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Supply chain management in the course of time - A systematisation of past, present and future objectives

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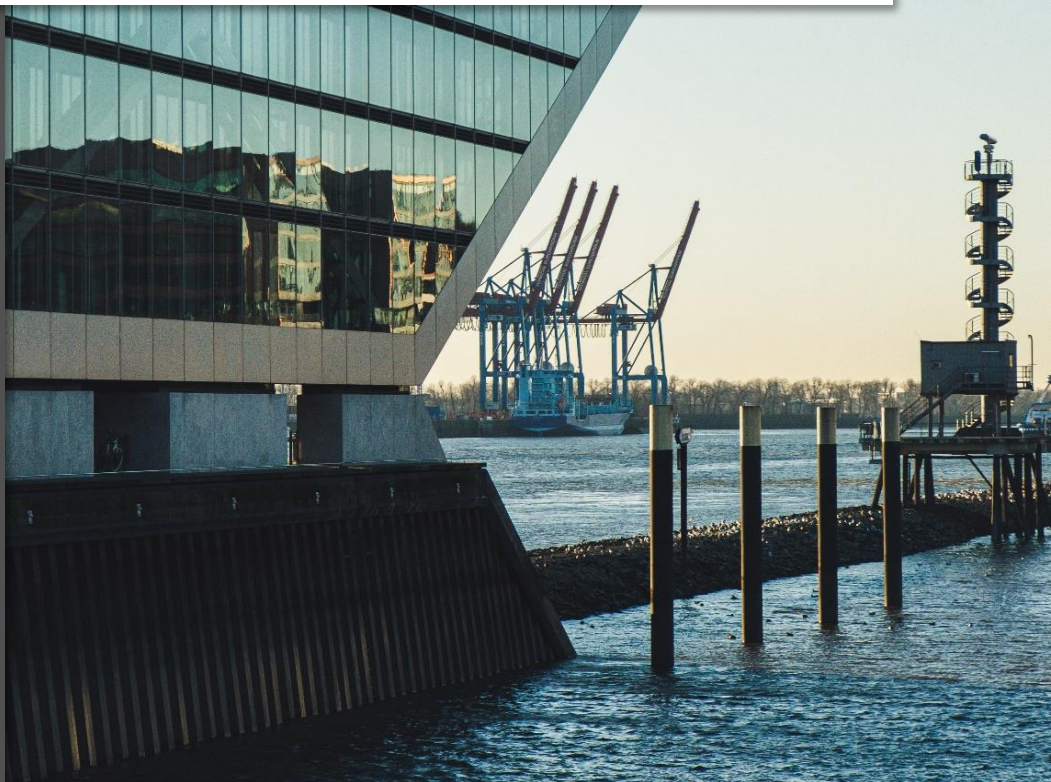
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Anna-Maria Nitsche, Wibke Kusturica, Denis Neumann, Christian-Andreas Schumann, and Christoph Laroque

Supply Chain Management in the Course of Time – A Systematisation of Past, Present and Future Objectives



Supply Chain Management in the Course of Time – A Systematisation of Past, Present and Future Objectives

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Purpose: *Supply chain management (SCM) has undergone a transformation since its origins in the 1990s as ecological considerations have influenced SCM goals in recent years. This systematic literature review of a preliminary sample of 2,471 publications aims to show how target design has changed over time.*

Methodology: *The systematic literature review is based on Tranfield et al. (2003) and Denyer and Tranfield (2009). Following extraction from the Scopus database and multiple screenings, the top 100 academic publications with the highest yearly average citations from the periods 1996 to 2000 and 2016 to 2020 are included in the analysis.*

Findings: *To highlight similarities and differences, the current and initial goals of SCM are assigned to one of the sustainability dimensions: ecological, economic, social. By comparing the publications at the time of the initial emergence of SCM and the current period, a significant shift in the main objectives of SCM could be derived.*

Originality: *This compact structured analysis and discussion of the change in SCM objectives helps to comprehend past developments, to understand current challenges, and to assess future trends. Furthermore, the comparison of the two periods provides a unique perspective on the development of the research field of SCM.*

