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Supplier segmentation: A systematic literature review

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Abstract – Supplier Segmentation is one of the key activities of supplier relationship management (SRM) for companies with a large number of suppliers. It involves dividing the suppliers into a manageable number of segments, to formulate SRM strategies for the various segments, rather than for each individual supplier. In recent years, supplier segmentation has drawn the attention of a number of researchers. The aim of this study is to provide a systematic review of existing literature on supplier segmentation and identify the future trend in this research area using a combination of Systematic Literature Review (SLR) and Citation Network Analysis (CNA). After determining the search protocol and paper selection indexes, 52 papers were eventually selected, and analyzed, in accordance with the steps proposed in the SLR and CNA methods. The results show that researchers tend to favor the portfolio-involvement approach and decision-making techniques in supplier segmentation research domain. A comprehensive analysis of the studies made it possible to distill the future research trend. This research area requires further study involving the supply chain paradigms, the impact of supplier segmentation on performance, and the analysis of the supplier relationship management as a whole, with supplier segmentation being one of its components.

Keywords: Supplier Segmentation; Supplier Classification; Purchasing Portfolio; Systematic Literature Review; Citation Network Analysis

1. Introduction

In recent decades, supplier participation has increased dramatically in terms of delivering products and services tailored to customer needs, making supplier management a key element in supply chain management (Jin et al. 2014). Therefore, companies adopt strategies to select, evaluate and manage relationships with their suppliers (Bai et al. 2017). In other words, qualifying, selection, segmentation, monitoring and controlling suppliers have become key elements in supply chain management (Segura and Maroto 2017). Without a systematic approach, working with a large number of suppliers, each with their own competitive advantage, is definitely difficult. According to Dyer et al. (1998) and Oghazi et al. (2016), supplier segmentation involves grouping together suppliers with shared characteristics, which can be grouped on the basis of different models or based on factors that are considered relevant by the decision-maker. As such, supplier segmentation plays a key role in enhancing the firm's operational capabilities in supply management, generating value and synergy in relation to the suppliers (Day et al. 2010). Evidence suggests that supplier segmentation, in theory or in practice, plays an important role in enhancing the performance and efficiency of supply chains. Examining existing studies in this area may shed further light on this issue and its role in the supply chain. To date, no systematic review of existing supplier segmentation literature has been conducted. Nellore and Söderquist (2000) examined existing approaches and Day et al. (2010) evaluated supplier segmentation in certain studies, dividing the relationships into two categories (power and dependence, and relationships). However, they did not include all the relevant aspects of supplier segmentation, while other researchers never went beyond mentioning supplier segmentation in their literature review. Rezaei and Ortt (2012), on the other hand, divided existing supplier segmentation studies into three methods: process, portfolio and

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engagement. Against that background, it is the aim of this paper to conduct a systematic review, using Systematic Literature Review (SLR) and Citation Network Analysis (CAN), to shed light on the issue of supplier segmentation. The two approaches (SLR and CAN) are integrated in a hybrid approach called Systematic Literature Network Analysis (SLNA) (Colicchia and Strozzi 2012). SLR is a method that is used to select articles from multiple and validated databases in accordance to regular protocols, while CNA creates a backbone in a citation network that describes the process of creating, applying knowledge or an issue that has evolved over time.

The contribution of this study is that it provides a comprehensive and systematic review of existing supplier segmentation studies. Also, the approaches, models and techniques available to examine supplier segmentation studies are discussed and analyzed in detail. Finally, relevant future research trends are analyzed.

The remainder of this paper is organized as follows. In Section 2, the concept of supplier segmentation is discussed, along with a summary of the research background. In Section 3, the research methodology is discussed, including the goals and research questions, the article search strategy and data extraction process. In Section 4, the results of this study are presented, starting with a discussion of the selected papers, following by an analysis of the article network and a closer look at the research questions. Finally, in Section 5, the research results and conclusions are presented.

2. Supplier Segmentation

Supplier relationship management (SRM) includes a set of activities related to the interaction between the buying company and its suppliers. As shown in Figure 1, supplier relationship management involves the identification, selection, segmentation, development and evaluation of suppliers. In recent years, many researchers have studied the different areas of SRM separately, but it has not yet been studied as an integrated whole (Glock et al. 2017). The first step of the process is the identification and definition of supplier evaluation indexes. In the second step, the suppliers are selected and ranked. Suppliers who fail to meet the minimum acceptance conditions and quality requirements are either eliminated or developed. In the third step, supplier segmentation takes place, based on the indexes mentioned earlier and the degree of their (past and present) cooperation (Rezaei and Ortt 2012). Next, the modes of interaction and development strategies are determined for every supplier segment, after which the improvement and development of suppliers takes place in accordance with the predefined strategies. And finally, the performance of the different suppliers is evaluated and used as input for the earlier steps of supplier identification, selection and segmentation. Supplier segmentation plays a key role in SRM and failure to get it right can result in a waste of time and money, as well as working together with undesirable suppliers.

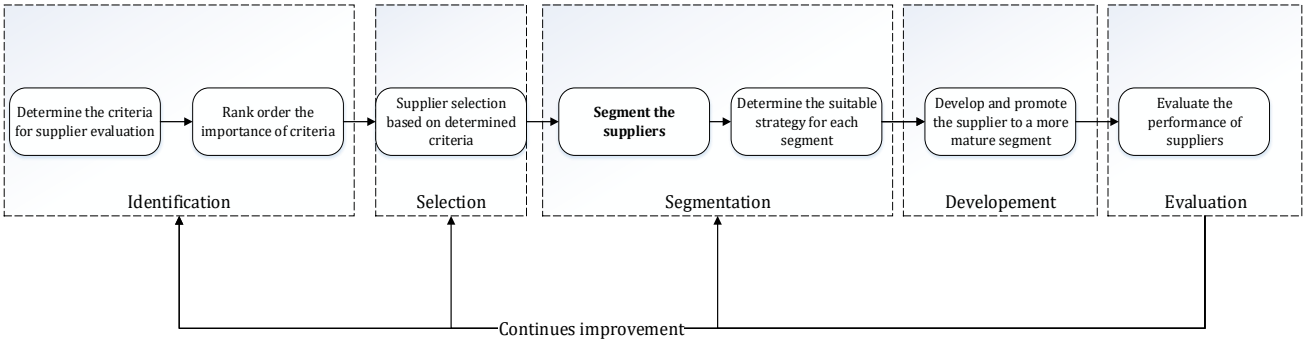

Figure 1: SRM process (Rezaei and Ortt, 2012, Glock et al. 2017)

Supplier Segmentation is a strategic supplier-related activity that takes place between the two processes of supplier selection and supplier development. Whereas consumer segmentation (also known as market segmentation) focuses on the demand side of the market, supplier segmentation (also known as industrial market segmentation or B2B segmentation) has a focus on the supply side of the market (Erevelles and Stevenson 2006, Rezaei and Ortt 2013). Smith (1956) suggested that the theories of perfect competition and pure monopoly are inadequate to explain the market. While the theory of perfect competition is based on the assumption of homogeneity in the components of the market, in general, both demand and supply sides of the market are heterogeneous. Market segmentation "consists of viewing a heterogeneous market (one characterized by divergent demand) as a number of smaller homogeneous markets in response to differing product preferences among

important market segment" (Smith 1956). Since its introduction by Smith, market segmentation has become a central concept in marketing (Wedel and Kamakura 2012). Consumer segmentation which are based on different variables such as geographic, demographic, psychographic, and behavioristic (Beane and Ennis 1987) has purposes such as creating advertising or developing new products (Yankelovich and Meer 2006). Unlike consumer segmentation, which has received a lot of attention in literature, a few studies have been conducted on supplier segmentation, which might have several possible explanations. One explanation is the traditional focus of marketing studies on the demand side of the market (Kotler 1972). Evidence suggests that the concept of market segmentation was introduced by Smith in 1956, while the first supplier segmentation studies were conducted decades later by Parasuraman (1980) and Kraljic (1983). Another explanation is the size of the supply side of the market. That is, while in the demand side, a company might serve thousands of consumers, in the supply side, it might work with a few numbers of suppliers, for instance, in the case of oligopolies. Having a large number of consumers, formulating different strategies to handle individual consumers seems almost impossible (as it needs a lot of resources), and even if it would be possible, it is not efficient (as there is a high chance of finding homogenous groups of consumers). On the other side, when a company works with a few numbers of suppliers, for instance three, it does not seem reasonable to segment them. This implies that supplier segmentation could be efficient when the company works with a relatively large number of suppliers. The supply base size could also vary from small to large companies. For instance, while Dutch manufacturing SMEs (small-to-medium-sized enterprises) work, on average, with 12 suppliers (Rezaei 2012), Philips (Philips Conflict Minerals Report 2017) has approximately 10,000 first tier suppliers.

