Universität Bremen
Fachbereich Wirtschaftswissenschaft | FB7

Publication series of Professorship for Global Supply chain Management

Chair Holder: Prof. Dr. Aseem Kinra

An analysis on

Supply Chain Performance Measurement

Berg, Carina; Kern, Marina; Pham, Lan Jie; Schlemermeyer, Gesa

Year 2020

Supervisor: Prof. Dr. Assem Kinra | Debarshee Bhardwaj

Table of Contents

List of Figures

List of Tables

List of Abbreviations

GCS	Global Citation Score
LCS	Local Citation Score
SC	Supply Chain
SCM	Supply Chain Management
SCP	Supply Chain Performance
SCPM	Supply Chain Performance Measurement

1 Introduction

1.1 Problem Situation

In today's business processes it has been stated, that a successful supply chain (SC) is a key factor to increase the company's productivity and profitability and consequently leads to a competitive advantage (Gunasekaran et al., 2004, p. 333; Holmberg, 2000, p. 847). This leads to the conclusion that supply chain performance (SCP) needs to be measured to achieve success (Gunasekaran et al., 2001, p. 1). The importance of performance measurement for the success of companies has also been emphasized by Santos (2002, p. 1246). Performance measurement is necessary for implementing and realizing strategic goals and further informs the decision makers at the operational, tactical and strategic level (Guanasekaran and Kobu, 2007). In order to maintain the competitive advantage, SCs need to be monitored and underly continuous improvements. Because of these reasons performance measurement and metrics are needed to support the SCP improvement (Hausman, 2002, p. 62).

Through the increasing importance of SCP improvement, different metrics have been examined and developed in the scientific research. As a consequence, a great amount of different kind of metrics have been evolved, including insufficient metrics and a lack of appropriate metrics (Holmberg, 2000, p. 851–852; Parker, 2000, p. 63–64). Bagchi (1996) identifies 28 metrics, which are categorized in time, quality, cost and diagnostic measures. Gunasekaran et al. (2001) focuses on 18 metrics and links them to the SC activities: plan, source, make/assemble and (customer) delivery. Gunasekaran et al. (2005) suggests 28 performance metrics in new enterprises. Griffis et al. (2004, p. 98) summarize ten metrics, that have been identified as the "most commonly recommended logistics performance measures". Beamon (1999, p. 281–284) provides exemplary metrics and links them to resources, output and flexibility. Hausman (2002, p. 67–69) classifies the metrics in service, inventory and speed. Furthermore, Gopal and Thakkar (2012, p. 521–522) provide a list, that shows how SCP can be measured in diverse ways.

The provided insight into the different metrics shows its broad extent and the differences in its approaches, which makes it difficult to get an overview and a clear fundamental classification. The literature about performance measurement is diverse and authors tend to focus on different aspects of performance measurement system designs (Neely et al., 1995, p. 84). Furthermore, there is evidence that the tendency of developing different metrics will increase, as external factors like globalisation, technology or the increasing need for environmental responsibility and sustainability force organisations to revise their business processes. This leads to a shift in the competencies of a SC. The shift in turn evokes the development and adaptation of new or modified metrics (Gopal and Thakkar, 2012, p. 521). Based on the defined research gap the following research questions have been arisen:

What are the main categories or core aspects of supply chain performance metrics? How can the categories be classified?

Whereas core aspects mean the focus of performance measures or measurements dealing in the scientific literature. Accordingly, the first research objective of the presented paper deals with the identification of the different categories or core aspects used in the literature. In order to extent the research the second research objective deals with the examination whether the identified literature of the SCP categories show a relation to the terms global supply chain management (SCM), SC complexity and SC risk.

The presented paper is structured as following: after presenting the introduction of the research field and stating the research questions and objectives, the theoretical background of supply chain performance measurement (SCPM) will be described. The next chapter explains the used research methodology, which includes the bibliometric and content analysis. After that, the results of the analysis are shown. Finally, the conclusion states whether the research question and objectives are fulfilled. In addition, the chapter illustrates the limitations and further research.

1.2 Fundamentals of Theory

SUPPLY CHAIN PERFORMANCE

The concept of performance is understood by Hoffmann (2000, p. 8) and Riedl (2000, p. 17) as an evaluated contribution to the goals of an organisation. In addition, Hausman et al. (2002) and Hausman (2004) describe SCP as the activities of a SC to satisfy the requirements of the end consumer. This includes punctual delivery, product availability and all necessary capacities and stocks in the SC to deliver the service in a fast response way (Hausman, 2004). SCP can be found within the entire company, as it starts with basic materials and ends with distribution through various channels to the end consumer. It also crosses organizational structures such as manufacturing, procurement, sales, marketing and research and development. (Kersten et al., 2009, p. 38)

SCs have to perform in three key aspects: (1) service, (2) speed and (3) assets. Service refers to the ability to identify and understand customer needs and meet them with personalized products and on-time delivery. The speed aspect is covered with metrics that are time-related, keeping a close track of execution speed and responsiveness. Assets cover everything of market value, especially inventory and liquid funds. (Hausman et al., 2002, p. 7)

In addition to the key aspects, there are also three evaluation criteria in SCP, which determine the efficacy, efficiency and effectiveness. The efficiency represents the best relationship between the level of customer satisfaction and the resources used to meet it. The efficiency is the relationship between the effort and the overall resources. The effectiveness is the balance between less cost and ensuring the satisfaction and motivation of the company members. (Estampe, 2014, p. 9)

SUPPLY CHAIN PERFORMANCE MEASUREMENT

The term performance measurement has been defined by Gunasekaran and Kobu (2007, p. 2821) as "the process of quantifying the efficiency and effectiveness of an action." A performance measure is "a metric used to quantify the efficiency and/or effectiveness of an action" (Neely et al., 1995, p. 80). In the definition, efficiency is a measure of the degree to which a firm's economic resources are used when a particular level of customer satisfaction is achieved. In contrast to efficiency, effectiveness refers to the extent to which customer needs are met (Neely et al., 1995, p. 80). Measuring performance means translating the complexity of performance into a succession of limited symbols that can be communicated and reported under similar conditions (Chan and Qi, 2003, p. 201). A metric describes how a measure will be calculated, who will carry out the calculation and where the data comes from (Neely et al., 1995, p. 110).

Performance measurement and metrics are important for setting objectives, evaluating the performance and determining future courses and actions (Gunasekaran et al., 2004, p. 333). According to Gunasekaran and Kobu (2007, p. 2820) the performance measurement of an organisation helps "(a) to identify success, (b) to identify whether customer needs are met, (c) to understand the processes within an organisation and to confirm what they know or reveal what they do not know, (d) to identify where problems, bottlenecks or waste exist and where improvements are necessary, (e) to ensure decisions are based on facts and not on supposition, emotion, faith or intuition, and (f) to show if improvements planned actually happened."

SC models mainly use two different types of performance measures, which are financial orientated measures and non-financial and process orientated measures (Gunasekaran, 2001, p. 72; Beamon, 1999, p. 77). Maskell (1995) notes in his literature that financial performance measures are relevant for external reporting and strategic decisions. He also points out that distribution operations and day-to-day control should be handled with non-financial measures. Examples for process-oriented measurements are SC reference model (SCOR) and balanced scorecard (Thakkar et al. 2009, p. 708). The financial oriented measurements are for example models like the strategic profit model (Stapleton et al., 2002), total cost of ownership model (Ferrin and Plank, 2002) and the activity-based costing model (Manunen, 2000).

2 Methodology

In this study the underlying method is the bibliometric analysis, which extracts the data. Bibliometrics are statistical and mathematical measurements, that quantify the bibliographical references in the literature (Osareh, 1996, p. 150). The inclusion and exclusion criteria of the bibliometrics for the underlying research will be stated in this section. At the beginning of the study a **citation analysis** will be applied. The objective of the citation analysis is to facilitate the understanding and the analysis of the interrelated research fields, by exploring the citations (Hamou-Lhadj and Hamdaqa, 2009, p. 280). A citation describes a relationship between two papers, where the author of one paper refers to another one (Hamou-Lhadj and Hamdaqa, 2009, p. 279). The citation analysis is a method that helps to process a large amount of information by evaluating the literature to understand the trends in periodicals, the reference rate and the research units (Shiau and Dwivedi, 2013, p. 1322). Furthermore, the citation analysis enables the researcher to identify the highly cited articles and gives an insight of which papers and authors have the highest influence and the highest degree in value and importance on the subject (Pilkington and Meredith, 2009, p. 187). Based on these aspects, the citation analysis will be applied to expose the evolution of SCPM and to identify significant characteristics and trends in the scientific research. Additionally, the citation analysis is used to develop an intellectual foundation of the performance measurement in the SC.

