within the supply chain allows companies to devise effective mitigation strategies, minimizing the impact of disruptions and safeguarding against significant operational setbacks;

c) empowers businesses to swiftly navigate through disruptions, guaranteeing continuous operations and service delivery to customers, which is crucial for maintaining trust and satisfaction;

d) there is no correct answer.

6. AGGREGATE PLANNING SYSTEMS IN THE SUPPLY CHAIN MANAGEMENT

6.1. INTRODUCTION IN AGGREGATE PLANNING ON SUPPLY CHAIN NETWORKS

If a manufacturing enterprise has poor operational efficiency and effective planning, then applying aggregate planning to the entire supply chain may be a feasible option. Aggregate planning in supply chain management in a manufacturing enterprise is critical when trying to improve production efficiency. While trying to view the supply chain needs months in advance, aggregate planning techniques can be used [44].

Such an approach allows for a full understanding of what inventory is needed to satisfy the demand for products. By placing orders for the full planning period, wholesale discounts can be obtained and, as a result, shortages can be avoided. Prior to incorporating aggregate planning into the supply chain, it is essential to learn some of the elements of aggregate planning and the supply chain [44].

Aggregate planning in supply chain management includes the following aspects [44]:

1. *Solid Demand Forecast*. Predicting product demand is vital in helping to plan supply. Based on past data, together with industry trends and projections, the demand for products in the coming period can be accurately forecasted. This prediction will show how much output is needed to satisfy demand, so to know how much supply will be required to keep productivity up.

2. *Production Capacity*. Production capacity depends on equipment, labour and efficiency. It refers to the use of production capability to set realistic production targets that take into account the need for human resources and equipment maintenance.

3. *Limitations on Capital*. Regardless of the number of supplies to order, it is important to be aware there may be a limit to the available capital. In case there are plans to borrow money to purchase supplies, there is a need to include the cost of interest in the profit calculation that will be generated from the production. Therefore, it is important to make

sure that capital for purchasing materials needed is adequate and available.

Aggregate planning is essential for production companies looking to improve their production planning across the manufacturing process. Aggregate planning can be enabled by the Advanced Planning and Scheduling (APS) system and increase the operational performance of the production. APS software allows users to visualise the production plan and manage areas that need to be optimised. Eventually, this results in increased profits, reduced waste, and an entirely improved operation. Aggregate planning and APS software is being introduced in production globally, and companies are getting advantages from their use [44].

Advanced Planning and Scheduling (APS) software solutions have been made essential to modern production operations because of increasing customer demand for a wider product range and faster delivery, along with pressure to reduce costs. APS can be easily integrated with ERP/MRP software to close the gaps between these systems where flexibility and accuracy in planning and scheduling are lacking. APS enables planners to reduce time by offering greater flexibility to update constantly changing priorities, manufacturing schedules and inventory plans. By implementing Advanced Planning and Scheduling (APS) software, production operations can be brought to a higher degree of production efficiency by leveraging the operational data already available in ERP [44].

By systemising approaches to supply chain planning, the following key elements can be noted [44]:

1. Developing optimised schedules that balance production efficiency with delivery efficiency.

2. Maximising output at bottlenecks to generate more revenue.

3. Synchronising supply and demand to optimise inventory.

4. Providing transparency of production capacities throughout the company.

5. Facilitating decision-making based on scenario data.

The common aggregate planning problem involves identifying production volumes, inventory held in the supply chain, employee hiring and firing, overproduction, backorders, and demand fulfilment levels to minimise costs or maximise profits. This represents the most common challenge in the supply chain management [45].

In [45], the standard aggregate planning model was broadened to incorporate carbon footprint, energy consumption, job security and employee motivation, employee health and work-family balance, and customer satisfaction factors to include a triple bottom line of sustainability. Carbon footprinting is measured by greenhouse gas emissions, while energy consumption is calculated by the use of electricity/heat throughout production. Furthermore, hiring and firing are determined quantitatively by factors of job security and employee morale, while factors of employee health and work-family balance are taken into account through overtime. Lastly, customer satisfaction is measured by the level of completion of the demand indicators.

Using these indicators, six models were developed in [45]: two models revised for environmental reasons (emissions and energy consumption limits), three models revised for social reasons (smoothing and limiting layoffs, overtime limits, and target service levels), and one model for TBL accounting. All models were analysed with mathematical programming formulations based on real-life data, and numerical sensitivity analysis.

The smoothing limit represents another new concept that is added by [45] to the aggregate scheduling model to capture reality. The smoothing limit reduces the impact of hiring or firing more employees based on the initial number of staff. If a large number of workers are dismissed, this leads to a significant decrease in employee morale and motivation.

With a large number of new hires, coordination between employees declines and this can result in conflict between new and old employees, thus reducing employee performance. A 35% smoothing limit refers to the fact that the total number of employees dismissed and hired during the year cannot be more than 35% of the initial number of employees. There is also a 10% smoothing limit for each month [45].

Aggregate planning represents a fundamental tool in managing the entire supply chain and operations. In [45], a methodological approach to integrating sustainability aspects into the aggregate planning issue is provided. The standard model is supplemented with realistic considerations, including a learning curve for new employees and smoothing out restrictions on employee hiring and firing.

In addition, the aggregate planning model is modified to include environmental and social impacts to perform an accounting-based triple bottom line sustainability analysis, and the solutions derived from the model are reviewed to gain insight into their effectiveness. The analysis reveals how environmental and social criteria can be added to traditional cost accounting so that the sustainability issues in supply chain and operations management can be addressed through an aggregate planning solution. Sensitivity analysis can be conducted to determine the impact of a carbon limit, overtime limit, smoothing limit, and service level on overall costs. These analyses are each performed under a different subcontracting limit (0 to 100 per cent) on demand per month [45].

6.2. AGGREGATE PLANNING STRATEGIES

Organizations can choose from ***three different types of aggregate planning strategies*** [46]:

1. *Level strategy*. The level strategy is aimed at keeping the production rate constant, as the term suggests. To increase or reduce production in expectation of lower or higher consumer demand, a company should make a sound demand forecast. The benefit of a level plan is that it provides a stable workforce. The drawbacks of a level plan are high inventories and an increase in unfinished orders.

2. *Chasing strategy*. The pursuit or chasing strategy is focused on dynamically matching demand with production. The advantages of the chasing strategy are lower inventory levels and lower schedule delays. The disadvantages are lower production volumes, deteriorating quality and a low morale of the workforce.

3. *Hybrid strategy*. It implies a balance between level and pursuit strategies.

Different products within a company may have different demand. If demand changes, it is necessary to determine how resources can be allocated to respond to this demand change. For example, a company could only be focused on general growth and the total amount of resources needed (people, equipment, warehouse space, and raw materials) for the following year. If it develops a forecast for three products separately, there could be some mistakes in each forecast. By combining these forecasts, the aggregate demand figure will have fewer errors. High and low

demand tend to overlap randomly. This results in a more accurate aggregate demand forecast than an individual demand forecast. Planning includes various elements shown in Fig. 6.1 [47].

Fig. 6.1. Elements of the aggregate planning [47]

Thus, the aggregation of demand for specific products and aggregate production plan management is preferable to dealing with single production plans. Better resource utilisation is the result [47].

It is important for companies to be aware of the capacity of their resources. This will enable the organisation to estimate its production capacity, allowing it to correctly forecast sales and deliver products to customers on time. It will also help keep the necessary balance between supply and demand without overextending resources. Inputs of resources may differ depending on the company, but aggregate capacity includes both hand and machine resources and does not distinguish between them [47].

For example, if a company manufactures bicycles, the end product quantity is only taken into account in the aggregate capacity. There is no consideration of the complexity of each bicycle, its design options and

specifications. It looks at it from a large-scale perspective. Aggregate planning is effective when there is an equal balance between aggregate demand and aggregate capacity. Otherwise, the enterprise should choose among the following options: increase or decrease capacity to meet demand or increase or decrease demand to meet capacity [47].

By managing the aggregate capacity, demand volatility can be handled. A flowchart of aggregate planning is shown in Fig. 6.2 [47].

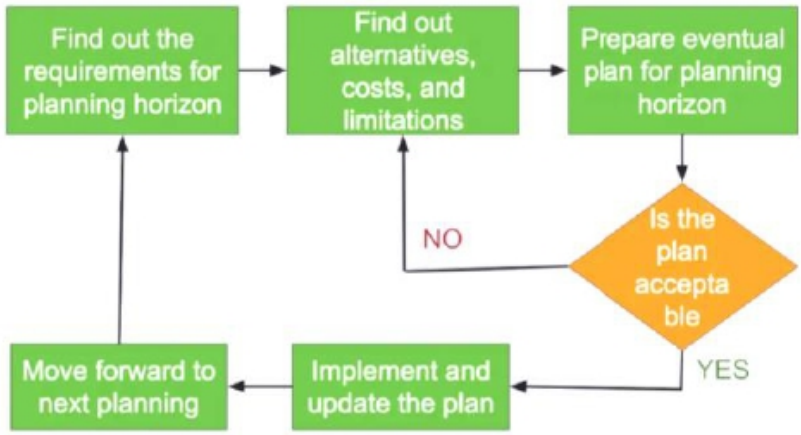


Fig. 6.2. Aggregate planning flowchart [47]

As a rule, businesses have clear strategies ready for unexpected scenarios. But a combination can be applied, dependent on the needs. Demand fluctuation management is shown in Fig. 6.3 [47].

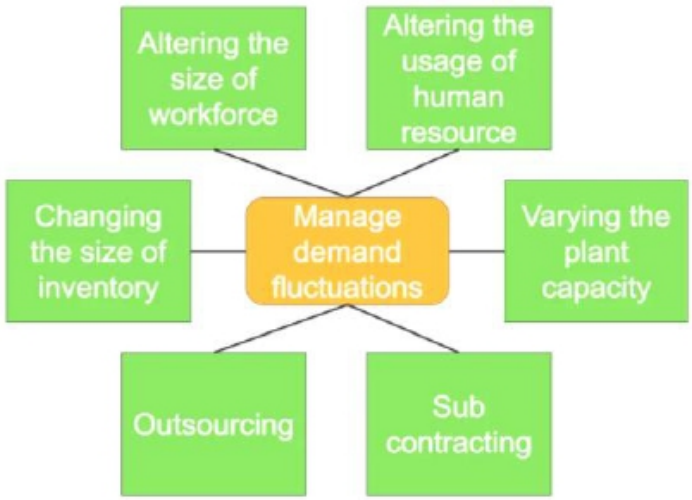


Fig. 6.3. Dimensions of the demand fluctuation management [47]

6.3. AGGREGATE PLANNING SOFTWARE

Effective aggregate planning requires demand and capacity data, which can be consolidated by using resource management tools. For instance, in terms of demand, it is possible to collect data on how many products are sold, what is the sales growth rate, and what internal or external factors affect sales [48].

In terms of capacity, the following can be identified [48]: the amount of raw materials, equipment and resources required to make the product; the incremental cost of producing one product; the actual capacity; and the actual inventory level [48].

With a project management software like ClickUp, a lot of this data can be immediately available. ClickUp Mind Maps are good tools to visualise the demand curve and associated capacity needs. Doing so provides a capacity planning tool for matching resources to demand [47].

ClickUp Mind Map for manufacturing and logistics is shown in Fig. 6.4 [48].

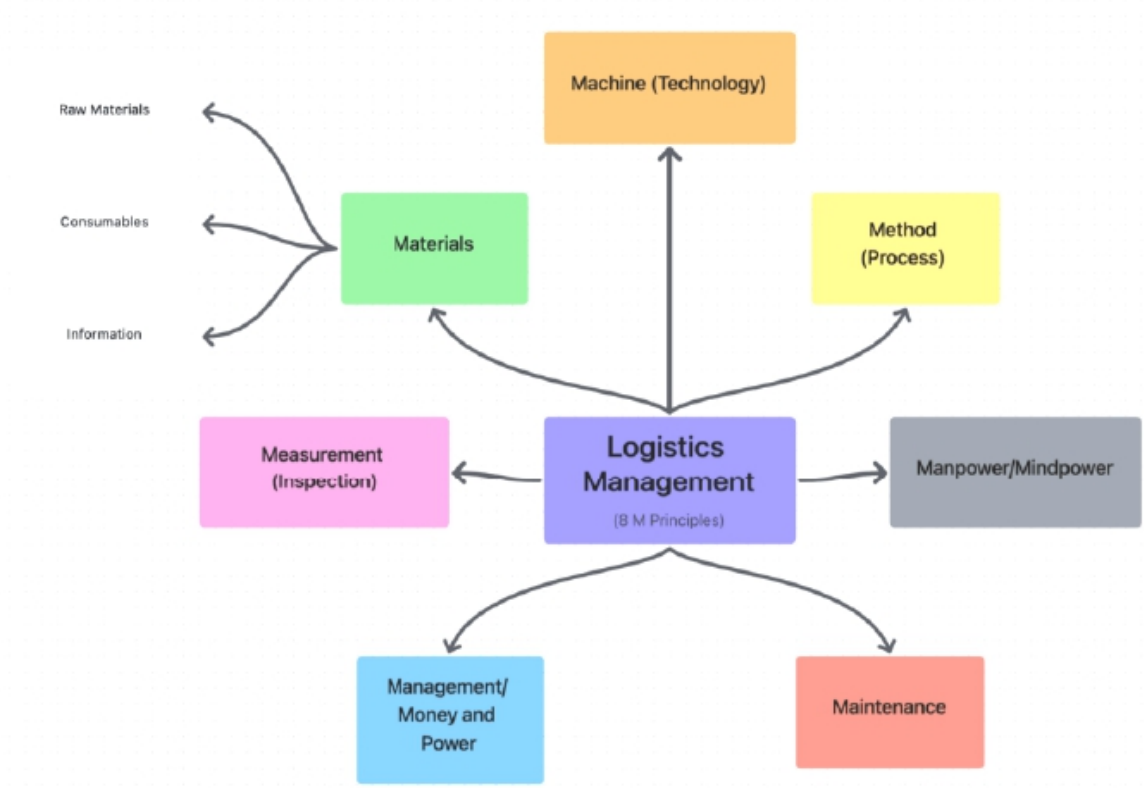


Fig. 6.4. ClickUp Mind Map for manufacturing and logistics [48]

It is a useful solution to apply ClickUp project increment (PI) planning templates when existing processes are too fragmented. It allows to improve project communication, foster better cooperation, and establish a shared vision. Adequate aggregate planning takes into account all expenses associated with the whole product lifecycle. Such planning allows to allocate available capacity and budget for upcoming needs [48].

ClickUp project cost management template is shown in Fig. 6.5 [48].

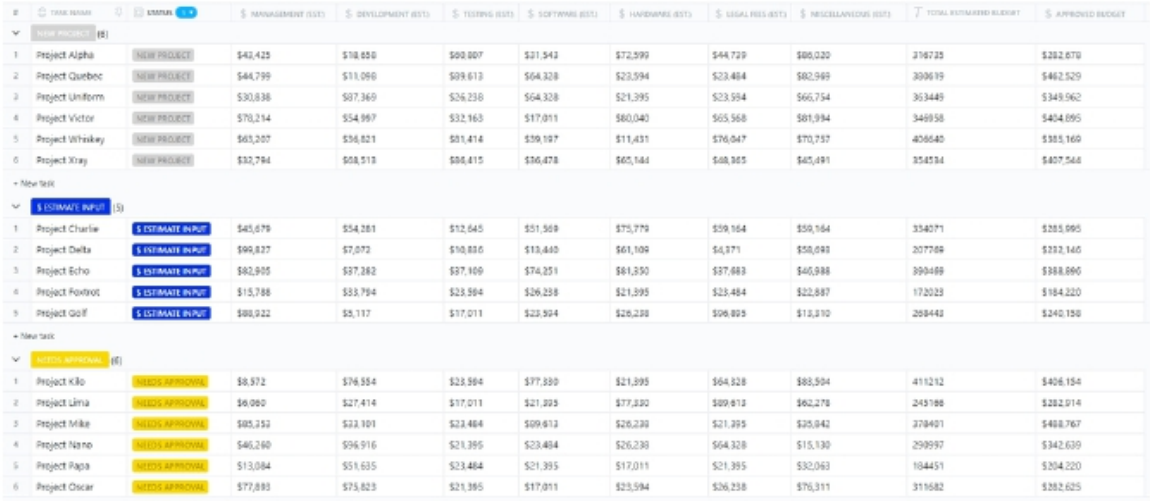


Fig. 6.5. ClickUp project cost management template [48]

Project management software simplifies aggregate planning. ProjectManager as a software enables producers in managing costs and resources to ensure smooth production. Planning with robust Gantt charts assists in controlling costs and resources related to production cycles and redistributing these resources as needed to provide continuous production lines. Additionally, it can help track planned and actual efforts in real time. Enhanced aggregate planning using robust real-time data from ProjectManager is shown in Fig. 6.6 [49].

So, aggregate planning aims to determine the production, inventory and labour levels necessary to meet demand changes over the medium run. Using this insight, a business can predict when demand will increase or decrease and stock enough products to satisfy it at the right time. Forecasting helps to eliminate the need to quickly change production schedules, which not only incurs additional costs but also leads to greater insecurity and uncertainty. Through aggregate planning, the company can make rather accurate medium-term demand and production capacity forecast [49].

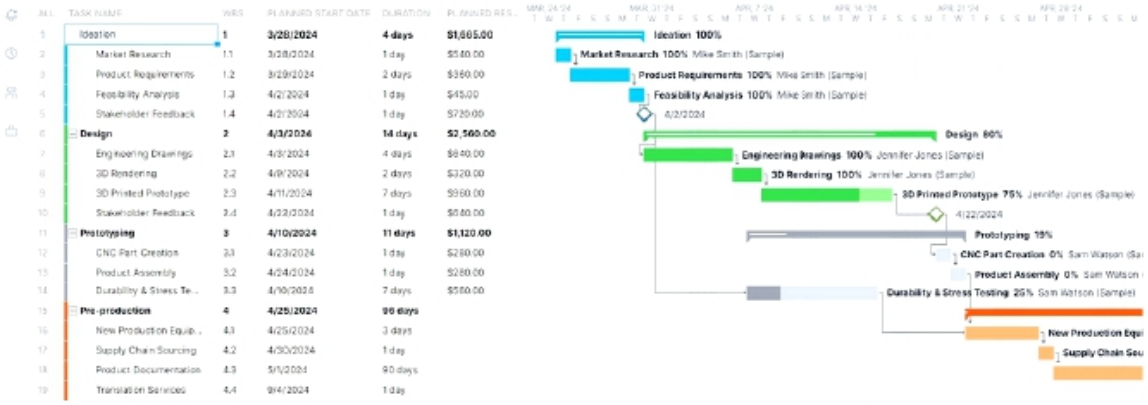


Fig. 6.6. Enhanced aggregate planning with robust real-time data from ProjectManager [49]

Aggregate planning supports companies in fulfilling their financial goals and improving their performance. It ensures maximising the use of available production capacity by meeting customer demand, reducing customer waiting times, and cutting down on the cost of holding overstock. A sample of a project budget template in ProjectManager is shown in Fig. 6.7 [49].

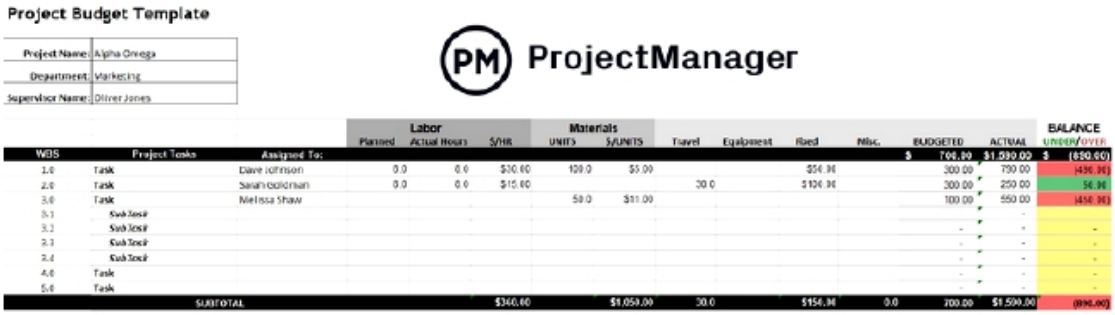


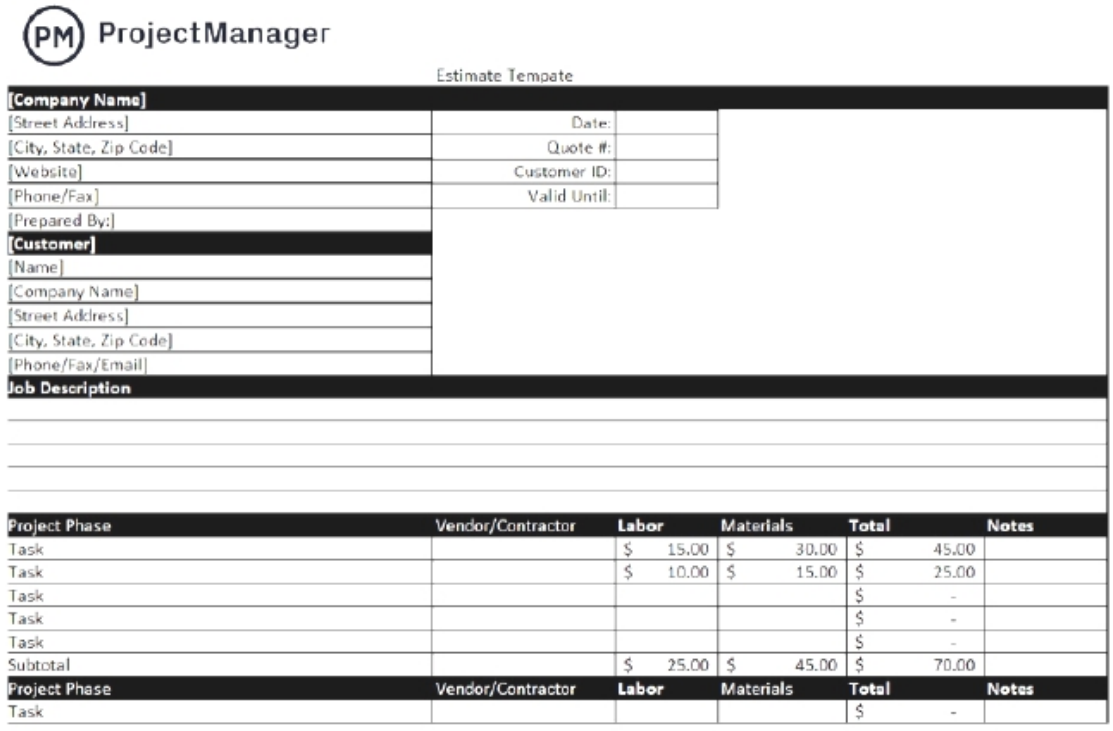
Fig. 6.7. Free project budget template in ProjectManager [49]

However, aggregate forecasting planning is not a panacea. It tends to be as good as the data collected (and the individuals involved in the forecasting). People are biased, they may misinterpret economic metrics or use flawed forecasting models. Unknown factors always exist, such as spikes in material prices, the introduction of new policies, and interest rate fluctuations, as well as labour force factors like changes in working conditions causing workforce unrest [49].

Having the following inputs is critical to success: a cumulative demand forecast for projected period, an assessment of capacity manage-

ment (covering subcontracting, outsourcing, etc.), and the current operational status of the workforce. This will provide higher accuracy and consequently a greater chance of success [49].

Regardless of the strategy chosen, some things should be taken into account when using aggregate planning. To start with, it is necessary to determine the demand and capacity for a given period. These two indicators need to match each other, even in cases where overtime or subcontracting may be required. Apparently, costs are also important, so for that reason, the fixed and variable costs along with direct and indirect labour costs need to be identified. The ProjectManager's project estimate template in Excel is shown in Fig. 6.8 [49].



ProjectManager

Estimate Tempate

[Company Name]							
[Street Address]		Date:					
[City, State, Zip Code]		Quote #:					
[Website]		Customer ID:					
[Phone/Fax]		Valid Until:					
[Prepared By:]							
[Customer]							
[Name]							
[Company Name]							
[Street Address]							
[City, State, Zip Code]							
[Phone/Fax/Email]							
Job Description							
Project Phase	**Vendor/Contractor**	**Labor**		**Materials**		**Total**	**Notes**
Task		$	15.00	$	30.00	$ 45.00	
Task		$	10.00	$	15.00	$ 25.00	
Task						$ -	
Task						$ -	
Task						$ -	
Subtotal		$	25.00	$	45.00	$ 70.00	
Project Phase	**Vendor/Contractor**	**Labor**		**Materials**		**Total**	**Notes**
Task						$ -	

Fig. 6.8. ProjectManager's project estimate template for Excel [49]

Work management tools assist in controlling variables in aggregate planning and allow managing production to meet demand. ProjectManager is a cloud-based software that provides a better understanding of the production process, labour and budget as it gives you real-time data. Managers realize that aggregate planning has to do with resources. It is possible to use a Gantt chart to plan production, screen the critical path, and create a baseline to have access to project deviations at all times,

create a budget and then manage costs. Resource costs are calculated automatically when the team logs hours worked. With a timeline, the Gantt chart provides a visualization of the entire production cycle. Marketing in ProjectManager is shown in Fig. 6.9 [49].

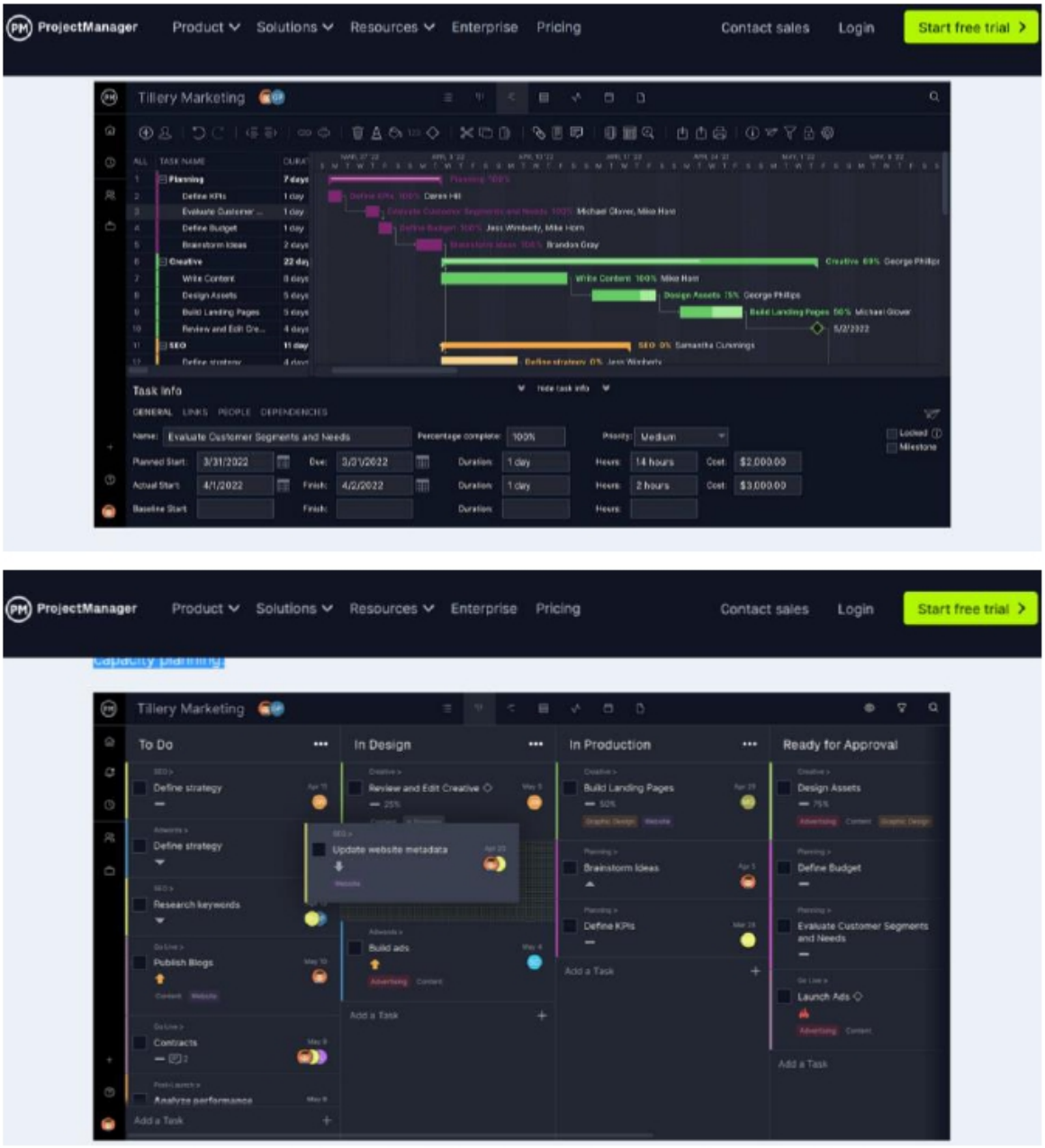


Fig. 6.9. Tillery Marketing in ProjectManager [49]

Monitoring teams, their working hours, and availability makes it possible to effectively execute the aggregate production plan. Using ProjectManager, work days, holidays, and PTO can be set for teams. Also,

tasks assigned to them can be viewed on the team page. It is possible to change to a color-coded workload chart. And from there, work can be redistributed to balance the workload to enable higher productivity. The Kanban board is one more of ProjectManager's working views. This is a visual workflow tool that allow teams to manage their backlog along with gaining clarity on which stage of the production cycle they are in. Aggregate planning is about aligning production capacity with demand [49].

By viewing the board, potential obstacles can be seen, and resources can be reallocated to keep the team on track. ProjectManager is rapid, agile, and providing the visibility required for project planning, resource management, and capacity planning [49].

PENTAGON 2000SQL is the benchmark. For more than 38 years, it has set the industry standard for completely integrated ERP systems for the aerospace, defence, electronics, energy, metals, and automotive industries, encompassing maintenance, manufacturing, supply chain logistics, and finance. It offers specialized workflows for each industry. This ensures efficiency where it matters and supports the highest quality standards [50].

Using third-party data centres reachable from the Internet (the cloud) allows all Pentagon 2000 software to run without the need for in-house servers. This has multiple benefits. The software enables external repairs, exchanges, stock consignment and batch purchases. The system interfaces with leading third-party networks and services including ILS, PartsBase SPEC2000 and AeroXchange [50].

Completely updated software can be used in the cloud at a fraction of the cost of on-premises software. Current staff or new employees can access the system instantly from any device and browser in any country. In addition, system availability is more than 99%, which includes the highest level of data protection and full backup. Pentagon 2000 SQL offers a wide range of mobile apps for tablets and devices. The applications specialise in material management, work order processing and flight management. The system architecture is designed to be mobile-friendly and web-efficient. It is easily scalable from small workgroups to corporate-class data centres, with a low cost of ownership [50].

Based on the aggregate plan, the planner should decompose the available information and build an approximate master production schedule (MPS) that defines the batches to be produced in each period at the

level of each product family. Aggregate planning is probably the area of the supply chain where information technology is used most often. The very first IT products for supply chains were aggregate planning modules, often referred to as factory, production or manufacturing planning. Some of the early modules were focusing only on deriving a feasible production plan, taking into account the restrictions imposed by demand and available capacity. More recent modules provided tools that selected the optimal solution among possible production plans given goals such as increasing output or reducing cost [17].

A number of software vendors (including SAP and Oracle) have advanced planning systems (APS) that allow companies to develop aggregate plans. The biggest issue with using an APS is that the results can be quite volatile in relation to the inputs. A minor change in inputs, such as demand, may result in a new optimal plan that is significantly different from the original one. Too volatile and unstable and the whole supply chain starts to distrust the plans soon, making them effectively useless. Therefore, it is important to make sure that as new data comes in, plans are adjusted to provide a certain level of stability [17].

Accurate data is essential for APSs to realise their full potential. Having an APS using lead times or capacities that differ from the actual ones, the resulting aggregate plan is bound to result in dissatisfied customers and high costs. Therefore, it is important to monitor the accuracy of these parameters and make sure that people are accountable for this data [17].

ERP systems have expanded their application areas to include other business areas such as marketing, finance and HR. The enormous popularity of a unified system for the entire organisation has led to the rapid spread of ERP systems worldwide and, eventually, to the introduction of specialised applications for different business areas that extend the capabilities of the ERP system. Advanced planning systems employ sophisticated mathematical algorithms to forecast demand, plan and schedule production within given restrictions, and make optimal decisions about sources and product mix [51].

SAP IBP Response & Supply and SAP Manufacturing for Planning and Scheduling PPO utilise a mathematical optimisation algorithm or a feasibility study programme. The SAP Manufacturing for Planning and

Scheduling (DS) optimiser applies a genetic algorithm to create optimised production schedules [52].

The SAP S/4HANA Manufacturing for Planning and Scheduling, which originated with SAP APO, has evolved into a well-established application and following integration with S/4HANA (optional subscription), has a distinct roadmap with more features and capabilities across multiple dimensions delivered to customers with each release. These enhancements cover user experience, industry-specific scheduling algorithms, cross-application integration, and architecture updates [52].

Discussion questions

1. What is the importance of aggregate planning in supply chain management?
2. Describe the key components of supply chain planning approaches.
3. What are the features of a standard aggregate planning problem?
4. What are the three types of aggregate planning strategies?
5. What are the elements of planning?
6. What are the prerequisites for aggregating the needs of individual products and managing the aggregate production plan?
7. What ensures the best use of enterprise resources?
8. What are the benefits of understanding the potential of the resources for the organisation?
9. Characterise the flowchart of aggregate planning.
10. What are the features of demand fluctuation management?
11. What are the features of the ClickUp smart map for production and logistics?
12. What are the characteristics of the ClickUp project cost management template?
13. What are the benefits of improved aggregate planning with reliable real-time data with ProjectManager?
14. Explain the free project budget template in ProjectManager.
15. What are the features of the ProjectManager project estimate template for Excel?
16. What are the features of Tillery Marketing in ProjectManager?
17. Describe the kanban board.
18. What are the peculiarities of PENTAGON 2000SQL?

19. What are the tasks of SAP IBP Response & Supply and SAP Manufacturing?

20. Characterise the SAP S/4HANA Manufacturing for Planning and Scheduling solution.

Cases

1. Identify the features of aggregate planning for the selected global supply chain option.

2. For the chosen option, assess the relevance of the key components of supply chain planning approaches.

3. Evaluate the effectiveness of a standard aggregate planning problem for the selected supply chain option.

4. For the chosen supply chain option, select the quantitative and qualitative designing of distribution networks.

5. Determine the feasibility of aggregating individual product requirements and managing the aggregate production plan for the selected supply chain option.

6. For the chosen option, assess the features of demand fluctuation management.

7. Determine the feasibility of using the ClickUp smart map for production and logistics for the selected company.

8. Evaluate the possibility of using improved aggregate planning with reliable real-time data from ProjectManager for the selected company.

9. Is it possible to implement Tillery Marketing in ProjectManager in the company of your choice?

10. Evaluate the feasibility of using PENTAGON 2000SQL for the selected company.

Tests

1. By ordering for the entire planning period one can:

a) qualify for bulk discounts and ultimately increase shortages;

b) qualify for bulk discounts and ultimately avoid shortages;

c) ultimately increase shortages;

d) there is no correct answer.

2. Aggregate planning in supply chain management includes:

a) solid demand forecast;

b) production capacity;
c) limitations on capital;
d) all answers are correct.

3. Using historical data, industry trends and forecast, it is possible to:
a) accurately predict demand for products for upcoming months;
b) inaccurately predict demand for products for upcoming months;
c) accurately predict proposal for products for upcoming months;
d) there is no correct answer.

4. The ability to produce depends on:
a) machinery;
b) work staff;
c) efficiency;
d) all answers are correct.

5. Utilizing production ability to set goals for producing products that are realistic, need allow for and:
a) personnel shortages;
b) public relations;
c) machinery maintenance;
d) there is no correct answer.

6. Aggregate planning can be implemented with:
a) CRM Systems;
b) Advanced Planning and Scheduling (APS) system;
c) PR Systems;
d) there is no correct answer.

7. Advanced Planning and Scheduling (APS) software allows to have a:
a) public representation of production plan and manipulate areas that are in need of efficiency enhancement;
b) visual representation of production plan and manipulate areas that are in need of efficiency enhancement;
c) unsystematic representation of production plan and manipulate areas that are in need of efficiency enhancement;
d) there is no correct answer.

8. APS can be quickly integrated with an ERP/MRP software to fill gaps where this system:
a) lacks planning;

b) accurately predicts demand;

c) schedules flexibility and accuracy;

d) all answers are correct.

9. Advanced Planning and Scheduling (APS) helps planners:

a) increase time while providing less agility in updating ever-changing priorities, production schedules, and inventory plans;

b) save time while providing greater agility in updating ever-changing priorities, production schedules, and inventory plans;

c) increase time while providing greater agility in updating ever-changing priorities, production schedules, and inventory plans;

d) there is no correct answer.

10. Implementation of Advanced Planning and Scheduling (APS) software will take manufacturing operations to the next level of production efficiency:

a) taking advantage of operational data already available in GDS;

b) taking advantage of operational data already available in CRM Systems;

c) taking advantage of the operational data already available in ERP;

d) there is no correct answer.

11. The standard aggregate planning problem aims to:

a) determine the production levels, inventory kept in the supply chain;

b) hiring and firing employees, overtime production backorders and demand satisfaction levels with the objective of having minimum cost or maximum profit;

c) personnel shortages efficiency;

d) there is no correct answer.

12. Smoothing limit is:

a) another novel concept that add to the aggregate planning model to reflect reality;

b) old concept that add to the aggregate planning model to reflect reality;

c) old concept that add to the aggregate planning system to reflect reality;

d) all answers are correct.

13. Level strategy aims to:

a) maintain an inconsistent production pace;

b) maintain a consistent production pace;

c) maintain a consistent production systems;

d) there is no correct answer.

14. To enhance or decrease production in anticipation of lower or higher consumer demand, the business needs:

a) an unsystematic demand forecast;
b) a weak demand forecast;
c) a strong demand forecast;
d) all answers are correct.

15. The advantage of a level plan is:

a) that it ensures a non-permanent workforce;
b) that it ensures a consistent workforce;
c) that it ensures consistent loses;
d) there is no correct answer.

16. Disadvantages of level strategy include:

a) mix flexibility;
b) high inventory;
c) increased backlogs;
d) all answers are correct.

17. Chase strategy aims to:

a) maintain a consistent production pace;
b) dynamically match demand with output;
c) statically match demand with output;
d) there is no correct answer.

18. The chasing strategy benefits from:

a) lower inventory levels and backlogs;
b) higher inventory levels and backlogs;
c) lower inventory levels and accumulation;
d) there is no correct answer.

19. The drawbacks of chase strategy include:

a) lower production;
b) inferior quality;
c) depressed workforce;
d) all answers are correct.

20. Hybrid strategy aims to:

a) dynamically match demand with output;
b) strike a balance between level and chasing strategies;
c) maintain a consistent production pace;

d) there is no correct answer.

21. Aggregate planning becomes successful:
a) when both aggregate demand and aggregate capacity are not equal;
b) when both aggregate supply and aggregate capacity are equal;
c) when both aggregate demand and aggregate capacity are equal;
d) all answers are correct.

22. ClickUp Mind Maps serves as:
a) a capacity planning tool to align resources with the demand;
b) a capacity planning tool to align resources with the proposal;
c) a capacity planning tool to align assets with the demand;
d) there is no correct answer.

23. Good aggregate planning considers:
a) all the profits involved in the entire product lifecycle;
b) all the costs involved in the entire product lifecycle;
c) all the revenues involved in the entire product lifecycle;
d) there is no correct answer.

24. ProjectManager is:
a) software that helps transport companies manage costs and resources to allow for uninterrupted production;
b) software that helps manufacturers manage costs and resources to allow for uninterrupted production;
c) software that helps logistics operators manage costs and resources to allow for uninterrupted production;
d) there is no correct answer.

25. Planning on powerful Gantt charts helps:
a) to control revenues associated with production runs and reallocate those resources as necessary to keep production lines running smoothly;
b) to control loses associated with production runs and reallocate those resources as necessary to keep production lines running smoothly;
c) to control costs and resources associated with production runs and reallocate those resources as necessary to keep production lines running smoothly;
d) there is no correct answer.

26. Making forecasts saves the company from:
a) changing its production schedule slowly, which is not only expensive but also creates insecurity and uncertainty;

b) changing its production schedule quickly, which is not only expensive but also creates insecurity and uncertainty;

c) changing its production schedule quickly, which is only expensive but also creates insecurity and uncertainty;

d) there is no correct answer.

27. PENTAGON 2000SQL is covering the following industries:

a) MRO;

b) manufacturing;

c) Supply Chain Logistics and Financials;

d) all answers are correct.

28. From an aggregate plan, a planner must:

a) disaggregate the available information and build a rough master production schedule (MPS) that identifies the batches produced in general at the level of each product family;

b) disaggregate the available information and build a rough master production schedule (MPS) that identifies the batches produced in each period at the level of each product family;

c) disaggregate the available information and build an exact auxiliary production schedule (MPS) that identifies the batches produced in each period at the level of each product family;

d) there is no correct answer.

29. The biggest challenge when using APSs is:

a) that the results can be fairly unstable relative to inputs;

b) that the results can be fairly stable relative to inputs;

c) that the results can be fairly unstable relative to products;

d) there is no correct answer.

30. Advanced Planning systems use:

a) complex mathematical algorithms to forecast demand, to plan and schedule production within specified constraints, and to derive optimal source and product-mix solutions;

b) non-complex mathematical algorithms to forecast demand, to plan and schedule production within specified constraints, and to derive optimal source and product-mix solutions;

c) complex mathematical algorithms to forecast proposed, to plan and schedule production within specified constraints, and to derive optimal source and product-mix solutions;

d) there is no correct answer.

7. SALES AND OPERATIONS PLANNING IN THE SUPPLY CHAIN

7.1. INTRODUCTION IN SALES AND OPERATIONS PLANNING

Sales and operations planning (S&OP) refers to the supply chain planning process used to support decision-making by business leaders in a wide range of aspects, such as [53]:

– aligning demand plans with supply plans;

– making scheduled corrections to sales and operations;

– introducing new products and discontinuing old products;

– reviewing proposals and investments linked by markets and suppliers;

– ensuring completion of annual operating plans and key performance indicators.

As a process defined and carried out by supply chain leaders, cross-departmental communication is a key to achieving success. Data inputs from finance, sales and marketing, procurement, engineering, and operations partners are typically needed. The *steps in the sales and operations planning process* are shown in Fig. 7.1 [53].

At the core of S&OP, the most significant attribute is ensuring that the executive stakeholder is directly engaged in the process by attending and leading each S&OP meeting. From this perspective, an executive leader is an organisation's chief executive, such as CEO, president, managing director, general manager or profit and loss owner [53].

S&OP succeeds by bridging planning between functions to achieve company goals and maximise performance. There are often trade-offs between functional areas, and sometimes there is a disagreement among functional managers on the best approach. The S&OP meeting is the forum for day-to-day decision-making, where the CEO considers the team's suggestions and determines how to proceed. But if the executive leader is not open to this forum, functional managers will seek alternative solutions to the problems, resulting in friction, confusion and poor productivity [53].

The S&OP process fosters inter-functional coherence and cooperation. Its success relies on the involvement of all functional managers like product, sales, marketing, supply chain, and finance vice presidents to ensure a synchronised action to achieve the company's goals [53].