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1 Introduction

Supply chain management (SCM) is an important part of business operations (GEODIS, 2017) as the alignment between business objectives and SCM has great potential to improve overall company performance. In a global survey, 77 % of companies acknowledged the importance of supply chains as they devote 5 % of their total turnover to SCM (GEODIS, 2017). A well-managed supply chain also incentivizes social and environmental factors (Jermisittiparsert et al., 2019, Mangla et al., 2018). At a time when climate change issues are becoming increasingly important, there is pressure on supply chains to reduce their carbon footprint (Taleizadeh et al., 2019). Government policies are also increasingly focusing on companies and their supply chains and directly addressing them to integrate economic, environmental and social sustainability into their activities (UN, 2015). This shift in social values is reflected by the fact that companies with sustainable goals experience the most pressure from governments, mass media and their own executives, followed by consumers and investors (Bateman, 2020).

Due to current developments and the ever-increasing pressure on companies, the goals of SCM have changed from its beginnings, in the 1990s, to today. This change in values can partly be explained by the substantial influence companies have on the ecological and social environment. A comprehensive systematic overview of the development of SCM objectives over time can accelerate the related discussion and add clarity and richness to this research field. However, previous literature reviews often focus on specific periods (e.g. Kannan et al., 2020), restricted sustainability dimensions (e.g. Jabbour and De Sousa Jabbour, 2016) or certain geographic regions (e.g. Jermisittiparsert et al., 2019). Thus, the purpose of this article is to provide a systematic overview of the existing comprehensive body of literature of SCM objectives and to discuss how economic, ecological and social goals have changed over recent decades. The research question derived from this purpose reads as follows: "How has the target design of SCM changed over the years?".

This systematic literature review finds that total cost reduction remains a central goal of SCM as supply chains have become longer and more complex. In addition to this relevant economic aim, SCM is increasingly oriented on customers' and society's values,

especially environmental and social sustainability. Prominent examples of social and environmental goals include circular supply chains, the reduction of carbon emissions, the reuse of materials, and improving cooperation and networking along the supply chain through the application of information and communication technologies. This paper thus highlights the importance of green economy and the social dimension for the research landscape, provides a useful concept matrix for benchmarking purposes, and offers helpful incentives and potential future research directions.

2 Methodology of the Systematic Literature Review

As the purpose of this article is to provide a systematic overview of the existing comprehensive body of literature of SCM objectives and to discuss how economic, ecological and social goals have changed over recent decades, this paper follows the systematic five step approach developed by Denyer and Tranfield (2009) (see Figure 1). The development and objectives of SCM are categorised according to the three sustainability dimensions: economic, ecological and social sustainability (WCED, 1987).

- Question Formulation

Due to the current interest and the long-lasting change in SCM research, this paper attempts to compare the current objectives of SCM with the original objectives of the 1990s to identify similarities and differences between these two periods: "How has the target design of SCM changed over the years?".

- Selection of Database and Definition of Search Strings

For this review, the Scopus database is chosen due to its comprehensiveness (Adriaanse and Rensleigh, 2013). The applied search string aims to identify articles related to SCM or supply chain in combination with the keywords "objective", "goal(s)" or "target".

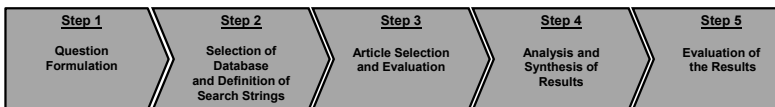


Figure 1: Systematic literature review approach (based on (Denyer and Tranfield, 2009))

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The search in February 2021 was limited to the subject areas Engineering, Business, Management and Accounting, Environmental Science and Decision Sciences. In addition, the query was limited to the periods 1996 to 2000 and 2016 to 2020 to provide an overview of the beginnings of SCM, when the first SCM models were developed, in contrast to the current focus of SCM research. For instance, the Supply Chain Operations Reference (SCOR) model and the supply chain modelling approach by Bowersox were first presented in 1996 (APICS, 2017, Bowersox and Closs, 1996). The resulting number of articles is 2,471, of which 104 have been published between 1996 and 2000 and 2,367 during the second period from 2016 to 2020.