Supplier segmentation involves grouping suppliers with similar characteristics (Rezaei and Ortt 2012). After segmenting the suppliers, specific strategies are considered to communicate and cooperate with each supplier segment. In his research, Kraljic (1983), a pioneer in the field of supplier segmentation, proposed a two-dimensional approach to supplier segmentation. According to this segmentation, which is based on product characteristics, the products are divided based on the two dimensions of risk and profit, and potential suppliers are classified along the same dimensions. The aim is to minimize supply risk and increase buyer power, known as the Purchasing Portfolio Matrix (PPM) (see Figure 2).

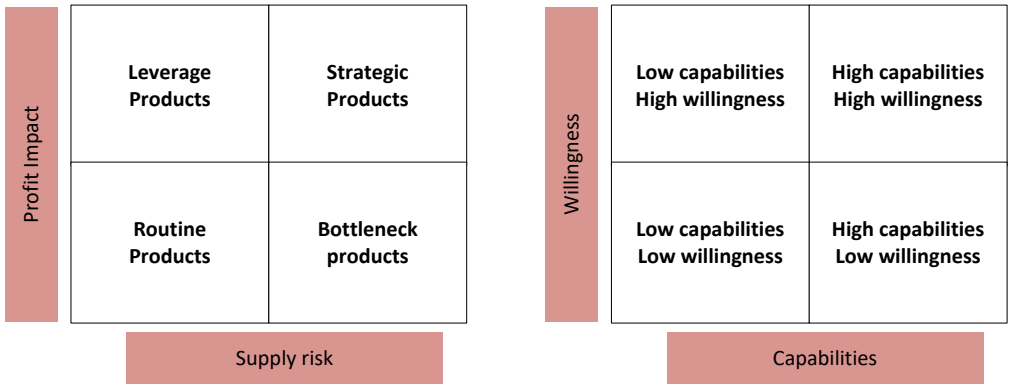

Figure 2. Two popular supplier segmentation models. Left: PPM Model, Right: SPM Model

Following Kraljic, supplier segmentation was also studied by different researchers using a variety of dimensions, although they failed to appeal to a wider audience, as is evident in the findings of our study. Rezaei and Ortt (2012) presented a portfolio model for supplier segmentation called the Supplier Potential Matrix (SPM), which is based on the two dimensions of Capabilities and Willingness (see Figure 2). They define supplier segmentation as "the identification of the capabilities and willingness of suppliers by a particular buyer in order for the buyer to engage in a strategic and effective partnership with the suppliers with regard to a set of evolving business functions and activities in the supply chain management". SPM has been considered by several other researchers (Rezaei and Fallah Lajimi 2019, Santos et al. 2017, Rezaei et al. 2015, Lo and Sudjatmika 2016). The concept of capabilities includes knowledge and experimental ability to coordinate supply chain processes, with the aim of providing a service or product to the buyer, while willingness refers to the commitment and motivation to enter into a long-term cooperation with a buyer. Obviously, supplier segmentation should be based on multiple criteria. Based on existing literature, Rezaei et al. (2015) extracted and proposed a number of criteria for each dimension of capability and willingness. The two approaches, PPM and SPM, appear to complement each other,

with PPM focusing on supplying goods with respect to product characteristics, and SPM emphasizing SRM. Applying these two approaches to companies helps make better decisions when it comes to working together with suppliers (Rezaei and Fallah Lajimi 2019).

Also in practice, Supplier segmentation has been adopted by many companies, here we discuss only a few. Coca-Cola (2017) segments their supply base universe of about 35,000 suppliers to direct (ingredients and packaging suppliers) and indirect (others such as IT, production equipment, spare parts, …) suppliers. They also segment their suppliers to three segments based on two dimensions criticality and potential opportunities: (i) Critical suppliers, those that fulfil criteria such as high percentage of spend, critical components, limited alternatives, and partnership supporting their business strategies; (ii) Country strategic suppliers, those that have strategic importance at a local or regional level; (iii) Tactical suppliers, including low-volume and/or low-spend suppliers, suppliers belonging to markets with many alternative suppliers.

Steelcase (2015), a metal office furniture company segments their hundreds of suppliers to three groups: (i) Ordinary suppliers: those that add significant present value in terms of safety, quality, delivery, and lifecycle cost impact; (ii) Critical suppliers: those that add significant present and future value in terms of quality, cost, innovation, safety, service, etc.; (iii) Problematic suppliers: those that have low performance. United utilities (2019), a water and wastewater company with around 2500 suppliers, segments their suppliers based on performance measures of: customer, regulatory/legal, sustainability/efficiency and health, safety and wellbeing to four segments (from high performance to low): (i) Partner; (ii) Strategic; (iii) Preferred, and (iv) Approved.

Our investigation into many practical implementations of supplier segmentation including the ones mentioned above reveals that companies usually segment their suppliers to a manageable number of segments (for instance, three or four) based on the characteristics of the supply and relationship.

2.1. A Summary of Conducted Literature Review

Supplier segmentation was examined by a number of researchers using a variety of approaches and techniques.

The first review paper on supplier segmentation was published by Nellore and Söderquist (2000), who examined existing approaches to supplier segmentation in automotive companies, establishing a relationship between product categories and supplier characteristics. Svensson (2004) conducted his quantitative research on supplier segmentation in the automotive industry. After reviewing and examining different approaches, a two-dimensional approach was used based on supplier commitment and the importance of commodities among vehicle manufacturers, and accordingly, four supplier relationship strategies were introduced. Finally, a four-step process designed to manage supplier relationships was proposed: analysis of the business environment, analysis of the relationship criteria, selection of the relationship strategy and managerial decisions involving the relationship strategy. Then, with the aid of statistical tests, Svensson analyzed the gap and difference between the research variables and the supplier. Day et al. (2010) found that all studies on supplier segmentation, up to that point, were conceptual or based on questionnaires and case studies. The authors conducted a thorough review of the available articles in terms of market conditions, supplier characteristics, buyer characteristics, and buyer and supplier relationships. They also identified and analyzed the dimensions of supplier segmentation in various researches, after examining the different approaches to supplier segmentation.

Rezaei and Ortt (2013) proposed a different approach to supplier segmentation, which became the basis for many other studies. They developed their new approach based on three requirements: long-term potential-based segmentation, involvement of other business functions beyond purchasing in segmentation process and considering supplier segmentation as one of the steps in selection process and relationship with suppliers. They introduced a two-dimensional approach, involving capability and willingness, along with their criteria, and used fuzzy logic to segment the suppliers of a broiler company. In another study, Rezaei and Ortt (2013) applied a multi-criteria decision-making (MCDM) technique to supplier segmentation, while Rezaei et al. (2015) later used a new method called Best-Worst Method (BWM) to segment the suppliers based on SPM. Santos et al. (2017) exploited SPM approach and AHP and multiple fuzzy linguistic methods to segment the suppliers of a pharmaceutical supply center of a teaching hospital.

3. Research Methodology

Using two review methods, this study provides a comprehensive analysis of supplier segmentation, based on a

systematic literature review and citation network analysis.

In recent decades, systematic literature reviews have attracted the attention of many researchers in different areas (Morioka and Carvalho 2016, Gosling and Naim 2009, Colicchia and Strozzi 2012). Here we describe the stages needed to conduct the systematic literature reviews and citation analysis. In the first stage, in which the research structure is created, the goals and questions are specified, after which a search protocol and paper analysis are conducted and the method of analysis specified. In the second phase, the activities required to collect, extract, and analyze the studies that were qualitatively evaluated are carried out, while the citation network analysis method is used in the third stage. In this method, the citation network of existing papers is formed and analyzed, and the main path analysis is performed in which the key articles in each time period are specified based on existing citations. In the final phase, the analysis of the results and suggestions are presented. The systematic review in this study took place between August and December of 2021. In the following section, the activities that took place at in each stage are discussed in greater detail.