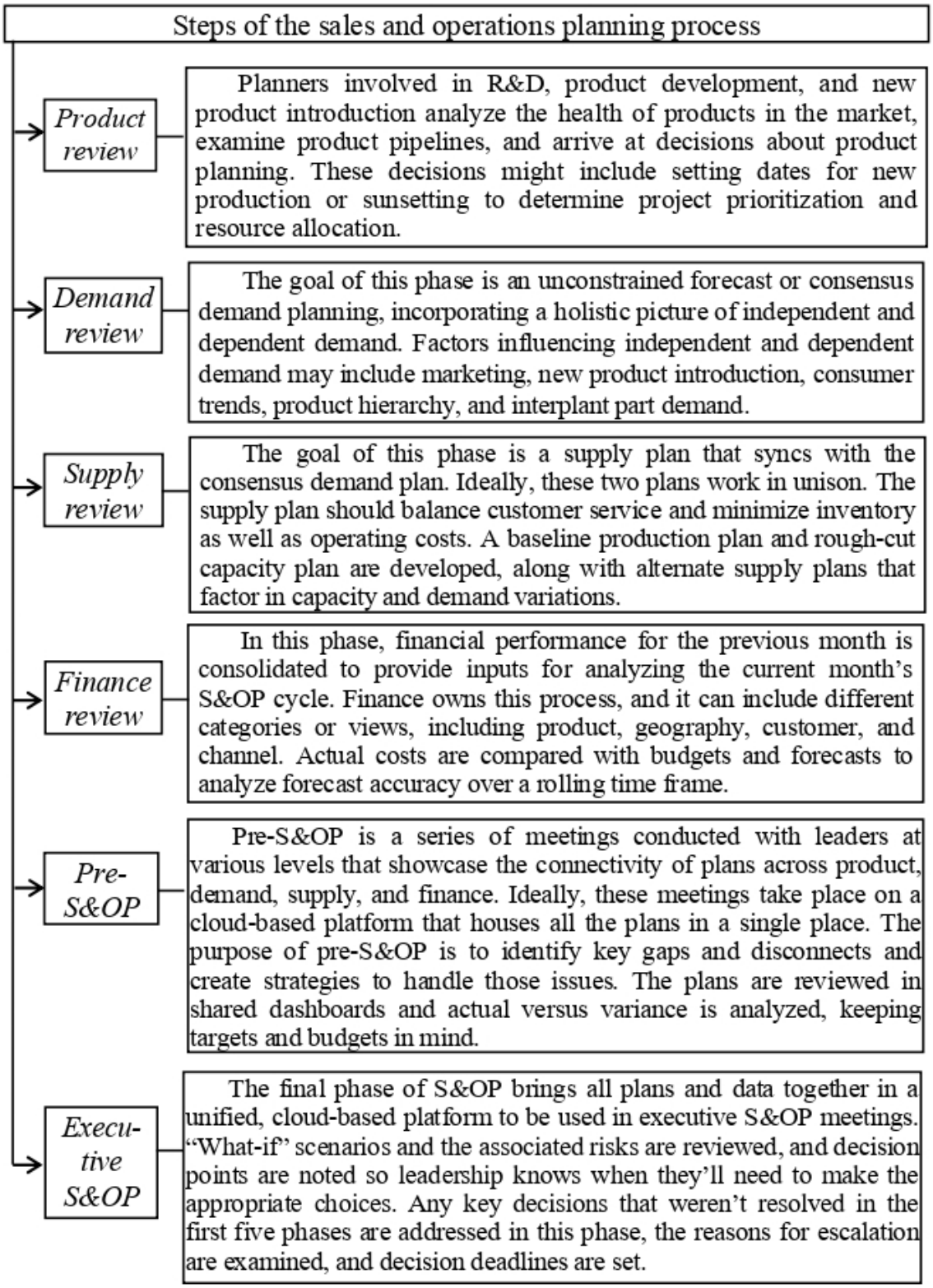


Fig. 7.1. Steps of the sales and operations planning process [53]

The missing functional area in the S&OP process is limiting the ability to create appropriate value for customers and improve financial results [53].

The effects of an unfilled space in the S&OP manifest differently based on the holder and can lead to inadequate coordination in introducing new products, shortfalls in sales, unforeseen promotions, material or capacity constraints. This could lead to mismatches in the volume, product mix, location or timing of production, which could have a negative impact on the company's results. If an overview of the S&OP process reveals an empty spot in the team, which at least should involve product, sales, marketing, supply chain and finance leaders, as a minimum, an opportunity to improve S&OP performance might have been found [53].

Many planners still rely on spreadsheets for S&OP, however, partly because of the software's widespread availability and flexibility. Spreadsheets, though, are failing to leverage the benefits of emerging advanced technologies such as artificial intelligence (AI) and are constrained in the data volume they can handle. Other concerns about spreadsheets providing a secure mechanism for sharing company data pose additional problems using this approach [54].

For example, the demand forecast of the sales team provides the input for the production schedules designed by the operations team. Meanwhile, the finance team relies on these forecasts and schedules for budget and cash flow planning. Also, the marketing team may adjust their strategies based on the expected availability of products. Thus, S&OP facilitates communications and cooperation throughout the company, which contributes to increased efficiency, lower costs, higher customer satisfaction, and overall improved business performance. Exploring the complexities of S&OP, there is a need to look at its value from different international practices and cases [55].

The S&OP process includes a core element of operations planning, which aims to develop strategies for responding effectively to expected demand. It is launched with an overview of the company's labour, equipment, material and time resources [55].

Despite the variations in the stages of the sales and operations planning process depending on the needs and dynamics of each business, the general process follows the pattern shown in Fig. 7.2 [56].

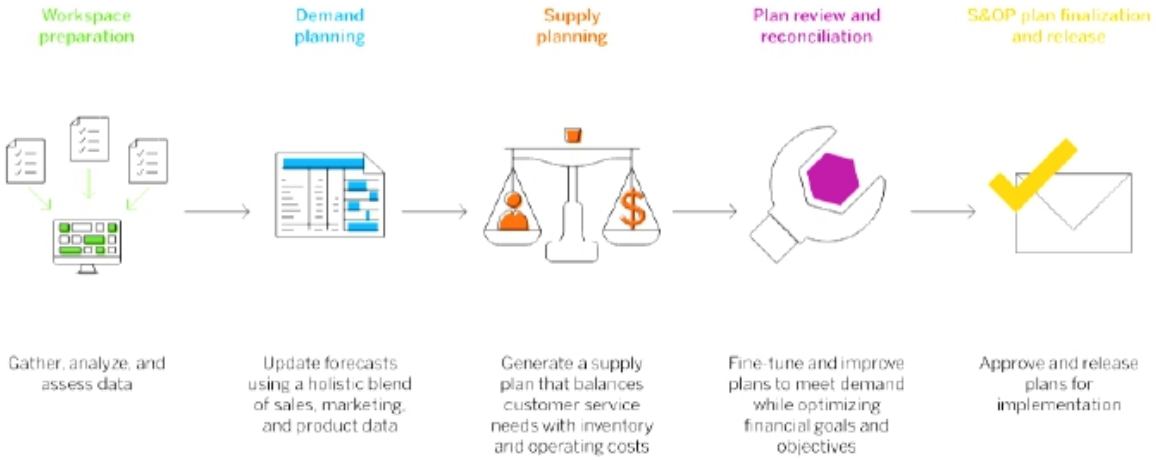


Fig. 7.2. Typical sales and operations planning process [56]

This insight is then converted into a comprehensive operational plan including production schedules, inventory management strategies, logistics planning, etc. The operations planning process addresses restrictions such as capacity constraints, cost factors and lead times, providing a balance between operational efficiency and the economic feasibility of the operational plan. By matching the operational plan with sales forecasts, the planning process provides an effective alignment of supply with demand [55].

Collecting data is a very important part of the S&OP process. It consists of collecting and analysing a wide range of data, from past sales data to current market trends and customer patterns. It provides the basis for accurate forecasts of demand, affecting supply planning, inventory management and operational strategies of the company [55].

7.2. GLOBAL BEST PRACTICES IN SALES AND OPERATIONS PLANNING

Organisations lacking inter-functional coordination are unable to be effective. Without the ability to share information on unforeseen events, functions can be completely disrupted, so companies will struggle to respond on time. Such operational inefficiencies lead to unsatisfied demand, business interruptions, idle production capacity, and over-investment in inventory. As a result, each of these inefficiencies has a direct and adverse effect on customer value and financial results [57].

Across industries, leaders in the marketplace have the highest alignment between their product, sales, marketing, supply chain and finance. Such companies can continuously provide high customer value as they share information regarding unforeseen events like demand shifts, capacity fluctuations, components' scarcity that could jeopardise the business throughout the entire network. This allows them to make timely and appropriate adjustments and use viable solutions for avoiding a breakdown [57].

For example, *Apple Inc.,* being a technological giant known for its trendsetting products such as iPhone, iPad and MacBook, has established a global standard for effective sales and operations planning. For Apple, this success is due to its capability of accurately predicting demand. Using a combination of past sales data, relevant market trends, and customer profiles, it provides detailed forecasts which serve as the basis for operations planning. With a sales force and clear customer demand, the company is able to optimise its production schedules and manage inventory, cut costs and improve availability of products [55].

An operational planning at Apple is equally thorough. Through the lean production and just-in-time inventory management principles, they optimise their operations and balance supply. Aligning their production schedules with demand forecasts, they prevent excessive production and overstocking costs. Moreover, Apple's supply chain is fully integrated with the S&OP process providing suppliers with information on demand forecasts and production plans. Visibility enables suppliers to effectively schedule their operations, with fewer disruptions to supply and greater efficiency in the entire supply chain [55].

The S&OP process at Apple is supported by robust analytics and advanced technology. They use cutting edge tools and software to collect and analyse data, adjust forecasts, and streamline operations planning. Such a data-driven approach has enabled Apple to react swiftly in response to market shifts and secure its competitive position in a challenging environment. Apple's S&OP process sets an excellent global benchmark by showcasing the way strategic forecasting, lean operational planning, supply chain planning and integration, along with technologies can converge to create excellence in the supply chain [55].

Amazon, being a global leader in e-commerce, has succeeded in collecting S&OP data. It collects a huge amount of data about customers' purchasing behaviour, online shopping history and reviews, as well as external factors including industry trends and seasonal fluctuations. This data is analysed by Amazon's advertising algorithms to produce detailed forecasts of supply and demand. This data is then applied for inventory optimisation, demand planning, reducing shortages and overstocks, and improving delivery times. Beyond that, Amazon's data-driven focus stretches to suppliers, allowing them visibility into sales forecasts to optimise their operations. This powerful system of data collection and analysis contributes to Amazon's operational efficiency and S&OP [55].

According to a 2020 Gartner survey, nearly 27% of respondents continue to operate with an S&OP time horizon of under one year, while 62% of respondents operate with an S&OP time horizon of under 18 months. Short-term S&OPs result in more short-term decisions and focus during the S&OP meetings and do not allow for a view beyond a 1-year horizon [58].

There are many decision-making processes that should be done beforehand, for instance, constructing and scaling up production or warehouse capacity, or reviewing the scope of contracts with suppliers. Only when something occurs, do most organisations react, whereas leaders plan for different scenarios to be able to respond flexibly. For example, companies with a more advanced planning process generate a multi-scenario supply response. This allows them to choose the optimal solutions for the company. Considering multiple viable scenarios at each S&OP meeting is also a controllable process, particularly if it is structured [58].

7.3. THEORETICAL MODEL AND HYPOTHESES BASED ON SALES AND OPERATIONS PLANNING COORDINATING MECHANISMS

Fig. 7.3 shows the theoretical model that was developed for the study [59], which includes several hypotheses connecting coordination mechanisms to supply chain performance.

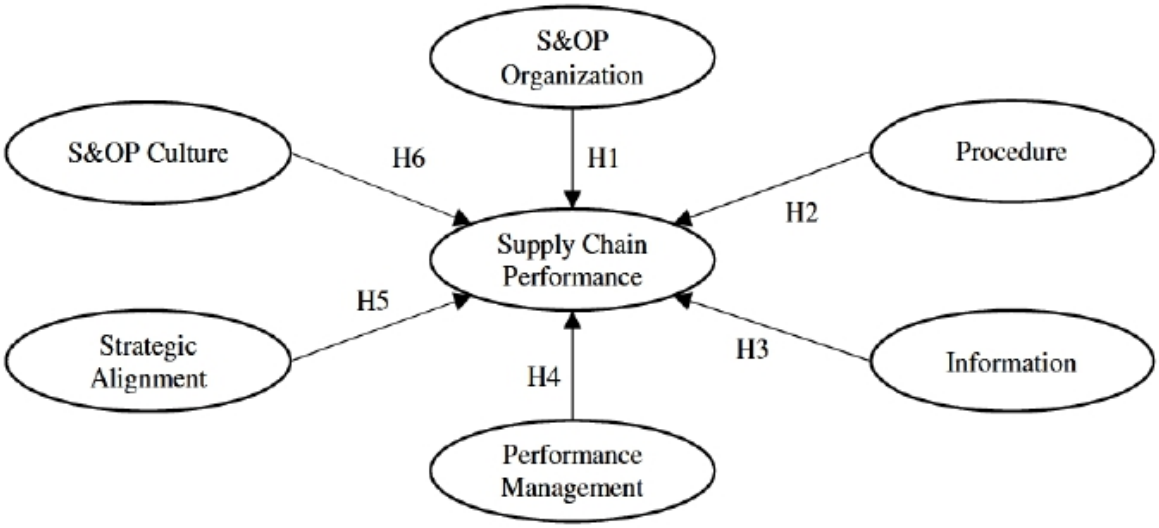


Fig. 7.3. Theoretical model and hypotheses based on S&OP coordinating mechanisms [59]

In order to keep the structural model economical, only general paths between individual S&OP coordination mechanisms and supply chain performance are included, rather than those indirectly mediated by second-order constructs like 'S&OP maturity'. Company size, volume of daily orders, product diversity and product life cycle were included as ordinal control variables. Countries, which can be used to identify region and economic maturity, and industry, further aggregated into industry sectors, were included as categorical variables. It is possible to broaden the basic hypotheses to investigate the unintended effects of these moderating variables [59].

Hypotheses based on S&OP coordinating mechanisms are as following [59]*:*

H1: S&OP organisation is strongly linked to supply chain performance.

H2: S&OP procedure/schedule is strongly positively linked to supply chain performance.

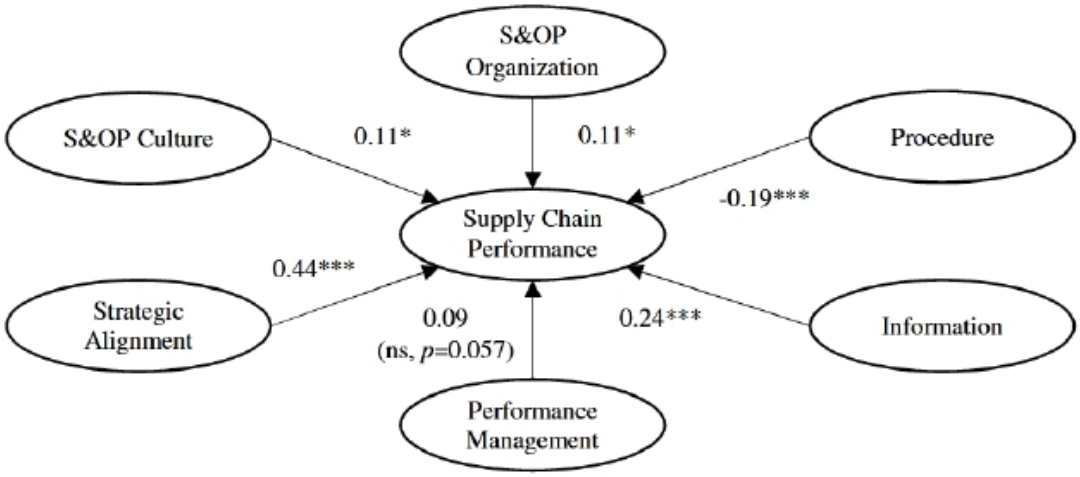
H3: Information collection/processing is positively linked to supply chain performance.

H4: Performance management is positively linked to supply chain performance.

H5: Strategic alignment is positively linked to supply chain performance.

H6: S&OP culture is positively linked to supply chain performance.

Fig. 7.4 shows the standardised regression weights of different S&OP designs (RQ1) to supply chain performance, and Table 7.1 provides the critical pairwise differences in the relative strength of the six mechanisms (RQ2) [59].



Controls on Supply Chain Performance	
Firm Size	0.00 (ns)
S&OP Experience	-0.05 (ns)
Daily Orders	-0.01 (ns)
Product Variety	-0.03 (ns)
Product Lifecycle	0.00 (ns)

*** $p<0.001$, ** $p<0.01$, * $p<0.05$
(ns): Not significant

Fig. 7.4. Structural modelling results (standardized coefficients) [59]

Obtained results in [59] indicate that:

• Strategic alignment (H5) had the biggest positive impact on supply chain performance among all the other mechanisms under study.

• Information acquisition/processing (H3), S&OP organisation (H1) and S&OP culture (H6) had a strong positive impact on supply chain performance.

• S&OP Procedure/schedule (H2) had a very high negative relation with supply chain performance.

• Hypothesis H4 (Performance management) did not receive support at 5%, although it was insignificant (p=0.057).

Table 7.1

Critical ratios for differences between unstandardized path coefficients [59]

Factor	1	2	3	4	5	6
1 S&OP Organization	0.00					
2 Procedure	3.83 ***	0.00				
3 Information	0.30	5.91 ***	0.00			
4 Performance Management	1.07	4.12 ***	1.68 *	0.00		
5 Strategic Alignment	2.29 **	9.39 ***	2.49 **	3.78 ***	0.00	
6 S&OP Culture	1.27	4.64 ***	2.42 **	-0.19	4.57 ***	0.00

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

The size of the company, the number of years of S&OP experience, daily volume of orders, product life cycle and product diversity did not affect the supply chain performance much [59].

For RQ3, Tables 7.2 and 7.3 report non-standardised b coefficients (instead of standardised β) to allow for a comparison of the relative magnitudes of each coordination mechanism between moderating variables. Apart from the importance of the path coefficients, the importance of the individual moderating effects (using one-tailed difference tests) is also given [59].

Table 7.2

Group moderation analysis results for categorical variables [59]

Moderator \ Hypothesis		Samples (N)	*H1* S&OP Organ-ization	*H2* Proced-ure	*H3* Inform-ation	*H4* Perform-ance Manage-ment	*H5* Strategic Align-ment	*H6* S&OP Culture
Overall		568	0.18 *	-0.28 ***	0.20 ***	0.09	0.38 ***	0.08 *
Industry Cluster	Consumer/ Tech	149	0.15	-0.22	0.13	0.13	0.32 ***	0.12
	Food	154	0.12	-0.36 **	0.19 *	0.07	0.43 ***	0.14
	Auto/ Industrial	156	0.39 *** ##	-0.35 **	0.12	0.19 ** #	0.42 ***	-0.05
Economic Maturity	Emerging	273	0.16	-0.26 **	0.08	0.09	0.40 ***	0.09
	Mature	295	0.19 *	-0.26 **	0.27 *** ###	0.08	0.35 ***	0.08

Table 7.2 (End)

Moderator \ Hypothesis		Samples (N)	*H1* S&OP Organ-ization	*H2* Proced-ure	*H3* Inform-ation	*H4* Perform-ance Manage-ment	*H5* Strategic Align-ment	*H6* S&OP Culture
Region	Americas	142	0.12	-0.09	0.21 *	-0.01	0.42 ***	0.08
	Asia	146	0.07	-0.23	0.19 *	0.37 ** ###	0.14 ###	0.11
	Europe	160	0.24	-0.47 **	0.22 **	0.14 *	0.32 ***	0.14 **
	Mid-East & Africa	120	0.24	-0.33 **	0.16	0.03	0.53 ***	0.01

Notes: Coefficients are unstandardized regression weights (b); Significance of path coefficients: * $p<0.05$, ** $p<0.01$, *** $p<0.001$; Significance of moderating effect: # $p<0.1$, ## $p<0.05$, ### $p<0.01$

Table 7.3

Group Moderation Analysis Results for Ordinal Variables [59]

Moderator \ Hypothesis		Samples (N)	*H1* S&OP Organ-ization	*H2* Procedure	*H3* Inform-ation	*H4* Perform-ance Manage-ment	*H5* Strategic Align-ment	*H6* S&OP Culture
Overall		568	0.18 *	-0.28 ***	0.20 ***	0.09	0.38 ***	0.08 *
S&OP Experience (years)	High (≥5)	266	0.27 **	-0.35 ***	0.27 *** #	0.08	0.34 ***	0.10
	Low (0-5)	302	0.10	-0.25 **	0.16 **	0.13	0.40 ***	0.07
Firm Size (employees)	Large (≥50,000)	242	0.30 ** ##	-0.43 *** #	0.18 **	0.10	0.38 ***	0.14 ** ##
	Small (<50,000)	326	0.10	-0.19 *	0.24 ***	0.09	0.36 ***	0.04
Product Lifecycle (years)	Long (>5)	240	0.23 *	-0.30 ***	0.30 *** ##	0.09	0.34 ***	0.05
	Short (0-5)	328	0.16	-0.28 **	0.13 *	0.08	0.40 ***	0.11 *
Daily Orders	High (≥500)	243	0.00	-0.23 *	0.16 **	0.21 * ##	0.36 ***	0.12 *
	Low (<500)	325	0.30 *** ##	-0.31 ***	0.22 ***	0.03	0.37 ***	0.07
Product Variety (SKUs)	High (≥2,000)	272	0.17	-0.30 ***	0.28 *** ##	0.14 *	0.43 ***	0.01
	Low (<2,000)	296	0.17	-0.26 **	0.11	0.07	0.34 ***	0.15 ** ##

Notes: Coefficients are unstandardized regression weights (b); Significance of path coefficients: * $p<0.05$, ** $p<0.01$, *** $p<0.001$; Significance of moderating effect: # $p<0.1$, ## $p<0.05$, ### $p<0.01$

7.4. SALES AND OPERATIONS PLANNING SOFTWARE

Example of the sales and operations planning SAP software is shown in Fig. 7.5.

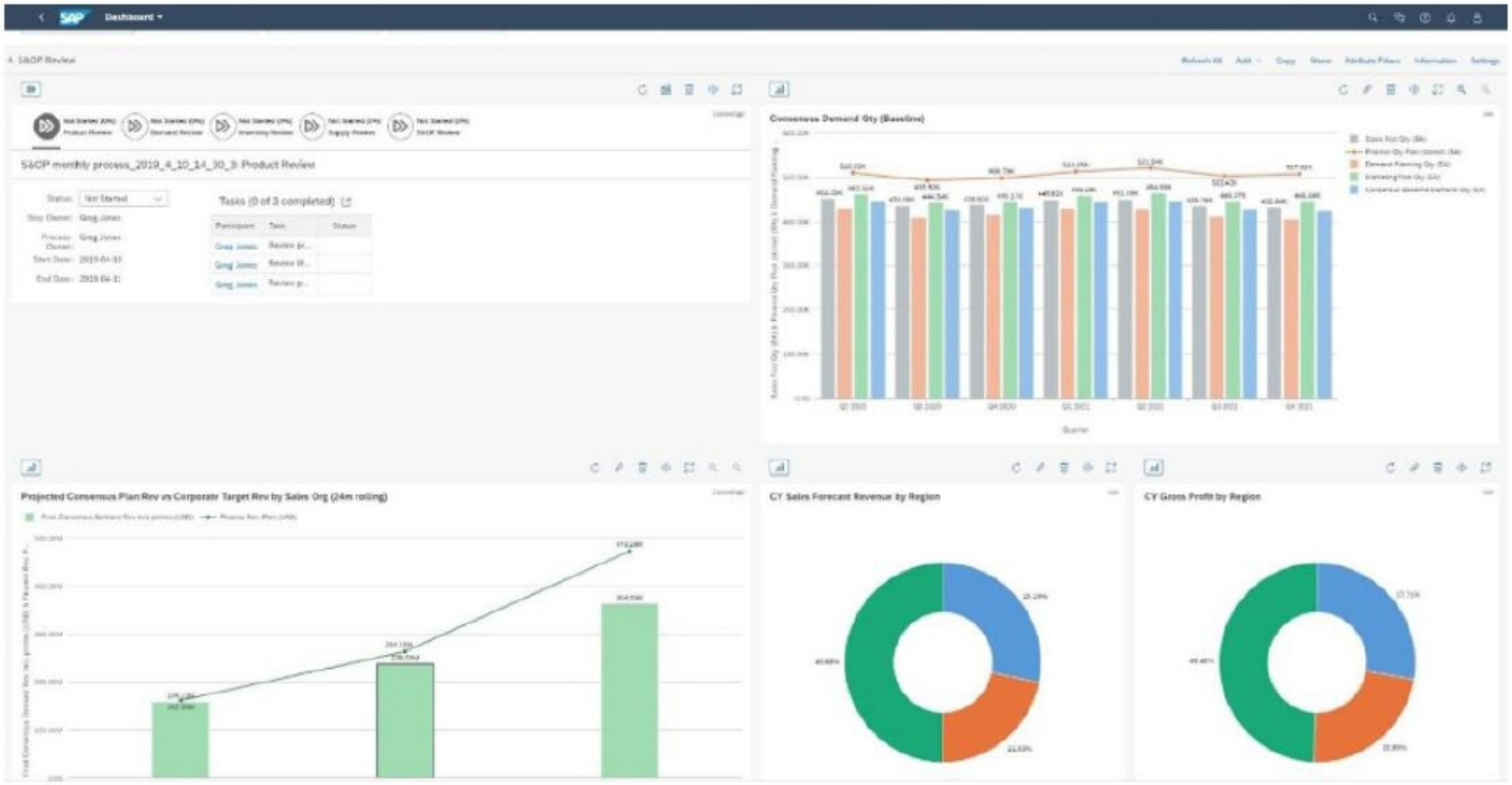


Fig. 7.5. Example of the sales and operations planning SAP software [56]

Demand planning fosters inter-functional cooperation, which is a fundamental pillar of effective S&OP. Sales, marketing and operations teams collaborate to share opinions and predictions, giving them a more complete insight into customer demand patterns. Basically, demand planning is an essential part of an effective S&OP strategy, which contributes to increasing both operational efficiency and profitability, and a providing customer-centric solutions to enhance the customer experience. An example of demand planning software is shown in Fig. 7.6 [55].

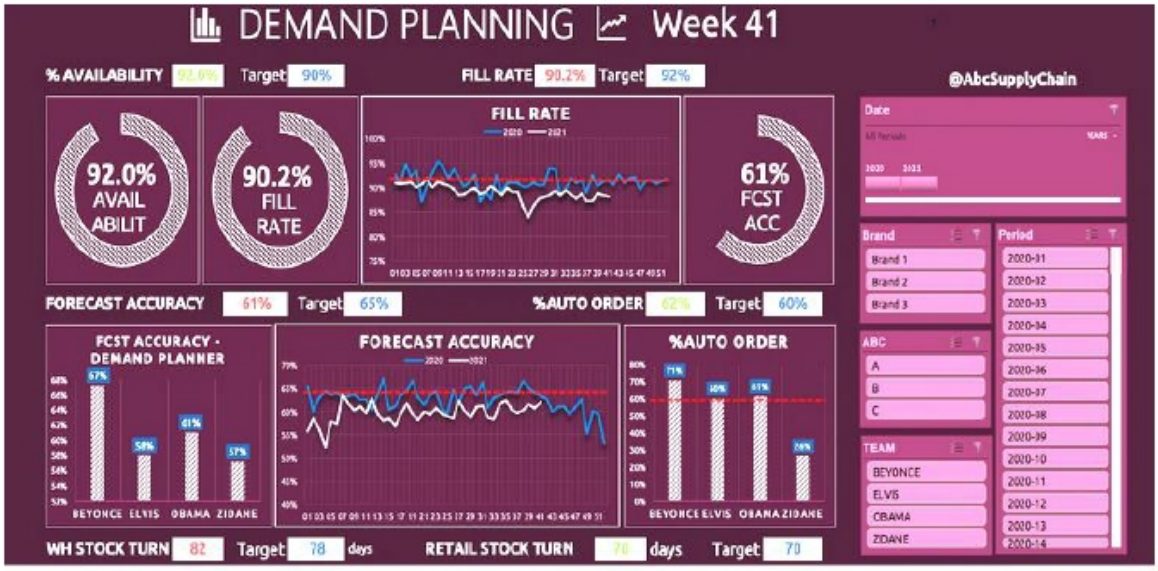


Fig. 7.6. Example of the demand planning software [55]

Microsoft Excel remains the basic tool for S&OP process management. Its extensive feature set, combined with an easy-to-use interface, combines both accessibility and capability. With Excel, businesses can collect data reliably, develop thorough supply and demand plans, and perform sophisticated scenario analysis. The ability to build complex forecasting models, organise production schedules, monitor stock levels, and design high-value reports is incredibly manageable. Additionally, the seamless sharing of information between multiple departments is made possible by Excel's real-time collaboration feature, enabling interdepartmental and inter-functional coordination. The flexibility of Excel allows it to adjust and meet the changing needs of the continuously growing business, delivering a robust solution competing with customised S&OP software. An example of sales forecasting software is shown in Fig. 7.7 [55].

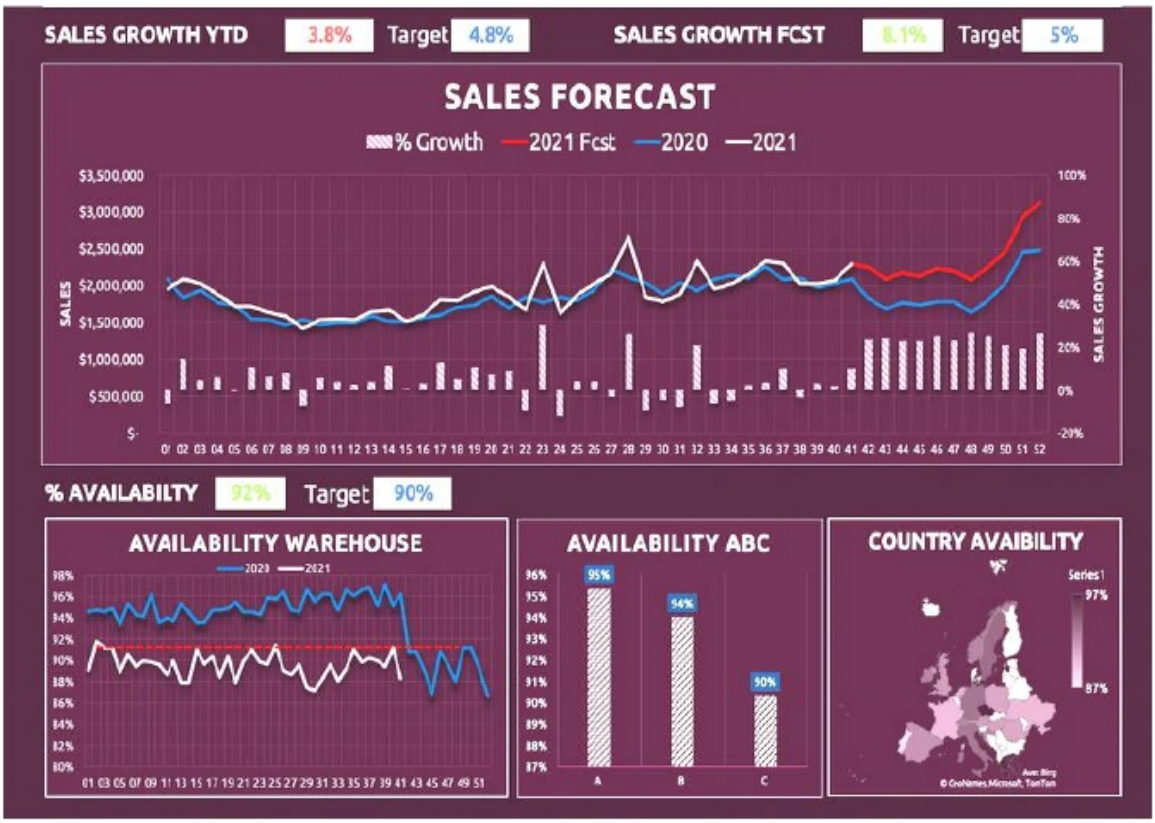


Fig. 7.7. Example of the sales forecast software [55]

Achieving inter-functional coordination is one of the main difficulties. A sales and operations plan demands cooperation between different departments operating independently, which can be challenging to accomplish. Improving everyone's awareness of their role in the S&OP process and the significance of cooperation is imperative. Data accuracy and consistency remains another concern. Imprecise or misaligned data can cause inadequate demand forecasts and inefficient planning of operations. To deal with this issue, companies should have reliable processes for collecting, validating and analysing data [55].

Artificial intelligence (AI) is shaping up to drive a breakthrough in S&OP, providing a bright future with increased efficiency and accuracy. By automatically correlating and improving data collection and analysis, AI can generate more consistent and accurate supply and demand forecasts. It can further improve supply planning through determining the most profitable and efficient production and logistics strategies. An example of inventory forecasting software is shown in Fig. 7.8 [55].

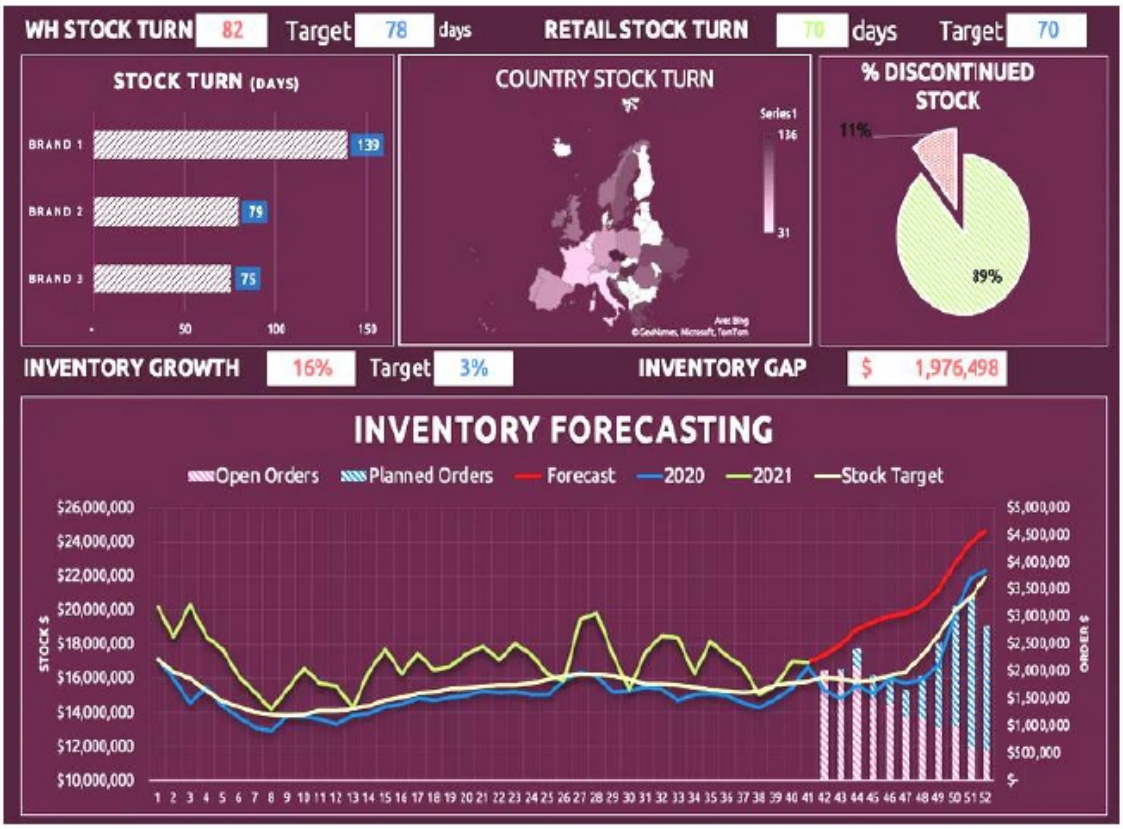


Fig. 7.8. Example of inventory forecasting software [55]

Effective S&OP efforts also have the potential to optimise logistics planning, thereby cutting carbon emissions. For example, effective route planning and loading optimisation can help minimise fuel consumption and emissions from transport. It also facilitates cooperation with suppliers, giving companies to seize an opportunity to jointly pursue sustainability activities. A platform for integrating sustainability criteria into the selection and assessment of suppliers, thus contributing to the sustainable sourcing practice [55].

By incorporating sustainability goals into the process of sales and operational planning, companies benefit from making sound decision-making that supports their general sustainability goals. By doing so, environmental and social effects can be included in the mix of traditional indicators such as cost and efficiency. Thus, S&OP serves a pivotal role in the sustainable supply chain management, empowering businesses to

operate effectively, minimising their environmental footprint and contributing to the social wellbeing [55].

Discussion questions

1. What does the sales and operations planning process involve?
2. Characterise the six stages of the sales and operations planning process.
3. What are the features of typical sales and operations planning process?
4. What are the global best practices in sales and operations planning?
5. What are the strengths of Apple Inc?
6. What are the prerequisites for the development of Amazon as a global e-commerce leader?
7. What determines the operational efficiency of Amazon's S&OP?
8. Describe six hypotheses that link the coordination mechanisms with Supply Chain Performance.
9. What is the characteristic of an example of SAP planning software?
10. What are the features of the example of demand planning software?
11. What are the peculiarities of the example of sales forecasting software?
12. What are the features of the inventory forecasting software example?

Cases

1. Identify the specifics of the sales and operations planning process for the selected company.
2. Assess the relevance of using the six-stage sales and operations planning process for the chosen option.
3. Evaluate the effectiveness of global best practices in sales and operations planning for the selected company.
4. For the chosen company option, evaluate the effectiveness of the sales strategy you selected.
4. Using Apple Inc as an example, evaluate the effectiveness of its global standard.
5. Using Amazon as an example, evaluate the effectiveness of its advanced algorithms.
6. Based on a more mature planning process, select the best business solution for the chosen company.

Tests

1. The process of sales and operations planning does not include:

a) balancing demand plans with supply plans;

b) making planning adjustments in sales and operations execution;

c) examining proposals and investments related to markets and suppliers;

d) all answers are correct.

2. The most important sales and operations planning vital sign is:

a) data support from partners in finance, sales and marketing, procurement, engineering, and operations are usually required;

b) whether executive stakeholder is directly involved in the process;

c) interdepartmental communication;

d) there is no correct answer.

3. Does the sales and operations planning process promote cross-functional alignment and collaboration?

a) yes;

b) no;

c) most likely yes;

d) there is no correct answer.

4. Does the success of the sales and operations planning process depend on the participation of all functional managers?

a) yes;

b) no;

c) most likely no;

d) all answers are correct.

5. The goal of step "Product review" of the sales and operations planning process is:

a) making an unconstrained forecast or consensus demand planning, incorporating a holistic picture of independent and dependent demand;

b) setting dates for new production or sunsetting to determine project prioritization and resource allocation;

c) developing a supply plan that syncs with the consensus demand plan. Ideally, these two plans work in unison;

d) there is no correct answer.

6. The goal of step "Demand review" of the sales and operations planning process is:

a) making a supply plan that syncs with the consensus demand plan. Ideally, these two plans work in unison;

b) setting dates for new production or sunsetting to determine project prioritization and resource allocation;

c) developing an unconstrained forecast or consensus demand planning, incorporating a holistic picture of independent and dependent demand;

d) there is no correct answer.

7. The goal of step "Supply review" of the sales and operations planning process is:

a) developing a supply plan that syncs with the consensus demand plan. Ideally, these two plans work in unison;

b) making an unconstrained forecast or consensus demand planning, incorporating a holistic picture of independent and dependent demand;

c) setting dates for new production or sunsetting to determine project prioritization and resource allocation;

d) there is no correct answer.

8. Factors influencing independent and dependent demand may include:

a) marketing and new product introduction;

b) consumer trends and product hierarchy;

c) interplant part demand;

d) all answers are correct.

9. The supply plan should:

a) balance customer service;

b) interplant part demand;

c) minimize inventory as well as operating costs;

d) there is no correct answer.

10. The step "Finance review" of the sales and operations planning process involves the following:

a) financial performance for the previous month is consolidated to provide inputs for analysing the current month's S&OP cycle;

b) actual costs are compared with budgets and forecasts to analyse forecast accuracy over a rolling time frame;

c) the plans are reviewed in shared dashboards and actual versus variance is analysed, keeping targets and budgets in mind;

d) there is no correct answer.

11. The step "Pre-S&OP" of the sales and operations planning process refers to the following:

a) including different categories or views, in particular product, geography, customer, and channel;

b) series of meetings conducted with leaders at various levels that showcase the connectivity of plans across product, demand, supply, and finance;

c) the final phase of S&OP brings all plans and data together in a unified, cloud-based platform to be used in executive S&OP meetings;

d) there is no correct answer.

12. The step "Executive S&OP" of the sales and operations planning process refers to the following:

a) series of meetings conducted with leaders at various levels that showcase the connectivity of plans across product, demand, supply, and finance;

b) including different categories or views, in particular product, geography, customer, and channel;

c) the final phase of S&OP brings all plans and data together in a unified, cloud-based platform to be used in executive S&OP meetings;

d) there is no correct answer.

13. The purpose of pre-S&OP is:

a) an unconstrained forecast or consensus demand planning, incorporating a holistic picture of independent and dependent demand;

b) identification of key gaps and disconnects and create strategies to handle those issues:

c) a supply plan that syncs with the consensus demand plan. Ideally, these two plans work in unison;

d) there is no correct answer.

14. Many planners still use spreadsheets for S&OP due to:

a) the widespread access to spreadsheet software;

b) its flexibility;

c) its complexity;

d) all answers are correct.

15. Spreadsheet technology issue is the following:

a) it is incapable of taking advantage of modern advanced technology, such as artificial intelligence (AI);

b) it has problematic nature;

c) it is limited in the amount of data it can process;

d) there is no correct answer.

16. S&OP fosters:

a) communication and collaboration across the organization;

b) driving improved efficiency, reduced costs and increased customer satisfaction;

c) better business performance;

d) all answers are correct.

17. Is the Operations Planning Process a critical component of the S&OP framework, focused on devising strategies to efficiently meet the anticipated demand?

a) yes;

b) no;

c) most likely yes;

d) there is no correct answer.

18. Steps of the sales and operations planning process vary according to:

a) the needs and dynamics of national economy;

b) the needs and dynamics of each organization, the overall process follows this progression;

c) the needs and dynamics of global economy;

d) there is no correct answer.

19. Detailed operations plan include:

a) outlining production schedules;

b) inventory management strategies;

c) logistics planning;

d) all answers are correct.

20. The operations planning process considers constraints such as:

a) capacity limitations, cost factors, and lead times;

b) inventory management strategies;

c) ensuring the plan is balanced between operational efficiency and cost-effectiveness;

d) there is no correct answer.

21. By aligning the operations plan with sales forecasts, the OP Process ensures that:

a) supply is effectively matched with pricing;

b) supply is effectively matched with demand;
c) demand is effectively matched with pricing;
d) there is no correct answer.

22. Operational ineffectiveness results in:
a) unmet demand and operational disruption;
b) idle capacity and excessive inventory investment:
c) loss of demand;
d) there is no correct answer.

23. Do the market leaders in any industry have the highest degree of alignment across functions – product, sales, marketing, supply chain and finance?
a) yes;
b) no;
c) most likely no;
d) all answers are correct.

