



Churn in services – A bibliometric review

Abandono en servicios - Una revisión bibliométrica

Hugo Ribeiro*, Belém Barbosa^{a, b, c}, António C. Moreira^{b, d, e, f}, Ricardo Rodrigues^{e, g}

^a University of Porto. School of Economics and Management – belem@fep.up.pt – <https://orcid.org/0000-0002-4057-360X>

^b GOCVOPP - Research Unit on Governance, Competitiveness and Public Policies, University of Aveiro, Portugal

^c cef.UP – Center for Economics and Finance at UPorto, University of Porto, Portugal

^d Aveiro University. Department of Economics, Management, Industrial Engineering, and Tourism – amoreira@ua.pt – <https://orcid.org/0000-0002-6613-8796>

^e NECE-UBI - Research Center for Business Sciences, Universidade da Beira Interior, Portugal

^f INESC TEC—Institute for Systems and Computer Engineering, Technology and Science, Faculdade de Engenharia da Universidade do Porto, Portugal

^g Universidade da Beira Interior, Department of Business and Economics – rgrodrigues@ubi.pt – <https://orcid.org/0000-0001-6382-5147>

* **Corresponding author:** Aveiro University. Department of Economics, Management, Industrial Engineering, and Tourism – hugo.ribeiro@ua.pt – <https://orcid.org/0000-0002-0410-6430>

ARTICLE INFO

Received 01 June 2021,
Accepted 29 December 2021

Available online 4 March 2022

DOI: 10.5295/cdg.211509hr

JEL: M30, M31

ABSTRACT

The purpose of this article is to identify the most impactful research on customer churn and to map the conceptual and intellectual structure of its field of study. Data were collected from the WoS database, comprising 338 articles published between 1995 and 2020. Several bibliometric techniques were applied, including analysis of co-words, co-citation, bibliographic coupling, and co-authorship networks. R software and the Bibliometrix/Biblioshiny package were used to perform the analyses. The results identify the most active and influential authors, articles, and journals on the topic. More specifically, through co-citations and bibliographic coupling, it was possible to map the oldest articles (retrospective analysis) and the current research front (prospective analysis). The retrospective analysis, based on co-citations, revealed that the foundations of this research field are constructs such as quality of service, satisfaction, loyalty, and changing behaviors. The prospective analysis, performed through bibliographic coupling, revealed that current research is embedded in predictive analysis, clusters, data mining, and algorithms. The results provide robust guidance for further investigation in this field.

Keywords: Customer Churn, Bibliometric Analysis, Co-citation Analysis, Bibliographic Coupling, Science Mapping, Biblioshiny.

RESUMEN

El objetivo de este artículo es identificar las investigaciones más impactantes sobre la pérdida de clientes y trazar la estructura conceptual e intelectual de su campo de estudio. Los datos han sido recogidos de la base de datos WoS, que comprenden 338 artículos publicados entre 1995 y 2020. Varias técnicas bibliométricas fueron aplicadas, incluyendo el análisis de co-palabras, cocitaciones, acoplamiento bibliográfico y redes de coautoría. Para realizar los análisis se utilizaron el software R y el Bibliometrix/Biblioshiny. Los resultados identifican los autores, artículos y revistas más influyentes y activos sobre el tema. Más específicamente, a través de las cocitaciones y el acoplamiento bibliográfico, fue posible mapear los artículos más antiguos (análisis retrospectivo) y la investigación más actual (análisis prospectivo). El análisis retrospectivo, basado en las cocitaciones, reveló que los fundamentos de este campo de investigación son constructos como la calidad del servicio, la satisfacción, la lealtad y el cambio de comportamientos. El análisis prospectivo, realizado a través del acoplamiento bibliográfico, reveló que la investigación actual está inmersa en el análisis predictivo, los conglomerados, la minería de datos y los algoritmos. Los resultados proporcionan una sólida orientación para seguir investigando en este campo.

Palabras clave: Churn de Clientes, Análisis Bibliométrico, Análisis de Cocitación, Acoplamiento Bibliográfico, Mapeo de la Ciencia, Biblioshiny.

1. INTRODUCTION

Customer churn is one of the most challenging topics for managers in several sectors involving contracted services, where customers tend to change service providers repeatedly (Kumar *et al.*, 2018). Also known as customer turnover, and customer defection or departure, customer churn refers to a customer's decision to cease business with a service provider (Adebiyi *et al.*, 2016; Eshghi *et al.*, 2007; Mahajan *et al.*, 2015; Prince & Greenstein, 2014), by switching to a new provider.

There are several clear indications of the relevance of this topic. Being widely accepted that attracting new customers by driving them away from a competitor is generally more expensive than retaining current customers by meeting their real needs (Kyei & Bayoh, 2017), the literature further stresses that higher retention rates result in higher market share, resulting in higher revenues (Kyei & Bayoh, 2017). Particularly in markets reaching high levels of saturation and concentration, finding and retaining new customers is increasingly difficult and expensive (Carrizo-Moreira *et al.*, 2017; Hadden *et al.*, 2007; Moreira *et al.*, 2016). For that reason, companies such as banks, telecommunications and airlines, to name but a few, use customer churn or retention rate as a critical business metric (Amiri & Daume III, 2016). In this connection, the literature suggests that higher priority should be given to retaining the most valuable existing customers rather than gaining new ones (Carrizo-Moreira *et al.*, 2017; Hadden *et al.*, 2007; Moreira *et al.*, 2016), which leads to a change in business paradigm, with a new emphasis on customer retention and relationship development, rather than looking mainly at customer acquisition.

Understanding and preventing customer churn, particularly by profitable customers, is critical to business survival (Adebiyi *et al.*, 2016), including identifying the customers who are most likely to switch service providers (Amin *et al.*, 2019). The determinants of customer churn have been the focus of a significant stream of research, remaining central constructs in marketing activities (Schweidel *et al.*, 2008). Keaveney (1995) was one of the first authors to study customer churn, and found that its main causes included price, service failure, and the company's responses to service problems. Rajan (2017) added that customer turnover may be based on dissatisfaction, higher costs, low quality, lack of resources, and privacy concerns. Satisfaction stands out as a predictor of customer retention (Anderson *et al.*, 1994; Eshghi, Haughton, & Topi, 2007), but it also causes customers to switch service providers (Becker *et al.*, 2015), namely in response to positive word-of-mouth from competitors' most satisfied customers (de Haan *et al.*, 2015).

Despite the steep increase in published articles on customer churn, no one has yet provided a summarized review of the scientific landscape, preventing a clear view of the state of the art. To the best of our knowledge, no work so far has focused on analyzing the development of scientific production on customer churn. In order to address this gap and present information on how churn has been addressed in the literature, this article uses a bibliometric analysis.

Once a scientific discipline has reached a certain degree of maturity, it is common practice for researchers to focus their attention on the literature generated by the scientific community to conduct literature reviews to assess the state of the art (Ramos-Rodriguez & Ruiz-Navarro, 2004). Indeed, synthesizing the results of past research is one of the most critical tasks for advancing knowledge in a particular research topic (Zupic & Cater, 2015), namely by adopting bibliometric research methods to map the structure and development of scientific fields and disciplines (Zupic & Cater, 2015). Specifically, this technique examines how disciplines, fields, expertise, and individual documents and authors relate (Small, 1999; Zupic & Cater, 2015). Bibliometric methods adopt a quantitative approach to describe, evaluate, and monitor published research, determining its cognitive structure and evolution (Small, 1999). They follow a systematic, transparent and replicable review process (Zupic & Cater, 2015) that systematically represents the nature of specific scientific disciplines, highlighting research trends (Zhang *et al.*, 2016). As such, they identify major research areas, providing researchers with a solid basis for positioning significant current contributions and detecting new avenues for future research (Ferreira, 2018).

Following the bibliometric analysis approach, this article aims to identify the most impactful research on customer churn and to map the conceptual and intellectual structure of its field of study. It is intended through this bibliometric analysis to answer the following research questions:

- What are the specific topics associated with customer churn research?
- What is the intellectual structure of the field?
- Who are the central, peripheral, or bridging researchers in this field?
- What is the intellectual structure of recent/emerging literature?
- What is the social structure of the field?

This article makes several contributions to development of the literature on customer churn in services. Firstly, it describes the structure of the conceptual field through co-word analysis and maps the intellectual field through a co-citation analysis of authors, articles, and journals. Secondly, it identifies and organizes the most recurrent themes and cutting-edge research through a bibliographic coupling analysis, which shows how the topic is developing. Finally, it identifies the social structure of the research field. Hence, this article provides scholars with guidance for future research, by highlighting the most prominent contributions on the topic and by identifying the trends in this field of research. This approach reveals that the literature is varied and covers topics such as defection, retention, customer churn, and switching behavior, encompassing different and sometimes complementary concepts. It is also worth noting that customer experience, disappointment, desertion, customer encounter and satisfaction, lack of service quality and attributes are among the main determinants of churning. Finally, it is important to mention that if predictive models are used extensively to analyze churn, behavioral models are also greatly used to understand what leads customers to swap one service provider for another.

2. BIBLIOMETRIC ANALYSIS OF THE LITERATURE

Bibliometric methods (for example, co-citation analysis, bibliographic coupling, analysis of co-authors, among others) use bibliographic data from publication databases to construct structural images of scientific fields (Zupic & Cater, 2015), discovering their essence (Pritchard, 1969). Bibliometric methods have two primary uses: performance analysis and scientific mapping (Cobo *et al.*, 2011). Performance analysis seeks to assess the performance of research and publication by individuals and institutions. Scientific mapping aims to reveal the structure and dynamics of scientific fields (Zupic & Cater, 2015).

Different approaches have been applied to extract networks using different units of analysis (authors, documents, journals, and terms). Table 1 shows the techniques that will be applied throughout this document.

Table 1

Most common bibliometric techniques by the unit of analysis

Bibliometric technique	Unit of analysis used	Kind of relation
Bibliographic Coupling	Author	Author's oeuvres
	Document	Document
	Journal	Journal's oeuvres
Coauthor	Author	Author's name
	Country	Country from affiliation
	Institution	Institution from affiliation
Co-citation	Author	Author's reference
	Document	Reference
	Journal	Journal's reference
Co-word	Keyword, or term extracted from title, abstract, or document's body	Terms' co-occurrence

Source: Adapted from Cobo *et al.* (2011).

2.1. Research methodology and article selection

Two types of research objectives can be defined by using the bibliography for scientific mapping: (1) to identify the knowledge base of a research topic or field and its intellectual structure; (2) to identify the main themes and trends (conceptual structure). The analysis carried out in this study serves to identify the conceptual and intellectual structures of the research field. To identify the existence of clusters of articles on customer churn, the most influential authors, their geographical origin, and authorship networks. To construct the bibliometric maps, the soft-

ware used was Biblioshiny (Aria & Cuccurullo, 2017), from the R Core Team (Team, 2021) Bibliometrix package. R is an open-source programming language, creating a software ecosystem accessible to the whole community. Indeed, all resources are shared by the community, and all knowledgeable users can contribute to the development of different software packages. Biblioshiny is an R software package that provides a graphical environment for using the Bibliometrix package. The Bibliometrix package allows the analysis and mapping of bibliographic data.

Regarding data collection, and to ensure that all relevant articles were considered in this study, we initially performed a search on the WoS¹ database with the main keyword “customer churn” and restricting the search to articles in English published until 2020. WoS is by far the most common source of bibliographic data (Zupic & Cater, 2015), with the oldest and most comprehensive records of citation indexes (Ellegaard & Wallin, 2015). This database contains enough data for most bibliometric analyses. Data, including article title, article type, authors, their institutional affiliations, keywords, abstract, number of citations, journal name, publisher name and address, year of publication, volume, issue number, and a list of cited references are available for analysis (Zupic & Cater, 2015). This search identified 253 articles, whose keywords and abstracts were extracted and subject to content analysis using NVIVO² qualitative analysis software. This procedure allowed us to identify synonyms, alternative phrasing, and combinations of the word “churn” with other words that could help identify additional articles on the topic. Content analysis software such as NVIVO was considered helpful because it can explore word search and analyze word frequency. As a result, additional keywords were identified for this study, including “customer turnover”, “customer switching”, “churn management”, “churn factors”, and “customer defection”. The resulting set of keywords is presented in Table 2.