- Article Selection and Evaluation

Prior to the two-stage article selection and evaluation step, the top 100 most-cited publications on an annual average in both periods are identified. The following inclusion criteria are applied for the title and abstract screening of this sample of 200 articles to restrict the wide-ranging thematic research field of SCM to the topic of this literature review: publication date 1996 to 2000 and 2016 to 2020, thematic focus on SCM. The accepted articles are subsequently reviewed in a full-text screening using the following criteria: full-text accessibility, thematic focus on SCM objectives. Applying these criteria reduces the total to 34 articles, of which 15 are from 1996 to 2000 and 19 papers are from 2016 to 2020. Further search strategies such as reference tracking result in the addition of another four sources to the analysis sample. The search and evaluation process is depicted in Figure 2.

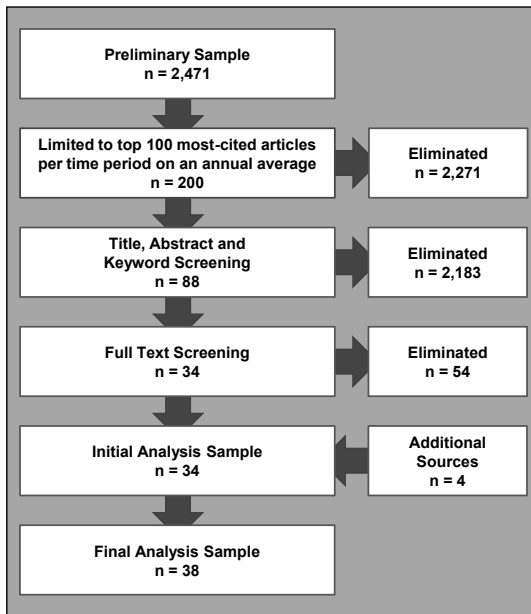


Figure 2: Overview of the article screening process

- Analysis and Synthesis of Results

First, a descriptive analysis based on the author keywords of all 2,471 articles from the preliminary sample is conducted to enable an overview of the main SCM research streams' development over time. Then, a thematic analysis using the 38 identified core publications is performed, and the findings of the literature review are synthesised to identify similarities and differences within and between the two periods under consideration. Since the different goals of SCM are interrelated, a clear assignment of certain articles to specific dimensions was not possible and the findings are included in all relevant dimensions.

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- Evaluation of the Results

The findings of the descriptive and thematic analysis as well as the discussion of theoretical and practical implementations are structured within a concept matrix according to the three sustainability dimensions and suitable identified sub-dimensions.

3 Presentation of the Findings

3.1 Descriptive Analysis

The descriptive analysis uses the software VOSviewer (Van Eck and Waltman, 2010) and includes all 2,471 articles of the preliminary sample. The analysis uses the author keywords to provide an overview of the main research streams from 1996 to 2000 (Figure 3) and 2016 to 2020 (Figure 4).

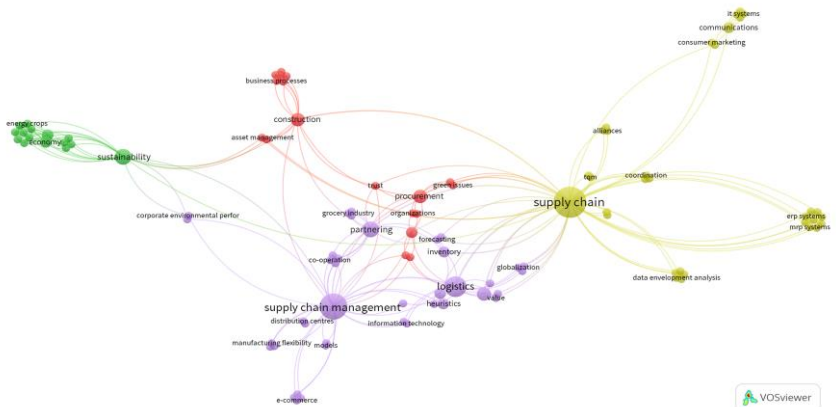


Figure 3: Author keywords cluster map 1996 – 2000

In the first period most articles deal with the topic of SCM, supply chain and logistics. This is in line with the statement that traditional SCM has evolved from logistics (Wisner and Tan, 2000). Sustainability plays a distant role and is not as important as the logistics branch (Ofori, 2000). Supply chains and their management seem to be mainly concerned

with the procurement side and only few research papers address the communication to the customer.