24. A key element of Apple's S&OP success is:
a) its ability to accurately forecast pricing;
b) its ability to accurately forecast demand;
c) its ability to accurately forecast proposal;
d) there is no correct answer.

25. Short-term S&OP drives:
a) more tactical discussions and decisions in S&OP meetings and fails to enable the participants to look beyond the 12-month horizon;
b) less tactical discussions and decisions in S&OP meetings and fails to enable the participants to look beyond the 12-month horizon;
c) less global discussions and decisions in S&OP meetings and fails to enable the participants to look beyond the 12-month horizon;
d) there is no correct answer.

26. By integrating sustainability goals into sales and operations planning, can businesses make informed decisions that contribute to achieving their overall sustainability goals?
a) yes;
b) no;
c) most likely no;
d) all answers are correct.

8. BUSINESS PROCESS MANAGEMENT AND COORDINATION IN A SUPPLY CHAIN

8.1. BUSINESS PROCESS MANAGEMENT IN THE SUPPLY CHAIN

Business process management (BPM) is becoming a revolutionary driver in the transport and logistics sector, optimising operations and adding value to the complex processes shaping the global flow of goods. [60].

Business process management benefits are as following [60]:

1. Improved Operational Efficiency. BPM implements a systems approach to managing and optimising business processes. In the transport and logistics sphere, where numerous activities need to be coordinated, BPM optimises workflows, eliminates unnecessary duplication and assures that every supply chain stage is running at the highest possible efficiency. As a result, operations are speedy, precise and cost-effective.

2. Real-time Visibility and Tracking. BPM incorporates extensive tracking and monitoring functions into the logistics process. Real-time visibility provides stakeholders with the ability of tracking shipments, monitoring stock levels and reacting quickly to any delays or breakdowns. The visibility provided by BPM improves decision-making and response times, both of which are essential for the operation in the high-volatility environment of the transport and logistics sector.

3. Cost Optimization. Through detection of bottlenecks and automation of repeatable tasks, BPM can help to cut costs significantly. Beyond optimising routes, warehouse management or procurement processes, BPM provides a rational use of resources, which results in lower operating costs and more efficient financial performance.

4. Improved Customer Experience. BPM fulfils a significant role in delivering a superior customer experience in the transport and logistics industry at a time of growing customer demands and expectations. Process optimisation allows for shortened delivery times, precise fulfilment of orders, and improved feedback, contributing to greater customer satisfaction and loyalty.

5. Compliance and Risk Management. The transport and logistics sector is regulated by a wide range of regulations and meeting compliance requirements. BPM provides an implementation of a structured system to

ensure compliance with relevant regulations, mitigating the risk of legal problems and business disruptions. This thorough approach ensures a resilient and compliance-driven supply chain.

6. Agility in Adapting to Changes. The transport and logistics industry is characterised by high volatility due to rapidly changing market forces and customer needs. BPM gives companies the flexibility they need to adjust to these shifts smoothly. Seamlessly scaling up operations, incorporating advanced technologies, or adapting to emerging market trends, BPM delivers the agility required for long-term business viability.

7. Data-driven Decision Making. Data analytics capabilities are used by BPM to generate understanding operations efficiency. By using data, businesses can improve decision-making, determine areas for enhancement and resolve issues in a proactive manner. In a highly competitive transport and logistics, decision-making based on data is a major driver of success.

8. Streamlined Cooperation. BPM supports cooperation between various departments and stakeholders in the transport and logistics ecosystem. Through coordination between suppliers, carriers, or regulators, BPM enables all participants to operate in a consistent way to achieve common goals, eliminating delays and bottlenecks.

9. Scalability for Growth. With the growth of the transport and logistics business, BPM offers a flexible and configurable platform evolving with the company. From dealing with increasing transaction volumes, entering new markets, or managing acquisitions, BPM provides the ability to maintain operational efficiency throughout rapid growth.

10. Continuous Improvement Culture. Business process management delivers great value to companies by introducing a culture of ongoing improvement throughout the business. Through the systematic revision and optimisation of processes, transport and logistics companies can maintain their competitive position in a constantly transforming industry by innovating and enhancing their capabilities.

Business process management tools represent software platforms built to enable companies to plan, analyse, automate and optimise their business processes. In an increasingly dynamic environment, those solutions are vital to improving operational efficiency, cutting costs and boosting customer experience [60].

Business process management tools can contribute to the following aspects [60]:

1. Visualization and modelling. It can provide a visual presentation of a company's business processes by using standardised methods such as Business Process Model and Notation (BPMN), and help determine surpluses, bottlenecks, and potential spheres for improvement in workflows.

2. *Automation and integration*. It can enable automation of repeated tasks and manual operations via integrated functions or integration with other systems, and it can also help to improve collaboration and flow of data across departments and different stakeholders.

3. *Optimization and monitoring*. It can help monitor key performance indicators (KPIs) to evaluate process performance, as well as analyse data and spot potential for further optimisation and enhancement.

4. *Governance and control*. It can support identifying roles and responsibilities within processes for greater transparency and compliance and managing access and permissions to secure data and keep integrity of processes.

5. *Ongoing improvements*. It can provide a platform for continuous tracking and analysis of processes, promoting a data-driven decision-making culture and continued improvement.

There are various types of business process management tools available, each catering to different needs and complexities (Fig. 8.1) [60].

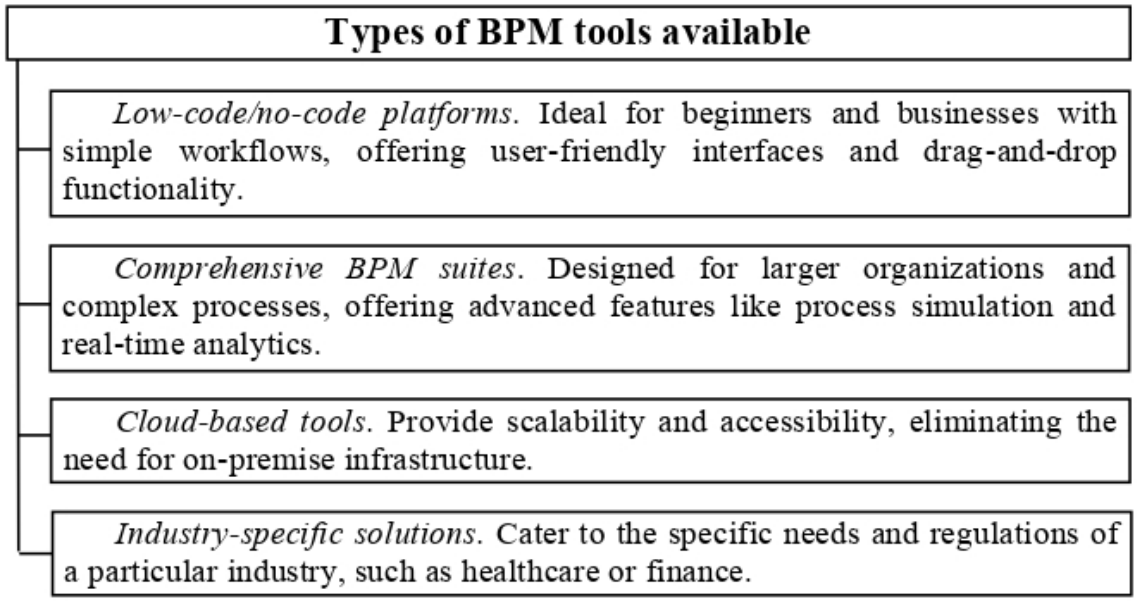


Fig. 8.1. Types of business process management tools available [60]

Selecting the appropriate BPM tool depends on specific factors, particularly [60]:

1. *Organizational size and complexity.* The number of users, processes and integrations required should be considered.

2. *Budget and technical expertise.* The financial capacity and existing IT support should be assessed.

3. *Specific needs and goals*. Areas to be improved and functions needed should be identified.

Main benefits of using business process management tools are shown in Fig. 8.2 [60].

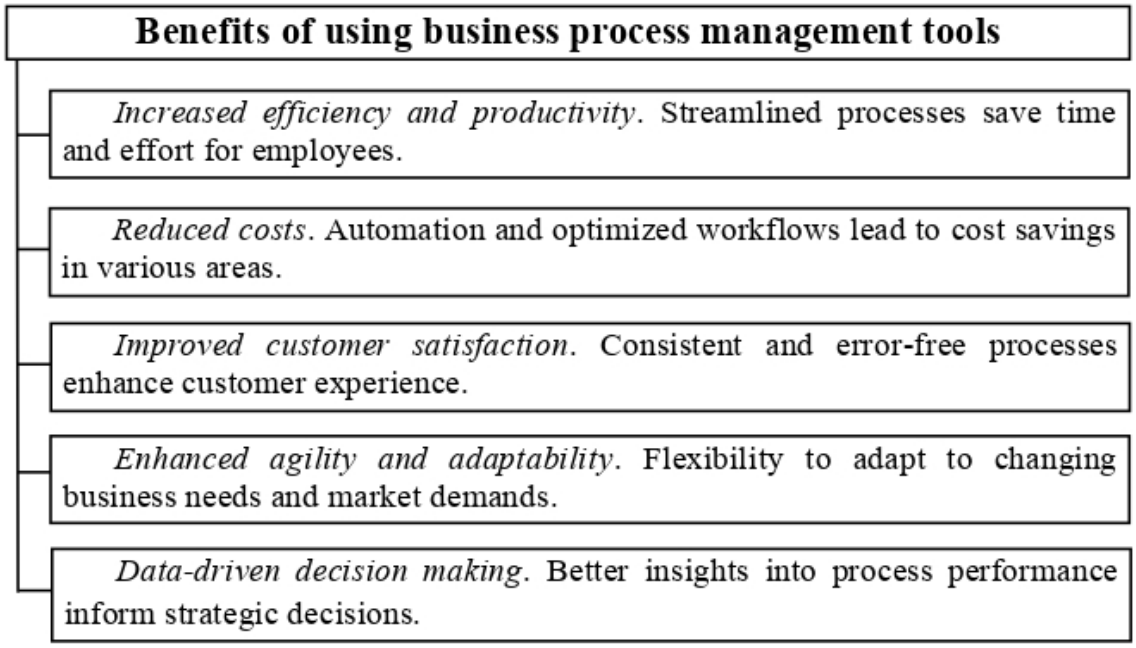


Fig. 8.2. Benefits of using business process management tools [60]

Going outside the box. Though BPM tools are capable, their effectiveness depends on proper implementation and willingness to continuously improve [60].

Process analysis and documentation. It is important to have a clear understanding of existing processes prior to optimising them.

Stakeholder engagement. All teams and individuals concerned should be involved.

Change management. It is necessary to train and assist employees during the transition to new processes.

By leveraging the capabilities of BPM tools and implementing an integrated approach, companies can significantly improve their workflows and ensure long-term growth [60].

Transport and logistics companies need to make sure they have a business process management plan in place, as BPM is not just a tool, but a strategic driver delivering significant value to the transport and logistics sector. Efficiency and cost optimisation to improved customer experience and resilience towards change, BPM enables businesses to address the global supply chain challenges with accuracy and efficacy. At a time when the industry is still growing, BPM is a key enabler for companies looking to take their operations to the next level of efficiency and value [60].

The supply chain and logistics processes are defined and goals are assigned to each process. Time, quality, cost and productivity are the main process indicators. Targets are set in meetings with suppliers, partners and customers. Industry standards are referenced to determine best-in-class goals. Then, for each process, cause and effect relations are set up to ensure that the accomplishment of the process metric target can be correlated with the completion of a specific business strategy, either customer or financial. Each process target is given leading indicators to provide an advance alert that shows when the required performance target is at risk of not being achieved. Root cause analysis can be used to find the primary cause of a failure to meet a targeted process performance indicator. It is followed by developing and implementing process improvement measures, and then measuring the progress of the process improvement. Then causation is investigated to quantify the impact that the improved process has had on customer and financial indicators. Afterwards, new goals for process improvement are set to reach the desired customer or financial metrics [61].

To analyse actual performance, a wide number of tools and methods are available. Process analysis reveals bottlenecks, redundant efforts, reasons for errors and wastes. For instance, product returns are a significant issue for many producers and distributors. It is possible to track eve-

ry shipping process since the transfer of goods to a third-party logistics provider. In case there is a trouble with the shipment delivery on the first attempt, rather than scheduling a repeat delivery the next day automatically, the process will receive a notification about it with a task sent to the call centre agent's desk to reach out to the customer and try to resolve the issue. Keeping the package in the field instead of returning to the dock saves the company hundreds of dollars on each shipment. Next, the cause and effect of the returns process should be investigated to measure the quantifiable effect of the improved process on customers and the financial bottom line [61].

The supply chain is characterised by end-to-end processes that cut through numerous departments inside and between organisations so there are many handoffs. By enhancing the management of these handoffs, there is greater alignment and timeliness of fulfilment. As a result, processes are accelerated, and errors are minimised, reducing/optimising inventory levels and creating time and cost savings. The simple supply chain is being substituted by a more sophisticated network of partners and suppliers. This complex one necessitates a non-stop flow of information and process-level focus on details between the actors involved – producers, suppliers, partners and intermediaries. Such visibility into supply chain processes allows organisations to identify process-level errors and delays – and apply BPM techniques to improve performance [61].

Business process management (BPM) delivers a holistic approach to solving SCM issues by optimising workflows, streamlining repeatable tasks and facilitating cooperation between stakeholders. Processes are standardised, made transparent and controlled through BPM, enabling suppliers to detect inefficiencies and improve performance [62].

BPM fulfils a major part in streamlining procurement processes to increase efficiency by generating real-time information, tracking key performance indicators (KPIs) and supporting constant improvement. By using BPM, suppliers can increase their visibility, flexibility, SCM scalability and response times throughout the supply chain, leading to lower costs, shorter turnaround times and improved decision-making processes [62].

8.2. COORDINATION IN THE SUPPLY CHAIN

A supply chain refers to the network of companies/businesses that transform raw materials, parts and components into final products and then offer them to consumers. In case a supply chain is administered by a central planner with the ability to control all decisions, it is called a centralised supply chain. The combination of activities considered to improve the supply chain is called a centralised optimal solution. In reality, however, supply chain actors are often independent organisations that seek to maximise their own individual objectives [63].

A coordinated supply chain is obviously the preferred scenario, as all participants can get a better position than if there is no coordination. Due to the varying goals and interests of the participants, the equilibrium result in a decentralised supply chain often deviates from the centralised optimal solution, resulting in supply chain inefficiencies [63].

The most important issue in the management of supply chains is how to coordinate a decentralised supply chain. Developing a contractual framework to leverage the incentives of all participants in such a way that individually optimal actions align with centrally optimal actions is one solution. Many common contracts can serve as coordination tools. A real supply chain can be highly complex [63].

For instance, the supply chain may have a complex network design with an unlimited number of companies, every company may have private information on its own costs and demand forecasts, and the decisions of the companies may not be visible or controllable. To clarity, a simple supply chain consisting of just two firms, a supplier and a retailer, can be considered. The retailer acts like a newsagent, i.e. it encounters random demand in one selling season and plans on how much to order from the supplier. All is public knowledge, and no hidden actions are involved. In addition, all participants are risk-neutral, thus attempting to maximise their estimated profits [63].

Coordination of the supply chain is strengthened when all links in the network undertake coherent actions that contribute to the overall supply chain value. Supply chain coordination demands that each link in the supply chain should exchange information and be aware of the impact of its actions on other links. Lack of alignment happens because different stages of the

supply chain operate with contradictory individual objectives, or because the information flowing between stages is either delayed or corrupted [17].

Different supply chain stages may have contradictory goals when each is seeking to maximise individual profits, leading to practices that ultimately reduce the overall supply chain profit. Modern supply chains are made up of stages with multiple owners [17].

Lack of proper coordination in the supply chain can result in a 'bull-whip' effect, where order volatility increases as it moves up the supply chain from retailers to wholesalers, producers, suppliers, as shown in Fig. 8.3. The bullwhip effect will distort information about demand in the supply chain since each link has a distinct view of what the demand situation looks like [17].

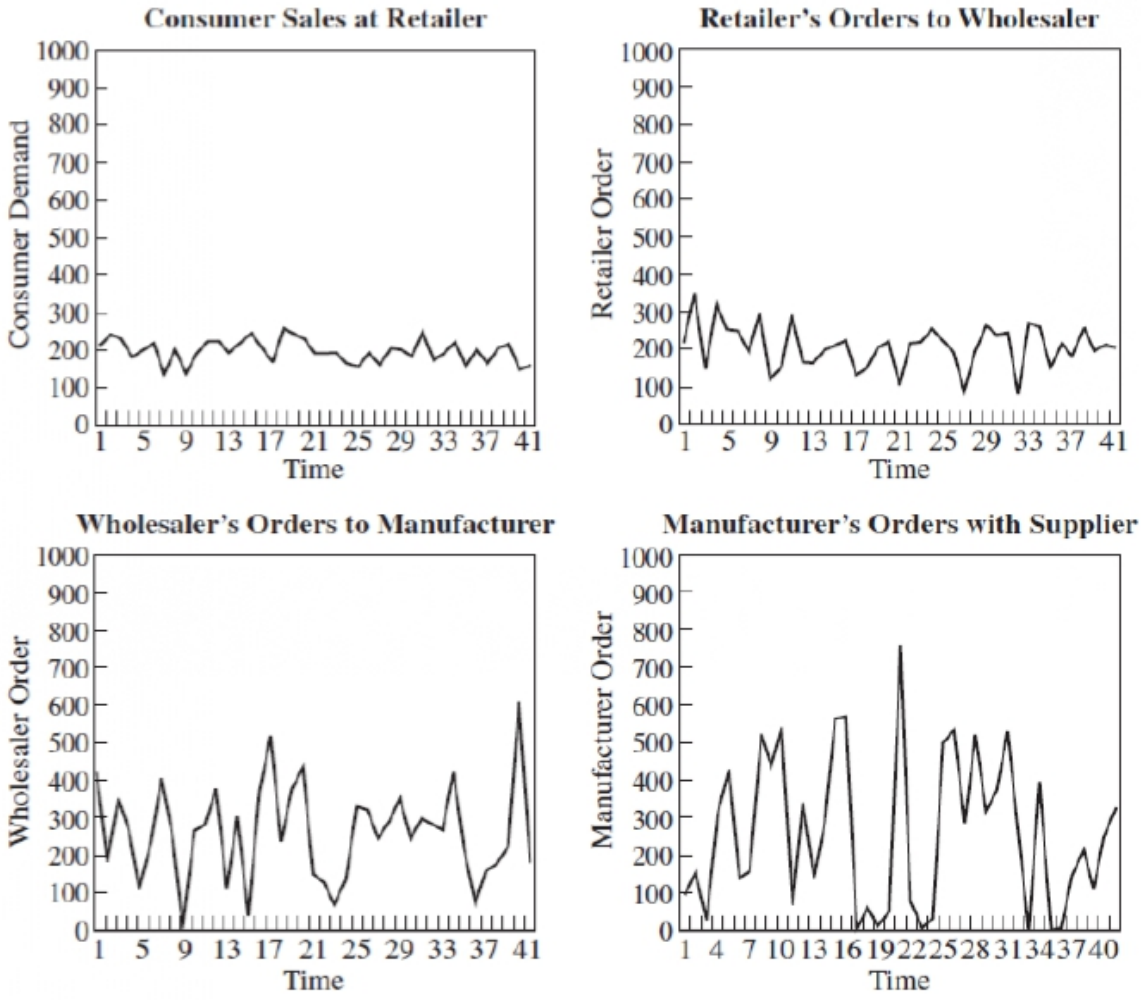


Fig. 8.3. Demand fluctuations at different stages of a supply chain [17]

All factors resulting in localised optimisation at different supply chain stages, or in increased delay, distortion and variation of information within the supply chain, are barriers to coordination. Once supply chain managers are able to spot the main barriers, they can implement appropriate measures to improve coordination. Major barriers can be grouped into five categories: incentive barriers, information processing barriers, operational barriers, price barriers and behavioural barriers [17].

Incentive barriers arise when incentives that are provided to different stages or players in the supply chain have resulted in moves that add to variability and decrease overall supply chain profits. Incentives focusing solely on the individual impact of an action lead to actions that fail to maximise overall supply chain value. Inappropriately structured seller incentives are a considerable barrier to supply chain alignment. Many firms base their sales incentives on exceeding sales targets within a monthly or quarterly performance period [17].

Information processing interference arises when information about demand is corrupted as it flows through different supply chain stages, resulting in an increase in the variability of orders in the supply chain. In this case, a slight shift in customer demand is amplified as it moves higher up the supply chain and is represented by customer orders. There is a need to examine the effect of a random rise in customer demand on retailers [17].

The inability to communicate across the supply chain stages increases the distortion of information. A retailer, such as Walmart, may decide to increase the size of a specific order due to a scheduled promotion activity. Operational impediments arise when actions taken during order placement and fulfilment cause variability to increase. As a company makes orders in large quantities which exceed greatly the demand, order variability escalates up the supply chain. Companies may place large quantities due to the fact that there are significant fixed costs for placing, taking or transporting the order. Big lots can also arise if a supplier has discounts on quantity based on the size of the lot. Fig. 8.4 shows the demand and order flow for a company that places order every five weeks. The order flow is much more volatile than the demand flow [17].

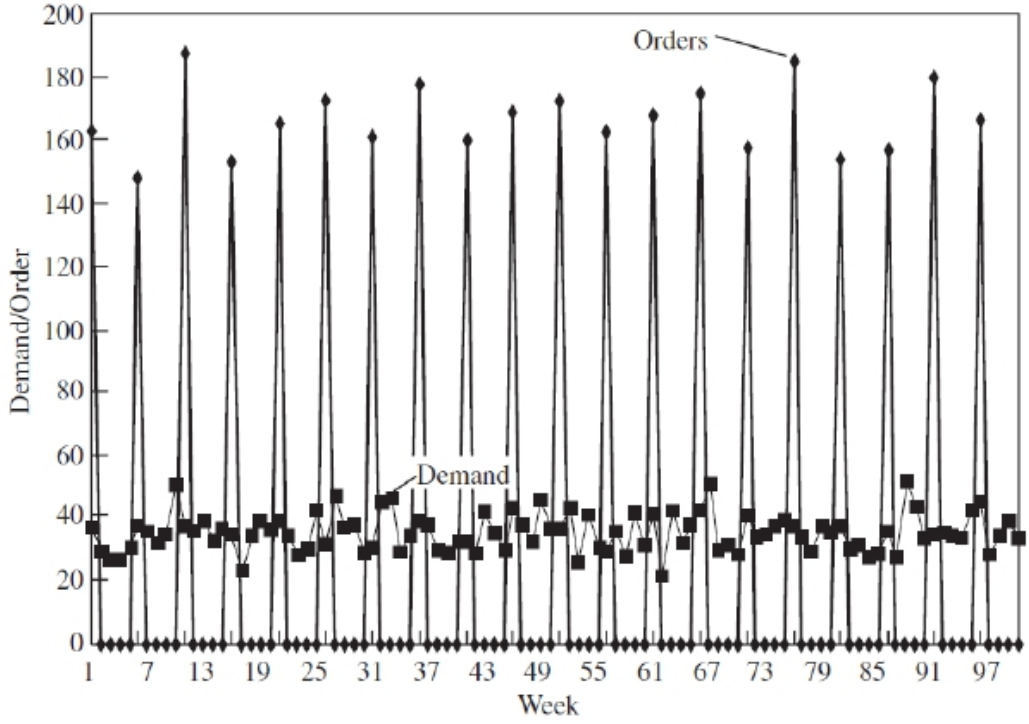


Fig. 8.4. Demand and order flow with order every five weeks [17]

Price barriers emerge when the product pricing policy causes an increase in the variability of orders placed. Lot size-based discounts tend to raise the size of orders placed in the supply chain, as lower prices are proposed for larger volumes. As noted earlier, large quantities increase the bullwhip effect in the supply chain. Behavioural barriers are learning issues inside companies that cause information to be distorted. These issues are typically associated with the structure of the supply chain and communications across different stages [17].

Having identified obstacles to coordination, we now focus on actions a manager can take to help overcome the obstacles and achieve coordination in the supply chain. The following managerial actions increase total supply chain profits and moderate information distortion: aligning goals and incentives; improving information visibility and accuracy; improving operational performance; designing pricing strategies to stabilize orders; building strategic partnerships and trust [17].

To improve alignment across the supply chain, managers can coordinate by agreeing on goals and incentives so that each supply chain player operates towards maximising the overall supply chain profit. Coordination

demands that each link in the supply chain concentrates on the supply chain surplus or total size of the market, not just its individual share. Alignment is all about developing mechanisms that create a win-win scenario in which supply chain surplus rises together with profits for all stages of the supply chain [17].

Ensuring that the target that each function applies to assess the decision is aligned with the overall objective of the company is one of the most important drivers of coordinated decisions within the organisation. In many cases, appropriate pricing patterns may be helpful in coordinating the supply chain. A producer may employ lot size-based discounts to accomplish alignment for commodities if there are high fixed costs related to each lot [17].

Leaders can improve coordination by enhancing the transparency and accuracy of information available across various stages of the supply chain. Exchanging customer demand data throughout the supply chain has the potential to mitigate the bullwhip effect. The main reason for the distortion of information is that each link in the supply chain relies on orders to predict upcoming demand. As soon as customer demand data becomes available, the different parts of the supply chain should be able to forecast and plan together if full alignment is to be obtained. Creating a supply chain in which one stage controls the restocking decisions for the whole supply chain can help lessen information distortion. The primary reason for information distortion, as noted earlier, is that each link in the supply chain uses the previous link's order as its past demand [17].

It is possible for managers to assist in mitigating information distortion by enhancing operational performance and developing suitable rationing schemes in the face of shortages. Managers are able to implement a number of measures at various stages of the supply chain to support the reduction of inventory restocking times. The use of electronic ordering, such as online or via electronic data interchange (EDI), can greatly cut down on the time required to place an order and pass on information [17].

It can reduce information distortion by implementing operational improvements that decrease lot sizes. By reducing lot sizes, managers can minimise the amount of variation that can occur between any pair of supply

chain stages, thereby reducing distortions. Also, managers can alleviate information misrepresentation by developing pricing strategies that incentivise retailers to order smaller quantities and reduce forward purchases. By offering quantity discounts based on lot size, retailers increase their lot size to get the full benefit of the discount. Providing quantity discounts based on volume removes the incentive to increase the volume of an individual lot since volume-based discounts take into account the total volume of purchases over a period of time rather than single lot purchases [17].

Managers are better able to use the tools presented above to facilitate alignment if they have built trusted and strategic partnerships within the supply chain. Exchanging precise, reliable information at every stage leads to better alignment of supply and demand across the supply chain. Improved relationships will also contribute to lower transaction costs between supply chain stages [17].

Conflicts of interest have a substantial impact on the supply chain operation. Accordingly, it is crucial to develop an appropriate alignment mechanism to deal with conflicts in supply chains. The study [64] addresses the coordination in a two-member supply chain with a flexible manufacturing system under conditions of limited customer service and stochastic demand. A multi-test policy is applied, and a discrete investment function is used to reduce setup costs. Bargaining is a basic subject for all business currently undertaken by supply chain participants to benefit from a cooperative centralised model The three supply chain models developed in [64] are the Stackelberg buyer model, the centralized decision-making model, and the Nash model. Correlating cost allocation with different bargaining power provides a clearer picture of the cost allocation scenario - the study tries to link negotiations with centralization and decentralization. Discrete investments contribute to further reducing overall costs if there is a cost-sharing ratio. Controlled lead times serve to link the cost-sharing ratio in the supply chain model. Analytical solution of the model is performed using a game-theoretic approach. Numerical examples and sensitivity analysis are included to validate the proposed models. Findings show that the Nash negotiation-based centralized cooperation model greatly increases the overall supply chain profit.

Discussion questions

1. What does business process management involve?
2. Describe the benefits of business process management.
3. What are the features of business process management tools?
4. What are the types of business process management tools available?
5. What are the benefits of using business process management tools?
6. What tools and techniques are used to identify insights into current performance?
7. What characterizes returns as a problem for many manufacturers and retailers?
8. Describe the cause-and-effect relationship for the product return process.
9. What allows to identify errors and delays at the process level and use business process management methods to improve them?
10. What are the features of a centralized optimal solution in the supply chain?
11. What are the features of demand fluctuations at different stages of a supply chain?
12. What are the features of demand and order stream with orders every five weeks?
13. What management actions increase the overall profit of the supply chain and moderately distort information?

Cases

1. Identify the features of business process management for the selected company.
2. For the selected option, identify the tools and methods used to identify insights into current performance.
3. For the selected company option, evaluate the effectiveness of the centralized optimal supply chain solution feature.

Tests

1. Enhanced operational efficiency as an advantage of business process management is manifested in the following:

a) it streamlines workflows, minimizing redundancies, and ensuring that each step in the supply chain operates at peak efficiency;

b) real-time visibility allowing stakeholders to track shipments, monitor inventory levels, and respond promptly to any disruptions or delays;

c) it allows to identify inefficiencies and automating repetitive tasks, contributing to significant cost savings;

d) there is no correct answer.

2. Real-time visibility and tracking as an advantage of business process management is manifested in the following:

a) it allows to identify inefficiencies and automating repetitive tasks, contributes to significant cost savings;

b) real-time visibility allows stakeholders to track shipments, monitor inventory levels, and respond promptly to any disruptions or delays;

c) it streamlines workflows, minimizes redundancies, and ensures that each step in the supply chain operates at peak efficiency;

d) there is no correct answer.

3. Cost optimization as an advantage of business process management is manifested in the following:

a) it streamlines workflows, minimizes redundancies, and ensures that each step in the supply chain operates at peak efficiency;

b) real-time visibility allows stakeholders to track shipments, monitor inventory levels, and respond promptly to any disruptions or delays;

c) it allows to identify inefficiencies and automating repetitive tasks, contributes to significant cost savings;

d) there is no correct answer.

4. Improved customer experience as an advantage of business process management is manifested in the following:

a) it equips organizations with the agility to adapt to these changes seamlessly;

b) it provides faster delivery times, accurate order fulfilment, and enhanced communication, fostering customer satisfaction and loyalty;

c) it introduces a structured framework for ensuring adherence to these regulations, reducing the risk of legal issues and disruptions, contributes to a secure and compliant supply chain;

d) there is no correct answer.

5. Compliance and risk management as an advantage of business process management is manifested in the following:

a) it introduces a structured framework for ensuring adherence to these regulations, reducing the risk of legal issues and disruptions, contributes to a secure and compliant supply chain;

b) it provides faster delivery times, accurate order fulfilment, and enhanced communication, fostering customer satisfaction and loyalty;

c) it equips organizations with the agility to adapt to these changes seamlessly;

d) there is no correct answer.

6. Agility in adapting to changes as an advantage of business process management is manifested in the following:

a) it provides faster delivery times, accurate order fulfilment, and enhanced communication, fostering customer satisfaction and loyalty;

b) it introduces a structured framework for ensuring adherence to these regulations, reducing the risk of legal issues and disruptions, contributes to a secure and compliant supply chain;

c) it equips organizations with the agility to adapt to these changes seamlessly;

d) there is no correct answer.

7. Data-driven decision making as an advantage of business process management is manifested in the following:

a) it harnesses the power of data analytics to provide insights into operational performance, organizations can make informed decisions, identify areas for improvement, and proactively address challenges;

b) it fosters collaboration across different departments and stakeholders within the shipping and logistics ecosystem;

c) it provides a scalable framework that can grow with the organization, whether it's handling increased transaction volumes, expanding to new markets, or integrating acquisitions, ensures that operational efficiency is maintained even during periods of rapid growth;

d) there is no correct answer.

8. Streamlined collaboration as an advantage of business process management is manifested in the following:

a) it harnesses the power of data analytics to provide insights into operational performance, organizations can make informed decisions, identify areas for improvement, and proactively address challenges;

b) it provides a scalable framework that can grow with the organization, whether it's handling increased transaction volumes, expanding to new mar-

kets, or integrating acquisitions, ensures that operational efficiency is maintained even during periods of rapid growth;

c) it fosters collaboration across different departments and stakeholders within the shipping and logistics ecosystem;

d) there is no correct answer.

9. Scalability for growth as an advantage of business process management is manifested in the following:

a) it provides a scalable framework that can grow with the organization, whether it's handling increased transaction volumes, expanding to new markets, or integrating acquisitions, ensures that operational efficiency is maintained even during periods of rapid growth;

b) it harnesses the power of data analytics to provide insights into operational performance, organizations can make informed decisions, identify areas for improvement, and proactively address challenges;

c) it fosters collaboration across different departments and stakeholders within the shipping and logistics ecosystem;

d) there is no correct answer.

10. Continuous improvement culture, as an advantage of business process management is manifested in the following:

a) it provides a scalable framework that can grow with the organization, whether it's handling increased transaction volumes, expanding to new markets, or integrating acquisitions, ensures that operational efficiency is maintained even during periods of rapid growth;

b) it harnesses the power of data analytics to provide insights into operational performance, organizations can make informed decisions, identify areas for improvement, and proactively address challenges;

c) it provides regular reviewing and optimizing processes, shipping and logistics companies can stay ahead of the curve, embracing innovation and ensuring that they remain competitive in an ever-evolving industry;

d) there is no correct answer.

11. Visualization and modelling as an opportunity for business process management tools is manifested in:

a) creating visual representations of business processes using standardized methods like BPMN, identification redundancies, bottlenecks, and areas for improvement within workflows;

b) automating repetitive tasks and manual processes through built-in features or integration with other systems, streamlining collaboration and data flow between different departments and stakeholders;

c) tracking key performance indicators to measure the effectiveness of processes, analyse data and identify opportunities for further optimization and improvement;

d) there is no correct answer.

12. Automation and integration as an opportunity for business process management tools is manifested in:

a) creating visual representations of business processes using standardized methods like BPMN, identification redundancies, bottlenecks, and areas for improvement within workflows;

b) tracking key performance indicators to measure the effectiveness of processes, analyse data and identify opportunities for further optimization and improvement;

c) automating repetitive tasks and manual processes through built-in features or integration with other systems, streamlining collaboration and data flow between different departments and stakeholders;

d) there is no correct answer.

13. Optimization and monitoring as an opportunity for business process management tools is manifested in:

a) tracking key performance indicators to measure the effectiveness of processes, analyse data and identify opportunities for further optimization and improvement;

b) creating visual representations of business processes using standardized methods like BPMN, identification redundancies, bottlenecks, and areas for improvement within workflows;

c) automating repetitive tasks and manual processes through built-in features or integration with other systems, streamlining collaboration and data flow between different departments and stakeholders;

d) there is no correct answer.

14. Governance and control as an opportunity for business process management tools is manifested in:

a) defining roles and responsibilities within processes for better accountability and compliance, managing access and permissions to ensure data security and process integrity;

b) creating visual representations of business processes using standardized methods like BPMN, identification redundancies, bottlenecks, and areas for improvement within workflows;

c) providing a platform for ongoing monitoring and analysis of the processes, fostering a culture of data-driven decision making and continuous improvement;

d) there is no correct answer.

15. Continuous improvement as an opportunity for business process management tools is manifested in:

a) defining roles and responsibilities within processes for better accountability and compliance, managing access and permissions to ensure data security and process integrity;

b) tracking key performance indicators to measure the effectiveness of processes, analyse data and identify opportunities for further optimization and improvement;

c) providing a platform for ongoing monitoring and analysis of the processes, fostering a culture of data-driven decision making and continuous improvement;

d) there is no correct answer.

16. Selecting an appropriate business process management tool depends on such factors as:

a) organizational size and complexity;

b) budget and technical expertise;

c) specific needs and goals;

d) all answers are correct.

17. The key supply chain and logistics process metrics are:

a) time;

b) quality;

c) cost and productivity;

d) all answers are correct.

18. The targets supply chain and logistics process are established:

a) during workshops with government organizations;

b) during workshops with suppliers, partners and customers;

c) during workshops with system managers;

d) there is no correct answer.

19. Industry benchmarks are used:

a) to define less-in-class targets;

b) to define best-in-all targets;

c) to define best-in-class targets;

d) there is no correct answer.

20. Cause and effect relationships established for each process mean the following:

a) the achievement of systems target can be mapped to the achievement of a particular business strategy – either a partner target or a financial target;

b) the achievement of process performance target can be mapped to the achievement of a particular business strategy – either a customer target or a financial target;

c) the achievement of systems target can be mapped to the achievement of a particular business strategy – either a loser target or a financial target;

d) there is no correct answer.

21. Leading indicators are defined for:

a) the process improvement achieved;

b) each process target so that an early warning can be provided to indicate when a desired performance target is in danger of not being met;

c) the underlying reason for not achieving the process performance target;

d) there is no correct answer.

22. Root-cause analysis is used to:

a) identify the process improvement achieved;

b) identify the underlying reason for not achieving the process performance target;

c) identify each process target so that an early warning can be provided to indicate when a desired performance target is in danger of not being met;

d) there is no correct answer.

23. Process improvement initiatives are defined and implemented, and subsequent assessment is done to:

a) identify each process target so that an early warning can be provided to indicate when a desired performance target is in danger of not being met;

b) identify the underlying reason for not achieving the process performance target;

c) identify the process improvement achieved;

d) there is no correct answer.

24. New process improvement targets are set to:

a) identify the underlying reason for not achieving the process performance target;

b) achieve the desired customer or financial target;

c) discover insight into current performance;

d) there is no correct answer.

25. A variety of tools and techniques are used to:

a) achieve the desired customer or financial target;

b) identify the underlying reason for not achieving the process performance target;

c) discover insight into current performance;

d) there is no correct answer.

26. Process analysis identifies:

a) bottlenecks;

b) duplicate efforts;

c) causes of defects and waste;

d) all answers are correct.

27. More complex supply web requires:

a) a continuous cargo flow and attention to detail at the process level among its members – manufacturers, suppliers, partners and retailers;

b) a continuous information flow and attention to detail at the process level among its members – manufacturers, suppliers, partners and retailers;

c) a continuous public flow and attention to detail at the process level among its members – manufacturers, suppliers, partners and retailers;

d) there is no correct answer.

28. Business process management offers:

a) a public approach to addressing non-coordinate challenges by streamlining workflows, automating repetitive tasks, and improving collaboration among stakeholders;

b) a public approach to addressing coordinate challenges by streamlining workflows, automating repetitive tasks, and improving collaboration among stakeholders;

c) a systematic approach to addressing SCM challenges by streamlining workflows, automating repetitive tasks, and improving collaboration among stakeholders;

d) there is no correct answer.

29. Business process management enables:

a) process standardization;

b) visibility, and control, allowing procurement companies to identify inefficiencies and optimize operations;

c) pubic relations;

d) there is no correct answer.

30. With business process management, procurement companies can:

a) enhance transparency, agility, threshold in scaling SCM,

b) provide responsiveness across the supply chain, resulting in cost savings, reduced cycle times, and better decision-making;

c) support pubic relations;

d) there is no correct answer.

31. If the supply chain is managed by a central planner who is able to control all decisions, then it can be called:

a) a centralized supply chain;

b) a decentralized supply chain;

c) a centralized system;

d) there is no correct answer.

32. Supply chain coordination improves if:

a) some stages of the chain take actions that are aligned and increase total supply chain surplus;

b) separate stages of the chain take actions that are aligned and increase total supply chain surplus;

c) all stages of the chain take actions that are aligned and increase total supply chain surplus;

d) there is no correct answer.

33. Any factor that leads to either local optimization by different stages of the supply chain or an increase in information delay, distortion, and variability within the supply chain is:

a) an obstacle to coordination;

b) an opportunity for coordination;

c) a priority for coordination;

d) there is no correct answer.

9. DIGITAL MARKETS AND GLOBAL SUPPLY CHAIN

9.1. DIGITAL SUPPLY CHAIN MARKET SIZE AND SHARE

In 2023, the digital supply chain market was estimated at USD 5.4 billion and is expected to grow to USD 12.8 billion by 2030, with a CAGR of 13.0% over the period from 2024 to 2030. Digital supply chain means the incorporation of digital technologies and systems across the entire supply chain process. It includes the application of software platforms, data analytics, automated processes, and more to streamline and improve operations [65].

With the introduction of digital technologies and data analytics, a supply chain is able to support decision-making, increase efficiency and react promptly to shifting environments that led to the creation of a digital supply chain. Data-driven supply chains leverage information from every stage of the supply chain to ensure optimal design and responsiveness to emerging and unforeseen delays. Factors including greater customisation, higher agility, and enhanced planning have contributed to the market growth. Digital supply chains demand has increased sharply in the last few years as they have enabled the simplification of transactions and the integration of multiple manufacturing, distribution and client service processes. The largest companies operating in the market now provide applications for data analysis and big data forecasting with advanced technological capabilities [66].

By using various toolkits such as lot, big data analytics, automation, blockchain and AI, companies will be capable of generating advantages that include improved performance, lower costs, increased transparency and enhanced responsiveness. The digital supply chain incorporates technologies and data to revolutionise traditional processes, allowing companies to build a competitive advantage in the modern highly competitive marketplace. Companies are experiencing increasing globalisation of their business activities as they broaden their international reach and are in need of cutting-edge technology solutions to successfully manage sophisticated global logistics, stimulating the digital supply chain market growth [65].

In addition, fast-growing e-commerce sector is boosting the demand for smart supply chain solutions that optimise supply chain operations, provide greater transparency and effectively address the needs of online

shoppers. For example, in 2021, the global e-commerce sector reached a remarkable growth rate, reaching USD 26.7 trillion. Due to the steady growth of the e-commerce sector, there is an intensifying need for an effective supply chain, propelling the development of the market [65].

Apart from that, developments in technologies like Internet of Things (IoT), big data analytics, and artificial intelligence (AI) continue to stimulate the overall industry growth. Such technologies serve to perform massive data analysis, provide demand forecasting, improve inventory management, and assist in logistics automation to facilitate the overarching supply chain effectiveness, contributing to the advancement in the business [65].

With digital supply chains, however, there can be considerable initial costs to implement, such as investing in both hardware, software and staff training, as well as exposure to potential risks of data leakage and non-authorised access, which can hamper market growth [65].

By contrast, the deployment of edge computing and 5G, combined with the adoption of blockchain technology, can generate significant growth opportunities in upcoming years. Such technologies allow for real-time data handling and secure decentralised transactions, resulting in new level of speed, efficiency, and visibility across the digital supply chain. The revenue dynamics of the digital supply chain market is shown in Fig. 9.1 [65].

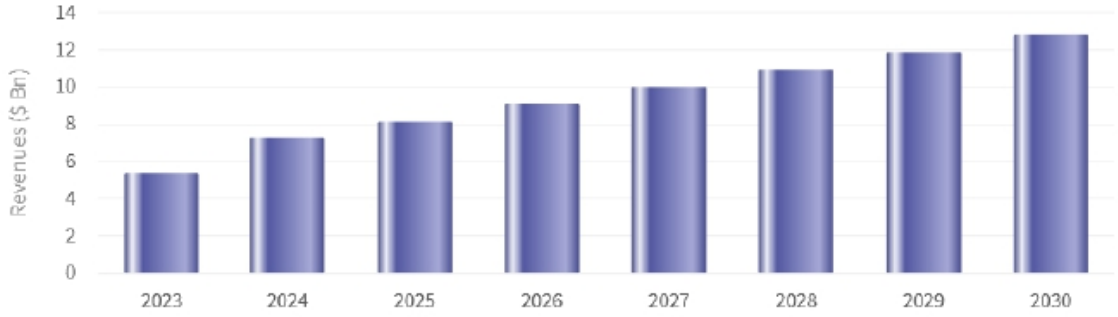


Fig. 9.1. Digital supply chain market revenue in 2023-2030 (USD Bn) [65]

The segmentation of the digital supply chain market share is performed based on component, business size, end customer, and region. By component, the market is segmented into solutions and services. By business size, the market is divided into large enterprises, small and medium

enterprises. By end customer, the market is split into healthcare and pharmaceuticals, retail and consumer goods, production, food and beverages, transport and logistics, automotive, etc. The segmentation by region and analysis of each of the market segments covers regions such as Asia Pacific, Europe, North America, and Rest of the World (ROW). The segments of the digital supply chain market are illustrated in Fig. 9.2 [65].