Table 2
Keywords used in the search

Keywords
customer churn
customer turnover
customer attrition
customer rotation
customer defection
customer switching
consumer switching behavior
customer switching behavior
stayers * switchers
churn management
churn determinants
churn factors
churn analysis
defection management

Source: Author's own elaboration.

¹ <http://www.webofknowledge.com>

² <https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home>

After identifying all the keywords, a new search was carried out in WoS, always using the Boolean operator “or” between them. The search was based on the articles’ title, abstract and keywords. Only journal articles were considered, because this type of publication is arguably considered most highly by academics and practitioners, due to representing most

peer-reviewed and also the most citable contributions. Hence, conference proceedings, books, book reviews, or conference abstracts were not considered. In addition, only articles written in English and published up to 2020 were considered, returning 452 articles. Data were extracted and analyzed in the first semester of 2021.

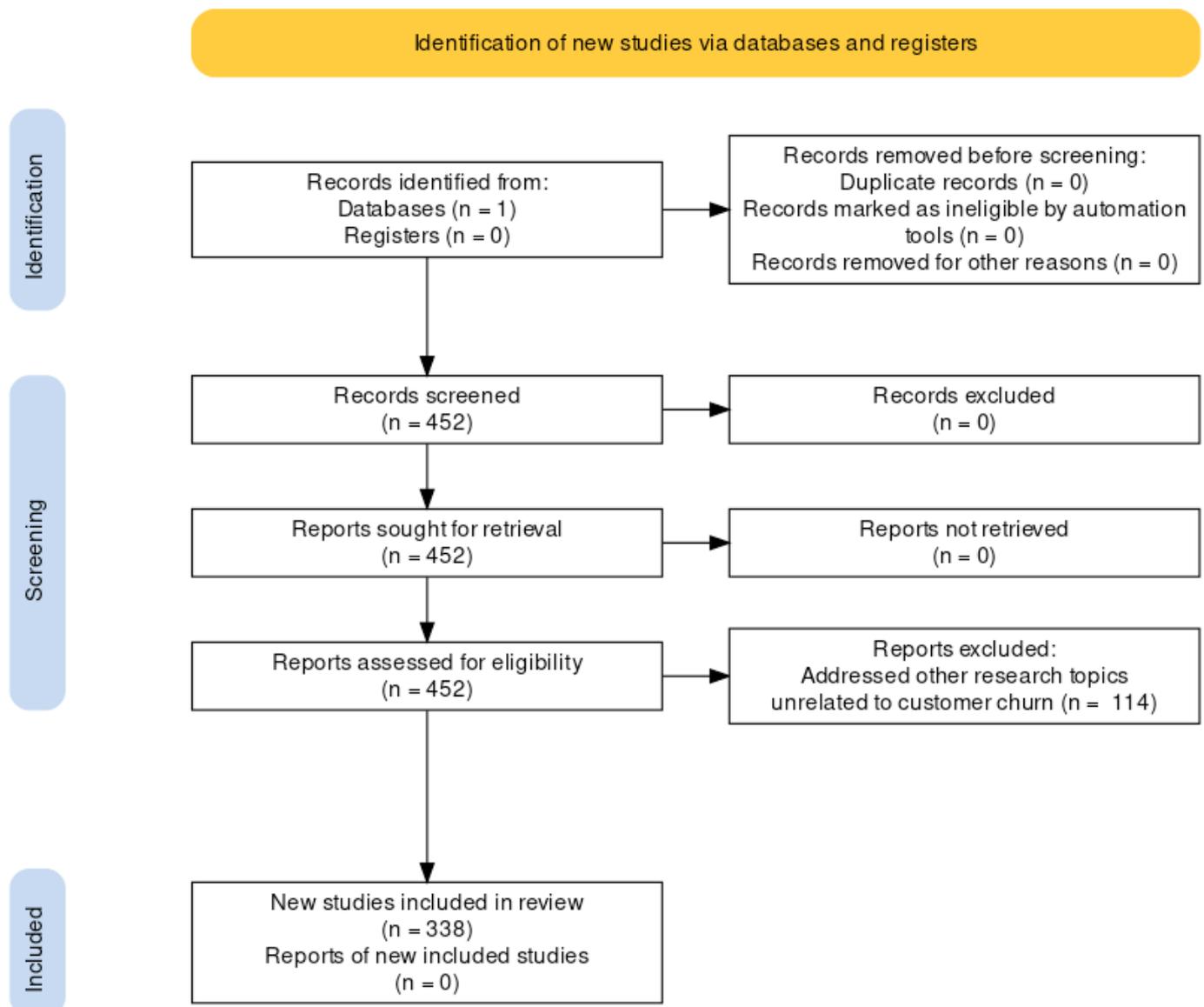


Figure 1
Search flowchart used in this investigation

Source: Author's own elaboration.

Figure 1 presents the search flowchart, created using the tool developed by Haddaway and McGuinness (2021), describing the various stages of screening and the number of articles excluded from the analysis. Firstly, all abstracts were read and analyzed in detail. As a result, 114 articles were excluded, either because they were outside the scope of this study or because they addressed other research topics unrelated to customer churn. Hence, only

articles that had customer churn as the object of study were included. Consequently, 338 articles were considered for this study.

In relation to bibliometric methods, different choices were made regarding the network layout, data normalization, and the clustering algorithm for the analysis of co-words, co-citations, bibliographic coupling, and co-authorship networks. Table 3 presents the choices made for each analysis typology, as presented in the next sections.

Table 3
Network Layout, Normalization and Clustering Algorithm

Analysis	Number of Nodes	Minimum edges	Network Layout	Normalization	Clustering Algorithm
Co-Word	50	2	Kamada & Kawai	Association	Walktrap
Co-Citation & Bibliographic Coupling					
Authors	50	2	Kamada & Kawai	N/A	Walktrap
Articles	50	2	Kamada & Kawai	N/A	Walktrap
Journals	50	2	Kamada & Kawai	N/A	Walktrap
Coauthor					
Authors	50	2	Fruchterman & Reingold	Association	Walktrap
Country of Affiliation	50	2	Fruchterman & Reingold	Association	Walktrap
Institution from affiliation	50	2	Fruchterman & Reingold	Association	Walktrap

Source: Author's own elaboration.

The data were normalized using association strength as a similarity measure. According to the theoretical and empirical results of Eck and Waltman (2009), this measure was considered the most appropriate to normalize data co-occurrence. A clustering algorithm was used to divide the overall network into different sub-networks to perform community detection (Cobo *et al.*, 2011). A community, or cluster, is generally defined as a subset of densely interconnected nodes relative to the rest of the network (Newman & Girvan, 2004). Walktrap, developed by Pons and Latapy (2005), was the algorithm used. As explained by its authors, Walktrap offers a measure of similarity between vertices based on random walks, with several important advantages: it captures the community structure of a network well, can be efficiently computed, and can be used in an agglomeration algorithm to compute efficiently the community structure of a network. This community detection algorithm was found to have one of the best results in identifying communities even for high values of mixing coefficient (Orman & Labatut, 2009).

The next step was to select co-occurrences, involving network filtering using two as a minimum edge value reduction. Only edges with a strength greater than or equal to two are plotted. In all analyses, only the 50 most cited references were plotted.

2.2. Descriptive Analysis

We started by performing a descriptive analysis of the database used, to summarize and explore the data. Table 4 shows the main statistics for the database. The period of analysis is from 1995 to 2020, presenting an annual growth rate of 17.84%. The 338 articles on the database have an average citation of 33.24. The articles were written by 796 authors, with an average of 2.36 authors per article.

Table 4
Main information about data

Description	
Articles	338
Period	1995 - 2020
Annual Percentage Growth Rate	17,84%
Average citations per article	33,24
Authors	796
Authors Appearances	995
Authors of single-authored articles	34
Authors of multi-authored articles	762
Authors per Article	2,36
Co-Authors per Articles	2,94
Collaboration Index	2,53

Source: Author's own elaboration.

As shown in Figure 2, the number of articles published before 2009 was relatively small, but publications increase after that period.

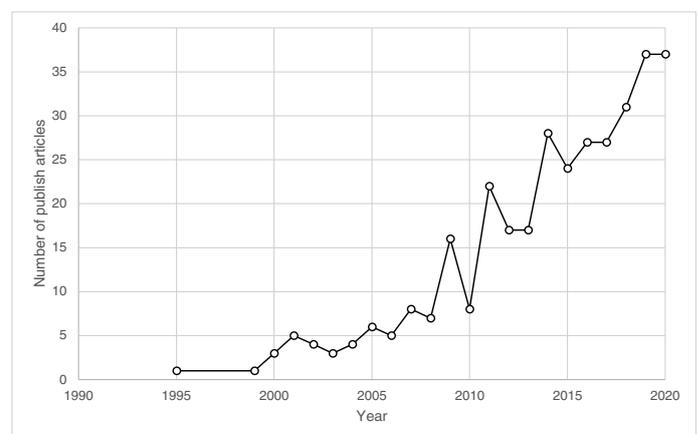


Figure 2

Publishing trend in the area of customer churn

Source: Author's own elaboration.

Note: Number of published articles per year.

The initial statistics show that the 338 articles were published in 177 different journals. The top 10 journals were responsible for 110 articles, about 33% of the total. Table 5 shows the leading journals where these articles were published. “Expert Systems with Applications” stands out, with 12% of all publications.

Table 5
The top 10 publishing journals contributing to the area of customer churn

Sources	No. of Articles	% of Articles
<i>Expert Systems with Applications</i>	41	12
<i>European Journal of Operational Research</i>	9	3
<i>European Journal of Marketing</i>	8	2
<i>Marketing Science</i>	8	2
<i>Journal of Marketing Research</i>	7	2
<i>Journal of Service Research</i>	7	2
<i>Telecommunications Policy</i>	7	2
<i>Decision Support Systems</i>	6	2
<i>Journal of The Academy of Marketing Science</i>	6	2
<i>International Journal of Advanced Computer Science and Applications</i>	5	1

Source: Author’s own elaboration.

Table 6 presents the top 10 authors and the number of articles of which they are authors or coauthors. Van Den Poel D, Baesens B, and Coussement, K have the greatest number of articles. These three authors have their publications mostly in “Operations Research Management Science” and “Computer Science Artificial Intelligence”.

Table 6
The top 10 contributing authors and number of articles

Author	Number of published articles
Van Den Poel D	13
Baesens B	12
Coussement K	8
Verbeke W	6
Amin A	5
Anwar S	5
Liu Y	5
Martens D	5

Source: Author’s own elaboration.

Table 7 shows the top 10 most cited articles. Those with the highest number of citations are (1) Customer switching behaviour in service industries: An exploratory study (Keaveney, 1995); (2) Consumer switching costs: A typology, antecedents, and consequences (Burnham *et al.*, 2003) and (3) Switching barriers and repurchase intentions in services (Jones *et al.*, 2000).

Table 7
Top 10-Most cited articles (Global)

Article	Total Global Citations (TC)	TC per Year
Keaveney Sm, 1995, <i>J Mark</i>	1154	42,74
Burnham Ta, 2003, <i>J Acad Mark Sci</i>	756	39,79
Jones Ma, 2000, <i>J Retail</i>	648	29,45
Bansal Hs, 2004, <i>J Acad Mark Sci</i>	427	23,72
Chen Py, 2002, <i>Inf Syst Res</i>	339	16,95
Aydin S, 2005, <i>Eur J Market</i>	260	15,29
Neslin Sa, 2006, <i>J Mark Res</i>	238	14,88
Keaveney Sm, 2001, <i>J Acad Mark Sci</i>	237	11,29
Wei Cp, 2002, <i>Expert Syst Appl</i>	198	9,90
Burez J, 2009, <i>Expert Syst Appl</i>	189	14,54

Source: Author’s own elaboration.

It is also interesting to analyze the top 10 most cited articles locally: articles that received citations from documents contained only in the database studied, as shown in Table 8. The most cited articles are (1) New insights into churn prediction in the telecommunication sector: A profit-driven data mining approach (Verbeke *et al.*, 2012); (2) Turning telecommunications call details to churn prediction: a data mining approach (Wei & Chiu, 2002); and (3) Customer attrition analysis for financial services using proportional hazard models (Van den Poel & Lariviere, 2004), with the exact quotes that (3) Customer base analysis: partial defection of behaviorally loyal clients in a non-contractual FMCG retail setting (Buckinx & Van den Poel, 2005).