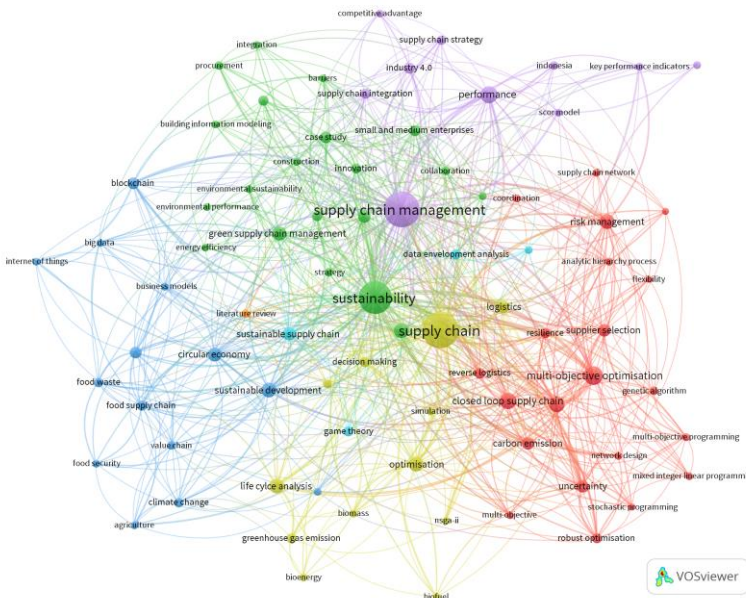


Figure 4: Author keywords cluster map 2016 - 2020

In the second period, the number of articles is significantly higher and there are more than 6,000 different author keywords. To improve visibility and clarity, only keywords that appear more than eleven times are included. Compared to the first period, research around SCM has grown substantially and the research field has become broader. Second, sustainability has gained a lot of importance in recent years (Gupta et al., 2019). Additional novel research fields include new information and communication technologies, supply chain optimisation, risk management and circular economy.

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3.2 Thematic Analysis

3.2.1 Overview of the Thematic Analysis

To highlight the economic, ecological and social goals of SCM, the findings are structured within a concept matrix according to Webster and Watson (2002) (Table 1). The sub-dimensions indicated in the table are derived from the iterative reading of the sample publications.

Table 1: Concept matrix SCM objectives

	TP		EcD	EnD			SoD			
	TP1	TP2	Ec	En1	En2	En3	So1	So2	So3	So4
Akkermans et al. (1999)	x		x							x
Anderson and Katz (1998)	x		x					x		
Badi and Murtagh (2019)		x		x	x	x				
Bateman (2020)		x	x	x	x	x	x	x	x	x
Beamon (1998)	x		x		x		x	x	x	

	TP		EcD	EnD			SoD			
	TP1	TP2	EC	En1	En2	En3	So1	So2	So3	So4
Caldwell and Down (1997)	x									x
Chen et al. (2017)		x	x			x				x
Chuang and Shaw (2000)	x		x				x			x
Desbarats (1999)	x						x			x
GEODIS (2017)		x	x	x	x	x	x	x	x	x
Gupta et al. (2019)		x	x			x				x
Hosseini and Khaled (2019)		x						x		
Jabbour and De Sousa Jabbour (2016)		x		x	x	x				x

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	TP		EcD	EnD			SoD			
	TP1	TP2	Ec	En1	En2	En3	So1	So2	So3	So4
Varsei and Polyakovskiy (2017)		x	x		x					x
WCED (1987)	x	x	x	x	x	x	x	x	x	x
Wisner and Tan (2000)	x							x		x
Wyatt et al. (2000)	x					x				
Zhang and Yousaf (2020)		x				x				x
Zhen et al. (2019)		x	x		x					