Asia Pacific region represents a leading position in the digital supply chain market and is estimated to maintain its supremacy throughout the upcoming years. Contributing to this is the explosive growth of the e-commerce sector in Asia Pacific region, which is driving the digital supply chain market development since companies are looking for viable solutions addressing the growing online retail demand. According to the International Trade Administration, China is the world's largest e-commerce market with a value of USD 2.29 trillion in 2020 and projected reaching USD 3.56 trillion by 2024 [65].

Fig. 9.2. Digital supply chain market segments [65]

Wider deployment of digital supply chains by large domestic companies to increase supply chain transparency, helping them to respond to growing consumer needs, cut costs and mitigate risks. In June 2022, for example, ITC launched a huge investment in digital technologies, covering the digital supply chain introduction. ITC strives to optimise operations and enhance visibility, flexibility and efficiency in its business processes by adopting digital technologies [65].

North American region, for its part, is estimated to demonstrate consistent digital supply chain market growth. The reason for this trend is the highly developed North American healthcare sector, implying the management of sophisticated supply chains requiring the alignment of

many operations, such as the sourcing of medical equipment, medicines and other materials, and on-time delivery to clinics and hospitals [65].

In 2021, US national healthcare spending was estimated at $4.3 trillion, up from $4.1 trillion in 2020, as reported by the Centers for Medicare & Medicaid Services. These large costs are driven by the growing demand for essential healthcare products, such as medicines, medical devices and equipment, in the US and across the world. Meeting these needs in a timely manner calls for high-performance supply chain management, which is boosting overall market growth across the region [65].

Furthermore, as major market leaders like IBM Corporation, Oracle Corporation, and MicroStrategy Inc. are operating in the region, it is expected to foster continued growth of the supply chain management market in North America. In June 2023, as an example, IBM Corporation entered a partnership with Adobe to design a content supply chain solution using generative AI. It aims to improve the creation of content, management and distribution processes using AI-enabled automation and cutting-edge analytics [65].

The digital supply chain market is dominated by companies such as Cloudera Inc., IBM Corporation, Infor, MicroStrategy Inc., Oracle Corporation, SAP SE, SAS Institute Inc., Software AG, Tableau Software, TIBCO Software Inc. and more. All these industry leaders are employing a variety of strategies based on product introductions and partnerships to maintain their leadership position in the market [65].

In April 2022, Infor formed a partnership with DB Schenker, a global logistics provider, for delivering an integrated supply chain solution. Together, they aim to bring end-to-end transparency and streamline supply chain activities, enabling companies to improve their efficiency and flexibility in the marketplace. Also, in November 2022, Cloudera has announced the broadening of its partnership agenda to concentrate on the digital supply chain. By cooperating in partnerships, Cloudera strives to provide innovative data solutions for optimising supply chain processes and enhancing market efficiency. In April 2023, Oracle released new AI and automation enhancements to its platform. It intends to boost businesses' capabilities through intelligent automation, predictive analytics, and advanced decision-making opportunities, enabling them to streamline their operations and foster innovative solutions across various industries [65].

9.2. DIGITAL SUPPLY CHAIN STRATEGY

Key components of a digital supply chain. There are a number of various technologies available for digitising the supply chain. A company's systems and technical solutions will vary depending on its individual needs and business objectives. It is worth considering a few of the most widespread technological components that make up modern supply chains [67].

Data Analytics and Business Intelligence. In supply chains, data analytics is essential, giving companies a means of predicting and planning demand, allowing them to stay ahead of potential threats. Insights tools such as Salesforce's Tableau, Microsoft's Power BI, and SAP Analytics Cloud provide visibility into key metrics and performance indicators. Businesses can apply such solutions to analyse past data, detect regularities, and utilise the insights to enhance their inventory management strategy [67].

Internet of Things (IoT). Through use of IoT devices, companies are able of real-time tracking and managing of goods throughout the supply chain. They assist teams in enhancing inventory management and improving operational efficiency by providing better data and insights. Large companies such as Walmart are utilising IoT devices including RFID tags and sensors for tracking levels and locations of inventory and streamlining store and warehouse processes [67].

Artificial Intelligence (AI) and Machine Learning (ML). Both AI and ML technologies have the potential to support distribution logistics in supply chain management. Through automating route generation and delivery-related decision-making, companies are able to improve delivery times and boost customer experience. UPS, for example, employs a system called Orion using AI and ML for continuous route improvement on a daily basis. Apart from delivering 100 million miles, this technology has saved UPS 10 million gallons of fuel per year [67].

Blockchain Technology. Greater visibility, security, and reliability of supply chain systems is provided to companies by blockchain technology. The IBM Food Trust works with food companies and producers to enhance supply chain visibility and trackability by linking a network of parties to better monitor food safety. It allows companies in the food

industry to deliver a more sustainable and resilient supply chain, reducing wastage and increasing safety assurance [67].

The global supply chain environment has experienced a remarkable evolution in the last few years. Companies have been challenged by a myriad of factors that are altering the perception of their supply chain strategy, ranging from geopolitical pressures to digital failures and climate change concerns. To address these challenges, a new supply chain paradigm is arising, requiring companies to reframe their strategies and take a holistic approach to build sustainability and seize new business opportunities [68].

Digital revolutions were also crucial in supply chain transformations. The digitalisation of supply chains have sped up, as 78% of supply chain managers recognise the disruptive force of digital technology. Making this shift towards digitalisation opens up a new set of potential opportunities to increase efficiency and improve decision-making process throughout the supply chain. It has become indispensable for companies looking to building stronger supply chains to implement strategic initiatives like near-shoring and reshoring. In fact, as many as 96% of executives view such strategic interventions as a way to reduce risk and secure a steady flow of goods and services [68].

Supply chain executives, across all industries, are now prioritising digitisation. Decision makers are considering increasing investments in supply chain digitalisation at a rate of 16.5% between 2024 and 2025. The reason for this is that they intend to improve their agility, response time, and thus their long-term competitiveness, by implementing advanced technologies and streamlining business operations. Given the uncertainty and variability of business in modern environment, making this move is a mandatory one for all companies. Yet businesses should also address an array of critical challenges in this regard [69].

Organisations need to take a holistic approach to rethinking their supply chain to cope with these challenges and capitalise on the opportunities. This concept is based on four key principles shown in Fig. 9.3 [68]. Implementing the supply chain rethinking framework has led to substantial advantages and benefits for customers in specific dimensions, as shown in Fig. 9.4 [68].

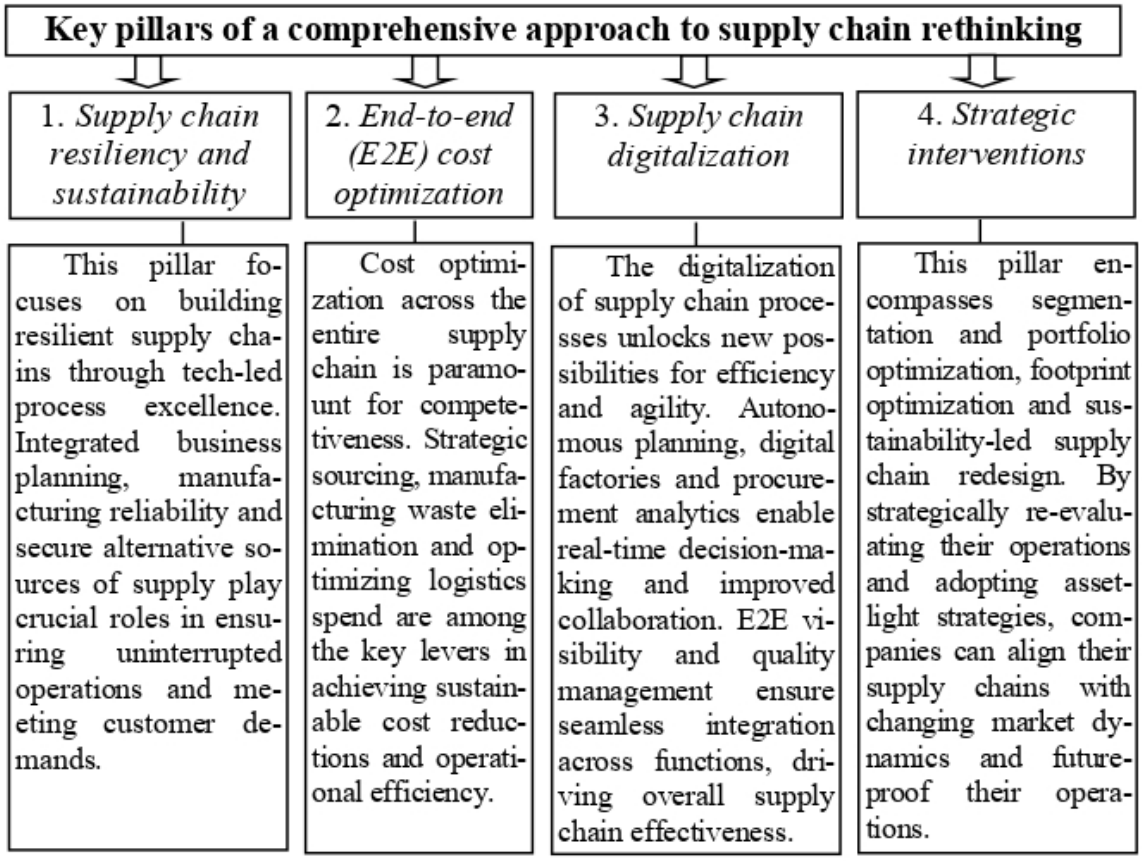


Fig. 9.3. Key pillars of the comprehensive approach to supply chain rethinking [68]

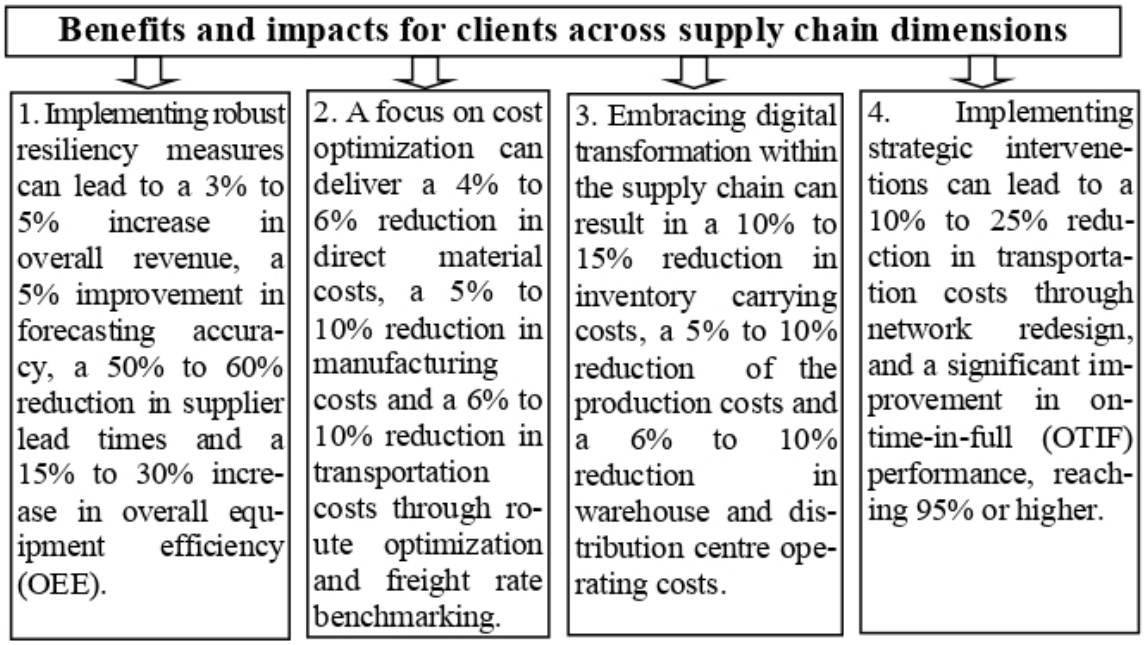


Fig. 9.4. Benefits and impacts for clients across chain dimensions [68]

9.3. ADVANTAGES AND CHALLENGES OF DIGITALISATION IN THE SUPPLY CHAIN

The benefits of supply chain digitalisation. The newly released survey, jointly conducted by the Council of Supply Chain Professionals and ToolsGroup, a global leader in digital supply chain planning and optimisation software, found that nearly 93% of companies claim to be actively pursuing their supply chain digitalisation. There is a reason why they are so invested in digitising supply chains, given that it provides substantial competitive edge to the business [69].

Costs reduction. The supply chain digitalisation and automation allows businesses to increase supply chain efficiency, accelerate processes, deliver better analytics and eliminate human error, all of which contributes to lower overall procurement costs. As a result, logistics teams are freed up from tasks with low added value (e.g. filling out waybills) and are able to devote their efforts to running more strategic processes [69].

Increasing productivity. When it comes to logistics, as previously mentioned, logistics teams do not need to do administrative paperwork, re-enter data or look for data. According to Julien Morin, Director of Software Sales (Easy WMS) at Mecalux, a global market leader in intralogistics and warehouse solutions, digitalising the supply chain boosts efficiency of the company by as much as 40% [69].

Improving the decision-making process. Disruptive modern technologies including big data, the Internet of Things, AI, etc. make decision-making easier and faster, and they increase operational efficiency by providing predictive analytics with continuously updated data. Using reliable, up-to-date and timely data streams in real time, companies are able to manage optimally their inventory and procurement while also increasing their flexibility and improving response time [69].

Strengthening cooperation between different stakeholders. With the digitalisation of the supply chain, companies are also able to communicate more efficiently (through EDI messaging, online portals, etc.) across their network of suppliers and distribution partners, resulting in better quality and delivery reliability. Over the long-term, this means improved customer service for the end user by preventing product shortages and other disruptions due to a superior level of supply chain management [69].

Contributing to the CSR strategy. Supply chain digitalisation can also support corporate social responsibility initiatives. To start with, companies can decrease their environmental footprint. As many as a quarter of all road transport is empty, according to JLL, the global leader in corporate real estate advisory services. By using the proper digital means, it is possible to optimise loads to minimise the number of trucks on the road and reduce the greenhouse gas emissions they can cause. On a wider scale, companies are able to put their CSR approach into action with the relevant digital tools, enabled by the advanced analytical features of emerging technologies. By digitising their supply chain, organisations are benefiting all round. Ultimately, they improve their operational, economic and environmental results [69].

The major challenges of supply chain digitalisation. Effective supply chain digitisation comes with many obstacles. Though these challenges vary depending on the maturity of each company, three inevitable problems are related to technical means and human factors [69].

The information system and data. The major issue with supply chain digitalisation currently lies in the technical realm. Basically, this is related to the existing information systems of companies, along with the data accessibility and quality. In order to embark on this digital shift, it is vital for companies to establish a sound technical framework founded on solid processes and governance [69].

Team training. The shortage of competent supply chain professionals also represents one of the key challenges facing supply chain digitalisation. Related to this, a new survey called *'PwC's 2023 Digital Trends in Supply Chain Survey'*, highlights that nearly two-thirds of decision makers anticipate that their supply chain digitalisation will necessitate improving the skills of their workforce. Enterprises require industry-specific skills (data analysis, statistical modelling, demand planning, inventory management, etc.) to be able to advance in strategic initiatives. But the supply chain sector is facing a talent deficit. Hence, it is important for companies to change strategies for recruitment and lifelong learning in order to enable people to adapt and progress [69].

Change management. With any transition process, adjusting the team and aligning the company culture is essential. Companies should

embrace proper change management and establish effective communications to guide teams through this digital transformation. Equipping teams adequately with the necessary resources is important to gain team engagement and ensure the future success of the transition. It is especially important because, according to CSCMP and ToolsGroup, over a third of decision makers still consider risk aversion to change to be one of the main barriers to executing digital transformation plans in the supply chain [69].

The recent global challenges and crises brought into focus the strategic aspect of the supply chain, where flexibility, trackability and security are key. Thus, the automation and digitalisation of the supply chain and potentially other business processes, together with the procurement digitalisation, is a totally new dimension of value creation. While most companies are leading this digital transition, they are still challenged to adjust to this new landscape to capture the advantages [69].

9.4. DIGITAL SUPPLY CHAIN FUTURE TRENDS

Digital supply chain trends are as following [70]:

Trend 1: EDI-as-a-Service. EDI (Electronic Data Interchange) traditionally delivered the technical foundation for automated supply chain communication, productivity and transparency. But EDI itself continues to develop – and this will have consequences for supply chain management best practices, existing and new [70].

There are numerous *benefits of EDI in supply chain management,* but it can really deliver the following [70]:

Efficiency. Automation of communication and management of supply chains, cutting total costs.

Visibility. The information that EDI provides across the supply chain gives unprecedented visibility into performance metrics.

Control. Standards-based data transfer, to whoever and whenever needed, is provided.

But the *drawbacks to EDI* have hindered its progress so far. These have included such as [70]:

Standards complexity. There are many standards for the same types of messages.

Supplier or customer capability. Some trade partners are not technically capable of implementing EDI.

The slowness of onboarding. Testing and parallel running consumes time.

EDI-as-a-Service overcomes these drawbacks. It is the modernisation of EDI, bringing it into step beyond hybrid EDI solutions to enable the digital supply chain shift. It delivers increased flexibility, simplicity and streamlined integration [70].

Trend 2: The emergence of the Industrial Internet of Things (IIoT). The Internet of Things (IoT) is based on the development of a broad network of inexpensive, interlinked sensors. Throughout the supply chain, these devices can monitor and authenticate products and shipments as they move through the supply chain. It can also check the storage conditions of products to improve quality management [70].

The Industrial Internet of Things (IIoT) is the broadening and application of the Internet of Things in industrial sectors and settings. The IIoT covers applications such as robotics and medical equipment, contributing to more efficient and resilient operations. IIoT benefits in supply chain management comprise fewer errors, increased efficiency, better predictive maintenance, lower costs and improved safety [70].

Since the majority of companies are still dealing with obsolete systems, new technologies, and connected and disconnected assets, the IoT and IIoT will likely take some time to become fully operational. A lot of the progress is being made in anticipation of 5G networks, which will deliver greater data processing rates, lower latency and better connectivity. This will require fast processing of huge amounts of data [70].

Advanced EDI solutions, such as EDI-as-a-Service, are well-qualified to support the successful use of IIoT in modern supply chains. EDI can enable the translation and standardisation of messages and documentation, along with the data transfer between IIoT and Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP) systems. It allows the supply chain to be connected to production line data in a way that was previously not possible [70].

Trend 3: The need for agility. Over the past few years, companies have seen winners and losers depending on their ability to address fast-changing market, business and partner demands. Unexpected disruptions in the supply chain are now to be anticipated, particularly in the form of: the emergence of multiple suppliers; the need for alternative sources; new and emerging business lines [70].

A seamless integration of suppliers is needed to effectively react to unexpected occurrences. Supporting supply chain systems and tools, such as EDI, need to be enhanced to facilitate such fast process shifts [70].

The bottleneck of EDI has been that for many companies, particularly those seeking to connect with multiple suppliers, the process of engaging trading partners has been problematic. Flexibility demands a more agile approach. EDI-as-a-Service is intrinsically more configurable as opposed to traditional EDI approaches. By customising the service to specific demands, EDI-as-a-Service can provide flexibility and reduce the cost of production downtime and the negative impact on the current supply chain [70].

Trend 4: The growth of automation. Automation of supply chains is used to cope with many of the difficulties associated with operating in modern marketplaces. Supply chain automation uses technologies like artificial intelligence (AI), machine learning (ML), robotic process automation (RPA), optical character recognition (OCR), and robotics [70].

The automation is also applied to every element of the modern supply chain, including payments and invoicing, inventory renewal/management, customer service, picking/packing, setting and tracking revenue targets [70].

To ensure the smooth running of such automation, EDI is required and, accordingly, it is crucial to increase the level of its implementation. By integrating EDI-as-a-Service into automation strategies, it is possible to obtain the following outcomes: direct and automatic exchange of all information; end-to-end system visibility for all participants; smooth communication for quick resolution of issues [70].

Trend 5: The growth of cyber-threats. Cyber threats to supply chains have an adverse impact on all supply chain processes and poten-

tially cover every element of manufacturing and delivery. They may involve the stealing of intellectual property, goods or malicious interference with operations - from animal rights to labour conditions and political agendas [70].

Data is difficult to secure if an organisation is still relying on phone, paper, fax and email for its business operations. Automating manual processes will be vital. EDI-as-a-Service simplifies the transition from any manual, paper-intensive processes and provides security, resilience and enhanced management of every business operation [70].

Discussion questions

1. What is a digital supply chain?
2. What does a digital supply chain involve?
3. Describe the market revenue of the digital supply chain.
4. How is the market divided on a component basis?
5. Characterize the digital supply chain market segments.
6. What are the key components of a digital supply chain?
7. What are the four key pillars of a comprehensive approach to supply chain reimagination?
8. Explain the benefits and impacts for customers across the four dimensions.
9. What does the use of a comprehensive approach to supply chain reimagination allow?
10. What are the benefits of supply chain digitalization?
11. What are the main challenges of supply chain digitalization?
12. Characterize the digital supply chain trends.

Cases

1. Identify the features of supply chain digitalization in the selected company.
2. Determine the benefits of supply chain digitalization for the selected option.
3. For the chosen company option, evaluate the possibility of using modern supply chain digitalization tools.

Tests

1. The Digital Supply Chain Market size in 2023 was:
a) USD 5.1 billion;
b) USD 5.4 billion;
c) USD 8.1 billion;
d) there is no correct answer.

2. A supply chain makes use of digital technologies and data analytics to:
a) help make decisions;
b) improve performance;
c) respond quickly to changing conditions;
d) all answers are correct.

3. Computerized supply chains utilize the information delivered by each step of an inventory network to:
a) design successfully and make dynamic reactions when unexpected deferrals emerge;
b) design successfully and make non-dynamic reactions when unexpected deferrals emerge;
c) design successfully and make public reactions when unexpected deferrals emerge;
d) there is no correct answer.

4. In recent years, the demand for digital supply chains has risen dramatically as they facilitate:
a) streamlined transactions;
b) connecting various production, distribution, and customer service functions;
c) making new problems;
d) there is no correct answer.

5. Organizations can achieve benefits such as improved efficiency, reduced costs, enhanced visibility, and faster response times by:
a) big data analytics;
b) automation;
c) artificial intelligence and blockchain;
d) all answers are correct.

6. The globalization of businesses is driving:

a) the fall of the digital supply chain market;

b) the growth of the digital supply chain market;

c) stabilization of the digital supply chain market;

d) there is no correct answer.

7. The rapid growth of e-commerce sector is further driving:

a) the proposal for efficient supply chain solutions to streamline their operations, improve visibility, and meet the demands of online customers effectively;

b) the demand for efficient supply chain solutions to streamline their operations, improve visibility, and meet the demands of online customers effectively;

c) the losses for efficient supply chain solutions to streamline their operations, improve visibility, and meet the demands of online customers effectively;

d) there is no correct answer.

8. Global e-commerce sector size in 2021 amounted to:

a) USD 26.7 trillion;

b) USD 56.7 trillion;

c) USD 46.7 trillion;

d) there is no correct answer.

9. Digital supply chains can involve significant upfront implementation costs, including:

a) investments in hardware, software, and training;

b) posing risks of data breaches and unauthorized access;

c) restraining the growth of the market;

d) all answers are correct.

10. The introduction of 5G and edge computing, along with the implementation of blockchain technology:

a) slightly increased the speed, efficiency, and transparency of the digital supply chain;

b) revolutionized the speed, efficiency, and transparency of the digital supply chain;

c) reduced the speed, efficiency, and transparency of the digital supply chain;

d) there is no correct answer.

11. The digital supply chain market share is segmented based on:

a) component;

b) organization size;

c) user;

d) all answers are correct.

12. Based on organization size, the market is segmented into:

a) retail and consumer goods, healthcare and pharmaceuticals, manufacturing, food and beverages, transportation and logistics, automotive, and others;

b) large enterprises and small and medium-sized enterprise;

c) public partners;

d) there is no correct answer.

13. Based on end-user, the market is divided into:

a) retail and consumer goods, healthcare and pharmaceuticals, manufacturing, food and beverages, transportation and logistics, automotive, and others;

b) large enterprises and small and medium-sized enterprise;

c) systems partners;

d) there is no correct answer.

14. Which region holds the dominant share of the digital supply chain market and is expected to maintain its dominance over the forecast period to 2040?:

a) Europe;

b) North America;

c) Asia-Pacific;

d) there is no correct answer.

15. Healthcare sector in North America involves:

a) managing complex supply chains that require coordination of multiple activities, including procurement of medical equipment, pharmaceuticals, and other supplies;

b) ensuring timely delivery to hospitals and clinics;

c) designing successfully and making dynamic reactions when unexpected deferrals emerge;

d) there is no correct answer.

16. Data analytics plays an important role in supply chains by offering companies a way to:

a) forecast and plan demand;

b) track and monitor goods in real time as they move through the supply chain;

c) help them get ahead of potential risks;

d) there is no correct answer.

17. Internet of Things devices allow organizations to:

a) track and monitor goods in real time as they move through the supply chain;

b) forecast and plan demand;

c) assist them get ahead of potential risks;

d) there is no correct answer.

18. From automating route generations and decision-making related to delivery, companies can:

a) optimize delivery times and improve customer satisfaction;

b) get ahead of potential risks;

c) track and monitor goods in real time as they move through the supply chain;

d) there is no correct answer.

19. The technology Orion has not only saved UPS:

a) 50 million miles but also reduced its fuel consumption by 10 million gallons per year;

b) 100 million miles but also reduced its fuel consumption by 5 million gallons per year;

c) 100 million miles but also reduced its fuel consumption by 10 million gallons per year;

d) there is no correct answer.

20. Blockchain gives companies:

a) greater transparency;

b) security;

c) trust in supply chain systems;

d) all answers are correct.

21. Digitalising and automating the supply chain enables companies to:

a) improve supply chain efficiency;

b) speed up processes and provide better insights;

c) cut down manual errors;

d) all answers are correct.

22. By relying on reliable, relevant and real-time data flows, companies can:

a) optimise the management of their revenues while improving their agility and responsiveness;

b) optimise the management of their stocks and supplies while improving their agility and responsiveness;

c) optimise the management of their systems while improving their agility and responsiveness;

d) there is no correct answer.

23. Improving collaboration between the various stakeholders, digitalisation enables companies to:

a) set up smoother communications with their network of suppliers and sales partners;

b) optimize process;

c) provide improving the quality and reliability of supplies and products;

d) there is no correct answer.

24. With the right digital tools, loads can be optimised to:

a) reduce the number of trucks on the road;

b) reduce the greenhouse gas emissions they can produce;

c) provide public relations;

d) there is no correct answer.

25. Digitalising the supply chain contributes to:

a) realisation of the public strategy;

b) implementation of the Corporate Social Responsibility strategy;

c) systemisation of the process;

d) there is no correct answer.

26. Companies benefit from the digitalization of their supply chain and, as a result, increase their:

a) factorial, economic and environmental performance;

b) operational, economic and environmental performance;

c) operational, economic and public performance;

d) there is no correct answer.

27. The main challenges of the supply chain digitalisation are:

a) problems with companies' current information systems;

b) problems with cargo flow and manufacturers, suppliers, partners and retailers;

c) the availability and quality of data;
d) there is no correct answer.

28. Organisations need the following specific skills for their respective industries:
a) data analysis and statistical modelling;
b) demand planning;
c) inventory management;
d) all answers are correct.

29. Companies should:
a) use genuine change management;
b) adopt effective communication to support teams with this digital shift;
c) perform inventory management;
d) all answers are correct.

30. Providing teams with appropriate resources is an essential condition if you want to:
a) obtain team support;
b) guarantee that the transformation is successful in the future;
c) the availability and quality of data;
d) there is no correct answer.

31. One of the main obstacles to implementing digital transformation plans in their supply chain:
a) fear of change at company;
b) fear of growth;
c) fear of choice;
d) all answers are correct.

32. The strategic dimension of the supply chain determine:
a) agility;
b) traceability;
c) security;
d) all answers are correct.

33. The benefits of EDI as a service for supply chain management are many, but it really does provide:
a) efficiency (automating supply chain communication and management, reducing overall costs);

b) supplier or customer capability (not all trading partners can technically implement EDI);

c) control (the standards-based transfer of data to who you want, when you want);

d) there is no correct answer.

34. The drawbacks to Electronic Data Interchange is:

a) standards complexity;

b) visibility;

c) slowness of onboarding;

d) there is no correct answer.

35. The premise behind the Internet of Things (IoT) is to:

a) create a vast network of high-cost interconnected sensors;

b) create a vast network of low-cost interconnected sensors;

c) create a little network of low-cost interconnected sensors;

d) there is no correct answer.

36. In the supply chain a vast network of low-cost interconnected sensors can:

a) track public systems;

b) track and authenticate products and shipments as they progress;

c) monitor the storage conditions of products to enhance quality management;

d) there is no correct answer.

37. Upheavals in the supply chain are:

a) the emergence of different suppliers;

b) a requirement for alternative sources;

c) new lines of business being pursued;

d) all answers are correct.

38. Supply chain cyber-threats affect all supply chain processes and can touch every element of production and delivery, and they can include:

a) the theft of intellectual property;

b) the theft of goods;

c) the malicious disruption;

d) all answers are correct.

10. THE ROLE OF MARKETING AND ONLINE BUSINESS IN ENSURING GLOBAL SUPPLY CHAIN

10.1. THE ROLE OF MARKETING IN THE SUPPLY CHAIN MANAGEMENT

A supply chain is defined as a network of actors engaged in the manufacturing and distribution of a company's products. It includes many activities, people, organisations, information and resources. It covers many stages and processes required to bring products or services to the market. These include raw material processing, production, transportation, inventory management, financial management, distribution, packaging and marketing. Managing supply chains is the essential process of planning, monitoring and improving on the way goods flow across the system. Building solid relationships in the supply chain has an influence on business costs and profitability. Therefore, all participants should be fully aware and clear on their respective roles in supply chain processes. Marketing can help with this [71].

Marketing is central to maintaining optimal supply chain performance. It has a strategic view and an operational role as follows [71]:

Marketing supports stakeholders in understanding their specific roles and the target markets they are serving. Marketing communications, including white papers, press releases, emails and newsletters, can help inform suppliers and others across all levels of the brand and the products supported by them, and the role they play in bringing the final product to market and meeting customer needs. This calls for marketers to develop an understanding of where all stakeholders belong in the supply chain.

Marketing facilitates cooperation between all parts of the supply chain. Through regular communication with partners, just like customers and prospects, foster a culture of partnership. There is a need to use tailored messaging and outreach tools to connect with suppliers and bring them together as a team. Use of multiple platforms to maintain communication is essential. Ongoing interaction ensures better coordination with both internal and external partners.

Marketing equips partners with insights into the market to match supply and demand. It is the responsibility of every department to keep

up to date with industry trends and shifts, but marketing is the department to stay ahead of the curve. It is crucial to gain an in-depth insight into target market's needs, preferences, and issues to meet them with products or services. There is a need to use the insights of the marketing department to communicate these insights across the supply chain and adjust the direction as needed.

Marketing provides customers with information about their supply chain experience. It can be shared to inform readers, communicate experiences, announce updates, showcase successes, etc. A marketing team creating content that demonstrates the expertise of its supply chain brings it forward. By including quotes from CEOs and other experts from suppliers, or providing reviews and case studies that illustrate successes, it's about leadership to support SCM.

Marketing capitalises on brand awareness to drive business performance. It is essential for supply chain partners to have the same brand identity so they can effectively connect and represent each other. Well-recognised and strong brands can be used in promotional activities to make potential customers aware of the quality and value of offered products or services.

Marketing converts data into meaningful information for the supply chain. By applying data, insights and analytics, the marketing team assists stakeholders in gaining an in-depth understanding of the company's operation details and the full picture. The marketing team should identify weaknesses and make recommendations on how to address them.

Marketing assists companies in reaching new customers by raising their product or service awareness via advertising, promotions and public relations. Marketing enables a company to preserve its existing customers by offering them better value beyond their expectations. Businesses in B2B marketing sell products to businesses and organisations. It is necessary to develop strong partnerships with these entities so that they will continue to buy products. Implementing proper B2B marketing strategies can boost demand for products at the same time as business expand [72].

The supply chain management – marketing integration as a key element in the digital era is shown in Fig. 10.1 [73].

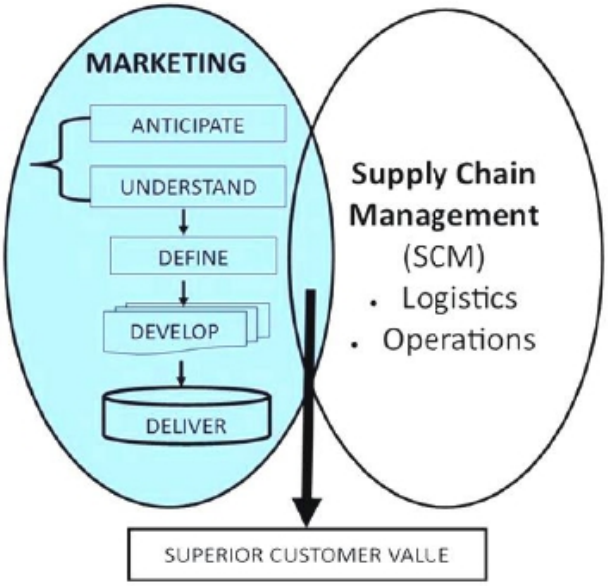


Fig. 10.1. The supply chain management – marketing integration as a key element in the digital era [73]

Offering the right kind of B2B marketing allows a business to acquire more customers by reaching out to those interested in purchasing one of the products or services it provides. This can be accomplished with the assistance of a trustworthy B2B marketing company. It is important to engage a highly skilled marketing firm to provide tailored, integrated B2B marketing services. Used to generate demand for products by discovering emerging market opportunities or customising products for particular markets, B2B marketing services are vital. B2B marketing strategies are more oriented towards demand generation rather than direct sales through distribution channels such as retail networks or online shops [72].

A successful business management involves good marketing of its products and services as an integral part of the business. It enables a company to generate demand for its offerings that is key to making the organisation profitable. Establishing strong partnerships with suppliers remains one of the most important aspects of B2B marketing and supply chain management. Getting the better prices on raw materials and components from suppliers will help to keep expenses for both the company and its customers as low as possible. It is important to develop effective business relationships with suppliers to ensure that they can deliver the best possible service. A skilled B2B marketing company should be able to provide

quality assurance that the supplier's standards are adhered to, since the supply chain will be negatively affected in case something fails [72].

In the marketplace, long-lasting survival and development of the company's business is possible through marketing efforts, as they enable adjustment to market dynamics and the changing landscape. Marketing establishes a link connecting the company's manufacturing operations with the target market across all phases of the production process. It facilitates the launch of a wide range of goods and services capable of addressing the needs and demands of different consumer segments and each individual customer. Market research uncovers the demands and expectations of consumers for products guiding manufacturing planners in developing and producing them [74].

In the context of all marketing activities of enterprises, notably transport and logistics, it is clear that the system effectiveness of getting goods from producer to consumer may affect social welfare issues. Global marketing refers to international marketing type meaning use of the similar marketing mix in all countries. For example, a company sells the same product with identical design and promotional tools in multiple markets. Mostly, global marketing is used by global corporations due to their worldwide presence [74].

The SCM concept emerged towards the end of XX century. Marketing researchers like Menzer et al. contributed to conceptualising SCM and formalising its definitions. Fig. 10.2 shows the 'Menzer model' of SCM [75].

By structure, the global supply chain resembles the internal supply chain, except for the broader geographical scope, i.e., its components are located worldwide. The global supply chain opens new opportunities for businesses, but also brings new risks and pressures [74].

Customer relationship management (CRM) is an essential component of any business's success, and B2B marketing offers a way to help manage relationships with customers. A solid CRM system allows tracking every single aspect of a client's interaction with a company. Among other things, this covers customer experience with products or services, as well as their demands and expectations. A B2B marketing company may assist in managing customer relationships. Increasing sales and revenues depend on this, and it is the responsibility of the supply chain team to manage all customer interactions with the company [72].

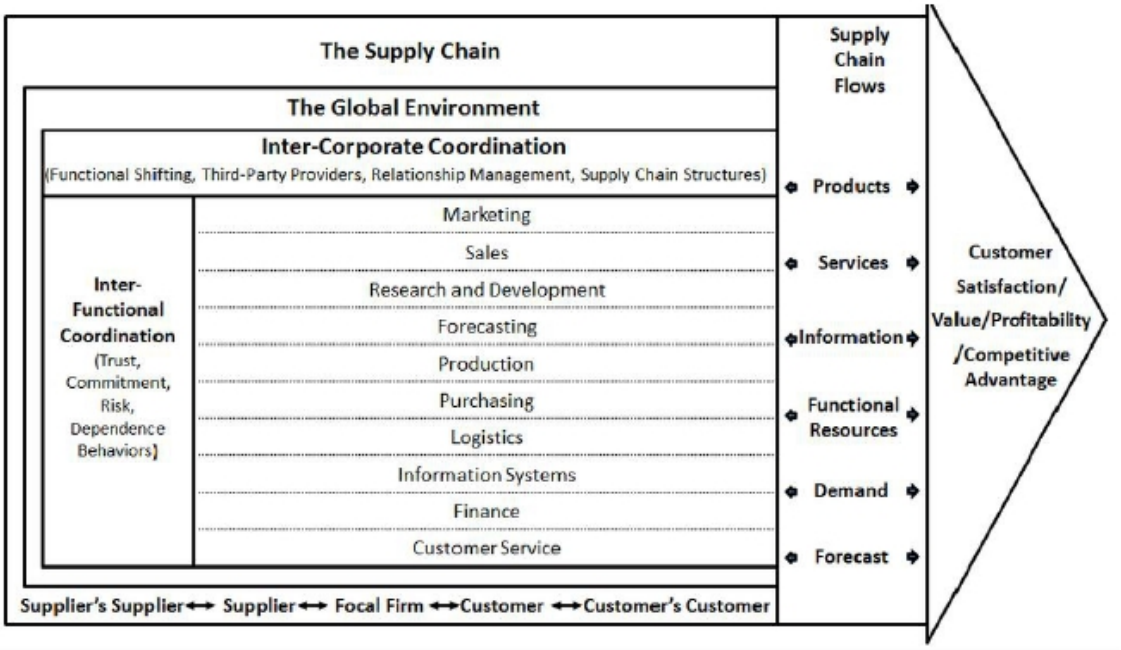


Fig. 10.2. The SCM Mentzer Model [75]

Marketing communications provide valuable input into establishing relationships among service delivery providers via communications and support initiatives. In this way, marketing contributes to creating conditions in which all stakeholders cooperate and engage in business development activities, resulting in a better customer experience. Moreover, digital marketing enables brands in managing relationships, material and information flows through e-marketing to aid supply chains in sustaining a competitive advantage. Therefore, digital marketing is essential for effective supply chain management [74].

The integration of supply chain management and B2B marketing allows businesses to enhance the customer service by delivering valuable real-time visibility. With insights into these dimensions of the customer experience, enterprises benefit from having actual usage data to guide enhancements, not just based on presumptions [72].

Clients are at the heart of any business, so it is important to understand their needs and aspirations. Engaging B2B marketing agency could provide support in developing a customer relationship management (CRM) strategy to increase sales and profits, as well as improve supply chain efficiency. Marketing is used to raise brand and product awareness

and drive up sales. Involving a B2B marketing company allows the company to gain more trust due to the greater brand recognition [72].

The traditional relationship between SCM and the role of marketing is shown in Fig. 10.3 [75].

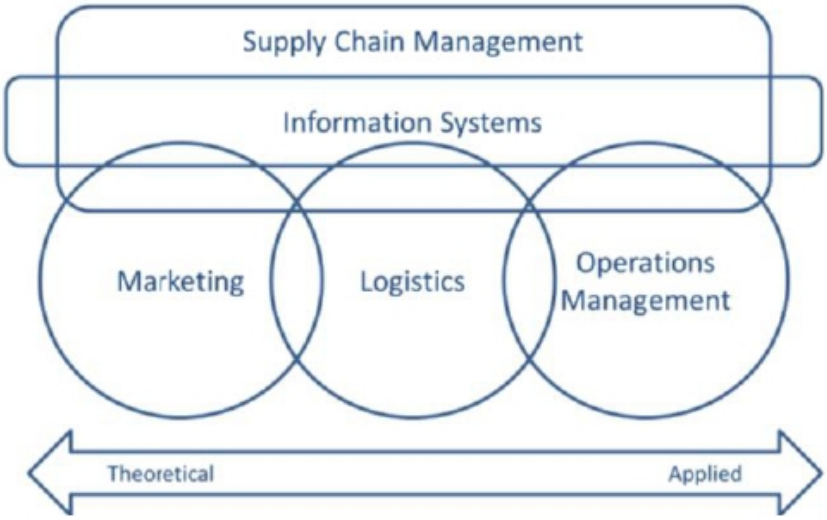


Fig. 10.3. Traditional relationship between SCM and marketing role [75]

A B2B marketing firm is able to help develop an impactful B2B marketing strategy to build awareness of the brand across potential target markets. Proving to be an industry standard expert and generating content interesting for people will allow companies to establish a good reputation and increase their attractiveness as an appropriate target for potential partners searching for new suppliers or sales force [72].

As part of the collaboration, supply chain partners enhance customer experience and contribute to making the company a better option for clients. Product availability information, pricing, order traceability, offers, promotion campaigns, and sales insights can be communicated by marketing. Having the appropriate knowledge of the market enables supply chain players to create extra value and participate proactively in the supply of goods and services. Marketing can help to design programmes to support partners in their business development and facilitate collaboration among supply chain participants.

In the CAGE model (Table 10.1), the initials of the four key gap components are used: Cultural, Administrative, Geographic and Economic [74].

Table 10.1

The CAGE four gap model [74]

	Cultural	**Administration**	**Geography**	**Economy**
Attribute that creates distance	Language Differences Ethnic Differences, Ethnic and social linkage network Regions Social norms and norms	Lack of connection of continents and countries Lack of monetary or political association Political Enemies National policy Weak institutions	Remote geographical location Lack of common border Lack of seaports and rivers National scale Lack of means of transportation or means of communication or communication Climate difference	Differences in consumer income Differences in cost and quality of: • Natural resources • Financial sources • infrastructure • Information or knowledge
Industry or product affected by the difference	Products with language content (TV) Products that impact the national or cultural identity of the consumer (food) Different product features show: • Size (car) • Standard (electrical equipment) • Pack Products with quality specified by country, association (alcohol)	There is a lot of government intervention in industries such as: • Manufacture of products (electrical) • National resource exploitation • Major supplier to government (transportation, transportation, transportation systems) • Manufacture of pharmaceuticals (drugs). • Important national security (information technology, communication) • Heavy use of labor force (farms) • High sunk cost (infrastructure)	Products with low value account for a large proportion (cement) Fragile and damaged products (glasses, fruits) Communication networks are important for (financial services) Requires a lot of monitoring of local operations (variety of services)	Needs are different from income level (car) Scale or standards of the economy are important (mobile) Cost of labor and other factors is very different (apparel) Various sales and distribution systems (insurance) The company needs to be responsive and agile (household appliances)

All four dimensions are usually overlapped: for example, it is hard to find countries, being a part of a free trade area and sharing administrative similarities, that are totally similar in cultural, geographical, and economic terms. A distinction, however, should be made between these four dimensions, as they have various origins and present different constraints and possibilities [74].