Table 8
Top 10-Most cited articles (Local)

Article	Total Local Citations (TC)
Verbeke W, 2012, <i>Eur J Oper Res</i>	55
Wei Cp, 2002, <i>Expert Syst Appl</i>	54
Van Den Poel D, 2004, <i>Eur J Oper Res</i>	44
Buckinx W, 2005, <i>Eur J Oper Res</i>	44
Burez J, 2009, <i>Expert Syst Appl</i>	43
Tsai Cf, 2009, <i>Expert Syst Appl</i>	39
Verbeke W, 2011, <i>Expert Syst Appl</i>	39
Ahn Jh, 2006, <i>Telecommun Policy</i>	35
Burez J, 2007, <i>Expert Syst Appl</i>	34
Hadden J, 2007, <i>Comput Oper Res</i>	27

Source: Author’s own elaboration.

Regarding the authors’ affiliation, Table 9 shows the organizations contributing most, based on the number of articles published. Comparing this list with the list of the top 10 authors, in Table 6, the Catholic University of Leuven, the University of Ghent, and the University of Southampton are represented by the most prolific authors, Van den Poel, Dirk (Ghent University) and Baesens, Bart (University of Southampton and Catholic University of Leuven).

Table 9
The top 20 contributing organizations

Organization	Location	Articles
Katholieke Univ Leuven	Belgium	31
University Ghent	Belgium	21
University Southampton	United Kingdom	16
Inst Management Sci	Pakistan	10
University Catholique Lille	France	10
University Tehran	Iran	10
Deakin University	Australia	8
Iqra National University	Pakistan	8
University Coll Dublin	Ireland	8
Georgia State University	United States	7
Hong Kong Polytech University	China	7
King Abdulaziz University	Saudi Arabia	7
K.N. Toosi University Technology	Iran	7
University Oviedo	Spain	7
Utah State University	United States	7
Columbia University	United States	6
Helwan University	Egypt	6
Kuhne Logistic University	Germany	6
Lebanese American University	Lebanon	6
National Central University	Taiwan	6

Source: Author's own elaboration.

Figure 3 shows the articles published by country. The intensity of the color is proportional to the number of publications. In general, the geographical dispersion indicates that research and practice regarding customer churn have attracted worldwide attention.

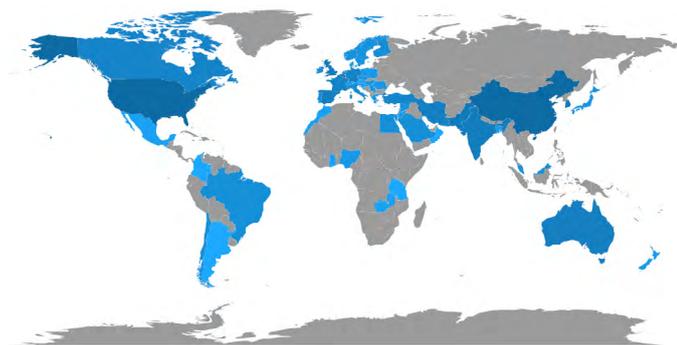


Figure 3
Scientific Production by Country

Source: Author's own elaboration-Biblioshiny output.

Note: The shade of blue represents the production of articles per country. The darker the color, the greater the production.

Table 10 shows the top 10 countries by publications, considering the corresponding author, with China, the United States, and Belgium accounting for 41% of the total.

Table 10
Top 10 Most productive countries
(based on first author's affiliation)

Country	Number of published articles	% of Articles
China	53	14
USA	51	13
Belgium	25	6
Korea	19	5
Pakistan	16	4
India	15	4
Iran	14	4
Australia	11	3
France	10	3
Germany	9	2

Source: Author's own elaboration.

The most frequently used words/phrases were also analyzed. The analysis was performed for the words/phrases defined by the original authors (Author Keywords) and the words/phrases defined automatically by a computerized algorithm (KeywordsPlus). These words or phrases that appear defined by the algorithm are frequently present in the titles of the references of an article and not necessarily in the title of the article or the author's keywords (Garfield & Sher, 1993). The KeywordsPlus algorithm can capture the content of articles with greater depth and variety (Garfield & Sher, 1993). It is as effective as the words defined by the authors in terms of bibliometric analysis investigating the knowledge structure of scientific areas. Still, it is less comprehensive in representing the content of an article (Zhang et al., 2016). The top 20 authors' words can be seen in Table 11, and the top 20 of the words generated by the KeywordsPlus algorithm in Table 12.

Table 11
Top 20-Most frequent Author Keywords

Author Keywords (DE)	No. of Articles	Author Keywords (DE)	No. of Articles
Churn Prediction	66	Customer Churn Prediction	14
Data Mining	47	Customer Loyalty	14
Customer Churn	45	Telecommunications	12
Classification	29	Churn Analysis	11
Customer Relationship Management	28	Customer Defection	11
Customer Retention	26	Logistic Regression	11
Churn	22	Satisfaction	11
Machine Learning	19	Telecommunication	11
Customer	18	Marketing	10
Customer Satisfaction	15	Prediction	10

Source: Author's own elaboration.

Regarding the words defined by the authors, "Customer Churn", "Customer Defection" and "Churn Analysis" should be read with due contextualization since they were part of the set of terms used to build the research.

Table 12
Top 20-Most frequent Keywords-Plus

Keywords-Plus (ID)	No. of Articles	Keywords-Plus (ID)	No. of Articles
Satisfaction	74	Determinants	28
Retention	63	Defection	27
Model	60	Quality	25
Loyalty	52	Management	24
Behavior	39	Customer Churn	23
Services	38	Selection	22
Models	37	Algorithm	20
Prediction	37	Attrition	20
Classification	33	Customer Satisfaction	18
Impact	32	Dynamic-Model	18

Source: Author’s own elaboration.

From analysis of the two tables, terms linked to data science —“Churn Prediction”, “Data Mining”, “Classification”, “Machine Learning”, “Prediction”, “Model”, “Algorithm” and “Selection”— stand out, representing the prominence of data analysis and data mining in investigating customer churn.

It is also interesting to note that customer retention, satisfaction and loyalty, and prediction also appear at the top of the most referenced words, either by the original authors or by the KeywordPlus algorithm, revealing the importance of these constructs in investigating customer churn.

Figures 4 and 5 show the evolutionary trend of the top 10 words/phrases. Concerning the authors’ words, there is a growing trend in “Churn Prediction”, “Machine Learning”, and “Customer Churn”, once again reinforcing the previous observations.

Concerning KeywordPlus words/phrases, and therefore with a broader spectrum, we observe adjacent research fields with significant growth, “satisfaction”, “retention” and “behavior”, but also the same terms that were observed in the authors’ words, related to data analysis, “Model” and “Prediction”.

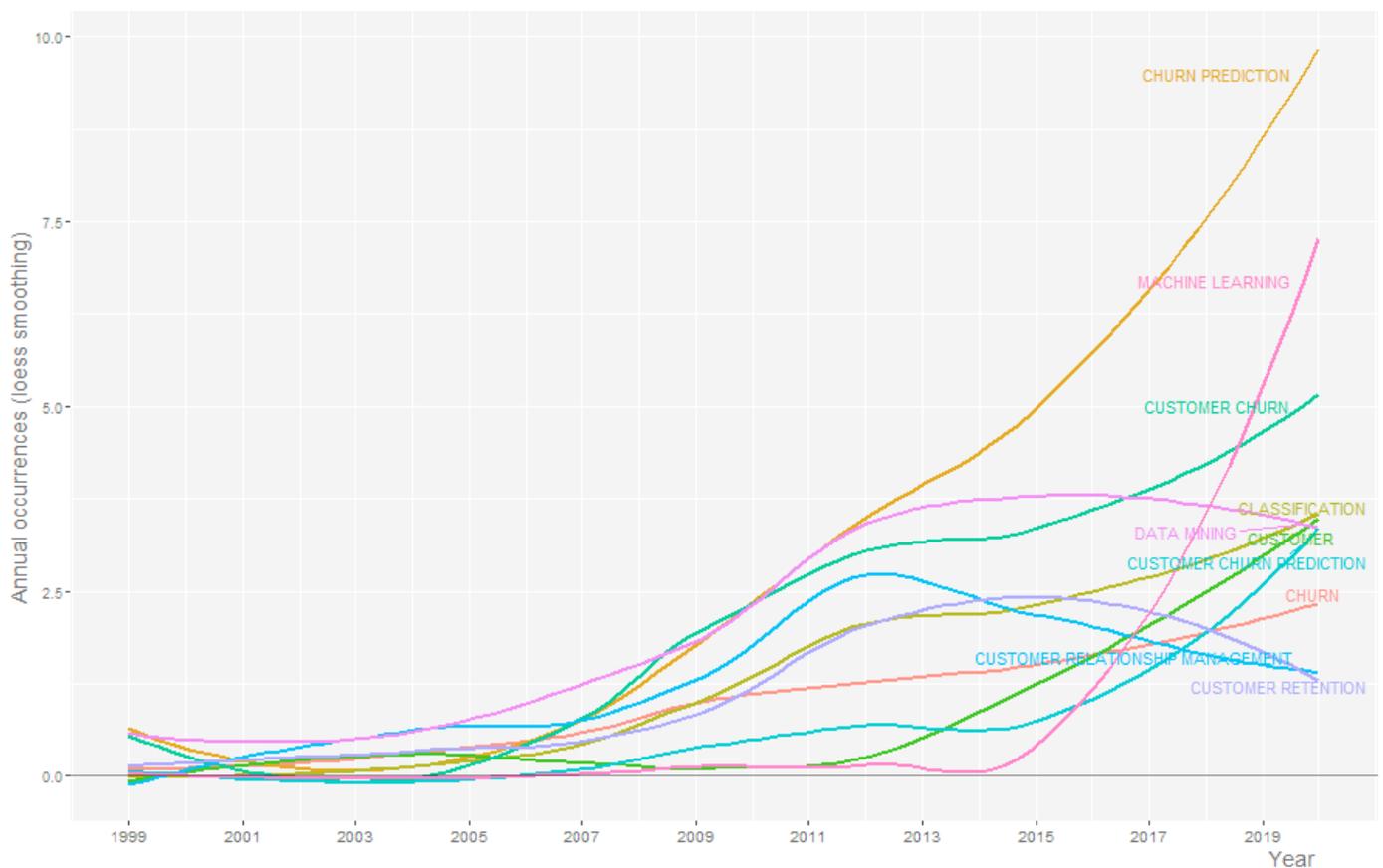


Figure 4
Timeline Word Growth (Author’s Keywords)

Source: Author’s own elaboration-Biblioshiny output.

Note: Number of occurrences of the author keywords over time.