TP = Time Period, EcD = Economic Dimension, EnD = Environmental Dimension, SoD = Social Dimension, TP1 = 1996–2000, TP2 = 2016–2020, Ec = Total Cost Reduction, En1 = Green Procurement, En2 = Green (Reverse-) Logistics, En3 = Green Design, So1 = Customer Satisfaction, So2 = Supplier Selection, So3 = Communication, So4 = Green Human Resources

As illustrated in the descriptive analysis, there are numerous publications dealing with optimization problems. The thematic analysis furthermore shows that a main objective of SCM was and is cost optimization. This is also reflected in the findings of a global survey

from 2017 (GEODIS, 2017). As the analysis shows, inventory, transport and storage costs are the biggest cost drivers. So it is not surprising that optimizing and reducing these costs are in practice two of the top goals in SCM (GEODIS, 2017). Sarkar et al. (2019) also consider that transport and storage costs have a significant impact on the maximization of supply chain profit.

We find that sustainability has become more important over the course of time. First and foremost, publications mostly deal with carbon emissions. It is therefore surprising that research and practice assign different preferences to the goal of reducing the carbon footprint. Companies put this target in the 15th position (GEODIS, 2017). A more recent survey from 2020, which focused only on sustainability, found that carbon emissions were ranked sixth among sustainability objectives (Bateman, 2020).

This review shows that sustainability involves environmental, economic and social dimensions. Other goals addressed in the ecological dimension are more environmentally friendly purchasing and logistics. Green design is gaining attention in today's research landscape and in business as well, because redesigning supply chain processes can achieve significant energy and water savings and reduce waste and end-of-life products. For example, Taleizadeh et al. (2019) consider the growing number of end-of-life products as one of the most damaging effects.

In the social dimension, customer satisfaction took a central role then as it does now, which is transferred to the entire SCM. This also reflects the objective of the companies, which see reaction speed, responding to customer expectations and quality as well as shortening delivery times to the customer as major challenges (GEODIS, 2017). Jermisittiparsert et al. (2019) see SCM as a key element in satisfying customers and reducing delivery times.

One objective that has become significantly more important in recent years is the transparency of the entire supply chain. Only 6 % of companies state that they have an overview of the entire supply chain (GEODIS, 2017). This goal includes many of the sub-goals mentioned in the previous section and the mutual reporting of the entire flow of finances, materials and information. Collaboration based on trust and a shared perception is the first step towards this goal. As already seen in the descriptive analysis, new information and communication technologies play a role in SCM. This is based on

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ensuring the continuous flow of information within the supply chain, and data management and analysis have an immense impact on success. At the same time, implementation supports the agility and transparency of the entire supply chain (Mangla et al., 2018).

The term green human resources is slightly misleading but illustrates that research focuses too much on 'green' areas and does not consider all three dimensions of sustainability as a whole. Nevertheless, the field of human resources is an underestimated factor in publications as employees also advocate for a more sustainable workplace and put pressure on their company (Bateman, 2020). Jabbour and De Sousa Jabbour (2016) also acknowledge the relevance of the human factor and emphasize its consideration in the ecological transformation.

In the research landscape, it is essential to know the difference between Green Supply Chain Management (GSCM) and Sustainable Supply Chain Management (SSCM). While GSCM addresses the impact of supply chains on the natural environment, in other words the environmental dimension, SSCM also deals with the economic and social dimensions of sustainability (Badi and Murtagh, 2019). While interest in GSCM has increased due to environmental concerns, in today's economy the full range of sustainability plays a more important role, especially as the social dimension has greatly increased in value.

3.2.2 Discussion of the Economic Dimension

In the 1990s, the economic goals were the central determinants for the objectives of SCM since the price was the primary incentive for the customer to buy and thus the greatest competitive advantage could be acquired (Narasimhan and Jayaram, 1998). That's why cost reduction was one of the guiding goals of SCM, in addition to customer satisfaction and improved reaction speed (Lockamy III et al., 2000). This is one of the first major differences between the beginnings of SCM and its current situation: in the past companies competed with each other, today the competition is mainly between entire supply chains (Chen et al., 2017).