There are two ways to perform the citation method. The forward citation is a kind of citation search, in which one first reads the article and then reviews the references. In contrast to the forward citation, the backward citation analyses the references given by the author in the very beginning and this occurs before reading the content of the article. In the conducted analysis, no time limitation will be set for the literature research. Therefore, the **backward method** is more suitable for the process of analysis within this term paper, as all citations are considered and the most influential papers and authors on the topic of SCPM can be identified. Another advantage is the relevant literature can be quickly found. Further the literature used by the authors have been reviewed for thematic relevance (Wang & Sun, 2019, p. 4676-4691). The applied steps of the citation analysis are following the pattern of Kotzab et al. (2020), which are shown in Table 1.

For the data extraction the keywords “Supply Chain”, “Performance Measures” or “Performance Measurement” or “Performance Metrics” have been used in the database Web of Science (WoS). By including the keywords, a result of 1588 papers have been obtained. In order to narrow these contributions, the following categories have been chosen: “Management”, “Operations Research Management Science”, “Business” and “Economics”. This step has led to a result of 970 articles. Further the document type was defined with “Article”, whereby the result decreased to 748 articles. In the last step the mandatory journals have been selected (Appendix A). The refinement shows 377 articles that need to be analysed.

Table 1: Search Methodology

Refinement step	Results
1. Search TOPIC (= in title, abstract and keyword) ("supply chain" and ("performance measures" or "performance measurement" or "performance metrics")) in WoS Core Collection (no time limitation)	1.588
2. CATEGORIES: Management, Operations Research Management Science, Business and Economics	970
3. DOCUMENT TYPE: Article	748
4. SOURCE Titles: Select Journals out of the list of the (Appendix 1)	377

According to Surwase et al. (2011, p. 180) The co-citation analysis is a method to show the similarity of a subject between two articles. It has been stated that the co-citation occurs if for example articles A and B appear in the reference list of a third article C. Even though article A and B are not directly citing each other, they show a relationship as article C cites both of them and therefore interrelates to both A and B. The bibliographic coupling is another method that indicates the similarity of a subject between two articles. In the bibliographic coupling two articles are identified as coupled, when these two articles for example A and B are citing a common article C. The higher the number of commonly cited articles the higher the strength of bibliographic coupling and therefore the higher the possibility of the similarity in the subject (Surwase et al., 2011, p. 179). The co-author analysis is about analysing the co-authorships in the area, in which the authors write articles together (Surwase et al., 2011, p. 180). The co-authorship naturally includes a more interactive and cooperative relationship. This assumes that at least two authors are willing to work together on a paper (Huang & Chang, 2011, p. 370). The co-word analysis counts and analyses the keywords (Ding et al., 2001, p. 818). Surwase et al. (2011) refer to the co-word analysis as the analysis in which the examined articles have the same keywords.

Regarding all bibliometrics, the analysis of **co-citation** has been chosen to show what articles are cited in the studies of SCPM. The focus is on the articles, which are commonly cited together and therefore have an interrelationship. Based on the exploration of the interrelationship a network of data can be developed (Pilkington and Meredith, 2009, p. 186). Furthermore, the examination of the co-citation provides information about how often articles are cited by others (Small, 1973, p. 265). This kind of numerical information can be used to identify the most cited articles that appear in third-party articles in the research field of SCP measurement and to outline the relevance of the origin articles and authors. The central aspects why the co-citation has been preferred over the other methods is that co-citation depends on the author and can change over time, as new subject fields can evolve. The co-citation patterns change accordingly to the shift in the interests and intellectual patterns of the research field. Consequently provides this information of why and to what extent the research field has been changed and developed. This is very useful to indicate the evolution within the research field. If two articles are frequently co-cited this means conversely, that they are also frequently cited individually. This leads to the assumption that frequently cited articles might represent key concepts, methods and experiment in a specific research field. After than the co-citation can be used to map the relationships of these key information (Small 1973, p. 265–266).

According to Zikmund et al. (2010, p. 593) factor analysis is "a prototypical multivariate, interdependence technique that statistically identifies a reduced number of factors from a larger number of measured variables." A factor analysis can be used in the co-citation analysis to analyse the relationship between the identified variables, which then can be reduced in a smaller set by grouping them into a similar factor (Shiau and Dwivedi, 2013, p. 1323). Zikmund et al. (2010, p. 597) describe the **cluster analysis** as "a multivariate approach for grouping observations based on similarity among measured variables." This method of grouping on the basis of certain characteristics increases the similarity within a group as well as increases the differences between groups (Zikmund et al., 2010, p. 597; Shiau and Dwivedi, p. 1323). The question which of the two methods is suitable for the examination depends on the intention of the analysis. For the illustration of the development of SCPM it is more appropriate to group the co-citation into clusters with similar characteristics and then into groups with similar factors. The cluster shows the most concerned subcategories of SCPM.

Finally, a content analysis will be processed with the identified top 40 articles (Appendix C). These are further analysed for their connection with the core SCP metrics, global SCM, SC complexity and SC risk. Tangpong (2010) outlines that content analysis is a method used to evaluate the qualitative content of all sources, which contain information. It allows researchers to classify and analyse rich textual data and convert these data into quantitative data for improved analysation by using predefined codes. The codes, within the content analysis, examine the metrics and will be based on the most influential authors within the field of SCPM. All metrics that cannot be assigned to the identified categories of the most influential authors will be stated as additional metrics, which require a more detailed examination in order to fullfill the research question. After that the content analysis examines the content of the top 40 articles regarding the connection towards global SCM, SC complexity and SC risk. The applied codes are global, risk and complexity. All papers that have more than ten direct references of these words will be considered for the content analysis.

HistCite has been chosen for the visualization of the bibliometric analysis. It helps to identify the top journals, top articles and top authors (Garfield, 2009). VOSviewer has been used to visualize the co-citation network of SCP measurement (Eck and Waltman, 2010). For the content analysis Nvivo has been utilized. The software is suitable for working with qualitative text-based data (Nvivo, 2020). Furthermore, the tools of Tableau have been applied for advanced visualization.

3 Analysis

In the following chapter the initial data statistics and the overall results of the bibliometric analysis will be provided. Furthermore, the most influential papers will be identified. The second part of the chapter includes the content analysis, which clarifies the established SCP categories and the evolutionary tendency of the most influential articles concerning the development of new SCP categories. In addition, the content of the top 40 articles regarding global SCM, SC complexity and SC risk will be examined.

3.1 Bibliometric Analysis

Initial Data

Figure 1 shows the trend and the distribution of the refined 377 articles over the years. The first identified articles were published in 1999. After this year, a growing tendency with a peak in 2012 has been developed. It can be suggested that topics like environmental sustainability has led to the increase. The suggestion could be underlined with the article of Mishra et al. (2017). The authors conducted a bibliometric analysis and found out that after 2007 the research field of green SCP measures have dramatically risen (Mishra et al., 2017, p. 89). Table 2 shows the top ten contributing authors. The most contributing author is Gunasekaran. He published twelve articles out of the 377 and his Local Citation Score (LCS) is 125. The Global Citation Score (GCS) is 2139, which is by far the highest number of GCS in the table. The second productive author is Sarkis with 10 articles. Beamon got the second highest GCS and LCS. The LCS shows the count of citations within the collection of 377 articles, whereby the GCS concerning the total number of citations in the WoS core collection (Garfield et al., 2006, p. 394). Therefore, the articles of Beamon and Gunasekaran contribute also to other topics or research fields.