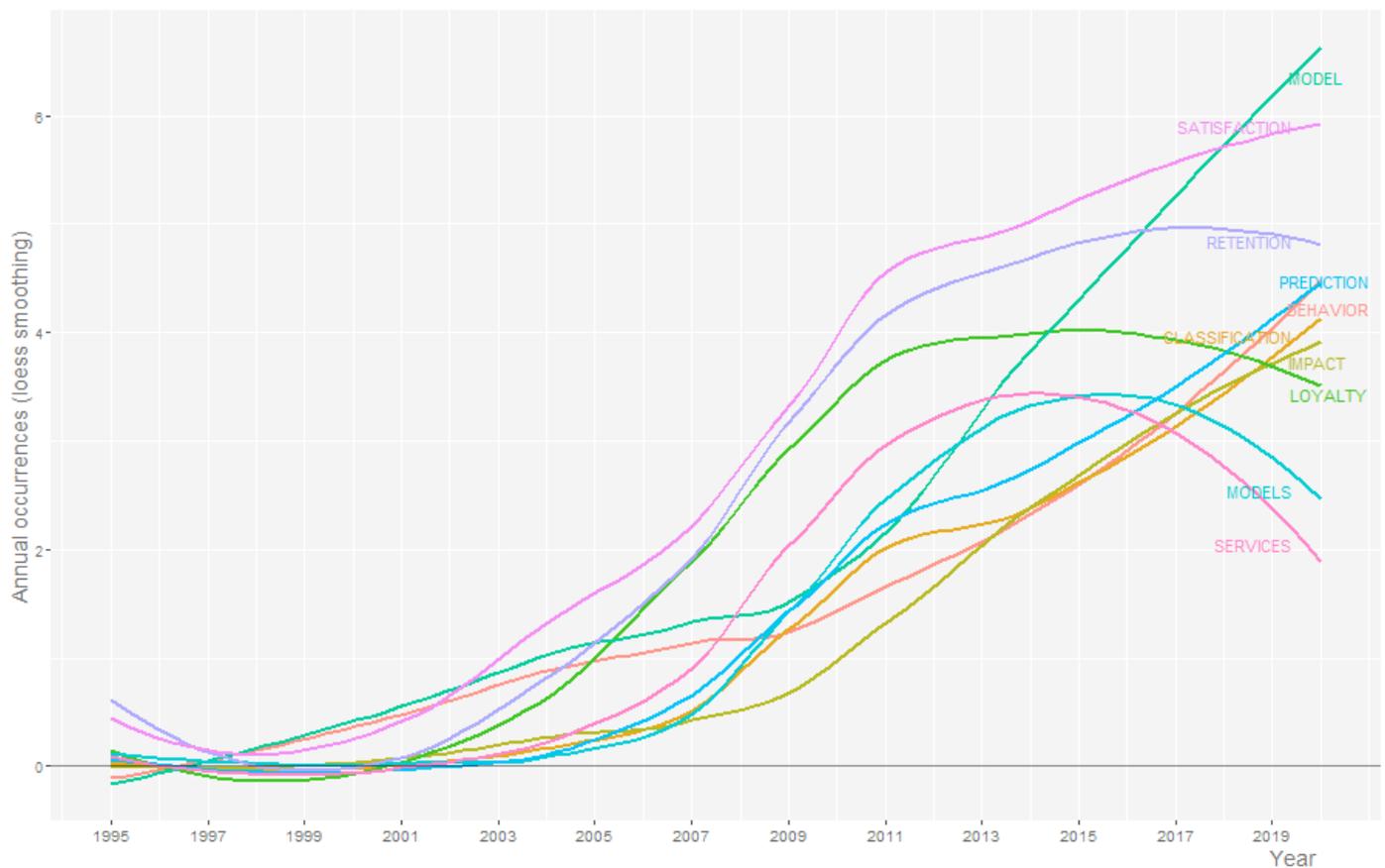


Figure 5
Timeline Word Growth (KeywordsPlus)

Source: Author's own elaboration-Biblioshiny output.

Note: Number of keyword plus occurrences over time.

2.3. Conceptual structure of the field

The conceptual structure allows understanding of what is being said in the research field, the main themes, and trends (Aria & Cuccurullo, 2017). It is often used to understand the topics covered by researchers and identify the most important and most recent issues. The most frequent co-word analysis was used for the conceptual structure and to understand what was being analyzed in the research field.

A. CO-WORD ANALYSIS

Co-word analysis is a content analysis technique that uses the most important words or keywords in documents, to establish relationships and build a conceptual structure of a research field, and to identify the main concepts analyzed in a given field (Callon *et al.*, 1991; Callon *et al.*, 1983). It can be applied to the keywords, abstracts, or texts in their entirety (Aria & Cuccurullo, 2017). The unit of analysis is usually a keyword or term extracted from the title, abstract, or body of the document (Aria & Cuccurullo, 2017).

In scientific mapping, a network graph is used to represent co-occurrences between bibliographic metadata. The graph is

made up of nodes or points (each node is a word) connected by lines. The size of each node is proportional to the occurrence of the item, and the size of the edges of the lines is proportional to their co-occurrence. The colors represent the groups to which each word belongs. Co-occurrences can be normalized using similarity measures to obtain similarities between the data (Cobo *et al.*, 2011).

Figure 6 shows the network diagram resulting from the authors' co-words analysis.

Two major groups/clusters of words can be distinguished. The first group deals with customer churn based on predictive analysis, feature selection, clustering, data mining, and algorithms such as decision trees, random forests, logistic regression, and support vector machine. Also appearing in this group are words such as big data, business intelligence, and telecom. The second group of words is related to customer retention, satisfaction, loyalty, customer relationship management, service quality, change intentions, and behavior. Relational marketing, trust, and switching costs also figure in this group. These two clusters show that the research field is essentially sustained by two streams of research, the most recurrent of which uses predictive methods.



Figure 6
Co-Word Analysis (Authors Keywords)

Source: Author's own elaboration-Biblioshiny output.

Note: Each color represents a different cluster. The size of each node represents the occurrence of the item, and the thickness of the lines is proportional to its co-occurrence.

By using a community detection algorithm, we can use Callon *et al.*'s (1991) centrality and density to measure the relationships between the clusters identified. Each cluster/theme can be represented in a given quadrant known as a strategic or thematic map (Cobo *et al.*, 2011).

The strategic map in Figure 7 shows the main themes detected in the study of customer churn in the period under analysis, categorizing them into four classes according to centrality and

density. Each theme is associated with a sphere and a label. The labels were chosen by selecting the most central node of their associated theme networks, where each node corresponds to a keyword. The size of the spheres represents the number of documents associated with each theme or keyword.

The position of each sphere is then defined according to Callon's centrality and density measurements (Callon *et al.*, 1991). Centrality measures the intensity of connections with

other clusters for a given cluster. The stronger these links are, the more this cluster represents a set of research problems considered crucial by the scientific community (Callon *et al.*, 1991). Centrality can be considered as the importance of the theme in

the whole field of investigation. In turn, density characterizes the strength of the links that unite the words making up the cluster (Callon *et al.*, 1991). It can be read as a measure of the theme's development.



Figure 7

Thematic Map/Strategic Diagram

Source: Author's own elaboration-Biblioshiny output.

Note: The size of each bubble is proportional to the number of documents containing each keyword.

According to Callon (1991), we have the following positions: (1) upper right quadrant: the motor themes, as they present strong centrality and high density. Their position is strategic, and they are likely to be treated systematically and over a long time by a well-defined group of researchers. The themes appearing in this quadrant are “support vector machine”, a set of supervised learning models with associated algorithms, and “churn analysis”; (2) lower right quadrant: basic themes are central themes, but the density of internal links is relatively low. They can also signal the emergence of a series of research problems that are becoming central. The theme with the most centrality here is “churn prediction”, followed by “churn” and “customer loyalty”; (3) lower left quadrant: emerging or endangered themes, have low density and low centrality, and are peripheral themes. Here the theme that stands out is “consumer behavior”; (4) upper left quadrant: peripheral and poorly developed themes, representing the most peripheral part of the network.

We can conclude that the most central quadrants are essentially made up of themes like “support vector machine” and “churn prediction”, and the more peripheral themes, by themes like “consumer behavior” and “customer defection”.

2.4. Intellectual structure of the field - Co-citation Analysis

Co-citation occurs when two articles are independently cited by one or more articles (Small, 1973). When the same articles are co-cited by several other articles, it can be assumed that they are in some way significantly related (Ferreira, 2018). Analysis is based on the premise that authors cite documents they consider essential for the development of their research. Therefore, it is likely that frequently cited documents have exerted a greater influence on the discipline than less cited ones (Ramos-Rodriguez & Ruiz-Navarro, 2004). Through co-citation analysis, it is possible to identify the set of articles most cited by the current research: the knowledge base of the research area. These publications are the foundations on which current research is being carried out and contain fundamental theories, innovative introductory work, and methodological principles from the field (Zupic & Cater, 2015). Co-citation analysis can answer questions such as, What is the intellectual structure of the literature on a given area of scientific research? (Zupic & Cater, 2015), Who are the central, peripheral, or intermediate researchers in this area of scientific research? (Zupic & Cater, 2015).

Co-citation analysis can be extended to authors and journals, using co-citation counts to construct similarity measures (Cobo *et al.*, 2011). Author co-citation aims to discover the authors who are frequently cited together, while journal co-citation analysis discovers the journals that are frequently co-cited (Cobo *et al.*, 2011), recording the number of documents that have cited any specific pair of documents. This is interpreted as a measure of content similarity between the two documents (Ramos-Rodriguez & Ruiz-Navarro, 2004). Co-citation analysis (Small, 1973) and bibliographic coupling (Kessler, 1963) are used to analyze the intellectual structure of a field of scientific research. This sub-section presents the co-citation analyses of authors, articles, and journals. Section 3.5 will address bibliographic coupling.

A. AUTHORS

As illustrated in Figure 8, author co-citation analysis reveals two clusters which stand out from the rest. In the maps, the size of the rectangles is proportional to the citation frequency, and authors with similar co-citation profiles tend to appear in clusters. Authors who are closely related to each other tend to occupy a central position in the “intellectual structure”, while those who are only loosely related tend to appear on the periphery. The proximity between items represents their similarity (van Eck & Waltman, 2010).

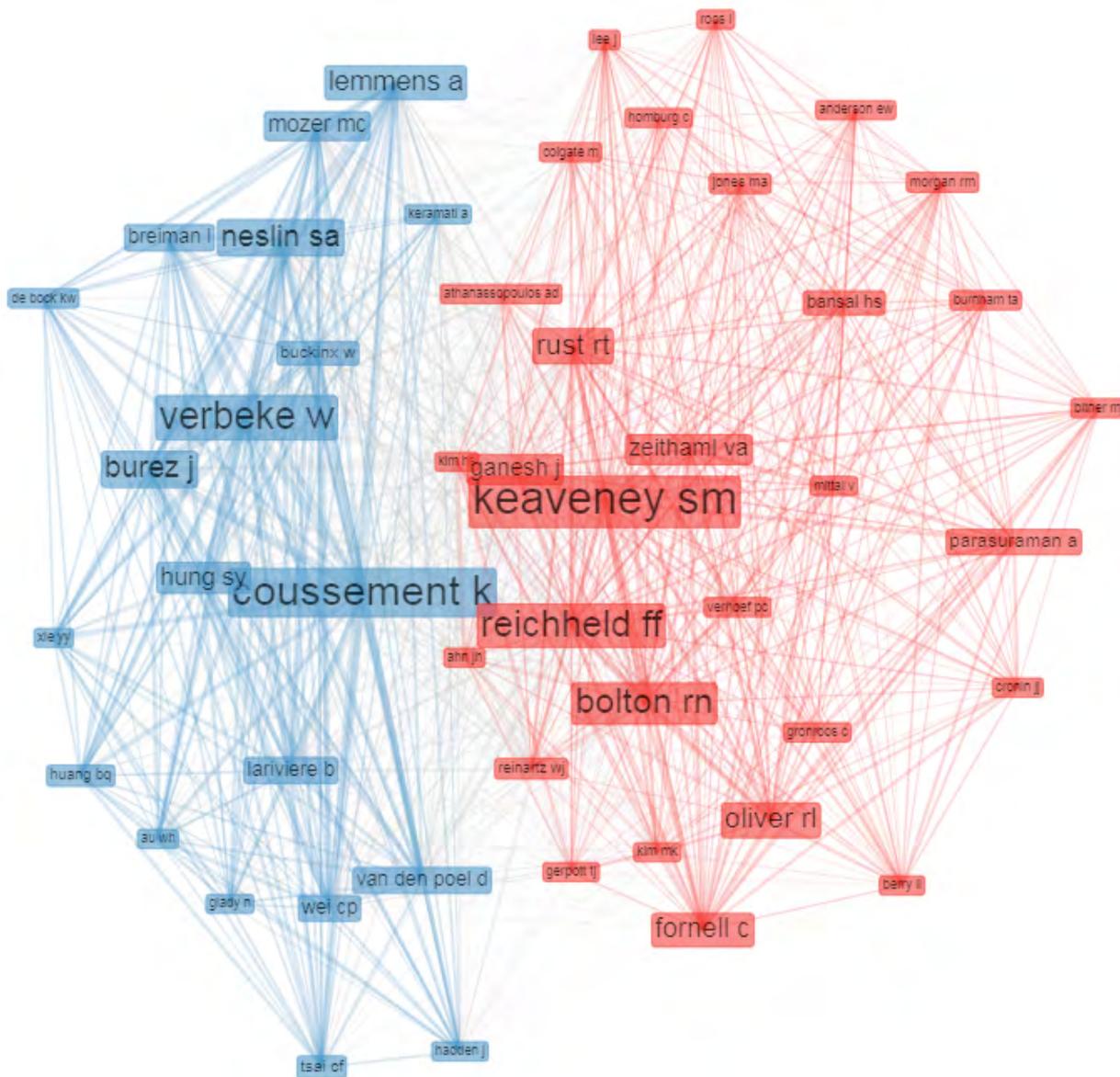


Figure 8

Network Co-citation analysis of authors

Source: Author’s own elaboration-Biblioshiny output.