At the beginning, it is important to develop a process flow diagram (PFD) that describes the combination of SCM and marketing activities for SCM documentation and marketing support. Both SCM and marketing should collaborate to specify the process along with the set of different parameters in general. As a result, it can create a process of interaction or feedback loop that starts with marketing, passes over SCM, and returns to marketing, as shown in Fig. 10.4 [76].

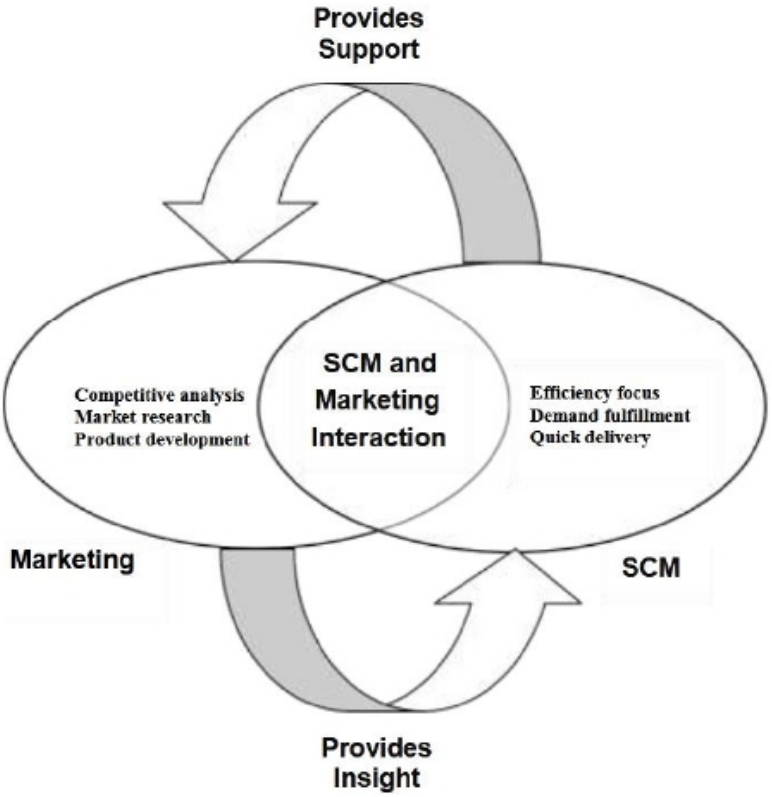


Fig. 10.4. SCM and marketing interaction: an interactive model [76]

SCM and marketing's cooperation with each other is expected to strengthen the value offer to customers, as shown in Fig. 10.5 [76].

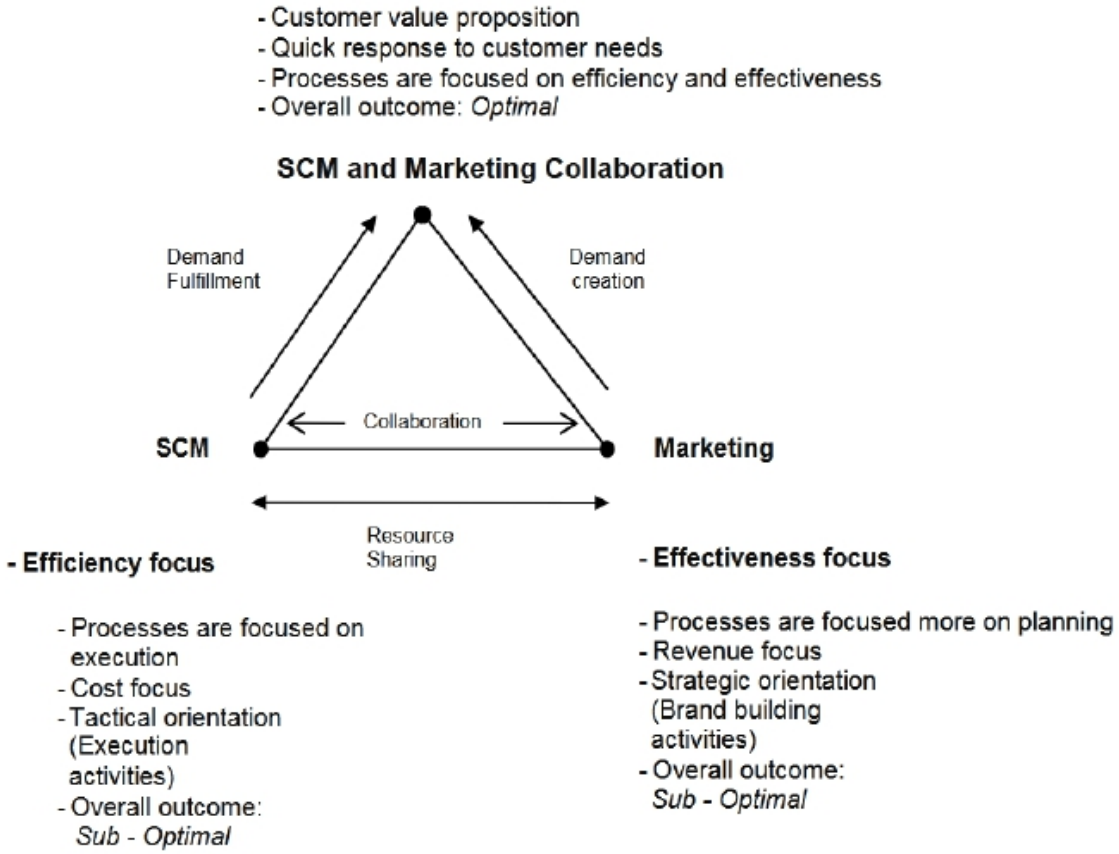


Fig. 10.5. SCM and marketing cooperation: a collaborative model [76]

In most companies, there is a significant synergy deficit between SCM and promotional activities. For many businesses, booklet production, direct mail, and advertising are at the core of their marketing communication strategies to draw customers into their retail networks using the "pull" strategy. This kind of promotional activity tends to boost store traffic, though if the marketing efforts are not backed by SCM, buyers may discover that there are no products for sale and may leave the store disappointed and underserved. The capabilities, potential, and strengths of a company's SCM can help or hinder the delivery of the promises it gives to customers. Consequently, SCM can have a major role in the success or failure of a marketing mix strategy. Enterprises of any type of specialisation, product or service, must consider SCM to be a market strategy driver, a customer experience enhancer, or a profit centre, rather than a purely cost for running the business. Thus, one should view SCM more as just cost, but as an investment in the brand and the entire business as it contributes to the ROI rise [77].

As per the CAGE model, the administrative gap causes major problems in the introduction of global marketing, wherein CAGE determines the characteristics posing the above-mentioned issues and also certain industries influenced by this administrative gap [74].

10.2. THE ROLE OF ONLINE BUSINESS IN ENSURING GLOBAL SUPPLY CHAIN

Supply chain management forms the foundation of e-commerce business. It helps to optimise the process of delivering goods from one point to another. For example, it can be the flow of materials from the manufacturing plant to the warehouse and finally from the warehouse to the customers. However, it is important to understand how e-commerce supports the supply chain management. The supply chain management is an overarching concept that encompasses across every logistics dimension, covering procurement, production, distribution, transportation, storage, and sales. The purpose of supply chain management is to ensure that everything in a company's business operates smoothly together to deliver outstanding customer experience at all stages of their buying journey, and guarantee that its products can be accessed by customers promptly and efficiently for them to fully enjoy immediately after the purchase [78].

Supply chain management (SCM) in e-commerce involves managing the flow of resources and information between stakeholders along the supply chain. It acknowledges that the combined performance of different players, like sellers, producers and delivery partners, is critical to establishing a resilient supply chain, and one missing link can disrupt the whole network and negatively impact the way and time products get to the end consumer. Therefore, supply chain management in e-commerce aims to manage the supply chain as efficiently and effectively as achievable. A number of methods and strategies are available to assist in driving greater efficiency, performance, and profitability in supply chain management. Managing supply chain in e-commerce is at the core of every production company's essential structure and makes a major contribution to the business success or failure. On average, nearly 79% of companies operating well-performing supply chains generate higher revenues compared to the average performing company of the same

specialisation. By optimising their supply chains, companies also cut costs on average by 15% [79].

An additional e-commerce influence on supply chains is the requirement for better agility. Online buyers are looking to be able to order products anytime and to receive them as soon as possible. It implies that companies should be capable of adjusting their supply chains to respond to unexpected bursts of demand. Effects of e-commerce on supply chains are still under development. With the advancement of digitalisation, companies have to figure out innovative solutions to meet the evolving needs of their clients [80].

Online buyers have an increasing demand for their orders to reach them rapidly and in a cost-efficient manner. This has forced companies to rationalise their supply chains and shorten the delivery time. Revolutionary solutions have emerged under such conditions: the same-day delivery and dropshipping. Some companies, such as Amazon, Walmart and Target, are now providing the same-day delivery in specific areas. It marks a considerable progression compared to the usual two-day or even three-day delivery. Dropshipping refers to a business model in which a seller does not keep stock in a warehouse. As soon as a customer places an online order, the seller purchases the product from a third-party supplier and sends it directly to the customer. It enables companies to provide swift deliveries with no need to spend money on stock [80].

To satisfy the needs of online customers, companies should ensure the ability to track and manage their products across the entire supply chain. To achieve this, complex supply chain management software is needed that can gather and process data from multiple channels. Multiple advantages have come with increased transparency in e-commerce supply chains. With greater transparency, companies are able of making more informed decisions on stock levels, shipping routes, and marketing strategies. Through streamlining the entire decision-making process, companies managed to boost their performance significantly within a limited time.

Improved transparency has also allowed companies to cut costs. Detecting and resolving potential failures at an early stage helps companies to lower costs caused by disruptions, delays, and product returns. As a result, higher levels of client satisfaction follow. When customers know the location of their products and the time of their arrival, it makes them much more willing to be pleased with their purchase choices [80].

The role of e-commerce in the supply chain management is illustrated in Fig. 10.6 [81].

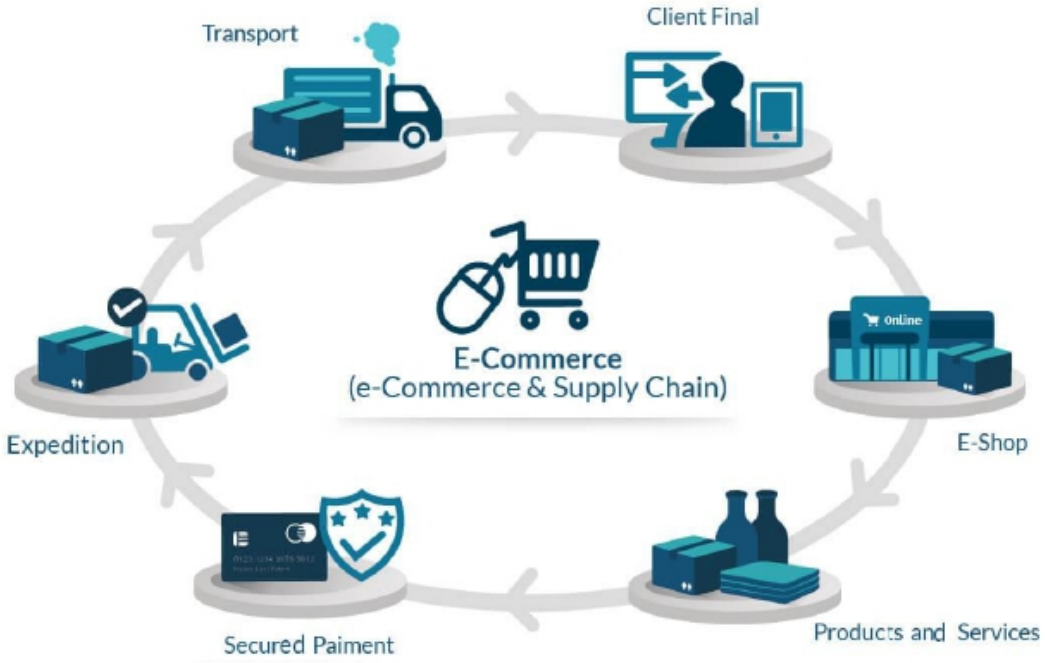


Fig. 10.6. The role of e-commerce in supply chain management [81]

E-commerce continues to have a major influence on supply chain management, reshaping traditional approaches and creating both opportunities and threats for organisations. Following are a few aspects in which e-commerce is impacting supply chain management [81]:

1. *Demand prediction and inventory management*. E-commerce brings higher demand fluctuations and seasonality, since there can be rapid shifts in consumer interest and purchasing behaviour. It challenges demand prediction and managing inventory, necessitating companies to use data analytics, machine learning and predictive modelling for accurate demand forecasting and optimising stock levels.

2. *Fulfilment and distribution*. In general, e-commerce implies fewer and more frequent orders versus traditional distribution, which requires modifications to the fulfilment and distribution operations. E-commerce players can use multiple warehouse fulfilment strategies, dropshipping, and third-party logistics providers (3PLs) to increase the speed and efficiency of order fulfilment.

3. *Last-mile delivery*. Final leg of delivery called last-mile delivery from distribution hubs door-to-door to customer doorsteps represents a

mission-essential piece of the e-commerce supply chain. E-commerce firms are challenged to improve their last-mile delivery to match customer demands for speedy and secure delivery, frequently leveraging technology solutions as route optimisation, real-time tracking, unmanned or autonomous delivery vehicles.

4. *Reverse logistics*. E-commerce operations often anticipate a higher rate of returns than traditional retailers, due to the ease of returning goods by customers. Reverse logistics management, i.e. handling returns, replenishing stock, restoring or disposing of returned goods, is a major concern facing e-commerce companies, calling for efficient operations and proper inventory management.

5. *Supply chain visibility and transparency*. E-commerce depends on real-time transparency of supply chain operations and stock levels so that orders can be executed precisely and customer needs can be addressed. E-commerce companies are using technologies of inventory management systems, blockchain, RFID tracking and barcode scanning to boost transparency and increase visibility in the supply chain.

6. *Cooperation and integration*. Enabling stronger partnerships and integration between supply chain parties, such as suppliers, producers, distributors and logistics providers, is also one of the impact of e-commerce. Companies engaged in e-commerce may introduce collaborative planning, forecasting and replenishment (CPFR) efforts and make investments in supply chain integration technologies to optimise supply chain communications and alignment.

7. *Globalization and market expansion*. E-commerce allows companies to enter new markets globally and broaden their customer base transcending geographical limits. Growing globalisation brings further challenges to supply chain management, such as international transportation, customs clearance, currency exchange and adherence to national regulations and trade agreements.

8. *Supply chain resilience and risk management*. It is important for e-commerce companies to manage emerging supply chain risks proactively, addressing failures due to geopolitical events, natural disasters, supply chain breakdowns and cyber security threats. A resilient supply chain requires diversifying supplier base, introducing business continuity plans and implementing risk minimisation strategies.

In summary, e-commerce is having a significant influence on supply chain management, necessitating flexibility, innovations and net-

working throughout the supply chain to respond to the challenges of the digital economy and provide outstanding customer service.

Discussion questions

1. What is the role of marketing in supply chains?
2. What are the specific messages and outreach to reach out to suppliers and integrate them into the team?
3. Describe marketing integration as a key element of the digital era in supply chain management.
4. What are the features of marketing research?
5. Characterize the global marketing.
6. What are the features of the Mentzer Model of SCM?
7. How are the traditional relationships among SCM and marketing role characterized?
8. Explain SCM and marketing interaction in terms of an interactive model.
9. What are the features of the collaborative model of SCM and marketing collaboration?
10. What are the features of the CAGE model?
11. Characterize the supply chain management (SCM) in e-commerce.
12. What is the role of e-commerce in supply chain management?
13. What are the ways in which e-commerce affects supply chain management?

Cases

1. Identify the characteristics of supply chain marketing in the selected company.
2. For the selected option, identify the benefits of using e-commerce.
3. For the chosen company option, evaluate the possibility of using the CAGE model.

Tests

1. What is the vital role that marketing plays in maintaining optimal supply chain performance?

a) it takes a tactic perspective and operational role;

b) it takes a strategic perspective and operational role;

c) it takes a strategic perspective and secondary role;
d) there is no correct answer.

2. Marketing communications are represented by:
a) white papers;
b) press releases;
c) email messaging and newsletters;
d) all answers are correct.

3. Marketing communications help inform suppliers and others at all levels about:
a) the brand and products they support;
b) factor changes;
c) the role they play in creating the final product and customer experience;
d) there is no correct answer.

4. Marketing fosters:
a) collaboration among any links in the supply chain;
b) collaboration among all links in the supply chain;
c) collaboration among some links in the supply chain;
d) there is no correct answer.

5. By regularly communicating with the partners as well as with existing and potential customers, the following is ensured:
a) a role of collaboration;
b) a culture of collaboration;
c) a public of collaboration;
d) there is no correct answer.

6. Consistent contact helps:
a) maintain worse alignment with all internal and external partners;
b) maintain better alignment with all internal and external partners;
c) maintain unchangeable alignment with all internal and external partners;
d) there is no correct answer.

7. Marketing gives partners:
a) the marketplace knowledge to align supply and demand considerations;
b) the public knowledge to align supply and demand considerations;
c) the finance knowledge to align supply and demand considerations;
d) there is no correct answer.

8. Marketing leverages brand awareness to:

a) restrain business efforts;

b) propel business efforts;

c) limit business efforts;

d) there is no correct answer.

9. It's important for supply chain partners to be:

a) system-aligned in order to understand and represent each other effectively;

b) non-aligned with brand order to understand and represent each other effectively;

c) brand-aligned in order to understand and represent each other effectively;

d) there is no correct answer.

10. Recognizable and successful brands can be leveraged in outreach, so:

a) prospects and customers know the quality and value of products or services;

b) competitors know the quality and value of products or services;

c) power structures know the quality and value of products or services;

d) there is no correct answer.

11. Marketing translates data into:

a) harmful expertise for the supply chain;

b) useful expertise for the supply chain;

c) excessive expertise for the supply chain;

d) there is no correct answer.

12. Using data, information and analytics, the marketing team helps stakeholders understand:

a) the inner workings of the company and how the pieces fit together;

b) the external workings of the company and how the pieces fit together;

c) the unsystematic workings of the company and how the pieces fit together;

d) there is no correct answer.

13. Marketing helps companies attract new clients by:

a) decreasing awareness of their product or service through advertising, promotions, and public relations efforts;

b) creating awareness of their product or service through advertising, promotions, and public relations efforts;

c) depriving awareness of their product or service through advertising, promotions, and public relations efforts;

d) there is no correct answer.

14. Marketing helps a company retain existing customers by:

a) providing them with more value than expected;

b) providing them with less value than expected;

c) providing them with the same value than expected;

d) there is no correct answer.

15. B2B marketing services are essential in driving product demand by:

a) identifying old market opportunities or tailoring products for specific markets;

b) identifying new market opportunities or tailoring products for specific markets;

c) identifying unpromising market opportunities or tailoring products for specific markets;

d) there is no correct answer.

16. Marketing strategies in B2B markets focus more on:

a) selling products directly through channels than generating demand like retail stores or online stores;

b) generating demand than selling products directly through channels like retail stores or online stores;

c) generating demand than selling products directly through systems like retail stores or online stores;

d) there is no correct answer.

17. Marketing creates a connection between:

a) the public relations of the enterprise and the market in all stages of the reproduction process;

b) the production activities of the enterprise and the market in all stages of the reproduction process;

c) the finance system of the enterprise and the market in all stages of the reproduction process;

d) there is no correct answer.

18. Marketing helps to create many types of goods that can satisfy:

a) the needs and wants of each public group, each seller;

b) the needs and wants of each customer group, each customer;

c) the needs and wants of each program group, each seller;

d) there is no correct answer.

19. Marketing research identifies:

a) seller needs and wants about products with specific forms and characteristics to guide production planners to implement;

b) mediator needs and wants about products with specific forms and characteristics to guide production planners to implement;

c) consumer needs and wants about products with specific forms and characteristics to guide production planners to implement;

d) there is no correct answer.

20. Global marketing is:

a) the application of the same marketing strategy by international companies in all markets on a local scale;

b) the application of the same marketing strategy by international companies in all markets on a global scale;

c) the application of the universally marketing strategy by international companies in all markets on a local scale;

d) all answers are correct.

21. With a robust CRM system, it is possible to track:

a) any aspects of customer's experience with company;

b) some aspects of customer's experience with company;

c) all aspects of customer's experience with company;

d) all answers are correct.

22. Digital marketing helps brands:

a) manage relationships, passenger flows of materials and information using e-marketing to help supply chains maintain a competitive edge;

b) manage materials and information using traditional marketing to help supply chains maintain a competitive edge;

c) manage relationships, flows of materials and information using e-marketing to help supply chains maintain a competitive edge;

d) there is no correct answer.

23. Integrating supply chain management and B2B marketing helps companies:

a) improve their seller experience by providing real-time insights into the seller experience;

b) improve their customer experience by providing real-time insights into the customer experience;

c) improve their agent experience by providing real-time insights into the agent experience;

d) there is no correct answer.

24. A B2B marketing agency can help develop a strategy for customer relationship management (CRM) that will help make:

a) more sales and revenue and increase efficiency in the supply chain;

b) less sales and revenue and increase efficiency in the supply chain;

c) more expenses and increase efficiency in the supply chain;

d) there is no correct answer.

25. A most simple way to document SCM and marketing interactive process is:

a) to firstly develop a system flow diagram (SFD) outlining a mix of SCM and marketing activities;

b) to firstly develop a public flow diagram (PFD) outlining a mix of SCM and marketing activities;

c) to firstly develop a process flow diagram (PFD) outlining a mix of SCM and marketing activities;

d) there is no correct answer.

26. SCM has:

a) a minor impact on the success or failure of its marketing mix strategy;

b) a powerful impact on the success or failure of its marketing mix strategy;

c) an uncontrolled impact on the success or failure of its marketing mix strategy;

d) there is no correct answer.

27. SCM should be seen not as a cost but rather as:

a) a system product in the brand and the organisation as it assists to enhance ROI;

b) an investment in the brand and the organisation as it assists to enhance ROI;

c) a public product in the brand and the organisation as it assists to enhance ROI;

d) there is no correct answer.

28. What percentage of companies with highly efficient supply chains achieve higher revenue growth than average companies in the same industries?

a) 75%;

b) 85%;

c) 79%;
d) there is no correct answer.

29. Impact of e-commerce on supply chains has been the need for:
a) greater flexibility;
b) greater immaturity;
c) lack of systematization;
d) there is no correct answer.

30. Online shoppers expect to:
a) be able to order products at fixed time and have them delivered quickly, sellers not need to be able to adjust their supply chains to meet sudden spikes in demand;
b) be able to order products at any time and have them delivered quickly, sellers need to be able to adjust their supply chains to meet sudden spikes in demand;
c) be able to order products at any time and have them delivered quickly, sellers not need to be able to adjust their supply chains to meet sudden spikes in demand;
d) there is no correct answer.

31. Dropshipping is a business model where:
a) the seller keep inventory on hand;
b) the seller does not keep inventory on hand;
c) the seller sometimes does not keep inventory on hand;
d) there is no correct answer.

32. With better visibility in e-commerce supply chains, businesses can:
a) make better decisions about things like inventory levels;
b) optimise transportation routes;
c) reduce their costs;
d) all answers are correct.

33. Managing reverse logistics includes:
a) processing returns;
b) restocking inventory;
c) refurbishing or disposing of returned items;
d) all answers are correct.

11. PREREQUISITES FOR DIGITALISATION OF THE FINANCIAL SECTOR IN GLOBAL SUPPLY CHAINS

11.1. THE DIGITALISATION OF FINANCIAL SERVICES

Digitisation in financial sector involves the introduction of advanced technologies into financial institutions. It transforms the way these businesses run their operations, deliver value to their customers and engage their employees. It aims to increase efficiency, performance and expertise. As for specialists, advanced software and technologies are enabling them to provide more customised solutions and advice. They allow to automate and optimise time and effort-consuming tasks that are performed manually. It unlocks the potential to develop customer relationships. As for customers, digital solutions provide better accessibility and usability. They can investigate alternatives and educate themselves independently. Digital platforms also allow for remote service [82].

The advantages of financial services digitalisation are shown in Fig. 11.1. Digital readjustment is affecting all aspects of the financial sector, but there are the actual deliverables from all these transitions [82].

The financial sector is currently experiencing a large-scale digital transition, necessitated by the demand for greater efficiency, enhanced customer service and improved operations resilience. Although this process is challenging, digitalisation has become indispensable for financial institutions' prospects of future success. Ranging from cutting-edge technologies like RPA, AI, and big data analytics to cybersecurity, data privacy, and ecosystem management approaches, financial organisations are using a suitable mix of digital tools to innovate and improve efficiency [83].

Deciding on the optimal strategy and the appropriate technology tools appear to be the initial critical stages in the financial services digitalisation journey. When it comes to reshaping their operations, providing tailored solutions, and pursuing sustainable development in a constantly volatile digital landscape, financial service providers may choose to implement a set of diverse strategies [83].

Financial service sector is vast embracing a variety of services. For the purpose of looking at specific trends there is a need to consider banking, investment, insurance, and tax and accounting in details [84].

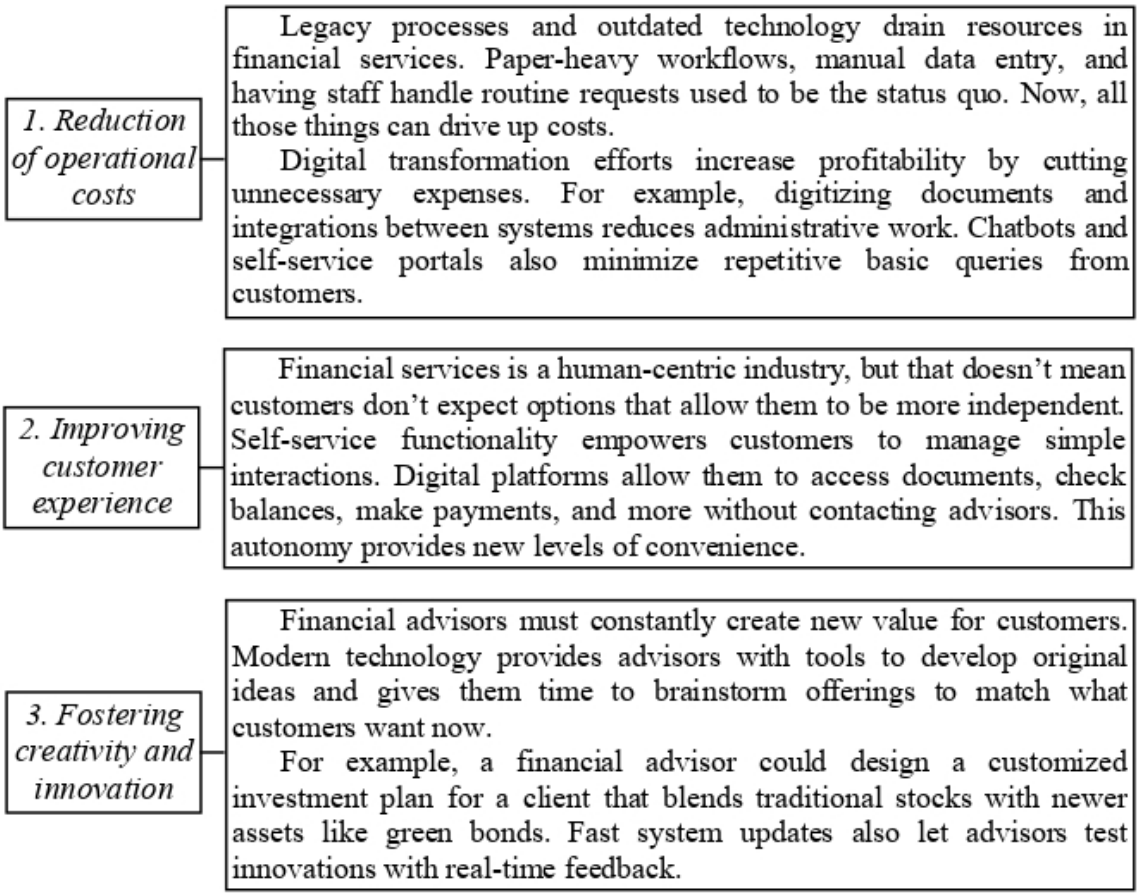


Fig. 11.1. Advantages of financial services digitalization [82]

Digital banking covers all banking levels beyond online and mobile banking, starting from the front end to the back end. Digital banks are institutions capable of automating administrative and data processing tasks and delivering a superior digital service experience to their clients. They can, for instance, enable remote deposits and transfers, application for loans, and accessibility of tailored online financial management products [84].

Payments are the most innovated banking service globally. Currently, they are getting swifter, safer and more integrated. In line with emerging fintech trends, financial services and payments are becoming more and more integrated. The PwC report 'Payments 2025 & beyond' suggests that by 2030, the value of non-cash payments is expected to grow almost threefold (Fig. 11.2). Among the key motivations for banking institutions to move to the cloud is to enhance control. Due to the latter and greater visibility, banks are able to perform process and information audits without problems [84; 85].

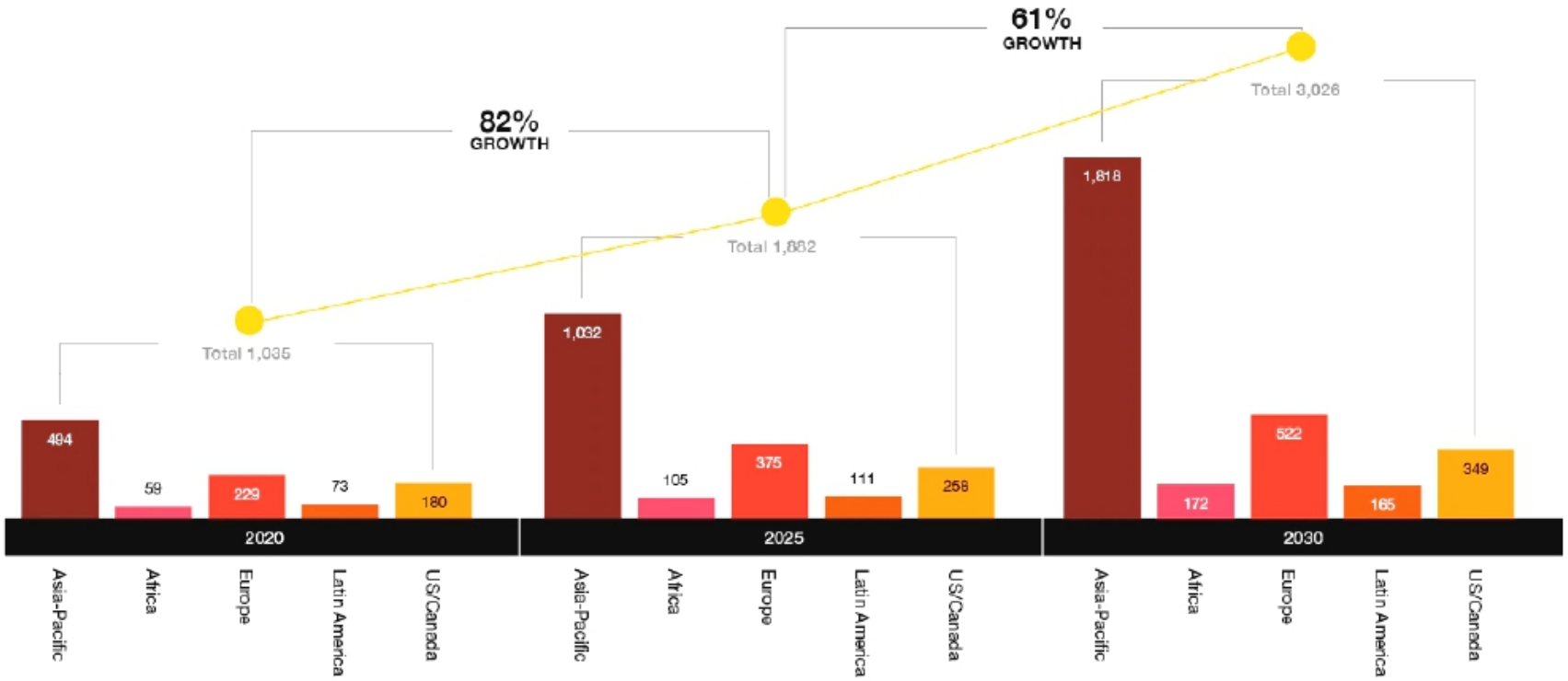


Fig. 11.2. The expected growth of cashless payment volumes by 2030 [85]

The insurance sector digitisation remains behind compared to other sectors due to strict continually evolving regulatory policies slowing down the introduction of advanced technologies. But now that clients are switching to online services for almost everything, insurers' aspirations are shifting as well. Insurance businesses should respond to relevant demands [84].

The four pillars of a highly efficient digital insurance business, according to McKinsey, are shown in Fig. 11.3 [84].

Fig. 11.3. The four pillars of a highly efficient digital insurance business by McKinsey [84]

Clients nowadays want to receive insurance services via multiple channels with a consistent customer service level. For this reason, a growing number of insurers are shifting to an omnichannel, customer-centric strategy for maintaining their competitive edge. For the most advanced insurers, the primary areas of interest will be offering online buying options, user-friendly mapping and online client experience, and enabling the consolidation of sales and advisory support. [84].

Currently, insurers are implementing process automation to increase customer satisfaction levels along with reducing operational costs. Beyond classic automation of processes, that covers all value chain stages, insurers also begin to implement robotic process automation (RPA) powered by advanced artificial intelligence to optimise the process overall [84].

The investment sector gathers huge amounts of personal data and performs large-scale financial operations, exposing it to a multitude of cyberattack threats. Capital management companies and banking institutions must provide comprehensive data protection. The potential cybersecurity dangers are shown in Fig. 11.4 [84].

Fig. 11.4. Potential cybersecurity threats [84]

A number of investment banking and capital management institutions continue to test voice biometrics to improve the customer security and service provided over the phone. Several cybersecurity strategies employ cutting-edge encryption technologies including e-signatures, multi-factor authentication such as virtual private networks (VPNs), content-based identification, anomaly detection, alerts for potential threats or hacks, etc. [84].

The issues of financial service digital transition are presented in Fig. 11.5. It is both promising and challenging at the same time, and there are some things to keep in mind. It is important to understand some of the major digital transformation issues for financial services institutions and how they can be addressed [82].

The Digital Financial Services (DFS) Handbook being a holistic guide to the worldwide DFS development pathway, was developed by the World Bank in collaboration with other international financial services players. Since the beginning of the last century, the availability of the Internet and the development of mobile technologies have led to a powerful development of innovations in finance. Banking institutions began to optimise their operations with key software and risk management systems, and agent networks became a feasible supplement for physical infrastructures. Smartphones have enabled this transformation, particularly with access to faster and better mobile internet or Wi-Fi. With advances in technologies, banks and other mainstream financial institutions have changed the way they digitally interact with their clients. Traditional infrastructure has been replaced by online banking, mobile applications and contactless payments, broadening channels of e-connectivity. The borrowing process has been greatly simplified due to the availability of machine-readable documents, e-signatures and online collateral registers. Multi-level customer verification rules and digital identification infrastructure have helped the financial service industry to embrace comprehensive digitalisation [86].

Fig. 11.5. Challenges of financial service digital transformation [82]

Digital transformation of a financial company into a digital bank, aimed at increasing the company's digital maturity and competitiveness after the introduction of all digital goods and services. Ensuring the full

digital readjustment of the bank and promoting a digital culture that drives a higher level of digital maturity is achieved through the implementation of all relevant software, systems and related digital capabilities and ensuring their interconnectivity [87].

Finance effective digitalisation strategies are shown in Fig. 11.6 [83].

Fig. 11.6. Strategies for effective digitalisation in finance [83]

The new platform made it possible to sell a full range of the bank's products, including data and document collection, fraud checking, consulting and loan analysis. The customisation of each product and running unique process were enabled by automation, which improved the customer service experience by providing multiple products simultaneously without requiring an account to be registered first. Also, the microservices-led architecture was enhanced by integration [87].

A comparative characteristic of available approaches to assess the digitalisation level of financial services is presented in Table 11.1 [88].

Table 11.1

Comparative characteristic of available approaches to assessing the digitalisation level of financial services [88]

Criteria for comparison	Approaches	
	FinTech Adoption Index (EY)	**FinTech Index (ING)**
The calculation method	Survey method. The index is calculated by determining the proportion of respondents who use two or more FinTech services in the total number of respondents.	Composite index. Based on three subindexes. All indicators used for the calculations are normalized and adjusted to values from 0 to 10.
Aspects of FinTech development considered in the study	- the category of consumers - individuals; small and medium business; - 5 categories and 19 types of FinTech services (2019 survey).	- supply, demand, and risks for the FinTech development; - 3 sub-indexes are calculated, each of which describes a separate group of FinTech development factors: the need for FinTech, FinTech infrastructure, and FinTech ecosystem.
Advantages	- simplicity and comprehensibility of the method; - the most total possible consideration of the financial services related to technological innovation.	- use of official statistical sources for calculation; - various aspects of the analysis: supply, demand, and risks for the FinTech development; - calculation of subindexes allows to carry out a detailed analysis of each component of FinTech development.
Disadvantages	- the survey is conducted among internet users, not the entire population; - the sample survey can give a significant margin of error; - only one aspect of financial and technological innovation introduction is considered – demand among consumers for FinTech start-up services.	- the analysis is only for low- and middle-income countries; - FinTech is seen as a substitution by the traditional banking services - for the sub-index that determines the need for FinTech, the share of the population without a bank account, SME credit gaps, etc. are considered to be stimulants for the FinTech development, contrary to the results obtained in other studies.

In financial services, the digital audit industry is constantly transforming along with the sector as a whole. There is a continuous need for auditors to innovate with technological shifts in financial services, in accordance with promising trends. It recognises the importance of leveraging advanced technologies to ensure the highest quality of services and to address challenges within larger and open business environment. Such

an audit transformation provides valuable advantages for financial institutions. By using tech tools to examine bigger data samples, auditors can gain a better insight into the internal processes of financial institutions, constructively apply professional judgement, effectively leverage management and better evaluate potential risks to build optimal audit strategy. This will also require the application of a range of advanced skills in critical thinking and problem-solving, data analysis, communication and creative thinking [89].

It is becoming a growing concern for financial institutions to establish trustful relations. Having a digital audit is among the means to deliver better visibility into their operations. The financial services industry is experiencing a major digital transition. Innovative technologies are reshaping business operations and the way financial services firms manage audit [89].

11.2. DIGITALISATION OF THE FINANCIAL SECTOR IN GLOBAL SUPPLY CHAINS

The resource flow arrangements for the manufacturing and distribution of products is an essential part of supply chain management and was the focus from mass production and distribution times. Inputs, workforce, and other production and distribution factors are financed using either internal sources or external working capital financing. Information technology developments have made supply chains grow and become more sophisticated and enabled customisation and scaling. They can also be helpful in evaluating risks and allowing financial institutions to provide financial services to a broader spectrum of supply chain participants [90].

Innovations impacting supply chain financing are shown in Fig. 11.7.

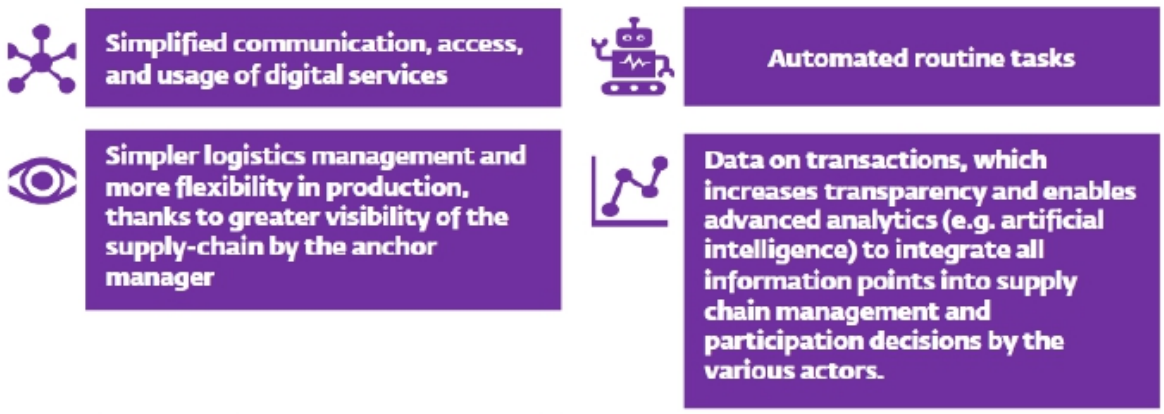


Fig. 11.7. Innovations impacting supply chain financing [90]

The development of supply chain financing and associated trends serve to highlight the transition of supply chain management. The supply chain 4.0 is shown in Fig. 11.8 [90].