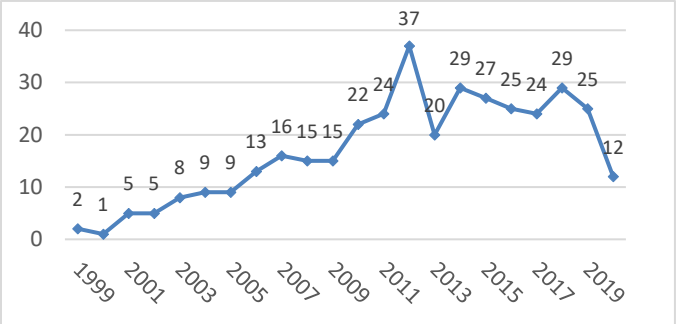


Figure 1: Amount of Publications during 1999–2020

Table 2: Ten most contributing Authors

Author	Recs	TLCS	TGCS
Gunasekaran A	12	125	2139
Sarkis J	10	33	499
Bai CG	5	19	230
Koh SCL	5	14	244
Dubey R	4	4	111
Gupta M	4	2	34
Reiner G	4	3	152
Beamon BM	3	70	1269
Cannella S	3	8	180
Chan FTS	3	21	261

Most of the articles were published in the US (Appendix B). The second largest amount of publications is in the UK and the third largest amount is in China. Overall, the dispersion shows that the topic has attracted researchers all over the world. One possible reason for the high number of published articles in the US could be due to many US companies going abroad. This can be seen in the list of Forbes top global companies, where US companies take eight out of the first 20 places. Therefore, there is a greater need for the improvement of the global SC and for this reason the performance must be measured.

CITATION ANALYSIS

In the following Figure 2 the historiography of the citation relations of the 40 most cited papers of the sample based on the LCS is mapped. The papers were identified by HistCite and are listed with the identification numbers in Appendix C. There are 40 nodes with 74 links with a minimum citation score of five and a maximum of 62.

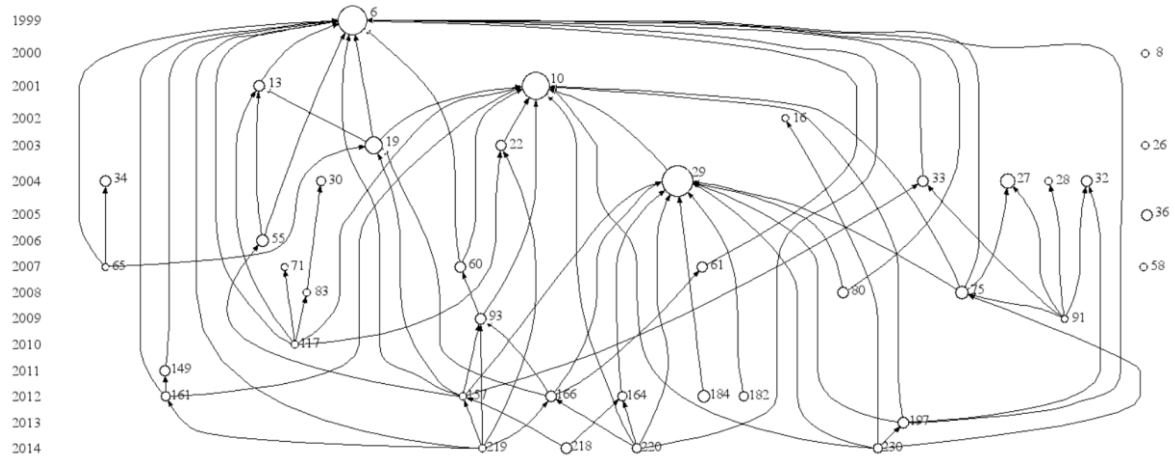


Figure 2: Citation relations of the 40 most cited Papers

Four references are isolated. Node eight represent the paper of Sabri and Beamon (2008). This paper deals with a multi-objective SC mode, that allows a use of a performance measurement model. The article of Olhager (2003), which is the node 26 in the network, is about the positioning of the order penetration point, whereas performance measurement is only one decision category. The article of Gimenez and Ventura (2005), node 36, examine with an empirical study the logistics-production and logistics marketing interfaces and the impact of the internal and external relationships on the logistic performance. And the node 58, which is the article of Ritchie and Brindley (2007), includes SC risk management, which is matched with performance in one part of the article. The articles of Beamon (1999), Gunasekaran et al. (2001) and Gunasekaran et al. (2004) are highly cited. In these most cited articles performance metrics and measures are presented and frameworks are evaluated or created. The high amount of citations indicates the high relevance of these articles within the research field of SCPM.

CO-CITATION & CLUSTER ANALYSIS

To conclude the bibliometric analysis, the next step is to conduct a co-citation analysis. Figure 3 illustrates the 30 most co-cited articles. Based on the co-citation analysis the articles can be clustered in four different topics as presented in Table 3. The red cluster is the core literature of the analysis and deals with performance measurement and its metrics. Some of the articles evaluate or construct frameworks like Beamon (1999) or Gunasekaran (2001). The density of this cluster is high, which indicates that the other articles are highly referring to this literature.

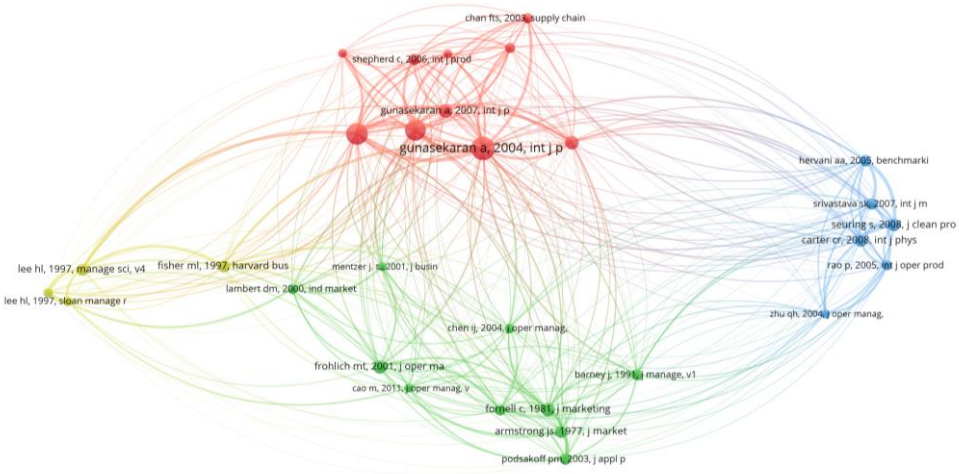


Figure 3: Visualization of identified Clusters within the Co-citation Analysis

Table 3: 30 most co-cited Articles (alphabetical order)

Red Cluster – Performance Measurement	Beamon (1999), Chan (2003), Chan and Qi (2003), Gunasekaran et al. (2001), Gunasekaran et al. (2004), Gunasekaran and Kobu (2007), Holmberg (2000), Kaplan and Norton (1992), Neely et al. (1995), Shepherd and Günter (2006)
Blue Cluster – Sustainable SC Performance	Carter and Rogers (2008), Hervani et al. (2005), Seuring and Müller (2008), Rao and Holt (2005), Srivastava (2007), Zhu and Sarkis (2004)
Green Cluster - Performance Improvement	Armstrong and Overton (1977), Barney (1991), Cao and Zhang (2011), Chen and Paulraj (2004), Flynn et al. (2010), Fornell and Larcker (1981), Frohlich and Westbrook (2001), Lambert and Cooper (2000), Mentzer et al. (2001), Podsakoff et al. (2003)
Yellow Cluster – SC Coordination Performance	Chen et al. (2000), Fisher (1997), Lee et al. (1997a), Lee et al. (1997b)

The blue cluster includes articles about green SCM and sustainability, which especially deals with its measures and impact on performance. These articles are all established after 2004. Therefore, the results show a modern trend in this topic, which is also supported by Mishra et al. (2017, p. 89) and the 377 articles from the bibliometric analysis. The green cluster is best described by the topic of performance improvement. These articles are mostly empirical and determine how to improve the performance by stressing specific competitive advantages like the reduction of biases, SC integration or collaboration between all SC partners. The aim of the

articles is to provide managerial directions. The yellow cluster deals with SC coordination performance, where are all the articles from 1997-2000. The articles serve as a foundation regarding problems with SC coordination and collaboration partly due to distorted information. Overall, the analysis shows that the different SCPM frameworks take an important role in the older as well in the modern literature. It shows that more modern literature refers to and expands the old framework with metrics to cope with the current SC complexity. In general, green SC measures, SC collaboration and coordination were stressed multiple times.