Note: Each color represents a different cluster. The lines represent co-occurrences between authors. The most connected nodes move to the center of the network while the more isolated (less connected) nodes move to the borders.

Table 13
Top 10 Authors with high Betweenness and Closeness

Authors	Betweenness	Authors	Closeness
Reichheld FF	23.496	Reichheld FF	0.020
Keaveney SM	22.788	Keaveney SM	0.020
Bolton RN	14.793	Bolton RR	0.020
Rust RT	14.180	Rust RT	0.020
Ganesh J	11.616	Ganesh J	0.020
Coussement K	11.529	Athanassopoulos AD	0.020
Zeithaml VA	7.531	Zeithaml VA	0.020
Lemmens A	6.772	Ahn JH	0.020
Reinartz WJ	6.313	Kim HS	0.020
Fornell C	5.870	Gerpott TJ	0.020

Source: Author’s own elaboration.

The analysis software calculated the centrality measures of the co-authorship network. The degree of centrality represents how many other authors have co-written an article (Fischbach, Putzke, & Schoder, 2011) and this can be subdivided into betweenness centrality and closeness centrality. Authors with high levels of closeness centrality can reach other authors in the network via a shorter path (Zupic & Cater, 2015). A high measure of betweenness centrality indicates that an author is a bridge between different research streams (Zupic & Cater, 2015). As seen in Table 13, the top 5 authors with the highest measure of betweenness centrality and closeness centrality are the same. These are Reichheld FF, Keaveney SM, Bolton RN, Rust RT, and Ganesh J.

B. ARTICLES

Regarding co-citation analysis, Figure 9 identifies two clusters. The centrality measures of betweenness and closeness were also calculated.

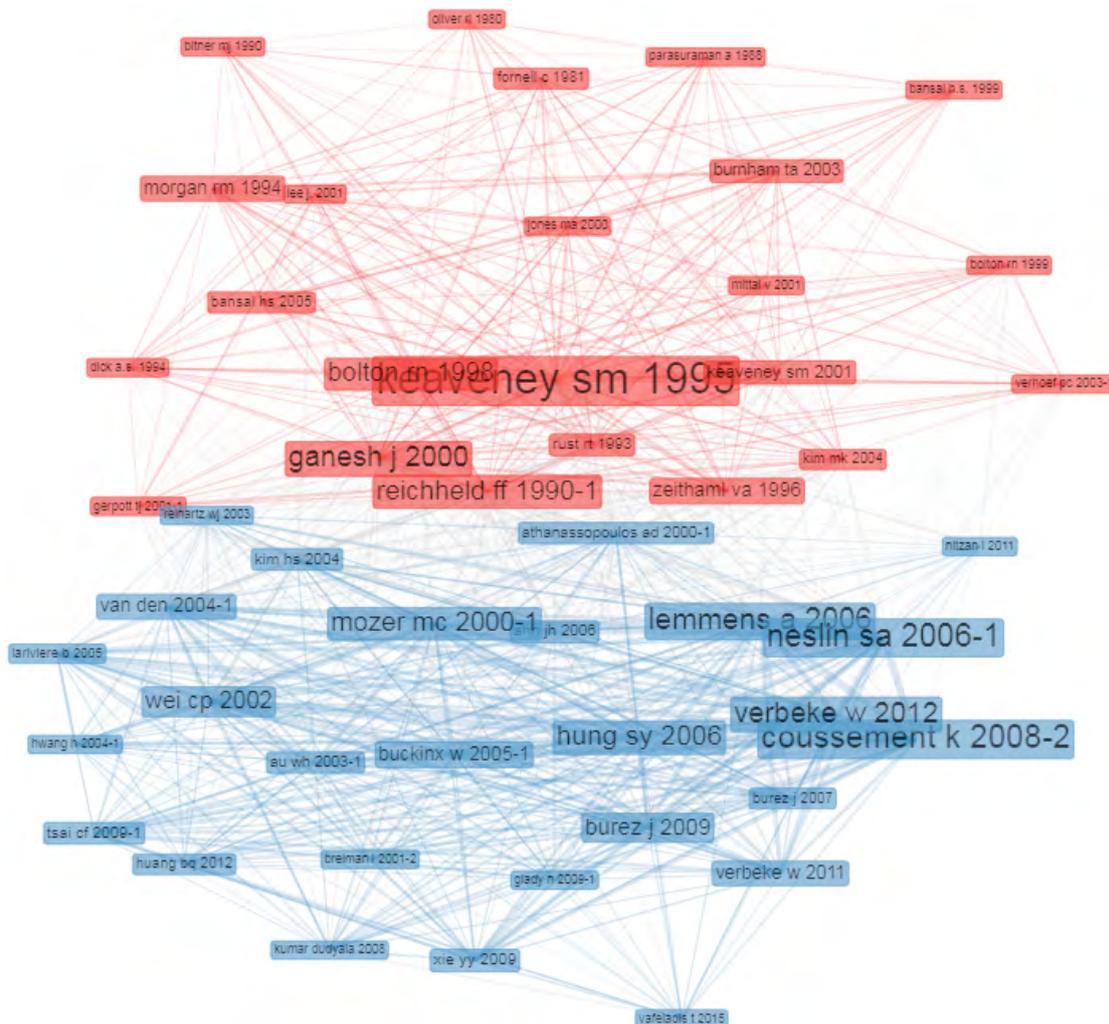


Figure 9

Network Co-citation analysis of articles

Source: Author’s own elaboration-Biblioshiny output.

Note: Each color represents a different cluster. The lines represent co-occurrences between articles. The most connected nodes move to the center of the network while the more isolated (less connected) nodes move to the borders.

The articles with the highest betweenness centrality are (1) Customer switching behavior in service industries: An exploratory study (Keaveney, 1995), (2) Understanding the customer base of service providers: An examination of the differences between switchers and

stayers (Ganesh, Arnold, & Reynolds, 2000), and (3) Zero defections: Quality comes to services (Reichheld & Sasser, 1990).

Table 14 shows the top 10 articles regarding the measure of betweenness centrality.

Table 14
Top 10 Articles with high Betweenness

Authors	Article	Betweenness
Keaveney Sm 1995	Customer switching behavior in service industries: An exploratory study	41.775
Ganesh J 2000	An examination of the differences between switchers and stayers	35.391
Reichheld FF 1990	Zero defections: Quality comes to services	35.255
Athanassopoulos Ad 2000	Customer satisfaction cues to support market segmentation and explain switch behavior	17.861
Rust Rt 1993	Customer satisfaction, customer retention, and market share	17.338
Bolton Rn 1998	A dynamic model of the duration of the customer's relationship with a continuous service provider: The role of satisfaction	17.214
Zeithaml Va 1996	The behavioral consequences of service quality	15.403
Lemmens A 2006	Bagging and boosting classification trees to predict churn	15.367
Neslin Sa 2006	Defection detection: Measuring and understanding the predictive Accuracy of customer churn models	14.461
Mozer Mc 2000	Predicting subscriber dissatisfaction and improving retention in the wireless telecommunications industry	11.367

Source: Author's own elaboration.

For the closeness centrality measure, the articles with the highest values were: (1) Zero defections: Quality comes to services (Reichheld & Sasser, 1990); (2) An examination of the differences between switchers and stayers (Ganesh et al.,

2000); (3) Customer satisfaction cues to support market segmentation and explain switch behavior (Athanassopoulos, 2000). Table 15 presents the 10 articles with the highest values.

Table 15
Top 10 Articles with high Closeness

Authors	Article	Closeness
Reichheld FF 1990	Zero defections: Quality comes to services	0.020
Ganesh J 2000	An examination of the differences between switchers and stayers	0.019
Athanassopoulos AD 2000	Customer satisfaction cues to support market segmentation and explain switch behavior	0.019
Rust RT 1993	Customer satisfaction, customer retention, and market share	0.019
Keaveney SM 1995	Customer switching behavior in service industries: An exploratory study	0.019
Bolton RR 1998	A dynamic model of the duration of the customer's relationship with a continuous service provider: The role of satisfaction	0.019
Mozer MC 2000	Predicting subscriber dissatisfaction and improving retention in the wireless telecommunications industry	0.018
Zeithaml VA 1996	The behavioral consequences of service quality	0.018
Lemmens A 2006	Bagging and boosting classification trees to predict churn	0.018
Neslin SA 2006	Defection detection: Measuring and understanding the predictive Accuracy of customer churn models	0.018

Source: Author's own elaboration.

C. JOURNALS

Figure 10 is a graphic representation resulting from the network of journal co-citations, identifying two clusters. A cluster that we call technological, with journals such as the Expert Systems with Applications, Journal of the Academy of Marketing Science, and Decision Support Systems, with a stream of re-

search closer to themes related to data mining, models prediction, algorithms, and other topics. The second cluster, which we call "theoretical foundations", consists of journals with greater proximity to the study of marketing science itself and constructs broadly classified as determinants of customer churn: satisfaction, quality of service, loyalty, customer behavior, and customer switching, among others.

2.5. Intellectual structure of the field - Bibliographic Coupling

The intellectual structure reveals how an author’s work influences a determined scientific community. Co-citation analysis and bibliographic coupling have been used to analyze the intellectual structure of a field of scientific research (Cobo et al., 2011). Bibliographic coupling answers questions such as; What is the intellectual structure of recent/emerging literature? (Zupic & Cater, 2015). Bibliographic coupling is particularly suitable for analyzing the research front of a research topic or field (Zupic & Cater, 2015). The concept of a research front is used to describe current scientific articles that cite the knowledge base publications, previously described as the set of articles most cited by current research.

Two articles are linked bibliographically if at least one cited source appears in the bibliographies or reference lists of both articles (Kessler, 1963). Bibliographic coupling describes the extent to which two articles are related because both refer to the same article (Ferreira, 2018). This analysis technique can also be applied to authors and journals. The author’s bibliographic coupling aims to discover co-author relationships between authors who cite the same references, while bibliographic coupling of journals aims to discover journals that cite the same references (Cobo et al., 2011).

For bibliographic coupling analysis, the 50 most cited authors, articles, and journals were selected.

A. AUTHORS

Bibliographic coupling of authors is a method of mapping active authors, which can give a realistic view of the current state

of research (Zhao & Strotmann, 2008). It can also analyze the social structure of a particular research field. Figure 11 presents the resulting network diagram.

The centrality measures of the co-authorship network were calculated. Based on betweenness centrality and closeness centrality, as explained previously, the authors with the greatest measure of proximity are: (1) Van Den Poel D; (2) Coussement K; and (3) Hsieh YC. Table 17 shows the top 10 authors regarding these two metrics (the complete list or the database itself can be obtained from the corresponding author upon request). We can conclude that these authors are the main constituents of the intellectual structure of the research field. They are the authors of the research front.

Table 17
Top 10 Authors with high Betweenness and Closeness (BC)

Authors	Closeness	Authors	Betweenness
Van Den Poel D	0.242	Mahajan V	0.012
Coussement K	0.241	Zhang Y	0.012
Hsieh YC	0.240	Kim D	0.010
Mahajan V	0.239	Van Den Poel D	0.009
Gerpott T	0.239	Gerpott TJ	0.008
Stakhovych S	0.239	Coussement K	0.008
Lee YS	0.238	Polo Y	0.006
De Bock KW	0.238	Javier Sese F	0.006
Ahmadi N	0.238	Gupta S	0.006
Ewing M	0.238	Ahmadi N	0.006

Source: Author’s own elaboration.