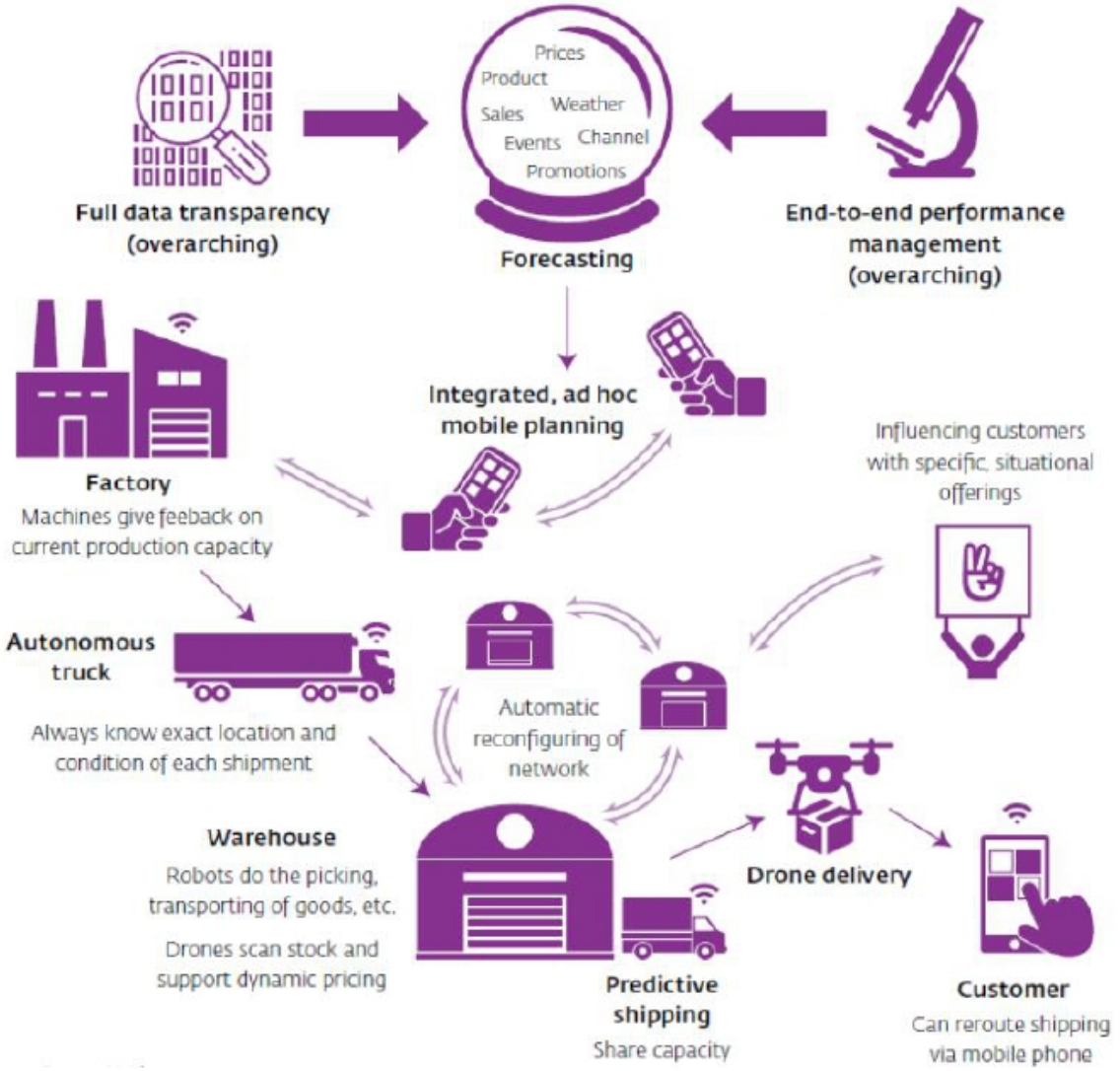


Fig. 11.8. The supply chain 4.0 [90]

Developments in digitalisation and automated technology provided the greater accessibility and efficiency of supply chain finance (SCF), resulting in the prevalence of solutions and frameworks that simplify invoice and payment processing, enabling any size company to launch SCF programmes. The working capital management is becoming increasingly complex, making it much more challenging to deal with it effectively. The gap between payment conditions and the real movement of goods can be addressed by SCF, assisting customers and suppliers to enhance

their cash flows by speeding up accounts receivable for suppliers and reducing accounts payable for customers [91].

Legal framework shifts, particularly regulatory changes to trade finance, for example the implementation of the Electronic Trade Documentation Act 2023 in the UK, may facilitate the introduction of SCF through the removal of regulatory and operating barriers. There is a growing global trend of SCF verification. In the United States, the FASB released an Accounting Standards Update in September 2022, effective as of 2023, that mandated disclosure of critical terms of SCF programmes on the balance sheet in the quarterly and annual reports [91].

Demand for detecting and resolving human rights and environmental issues in supply chains is also increasing. For instance, since 2019, the EU Green Deal obliges commodities sold through the EU and products distributed on the EU markets to be responsibly sourced and produced. In January 2023, the EU Corporate Sustainability Reporting Directive entered into force. The growth of SCF has been fuelled by a combination of drivers enabling it to be an appealing option for all businesses. Its wide usage is also connected with its potential to enhance managing working capital, establish solid relations with suppliers, and reduce risks in sophisticated supply networks [91].

It captures the emphasis of digital transition on creating chains of deep collaboration between industry players to achieve lasting competitive advantage. At present, there are two main types of digital transformation research. The first one concentrates on the study of the preconditions and implications of digital transition. The second one is carried out on various subjects, examining digital development within domains or sectors [92].

The first option implies ongoing improvement of studies on the comprehensive digitalisation impact. Digital reshaping in the supply chain means an approach to management based on information and data that focuses on the customer. Digitalisation encompasses capturing and analysing all aspects of the process from product sourcing to its deliveries via application of digital technologies. Current studies have shown that digital transition can influence at the organization level as well as at the supply chain level [92].

Digital transition has a considerable impact on strengthening the supply chain performance of vulnerable actors at the organizational level [93]. At the level of the supply chain, constant use of modern digital technologies streamlines product design, inventory management,

logistics transparency, and quality assurance, resulting in appropriate enhancements to the supply chain and business processes [94]. This is also facilitating cooperation between supply chain actors, generating synergy and resilience across the supply chain, improving financial metrics [95], innovative capabilities [96], development of new products [97], etc.

In [98] based on the case of Ding Talk helping ADOPT A COW to complete digital transformation, analyses the specific process of platform enterprises helping traditional enterprises digital transformation, explores how platforms can promote participants' innovation and obtain complementary innovation after participants' successful transformation from a bilateral perspective, and studies the mechanism of collaborative innovation. Fig. 11.9 shows the theoretical digital transformation modelling diagram [98].

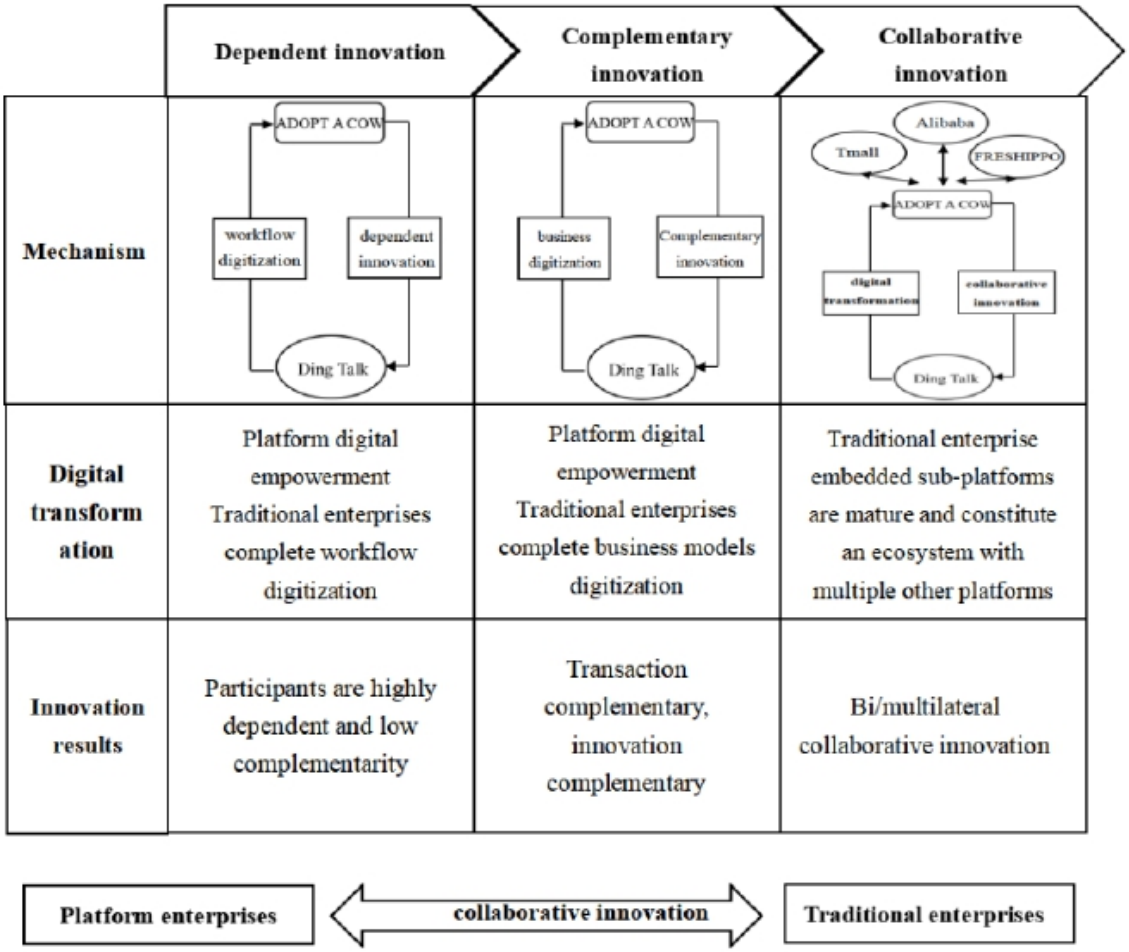


Fig. 11.9. The theoretical digital transformation modelling diagram [98]

In the beginning, the platform prevails in a one-sided way. Traditional businesses carry out the basic digital transition, i.e. workflow digitization, and management performance is significantly upgraded. Following the workflow digitisation, the traditional participants will make independent moves to accomplish the extensive digital transformation stage, i.e. business model transformation, and their profits will be significantly boosted. Re-examination is beneficial to the theory of companies' digital transformation [98].

The joint innovation mechanism between the platform and the parties is viewed from a two-sided standpoint. At the initial phase, the platform companies facilitated cross-cutting innovations in the actors' workflow via the expansion of digital capabilities. The feedback from participants to the platform on innovation tended to be weak, and there was a high degree of dependency and low level of interoperability among participants. Through the advanced innovation of the parties, the core components of the platform in the relevant industry can be offset and upgraded. The traditional company to some extent becoming an integrated sub-platform to ensure the innovation and interoperability of the platform, and progressively collaborating with a number of platforms to finalize the transition from bilateral collaborative innovation to multilateral collaborative innovation [98].

It is reasonable to analyse the impact of supply chain digitisation on operational results and emerging revenue flows, for example using the cases of companies listed on the Indonesian Stock Exchange, covering service, production and financial companies. The findings revealed that supply chain digitisation in Indonesia positively impacts operational metrics in the short and long run, while having a negative impact on emerging revenue flows in the short run and zero impact in the long run. These conflicting results on emerging revenue flows can be interpreted as the larger the time delay in supply chain digitalisation, the lower the competition, resulting in higher costs that subsequently are not essential for emerging revenue flows. Additional studies are needed to clarify the impact of supply chain digitalisation on emerging revenue flows through in-depth insights into the significance of organisational structure and company's place in the value chain for creating competitive edge [99].

The digitalization of supply chains should continue to be implemented and maintained both by the company and the authorities. It is important for the company to make a strong commitment to further digitalise its supply chain. Digital transition cannot automatically improve

the company's performance, and it is still uncertain whether the effect of applying information technologies on company results will be positive. The adoption of specific technologies and innovative solutions by one company can be imitated or adapted by other companies, thus often resulting in no lasting competitive edge for the business. Therefore, it is necessary for companies to act more cautiously in introducing supply chain digitalisation. As a regulator, the authorities can create appropriate regulatory frameworks associated with the digitisation trend. Businesses also should choose the appropriate approach to manage supply chain digitisation and introduce supply chain strategy in line with the company's place in the value chain, that can enhance the competitive advantage of the company, so it can generate an emerging revenue flow. It can be a lasting competitive edge for the company, and it can provide better outcomes from introducing supply chain digitisation [99].

Discussion questions

1. What are the features of digital transformation in financial services?
2. What are the benefits of digitalisation of financial services?
3. Characterise digital banking.
4. What are the main characteristics of digital transformation in insurance?
5. Describe the four fundamental elements of a highly effective digital insurance business according to McKinsey.
6. What are the features of potential cybersecurity threats?
7. What are the characteristics of the financial services' digital transformation challenges?
8. Characterise the Digital Financial Services Reference (DFS) Guide.
9. What are the peculiarities of digital transformation of a financial company?
10. What are the features of the seven strategies for effective digitalisation in finance?
11. Provide a comparative description of existing approaches to assessing the level of digitalisation of financial services.
12. What is the role of digital audit in financial services?
13. Characterise the innovations that affect supply chain finance.
14. What are the features of the supply chain 4.0?

15. Explain the focus of digital transformation on building networks of deep integration between industry chain participants.

16. What are the features of the theoretical scheme of digital transformation modelling?

17. Explain the mechanism of collaborative innovation.

Cases

1. Identify the features of digital transformation in the financial services for the selected option.

2. For the chosen option, identify the benefits of using digital banking.

3. For the selected company option, evaluate the possibility of using seven strategies for effective digitalisation in finance.

4. Is it possible to integrate your chosen company into the supply chain 4.0?

5. Identify the features of the focus of digital transformation on building deep integration networks among participants in the industry chain.

Tests

1. For professionals, new software and technology power:

a) allows to independently study options and engage in self-education;

b) provides more personalized recommendations and advisory;

c) expands access and convenience;

d) there is no correct answer.

2. For consumers, digital platforms:

a) allow to independently explore options and self-education;

b) expand access and convenience;

c) provide more personalized recommendations and advisory;

d) there is no correct answer.

3. For customers, new software and technology:

a) provide more personalized recommendations and advisory;

b) expand access and convenience;

c) allow to independently explore options and self-education;

d) there is no correct answer.

4. Do virtual tools enable remote services?

a) always so;

b) always no;

c) sometimes yes;

d) there is no correct answer.

5. The first step toward digitalization in financial services is:

a) choosing the best tactical means and the right tech tools;

b) choosing the best strategy and the right tech tools;

c) choosing the strategy with minimal risks and any tech tools;

d) there is no correct answer.

6. Digital banks are the banks that manage to:

a) automate administrative tasks and data processing;

b) provide clients with a better digital experience;

c) provide more personalized recommendations and advisory;

d) there is no correct answer.

7. The PwC report predicts that the volume of non-cash payments will almost_____ by 2030:

a) double;

b) quadruple;

c) triple;

d) there is no correct answer.

8. More and more insurers are transitioning to:

a) one channel strategy to a user-first and stay competitive;

b) some channel strategy to a user-first and stay competitive;

c) omnichannel strategy to a user-first and stay competitive;

d) there is no correct answer.

9. The most successful insurers will focus on such elements as:

a) smooth navigation;

b) providing online purchasing capabilities;

c) online customer journeys, as well as integration of sales support and advice capabilities;

d) all answers are correct.

10. The main benefit of the process automation implemented in insurance companies today is:

a) increasing customer satisfaction while reducing operating costs;

b) improving customer satisfaction level while reducing operating costs;
c) increasing operators' satisfaction level while reducing operating costs;
d) there is no correct answer.

11. Insurers start adopting robotic process automation (RPA) with:
a) advanced systems to streamline the whole process;
b) advanced AI to streamline the whole process;
c) advanced resources to streamline the whole process;
d) there is no correct answer.

12. Digital audit auditors in financial services use:
a) professional scepticism constructively;
b) technological tools to interrogate larger samples of data, so they will be in a better position to understand a financial services company's internal processes;
c) challenge management and assess risks better in order to develop a more effective and efficient audit strategy;
d) there is no correct answer.

13. Advancements in the information technology have enabled the following:
a) the growth and complexity of supply chains;
b) opportunities for specialization and scale;
c) challenge management and assess risks better in order;
d) there is no correct answer.

14. Technological advancements in digitalization and automation have made supply chain finance (SCF) more accessible and efficient, which has led to:
a) enabling the use of platforms and solutions that streamline the processing of invoices and payments, making it easier for companies of all sizes to implement SCF programmes;
b) promoting platforms and solutions that simplify invoice and payment processing, making it easier for companies of all sizes to implement SCF programmes;
c) folding of platforms and solutions that streamline the processing of invoices and payments, making it easier for companies of all sizes to implement SCF programmes;
d) there is no correct answer.

15. The increased complexity of supply chains makes managing working capital efficiently much more:

a) simpler;

b) challenging;

c) undesirable;

d) there is no correct answer.

16. Regulatory changes can encourage the adoption of SCF by:

a) reducing strategic and operational barriers;

b) reducing legal and operational barriers;

c) reducing legal and non-operational barriers;

d) there is no correct answer.

17. Research on digital transformation can be categorized into two main types:

a) focuses on studying the antecedents and consequences of digital transformation;

b) conducts on different subjects or entities and explores digital transformation in specific contexts or industries;

c) improves working capital management and builds stronger supplier relationships;

d) there is no correct answer.

18. Digital transformation can have an impact at both the organizational and _____ levels:

a) company;

b) supply chain;

c) public;

d) there is no correct answer.

19. At the organizational level, digital transformation has a significant effect on enhancing the supply chain capabilities of:

a) stronger members;

b) weaker members;

c) the most critical members;

d) there is no correct answer.

20. At the supply chain level, the ongoing application of digital technologies:

a) optimizes product development;

b) improves warehouse management;

c) enhances logistics visibility, and quality traceability, leading to effective improvements in the supply chain network and business processes;

d) all answers are correct.

21. Promoting cooperation between supply chain participants, creating synergies and stability throughout the supply chain, thereby enhancing:

a) financial performance;

b) innovation performance;

c) new product development performance;

d) all answers are correct.

22. Traditional enterprises realize:

a) secondary digital transformation, i.e. digitisation of work processes, and management efficiency is significantly improved;

b) primary digital transformation, i.e. digitisation of work processes, and management efficiency is significantly improved;

c) non-public digital transformation, i.e. digitisation of work processes, and management efficiency is significantly improved;

d) there is no correct answer.

23. After the digitisation of the work process, the traditional participating enterprises will exert their own efforts to complete the digital transformation of the advanced stage, i.e. the transformation of the business model, and the profits:

a) will fall;

b) will not change;

c) will greatly increase;

d) there is no correct answer.

24. At the initial stage of implementing the collaborative innovation mechanism, the platform companies promoted:

a) programme innovation of participants' workflow through digital empowerment;

b) unsystematic innovation of participants' workflow through digital empowerment;

c) multi-faceted innovation of participants' workflow through digital empowerment;

d) there is no correct answer.

25. With the in-depth innovation of participants, the basic blocks of the collaborative innovation mechanism platform in the corresponding industry:

a) cannot be compensated and improved;

b) can be compensated and improved;

c) can be uncompensated and unimproved;

d) there is no correct answer.

26. The traditional enterprise has become:

a) an embedded sub-platform to provide innovation and complementarity for the platform, and gradually cooperate with multiple platforms to complete the transformation of bilateral collaborative innovation to multilateral collaborative innovation;

b) an embedded sub-platform to provide disruption and complementarity for the platform, and gradually cooperate with multiple platforms to complete the separation of bilateral collaborative innovation to multilateral collaborative innovation;

c) an embedded sub-platform to provide innovation and complementarity for the system, and gradually cooperate with multiple systems to complete the separation of bilateral collaborative renovation to multilateral collaborative innovation;

d) there is no correct answer.

27. Does digital transformation guarantee an increase in company efficiency, while the impact of information technology on company performance is still unclear?

a) yes;

b) no;

c) partially;

d) there is no correct answer.

28. Can the use of certain technologies and various innovations by the company be easily imitated or emulated by other companies, so that they often do not provide a sustainable competitive advantage for the company?

a) yes;

b) no;

c) partially;

d) there is no correct answer.

12. MANAGEMENT OF INFORMATION TRANSFORMATION IN THE CONTEXT OF THE FINANCIAL SECTOR DIGITALIZATION

12.1. DIGITAL TRANSFORMATION AS A DRIVER OF THE FINANCIAL SECTOR SUSTAINABLE DEVELOPMENT

The financial services market is being greatly impacted by the dynamic advancement of new technologies. Digitalisation serves as a managerial enabler, and digital transformation (DT) refers to ongoing integration of digital technologies throughout the value chain of operations to provide added value to all stakeholders, resulting in superior business outcomes. Digitalisation is also a powerful driver of sustainability, highlighting a strategic orientation of the business that benefits multiple parties in complex [100].

By incorporating the latest technologies in the financial services industry, a greater value is created in the context of product offerings, customer service propositions, innovative business models, value chain and ecosystem enhancements, emerging new product distribution channels, transforming business interactions between financial services companies, etc. It improves the efficiency and performance of financial companies while enabling them to move towards sustainability. Digitalisation brings social impacts through enhanced financial inclusion, with better customised financial offerings and convenient digital channels for accessing them [100].

In [100], the financial sector digitalisation indicators were analysed, and digital payments were selected to be the leading digital technology to determine the correlation between the financial inclusion intensity and its development globally and in the EU. To conduct the empirical analysis, the financial inclusion data were compiled from The World Bank's Global Financial Inclusion Database 2022 and banking cost data from the European Central Bank's Consolidated Banking Database 2022. Data sources included 26 EU member states for 2014, 2017, and 2021.

According to Fig. 12.1, Denmark had the highest digital payment intensity across the EU in 2021, with 99.9% of the population aged from 15 years and older making digital payments, with Germany (99.5%), Austria (99.2%), Sweden (98.4%), and France (98.4%) following. Esto-

nia (97.7%) and Latvia (93.0%) were also both higher than average in the Baltic States, but Lithuania was a little behind with 83.4% [100].

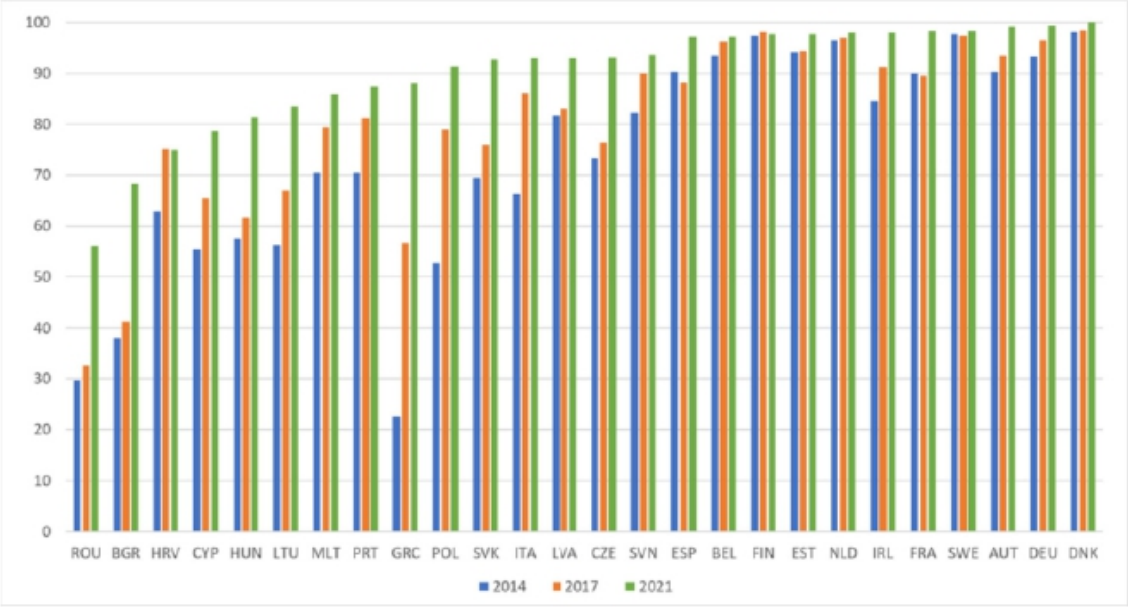


Fig. 12.1. Digital payment intensity in the EU member states in 2014, 2017 and 2021, % [100]

The most rapid growth rates in digital payments over the past 8 years have been in Greece (290.3%), Romania (88.8%), and Bulgaria (79.5%), driven mainly by poor digital payment intensity in 2014. In the Baltic States, Lithuania experienced the highest growth rate in 2021 in comparison to 2014 (48.2%), followed by Latvia with 14.0% and Estonia with 3.7% [100].

According to data provided in Fig.12.2, for 2021, Estonia with 93.0%, followed by Sweden with rate of 91.4%, then Slovenia with 90.4%, Denmark with 88.9%, Slovakia with 82.9%, and Latvia with 82.8%, was the leading EU countries by received digital payment intensity. Among the Baltic States, this indicator was the smallest (64.7%). Over the last 8 years Hungary (48.1%), Slovenia (42.0%), and Romania (32.1%) have seen the highest growth in the received digital payments, to a large extent due to the small intensity rate in 2014. Across the Baltic States, Estonia (9.8%) and Latvia (3.6%) showed the strongest growth in 2021 against 2014, followed by Lithuania on the decline (-5.7%) [100].

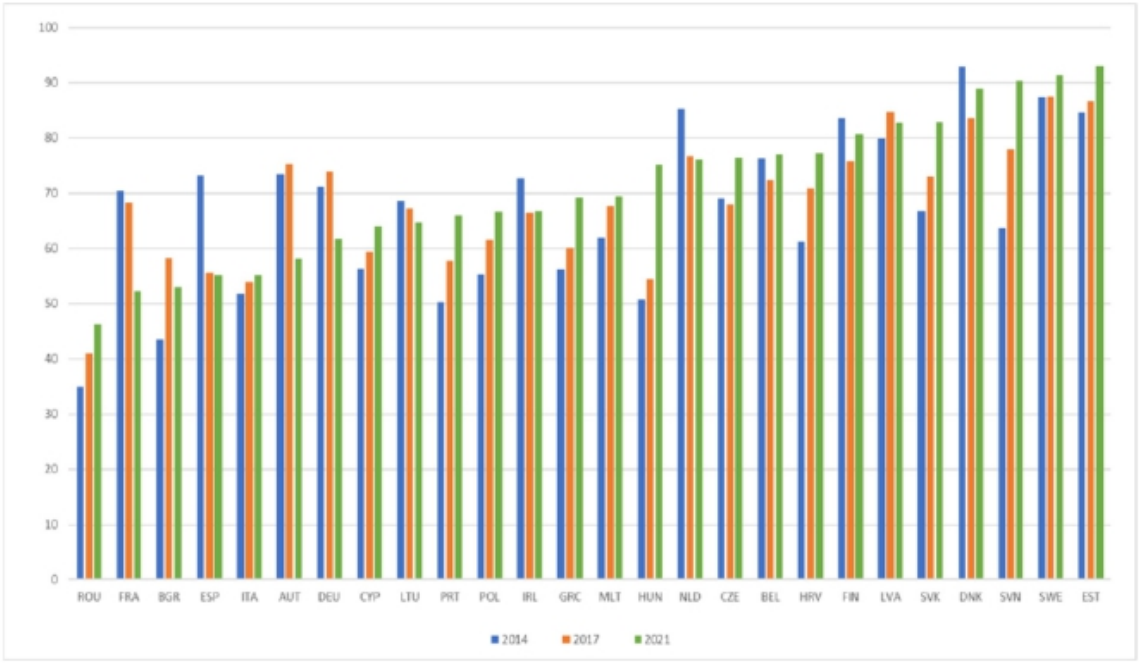


Fig. 12.2. The received digital payments in the EU member states in 2014, 2017 and 2021, % [100]

As correlation coefficient analysis confirms the statistics of the interconnection between the digital payment intensity and financial inclusion indicators, the share of account holders in the age group 15-plus years is growing linearly with the improvement of the ability of making and receiving digital payments (Fig. 12.3) [100].

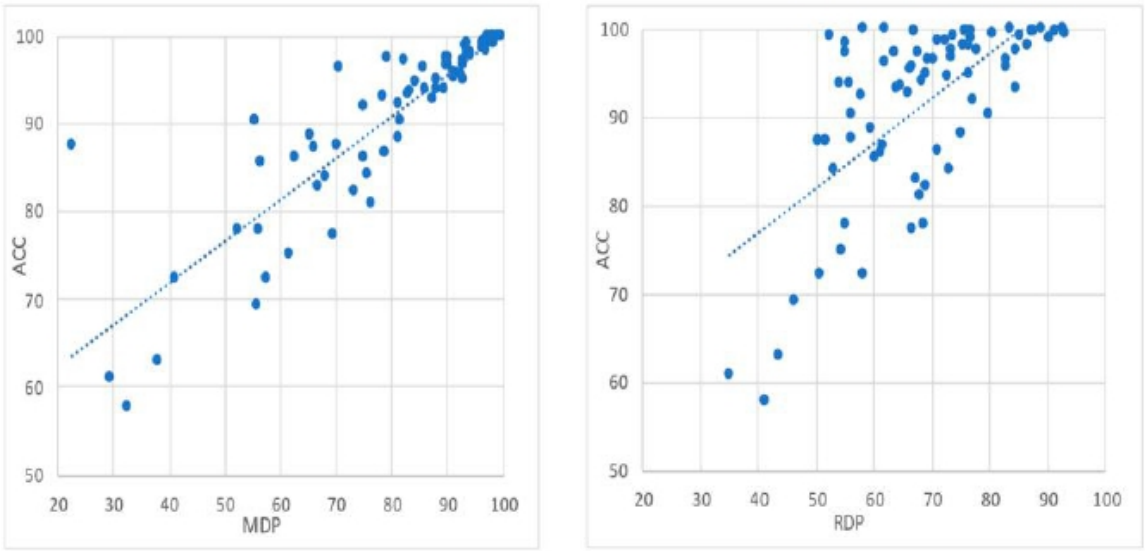


Fig. 12.3. The correlation between made (MDP) and received (RDP) digital payment intensity and accounts intensity (ACC) [100]

Further, as the made digital payment intensity grows by 1%, the accounts intensity grows by 0.48%. As for received digital payments, there is a somewhat larger growth in accounts at 0.51%. With respect to the interconnection between digital payments and the intensity of savings in financial institutions, the findings suggest that as the ability to make and receive digital payments grows, there is a linear increase in the intensity of savings in financial institutions among the age group 15-plus (Fig. 12.4). Also, with a 1% rise in the digital payment intensity, the savings intensity grows by 0.75%. As for received digital payments, the increase in savings intensity is somewhat larger at 0.81%, meaning that there is an extra option for involved parties to save money when receiving a payment [100].

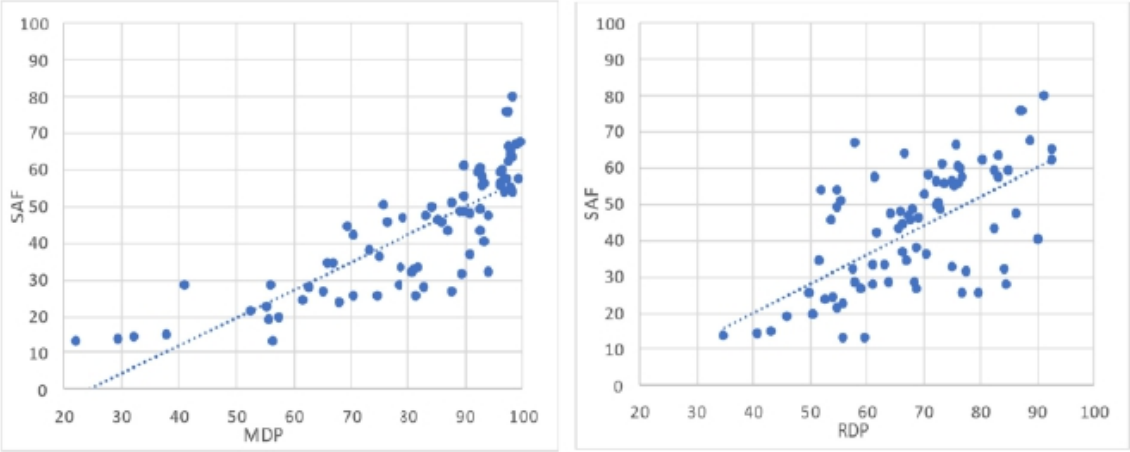


Fig. 12.4. The correlation between made (MDP) and received (RDP) digital payment intensity and accounts intensity with savings in financial institutions (SAF) [100]

Concerning the interconnection between digital payments and the saving intensity for old age clients, the analysis findings suggest that as the opportunities to make and receive digital payments expand, the saving intensity for old age clients in the group of 15-plus years old grows linearly (Fig. 12.5).

At the same time, a 1% rise in the digital payment intensity results in a 0.60% rise in the savings intensity. For received digital payments, the increase in the savings intensity is quite the same, at the level of 0.59% [100].

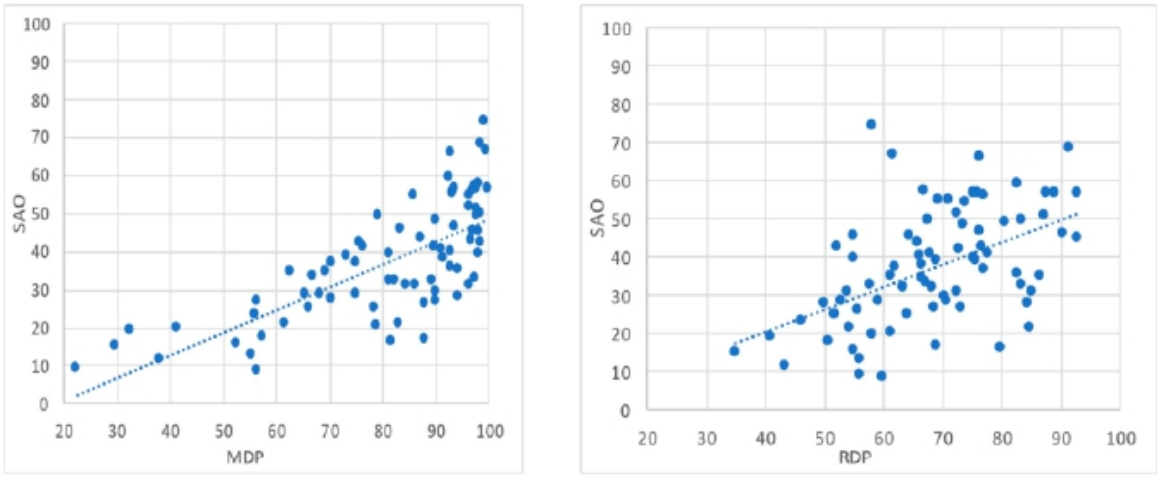


Fig. 12.5. The correlation between the made (MDP) and received (RDP) digital payment intensity and the savings intensity of old age clients (SAO)[100]

As regression model and coefficient testing confirmed the statistical significance of the interconnection between the digital payment intensity and operational efficiency of financial institutions, it was concluded that as the digital payment intensity rises, total expenses and personnel costs to bank assets decline (Fig. 12.6, Fig. 12.7) [100].

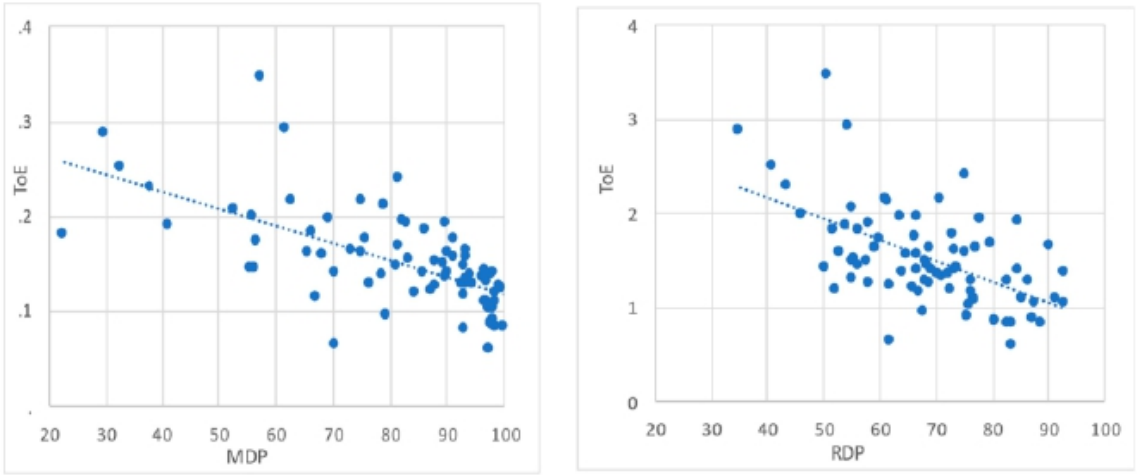


Fig. 12.6. The correlation between the made (MDP) and received (RDP) digital payment intensity and the banks' total costs (ToE, % of assets) [100]

A 1% growth in the made digital payment intensity also results in a 0.018% average reduction in total asset costs. For digital payments received, there is a modestly bigger decline in total asset costs at a rate of 0.023% [100].

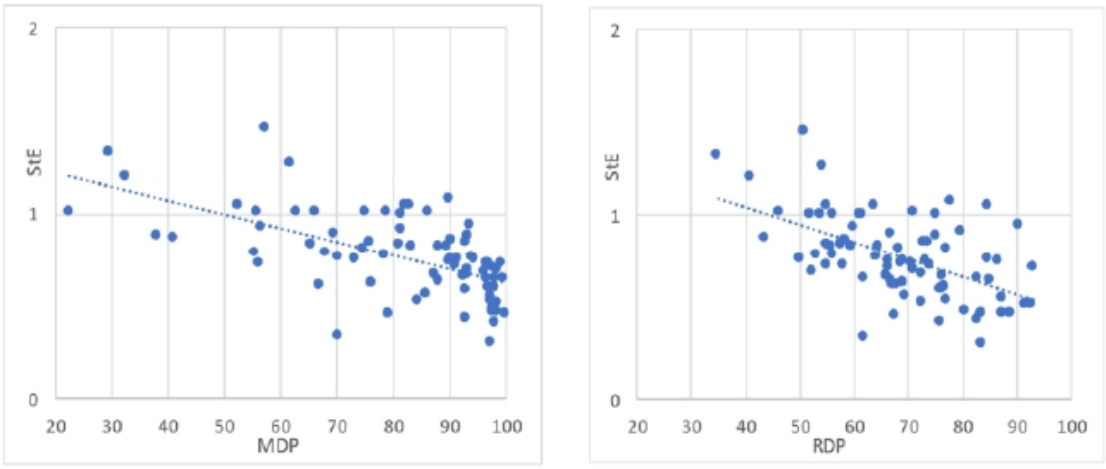


Fig. 12.7. The correlation between the made (MDP) and received (RDP) digital payment intensity and the banks' personnel costs (% of assets) [100]

Latvian total costs were somewhat below the EU average across the Baltic States, showing made digital payment rate of -0.49% and received digital payment rate of -0.38%. The numbers for Estonia, meanwhile, were positive at +0.16% and +0.41%, and for Lithuania they were at +0.07% and -0.05%, respectively [100].

Semi-structured expert interviews were carried out to verify the research results with a view to performing an extensive study on digital transition and sustainability of financial industry players operating in the Baltic States. It is important to consider the cost-effectiveness of sustainable development in the financial market [100].

12.2. DIGITAL TRANSFORMATION IN THE FINANCIAL MANAGEMENT

Internal and external processes of financial institutions were improved in terms of efficiency due to the implementation of digital transition. By automating different finance processes, including cash management, invoicing and financial reporting, digitisation has decreased the number of human errors, improved data accuracy and shortened the time required to accomplish set tasks. Furthermore, the advantages of digital transition also extend to real-time availability and accessibility of financial data. Financial teams can have direct and immediate visibility into needed real-time financial data using available digital financial technologies. Such an immediate access enables financial executives for

making more precise financial decisions supported by the most recent data. In this way, they can streamline the allocation and use of financial resources and more effectively mitigate risks. Exploiting complex financial analysis techniques can also benefit financial institutions as part of the ongoing financial management reshaping by means of digital means. Businesses are now capable of performing more sophisticated financial data analysis via technologies of big data analytics and machine learning. Such solutions can reveal new emerging market trends, regularities, and potential opportunities which would have otherwise been left unnoticed if only traditional analytical tools were applied. With improved forecasting, organisations can respond to market changes with enhanced strategic decision-making capabilities [101].

Leveraging advanced financial technologies has also enabled organizations to generate more precise predictions. These can include the application of complex algorithms and models to forecast prospective financial metrics, detect potential vulnerabilities and design optimal long-term strategies and plans for their implementation. With more reliable forecasts, businesses can select more evidence-based and justified solutions for realisation to address emerging challenges in the future. Beyond that, as financial management is digitally revolutionized, companies are able to maximize their financial audit process efficiency. Through an integrated and streamlined customised system, all financial records and data may be easily retrieved and checked with accuracy having authorised access. As a result, it will simplify the auditing process, shorten the time needed making it less time-consuming, and also enhance the total quality of the audit. Digitisation makes it easier to establish partner relationships between financial teams and all other departments of the organization. They can exchange information and collaborate seamlessly with each other thanks to an interoperable integrated digital platform. For instance, the budget planning and project monitoring can be handled directly by the financial team by using a digital project management system, eliminating mistakes and minimizing disruptions in communication [101].

Financial risk management in organisations is being greatly impacted by digitisation. Advanced financial technologies enable compa-

nies to be proactive in detecting and mitigating risks. Comprehensive data analysis empowers businesses to recognise financial risks faster and more precisely, giving an opportunity to address them in the right time frame. From this point of view, digital transition supports businesses in developing and executing optimal strategies to manage risks. Gaining a clearer picture of potential financial risks can help organisations to undertake proactive actions aimed at minimising the exposure and duration of financial risks. In this case, relevant predictive analytics instruments are used to help businesses foresee possible damages or losses and implement corresponding actions to prevent them. Digitisation is also facilitating the monitoring and management of companies' financial resources. By leveraging blockchain technologies, financial operations can be registered visibly and authentically. With this in place, the fraud and deception threats are eliminated or lessened. Applying AI technologies can assist companies in detecting patterns of fraud or financial irregularities faster and more reliably [101].

Financial decision-making has been transformed by digital technologies to a great extent. A key advantage is the enablement of more sophisticated, insightful and precise financial data analysis. More efficient financial data gathering, consolidation, and analysis is possible with the help of modern fintech. The financial managers can gain a deeper comprehension of the company's financial metrics, discover emerging trends, and fully assess business results. From this perspective, digital transition facilitates the application of complex data analytics tools, such as machine learning and big data analytics. All these advanced tools provide companies with the potential to make financial data analyses in deeper and more sophisticated ways. For instance, to determine cause-and-effect connections between financial indicators and business results, financial data analytics enable financial managers to improve their decision-making process by providing stronger evidence-based insights. To complement more precise data analysis, digitisation empowers the use of predictive technologies to assist in making financial decisions. Algorithms and predictive models can help organisations produce more reliable financial forecasts and project the possible results of specific scenarios. They are helping financial managers perform

planning and decision-making in a more grounded way, taking into account multiple interconnected factors and potential threats that may arise in the upcoming period [101].

Embracing financial management digitalisation carries a number of complexities. Among the main concerns is ensuring financial data security and confidentiality. The digital age has brought growing security threats, particularly cyber-attacks and data theft, to organisations. For this reason, it is essential for companies to safeguard their financial data with robust security solutions including encryption of data, multiple authentication systems, and defences from continuously advancing cyber risks. Moreover, digital transition also necessitates internal cultural changes inside the company and the realignment of staff roles. When introducing any new financial technology, it is crucial for companies to modify their current operating practices and address opposition to change. The active engagement of managers and employees in the transition process is required, providing them with the necessary training and assistance to acquire the relevant skills to operate using digital technologies [101].

Investing in finance technologies and selecting the appropriate ones is challenging. Digitisation in financial management frequently involves large inputs in technological infrastructure, software and competent staff. It is important for companies to thoroughly examine their business goals, compare the options currently offered on the market, and select the optimal match for both their goals and budgets. Furthermore, digitisation refers to comprehensive cross-system integration. In many cases, companies have multiple independent systems, like accounting system, financial management system, and inventory management system. Adequate integration of these systems is required to ensure that financial data can be shared seamlessly between them, allowing for coherent analysis and intelligent decision-making. Rapid and expanding technology evolution represents quite a challenge. FinTech keeps evolving very fast, and it is essential for companies to remain competitive on this path. Adopting technology too quickly might also pose a risk, since it can interrupt company processes and cause breakdowns or damage the system.

Also, stringent regulatory frameworks in the financial sector are becoming increasingly problematic. It is important for companies to

secure that their digitisation is compliant with relevant regulations, namely data protection, accounting standards, and rules for combating money laundering [101].