3.2 Content Analysis

CATEGORIES OF SUPPLY CHAIN PERFORMANCE METRICS

The main categories of SCP metrics have been adopted from Beamon (1999) and Gunasekaran et al. (2004) as the bibliometric analysis has shown that both authors have significantly contributed to the subject of SCPM. The categories adopted from Beamon (1999) are resources, output and flexibility. The resources measure the level of efficiency. The output considers the level of customer service and flexibility describes the ability to respond to a changing environment. The categories adopted from Gunasekaran et al. (2004) are stated as follow: metrics for order planning describes every aspects until an order is posed. The evaluation of supply link measures the strategic, operational and tactical level of SC partnerships. The measures and metrics at production level include all activities that are carried out by an organization with production sites. The evaluation of delivery link describes every factor that impact the customer through the delivery. The measurement of customer service and satisfaction measures the fulfilled of customer's need and demand for the most satisfied way. Further SC and logistics cost include financial measures.

Within the top 40 articles, the evaluation of supply link and resources include a significant large amount of all the codes. These have been coded 145 and 125 times (Figure 4). It can be concluded that, when it comes to the assessment of SCP, the evaluation of the supply link is regarded as an important measurement. Within this measurement the metrics cycle time, lead time reliability, flexibility, quality, information exchange and cost play a major role to quantity the efficiency of the SC partnerships. The resources have also been considered as an important measurement. In order measure the level of efficiency the metrics transportation, energy, inventory and material costs are used. Furthermore, the allocation of material, labour, technology and intangible assets (e.g. information, knowledge) is a crucial action to use the resources as efficient as possible. The additional metrics that could not be assigned to the defined categories of Beamon (1999) and Gunasekaran et al. (2004), could be classified in environmental, country-specific, innovation and safety metrics.

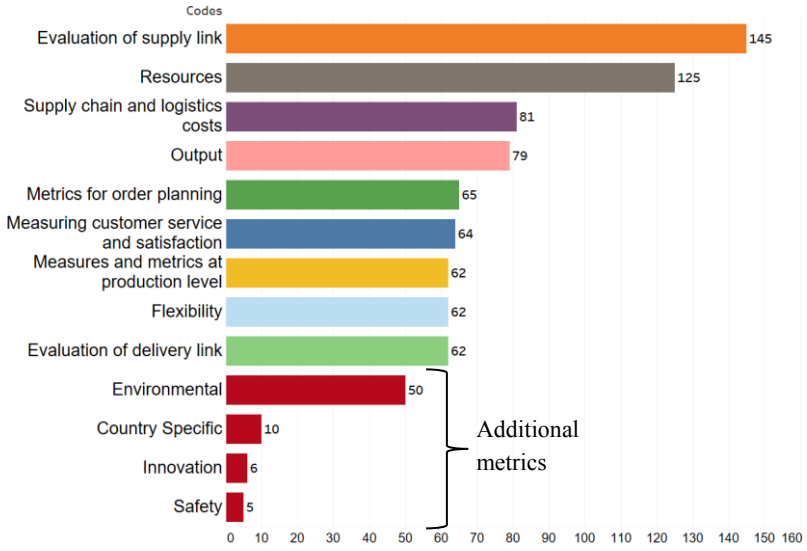


Figure 4: Amount of all Codes

The content analysis has shown that the code environmental is the most significant one in the identified additional metrics, which can be seen in Figure 5. All codes that have an environmental association have a large portion. In total environment has been coded 50 times in eight articles. It is important to emphasize that this topic is reflected in the more recent articles. The analysis covers the period from 1999 to 2014, whereby the topic of environmental metrics first appeared in 2004 and has been increasing in importance since 2007 (Appendix D). The mentioned environmental metrics deal with environmental costs (e.g. environmental cost performance variance, environmental costs savings initiatives), the process with hazardous and toxic materials (e.g. chemical releases, the use of hazardous and toxic substances), energy consumption (e.g. energy efficiency of systems, energy consumption rate, green image), water consumption, recycling and emissions (e.g. global warming gases, CO2 emissions).

The environmentally aware actions of companies are becoming increasingly important (Umweltbundesamt, 2018), which is reflected in the time scale of distribution of the codes. Another reason for the environmentally conscious operations of companies could be the influence of government intervention through fines. In Germany, environmental regulations are written down in law and the violation would therefore be financially damaging to the company and socially harmful (Bußgeldkatalog, 2020). Furthermore, one reason for using environmental metrics could be the need to comply with corporate social responsibility, which can lead to an improved image of a company. Corporate social responsibility requires companies to take a voluntary approach to climate change and to make their operations environmentally friendly (Bmas, 2020). In addition to the legal requirements and image advantages, a study has shown that financial and tax benefits, as well as competitive advantages are interesting for companies (Statista, 2012).

Figure 5: Additional Metrics

The code country specific was found in the articles published by Cousins et al. (2008) and Huang and Keskar (2007) and has been coded ten times. The country specific metrics are financial metrics (e.g. local price control, financial stability), ethical, cultural and political metrics. Huang and Keskar (2007) state in their paper that the business model and the SC needs to be aligned with each other, thereby addressing country-specific metrics to be more competitive and profitable.

Innovation has been coded six times in four articles. These deal with the extent of technological capabilities, innovative processes, investments in IT systems and the use of information technologies. The reason why this metric has been introduced in the SCPM can be argued by the increasing importance of innovations that are driver of competitive advantage in the development of efficient SCs (Zimmermann et al., 2016, p. 298). Innovations can help to improve the performance, increase the demand and reduce costs and therefore open up new opportunities for further advancement in building efficient and effective SC processes (Arli et al., 2013, p. 35; Zimmermann et al., 2016, p. 289).

The code safety has been found in the articles of Azevedo et al. (2012) and Huang and Keskar (2007). The code was coded five times and has the smallest share of the identified additional metrics. This metric indicates how safe the environment of the employees and the company in a safe environment are. The safety of employees is measured by the extent of the safety training and how often incidents are happening. The company's safety is measured by the corruption level of the environment in which the company operates in. It cannot not be stated that safety is a significant metric in the SCP as only two articles refer to this metric. But it can be assumed that due to the fact, that employees are important resources of a company, employees need to be trained in order to avoid incidents that disrupt the SC and therefore harm the performance. Furthermore, it can be assumed that while the globalization increases and companies operate across national borders, the corruption can play a major role especially in those countries that have lose political regulations. These will negatively affect the SC of a company and disrupt the overall performance.

INTERRELATION OF THE TOP 40 ARTICLES TO GSM, SC COMPLEXITY AND SC RISK

The top 40 articles of the citation analysis were examined in Nvivo to quantity the terms "Global", "Risk" and "Complexity". This step helps to inspect the intercorrelation between those and the research analysis. In Appendix E, the top ten articles with the most references are described. There are two articles with noticeable high amount of codes. The article by Ritchie and Brindley (2007) includes 233 references and Huang and Keskar (2007) includes 46 references. The article by Ritchie and Brindley (2007) establishes a framework of risk management with the goal to integrating SCP and SC Risk. The article indicates to the relevance of risk within the research field of SCP measurement. The article by Huang and Keskar (2007) introduces different metrics considering the product type, supplier type and supplier integration level to measure the overall supplier performance. The article helps to integrate supplier into the huge SC network, which further indicates that the complexity of global SCs are increasing.

Further a manual coding on the top ten articles was conducted to state whether the articles acknowledge the topic in a broader sense. Global SC was coded 58 times and the codes deal about introducing global performance metrics, integrating supplier in connection with collaborative performance metrics and the rising importance of environmental sustainability within a global SC. Once more environmental sustainability of a SCM gains attention within the articles, which indicates the important role of it in this research field of SCPM. The reason why SC integration and collaboration have been emphasised is that both decrease the SC complexity and risk. SC complexity was coded 15 times. The codes include methods on how to reduce complexity and mainly the rise of complexity due to globalisation and sustainability. This shows the tight connection between SCPM and complexity. SC risk was coded 33 times. The codes deal about the management of different risks occurring within the whole SC. This indicates the interconnection of risk management and performance measurement. To guarantee an efficient performance measurement of the SC, the risk has to be addressed and assessed. In conclusion global SC, risk and complexity are negatively influencing the efficiency of SCPM. Further research may advise on how to manage the increased complexity and risk.