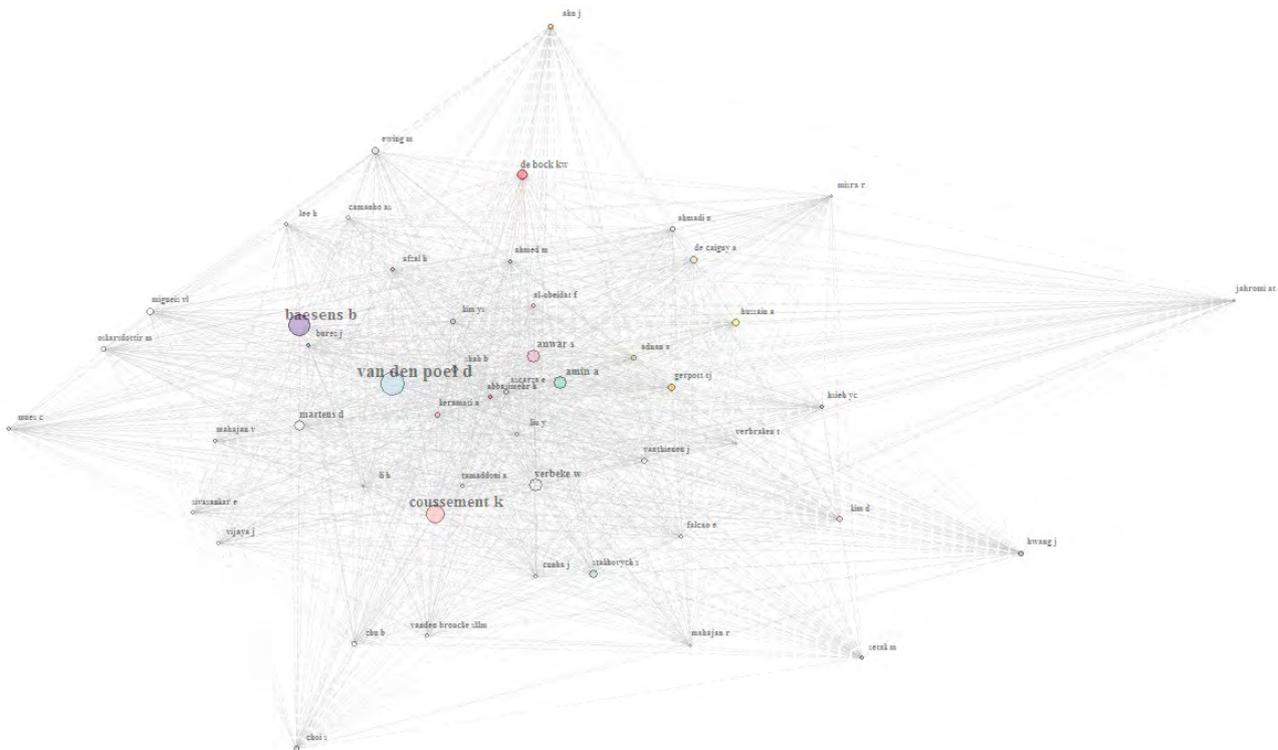


Figure 11
Bibliographic coupling of authors

Source: Author’s own elaboration-Bibliometrix output.

Note: The size of the circle indicates an item’s weight, the lines indicate the links between the items, the distance between the items shows their relationship, and the different colors indicate the clusters.

B. ARTICLES

As mentioned previously, bibliographic coupling describes the extent to which two articles are related by both citing the same article (Ferreira, 2018). Figure 12 shows the network diagram resulting from bibliographic coupling of the articles. Centrality measures for the network and the respective nodes were calculated. The articles with the greatest centrality measure are:

- (1) Improving customer attrition prediction by integrating emotions from client/company interaction emails and evaluating multiple classifiers (Coussement & Van den Poel, 2009);
- (2) A new hybrid classification algorithm for customer churn prediction based on logistic regression and decision trees (De Caigny *et al.*, 2018);
- and (3) Regaining drifting mobile communication customers: Predicting the odds of success of winback efforts with competing risks regression (Gerpott & Ahmadi, 2015).

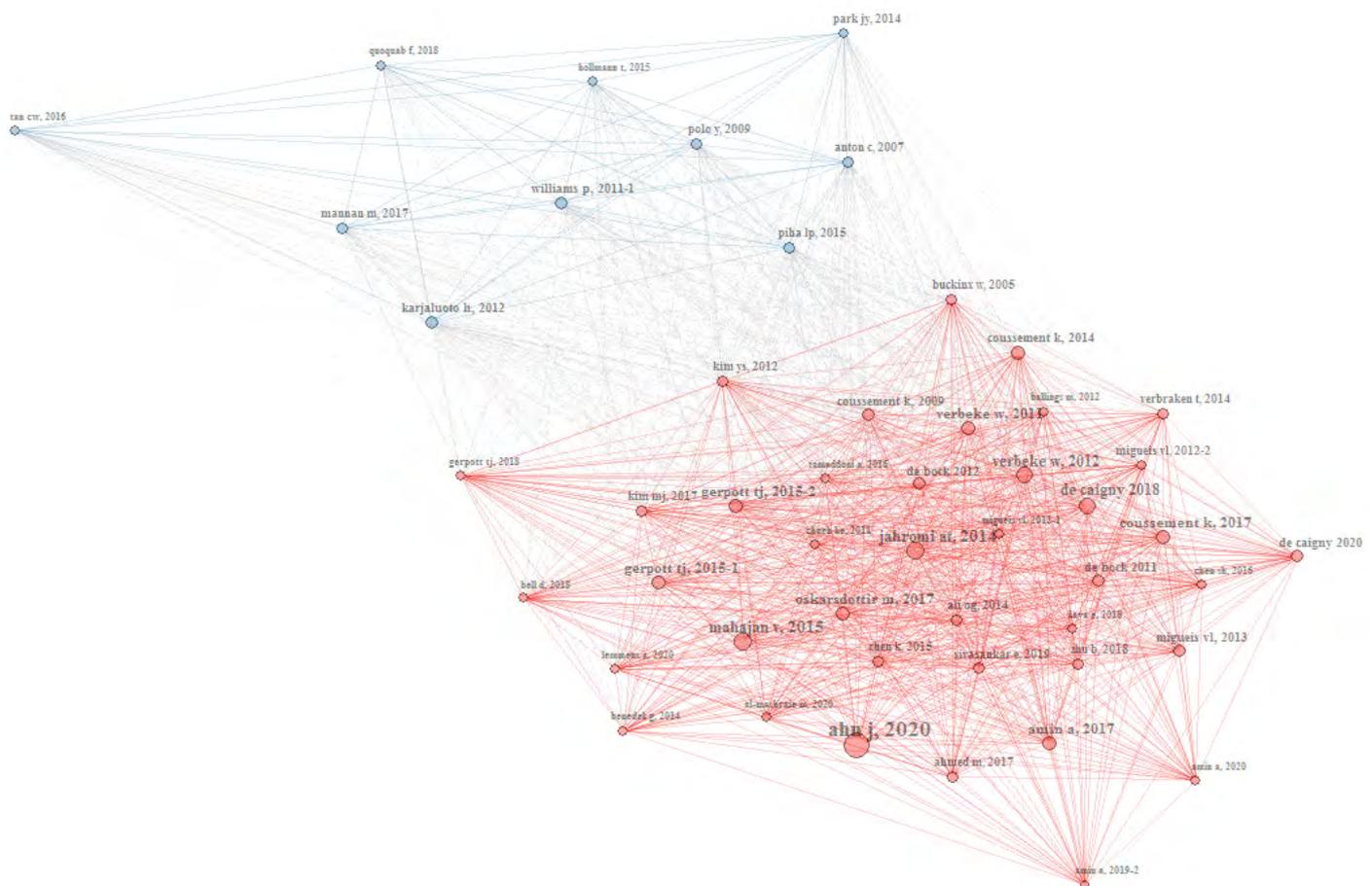


Figure 12
Bibliographic Coupling of Articles

Source: Author's own elaboration-Bibliometrix output.

Note: The size of the circle indicates an item's weight, the lines indicate the links between the items, the distance between the items shows their relationship, and the different colors indicate the clusters.

Table 18 shows the top 10 articles concerning their degree of closeness centrality, that is, the articles most similar to each other.

Table 19 shows the articles with a higher degree of betweenness centrality: the articles representing a bridge between the different research streams. The articles in both tables constitute the research front on customer churn.

The majority of articles come after 2009, with 90% of the articles in the tables belonging to this period. More than half the articles are from 2015 onwards. This was also observed in the descriptive analysis, in the evolution of article publication over time. The research front is related mainly to predictive analysis.

Table 18
Top 10 Articles with high Closeness (BC)

Authors	Article	Closeness
Coussement K, 2009	Improving customer attrition prediction by integrating emotions from client/company interaction emails and evaluating multiple classifiers	0.309
De Caigny, 2018	A new hybrid classification algorithm for customer churn prediction based on logistic regression and decision trees	0.308
Gerpott TJ, 2015	Regaining drifting mobile communication customers: Predicting the odds of success of winback efforts with competing risks regression	0.306
Coussement K, 2014	Improving customer retention management through cost-sensitive learning	0.306
Mahajan V, 2015	Review of data mining techniques for churn prediction in telecom	0.306
Ahn J, 2020	A survey on churn analysis in various business domains	0.306
Jahromi AT 2014	Managing B2B customer churn, retention and profitability	0.305
Gerpott TJ, 2015	Who is (not) convinced to withdraw a contract termination announcement? - A discriminant analysis of mobile communications customers in Germany	0.304
Verbeke W, 2012	New insights into churn prediction in the telecommunication sector: A profit driven data mining approach	0.304
Buckinx W, 2005	Customer base analysis: Partial defection of behaviourally loyal clients in a non-contractual FMCG retail setting	0.300

Source: Author's own elaboration.

Table 19
Top 10 Articles with high Betweenness (BC)

Authors	Article	Betweenness
Ahn Y, 2020	Customer attrition analysis in the securities industry: A large-scale field study In Korea	0.014
Mahajan V, 2015	Review of data mining techniques for churn prediction in telecom	0.014
Coussement K, 2009	Improving customer attrition prediction by integrating emotions from client/company interaction emails and evaluating multiple classifiers	0.013
Gerpott TJ, 2015	New insights into churn prediction in the telecommunication sector: A profit driven data mining approach	0.013
Benedek G, 2014	The importance of social embeddedness: churn models at mobile providers	0.011
Ahn J, 2020	A survey on churn analysis in various business domains	0.011
Al-Mashraie M, 2020	Customer switching behavior analysis in the telecommunication industry	0.010
De Caigny, 2018	A new hybrid classification algorithm for customer churn prediction	0.009
Polo Y, 2009	How to Make Switching Costly: The role of marketing and relationship characteristics	0.009
Hadden J 2007	Computer-assisted customer churn management: State-of-the-art and future trends	0.008

Source: Author's own elaboration.

C. JOURNALS

The bibliographic coupling of journals seeks to study the relationship between common references among the journals' publications (Cobo *et al.*, 2011). Figure 13 presents the network diagram resulting from the bibliographic coupling of journals.

Centrality measures were calculated for the co-authorship network. Regarding closeness centrality, the journals with the highest value are (1) Expert Systems with Applications, (2) Telecommunications Policy, (3) European Journal of Marketing. Expert Systems with Applications has the highest number of

articles in the sample under study, at 12%. Regarding betweenness centrality, the journals with the highest values are (1) International Journal of Bank Marketing; (2) Expert Systems with Applications; and (3) European Journal of Operational Research. Table 20 shows the top 10 journals in terms of centrality measures.

From the research field of the journals, we can conclude that the research front has been primarily published by journals whose focus is on intelligent systems, technologies, applications, intelligence, and data science. Also noteworthy are two journals, which are more sector-oriented, with publications on telecommunications and banking.