The conflict of objectives between individual costs and total supply chain costs was discussed intensively in the past (Beamon, 1998), and this area of tension is still

addressed today (Chen et al., 2017), but seems to be generally accepted and is rarely addressed in publications. By shifting focus away from the traditional approach to considering the total cost of the entire supply chain, companies have permanently changed how and what they buy. Removing the two-way win-lose perspective allows companies to create a win-win relationship for the entire system. As a result, significant cost reductions and profit increases are obtainable for the entire supply chain (Anderson and Katz, 1998, Spekman et al., 1999).

Successful supply chain managers focused on reducing total delivery costs (Spekman et al., 1999). Lockamy III et al. (2000) also consider transportation costs to be the main cost in the supply chain, but break down total supply costs into factory, logistics and transportation costs. Other researchers (e.g. Sarkar et al., 2019) still consider transportation, inventory and warehousing costs as the most expansive costs of all SCM activities which need to be reduced (see Figure 5). This overarching view means that not only one's own profitability plays a role, but also the economic situation of the entire supply chain and the entire financial flow (Anderson and Katz, 1998). Today, costs still play a role in the supplier selection process, but now environmental and social criteria play a bigger part than in the past (Tirkolaee et al., 2020).

In modern supply chain total cost considerations, the difference between fixed and variable costs plays an important role. The variable costs are of key importance as they are directly related to the ecological objective (Taleizadeh et al., 2019, Varsei and Polyakovskiy, 2017). This again illustrates the above-mentioned conflict between the ecological and social objectives versus the economic aspects. Additional investments and the use of cost-intensive technology reduce carbon emissions (Zhen et al., 2019), provide more job satisfaction and safety for employees and improved communication with customers (Taleizadeh et al., 2019).

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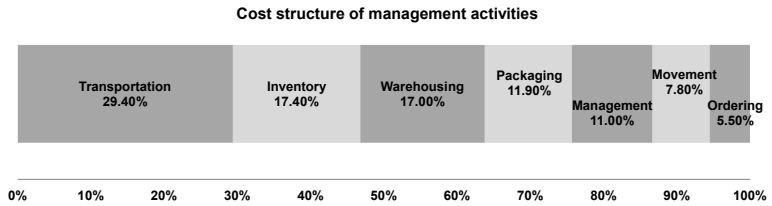


Figure 5: Cost structure of management activities (based on Sarkar et al., 2019)

Another way towards total costs reduction is proposed by Chen et al. (2017) who address the distribution of power within the supply chain. A balanced distribution of power between producers and traders assures the best economic performance (Chen et al., 2017). During the emergence of SCM, the overarching economic goal was to develop improvements that reduce the total cost of the supply chain without sacrificing customer and trading partner satisfaction (Lockamy III et al., 2000, New, 1997). This is in line with the findings of Jermstittiparsert et al. (2019) who considered logistics a core task for SCM. Despite the fact that today's supply chains are larger and more complex (Namdar et al., 2018), and the environmental dimension is included in the total cost by a large margin (Tirkolae et al., 2020), effective SCM still aims to satisfy customer demand in full while minimising the cost of the activities across the supply chain process (Jermstittiparsert et al., 2019).

3.2.3 Discussion of the Environmental Dimension

In the late 1990s, there was a growing environmental awareness among companies, which has become more and more important over the years until today. With increasing government regulation and greater public interest in environmental responsibility, companies realised that they could not ignore environmental issues. However, SCM was preoccupied with reducing costs and better serving customer needs. These two trends were in conflict at that time, which is why the economic goal was preferred over the environmental one for the time being (Ofori, 2000).

The construction industry, which requires long-lasting products, can be described as a

pioneer in retrospect. According to Wyatt et al. (2000), the supply chain of this industry has a strong negative impact on the environment. Therefore, this industry was especially interested in addressing environmental issues and goals at an early stage. The redesign of the supply chain was based on the long product life cycle and the reuse of components or materials was integrated into the product and production design. These concerns from back then are exactly what can still be found in the construction industry today and are also being transferred to other supply chains (Badi and Murtagh, 2019).