The digital transition needs to be carried out with proper compliance with these policies to prevent potential legal sanctions and reputational damage. Managing risks also represents a challenge within financial management digitisation. The adoption of advanced fintech may reshape the risk landscapes of companies, and they should be equipped with an appropriate strategy to mitigate risks. Organisations must be proactive in detecting and addressing risks posed by digital transition, for example, data security risk, system failure or the loss of skills of available employees. Gaining stakeholder support, trust and engagement remains another concern. Implementing digital readjustment needs the cooperation from CEOs, boards of directors and other key stakeholders. To gain the necessary support, companies should communicate the advantages of digitisation well, make a solid rationale for it, and be transparent about the execution plans [101].

12.3. DIGITAL TRANSFORMATION AND INFORMATION MANAGEMENT ENABLING CHANGES

While information is at the very heart of a digital transition, that connection between information management and digitisation is not often done well in practice. Looking at all the other underlying factors of digitisation such as stakeholders, human resources, responsiveness, processes, digital enablers, etc., it is a real problem. Information, be it in the form of data or content, is critical success factor towards enabling optimisation, collaboration, engagement, experience, innovation, communication, etc. when combined and used appropriately together with human drivers, leadership, processes, organisation and so on [102; 103].

John Mancini, President of the AIIM (Association of Information Management Professionals), discussed four main challenges in information management and digitisation in an interview (Fig. 12.8) [102; 103].

While information is not exclusively a key component of digitisation per se, it is essential at every point along the way to delivering on individual and organisational digital goals, like enhancing the customer journey, forming and sustaining the long-term competitive advantages.

Considering information more widely, one of the most commonly referred to linkages between digitisation and information is Big Data and Analytics as well as the IoT [102; 103].

Fig. 12.8. Digital transition and main challenges in information management according to John Mancini [102; 103]

Digitalisation requires information that is digital and digitised. It needs data, information storage, analytics and agility. The digital capability framework structure is presented in Fig. 12.9 [102; 103].

The digitalisation goals are as following [102; 103]:

1. Customer focus means understanding customers and providing them with the necessary information and/or knowledge to meet their demands.

2. A capable knowledge professional should be proficient in dealing with knowledge and without additional explanation of where it comes from and that it requires storage, dissemination, protection and use.

3. Operational excellence means defining potential improvements in operations and processes, rather than just possessing adequate information and data to achieve it.

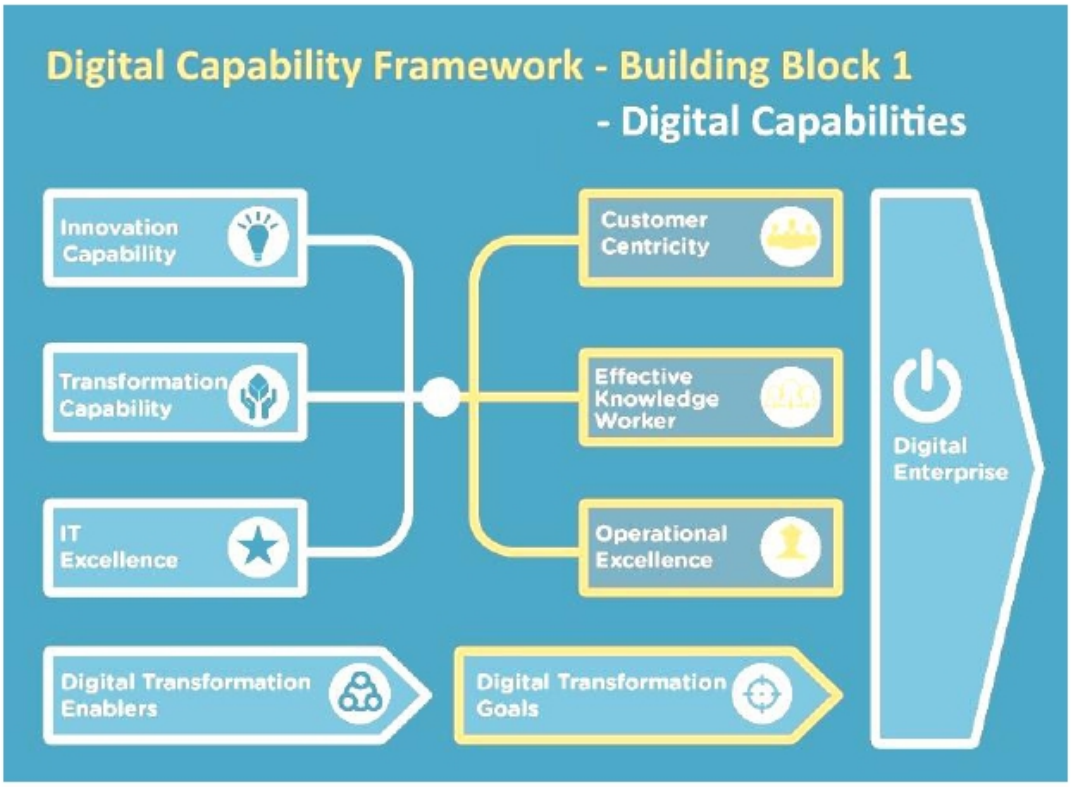


Fig. 12.9. The digital capability framework structure [103]

Whatever the extent of a digitisation initiative, data and digital information are crucial. Coupled with the human and process factors, it is even more essential as compared to the tech aspects [102; 103].

The clients are looking for information about their terms and conditions. Companies need data and an understanding these aspects to deliver that information. Also collecting the information, digitising it if necessary, and using it are needed to generate the appropriate results and drive the proper processes. Among other aspects are cooperation, decision-making, improved client-oriented approach having the right information, being aware of where it is and using it in an automated, swift, simple and, when necessary, personal way [102].

Capturing multiple channels for processing is growing in importance. This is not simply about digitising paper. It means covering all information sources and all communication channels accessed by cus-

tomers and stakeholders (i.e. employees, suppliers). It is source and channel fragmentation, as well as the explosive increase in data volumes and the diversity of data formats that are fuelling digitisation. Inputs from multiple sources generate data that directs workflows and processes [102].

It is easy to understand how a single document or piece of information entering an organisation can influence numerous processes and departments. The extent is enormous when it occurs in this information-abundant and data-intensive digital business reality. Predictably, intelligent insight into most of the information components that serve stakeholders will be integrated with business process management (BPM) to facilitate decision-making and predictive analytics. Information for processing, processing for information and innovations, value and transition are intertwined [102].

Digitalisation has allowed consumers to gain immediate access to a broad spectrum of banking products and services, giving banks the opportunity to meet the expectations of tech-savvy clients. Subsequently, digital financial systems have emerged as a viable means of delivering banking services to match the technological advancements. This concept implies that economic and social aspects of life are continuously changing. The dynamism and intensity of the ongoing stream of information are crucial features of this evolution. This is what is encouraging customers to abandon traditional financial services in preference to modern solutions. To meet the growing need for upgraded customers, financial institutions are partnering with fintechs, which are essentially innovative and technologically advanced financial solutions. The introduction of automated processes leading to cost savings typifies the previously mentioned structure. A scenario involving a financial operation being carried out online can considerably cut costs or even eliminate the need to spend [104; 105].

Over the past decade, numerous different industries have incorporated the digital landscape into their operational practices. A number of institutions, both public and private, are trying to develop appropriate strategies to facilitate the smooth integration of advanced technologies. Digital evolution encompasses all areas including socio-cultural, politi-

cal and economic dimensions. The financial institutions of the next generation will be driven by the speed, simplicity and security priorities, as well as by the value of technology and its use by individuals. The ongoing digital information revolution is having a profound impact on financial transactions. It is likely that future financial professionals have a unique set of capabilities that differ from current ones [104; 105].

Discussion questions

1. What are the main features of digitalisation?
2. What has digital transformation delivered?
3. Characterise the adaptation of digital technologies in the financial sector.
4. What are the features of the intensity of digital payments performed in the EU in 2014, 2017 and 2021?
5. Explain the statistical data on the digital transformation of the EU financial sector.
6. What are the features of the intensity of digital payments received in the EU in 2014, 2017 and 2021?
7. What is the relationship between the intensity of digital payments made and received and the intensity of accounts?
8. Characterise the relationship between the made and received digital payment intensity and the intensity of accounts with savings in financial institutions.
9. What are the peculiarities of the relationship between the intensity of digital payments made and received and the total costs of banks in the EU?
10. What are the features of the relationship between the intensity of digital payments made and received and the staff costs of EU banks?
11. Characterise digital transformation in financial management.
12. What are the features of digital transformation and the four key problems of information chaos according to John Mancini?
13. Outline and characterise the goals of digital transformation.
14. What are the features of the structure of digital capabilities?

Cases

1. Identify the features of the digital transformation of the selected company.
2. For the chosen option, identify the benefits of adopting digital technologies in the financial sector.

3. For the selected company option, assess the feasibility of the digital transformation goal.

4. Is it possible to take into account the four key problems of information chaos according to John Mancini in the company you have chosen?

5. Identify the features of digital transformation in the financial management.

Tests

1. Process of integrating digital technologies into the value chain of activities, in order to deliver added value to both customers and broader stakeholders, which leads to improving organizational performance is:

a) digitalization;

b) digital transformation;

c) sustainable development;

d) there is no correct answer.

2. Adaptation of new technologies in the financial sector leads to:

a) the development of new value in a form of offering, value proposition and business model innovation;

b) the transformation of value chains and ecosystems;

c) the development of new product delivery channels and changing the relation-ship between companies in the financial sector;

d) all answers are correct.

3. Digital transformation enables social benefits by improving financial inclusion, which provides:

a) more personalized financial products;

b) usable digital access channels;

c) development of new product delivery channels and changing the relation-ship between companies in the financial sector;

d) there is no correct answer.

4. The highest intensity of digital payments from 2021 in the EU countries was:

a) in Denmark – 97.9%;

b) in Denmark – 99.9%;

c) in Germany – 99.5%;

d) there is no correct answer.

5. The fastest growth of digital payments made in the last 8 years was:

a) in Greece – 290.3%;

b) in Greece – 280.3%;

c) in Romania – 180.3%;

d) there is no correct answer.

6. Leaders in the EU in terms of the intensity of digital payments received were:

a) in Estonia – 97.0%;

b) in Estonia – 93.0%;

c) in Slovakia – 82.9%;

d) there is no correct answer.

7. The fastest growth in digital payments received over the last 8 years was:

a) in Hungary – 48.1%;

b) in Hungary – 49.1%;

c) in Slovenia – 42.0%;

d) there is no correct answer.

8. When the intensity of digital payments increases by 1%, the intensity of accounts grows by:

a) 0.44%;

b) 0.48%;

c) 0.56%;

d) there is no correct answer.

9. When the intensity of digital payments increases by 1%, the intensity of savings increases by:

a) 0.60%;

b) 0.75%;

c) 0.85%;

d) there is no correct answer.

10. As the intensity of digital payments received increases by 1%, the intensity of savings increases by:

a) 0.60%;

b) 0.50%;

c) 0.59%;

d) there is no correct answer.

11. With the increased intensity of digital payments, the total and staff costs to bank assets:

a) increase;

b) do not change;

c) decrease;

d) there is no correct answer.

12. Tests of regression models and coefficients substantiate the statistical significance of the relationship between:

a) the intensity of public payments and financial institutions operational efficiency;

b) the intensity of digital payments and financial institutions operational efficiency;

c) the intensity of digital payments and public institutions operational efficiency;

d) there is no correct answer.

13. As the intensity of digital payments increases by 1%, total asset costs decrease by:

a) 0.016% on average;

b) 0.018% on average;

c) 0.019% on average;

d) there is no correct answer.

14. By automating various financial processes, such as cash management, invoicing and financial reporting, digital transformation can:

a) eliminate human errors;

b) improve accuracy and reduce the time required to complete these tasks;

c) enhance development of new product delivery channels, changing the relationship between companies in the financial sector;

d) there is no correct answer.

15. Instant access to financial data allows financial managers to make:

a) less accurate decisions based on the latest information;

b) more accurate decisions based on the latest information;

c) more accurate decisions based on the general data;

d) there is no correct answer.

16. What technologies can companies use to analyse financial data more deeply?

a) big data analytics;
b) machine learning;
c) public relations;
d) there is no correct answer.

17. The utilization of sophisticated financial technology allows companies to make:
a) less accurate predictions;
b) more accurate predictions;
c) inaccurate predictions;
d) there is no correct answer.

18. Companies can use complex algorithms and models to:
a) predict future financial performance;
b) identify potential risks;
c) make better strategic plans;
d) all answers are correct.

19. Digital transformation is helping to strengthen cooperation between:
a) non-profit teams and other departments within a company;
b) finance teams and other departments within a company;
c) public teams and other departments within a company;
d) there is no correct answer.

20. Through a digital project management system, the finance team can be directly involved in:
a) budget planning;
b) project monitoring;
c) minimizing errors and communication delays;
d) all answers are correct.

21. Digital transformation enables companies to implement:
a) effective risk formalization strategies;
b) effective risk mitigation strategies;
c) effective risk intensification strategies;
d) there is no correct answer.

22. Using artificial intelligence tools allows companies to more quickly and accurately identify:
a) suspicious patterns of fraud or financial violations;
b) suspicious patterns of digitisation or financial profits;

c) suspicious patterns of public or non-public violations;
d) there is no correct answer.

23. The implementation of digital transformation in financial management has certain challenges, namely:
a) the security and privacy of financial data;
b) cyber attacks;
c) data theft;
d) all answers are correct.

24. Companies must protect their financial data with strong security measures, such as:
a) data encryption;
b) multiple authentication systems;
c) protection against ever-evolving cyber threat;
d) all answers are correct.

25. An important condition for the seamless exchange of financial data between systems, which allows for holistic analysis and informed decision-making, is:
a) tactical integration;
b) proper system integration;
c) public integration;
d) there is no correct answer.

26. Adopting technology too quickly can also be a problem, as it can:
a) disrupt company operations;
b) create vulnerability to errors;
c) cause system damage companies;
d) all answers are correct.

27. Companies must ensure that their digital transformation complies with applicable regulatory and compliance requirements, such as:
a) data protection regulations;
b) accounting standards;
c) anti-money laundering rules;
d) there is no correct answer.

28. Companies must proactively identify and manage the risks that arise from digital transformation, such as:
a) system failure;

b) data security risk;

c) the risk of losing the skills of existing employees;

d) all answers are correct.

29. Digital transformation implementation requires support from:

a) executive management;

b) company's board of directors;

c) other stakeholders;

d) all answers are correct.

30. Regardless of the form of optimisation, communication, collaboration, interaction, experience, innovation, etc., information is:

a) irrelevant success factor;

b) key success factor;

c) secondary success factor;

d) there is no correct answer.

31. Customer-centricity is:

a) the knowledge of the customers;

b) offering the best information taking into account client characteristics;

c) gaining the necessary knowledge to serve customers according to their needs;

d) all answers are correct.

32. Operational excellence is:

a) improving operations and processes;

b) knowledge;

c) offering the best information;

d) there is no correct answer.

13. TRANSPORTATION IN THE SUPPLY CHAIN

13.1. THE ROLE OF TRANSPORTATION IN THE SUPPLY CHAIN

To understand transportation in a supply chain, it is important to consider the perspectives of four parties. A carrier makes investment decisions regarding the transportation equipment (e.g., locomotives, trucks, airplanes) and, in some cases, infrastructure (rail), and then makes operating decisions to try to maximize the return from these assets. A shipper, in contrast, uses transportation to minimize the total cost (transportation, inventory, information, sourcing, and facility) while providing an appropriate level of responsiveness to the customer [17].

The effectiveness of carriers is influenced by infrastructure such as ports, roads, waterways, and airports. Most transportation infrastructure throughout the world is owned and managed as a public good. It is important that the infrastructure is managed in such a way that funds are available to maintain and invest in further capacity as needed. Transportation policy sets direction for the number of national resources that go into improving transportation infrastructure. Transportation policy also aims to prevent abuse of monopoly power; promote fair competition; and balance environmental, energy, and social concerns in transportation [17].

The effectiveness of any mode of transport is influenced by equipment investments and operating decisions by the carrier and the available infrastructure and transportation policies. The carrier's primary objective is to ensure good utilization of its assets while providing customers with an acceptable service level. Carrier decisions are affected by equipment cost, fixed operating costs, variable operating costs, the responsiveness the carrier seeks to provide its target segment, and the prices that the market will bear [17].

The modes of transportation – be it road, air, sea, or rail – each have unique advantages and applications in the supply chain. Any company recognizing the diversity of transportation options, strategically selects the most suitable modes for different scenarios. For instance, time-sensitive deliveries might benefit from air transport, while bulk shipments might be more cost-effectively handled via sea or rail [106].

The supply chain is held together by the link of transportation. Since raw materials are moved from dealers or the location where they are purchased to the location where they are manufactured and then to the final consumer, every step of the process needs to be connected by optimized transportation. Without a reliable and cost-effective shipping strategy in place, companies risk losing a lot of time and money, which could negatively impact their competitive advantage. This includes having solutions ready for potential disruptions, like equipment failure, natural disasters, work stoppages, government interventions, etc. [107].

Air carriers offer a fast and expensive mode of transportation for cargo. Small, high value items or time-sensitive emergency shipments that must travel a long distance are best suited for air transport. Air carriers normally move shipments under 500 pounds, including high value but lightweight high-tech products. Given the growth in high technology, the weight of freight carried by air has diminished over the past two decades even as the value of the freight has increased somewhat [17].

Package carriers are transportation companies such as FedEx, UPS, and the U.S. Postal Service, which carry small packages ranging from letters to shipments weighing about 150 pounds. Package carriers use air, truck, and rail to transport time-critical smaller packages. Package carriers are expensive and cannot compete with LTL carriers on price for large shipments. The major service they offer shippers is rapid and reliable delivery. Thus, shippers use package carriers for small and time-sensitive shipments. Package carriers also provide other value-added services such as package tracking and, in some cases, processing and assembly of products. Given the small size of packages and several delivery points, consolidation of shipments is a key factor in increasing utilization and decreasing costs for package carriers. Package carriers have trucks that make local deliveries and pick up packages. Packages are then taken to large sorting centres, from which they are sent by full truckload, rail, or air to the sorting centre closest to the delivery point [17].

The trucking industry consists of two major segments – truckload (TL) or less than truckload (LTL). Trucking is more expensive than rail but offers the advantage of door-to-door shipment and a shorter delivery time. It also has the advantage of requiring no transfer between pickup and delivery. TL operations have relatively low fixed costs, and owning

a few trucks is often sufficient to enter the business. LTL operations are priced to encourage shipments in small lots, usually less than half a TL, as TL tends to be cheaper for larger shipments. LTL is suited for shipments that are too large to be mailed as small packages (typically more than 150 lbs.) but that constitute less than half a TL [17].

LTL operators tend to run regional or national hub-and-spoke networks that allow consolidation of partial loads. LTL shipments take longer than TL shipments because of other loads that need to be picked up and dropped off [17].

Rail carriers incur a high fixed cost in terms of tracks, locomotives, cars, and yards. A significant trip-related labour and fuel cost is independent of the number of cars (fuel costs do vary somewhat with the number of cars) but does vary with the distance travelled and the time taken. Any idle time, once a train is powered, is expensive because labour and fuel costs are incurred even though trains are not moving. Idle time occurs when trains exchange cars for different destinations [17].

Major global ocean carriers include Maersk, Evergreen Group, American President Lines, and Hanjin Shipping Co. Water transport, by its nature, is limited to certain areas. Water transport is ideally suited for carrying large loads at low cost. Within the United States, water transport is used primarily for the movement of large bulk commodity shipments and is the cheapest mode for carrying such loads. It is, however, the slowest of all the modes, and significant delays occur at ports and terminals. This makes water transport difficult to operate for short-haul trips, although it is used effectively in Japan and parts of Europe for daily short-haul trips of a few miles [17].

Pipeline is used primarily for the transport of crude petroleum, refined petroleum products, and natural gas. Pipeline may be an effective way of getting crude oil to a port or a refinery. Sending gasoline to a gas station does not justify investment in a pipeline and is done better with a truck. Pipeline pricing usually consists of two components: a fixed component related to the shipper's peak usage and a second charge relating to the actual quantity transported. This pricing structure encourages the shipper to use the pipeline for the predictable component of demand with other modes often being used to cover fluctuations [17].

Intermodal transportation is the use of more than one mode of transport to move a shipment to its destination. A variety of intermodal combinations are possible, with the most common being truck/rail. Intermodal traffic has grown considerably with the increased use of containers for shipping and the rise of global trade [17].

Intermodal transportation is one of the major supply chain trends currently prevalent in the transportation sector. Here, the freight is transported from source to destination by at least two different modes of transport. Generally, each means of transport is associated with a distinct supplier and governed by individual contracts. However, every segment works in sync to achieve the agreed delivery timeline [107].

The intermodal transportation method is of great help to ensure hassle-free international movement of products. For international shipments, once the products are loaded onto a container, they remain so through the entire journey. As this involves a mix of sea, air, and land travel, it is more fuel-efficient and cost-effective for companies to move bulk orders across borders. As it ensures greater consistency and capacity utilization, intermodal transportation is fast shaping the evolving role of transportation in the supply chain [107].

13.2. DESIGN OF THE TRANSPORTATION NETWORK

The design of a transportation network affects the performance of a supply chain by establishing the infrastructure within which operational transportation decisions regarding scheduling and routing are made. A well-designed transportation network allows a supply chain to achieve the desired degree of responsiveness at a low cost [17].

With the direct shipment network to a single destination option, the buyer structures the transportation network so that all shipments come directly from each supplier to each buyer location, as shown in Fig. 13.1. The major advantage of a direct shipment transportation network is the elimination of intermediate warehouses and its simplicity of operation and coordination. The shipment decision is completely local, and the decision made for one shipment does not influence others. The transportation time from supplier to buyer location is short because each shipment goes direct. A direct shipment network to single destination is justified only if demand at buyer locations is large enough that optimal replenishment lot sizes are close to a truckload from each supplier to each location [17].

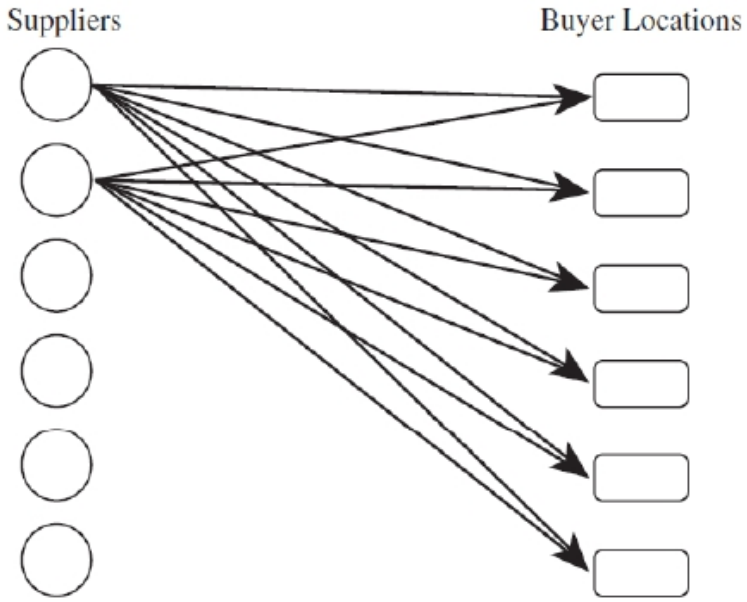


Fig. 13.1. Direct shipment network [17]

Runs from multiple suppliers or to multiple buyer locations are shown in Fig. 13.2. In direct shipping with runs, a supplier delivers directly to multiple buyer locations on a truck, or a truck picks up deliveries destined for the same buyer location from many suppliers. When using this option, a supply chain manager must decide on the routing of each run. Direct shipping provides the benefit of eliminating intermediate warehouses, whereas runs lower transportation cost by consolidating shipments to multiple locations on a single truck [17].

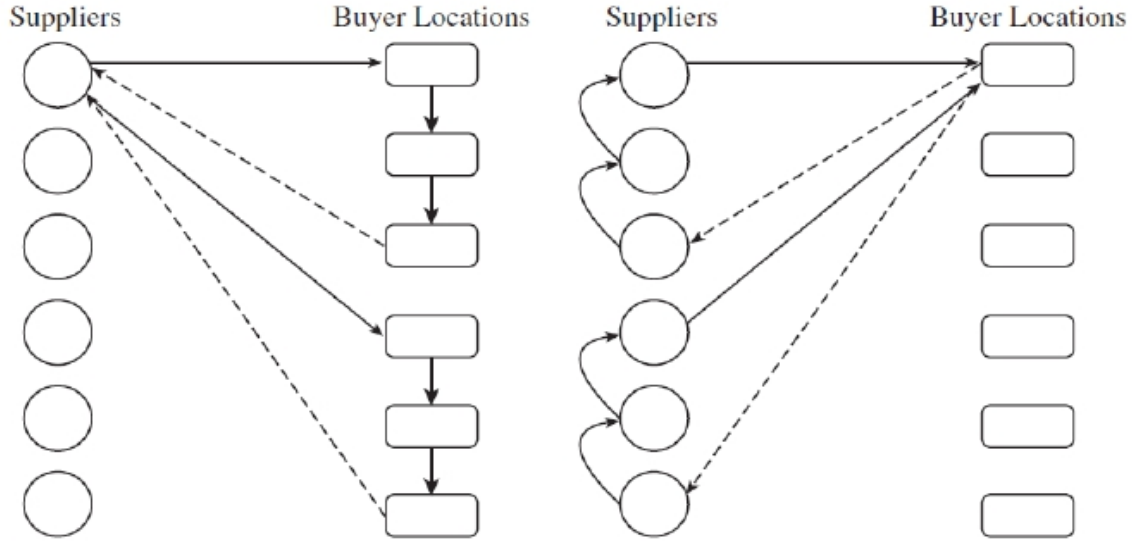


Fig. 13.2. Runs from multiple suppliers or to multiple buyer locations [17]

Runs make sense when the quantity destined for each location is too small to fill a truck, but multiple locations are close enough to each other such that their combined quantity fills the truck [17].

All shipments via intermediate distribution centre (DC) with storage product is shipped from suppliers to a central distribution centre, where it is stored until needed by buyers when it is shipped to each buyer location, as shown in Fig. 13.3. Storing product at an intermediate location is justified if transportation economies require large shipments on the inbound side or shipments on the outbound side cannot be coordinated. In such a situation, product comes in large quantities into a DC, where it is held in inventory and sent to buyer locations in smaller replenishment lots when needed [17].

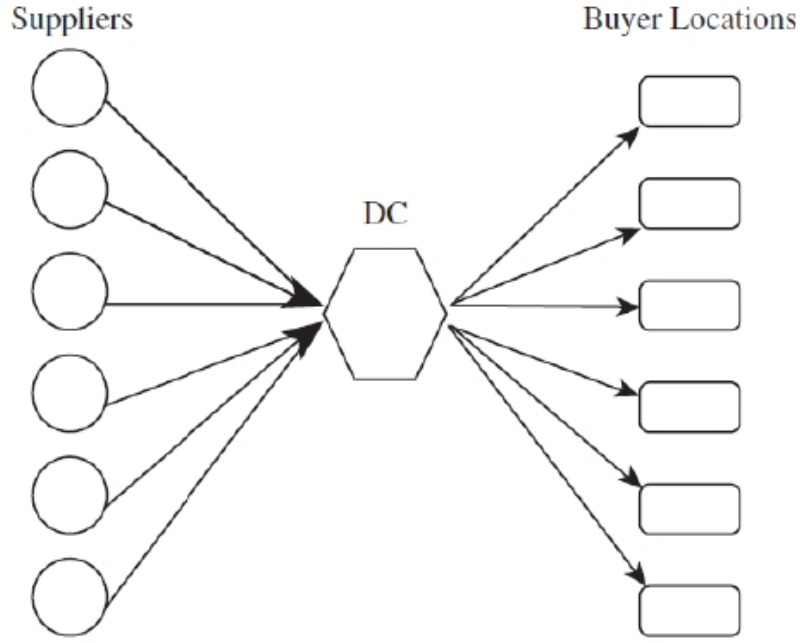


Fig. 13.3. All shipments via distribution centre [17]

As shown in Fig. 13.4, runs can be used from a DC if lot sizes to be delivered to each buyer location are small. Runs reduce outbound transportation costs by consolidating small shipments [17].

To understand transportation in a supply chain, it is important to consider the perspectives of four parties. A carrier makes investment decisions regarding the transportation equipment (e.g., locomotives, trucks, airplanes) and, in some cases, infrastructure (rail), and then makes operating decisions to try to maximize the return from these assets [17].

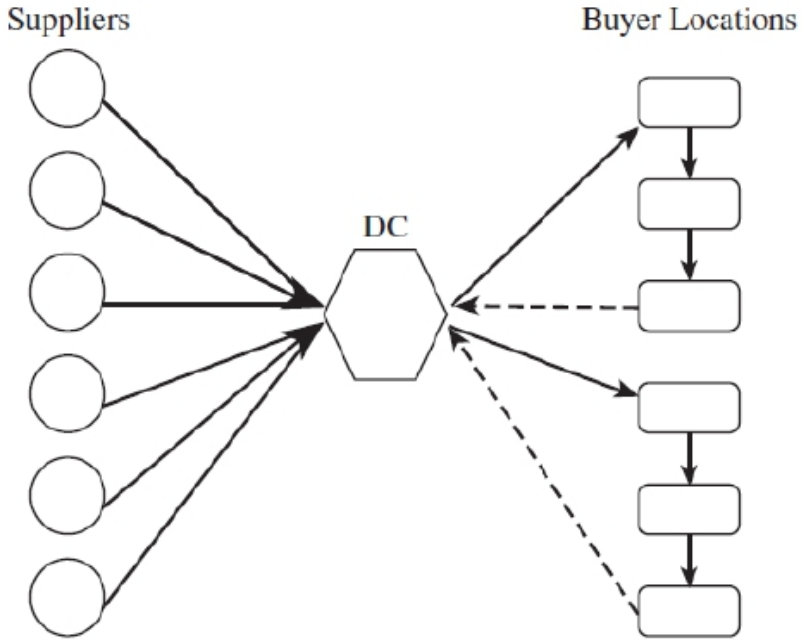


Fig. 13.4. Runs from distribution centre [17]

The tailored network option is a suitable combination of previous options that reduces the cost and improves the responsiveness of the supply chain. Here, transportation uses a combination of cross-docking, and TL and LTL carriers, along with package carriers in some cases. The goal is to use the appropriate option in each situation. High-demand products may be shipped directly to high-demand retail outlets, whereas low-demand products or shipments to low-demand retail outlets are consolidated to and from the DC. The complexity of managing this transportation network is high because different shipping procedures are used for each product and retail outlet. Operating a tailored network requires significant investment in information infrastructure to facilitate the coordination. Such a network, however, allows for the selective use of a shipment method to minimize the transportation as well as inventory costs. Table 13.1 summarizes the pros and cons of the various transportation network options discussed [17].

The analysis of supply chains considers several factors, Fig.13.5 [108]:

1. *Stages*. There are four functional stages involving a wide variety of activities, from the production of commodities through the extraction of raw materials, the manufacturing and assembly of parts and finished goods, to their distribution to markets.

Table 13.1

Pros and cons of different transportation networks [17]

Network Structure	Pros	Cons
Direct shipping	No intermediate warehouse Simple to coordinate	High inventories (due to large lot size)
Direct shipping with milk runs	Lower transportation costs for small lots Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation cost through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement Lower transportation cost through consolidation	Increased coordination complexity
Shipping via DC using milk runs	Lower outbound transportation cost for small lots	Further increase in coordination complexity
Tailored network	Transportation choice best matches needs of individual product and store	Highest coordination complexity

2. *Locations*. A primary freight supply and demand issue reveals comparative advantages, locational preferences, and market size. A supply chain is commonly organized as a sequence of locations, from the extraction of raw materials taking place in resource regions to the locations of final consumption, forming a network.

3. *Distribution channels*. Supply chains are articulated through channels supported by logistical service providers interfacing with manufacturers and retailers. It also considers the nature, and the level of control shipping companies have over the supply chains they use through agreements, mergers, and alliances.

4. *Modes*. The nature of the transport chains is used to accommodate the supply chains in terms of modes, terminals, and freight forwarders. The goal is to improve the connectivity of the supply chain.

5. *Load units*. Considers how the material flows in the supply chain are circulating, often related to how fragile, perishable, or valuable a product is. While raw materials tend to be distributed using bulk shipping, intermediate goods are more reliant on container shipping, and city logistics is reliant on less than truckload shipments using vans.

6. Cost function. Evaluates the costs incurred for the activities taking place along the supply chain, such as procurement costs, manufactur-

ing costs, distribution costs, and retailing costs. The whole is commonly expressed as total logistics costs.

7. *Added value.* The consideration of which parts of the supply chain contribute the most to added value. This is an important strategic goal, as added value is linked with profit margins.

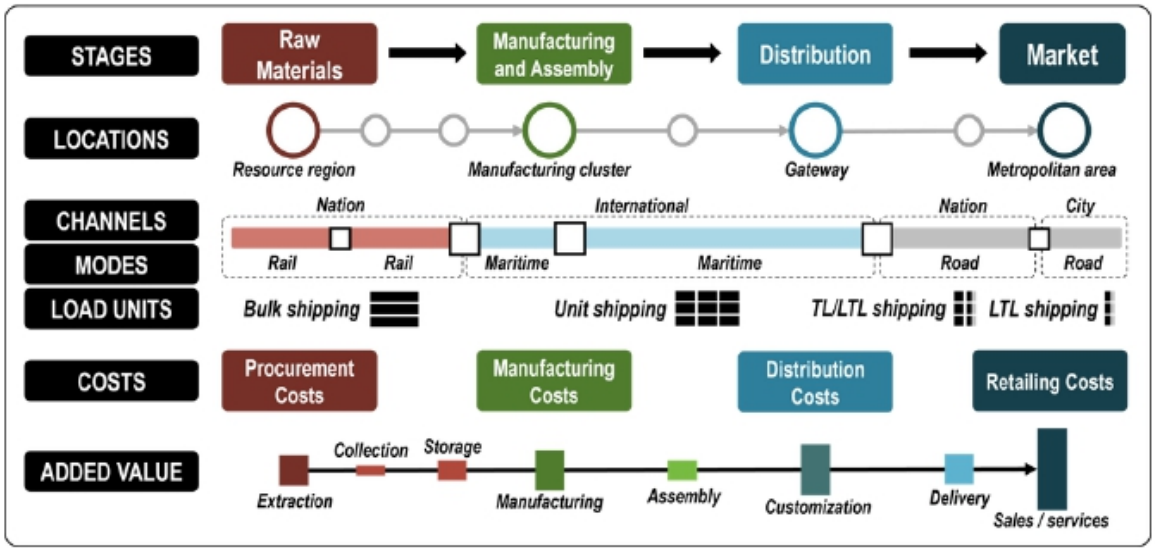


Fig. 13.5. Supply chain analysis [108]

Value chains, known as commodity chains, are a series of stages conditioned by the location and availability of raw materials, production costs, and the location of main consumption markets (Fig. 13.6).

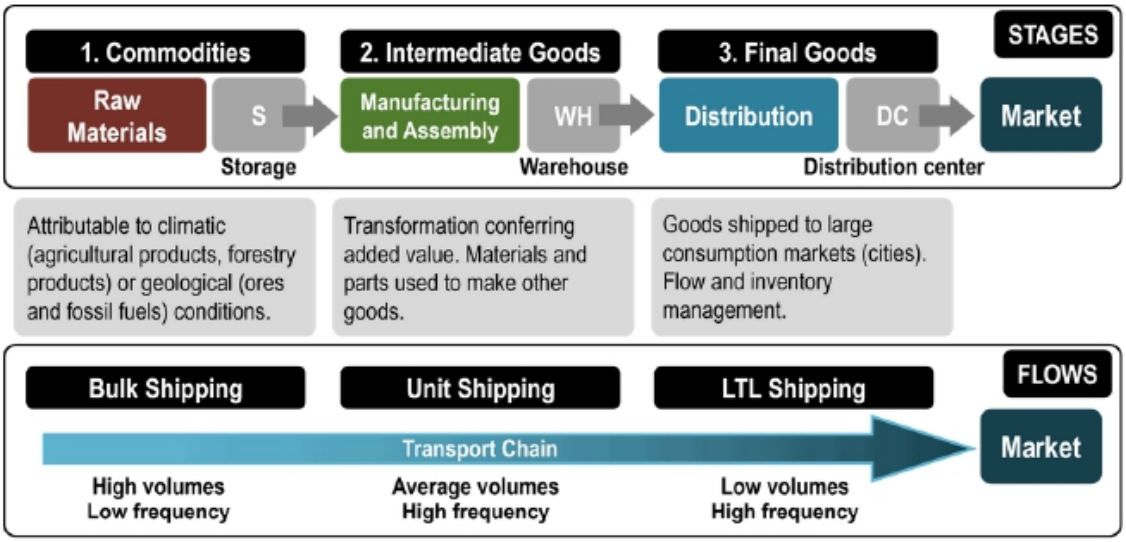


Fig. 13.6. Value chains [108]

The sequence allows for the provision of goods to markets. Value chains are also integrated by a transport chain routing raw materials, parts, and finished goods from extraction and transformation sites to markets and correspond to the unique geography of flows [108].

An economic activity involved in manufacturing or distribution is linked to a complex system of suppliers and customers, which must be supported by a transport system. The system is known as a supply chain, a sequence of transportation and inventory management tasks. Nature of the supply chain is shown in Fig. 13.7 [108].

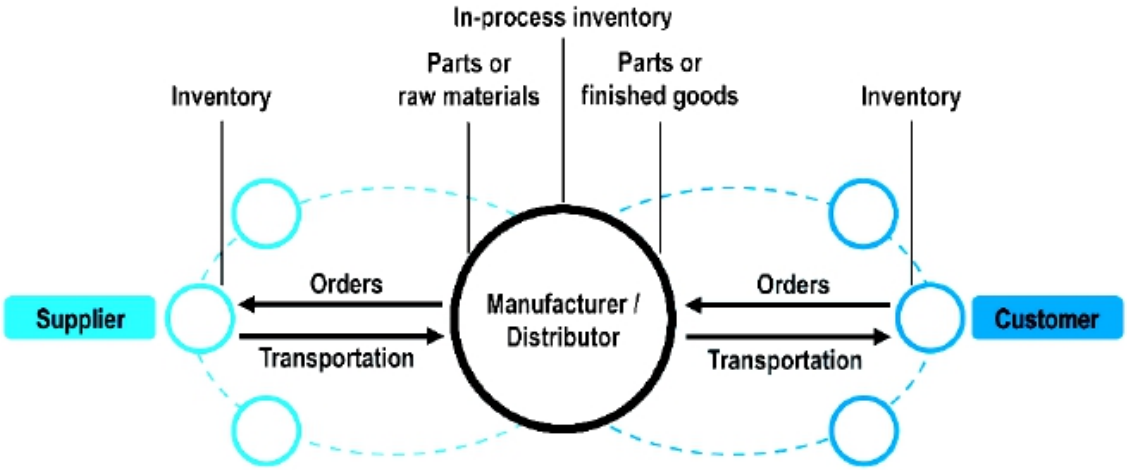


Fig. 13.7. Nature of the supply chain [108]

13.3. TAILORED NETWORK AND TRADE-OFFS IN THE TRANSPORTATION DESIGN

All transportation decisions made by shippers in a supply chain network should take into account their impact on inventory costs, facility and processing costs, the cost of coordinating operations, and the level of responsiveness provided to customers [17].

The cost of coordinating operations is generally hard to quantify. Shippers should evaluate different transportation options in terms of various costs and revenues and then rank them according to coordination complexity. A manager can then make the appropriate transportation decision [17].

Managers must consider the following trade-offs when making transportation decisions: transportation and inventory cost trade-off; transportation cost and customer responsiveness trade-off. Selecting a

transportation mode is both a planning and an operational decision in a supply chain. The decision regarding carriers with which a company contracts is a planning decision, whereas the choice of transportation mode for a particular shipment is an operational decision. For both decisions, a shipper must balance transportation and inventory costs [17].

The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain. Cheaper modes of transport typically have longer lead times and larger minimum shipment quantities, both of which result in higher levels of inventory in the supply chain. Modes that allow for shipping in small quantities lower inventory levels but tend to be more expensive. Apple, for example, airfreights several of its products from Asia. This choice cannot be justified based on transportation cost alone. It can be justified only because the use of a faster mode of transportation for shipping valuable components allows Apple to carry low levels of inventory and still be responsive to its customers [17].

The impact of using different modes of transportation on inventories, response time, and costs in the supply chain is shown in Table 13.2. Each transportation mode is ranked along various dimensions, with 1 being the best and 6 being the worst [17].

Table 13.2

Ranking of transportation modes in terms of supply chain performance (1 = best, 6 = worst) [17]

Mode	Cycle Inventory	Safety Inventory	In-Transit Cost	Transportation Cost	Transportation Time
Rail	5	5	5	2	5
TL	4	4	4	3	3
LTL	3	3	3	4	4
Package	1	1	1	6	1
Air	2	2	2	5	2
Water	6	6	6	1	6

Faster modes of transportation are preferred for products with a high value-to-weight ratio for which reducing inventories is important, whereas cheaper modes are preferred for products with a small value-to-weight ratio for which reducing transportation cost is important. The choice of

transportation mode should consider potential lost sales and cycle, safety, and in-transit inventory costs in addition to the cost of transportation. The lost sales and inventory costs are influenced by the speed, flexibility, and reliability of the mode. The purchase price must also be included if it changes with the choice of transportation mode (perhaps because of a change in lot sizes) [17].

Tailored transportation is the use of different transportation networks and modes based on customer and product characteristics. Most firms sell a variety of products and serve many different customer segments. When a firm serves a high density of customers close to the DC, it is often best for the firm to own a fleet of trucks that are used with product runs originating at the DC to supply customers, because this scenario makes good use of the vehicles and provides customer contact. As customer density decreases, use of an LTL carrier or a third party doing product runs is more economical because the third-party carrier can aggregate shipments across many firms. If a firm wants to serve an area with a low density of customers far from the warehouse, even LTL carriers may not be feasible, and the use of package carriers may be the best option as long as loads are small. Boise Cascade Office Products, an industrial distributor of office supplies, has designed a transportation network consistent with the suggestion in Table 13.3 [17].

Table 13.3

Transportation options based on customer [17]

	Short Distance	Medium Distance	Long Distance
High density	Private fleet with milk runs	Cross-dock with milk runs	Cross-dock with milk runs
Medium density	Third-party milk runs	LTL carrier	LTL or package carrier
Low density	Third-party milk runs or LTL carrier	LTL or package carrier	Package carrier

Customer density and distance should also be considered when firms decide on the degree of temporal aggregation (which affects response time) to use when supplying customers. Firms should serve areas with high customer density more frequently because these areas are likely to provide sufficient economies of scale in transportation, making temporal aggregation less valuable [17].

To lower transportation costs, firms should use a higher degree of temporal aggregation and aim for somewhat lower responsiveness when serving areas with a low customer density. Firms must consider customer size and location when designing transportation networks. Large customers can be supplied using a TL carrier, whereas smaller customers will require an LTL carrier or product runs. When using runs, a shipper incurs two types of costs: transportation cost based on total route distance; delivery cost based on number of deliveries [17].

The transportation cost is the same whether going to a large or small customer. If a delivery is to be made to a large customer, including other small customers on the same truck can save on transportation cost. For each small customer, however, the delivery cost per unit is higher than that for large customers. Thus, it is not optimal to deliver to small and large customers with the same frequency at the same price. One of the options that firms can offer is to charge higher shipping costs for smaller customers. Another option is to tailor product runs so they visit larger customers with a higher frequency than smaller customers. Firms can partition customers into large (L), medium (M), and small (S), based on the demand at each [17].