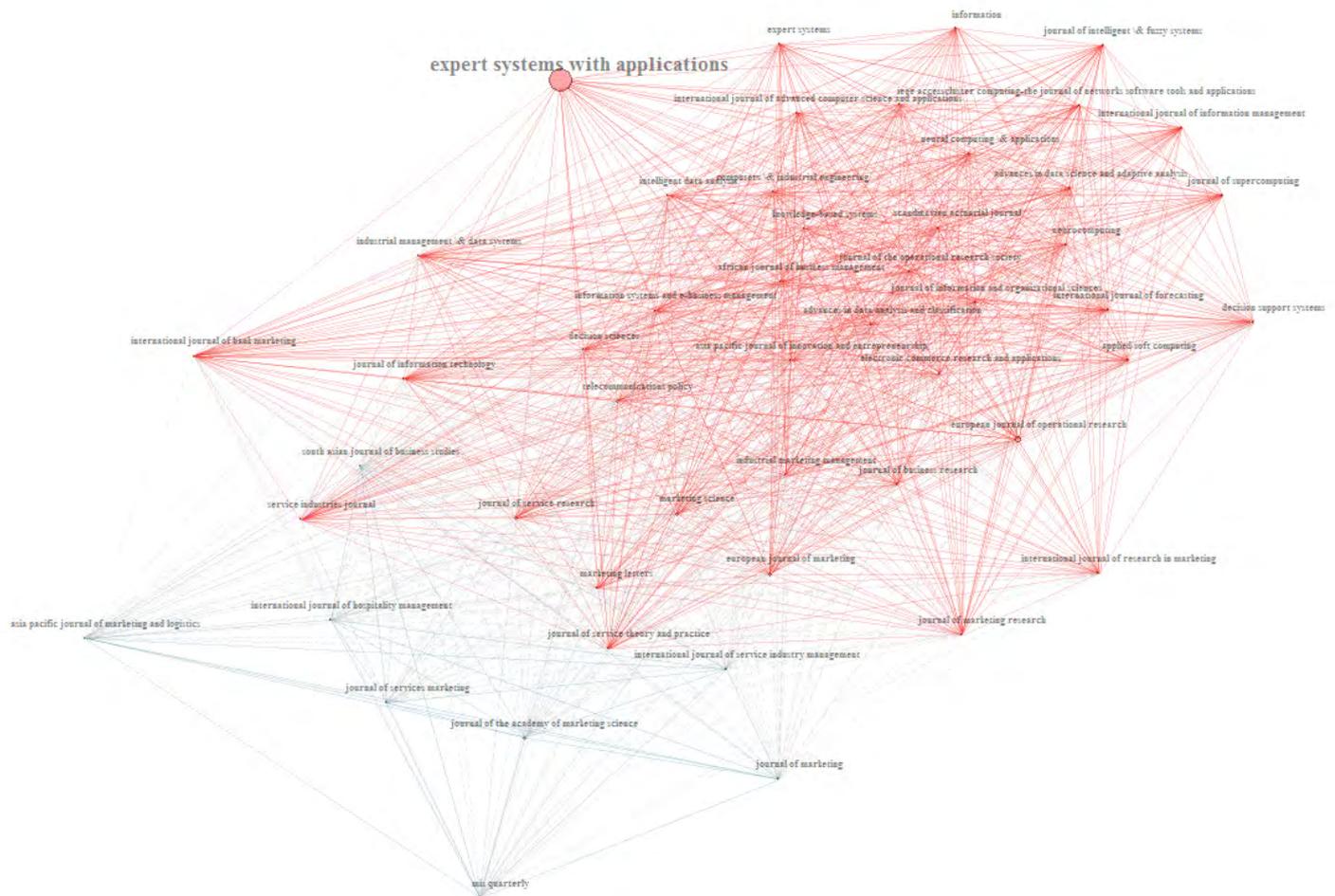


Figure 13
Bibliographic Coupling of Sources

Source: Author’s own elaboration-Bibliometrix output.

Note: The size of the circle indicates an item’s weight, the lines indicate the links between the items, the distance between the items shows their relationship, and the different colors indicate the clusters.

Table 20
Top 10 Journals with high Betweenness and Closeness (BC)

Journal	Closeness	Journal	Betweenness
<i>Expert Systems With Applications</i>	0.326	<i>International Journal of Bank Marketing</i>	0.035
<i>Telecommunications Policy</i>	0.321	<i>Expert Systems with Applications</i>	0.030
<i>European Journal of Marketing</i>	0.321	<i>European Journal of Operational Research</i>	0.025
<i>European Journal of Operational Research</i>	0.320	<i>Decision Sciences</i>	0.025
<i>Industrial Marketing Management</i>	0.319	<i>European Journal of Marketing</i>	0.021
<i>International Journal of Bank Marketing</i>	0.317	<i>Journal of Business Research</i>	0.016
<i>Journal of Business Research</i>	0.317	<i>Telecommunications Policy</i>	0.015
<i>Journal of Service Research</i>	0.317	<i>Journal of Service Research</i>	0.015
<i>Marketing Science</i>	0.315	<i>Marketing Science</i>	0.015
<i>Information Systems and e-Business Management</i>	0.310	<i>Industrial Marketing Management</i>	0.014

Source: Author’s own elaboration.

2.6. Co-author analysis

Co-author analysis looks at authors and their affiliations to study social structure and collaboration networks (Peters & Vanraan, 1991). It is particularly well suited to studying research questions involving scientific collaboration (Zupic & Cater, 2015). The most commonly used method to study social structure is the co-author network. However, it is also possible to use information about authors' geographical location and institutional affiliations to examine collaboration at the level of institutions and countries (Zupic & Cater, 2015).

A. AUTHOR

Figure 14 shows the co-authorship network graph. There are 10 clusters, and three stand out with a higher number of co-authors. The first was led by Baesens B and Verbeke W, the second by Van Den Poel D and Coussement K, and the third by Amin A and Anwar S. These authors also have the highest number of articles in the sample studied.

Table 21 presents the author networks, ordering them by PageRank. For co-authoring networks, PageRank gives greater weight to authors who collaborate with different authors and those who collaborate with few authors but do so frequently (Yan & Ding, 2011).

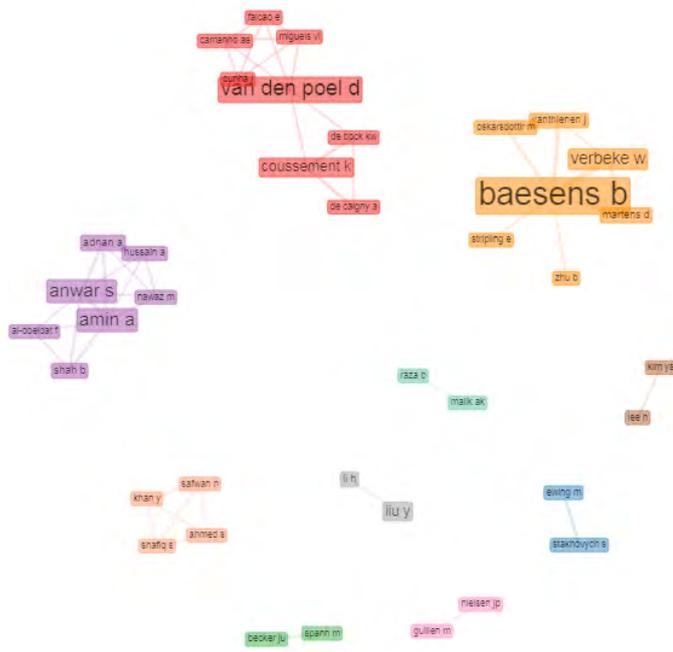


Figure 14
Co-authorship analysis

Source: Author's own elaboration-Biblioshiny output.

Note: The rectangles denote author nodes and are labeled by the author's last name and initials. The node size corresponds to the number of publications, and the color of the different clusters.

Table 21

Articles of each co-authorship cluster: PageRank measure

Cluster 1	PageRank	Cluster 2	PageRank
Van den Poel D	0.037	Stakhovych S	0.026
Coussement K	0.028	Ewing M	0.026
Migueis VI	0.026		
Camanho As	0.026		
Falcao E	0.026		
Cunha J	0.026		
De Bock Kw	0.024		
De Caigny A	0.019		
Cluster 3	PageRank	Cluster 4	PageRank
Becker Ju	0.026	Amin A	0.040
Spann M	0.026	Anwar S	0.040
		Shah B	0.021
		Nawaz M	0.021
		Hussain A	0.021
		Al-Obeidat F	0.016
Cluster 5	PageRank	Cluster 6	PageRank
Baesens B	0.063	Kim Ys	0.026
Verbeke W	0.036	Lee H	0.026
Vanthienen J	0.026		
Martens D	0.023		
Oskarsdottir M	0.019		
Stripling E	0.009		
Zhu B	0.009		
Cluster 7	PageRank	Cluster 8	PageRank
Guillen M	0.026	Li H	0.026
Nielsen Jp	0.026	Liu Y	0.026
Cluster 9	PageRank	Cluster 10	PageRank
Raza B	0.026	Khan Y	0.026
Malik Ak	0.026	Shafiq S	0.026
		Ahmed S	0.026
		Safwan N	0.026

Source: Author's own elaboration.

This analysis also shows that the clusters of authors with the greatest scientific collaboration are essentially those identified as mainly responsible for the research front through the bibliographic coupling analysis, meaning there is high collaboration on the research front. Van Den Poel D and Coussement K stand out with the highest centrality measure, meaning they can reach other authors in the network via a shorter path.

B. COUNTRY OF AFFILIATION

Regarding co-authorship in the author's country of affiliation, Figure 15 presents five clusters, two of which have a higher number of co-authors.

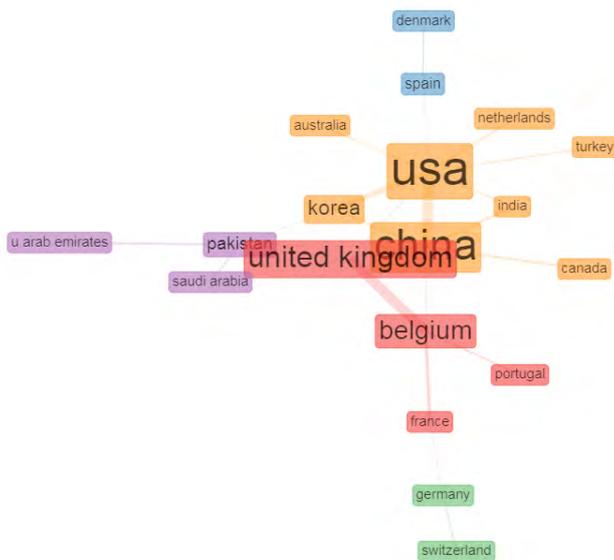


Figure 15

Co-authorship analysis (Country)

Source: Author's own elaboration-Biblioshiny output.

Note: The nodes represent countries and links connect countries in the form of co-authorships. Bibliometrix software attributes a different color to each cluster.

The first cluster comprises the United States and China with a higher PageRank, and a second made up of the United Kingdom and Belgium with a high PageRank. We recall that China, the United States, and Belgium are responsible for 41% of all publications. Table 22 presents the country networks, sorting them by PageRank.

Table 22

Countries of each co-authorship cluster: PageRank measure

Cluster 1	PageRank	Cluster 2	PageRank
United Kingdom	0.121	Spain	0.036
Belgium	0.106	Denmark	0.023
France	0.042		
Portugal	0.016		
Cluster 3	PageRank	Cluster 4	PageRank
Germany	0.041	Pakistan	0.0637
Switzerland	0.026	United Arab Emirates	0.0214
		Saudi Arabia	0.0245
Cluster 5	PageRank		
USA	0.170		
China	0.148		
Korea	0.057		
India	0.031		
Netherlands	0.020		
Canada	0.019		
Australia	0.016		
Turkey	0.016		

Source: Author's own elaboration.

Figure 16 shows the collaborative map between countries, where the frequencies between China and the United States and between the United Kingdom and Belgium stand out, as seen earlier.

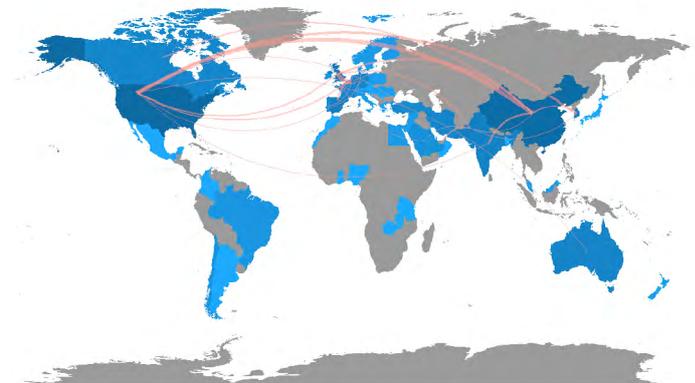


Figure 16

Country CollaborationMap

Source: Author's own elaboration-Biblioshiny output.

Note: The blue color on the map represents research cooperation among countries. The darker the color, the higher the country collaboration. The scale of cooperation is represented through the thickness of the line.