4 Conclusion and Reflection

In the presented research the bibliometric analysis has been applied in order to provide an intellectual foundation of the performance measurement in the SC.

"*What are the main categories or core aspects of supply chain performance metrics? How can the categories be classified?"*

The research question and the research objective were successfully answered. The analysis has significantly contributed to the research gap by revealing that the research of SCP has been started in 1999 and the main research fields are performance measurement, sustainable SCP, performance improvement and SC coordination. Furthermore, the analysis shows that both authors Gunasekaran and Beamon have shaped the research of SCPM. For that reason, the main categories of SCP metrics of both authors have been adopted. The categories include metrics for order planning, evaluation of supply link, measures and metrics at production level, evaluation of delivery link, measuring customer service and satisfaction, SC and logistics cost, resources, output and flexibility.

The content analysis contributed to the research question by identifying new additional metrics. These are environment, country-specific, innovation and safety metrics. It can be emphasized that especially the environmental sustainability SCP metrics have grown in relevance in the last years. The articles highly mentioned sustainability in combination with global complexity of SCs. Both are increasing in complexity due to environmental changes like the globalisation. The examination of the relationship between global SC and SCP has shown that performance does matter in the global context, so that even global SCP metrics have been developed. Furthermore, as SCP is affected by environmental complexity and risk, management activities are suggested to ensure the company's SCP.

A potential limitation of the paper is that, the qualitative content analysis is a subjective method, which requires a profound understanding of the subject in order to avoid decision biases. However, it is still possible that other researchers receive a different result, as the classification of the metrics indicates some subjective assessment of the authors. In addition, due to the results of the citation analysis, only articles that were published between 1999 and 2014 were examined in the content analysis. Therefore, recently published articles were not considered, which could provide another result. A further limitation is that only the top ten articles out of the 40 articles were examined on an interrelation of SCPM to global SCM, complexity and risk. In order to examine the interrelation of these aspects a more extent research is required, and a second bibliometric analysis is suggested. Regarding the increasing number of SCP metrics due to the shift of the SC, the presented research provides an initial insight into the upcoming development of new categories of performance metrics, which might gain in relevance. Therefore, this paper could be helpful to conduct a further research with a focus on the articles established in the last years within the field of SCPM. A possible further research method could be a literature review, which provides new and modern ideas of SCPM and SCP metrics. Further, it will be possible

to include current topics like the Covid-19 pandemic. The influence of such an event on SCPM could be examined and whether there is a need for a change in SCPM. Examining the strategy of different companies during and after disruption events indicate towards well working strategies within the SC. This practically supports the theoretical configurations and illustrates another research gap. In addition, within the top 40 articles the increase of complexity due to environmental sustainability was highly mentioned. Whereby, further research can focus on the sustainability complexity and explain on how to decrease or how to deal with it. During the analysis it became apparent that the majority of the articles refer to a selected aspect. An interesting point for the future could be to create a framework that includes and considers all additional metrics for a global sustainable SC. Further future research could consider conducting a bibliometric analysis on SCP, instead of SCPM to clarify the connections between SCP and SC complexity, SC risk and global SC.

Bibliography

Arli, Verdi/Dylke, Sean/Burgess, Rosie/Campus, Romain/Soldo, Evita (2013): Woolworths Australia and Walmart US: Best Practices in Supply Chain Collaboration. In: Journal of Economics, Business, and Accountancy Ventura, 16 (1), pp. 27–46.

Armstrong, Scott J./Overton, Terry S. (1977): Estimating Nonresponse Bias in Mail Surveys. In: Journal of Marketing Research, 14, pp. 396-402.

Azevedo, Susana G./Carvalho, Helena/Duarte, Susana/Cruz-Machado, Virgílio (2012): Influence of Green and Lean Upstream Supply Chain Management Practices on Business Sustainability. In: IEEE Transactions on Engineering Management, 59 (4), pp. 753–765.

Bagchi, Prabir K. (1996): Role of benchmarking as a competitive strategy: the logistics experience. In: International Journal of Physical Distribution & Logistics Management, 26 (2), pp. 4–22.

Barney, Jay (1991): Firm Resources and Sustained Competitive Advantage. In: Journal of Management, 17 (1), pp. 99–120.

Beamon, Benita M (1999): Measuring Supply Chain Performance. In: International Journal of Operations & Production Management, 19 (3), pp. 275–92.

Bmas (2020): Gesellschaftliche Verantwortung von Unternehmen. Online available at: https://www.bmas.de/DE/Themen/Soziales-Europa-und Internationales/International/gesellschaftliche-verantwortung-von-unternehmen.html (Accessed 01.07.2020; [MEZ] 10:40 am).

Bußgeldkatalog (2020): Umwelt-Bußgeldkatalog 2020. Online available at: https://www.bussgeldkatalog.org/umwelt/ (Accessed 01.07.2020; [MEZ] 10:25 am).

Cao, Mei/Zhang, Qingyu (2011): Supply chain collaboration: Impact on collaborative advantage and firm performance. In: Journal of Operations Management, 29 (3), pp. 163–180.

Carter, Craig R./Rogers, Dale S. (2008): A framework of sustainable supply chain management: moving toward new theory. In: International Journal of Physical Distribution & Logistics Management, 38 (5), pp. 360–387.

Chan, Felix T.S. (2003): Performance Measurement in a Supply Chain. In: The International Journal of Advanced Manufacturing Technology, 21 (7), pp. 534–548.

Chan, Felix T.S./Qi, H. J. (2003): An innovative performance measurement method for supply chain management. In: Supply Chain Management, 8 (3), pp. 209–223.

Chen, Frank/Drezner, Zvi/Ryan, Jennifer K./Simchi-Levi, David (2000): Quantifying the Bullwhip Effect in a Simple Supply Chain: The Impact of Forecasting, Lead Times, and Information. In: Management Science, 46 (3), pp. 436–443.

Chen, Injazz J./Paulraj, Antony (2004): Towards a theory of supply chain management: the constructs and measurements. In: Journal of Operations Management, 22 (2), pp. 119–150.

Cousins, Paul D./Lawson, Benn/Squire, Brian (2008): Performance measurement in strategic buyer-supplier relationships: The mediating role of socialization mechanisms. In: International Journal of Operations & Production Management, 28 (3), pp. 238-258.

Ding, Ying/Chowdhury, Gobinda G./Foo, Schubert (2001): Bibliometric cartography of information retrieval research by using co-word analysis. In: Information Processing & Management, 37 (6), pp. 817-842.

Eck, Ness J./Waltman, Ludo (2010): Software survey: VOSviewer, a computer program for bibliometric mapping. In: Scientometrics, 84, pp. 523–538.

Estampe, Dominique (2014): Supply Chain Performance and Evaluation Models. In: John Wiley & Sons, p. 9.

Ferrin, Bruce G./Plank, Richard E. (2002): Total cost of ownership models: An exploratory study. In: Journal of Supply Chain Management, 38, p. 18.

Fischer, Marshall L. (1997): What Is the Right Supply Chain for Your Product? A Simple Framework Can Help You Figure out the Answer. In: Harvard Business Review, 75 (2), pp. 105–116.

Flynn, Barbara B./Huo, Baofeng/Zhao, Xiande (2010): The impact of supply chain integration on performance: A contingency and configuration approach. In: Journal of Operations Management, 28 (1), pp. 58–71.

Fornell, Claes/Larcker, David F. (1981): Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. In: Journal of Marketing Research, 18 (1), pp. 39-50.

Frohlich, Markham T./Westbrook, Roy (2001): Arcs of integration: an international study of supply chain strategies. In: Journal of Operations Management, 19 (2), pp. 185–200.

Garfield, Eugene (2009): From the science of science to Scientometrics visualizing the history of science with HistCite software. In: Journal of Informetrics, 3 (3), pp. 173–179.