3.1. Systematic Literature Review and Citation Network Analysis

A systematic literature review (SLR) involves the identification, assessment and reporting of all existing studies involving a related area or specific subject that is a secondary study of earlier articles and studies (Kitchenham et al. 2010). A systematic literature review can be used to identify gaps in existing research and provide suggestions for organizing or preparing the framework of new research activities. A systematic review should be based on a predetermined search strategy with the ability to evaluate research. Reviewing existing literature allows researchers to assess the accuracy, comprehensiveness and duplication of existing research processes and collect information about the effectiveness of empirical methods, or identify techniques that received less attention in the papers under examination. Moreover, SLR provides the possibility of combining the data used in quantitative research, using meta-analysis. Because SLR requires a great deal of effort to review the existing studies, in the first step of the systematic review, a review protocol should be specified that includes the research questions and review methods, as well as clear inclusion and exclusion criteria.

Citation Analysis is a scientific method used to evaluate various research based on citations. Citation analysis is one branch of the Citation Network Analysis first developed by Garfield et al. (1996). When an article is cited frequently, that indicates it has contributed more to knowledge enhancement (Small 1978). The main purpose of network analysis is to identify and describe different patterns among different actors, even though the actors involved are different in terms of research type (Nooy et al. 2011). Citation Network Analysis is used to analyze the data on two levels. On a static level dimension, it deals with the citation analysis of the network, while on a dynamic level, Main Path Analysis is presented (Colicchia and Strozzi 2012).

3.2. Goals and Research Questions

The main purpose of this study is to review existing studies on supplier segmentation and to predict future trends. It is necessary to list a few research questions that fit the purpose and are in accordance with SLR procedure. The research questions include:

- **RQ1**: Which supplier segmentation *approaches* have been adopted in the studies being analyzed?
- **RQ2**: Which *models* have been used for supplier segmentation?

In fact, the difference between approach and model can be expressed by that researcher use specific approaches and thought patterns to construct and develop segmentation models. In other words, approaches are the intellectual foundations for model presentation.

- **RQ3**: Which *techniques* have been used for supplier segmentation in the studies under analysis?
- **RQ4**: What is the trend for future research in the field of supplier segmentation?

3.3. Search Strategy and Research Resources

After setting goals and questions, the studies to be analyzed had to be identified. The digital databases used in this study are Emerald, Google Scholar, IEEE, Sciencedirect, Scopus, and Springer. The keywords used included “Supplier Segmentation”, “Supplier Clustering”, “Supplier Classification”, “Supplier Categorization”, “Purchasing Portfolio” and “Kraljic”. Supplier clustering is a subject that has been included in segmentation

studies. Since Kraljic was a pioneer in supplier segmentation, much of the research in this area is based on his model, which is why we include "Purchasing Portfolio" and Kraljic in the list of keywords as well.

Conducting the search process, 200 preliminary papers were identified through the use of keywords in different databases. Based on the title (61 rejected papers), abstract (26 rejected papers), only journal papers in English (33 rejected papers), and text review (29 rejected papers), a number of studies were excluded, leaving a total of 52 papers for the actual analysis.

3.4. Extraction of The Required Data

The Data Extraction List contains the required information on the articles' characteristics. This data should be extracted from the final selection of papers, which is a combination of general information (the year of publication, place of publication, citations, and the names of the authors) and research questions (approaches, models, techniques, and future trend).

4. Study Result

4.1. Selection of Papers and Studies

Table 1 shows the final list of articles. In the remainder of the study, all reports and analyses are based on these 52 articles.

Table 1. Selected studies (52)

Authors (Year)	Title
Parmar et al. (2010)	A clustering algorithm for supplier base management
Segura and Maroto (2017)	A multiple criteria supplier segmentation using outranking and value function methods
Rezaei and Ortt (2012)	A multi-variable approach to supplier segmentation
Olsen and Ellram (1997)	A portfolio approach to supplier relationships
Zhu et al. (2010)	A portfolio-based analysis for green supplier management using the analytical network process
Luzzini et al. (2012)	A transaction costs approach to purchasing portfolio management
Brun and Pero (2011)	Assessing suppliers for strategic integration: a portfolio approach
Gangurde and Chavan (2016)	Benchmarking of purchasing practices using Kraljic approach
Day et al. (2010)	Evaluating the bases of supplier segmentation: A review and taxonomy
Hallikas et al. (2005)	Risk-based classification of supplier relationships
Moeller et al. (2006)	A Framework for Supplier Relationship Management (SRM)
Trautmann et al. (2009)	Global sourcing in integrated network structures: The case of hybrid purchasing organizations
Gelderman and Van Weele (2003)	Handling measurement issues and strategic directions in Kraljic's purchasing portfolio model
Knight et al. (2014)	Integrating skills profiling and purchasing portfolio management: An opportunity for building purchasing capability
Rezaei et al. (2015)	Linking supplier development to supplier segmentation using Best Worst Method
Gelderman and Semeijn (2006)	Managing the global supply base through purchasing portfolio management
Hesping and Schiele (2016)	Matching tactical sourcing levers with the Kraljic matrix: Empirical evidence on purchasing portfolios
Hudnurkar et al. (2016)	Multi-criteria decision framework for supplier classification in collaborative supply chains: Buyer's perspective
Rezaei and Ortt (2013a)	Multi-criteria supplier segmentation using a fuzzy preference relations based AHP
Montgomery et al. (2018)	A quantified Kraljic Portfolio Matrix: Using decision analysis for strategic purchasing

Authors (Year)	Title
Padhi et al. (2012)	Positioning of commodities using the Kraljic Portfolio Matrix
Caniëls and Gelderman (2007)	Power and interdependence in buyer supplier relationships: A purchasing portfolio approach
Caniëls and Gelderman (2005)	Purchasing strategies in the Kraljic matrix-A power and dependence perspective
Torres-Ruiz and Ravindran (2018)	Multiple criteria framework for the sustainability risk assessment of a supplier portfolio
Medeiros and Ferreira (2018)	Development of a purchasing portfolio model: an empirical study in a Brazilian hospital
Lo and Sudjatmika (2016)	Solving multi-criteria supplier segmentation based on the modified FAHP for supply chain management: a case study
Gelderman and Van Weele (2002)	Strategic direction through purchasing portfolio management: a case study
Nudurupati et al. (2015)	Strategic sourcing with multi-stakeholders through value co-creation: An evidence from global health care company
Dyer et al. (1998)	Strategic supplier segmentation: “The next best practice" in supply chain management
Bai et al. (2017)	Multicriteria Green Supplier Segmentation
Svensson (2004a)	Supplier segmentation in automotive industry: A dyadic approach of a managerial model
Rezaei and Ortt (2013b)	Supplier segmentation using fuzzy logic
Drake et al. (2013)	The lean and agile purchasing portfolio model
Bensaou (1999)	Portfolios of buyer-supplier relationships
Kaufman et al. (2000)	Collaboration and technology linkages: a strategic supplier typology
Kraljic (1983)	Purchasing must become supply management
Masella and Rangone (2000)	A contingent approach to the design of vendor selection systems for different types of co-operative customer/ supplier relationships
Nellore and Söderquist (2000)	Portfolio approaches to procurement: Analyzing the missing link to specifications
Svensson (2004b)	Interactive vulnerability in buyer-seller relationships: a dyadic approach
Tang (1999)	Supplier relationship map
Parasuraman (1980)	Vendor Segmentation: An Additional Level of Market Segmentation
Santos et al. (2017)	A model based on 2-tuple fuzzy linguistic representation and Analytic Hierarchy Process for supplier segmentation using qualitative and quantitative criteria
Rezaei et al. (2017)	Embedding carbon impact assessment in multi-criteria supplier segmentation using ELECTRE TRI-rC
Ferreira et al. (2015)	Development of a purchasing portfolio model for the construction industry: an empirical study
Hadeler and Evans (1994)	Supply strategy: capturing the value
Boujelben (2017)	A unicriterion analysis based on the PROMETHEE principles for multicriteria ordered clustering
Parkouhi et al. (2019)	Resilient supplier selection and segmentation in grey environment
Rezaei and Fallah Lajimi (2019)	Segmenting supplies and suppliers: bringing together the purchasing portfolio matrix and the supplier potential matrix
Duc et al. (2021)	A dynamic generalized fuzzy multi-criteria croup decision making approach for green supplier segmentation
Rajesh and Raju (2021)	A fuzzy inference approach to supplier segmentation for strategic development
Matshabaphala and Grobler (2021).	Supplier segmentation: a case study of Mozambican cassava farmers
Rius-Sorolla et al. (2020)	Multivariable Supplier Segmentation in Sustainable Supply Chain Management

Figure 3 shows the evolution of the final papers, based on publication year, covering 41 years (from 1980 to 2021). The number of published articles can inform the researchers about the existing situations and facilitate the research process in the field of supplier segmentation. According to this diagram, about 62% of the articles in this field had been published since 2010. It is expected that this trend will continue. Table 2 lists the number of articles published in different journals, with the Journal of Purchasing and Supply Management coming in first with 6 papers (11.54% of the total number of articles). Also, more than 63.46% of the articles (of the 33 selected articles) were published in only 12 journals.