Nowadays, criteria such as minimising waste, emissions or risks, along with reducing resource consumption and maximising net profit, are included in the decision-making process (Taleizadeh et al., 2019). The implementation of these ecological considerations in traditional SCM creates important activities that should be implemented in a company: green purchasing, green (reverse) logistics and eco-design (Jabbour and De Sousa Jabbour, 2016, Jermisittiparsert et al., 2019).

Green purchasing had already been a relevant idea in the past and the focus was to reduce, reuse and recycle materials. As the foundation of any sustainable value chain, purchasing requires special attention and cooperation between different companies in the supply chain. The green purchasing approach ensures that only goods that meet the attributes of ecology, which include recyclability, reusability and the use of non-toxic materials, are procured (Somjai and Jermisittiparsert, 2019).

Another goal of SCM is to implement environmentally responsible and resource-saving logistics across the entire supply chain. This is characterised by low impact on climate and environment, pollution, noise and accidents in the fields of transport, warehousing, management and handling (Jermisittiparsert et al., 2019). However, research previously focused only on the addition of reverse logistics to the existing logistics system (Beamon, 1998). Transport and warehousing have a decisive influence on the ecological dimension. The goal of logistics is to create an optimised shipping plan that balances the discrepancy between the carbon emissions and the profit target.

Sarkar et al. (2019) find that multiple use of transport packaging has a major positive impact on transport costs and environmental impact. The design of environmentally friendly packaging goes hand in hand with other aspects of green design (Somjai and Jermisittiparsert, 2019). Self-healing and reusable packaging is a solution in this respect

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(Sarkar et al., 2019). So-called end-of-life products should be eliminated as products must be designed to be either reusable or repairable (Taleizadeh et al., 2019). The aim of product and production redesign is to avoid toxic ingredients, optimise the use of resources and ensure easy repair, recyclability and disassembly of equipment and products (Jabbour and De Sousa Jabbour, 2016).

Eco-design or green design involves not only the redesign of products, but the reengineering of the entire supply chain processes (Zhen et al., 2019). Redesign focuses on reducing the energy and resource consumption during the production process, transport and usage (Jabbour and De Sousa Jabbour, 2016). The environmental objective of today's SCM is concerned with greening all activities in the supply chain and between its parties, from production to delivery and reuse of products, to be cost-effective and efficient (Jermstittiparsert et al., 2019). So-called closed-loop chains are circularly designed supply chains that seek that value is created and recovered during the entire product life cycle (Gupta et al., 2019).

3.2.4 Discussion of the Social Dimension

The most important social goals of the 1990s are the timely fulfilment of customer orders, the related customer satisfaction and a fast reaction speed of the whole supply chain on market events (Lockamy III et al., 2000). Customers represent the starting point for all internal and cross-company activities. This great influence and the competitive advantage generated by high customer satisfaction mean that the customer's values have a great influence on the further objectives of SCM, which must be oriented towards the customer (Narasimhan and Jayaram, 1998).

Strategic sourcing, which describes the development of supply channels at the lowest total cost, has a direct positive effect on the goals of reliability, flexibility, cost and quality, which had a positive effect on customer satisfaction (Beamon, 1998, Narasimhan and Jayaram, 1998). More consumers are demanding environmental responsibility from companies and supply chains, so that low prices alone are no longer enough (Masi et al., 2017). This also includes maintaining social justice within a supply chain and avoiding conflicts (WCED, 1987). Supplier selection has a direct influence on costs, quality and reliability. A long-term view, shared beliefs and goals are required for a beneficial

cooperation, so the selection of partners is an important task of SCM (Akkermans et al., 1999, Desbarats, 1999). The opinion that supplier performance has a direct influence on costs, quality and delivery is still shared today. As in the past, cost, quality and delivery reliability are relevant, but in recent years sustainability has become another important factor in supplier selection (Tirkolaee et al., 2020). New environmental factors include pollution, resource consumption and waste, as well as social criteria such as workers' rights, number of employees, health and safety of employees (Kannan et al., 2020, Tirkolaee et al., 2020).