Garfield, Eugene/Paris, Soren W./Stock, Wolfgang G. (2006): HistCiteTM: A Software Tool for Informetric Analysis of Citation Linkage. In: NFD Information-Wissenschaft und Praxis, 57 (8), pp. 391-400

Gimenez, Cristina/Ventura, Eva (2005): Logistics-production, Logistics-marketing and External Integration: Their Impact on Performance. In: International Journal of Operations & Production Management, 25 (1), pp. 20–38.

Gopal, P. R. C. / Thakkar, Jitesh (2012): A review on supply chain performance measures and metrics: 2000-2011. In: International Journal of Productivity and Performance Management, 61 (5), pp. 518–547.

Griffis, Stanley E./ Cooper, Martha/ Goldsby, Thomas J./ Closs, David J. (2004): Performance Measurement: Measure selection based upon firm goals and information reporting needs. In: Journal of Business Logistics, 25 (2), pp. 95–118.

Gunasekaran, Angappa/ Kobu, Bulent (2007): Performance measures and metrics in logistics and supply chain management: a review of recent literature (1995–2004) for research and applications. In: International Journal of Production Research, 45 (12), pp. 2819–2840.

Gunasekaran, Angappa/ Patel, Chetna A./ McGaughey, Ronald E. (2004): A framework for supply chain performance measurement. In: International Journal of Production Economics, 87 (3), pp. 333–347.

Gunasekaran, Angappa/ Patel, Chetna A./ Tirtiroglu, Ercan (2001): Performance measures and metrics in a supply chain environment. In: International Journal of Operations & Production Management, 21 (1/2), pp. 71–87.

Gunasekaran, Angappa/ Williams, H. James/ McGaughey, Ronald E. (2005): Performance measurement and costing system in new enterprise. In: Technovation, 25 (5), 523-533.

Hamou-Lhadj, Abdelwahab/ Hamdaqa, Mohammad (2009): Citation Analysis: An Approach for Facilitating the Understanding and the Analysis of Regulatory Compliance Documents. In: 2009 Sixth International Conference on Information Technology: New Generations, pp. 278–283.

Hausman, Warren H. (2004): Supply Chain Performance Metrics. In The Practice of Supply Chain Management: Where Theory and Application Converge. In: International Series in Operations Research & Management Science. Springer, 62, pp. 61–73.

Hervani, Aref A./Helms, Marilyn M./Sarkis, Joseph (2005): Performance measurement for green supply chain management. In: Benchmarking, 12 (4), pp. 330–353.

Hoffmann, Olaf (2000): Performance Management. Systeme und Implementierungsansätze. (Schwerpunkt Balanced Scorecard). In: Haupt Verlag, 3, pp. 8.

Holmberg, Stefan (2000): A systems perspective on supply chain measurements. In: International Journal of Physical Distribution & Logistics Management, 30 (10), pp. 847–868.

Huang, Mu H./ Chang, Yu W. (2011): A study of interdisciplinarity in information science: using direct citation and co-authorship analysis. In: Journal of Information Science, pp. 369-378.

Huang, Samuel H./Keskar, Harshal (2007): Comprehensive and configurable metrics for supplier selection. In: International Journal of Production Economics, 105 (2), pp. 510–523.

Kaplan, Robert S./Norton, David P. (1992): The Balanced Scorecard - Measures that Drive Performance. In: Harvard Business Review, 70 (1), pp. 71-79.

Kersten, Wolfgang/Blecker, Thorsten/Meyer, Matthias (2009): Supply Chain Performance Management. Operations and Technology Management. In: Erich Schmidt Verlag, p. 38.

Kotzab, Herbert/ Bäumle, Ilja/ Gerke, Paul (2020): Supply Chain Integration: A Bibliometric Analysis. In: International Conference on Dynamics in Logistics, pp. 286–298.

Lambert, Douglas M./Cooper, Martha C. (2000): Issues in Supply Chain Management. Industrial Marketing Management, 29 (1), pp. 65–83.

Lee, Hau L./Padmanabhan, V./Whang, Seungjin (1997a): Information Distortion in a Supply Chain: The Bullwhip Effect. In: Management Science, 43 (4), 546–558.

Lee, Hau L./Padmanabhan, V./Whang, Seungjin (1997b): The Bullwhip Effect in Supply Chains. In: Sloan Management Review, 38 (3), pp. 93–102.

Maditati, Dhanavanth R./Munim, Ziaul H./Schramm, Hans J./Kummer, Sebastian (2018): A review of green supply chain management: From bibliometric analysis to a conceptual framework and future research directions. In: Resources, Conservation and Recycling, 139, pp. 150-162.

Manunen, Outi (2000): An Activity-Based Costing Model for Logistics Operations of Manufacturers and Wholesalers. In: International Journal of Logistics, 3 (1), pp. 53-65.

Maskell, Brian H. (1991): Performance Measurement for World Class Manufacturing. In: Productivity Press, p. 1.

Mentzer, John T./DeWitt, William/Keebler, James S./Min, Soonhong/Nix, Nancy W./ Smith, Carlo D./Zacharia, Zach G. (2001): DEFINING SUPPLY CHAIN MANAGEMENT. In: Journal of Business Logistics, 22 (2), pp. 1–25.

Mishra, Deepa/Gunasekaran, Angappa/Papadopoulos, Thanos/Hazen, Benjamin (2017): Green Supply Chain Performance Measures: A Review and Bibliometric Analysis. In: Sustainable Production and Consumption, 10, pp. 85–99.

Neely, Andy/ Gregory, Mike/ Platts, Ken (1995): Performance measurement system design: A literature review and research agenda. In: International Journal of Operations & Production Management, 15 (4), pp. 80–116.

Olhager, Jan (2003): Strategic Positioning of the Order Penetration Point. In: International Journal of Production Economics, 85 (3), pp. 319–329.

Osareh, Farideh (1996): Bibliometrics, Citation Analysis and Co-Citation Analysis: A Review of Literature I. In: Libri, 46 (3), pp. 149–158.

Parker, Charles (2000): Performance measurement. In: Work study, 49 (2), pp. 63–66.

Pilkington, Alan/Meredith, Jack (2009): The evolution of the intellectual structure of operations management—1980–2006: A citation/co-citation analysis. In: Journal of Operations Management, 27 (3), pp. 185–202.

Podsakoff, Philip M./MacKenzie, Scott B./Lee, Jeong-Yeon/Podsakoff, Nathan P. (2003): Common method biases in behavioral research: A critical review of the literature and recommended remedies. In: Journal of Applied Psychology, 88 (5), pp. 879–903.

Rao, Purba/Holt, Diane (2005): Do green supply chains lead to competitiveness and economic performance? In: International Journal of Operations & Production Management, 25 (9), pp. 898–916.

Riedl, Jens B. (2000): Unternehmungswertorientiertes Performance Measurement; Konzeption eines Performance-Measure-Systems zur Implementierung einer wertorientierten Unternehmungsführung. In: Deutscher Universitätsverlag, pp. 17.

Ritchie, Bob/Brindley, Clare (2007): Supply Chain Risk Management and Performance: A Guiding Framework for Future Development. In: International Journal of Operations & Production Management, 27 (3), pp. 303–22.

Sabri, Ehap H./Beamon, Benita M. (2000): A Multi-Objective Approach to Simultaneous Strategic and Operational Planning in Supply Chain Design. In: Omega, 28 (5), pp. 581–98.

Santos, Sérgio P./Belton, Valerie/ Howick, Susan (2002): Adding value to performance measurement by using system dynamics and multicriteria analysis. In: International Journal of Operations & Production Management, 22 (11), pp. 1246-1272.

Seuring, Stefan/Müller, Martin (2008): From a literature review to a conceptual framework for sustainable supply chain management. In: Journal of Cleaner Production, 16 (15), pp. 1699–1710.

Shepherd, Craig/Günter, Hannes (2006): Measuring supply chain performance: current research and future directions. In: International Journal of Productivity and Performance Management, 55 (3/4), pp. 242–258.

Shiau, Wen-Lung/ Dwivedi, Yogesh K. (2013): Citation and co-citation analysis to identify core and emerging knowledge in electronic commerce research. In: Scientometrics, 94, pp. 1317–1337.

Small, Henry (1973): Co-citation in the scientific literature: A new measure of the relationship between two documents. In: Journal of the American Society for Information Science, 24 (4), pp. 265–269.