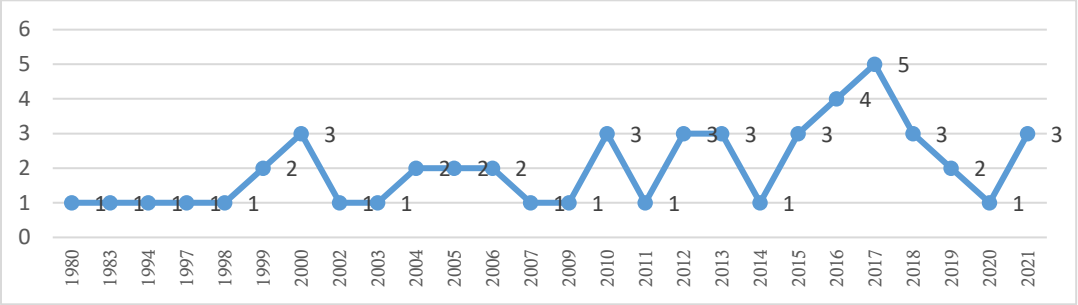

Figure 3. Number of papers in years between 1980-2021 Note: Part of year 2021 only. Years not shown have zero publication.

Table 2. Number of papers published in Journals

Journal	Count
Journal of Purchasing and Supply Management	6
Industrial Marketing Management	5
International Journal of Production Economics	3
Expert Systems with Applications	3
International Journal of Logistics Research and Applications	2
International Journal of Operations and Production Management	2
International Journal of Physical Distribution and Logistics Management	2
International Journal of Production Research	2
Journal of Cleaner Production	2
Supply Chain Management: An International Journal	2
Production Planning and Control	2
South African Journal of Industrial Engineering	2
Annals of Operations Research	1
Benchmarking: An International Journal	1
California management review	1
European Journal of Operational Research	1
Harvard Business Review	1
Transactions on Engineering Management	1
Industrial Management	1
International Journal of Business Excellence	1
International Journal of Productivity and Performance Management	1
Journal of Business-to-Business Marketing	1
Journal of Supply Chain Management	1
Long Range Planning	1
Omega	1
Plos One	1
MIT Sloan Management Review	1
Soft Computing	1
Strategic Management Journal	1
Sustainability	1

4.2. Citation Network Analysis

According to Nooy et al. (2011), the most important issue in the CNA is the definition of a network. The purpose of CNA is to identify the research domains and determine the evolutionary path of research to date (Colicchia and Strozzi 2012). In that sense, the CNA approach offers a more objective analysis than SLR.

In this study, various articles are considered to be network nodes. As stated earlier, the CNA is examined from two perspectives, both of which will be described in further detail in this study.

To conduct the CNA analysis, a zero and one matrix was created for the selected articles in the citation network, with 1 indicating that the article in the row used the article in the related column as the reference, and 0 indicating that that was not the case.

In the static dimension, 52 papers which were selected between 1980-2019, and examined using UCINET software, with which effective and influential research can be identified (Borgatti et al. 2002), the results of which are shown in Figure 4, where the articles were considered as nodes, and the size of each node indicates the number of the references to this article in other studies.

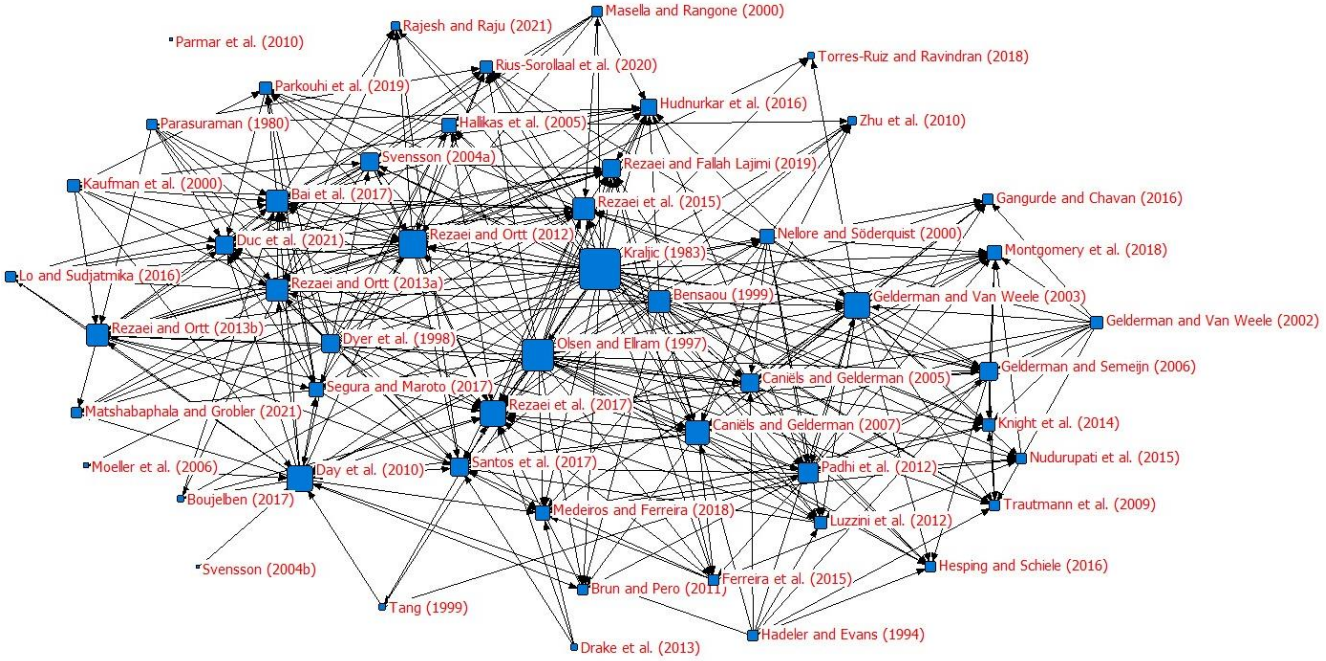

Figure 4. Citation network

The node with a highest number of connections in the network is the article by Kraljic, which was published in 1983, and which was referred by 40 out of the 51 other articles reviewed in our study. The size of the nodes can also be deduced from the data presented in Table 3, where the top 10 articles with the highest Local Citation Score (LCS) are shown in greater detail. In Table 3, the title of the article is accompanied by the names of the author and of the journal, the year of publication, and LCS and Global Citation Score (GCS). The LCS indicates how many of the 52 articles included in this study refer to a specific article, while the GCS represents the number of articles refer to a specific article considering all the databases. The article by Kraljic is ranked first in Table 3, followed by "A portfolio approach to supplier relationships" and "Portfolios of buyer-supplier relationships".

The final column of the table contains the Centrality criterion, which indicates the influence of an article based on the amount of relationship that it has within the network. Centrality is an indication of the status of an article among other articles, and the way each article is linked to other articles. The paper by Kraljic has the highest Centrality of 0.169.

Table 4 lists the most influential journals, organized on the basis of the Total Local Citation Score (TLCS). The most influential journal is Industrial Marketing Management, with the highest number of articles involving Supplier Segmentation being published in that journal. Harvard Business Review, Industrial Marketing

Management and MIT Sloan Management Review have the highest Total Global Citation Score (TGCS) (all the citations – according to all databases- which are received by the papers published in that journal).