Building mutual trust and effective communication between members of the supply chain is a complex task of SCM. Implementing an end-to-end SCM can only be successful if all parties are willing to cooperate intensively and inform each other about their business operations and exchange information about their business plans and processes. Involving suppliers in the product development process can also have a positive impact, not just on the social climate, but also on the overall costs of the supply chain (Wisner and Tan, 2000, Ofori, 2000). Good communication between all parties in the supply chain is an objective pursued then and now. In addition to the flow of materials, the flow of information also plays a crucial role in SCM (Beamon, 1998). To generate a competitive advantage from the flow of information, it is necessary to establish communication within the supply chain using and constantly improving it with the help of new information technologies (Spekman et al., 1999, Ofori, 2000). Response time is one of the most important elements of the social goals of SCM (Wisner and Tan, 2000), which can be greatly reduced through the use of new technology.

With today's approach towards circular supply chains and enforcing green activities, collaboration across organisational borders is more important than ever. There is a need for partners upstream and downstream to work together to allow practices such as product take-back, reuse and recycling (Masi et al., 2017).

SSCM leads to long-term benefits in building effective communication and removing barriers of communication. Traditional supply chains are characterised by a forward flow of materials and a return flow of information (Beamon, 1998). In today's fast-paced world, where decisions must be made in real time to gain a competitive advantage, the flow of data and the analysis of information are of special importance (Tirkolaee et al.,

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2020). In the information age, knowledge is considered a valued resource on which decisions and changes are made. Therefore, at each point of the supply chain, data is collected, analysed and distributed across the supply chain. A lack of adequate data leads managers to make wrong decisions, so the entire supply chain must be technically connected (Gupta et al., 2019). These actions need to be well coordinated through effective management so each party knows what needs to be done (Chen et al., 2017). For this reason, SSCM relies on active and continuous communication to ensure transparency throughout the supply chain (Jermisittiparsert et al., 2019).

Few articles cover green human resources, although educating all members on relevant environmental issues leads to greater employee engagement in sustainability management (Teixeira et al., 2016). To implement green practices there is a need for support from higher levels of management and human resources. A green corporate culture can only be successfully integrated through the participation of all parties (Jabbour and De Sousa Jabbour, 2016).

The objective of harmony between sustainable social goals and ecological goals, which are in conflict with the economic dimension, becomes obvious (Varsei and Polyakovskiy, 2017). For example, a positive social impact on the region is the creation of jobs. The capacities of recycling, reprocessing or disposal departments would be expanded. Investments in product and production design also support social goals by improving the health, safety and job satisfaction of employees and reducing the risk of customer injury from the product (Taleizadeh et al., 2019).

4 Conclusion, Implications and Limitations

The purpose of this paper is to compare the objectives of SCM during its early years with today's and to provide an overview of the current focus of the research field. We find that a key goal of SCM remains total cost reduction as supply chains have become longer and more complex, which has also made this task more multifaceted and costly. Society's values have shifted towards environmental and social sustainability, which is also reflected in companies' goals. This means that SCM is increasingly oriented on the customer and society's values. The environmental dimension has changed the most. Due

to the emergence of environmental issues, these dimensions have evolved from a peripheral issue to a central issue in SCM. Environmental sustainability is now the guideline for supply chain design. The development from a linear supply chain towards a circular form is apparent and will become more relevant in the coming years. In this context, the reduction of carbon emissions plays a lesser role than the environmentally friendly use of resources and the reuse of materials. As social objectives and sustainability are currently playing the biggest role in SCM activities, not only do external factors such as customer satisfaction matter, but there is also an internal call for more social sustainability. New information and communication technologies are an essential part of improving cooperation and networking along the supply chain.

This literature review provides several implications for research and practice. First, it highlights the importance of green economy and the social dimension for the research landscape. Second, circular economy as well as the advancement of the transparency of the entire supply chain are identified as potential future research directions. Third, organisations and supply chain managers can use the provided concept matrix for benchmarking purposes along all processes. Fourth, global social change movements impact future SCM and this review thus offers helpful incentives.

Despite the systematic approach and comprehensive literature search, this literature review is limited by the use of only one literature database. Furthermore, the representativeness of the findings is reduced by the decision to analyse only the top 100 most cited publications in each period.

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