Srivastava, Samir K. (2007): Green supply-chain management: A state-of-the-art literature review. In: International Journal of Management Reviews, 9 (1), pp. 53–80.

Stapleton, Drew/Hanna, Joe B./Yagla, Steve/Johnson, Jay/Markussen, Dan (2002): Measuring logistics performance using the strategic profit model. In: International Journal of Logistics Management, 13, p. 89.

Statista (2012): Was sind die Hauptgründe, weshalb Ihr Unternehmen Maßnahmen zur Verbesserung der Ressourceneffizienz ergreift? Online available at: https://de.statista.com/statistik/daten/studie/255790/umfrage/gruende-von-unternehmen-fuer-massnahmen-zur-verbesserung-der-resourceneffizienz/ (Accessed 01.07.2020; [MEZ] 11:30 am).

Stoller, Kristin (2017): The World's Top Regarded Companies 2017: German Conglomerate Siemens Takes Top Spot. Online available at: https://www.forbes.com/sites/kristinstoller/2017/10/10/the-worlds-top-regarded-companies-2017/#7246ef3e6726 (Accessed 18.07.2020; [MEZ] 15:32 pm).

Surwase, Ganesh/Sagar, Anil/Kademani, B. S./Bhanumurth, K. (2011): Co-citation Analysis: An Overview. Online available at: https://www.researchgate.net/publication/277119876_Co-citation_Analysis_An_Overview (Accessed: 17.07.2020; [MEZ] 11 am).

Tangpong, Chanchai (2010): Content analytic approach to measuring constructs in operations and supply chain management. In: Journal of Operations Management, 29 (6), n.p.

Thakkar, Jitesh/Kanda, Arun/Deshmukh, S.G. (2009): Supply chain performance measurement framework for small and medium scale enterprises. In: Benchmarking: An International Journal, 16 (5), pp. 702-723.

Umweltbundesamt (2018): Environmental Awareness Study 2018. Online available at: https://www.umweltbundesamt.de/en/press/pressinformation/environmental-awareness-study-2018 (Accessed 01.07.2020; [MEZ] 09:05 am).

Wang, Qingfeng/Sun, Xu (2019): The international journal of production research in the past, the present and the future: a bibliometric analysis. In: International Journal of Production Research, 57 (15-16), pp. 4676-4691.

Zhu, Qingh Zhu, Qinghua/Sarkis, Joseph (2004): Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. In: Journal of Operations Management, 22 (3), pp. 265–289.

Zikmund, William G./Babin, Barry J./Carr, Jon C./Griffin, Mitch (2010): Business research methods. 8th edition. Andover: Cengage Learning.

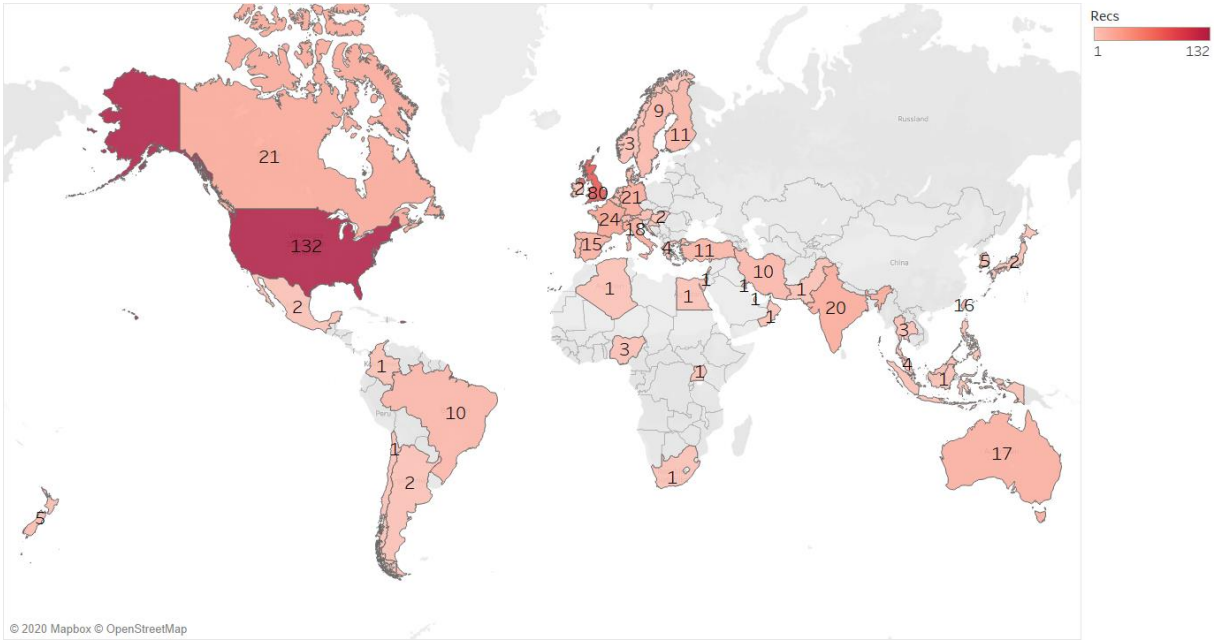
Zimmermann, Ricardo/Ferreira, Luís Miguel D. F./Moreira, Antonio Carrizo (2016): The influence of supply chain on the innovation process: a systematic literature review. In: Supply Chain Management, 21 (3), pp. 289–304.

Appendix

[A] Included Journals:

No.	Source title (sorted in alphabetical order)
1.	Annals of Operations Research
2.	Decision Science
3.	Decision Support Systems
4.	European Journal of Operations Research
5.	IEE Transactions on Engineering Management
6.	International Journal of Logistics Management
7.	International Journal of Logistics Research and Application
8.	International Journal of Operations and Production Management
9.	International Journal of Physical Distribution and Logistics Management
10.	International Journal of Production Economics
11.	International Journal of Production Research
12.	Journal of Business Logistics
13.	Journal of Operations Management
14.	Journal of Purchasing and Supply Management
15.	Journal of Supply Chain Management
16.	Journal of Operational Research Society
17.	OMEGA – International Journal of Management Science
18.	Operations Research
19.	Production and Operations Management
20.	Supply Chain Management: An International Journal
21.	Transportation Research Part E: Logistics and Transportation Review

[B] Published Articles by Country:

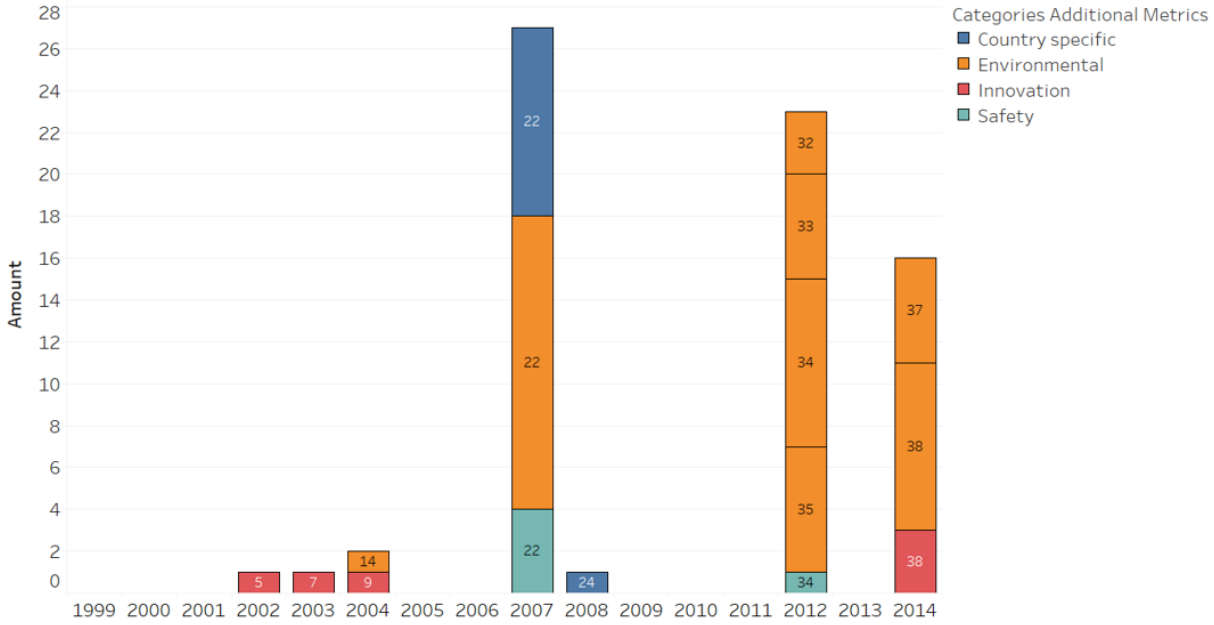


[C] 40 most cited Articles by LCS:

Nodes: 40, Links: 74
LCS, top 40; Min: 4, Max: 62 (LCS scaled)

		LCS	GCS
1.	6 Beamon BM, 1999, INT J OPER PROD MAN, V19, P275	55	865
2.	8 Sabri EH, 2000, OMEGA-INT J MANAGE S, V28, P581	5	310
3.	10 Gunasekaran A, 2001, INT J OPER PROD MAN, V21, P71	52	795
4.	13 Beamon BM, 2001, INT J PROD RES, V39, P3195	10	94
5.	16 Bullinger HJ, 2002, INT J PROD RES, V40, P3533	4	84
6.	19 Chan FTS, 2003, SUPPLY CHAIN MANAG, V8, P209	21	188
7.	22 Kleijnen JPC, 2003, J OPER RES SOC, V54, P507	8	152
8.	26 Olhager J, 2003, INT J PROD ECON, V85, P319	5	272
9.	27 Lockamy A, 2004, INT J OPER PROD MAN, V24, P1192	15	157
10.	28 Simatupang TM, 2004, SUPPLY CHAIN MANAG, V9, P57	5	102
11.	29 Gunasekaran A, 2004, INT J PROD ECON, V87, P333	62	837
12.	30 Kulp SC, 2004, MANAGE SCI, V50, P431	6	430
13.	32 Schmitz J, 2004, INT J PROD ECON, V89, P231	10	96
14.	33 Lohman C, 2004, EUR J OPER RES, V156, P267	10	201
15.	34 Wang G, 2004, INT J PROD ECON, V91, P1	10	293
16.	36 Gimenez C, 2005, INT J OPER PROD MAN, V25, P20	9	195
17.	55 Angerhofer BJ, 2006, DECIS SUPPORT SYST, V42, P283	11	110
18.	58 Ritchie B, 2007, INT J OPER PROD MAN, V27, P303	5	183
19.	60 Aramyan LH, 2007, SUPPLY CHAIN MANAG, V12, P304	10	159
20.	61 Giannakis M, 2007, SUPPLY CHAIN MANAG, V12, P400	8	56
21.	65 Huang SH, 2007, INT J PROD ECON, V105, P510	4	194
22.	71 Towill DR, 2007, INT J PROD ECON, V108, P444	4	67
23.	75 Cousins PD, 2008, INT J OPER PROD MAN, V28, P238	12	95
24.	80 Sezen B, 2008, SUPPLY CHAIN MANAG, V13, P233	9	140
25.	83 Wright D, 2008, INT J PROD ECON, V113, P587	5	70
26.	91 Forslund H, 2009, INT J OPER PROD MAN, V29, P77	4	47
27.	93 Chae B, 2009, SUPPLY CHAIN MANAG, V14, P422	10	98
28.	117 Cannella S, 2010, INT J PROD RES, V48, P6739	5	78
29.	149 Azevedo SG, 2011, TRANSPORT RES E-LOG, V47, P850	8	205
30.	157 Bai CG, 2012, INT J PROD RES, V50, P2484	5	22
31.	161 Cabral I, 2012, INT J PROD RES, V50, P4830	6	106
32.	164 Bjorklund M, 2012, SUPPLY CHAIN MANAG, V17, P29	6	90
33.	166 Bai CG, 2012, SUPPLY CHAIN MANAG, V17, P78	9	114
34.	182 Azevedo SG, 2012, IEEE T ENG MANAGE, V59, P753	6	93
35.	184 Hassini E, 2012, INT J PROD ECON, V140, P69	11	437
36.	197 Estampe D, 2013, INT J PROD ECON, V142, P247	9	106
37.	218 Varsei M, 2014, SUPPLY CHAIN MANAG, V19, P242	10	137
38.	219 Bai CG, 2014, SUPPLY CHAIN MANAG, V19, P275	5	80
39.	220 Acquaye A, 2014, SUPPLY CHAIN MANAG, V19, P306	6	43
40.	230 Koufteros X, 2014, J OPER MANAG, V32, P313	6	65

[D] Distribution of the additional Metrics according to the identified Articles in the different Years:



[E] Articles with highest References of Global, Complexity and Risk:

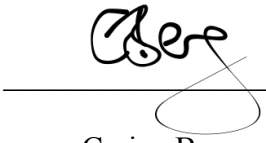
Article	References	Coverage
18. Ritchie, Bob/Brindley, Clare (2007): Supply chain risk management and performance - A guiding framework for future development. In: International Journal of Operations & Production Management, 27 (3), pp. 303-322.	233	0,77%
21. Huang, Samuel H./Keskar, Harshal (2007): Comprehensive and configurable metrics for supplier selection. In: International Journal of Production Economics, 105 (2), pp. 510–523.	46	0,24%
4. Beamon, Benita M./Chen, V. C. P. (2010): Performance analysis of conjoined supply chains. In: International Journal of Production Research, 39 (14), pp. 3195-3218.	21	0,10%
36. Estampe, Dominique; Lamouri, Samir; Paris, Jean-Luc; Brahim-Djellould, Sakina (2013): A framework for analysing supply chain performance evaluation models. In: International Journal of Production Economics, 142 (2), pp. 247-258.	20	0,10%
35. Hassini, Elkafi; Surti, Chirag; Searcy, Cory (2012): A literature review and a case study of sustainable supply chains with a focus on metrics. In: International Journal of Production Economics, 140(1), pp. 69-82.	18	0,05%
39. Acquaye, Adolf; Genovese, Andrea; Barrett, John; Koh, SCL (2014): Benchmarking Carbon Emissions Performance in Supply Chains. In: Supply Chain Management: An International Journal, 19 (3), pp. 1-47.	17	0,08%
37. Varsei, Mohsen; Soosay, Claudine; Fahimnia, Behnam; Sarkis, Joseph (2014): Framing sustainability performance of supply chains with multidimensional indicators. In: Supply Chain Management, 19 (3), pp. 242-257.	16	0,05%

10. Simatupang, Togar M.; Wright, Alan C.; Sriharan, Ramaswami (2004): Applying the theory of constraints to supply chain collaboration. In: Supply Chain Management, 9 (1), pp. 57-70.	16	0,08%
14. Lohman, Clemens; Fortuin, Leonard; Wouters, Marc (2004): Designing a performance measurement system: A case study. In: European Journal of Operational Research, 156 (2), pp. 267-286.	11	0,05%
34. Azevedo, Susana; Carvalho, Helena; Duarte, Susana; Cruz-Machado, Virgilio. (2012): Influence of Green and Lean Upstream Supply Chain Management Practices on Business Sustainability. In: IEEE Transactions on Engineering Management, 59 (4), pp. 753-765.	11	0,03%

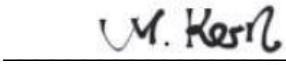
Affidavit

We hereby declare that we have produced the present work independently and without the use of any aids other than those specified. All passages that have been taken literally or analogously from published or unpublished writings are marked as such. The paper has not yet been submitted in the same form or in extracts in the context of other examinations.

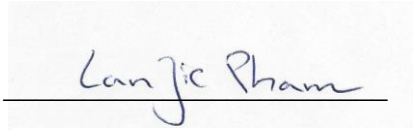
Bremen, 09.06.2021



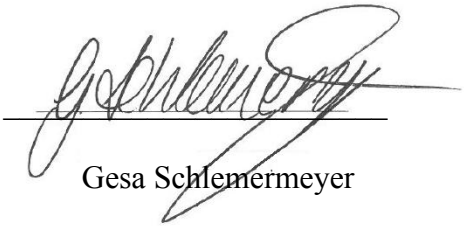
Carina Berg



Marina Kern



Lan Jie Pham



Gesa Schlemermeyer