Table 3. Information about the highest Closeness Centrality Articles

Title	Author	LCS	GCS	Centrality
Purchasing must become supply management	Kraljic (1983)	40	3658	0.169
A portfolio approach to supplier relationships	Olsen and Ellram (1997)	29	1029	0.082
Portfolios of buyer-supplier relationships	Bensaou (1999)	21	1473	0.058
Strategic supplier segmentation: The next best practice" in supply chain management"	Dyer et al. (1998)	17	1053	0.054
Handling measurement issues and strategic directions in Kraljic's purchasing portfolio model	Gelderman and Van Weele (2003)	18	357	0.049
Power and interdependence in buyer supplier relationships: A purchasing portfolio approach	Caniëls and Gelderman (2007)	14	489	0.034
A multi-variable approach to supplier segmentation	Rezaei and Ortt (2012)	16	145	0.035
Evaluating the bases of supplier segmentation: A review and taxonomy	Day et al. (2010)	13	128	0.028
Strategic direction through purchasing portfolio management: a case study	Gelderman and Van Weele (2002)	10	218	0.027
Portfolio approaches to procurement: Analysing the missing link to specifications	Nellore and Söderquist (2000)	10	253	0.025

Table 4. Information about 10 most influential journals sorted by TLCS

Journal	Records	TLCS	TGCS
Industrial Marketing Management	5	74	1783
Journal of Purchasing and Supply Management	6	52	1333
Harvard Business Review	1	40	3658
MIT Sloan Management Review	1	21	1473
California management review	1	17	1053
International Journal of Physical Distribution and Logistics Management	3	16	493
International Journal of Production Research	2	16	187
Journal of Supply Chain Management	1	16	218
Long Range Planning	1	11	253
Strategic Management Journal	1	10	526

In terms of network structure dynamics, the Main Path Analysis method is used to identify the leading articles in each time period, and to outline the main direction of the trends in these papers (Colicchia and Strozzi 2012). This method was proposed by Hummon and Dereian (1989) to determine the main direction of a scientific field in a citation network of scientific papers. Since then, many researchers have implemented this method for network analysis in the domains of designing technological development pathways (Park and Magee 2017, Kuan et al. 2018), the study of technological changes and the knowledge direction (Lucio-Arias and Leydesdorff 2008) and literature review (Colicchia and Strozzi 2012, Zhouet al. 2018, Fan et al. 2014, Calero-Medina and Noyons 2008). According to this method, there is a link between each two nodes (papers), and that link has a certain weight. After the formation of the zero and one network, the weight of each path is calculated as $Weight_{ij} = TP_{ij} / TSS_j$, where TP_{ij} shows the total number of paths in network *j* that includes citation *i*, andTSS_j shows the total number of paths between the sources (an article that is not citing any others) and the sinks (an article that is not cited by others) in network *j*, which is called the Search Path Count (SPC) method (Batagelj 2003).

In the next step on the main paths, using the traversal weights, the links between the articles are extracted that are viewed as the main flow and the main pathway of the literature. Finally, the main elements (or the main nodes) of the main path are selected, using the numbers between zero and one as the threshold for the removal of non-

essential elements, with the default number being 0.5. To determine the Main Path Analysis in this study, the Pajek software was used (Nooy et al. 2011), as shown in Figure 5.

In this graph, which is the backbone of the research process governing supplier segmentation, the key articles are displayed in each time period. The articles are not selected based on their number of citations, but instead on the maximum total of citations in all the paths over time. Using the $weight_{ij}$ formula mentioned above, 13 articles were selected from 1980 to 2018 and sorted in the graph.

The head of this graph displays the research by Kraljic, which is referred to as the origin of Supplier Segmentation studies. After Kraljic, there were a number of studies that focused on his model, examining how to use the portfolio model in practice.

The research by Olsen and Ellram (1997) is located at the second point of the Main Path graph. Several studies were conducted during the years 1983 to 1997, and, after the study by Kraljic, the research by Olsen and Ellram (1997) was a turning point in the Supplier Segmentation studies. In accordance with Kraljic's portfolio model, they addressed supplying goods and the relationships with suppliers on the basis of two dimensions - relative supplier attractiveness and relationship strength.

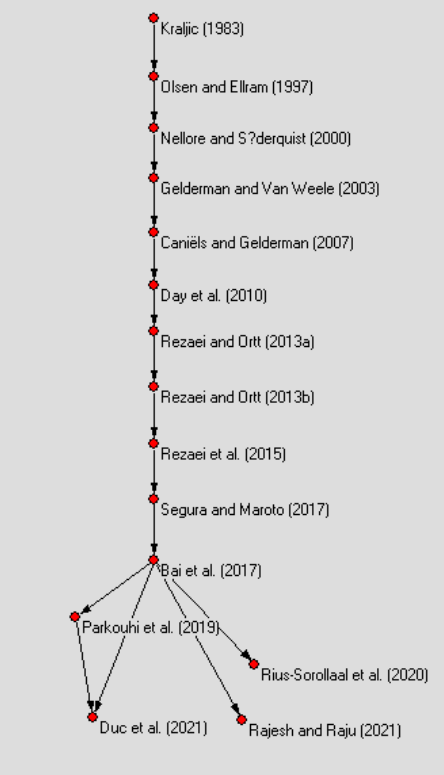

Figure 5. Main path

Nellore and Söderquist (2000) reviewed the studies and application of the models proposed by Kraljic (1983), Olsen and Ellram (1997) and Bensaou (1999). Perhaps a thorough review of earlier models by these researchers was the reason Olsen and Ellram (1997) was included as one of the turning points in this graph. The most important result of the research by Olsen and Ellram (1997) was the establishment of a relationship between the type of product and it's capability and capacity of the suppliers involved.

The next node in Main Path is related to the research by Gelderman and Van Weele (2003), who reviewed various aspects of the model proposed by Kraljic, and identified the strategies for staying in one section or moving from any part of the model to another part.

Caniëls and Gelderman (2007) analyzed the power and interdependence of the buyer and supplier in each of the four areas of Kraljic's model, and showed that level of influence and reliance of each of the two main members of the value chain – the buyer and the supplier – in each of these regions. They found that, for the first and fourth

regions (strategic and non-critical goods), the degree of dependency of the buyer and supplier is equal, backing their claims with data obtained from a survey.

There was a clear change in how supplier segmentation is approached in the study by Rezaei and Ortt (2012, 2013a,b). In the two successive studies, reviewing all the previous models and approaches in supplier segmentation, the authors identified two key dimensions in the way buyers deal with suppliers. In the capability dimension, they assessed the knowledge, skills and experience of the suppliers, and in the willingness dimension, they examined the level of commitment and motivation of the supplier to cooperate. In the next sections of this study, we can see that the introduction of those two dimensions to supplier segmentation changed research approaches and attitudes towards supplier segmentation.

Continuing their research into supplier segmentation, Rezaei and Ortt (2013b) used a rule-based system to create the conditions for the relationships between variables, dividing suppliers into four segments and conducting a sensitivity analysis. The research by Rezaei and Ortt paved the way for the introduction of Multi-Criteria Decision-Making techniques to Supplier Segmentation. In another research, Rezaei et al. (2015), after segmenting the suppliers by best-worst method (BWM), identified and introduced strategies for improving or maintaining the suppliers in each segment.

In the paper by Bai et al. (2017), which dealt with supplier segmentation in green supply chain, using the SPM approach, the criteria of these two dimensions were identified and used to incorporate clustering techniques and VIKOR to segment the suppliers of a large chemical company.

The study by Medeiros and Ferreira (2018) is one of the most recent studies in the area of supplier segmentation. Using the Kraljic model as a basis for segmentation, and using Fuzzy TOPSIS technique, supplier segmentation was applied to a large Brazilian hospital, after reviewing all major studies based on Kraljic's model, and identifying two criteria (Supply Risk and Profit Impact) to assess suppliers.

Parkouhi et al. (2019) examined the segmentation, selection and development of resilient suppliers. The authors looked at two dimensions –Enhancer and Reducer. The criteria used to identify resilient suppliers from a literature review were divided into those two dimensions. After determining the weight of the criteria, via the DEMATEL method, and ranking the suppliers on the dimensions, using the SAW method, the suppliers were divided into four segments (Vulnerable, Volatile, Sensitive and Resilient). Finally, to manage the suppliers, the suppliers in the resilient section were selected as resilient suppliers, after which a number of strategies were suggested to develop the suppliers in the other segments.

In the paper by Rius-Sorolla et al. (2020), provided a framework for segmenting sustainable suppliers. This article provides feedback on senior management responsibilities in sustainable development and guidance on how to coordinate sustainable development in the supply chain.