The degree of inventory aggregation and the modes of transportation used in a supply chain network should vary with the demand and value of a product, as shown in Table 13.4 [17].

Table 13.4

Aggregation strategies based on value/demand [17]

Product Type	High Value	Low Value
High demand	Disaggregate cycle inventory. Aggregate safety inventory. Inexpensive mode of transportation for replenishing cycle inventory and fast mode when using safety inventory.	Disaggregate all inventories and use inexpensive mode of transportation for replenishment.
Low demand	Aggregate all inventories. If needed, use fast mode of transportation for filling customer orders.	Aggregate only safety inventory. Use inexpensive mode of transportation for replenishing cycle inventory.

The cycle inventory for high-value products with high demand is disaggregated to save on transportation costs because this allows replenishment orders to be transported less expensively [17].

Discussion questions

1. What is the peculiarity of transport organisation in the supply chain from the point of view of the carrier?

2. What is the peculiarity of transport organisation in the supply chain from the point of view of the shipper?

3. Characterise transport policy from the perspective of infrastructure management.

4. What are the features of the direct shipment network?

5. Characterise runs from multiple suppliers or to multiple buyer locations.

6. What are the features of all shipments via distribution centre?

7. What is the characteristic of runs from distribution centre?

8. Characterise the tailored network option.

9. What are the pros and cons of different transport networks?

10. What are the features of the supply chain analysis?

11. Characterise the value chains.

12. What characterises the nature of a supply chain?

13. Describe trade-offs in transport design.

Cases

1. Identify the features of the direct shipping network for the selected company.

2. For the chosen option, identify the benefits of runs from distribution centre.

3. Evaluate the possibility of supply chain analysis for the selected company.

Tests

1. The carrier's primary objective is:

a) to ensure low utilization of the assets while providing customers with an acceptable level of service;

b) to ensure good utilization of the assets while providing customers with an acceptable level of service;

c) to ensure low utilization of the assets while providing partners with an acceptable level of service;

d) there is no correct answer.

2. Carrier's decisions are affected by:

a) equipment cost;

b) fixed operating costs;

c) variable operating costs;

d) all answers are correct.

3. The supply chain is held together by:

a) the link of systematisation;

b) the link of transportation;

c) the link of publication;

d) there is no correct answer.

4. While raw materials are moved from dealers or the location where they are purchased to the location where they are manufactured and then to the final consumer, every step of the process needs to be:

a) connected by public transportation;

b) connected by functional transportation;

c) connected by optimised transportation;

d) there is no correct answer.

5. Without a reliable and _____ in place, companies risk losing a lot of time and money, which could negatively impact their competitive advantage:

a) cost-effective shipping strategy;

b) price-effective shipping strategy;

c) low-effective shipping strategy;

d) there is no correct answer.

6. Shippers use package carriers for:

a) big and time-sensitive shipments;

b) small and time-sensitive shipments;

c) small and time-not sensitive shipments;

d) there is no correct answer.

7. A key factor in increasing utilisation and decreasing costs for package carriers is:

a) utilisation of shipments;

b) consolidation of shipments;

c) realisation of shipments;

d) there is no correct answer.

8. Truckload operations have some advantages:

a) relatively low fixed costs;

b) leadership systems;

c) owning a few trucks is often sufficient to enter the business;

d) there is no correct answer.

9. Less-than-truckload operators tend to run:

a) global hub-and-spoke networks that allow consolidation of partial loads;

b) regional or national hub-and-spoke networks that allow consolidation of partial loads;

c) local hub-and-spoke networks that allow consolidation of partial loads;

d) there is no correct answer.

10. LTL shipments take _____ than TL shipments:

a) same time;

b) less time;

c) longer time;

d) there is no correct answer.

11. Water transport is ideally suited for carrying:

a) large loads at low cost;

b) small loads at low cost;

c) large loads at high cost;

d) there is no correct answer.

12. Pipelines are used primarily for the transportation of:

a) crude petroleum;

b) refined petroleum products;

c) oil and gas;

d) there is no correct answer.

13. Pipeline pricing usually consists of two components:

a) a not-fixed component related to the shipper's peak usage and a second charge relating to the actual quantity transported;

b) a fixed component related to the shipper's peak usage and a second charge relating to the actual quantity transported;

c) a fixed component related to the shipper's peak usage and a second charge relating to the non-actual quantity transported;

d) there is no correct answer.

14. The intermodal transportation method is of great help to:

a) ensure hassle-off international movement of products;

b) ensure hassle-free international movement of products;

c) ensure hassle-on international movement of products;

d) there is no correct answer.

15. Intermodal transportation is fast shaping the evolving role of transportation in the supply chain and it ensures:

a) greater consistency and capacity systematisation;

b) greater consistency and capacity utilization;

c) lower consistency and capacity systematisation;

d) there is no correct answer.

16. The design of a transportation network affects the performance of a supply chain by establishing the infrastructure within which are made:

a) non-operational transportation decisions regarding scheduling;

b) operational transportation decisions regarding scheduling and routing;

c) operational transportation decisions regarding scheduling and riling;

d) there is no correct answer.

17. A well-designed transportation network allows a supply chain to achieve the desired degree of responsiveness at:

a) moderately high costs;

b) a high cost;

c) a low cost;

d) there is no correct answer.

18. The major advantage of a direct shipment transportation network is:

a) the elimination of intermediate warehouses;

b) network effect;

c) simplicity of operation and coordination;

d) all answers are correct.

19. Runs make sense when:

a) the quantity destined for each location is too small to fill a truck but multiple locations are close enough to each other that their combined quantity fills the truck;

b) the quantity destined for each location is too high to fill a truck but multiple locations are close enough to each other that their combined quantity fills the truck;

c) the quantity destined for each location is too high to fill a truck and multiple locations are close enough to each other that their combined quantity fills the truck;

d) there is no correct answer.

20. Storing product at an intermediate location is justified if:

a) the quantity destined for each location is too high to fill a truck but multiple locations are close enough to each other that their combined quantity fills the truck;

b) transportation economies require large shipments on the inbound side or shipments on the outbound side cannot be coordinated;

c) the quantity destined for each location is too high to fill a truck and multiple locations are close enough to each other that their combined quantity fills the truck;

d) there is no correct answer.

21. Runs reduce outbound transportation costs by:

a) deconsolidating small shipments;

b) consolidating small shipments;

c) consolidating big shipments;

d) there is no correct answer.

22. A primary freight supply and demand issue reveals:

a) comparative advantages;

b) locational preferences;

c) market size;

d) all answers are correct.

23. Supply chains are articulated through channels supported by logistical service providers interfacing with:

a) customers and retailers;

b) manufacturers and buyers;

c) manufacturers and retailers;

d) there is no correct answer.

24. The nature of the transport chains is used to accommodate the supply chains in terms of:

a) modes;

b) terminals;

c) freight forwarders;

d) all answers are correct.

14. SUPPLY CHAIN MANAGEMENT IN CONDITIONS OF SUSTAINABLE DEVELOPMENT

14.1. THE ROLE OF SUSTAINABILITY IN THE SUPPLY CHAIN

Each supply chain is only a small part of the world in which it resides. Ultimately, the health and survival of every supply chain and every individual depend on the health of the surrounding world. It is thus important to expand the goal of a supply chain beyond the interests of its participants (which the supply chain surplus represents) to others that may be affected by the supply chain decisions. It is in this context that the twenty-first century has seen a growing focus on sustainability [17].

The factors driving an increased focus on supply chain sustainability can be divided into three distinct categories [17]:

1. Reducing risk and improving the financial performance of the supply chain.
2. Community pressures and government mandates.
3. Attracting customers that value sustainability.

Even though there has been a great deal of talk about all three categories, most concrete action has been observed in reducing risk for the supply chain and improving financial performance. The early part of the twenty-first century has seen an increase in community pressure and government mandates in some parts of the world [17].

Sustainability in a supply chain can be viewed along three pillars – social, environmental, and economic. Major global corporations such as Walmart and Starbucks report their economic performance in their annual reports and their social and environmental performance in their global responsibility reports (also called corporate social responsibility reports) [17].

Two fundamental challenges exist in a supply chain in the measurement and reporting of the social and environmental pillars. The first challenge relates to the scope over which a category is measured. For example, considering a company that reports only on energy consumption within its own operations. If it decides to outsource some production to an offshore supplier, its own energy consumption will show a decline even though the energy consumption in the entire supply chain

may have increased. If it decides to bring some production in-house and onshore, the energy consumption within its operations will show an increase even if the energy consumption for the entire supply chain has decreased. Thus, it is important to clearly define the scope across which all metrics are measured and reported [17].

The second challenge in measurement and reporting relates to the use of absolute or relative measures of performance. An absolute measure reports the total amount of energy consumption, whereas a relative measure may report the energy consumed per unit of output. The advantage of using an absolute measure is that it reports the full impact of the supply chain along the category being measured [17].

The social pillar measures a firm's ability to address issues that are important for its workforce, customers, and society. Workforce-related factors include employment quality, health and safety, training and development, and diversity and opportunity. Customer-related factors include accurate product information and labelling, along with the impact of the product on the customer's health and safety. Social issues include human rights and the impact on local communities [17].

The environmental pillar measures a firm's impact on the environment, including air, land, water, and ecosystems. Firm activities that improve the environmental pillar can be categorized as resource reduction, emission reduction, and product innovation. Resource reduction activities result in a more efficient use of natural resources in the supply chain. When starting on its sustainability improvement journey, it is best for a firm to first focus on resource reduction activities. Whether reducing packaging material, energy use, or transportation, resource reduction activities are most likely to provide a win-win outcome that helps the environment while improving profits. Such successes can provide the momentum for more challenging sustainability activities. The push for resource reduction is likely to be aided by the increase in fuel and shipping costs [17].

As shipping costs grow, supply chain networks are likely to become somewhat more regional, helping reduce emissions from transportation. In the long run, however, the biggest benefits to society are likely to accrue when firms include the social and environmental pillars when making their sourcing decisions. The biggest challenge to social and

environmental improvements is likely to be the fact that most of the effort is local to a firm (and maybe its supply chain), whereas the benefits are more widely distributed. The tragedy of the commons and the difficulty of measuring change across the entire scope of the supply chain are likely to make real progress slow while companies continue to claim large improvements related to sustainability [17].

Opportunities for improving supply chain sustainability can be identified by matching the social (workforce, customer, society) and environmental (resource reduction, emission reduction, product innovation) pillars with the various supply chain drivers. The goal is for every firm to measure its environmental impact for each driver along each of the social and environmental categories. It is useful to discuss some of the options available to each driver [17].

Facilities tend to be significant consumers of energy and water and emitters of waste and greenhouse gases and thus offer significant opportunities for profitable improvement. Once a firm measures the direct impact of each facility in terms of energy, water, emissions, and waste, it should separate the improvement opportunities into those that generate positive cash flows and those that do not. Successful companies start by identifying and implementing the profitable projects first [17].

Transportation is another driver with which firms are likely to find several positive cash flow opportunities that improve environmental performance through resource as well as emission reduction. Any supply chain design innovation that lowers transportation costs also tends to reduce fuel consumption, as well as emissions and waste generated from transportation. As fuel costs increase in the future, firms are likely to restructure their products and supply chains to reduce transportation costs. Along with a decrease in transportation costs, these changes (such as near-shoring or onshoring) are also likely to decrease fuel use and emissions [17].

Verifying and tracking supplier performance regarding sustainability, however, continues to be a major challenge for most firms. This challenge arises, at least partially, due to the community tragedy. After all, the benefits from improved social and environmental responsibility at suppliers are shared, whereas the verification and tracking efforts are often concentrated. As a result, firms rarely put in as much effort in this regard as they should. It often requires outside activists, and third par-

ties focused on social and environmental improvement to push a company to change [17].

Good information continues to be one of the biggest challenges to the improved supply chain sustainability. The absence of standards for measurement and reporting has led to claims of improvement that are often not verifiable. In the short term, this has led to company-specific standards and an explosion of certifications and certifying agencies. Companies talk of working toward a common set of standards, but it is unlikely that such standards will emerge because incentives are not aligned across different firms. One of the biggest challenges to improved sustainability of a supply chain is changing the customer's willingness to pay for a product that is produced and distributed by a supply chain in a more sustainable manner but ends up costing more [17].

Sustainable supply chain management (SSCM), a concept deriving from the main concept of SD, refers to the integration of environmentally and socially responsible practices into the entire supply chain process, from the sourcing of raw materials to the distribution of finished products [109–111].

It aims to minimise the negative impacts of supply chain activities on the environment, society and the economy while maximising long-term value creation. SSCM is guided by various principles. Some of them are as follows [109–111]:

1) Reducing the ecological footprint of the supply chain by minimising energy consumption, waste generation and greenhouse gas emissions. It includes practices such as using renewable energy, implementing recycling and waste management programs and adopting eco-friendly transportation options.

2) Emphasising fair labour practices, human rights and social welfare, ensuring safe working conditions, fair wages and ethical treatment of workers throughout the supply chain.

3) An economic viability for all stakeholders involved, including the total cost of ownership, optimising resource allocation and improving operational efficiency to achieve cost savings and profitability.

To achieve these, greater collaboration amongst supply chain partners is needed. Transparency and information sharing may enable better decision-making, risk management and identification of improvement opportunities across the supply chain. It also involves working closely

with suppliers, customers and other stakeholders to drive sustainability initiatives [109–111].

The literature analysed in [111] presents several practices to ensure the SDGs in supply chain activities, such as green purchasing and raw material procurement, green packaging, sustainable transportation, material recycling, eco-design, green manufacturing and remanufacturing, emission reduction, training and education to the employees, leadership opportunities for women, research and innovation, cooperation with local food suppliers, water consumption reduction, monitoring of unethical behaviour in supply chains and investment in new technologies and renewable energy generation [112–113].

However, it should be noted that each company has its specific drivers, challenges and barriers and needs to find its own path and strategies to establish the SDGs in its supply chain practices. Fig. 14.1 summarises the connection between the SSCM facilitators and actors and the UN SDGs [111–113].

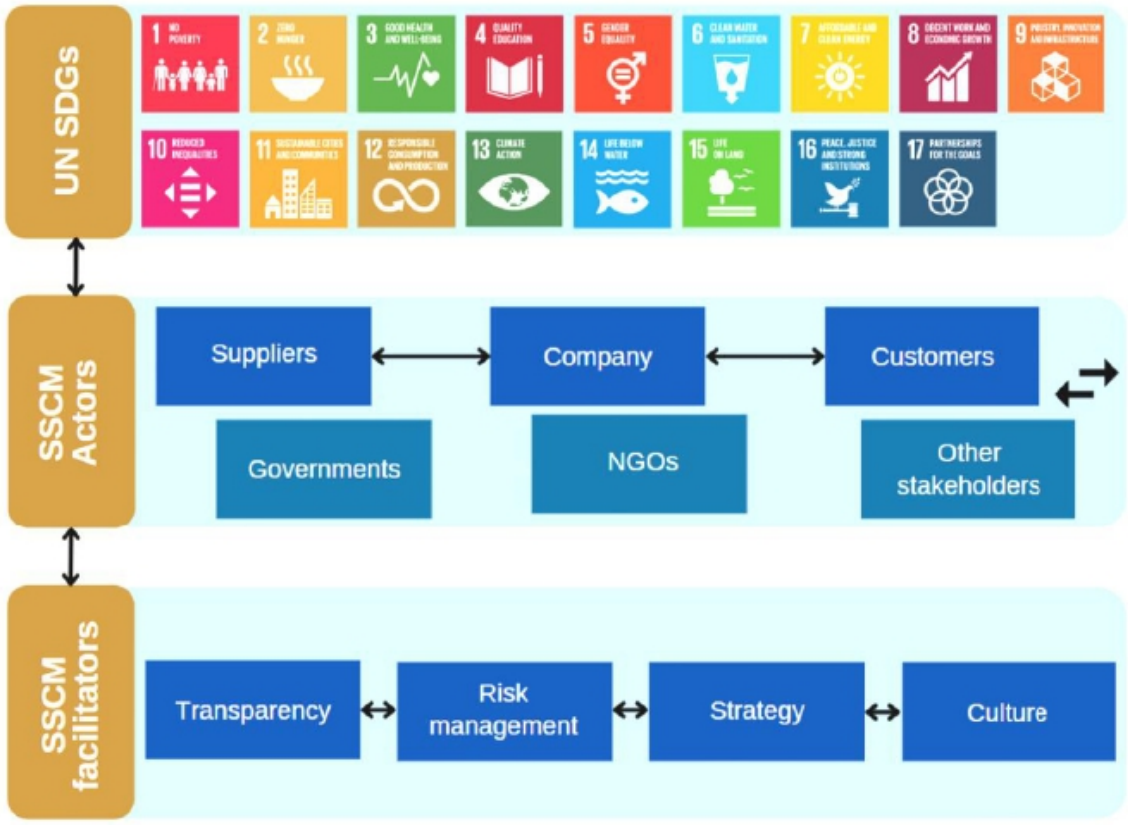


Fig. 14.1. The connection between sustainable supply chain management and the UN sustainable development goals [111]

14.2. CLOSED-LOOP SUPPLY CHAINS AND THE PRICING OF SUSTAINABILITY

One of the biggest opportunities to improve sustainability is for firms to design products that use fewer resources and can be recycled and remanufactured after use. An example of a commonly remanufactured product is retreaded tires. Retreaded tires are used in trucks, buses, heavy construction and agricultural equipment, aircraft, and passenger vehicles. Retreaded tires are cheaper to produce, and tires can be retreaded multiple times [17].

Unless they are forced to, manufacturers have typically limited their efforts to design recyclable/remanufacturable products. Even when such products have been designed, recycling rates have often been low because of the lack of customer and manufacturer effort. The absence of successful recycling and remanufacturing can be explained by the tragedy of the commons, manufacturer concerns that remanufactured products may cannibalize demand from new products, and the lack of effort from customers to return used product. The cost of a product ending up in a landfill is borne by society (until recently, it has been free for manufacturers), whereas the additional cost of recyclable products is borne by each manufacturer [17].

The fear of cannibalization of demand for new products is a major deterrent to remanufacturing. Manufacturers are concerned that sales of the remanufactured product will reduce demand for new products, thus hurting firm profitability. The impact of cannibalization depends on the presence of distinct customer segments for the product. If there are at least two distinct customer segments, remanufacturing can be used to target the lower-price segment while new products target the higher-price segment [17].

This strategy is used by tire manufacturers for truck tires, as remanufacturing allows strong brands to compete with lower-end brands without diluting the value of the new product. When there are two distinct segments, remanufacturing can help rather than hurt profits. However, when this distinction between segments is not feasible, customers are likely to be strategic and purchase the remanufactured product at a lower price, leading to cannibalization of demand for new products [17].

If a customer could be charged for pollution based on the precise cost to society, customers are likely to return recyclable products at a

high rate. The challenge, however, is that most people pay a fixed monthly fee for collection, hauling, and dumping of trash. In such a setting, people have a lower incentive to recycle [17].

Even when the right incentives are in place, the actual cost of recycling or remanufacturing has a significant impact on the extent of recycling. Much of the cost in such instances is linked to the logistics cost of collection and transportation. Consumer electronics are a classic example for which the high cost of collection and transportation hurts recycling and remanufacturing. Most of the consumer electronics are manufactured in Asia, with large consumer markets in Europe and North America. Not only is it expensive to recover used electronics from customers, but it is also very expensive to ship any recycled parts back to Asia for remanufacturing. This makes the cost high enough that remanufactured products are often not cheaper to produce than new ones [17].

Single-use cameras were one of the most successful examples of a closed-loop supply chain with remanufacturing. This was an instance in which remanufacturing was successful because all the incentives were right, and the costs were low. The cost of collection was low because customers naturally brought their single-use cameras to a retailer for printing pictures. No further incentives were needed to encourage customer returns. Manufacturers had the right incentive because remanufacturing saved the manufacturers money and there was no difference in price between a remanufactured camera and a new one. There are few other examples, however, with the same success. The right incentives for both manufacturers and customers, along with well-developed reverse supply chains, will be required for greater use of recycling and remanufacturing [17].

For individuals and firms to focus on sustainability, it is crucial that they internalize the "monetary value" of the social or environmental cost of their actions. Firms are structured to naturally account for all factors that they must pay for. Every effort is put into place to reduce these costs. For example, firms optimize the use of water based on its cost. This cost does not, however, include the impact of a water shortage on the firm as well as the surrounding community [17].

As a result, firms use more water than they would if they had to internalize the cost of future shortages on society. Similar inefficiencies exist along a variety of social and environmental factors. To improve sustainability in the supply chain, it is thus important to incorporate

suitable prices for the social and environmental impacts of different actions such as emissions. There are, however, significant challenges to setting these prices appropriately. In the context of emissions pricing, some of these challenges can be discussed [17].

Two approaches used to price emissions are a carbon tax and a cap-and-trade system. By charging for emissions, both methods encourage firms to reduce emissions per unit of output. The prices in the two cases, however, are set differently. Under a carbon tax, the price of emissions is the tax rate set directly by the regulatory authority. A carbon tax fixes the price of emissions, but the quantity of emissions is decided by the emitters. Under a cap-and-trade system, the total quantity of emissions is set by the regulatory authority and the price is set indirectly. The regulatory authority sets an overall limit on the quantity of emissions by providing allowances equal to this limit. Firms that emit less than their share of allowances can sell the surplus allowances to firms that emit more than their share. This market for allowances then yields a price of emissions. A cap-and-trade system fixes the quantity of emissions through the allowances, but the price of emissions is allowed to change [17].

14.3. A NEW PARADIGM FOR THE SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN BUSINESS OPERATIONS

As supply chains are integral to business operations, sustainable supply chain management (SSCM) can be applied when designing corporate strategy and creating practices that are environmentally and socially friendly for sustainable development [114].

This study is expected to provide understanding of the balance between society, the environment, and the economy for sustainable development. By assessing a company's long-term performance, this study investigates the impact of SSCM on overall business, leading to the appropriate management and promotion of development that is environmentally and socially friendly [114].

While existing studies have examined various aspects of SSCM, there is still a lack of research from an institution and policy perspective. This perspective is crucial for business operations under SSCM, especially in developing countries where regulations are not fully or consistently enforced. It is feasible to investigate the long-term performance of companies that implement SSCM and contribute valuable

insights to investors, public authorities, and stakeholders. The study [114] also identifies factors impacting the operation under SSCM. In this research, the data were compiled from experts in businesses through a questionnaire structured on a 5-point Likert Scale. The experts were sampled under the snowball sampling method. After obtaining the answers, the scores were then analysed using descriptive statistics and confirmatory analysis, exploratory factor analysis, factor analysis, and structural equation modelling (SEM).

To fill the academic gap, a model of sustainable supply chain management for business operations (SSCM-B) was provided. The model is expected to support the development of business towards sustainability in all relevant dimensions [114].

Sustainable development does not involve only an institution or a specific company, it also covers the collaboration between public and private sectors to create a guideline on policy and regulations for sustainable operation with a focus on long-term adjustment. Hence, the perspective of institution and policy is separately considered to emphasize the significance of policy, regulation, and organizational structure that supports and stimulates sustainable development effectively [114].

With a focus on responsibility in operations with achievable results in all perspectives of sustainable supply chain management for business operations (SSCM-B), in [114] the following hypotheses were set.

Hypothesis 1 (H1). The proposed SSCM-B model is consistent with the empirical data.

Hypothesis 2 (H2). The economic dimension correlates with the social dimension.

Hypothesis 3 (H3). The economic dimension correlates with the institution and policy dimension.

Hypothesis 4 (H4). The economic dimension correlates with the environmental dimension.

Hypothesis 5 (H5). The social dimension correlates with the institution and policy dimension.

Hypothesis 6 (H6). The social dimension perspective correlates with the environmental dimension.

Hypothesis 7 (H7). The institution and policy dimension correlates with the environmental dimension.

Based on the existing theory of SSCM that integrates sustainability with the practices in a supply chain to mitigate risks and gain trusts from

customers, this research assesses the long-term performance of a company with contributions to investors, public authorities, and stakeholders [114].

Index of Item-Objective Congruence (IOC) is a statistical method used to measure congruence between the items in the questionnaire and objectives or the preset indicators. The objectives were presented to three experts during data-assessment process to verify the quality of the questionnaire, which was the tool deployed [114].

Inferential statistics is another statistical method used in the study. It involves the analysis of SEM through exploratory factor analysis (EFA), an exploratory method to analyse data structure and group variables. It tests construct validity that is designed for unstructured data or data without predefined theory by grouping highly correlated variables into one factor. Then, the process moves to confirmatory factor analysis (CFA), which is designed to verify and confirm hypotheses and structural factors recommended by EFA or other theories. Afterwards, latent variables are considered to verify structure and correlation of the proposed variables. Thereafter, the hypothetical model is assessed of its fit with data through the Absolute Fit Index and Incremental Fit Index. The Absolute Fit Index includes CMIN/DF, RMSEA, GFI, AGFI, and RMR; where the Incremental Fit Index consists of NFI, TLI, CFI, and IFI [114].

Confirmatory Factor Analysis (CFA) on the proposed SSCM-B model shows structural correlation among the observed variables within each latent variable related to Economy (EC1–EC3), Society (SC1–SC5), Environment (EV1–EV4), and Institution and Policy (IP1–IP3). The CFA results are found to be consistent with the empirical data. To test the model's fit, the Absolute Fit Index, including CMIN/DF of 1.868 (where the value not over 3 was considered as good), indicated that the model fits well with statistical data. The Absolute Fit Index was also supported by an RMSEA of 0.047 (where the value not over 0.05 was considered as good), a GFI of 0.957 (where the value not less than 0.95 was considered as good), an AGFI of 0.929 (where the value not less than 0.90 was considered as good), and an RMR of 0.023 (where the value should be closed to 0) [114].

Furthermore, the Incremental Fit Index showed positive results. The Incremental Fit Index included an NFI of 0.965 (where the value not less than 0.95 was considered as good), a TLI of 0.976 (where the value not less than 0.95 was considered as good), a CFI of 0.983, and an

IFI of 0.983 (where the value not less than 0.90 was considered as good). Therefore, the model was concluded to be suitable for statistical data. Despite the p-value of the Chi-square being 0.000, it was considered as not statistically significant due to the characteristics of the Chi-square value being dependent on the sample size [114].

The validity test of the research instrument, the questionnaire, included the C.R. where the acceptable internal consistency of the questions or indicators within a factor should not be lower than 0.70. The convergent validity, observed from the AVE, should not be lower than 0.50. Additionally, the C.A. should not be lower than 0.7, as demonstrated in the structural model shown in Fig. 14.2 [114].

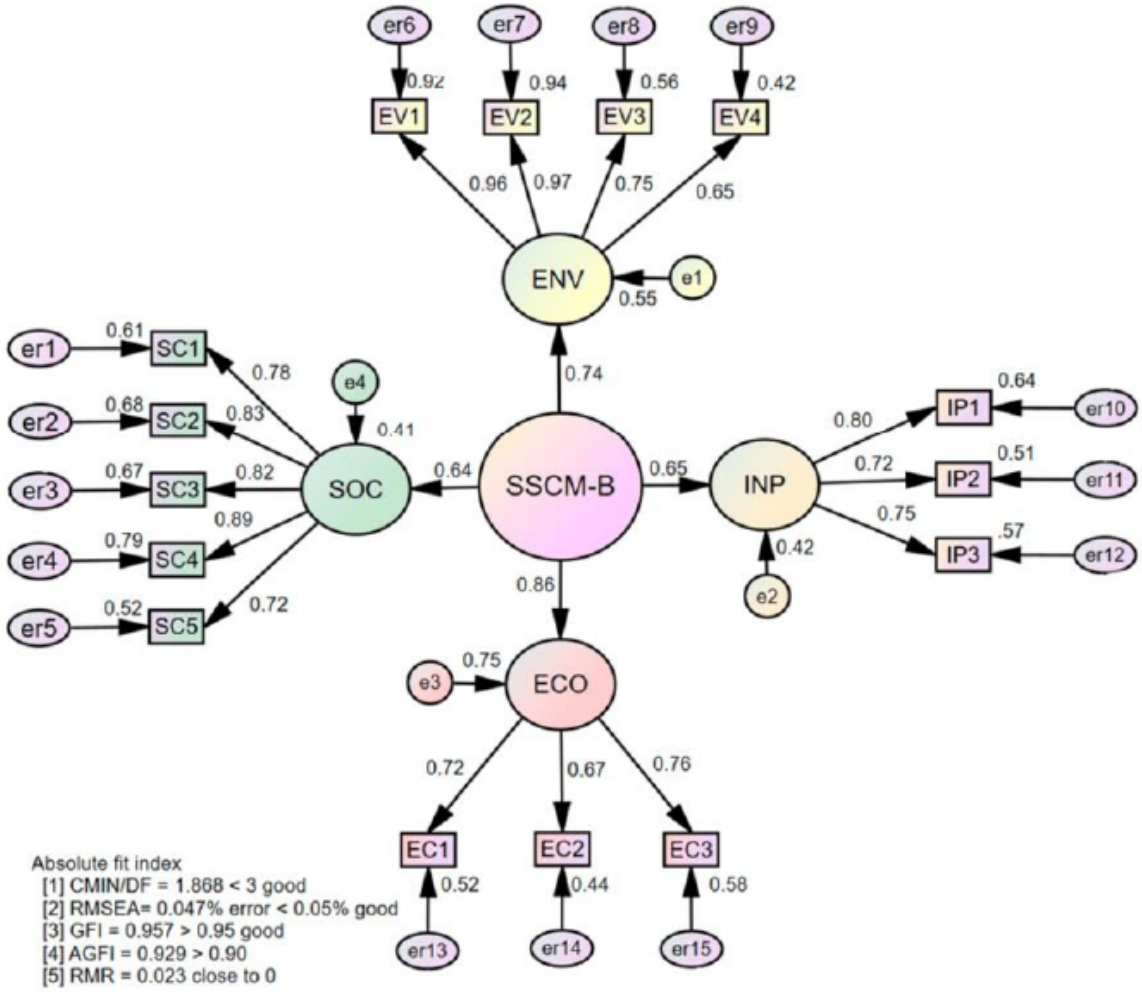


Fig. 14.2. Structural model of the SSCM-B [114]

The analysis in discriminant validity was considered on the AVE. When the AVE is greater than MSV and p-value is less than 0.01, it is considered valid. The test shows that all dimensions were correlated; therefore, all hypotheses were accepted, with the correlations among the four dimensions (economy, society, environment, institution and policy) as illustrated in Fig. 14.3 [114].

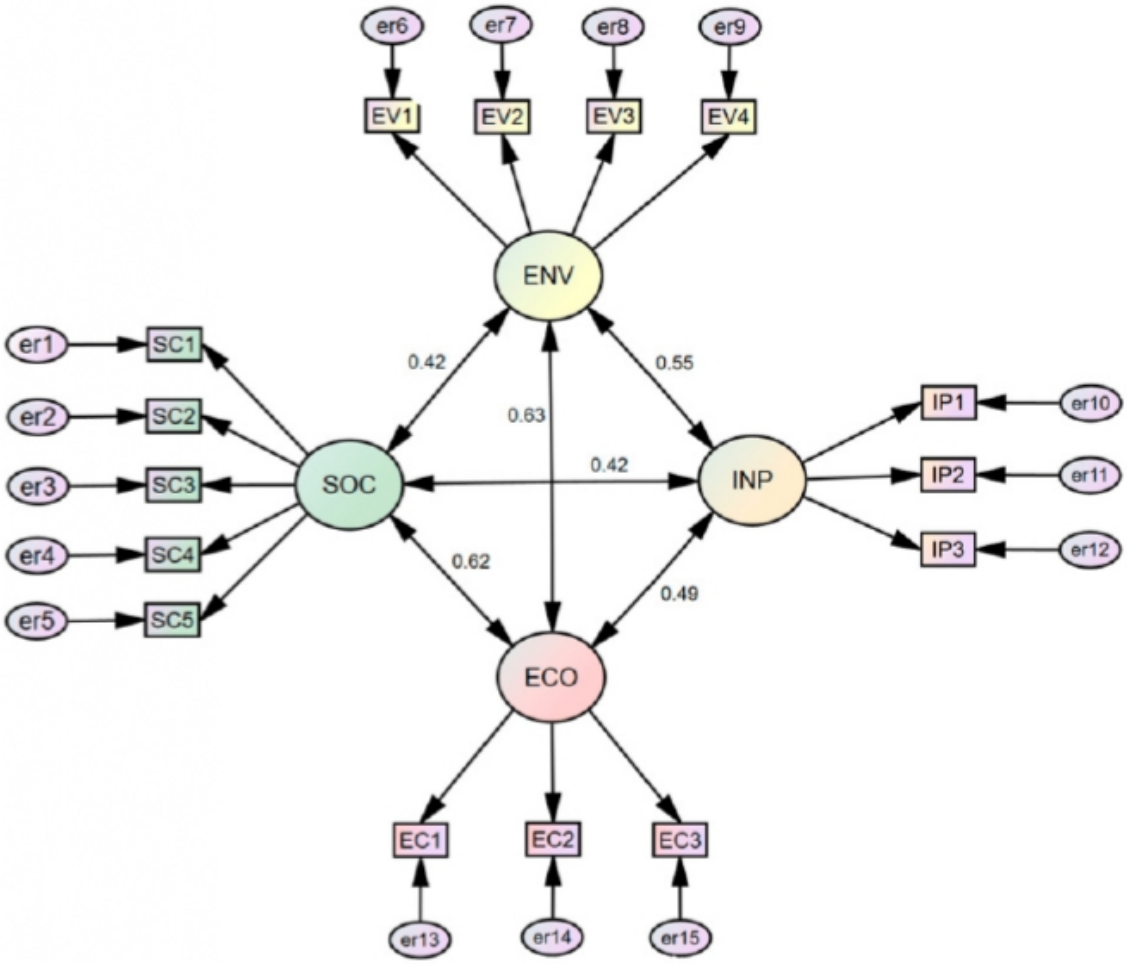


Fig. 14.3. The interrelation among the four dimensions [114]

The results indicate the acceptance of H1 to H7, which demonstrates significant correlations among the dimensions (economy, society, environment, and institution and policy) related to sustainable supply chain management in business operations. The acceptance of these hypotheses clearly shows the significance in considering sustainability from other aspects for efficient sustainable supply chain management in business operation [114].

Research [114] presents a model that considers sustainable supply chain management in business operations. Although previous research did not consider the institution and policy dimension, proposed model integrates this dimension with the other dimensions of sustainability (society, the environment, and the economy). The understanding of the complexity and correlation among these factors, provided by including the institution and policy dimension, enables businesses to operate sustainably and efficiently in the long term. The tool deployed in this study is derived from the consensus of the experts and factor analysis. The proposed model consists of 49 indicators, 15 factors, in four dimensions. The model fit, tested by SEM, shows that both the Absolute Fit Index and the Incremental Fit Index are consistent with empirical data. Subsequent checks on validity and reliability confirm that each factor in all dimensions meets the predefined criteria and aligns with the expert consensus. Finally, the correlations among the four dimensions are tested and it was found that all dimensions positively correlated to each other. Thus, a change in one dimension directly influences the other dimensions [114].

Such a study serves as a valuable resource for stakeholders, providing clarity on the complexities of sustainable supply chain management in business operations. It offers a detailed examination of influential factors across dimensions, presenting insights unexplored in the existing research. Business operators can leverage this in-depth information to tailor the indicators relevant to their organizations, and public and non-profit organizations can refer to the information to design supportive policies for private entities. For businesses, they can prioritize strategies and approaches in sustainable supply chain management in their operation [114].

The results have theoretical implications, significantly in three aspects of the concept of sustainable supply chain management in business. Firstly, a new model that includes the social perspective, the environmental perspective, the economic perspective, and the institutional and policy perspective for sustainable supply management in business operations can be used. Secondly, focus on complexities and correlations among factors in sustainable supply management was provided

with a study of the institution and policy perspective that positively enables a business to operate sustainably and efficiently. Lastly, the integrity with expert consensus was presented as it conducts factor analysis and SEM to examine model fit with real data [114].

Practically, these enhancements contribute to business operations and management in particular aspects. A business can improve its practice or implement a concept of sustainable supply chain management from the perspectives of the economy, society, the environment, and institution and policy. The development of policy and regulation for a business that is responsible to society and the environment can be carried out to be innovative in using resources and reducing impacts on the environment. A business can define or adjust its practices in supply chain management to become more sustainable using valuable results of applied researches. Provided practices may be an important resource for stakeholders in the public and private sectors to gain a better understanding of the complexities in supply chain management and sustainable practices in business operations [114].

Discussion questions

1. What is the peculiarity of expanding the purpose of the supply chain beyond the interests of its participants?
2. What are the factors that lead to increased attention to supply chain sustainability?
3. Characterise the two fundamental challenges in supply chains related to the measurement and reporting of social and environmental performance.
4. What are the main features of the sustainable supply chain management?
5. Explain the sustainable supply chain management principles.
6. Summarise the connection between the sustainability supply chain management facilitators and actors and the UN SDGs.
7. What characterises a new paradigm for sustainable supply chain management for business operation?
8. Explain the understanding of the balance between society, environment and economy for the sustainable development.

9. What are the peculiarities of selecting experts using the snowball method?

10. What is the long-term effectiveness of companies that implement sustainable supply chain management?

11. Characterise the concept of 'convergent validity'.

12. What is the characteristic of the Incremental Fit Index?

13. Explain the structural model of the SSCM-B.

14. What are the features of the analysis in discriminant validity?

Cases

1. Identify how the purpose of the supply chain can be extended beyond the interests of its participants for the selected company.

2. Determine the level of sustainability of the relevant supply chain for the option you have chosen.

3. For the selected company option, assess the feasibility of applying sustainable supply chain management.

4. Evaluate the effectiveness of the sustainable supply chain management principles in the selected company.

5. Evaluate the possibility of applying the new paradigm for sustainable supply chain management for business operation in the chosen company.

6. Determine the level of balance between society, the environment and the economy for the sustainable development in the selected company.

7. Determine the effectiveness of the snowball sampling method for assessing the sustainable supply chain in the selected company.

8. Evaluate the long-term effectiveness of the sustainable supply chain management in the chosen company.

9. Calculate the Incremental Fit Index in accordance with the methodology proposed in the new paradigm for sustainable supply chain management for business operation in the selected company.

Tests

1. Sustainability in a supply chain can be:

a) social;

b) environmental;

c) economic;

d) all answers are correct.

2. The social pillar:

a) measures a firm's ability to address issues that are not important for its workforce, customers, and society;

b) measures a firm's ability to address issues that are important for its workforce, customers, and society;

c) measures a firm's ability to address issues that are important for country;

d) there is no correct answer.

3. Workforce-related factors include:

a) employment quality;

b) health, safety, training and development;

c) diversity and opportunity;

d) all answers are correct.

4. Customer-related factors include, , but are not limited to:

a) accurate product information and labelling;

b) employment quality;

c) impact of the product on the customer's health and safety;

d) there is no correct answer.

5. Social issues include:

a) human rights;

b) the impact on local communities;

c) the impact of the product on the customer's health and safety;

d) there is no correct answer.

6. Firm activities that improve the environmental pillar can be categorized as:

a) resource reduction;

b) product innovation;

c) emission reduction;

d) all answers are correct.

7. Resource reduction activities result in a:

a) less efficient use of natural resources in the supply chain;

b) more efficient use of natural resources in the supply chain;

c) more efficient use of national economy in the supply chain;

d) there is no correct answer.

8. Opportunities for improving supply chain sustainability can be identified by matching the social (workforce, customer, society) and environmental (_____) pillars with the various supply chain drivers:

a) resource reduction, emission reduction, product innovation;

b) resource reduction, local reduction, product organisation;

c) resource localisation, emission reduction, public innovation;

d) there is no correct answer.

9. Any supply chain design innovation that lowers transportation costs also tends to:

a) increase fuel consumption, as well as emissions and waste generated from transportation;

b) reduce fuel consumption, as well as emissions and waste generated from transportation;

c) stabilization of fuel consumption, as well as emissions and waste generated from transportation;

d) there is no correct answer.

10. One of the biggest challenges to improved sustainability of a supply chain is:

a) changing the customer's willingness to pay for a product that is produced and distributed by a supply chain in a more sustainable manner but ends up costing less;

b) changing the customer's willingness to pay for a product that is produced and distributed by a supply chain in a more sustainable manner but ends up costing more;

c) changing the customer's willingness to pay for a product that is produced and distributed by a supply chain in a more sustainable manner but ends up will cost the same;

d) there is no correct answer.

11. Sustainable supply chain management (SSCM) is:

a) a concept deriving from the main concept of SD, refers to the integration of environmentally and socially responsible practices into the entire supply chain process, from the sourcing of raw materials to the distribution of finished products;

b) a concept deriving from the main concept of SD, refers to the integration of system practices into the entire supply chain process, from the sourcing of raw materials to the distribution of finished products;

c) a concept deriving from the main concept of SD, refers to the integration of local practices into the entire supply chain process, from the sourcing of raw materials to the distribution of finished products;

d) there is no correct answer.

12. Reducing the ecological footprint of the supply chain realised by:

a) maximising energy consumption, waste generation and greenhouse gas emissions;

b) minimising energy consumption, waste generation and greenhouse gas emissions;

c) losing energy consumption, waste generation and greenhouse gas emissions;

d) there is no correct answer.

13. Reducing the ecological footprint of the supply chain includes practices of:

a) using renewable energy, implementing recycling;

b) waste management programs;

c) improving operational efficiency to achieve cost savings and profitability;

d) all answers are correct.

14. An economic viability for all stakeholders involved includes:

a) the total cost of ownership;

b) optimising resource allocation;

c) adopting eco-friendly transportation options;

d) there is no correct answer.

15. The biggest opportunity to improve sustainability for firms is:

a) to design products that use fewer resources and can be recycled and remanufactured after use;

b) to design products that use more resources and can be recycled and remanufactured after use;

c) to develop products that use fewer resources and cannot be recycled and recovered after use;

d) there is no correct answer.

16. To improve sustainability in the supply chain, it is important to incorporate _____ for the social and environmental impacts of different actions such as emissions:

a) higher prices;

b) local prices;

c) suitable prices;

d) there is no correct answer.

17. Approaches used to price emissions include:

a) a carbon tax;

b) cap-and-trade system;

c) local prices system;

d) there is no correct answer.

18. Under a carbon tax:

a) the total quantity of emissions is set by the regulatory authority and the price is set indirectly;

b) the price of emissions is set by the regulatory authority, but the quantity of emissions is decided by the emitters;

c) the price of emissions is the tax rate set directly by the regulatory authority;

d) all answers are correct.

19. Under a cap-and-trade system:

a) the total quantity of emissions is set by the regulatory authority and the price is set indirectly;

b) the price of emissions is the tax rate set directly by the regulatory authority;

c) the price of emissions is set by the regulatory authority, but the quantity of emissions is decided by the emitters;

d) there is no correct answer.

20. Sustainable development does not involve only an institution or a specific company, it also covers the collaboration between _____ sectors to create a guideline on policy and regulations for sustainable operation with a focus on long-term adjustment:

a) public and private;

b) non-public and private;

c) public and co-operative;

d) there is no correct answer.

21. The Index of Item-Objective Congruence (IOC) is:

a) an economy method used to measure congruence between the items in the questionnaire and objectives or the forecast indicators;

b) a statistical method used to measure congruence between the items in the questionnaire and objectives or the preset indicators;

c) an economy method used to measure congruence between the items in the questionnaire and objectives or the less indicators;

d) there is no correct answer.

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