Finally, two studies were conducted in 2021. Duc et al. (2021), used dynamic generalized fuzzy multi-criteria group decision making and capability and willingness dimensions in an environment of uncertainty to segment green suppliers. Rajesh and Raju (2021), also presented a new approach to segmenting strategic suppliers based on the dimensions of agility capability and business excellence.

4.3. Answer to Research Questions

RQ1: Approaches used. In response to the first research question, it is necessary first to define different approaches to segmentation. In their research, Rezaei and Ortt (2012) divided the existing supplier segmentation approaches into three categories. 1) A process approach in which supplier segmentation is based on the key characteristics of customer segmentation. Parasuraman (1980) is among the first authors to discuss the process approach to supplier segmentation. He suggested that supplier segmentation is a logical step after customer segmentation; 2) The Portfolio approach, which Kraljic (1983), another pioneer in supplier segmentation, first applied to purchasing and supplier segmentation; 3) The collaborative approach, in which the level of participation determines the type of relationship. Olsen and Ellram (1997), for example, identified a continuum of supply chain relationships that includes short-term contracts, long-term contracts, joint ventures and equal interests. Of course, in recent years, a combination of different approaches has been used in various studies. The data in Table 5 indicate the frequency with which different approaches were applied in studies on supplier segmentation.

Table 5. Approaches used in Supplier Segmentation (RQ1)

Approach	**Covered by study**
Portfolio and involvement (21 papers)	Rezaei and Ortt (2012) , Hallikas et al. (2005), Trautmann et al. (2009), Knight et al. (2014), Rezaei et al. (2015), Rezaei and Ortt (2013a), Lo and Sudjatmika (2016), Bai et al. (2017), Svensson (2004a), Rezaei and Ortt (2013b), Bensaou (1999), Kaufman et al. (2000), Masella and Rangone (2000), Svensson (2004b), Tang (1999), Santos et al. (2017), Rezaei et al. (2017), Boujelben (2017), Parkouhi et al. (2019) and Rezaei and Fallah Lajimi (2019), Duc et al. (2021)
Involvement (1 paper)	Dyer et al. (1998)
Portfolio (26 papers)	Segura and Maroto (2017), Olsen and Ellram (1997), Zhu et al. (2010), Luzzini et al. (2012), Brun and Pero (2011), Gangurde and Chavan (2016), Moeller et al. (2006), Gelderman and Van Weele (2003), Gelderman and Semeijn (2006), Hesping and Schiele (2016), Hudnurkar et al. (2016), Montgomery et al. (2018), Padhi et al. (2012), Caniëls and Gelderman (2007), Caniëls and Gelderman (2005), Torres-Ruiz and Ravindran (2018), Medeiros and Ferreira (2018), Gelderman and Van Weele (2002), Nudurupati et al. (2015), Drake et al. (2013), Kraljic (1983), Ferreira et al. (2015), Hadeler and Evans (1994), Rajesh and Raju (2021), Matshabaphala and Grobler (2021), Rius-Sorolla et al. (2020)
Process (1 paper)	Parasuraman (1980)
No approaches (3 papers)	Parmar et al. (2010), Day et al. (2010), Nellore and Söderquist (2000)

Portfolio and hybrid approaches were used with the greatest frequency. In three articles, no approach is adopted, two articles are in the form of review, and in one, a clustering method has been used, and some indexes, which were mainly related to information systems, which became the basis for the segmentation.

It appears that process approach introduced by Parasuraman (1980) has not been adopted by other researchers. What he suggests is to link supplier segmentation to consumer segmentation. That is, while a supplier might be a good supplier serving particular needs of a consumer segment, that supplier might not be the best for another segment of consumers. We think this is a very effective approach to segment the suppliers for trading companies as it looks at the entire value chain. One explanation for this approach not getting attention by other researchers might be its focus on trading companies. It is not a proper approach for manufacturing companies that use suppliers for their raw materials. For manufacturing companies, it might not be necessary to link the supplier segments to the consumer segments as the material which is supplied by a particular supplier could be used in producing different products for serving different consumer segments.

The involvement approach proposed by Dyer et al. (1998) has a focus on the relationship between the buyer and suppliers. Although it makes a clear distinction between different types of partnership, as it generates two segments of suppliers it might not be effective enough. We think that this approach can be more effective if it is used in combination with other segmentation approaches or in a hierarchical segmentation as proposed by Wind and Cardozo (1974).

The portfolio approach initiated by Kraljic (1983) has been the dominant approach in supplier segmentation. We think its popularity is due to its excellent way of segmenting the supplies in terms of two dimensions supply risk and profit impact. However, it suffers from several issues which is the reason behind its recent popularity decline. The portfolio approach proposed more than three decades ago when purchasing had a more operational function. Today, by considering the more strategic role of purchasing and supply management, portfolio approach which has a focus on ‘supply’ and not the ‘supplier’ cannot be used as a tool to solve the strategic relationship between the buyer and its suppliers (Rezaei and Fallah Lajimi 2019). We think a successful supplier relationship management relies on a segmentation which considers all aspects of the relationship. Rezaei et al. (2019), reviewing some definitions of supply chain management identify four common elements in the definitions including: actors, elements of exchange (e.g., material, information), coordination, objectives (e.g., minimizing costs). As such, a proper supplier segmentation should consider all these elements, which have been considered in the other approach, portfolio and involvement.

In fact, 'portfolio and involvement' approach, which is the latest development in supplier segmentation is the most mature approach to supplier segmentation. This approach looks at all the four elements mentioned above and not only looks at the characteristics of supply, it also considers the characteristics of the suppliers. We think that this approach is also very well in line with the strategic function of purchasing and supply management. Rezaei and Fallah Lajimi (2019) have combined the Kraljic approach with this approach which has the most comprehensive view on both supplies and suppliers.

RQ2: Model used. Supplier segmentation studies are based on a number of dimensions (each containing a number of variables), which are used as a basis for the segmentation. We define a supplier segmentation model based on the dimensions it uses. Table 6 lists the dimensions that are used in the various studies and their frequency. The dimensions proposed by Kraljic (Supply Risk, Profit Impact) provide the basis of 17 supplier segmentation studies. The Kraljic's model is based on the characteristics of supplying goods by the supplier. In their study, Rezaei and Ortt (2012) introduced two dimensions based on relationships with suppliers, introducing a number of variables (criteria) under the two dimensions of capability and willingness. Based on those dimensions (and the associated criteria), suppliers are divided into four segments. The dimensions of capability and willingness are found in ten of the papers in Table 6. Because in some of the articles, an overview is presented or clustering techniques are applied, general dimensions were used in 5 articles. All the other 15 dimensions were used only once in the intended study.

Table 6. Dimension used in Supplier Segmentation studies (RQ2)

Dimensions	**Covered by study**	**Number of studies**
Products and Suppliers	Segura and Maroto (2017)	Total= 1
Agility & Business excellence	Rajesh and Raju (2021)	Total= 1
Agility and Leanness	Drake et al. (2013)	Total= 1
Capabilities and Willingness	Rezaei and Ortt (2012), Rezaei et al. (2015), Rezaei and Ortt (2013a), Lo and Sudjatmika (2016), Bai et al. (2017), Rezaei and Ortt (2013b), Santos et al. (2017), Rezaei et al. (2017), Boujelben (2017), Duc et al. (2021)	Total= 10
Cost control and risk reduction	Hadeler and Evans (1994)	Total= 1
Customization, Supply market volatility, Technological uncertainty and Supplier power	Luzzini et al. (2012)	Total= 1
Durable arms-length and strategic partnership	Dyer et al. (1998)	Total= 1
Economies of Process and Economies of Information and Economies of Scale	Trautmann et al. (2009)	Total= 1
Strategic importance and Relationship contribution	Moeller et al. (2006)	Total= 1
Strategic importance of part to the buyer and buyers bargaining power	Tang (1999)	Total= 1
Supplier dependency risk and Buyer dependency risk	Hallikas et al. (2005)	Total= 1
Supply risk and Profit impact	Olsen and Ellram (1997), Brun and Pero (2011), Gangurde and Chavan (2016), Gelderman and Van Weele (2003), Gelderman and Semeijn (2006), Hesping and Schiele (2016), Montgomery et al. (2018), Padhi et al. (2012), Caniëls and Gelderman (2007), Caniëls and Gelderman (2005), Torres-Ruiz and Ravindran (2018), Medeiros and Ferreira (2018), Gelderman and Van Weele (2002), Nudurupati et al. (2015), Kraljic (1983), Ferreira et al. (2015), Rius-Sorolla et al. (2020)	Total= 17

Dimensions	Covered by study	Number of studies
Supply risk and Profit impact and Capabilities and Willingness	Hudnurkar et al. (2016), Rezaei and Fallah Lajimi (2019)	Total= 2
Suppliers commitment and Commodity importance	Svensson (2004a), Svensson (2004b)	Total= 2
Suppliers Relative Power and Suppliers Overall Performance	Zhu et al. (2010)	Total= 1
Suppliers specific investments and Buyers specific investments	Bensaou (1999)	Total= 1
Technology and Collaboration	Kaufman et al. (2000)	Total= 1
Time frame and Content reducer resiliency and enhancers resiliency	Masella and Rangone (2000)	Total= 1
	Parkouhi et al. (2019)	Total= 1
No dimension	Parmar et al. (2010), Day et al. (2010), Knight et al. (2014), Nellore and Söderquist (2000), Parasuraman (1980), Matshabaphala and Grobler (2021)	Total= 6

It appears that two models are dominant in literature: the one proposed by Kraljic's in 1983 with two dimensions supply risk and profit impact (16 studies), and the one proposed by Rezaei and Ortt (2012) with the two dimensions capabilities and willingness. The other models, however, have not attracted the attention of researchers. We think that the reason behind the popularity of these two models is the comprehensiveness of these two models. Although the other models have considered some important dimensions in segmenting the suppliers, they are not able to provide a full picture. It is also interesting to see the effort of researchers in combining some of these models (e.g. Rezaei and Fallah Lajimi 2019). When combining the models, the number of segments increases. For instance, while using Kraljic or Rezaei and Ortt models, usually four segments are resulted, combining the two, we end up with 16 segments. We think that for a company that is working with a relatively small number of suppliers (for instance, 50), it is better to use a model which results in a few numbers of segments, while a company that is working with hundreds or thousands of suppliers combining the models could be more efficient as, for instance, segmenting 2000 suppliers to 16 segments does not seem unreasonable while it does not seem efficient to segment 50 suppliers to 16 segments.

RQ3: Techniques used. The third research question is related to the techniques used in supplier segmentation studies. In recent years, MCDM techniques have been used in many supplier segmentation researches. Almost all the MCDM studies (23 studies) were published from 2010 onward. Fourteen articles used the conceptual approach, which ranked second, after the MCDM techniques, and as shown in Table 7, nine papers used statistical and clustering techniques.

It appears that MCDM methods and statistical techniques are the dominant techniques in supplier segmentation studies that work with data. This is mainly due to the nature of the problem. That is to say, in supplier segmentation we have data on different dimensions (model) of the supplies, suppliers or the relationship and we need a technique to aggregate the data on the variables under each dimension and then segment (or cluster or classify or sort) the suppliers. If we want to incorporate the preferences of the decision-maker (who is the buying company here), in the segmentation task, usually MCDM are the most proper techniques. Whereas if we do not want to incorporate the opinion of the decision-maker in the segmentation, statistical techniques seem more relevant. It is important to also consider the size of the supply base. While for statistical techniques we usually need a relatively large number of observations, MCDM methods work very well with a small number of observations. Nevertheless, MCDM methods are also proper for segmenting large number of suppliers. It is surprising not to see the applications of other promising classification techniques such as machine learning (Kotsiantis et al. 2007) or neural networks (Zhang 2000) in this area.

Table 7. Techniques used in Supplier Segmentation studies (RQ3)

Technique	Covered by study
Statistical tests and Clustering (13 papers)	Parmar et al. (2010), Luzzini et al. (2012), Brun and Pero (2011), Gangurde and Chavan (2016), Hallikas et al. (2005), Knight et al. (2014), Hesping and Schiele (2016), Caniëls and Gelderman (2007), Caniëls and Gelderman (2005), Svensson (2004a), Kaufman et al. (2000), Svensson (2004b), Matshabaphala and Grobler (2021)
Conceptual (14 papers)	Moeller et al. (2006), Trautmann et al. (2009), Gelderman and Van Weele (2003), Gelderman and Semeijn (2006), Hudnurkar et al. (2016), Gelderman and Van Weele (2002), Nudurupati et al. (2015), Dyer et al. (1998), Bensaou (1999), Kraljic (1983), Masella and Rangone (2000), Tang (1999), Parasuraman (1980), Hadeler and Evans (1994)
Multi Criteria Decision Making (23 papers)	Segura and Maroto (2017), Rezaei and Ortt (2012), Olsen and Ellram (1997), Zhu et al. (2010), Rezaei et al. (2015), Rezaei and Ortt (2013a), Montgomery et al. (2018), Padhi et al. (2012), Torres-Ruiz and Ravindran (2018), Medeiros and Ferreira (2018), Lo and Sudjatmika (2016), Bai et al. (2017), Rezaei and Ortt (2013b), Drake et al. (2013), Santos et al. (2017), Rezaei et al. (2017), Ferreira et al. (2015), Boujelben (2017), Parkouhi et al. (2019), Rezaei and Fallah Lajimi (2019), Duc et al. (2021), Rajesh and Raju (2021), Rius-Sorolla et al. (2020)
Review (2 papers)	Day et al. (2010), Nellore and Söderquist (2000)

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RQ4: Future Trend. The final research question involves research trends in the area of supplier segmentation. To answer that question, we use the answers to the earlier questions. In Figure 6, which presents a cumulative diagram of the number of articles in terms of the techniques being used, it can be seen that, at the beginning, most papers in this field were focused on the conceptualization of segmentation, which seems natural for establishing a new concept. After 2004, that has changed, and the articles became more practical. Between 2004 and 2012, supplier segmentation research tended to use clustering and statistical techniques. After 2012, the trend changed again, with most of the studies adopting MCDM methods.

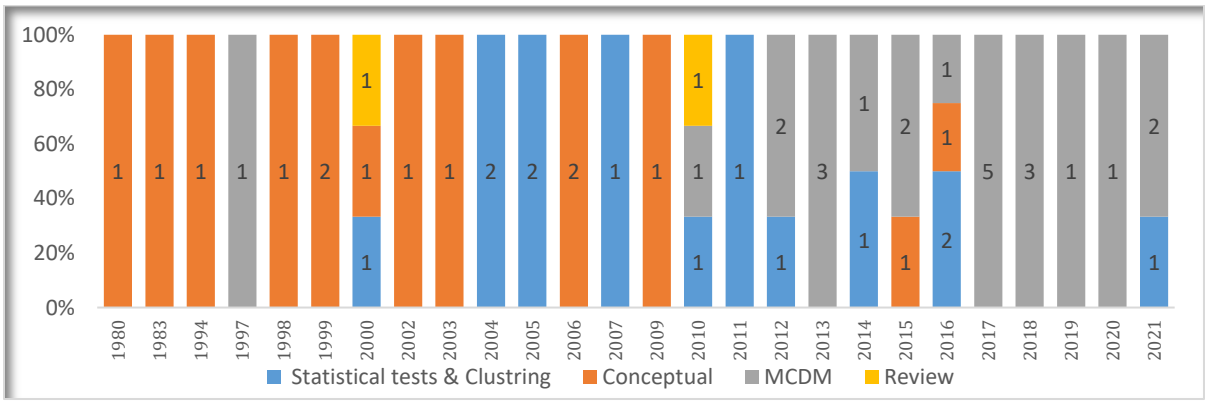

Figure 6. Cumulative diagram of the trend in research technique

In the portfolio and the involvement approaches, as well as in combinations of the two, multiple quantitative and qualitative criteria (factors, variables) are used to evaluate suppliers, which is why MCDM techniques are proper to calculate and evaluate the privilege score assigned to each supplier (Santos et al. 2017, Rezaei et al. 2015). Generally speaking, the segmentation problem can be solved by both data-based classification/clustering techniques and expert-based MCDM techniques. We think that both are promising tools in segmentation and in the future, we expect to see the hybrid techniques using both data-based and expert-based together and also machine learning and neural networks classification techniques.

Considering the trend of research approaches which is shown in Figure 7, one of the things standing out is that Kraljic's (1983) portfolio approach is still used as a reference and standard approach, because it is intuitive, implicit and easy to use (Torres-Ruiz and Ravindran 2018). In addition, many researchers have used a combination of the portfolio approach and the involvement approach as a basis for their study. It appears that, with the emergence of new models in these two approaches, including the capability and willingness model, they will be of more interest in the future, with the portfolio approach, which is a static approach, emphasizing the type of goods, and the involvement approach, which is a dynamic approach, addressing the relationship between buyer and supplier (Rezaei and Ortt 2012). In practice, combining the two approaches may make it possible to assess suppliers more effectively.

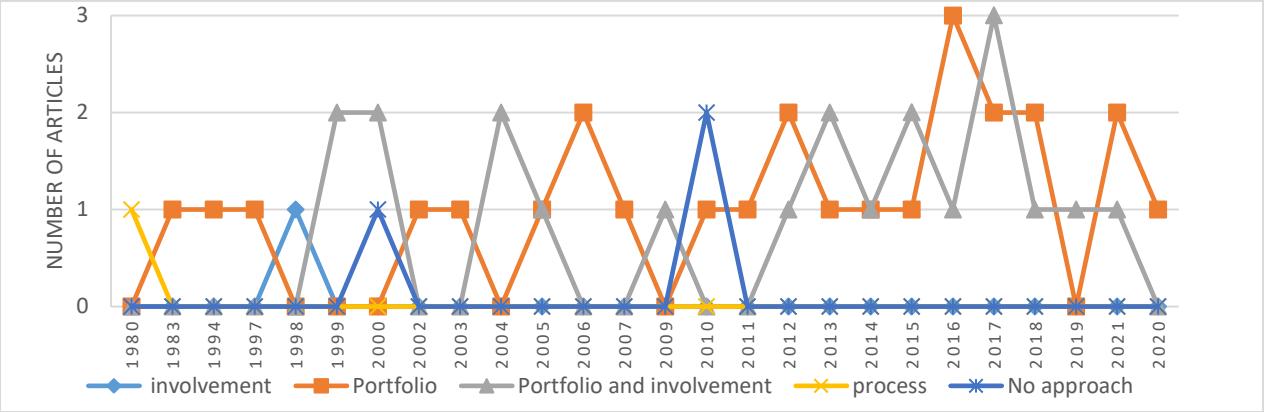

Figure 7. Diagram of the trend in Research approach

When we look at the dimensions used in the segmentation (model), we can also predict future research trends, as shown in Figure 8. As shown in Table 6, the studies we listed have applied several dimensions, in most cases only once. Of those dimensions, Supplier Risk and Profit Impact (Kraljic 1983), and Capabilities and Willingness (Rezaei et al. 2012) were used the most, and in fact, in in Figure 8, those are the only dimensions to be mentioned. Supplier Risk and Profit Impact were used regularly by researchers since they were first introduced in 1983. However, from 2012 onwards, with the introduction of Capabilities and Willingness dimensions, the new model attracted the interest of researchers, and showed a significant growing trend. Both sets of dimensions serve a specific purpose and combining them can provide a more comprehensive supplier assessment, by taking into account not only the characteristics of the goods, but also the relationship between the supplier and the buyer (Rezaei and Fallah Lajimi 2019).

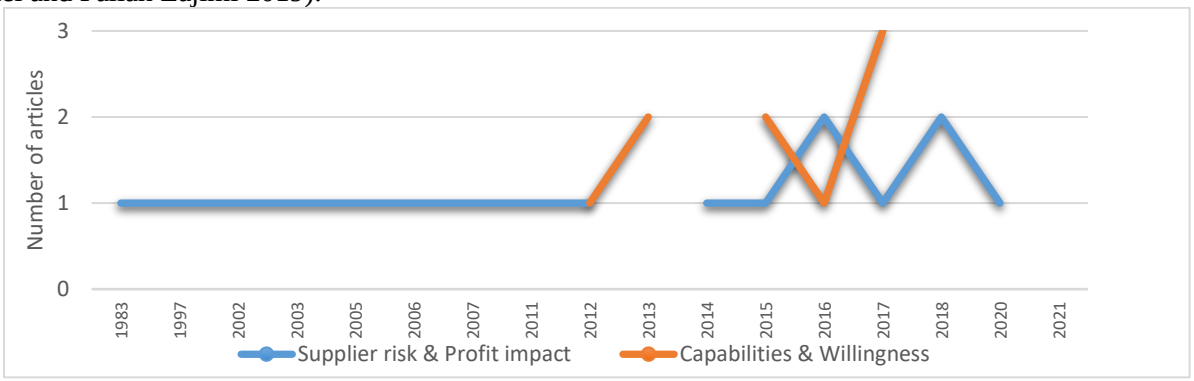

Figure 8. Diagram of the trend in research dimensions

5. Discussion, Conclusion and Future Research

In accordance with the aim of this study and the search protocol, 52 papers were selected for a systematic review involving supplier segmentation. The overall findings indicate that, in recent years, there has been a growing number of studies in this particular area, which would suggest that, for companies and other organizations, the importance of supplier segmentation in the overall performance of supply chain is increasing. In other words, supplier segmentation is applied on an operational level by an increasing number of companies as a way of optimizing their business results.

Using a research citation network analysis, some of the articles, which introduced a new approach, model, or technique to supplier segmentation at some point in time and which were more operational for companies, were considered to be key articles, in part because of their number of citations and other indexes in the network analysis. Kraljic and Rezaei are clearly the most influential researchers when it comes to supplier segmentation. The approaches that were used in relevant studies were examined. Arguably, applying the involvement and portfolio approaches at the same time can increase the effectiveness of the research into supplier segmentation. The models used in supplier segmentation research were also examined. The results indicate that the models can be useful and practical for companies in terms of product characteristics and supplier interaction and it is expected that future studies will focus increasingly on combining those two elements in their models. Looking at the techniques applied in literature, it is expected that researchers will increasingly resort to quantitative techniques in the future.

Reviewing the related articles from the beginning (1980) to 2019 has made it possible to clarify the stages in the development of key concepts in supplier segmentation, as well as present an overview of the research's status, which can be used for future research in this domain. However, there is still a huge research gap that can be investigated by researchers in the future. Some possible areas of future research are listed below.

- **Investigation of supplier segmentation in other contexts**: So far, supplier segmentation research has focused on regular supply chains. Bai et al. (2017) is one of a few studies to have addressed supplier segmentation in the green supply chain, while Parkouhi et al. (2019) has examined supplier segmentation in the resilience supply chain. For the sake of competition, companies need to align with the supply chain's new paradigms. The existing challenges of the competitive supply chain include the ability to respond to unpredicted disruptions, responding quickly to market changes and customer demands in a turbulent market, with an environmental (green) responsibility along with reducing costs and eliminating waste. Investigating supplier segmentation in other contexts may offer interesting results, for instance in the green supply chain, in volatile environments, in risky environments, in different cultural contexts, and in relation to the company's overall business strategy.
- **Investigation of the impact of supplier segmentation on the performance of the company, the suppliers and the supply chain**: Existing studies have so far only looked at supplier segmentation within the supply chain, while one of the main elements of SRM is to evaluate the suppliers on a periodical basis and to give them feedback. It would be also interesting to see how the suppliers see themselves when it comes to the segmentation problem. Therefore, it is necessary to include a more practical evaluation of the impact of supplier segmentation on the performance of the company itself and of its suppliers, and of the overall performance of the supply chain. This will connect supplier segmentation to the other two supplier-related activities supplier selection and supplier development. By regularly monitoring the performance of the suppliers and the quality of the relationship, supplier could get support from the buying company to improve their performance and the relationship could also improve to have a more sustain relationship.
- **Integrating supplier segmentation with the other supplier-related activities**: Supplier segmentation is not an isolated strategic activity. It is closely linked to supplier selection, supplier development and other supplier-related activities. While existing literature tends to look at supplier segmentation almost in isolation, future research could examine the integration of supplier segmentation and other supplier-related activities to allow companies to consider a more holistic approach to supply chain management.
- **Using other techniques**: The dominant techniques applied in existing literature are statistical and MCDM techniques, which is because of the nature of the problem. There exist other proper techniques such as machine learning, neural network which are suggested for future studies. It would also be interesting to use tools to monitor the move of the suppliers from one segment to another one over time. This will help the buying company to improve their supplier relationship management strategies.

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