C. INSTITUTION FROM AFFILIATION

Finally, concerning the authors' affiliated institutions, the co-authorship network reveals one prominent cluster, with the University of Southampton and the Catholic University of Leuven at the head, affiliated universities of Baesens B, who is also the author with the second highest number of articles on the database. Figure 17 presents the graph of the co-authorship network by educational institution.



Figure 17

Co-authorship analysis (Institution)

Source: Author's own elaboration-Biblioshiny output.

Note: The nodes represent institutions and are labeled by the institution name. The node size corresponds to the number of occurrences of co-authorships publications, and links connect institutions in the form of co-authorships. Bibliometrix software attributes different colors to each cluster.

Table 23 shows the networks of institutions by cluster, ordered by PageRank.

Table 23

Institutions of each co-authorship cluster: PageRank measure

Cluster 1	PageRank	Cluster 2	PageRank
Katholieke University Leuven	0.121	Inst Management Sci	0.084
University Southampton	0.108	Zayed University	0.039
University of Antwerp	0.035	Taibah University	0.050
Vrije Universiteit Brussel	0.026	University Stirling	0.050
Sichuan University	0.026		
University Ghent	0.017		
Cluster 3	PageRank	Cluster 4	PageRank
Columbia University	0.056	Monash University	0.003
University of Pennsylvania	0.056	Deakin University	0.003
Cluster 5	PageRank		
Chinese Academy of Sciences	0.056		
University Nebraska	0.056		

Source: Author's own elaboration.

3. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

As markets become increasingly saturated, academic researchers and companies have recognized it is essential to identify the customers most likely to switch to another service provider (Keaveney & Parthasarathy, 2001). The intention here was to present a structured review of customer churn, using bibliometric techniques to analyze the research field's intellectual and conceptual structure. As far as we know, a bibliometric analysis has never been carried out to identify analytically and objectively the most influential studies and authors, as well as the emerging research clusters, so we believe that this study advances knowledge about the field of studies analyzed.

This study synthesizes insights from a considerable amount of relevant literature on customer churn. The data show that research on customer churn has been published more and more, thus demonstrating the growing importance of this field of research.

As for the most influential outlets for the dissemination of research about customer churn, *Expert Systems with Applications* is the journal of choice. Amongst the most prolific authors, we highlight Van Den Poel, Baesens B and Coussement K, which explains, in part, why Belgium is one of the countries that have contributed most to developing and disseminating research on customer churn. Interestingly, when we focus our analysis on the most cited references, the work by Keaveney S.M ranks very highly, suggesting the relevance of this author's research in this area of knowledge. However, when one analyzes the global and

local citations, one realizes that Verbeke and Burez stand out among the top-10 most local-cited articles, Burez being in the last place in the top-10 global-cited articles. One possible explanation why they are not among the top-10 most globally cited articles is that their publications are from 2011 and 2012 (Verbeke) and from 2007 and 2009 (Burez).

In order to complement the descriptive analysis and obtain further insights into the customer churn literature, this article analyzed the conceptual and intellectual structure of the research field. Determination of the intellectual structure and the research front of the scientific domains are essential not only for research but also to elaborate policies and practices (Aria & Cuccurullo, 2017). The importance of having "a conceptual and intellectual map" is undeniable for the construction of a holistic view of a field of studies. The bibliometric analysis (1995-2000) carried out in this study allows mapping and synthesizing the relationships between authors, articles, and fundamental journals in the field of customer churn.

Regarding the first research question proposed for this article, which was about the specific topics associated with customer churn research, we performed a co-word analysis. We observed in the first instance that there are two different angles, two major lines of investigation, which are complementary. One, in which the researchers' objectives are to understand what leads to customer churn and to define essential churn factors, such as satisfaction, service quality and service attributes (e.g., Athanassopoulos, 2000; Keaveney, 1995; Reichheld & Sasser, 1990; Rust & Zahorik, 1993). The second, where researchers focus on improving customer churn forecasting models to boost predictive performance (e.g., Verbeke et al., 2012; Verbeke et al., 2011; Wei & Chiu, 2002). These predictive studies typically apply modeling techniques, such as artificial neural networks, decision trees, and random forests, to large samples of subscribers. Complementarily, and through the construction of a thematic map³, churn prediction was found to be the most important theme in the field of investigation. This theme relates to different concepts such as "classification", "machine learning" and "telecommunication", among others. Since telecommunications is an area suitable for this type of investigation, future research on customer turnover is recommended, using not predictive models, but behavioral models, with antecedents focusing on satisfaction, quality of service, switching costs, and socio-demographic data, to name just a few. However, despite these findings, churn seems to be an unresolved issue as customer experience, encounter, disappointment and interaction are continuously present in the services provided. Moreover, beyond the relational aspects of situational interaction, there is a lack of knowledge on how cumulative experience and customer encounters influence churn.

Regarding the intellectual structure of the field, approached by the second research question, two techniques of bibliometric analysis were used, co-citation analysis and bibliographic coupling. Firstly, through analyzing articles, journals and authors, we sought to map older works, identifying the intellectual structure at the base of the field of studies through analysis of co-ci-

³ Thematic mapping consists of a word co-occurrence network analysis to define what science talks about in a research field, main themes, and trends.

tations. Secondly, we mapped the current front of the research field through bibliographic coupling.

Co-citation analysis revealed that the authors with the greatest closeness and betweenness centrality are Reichheld FF, Keaveney SM, Bolton RN, Rust RT, and Ganesh J, that is, these are the primary authors most cited by current research, and they are the foundations of current research. The article “Customer switching behavior in service industries: An exploratory study” by Keaveney (1995), which in the intellectual structure of the research field emerges as the article with the greatest measure of closeness centrality, is one of the main founding articles of the research field and is also the most cited article globally. It was the first article to present a model explaining customer churn in service industries considering a possible number of causal factors and their interrelationships. These data tackle the third research question proposed by this article, regarding the central, peripheral, or bridging researchers in this field.

Regarding cutting-edge research and the intellectual structure of emerging literature (fourth research question), bibliographic coupling revealed that the principal authors are Coussement K and Van den Poel D, with the most prominent article being by these authors, Improving Customer Attrition Prediction by Integrating Emotions from Client/Company Interaction Emails and Evaluating Multiple Classifiers (Coussement & Van den Poel, 2009). Hence, predictive methods are found to be at the cutting edge of customer churn research.

Finally, in relation to the social structure of the research field (fifth research question), the United States and China are the main collaborating countries. This collaboration should be extended to other clusters of countries, since customer turnover is transversal to all countries, and a more comprehensive view of cross-cultural management is clearly necessary.

Throughout the study, and in all the analyses performed, no references were found to the research field about customer experience. A good customer experience tends to reduce significantly the propensity to switch to another brand (Sirapracha & Tocquer, 2012). Experiences can be seen as the “impressions” that remain in customers’ minds, as the result of a holistic encounter with an offer or object (Iglesias *et al.*, 2011), culminating in satisfaction or disappointment and desertion or abandonment (Meyer & Schwager, 2007). A positive experience can promote an emotional bond between the brand and its customers, which, in turn, increases customer loyalty (Gentile *et al.*, 2007). One recommendation for future investigation is to study the relationship between the customer experience and customer churn, the determinants and their impact on customer churn. We share the same question referred to by Lemon and Verhoef (2016) who ask if customer experience can explain the customer’s behavior and the company’s performance. It is also important to address how disconnected the relation between customer satisfaction and involvement with churn is. Once again, we emphasize the need to approach churn addressing the behavioral side, not only with predictive methods but also addressing how emotional drivers influence behavioral responses leading to churn, both in relational or transactional encounters. Moreover, there is lack of references to how competitors’ action influences churning behavior.

Although this investigation contributes to knowledge in this area, being the first attempt to map the research field systematical-

ly, several limitations and future research opportunities are worth mentioning through a bibliometric analysis. Data collection was carried out exclusively on the “Web of Science” database and, consequently, articles and other types of documents indexed by other platforms were not covered. This decision was because the software used for bibliometric analysis is still unable to merge the references cited correctly. In the future, other databases (e.g., Scopus) should be analyzed together with WoS. Only scientific articles were considered, excluding books, conference proceedings, editorial material, and others, so it will be of interest to examine other publications not included in the sample, to complement the results obtained. Moreover, the focus of this article was on bibliometric analysis and the intellectual structure of churn. As such, a literature review based on content analysis is mandatory to explore the intricacies relating consumer behavior, customer satisfaction, customer loyalty, churn prediction, customer churn and their emotional drivers.

4. REFERENCES

- Adebiyi, S. O., Oyatoye, E. O., & Amole, B. B. (2016). Relevant drivers for customers’ churn and retention decision in the Nigerian mobile telecommunication industry. *Journal of Competitiveness*, 6(3), 52-67. <https://doi.org/10.7441/joc.2016.03.04>
- Ahn, J. H., Han, S. P., & Lee, Y. S. (2006). Customer churn analysis: Churn determinants and mediation effects of partial defection in the Korean mobile telecommunications service industry. *Telecommunications Policy*, 30(10-11), 552-568. <https://doi.org/10.1016/j.telpol.2006.09.006>
- Ahn, J., Hwang, J., Kim, D., Choi, H., & Kang, S. (2020). A Survey on churn analysis in various business domains. *IEEE Access*, 8, 220816-220839. <https://doi.org/10.1109/access.2020.3042657>
- Al-Mashraie, M., Chung, S. H., & Jeon, H. W. (2020). Customer switching behavior analysis in the telecommunication industry via push-pull-mooring framework: A machine learning approach. *Computers & Industrial Engineering*, 144. <https://doi.org/10.1016/j.cie.2020.106476>
- Amin, A., Shah, B., Khattak, A. M., Moreira, F. J. L., Ali, G., Rocha, A., & Anwar, S. (2019). Cross-company customer churn prediction in telecommunication: A comparison of data transformation methods. *International Journal of Information Management*, 46, 304-319. <https://doi.org/10.1016/j.ijinfomgt.2018.08.015>
- Amiri, H., & Daume III, H. (2016). *Short text representation for detecting churn in microblogs*. Paper presented at the Thirtieth AAAI Conference on Artificial Intelligence.
- Anderson, E. W., Fornell, C., & Lehmann, D. R. (1994). Customer satisfaction, market share, and profitability - Findings from Sweden. *Journal of Marketing*, 58(3), 53-66. <https://doi.org/10.1177/002224299405800304>
- Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Athanassopoulos, A. D. (2000). Customer satisfaction cues to support market segmentation and explain switching behavior. *Journal of Business Research*, 47(3), 191-207. [https://doi.org/10.1016/s0148-2963\(98\)00060-5](https://doi.org/10.1016/s0148-2963(98)00060-5)
- Aydin, S., & Ozer, G. (2005). The analysis of antecedents of customer loyalty in the Turkish mobile telecommunication market. *European Journal of Marketing*, 39(7-6), 910-925. <https://doi.org/10.1108/03090560510601833>
- Bansal, H. S., Irving, P. G., & Taylor, S. F. (2004). A three-component model of customer commitment to service providers. *Journal of the Academy of Marketing Science*, 32(3), 234-250. <https://doi.org/10.1177/0092070304263332>

- Becker, J. U., Spann, M., & Schulze, T. (2015). Implications of minimum contract durations on customer retention. *Marketing Letters*, 26(4), 579-592. <https://doi.org/10.1007/s11002-014-9293-2>
- Benedek, G., Lubloy, A., & Vastag, G. (2014). The Importance of Social Embeddedness: Churn Models at Mobile Providers. *Decision Sciences*, 45(1), 175-201. <https://doi.org/10.1111/dec.12057>
- Bolton, R. N. (1998). A dynamic model of the duration of the customer's relationship with a continuous service provider: The role of satisfaction. *Marketing Science*, 17(1), 45-65. <https://doi.org/10.1287/mksc.17.1.45>
- Buckinx, W., & Van den Poel, D. (2005). Customer base analysis: Partial defection of behaviourally loyal clients in a non-contractual FMCG retail setting. *European Journal of Operational Research*, 164(1), 252-268. <https://doi.org/10.1016/j.ejor.2003.12.010>
- Burez, J., & Van den Poel, D. (2007). CRM at a pay-TV company: Using analytical models to reduce customer attrition by targeted marketing for subscription services. *Expert Systems with Applications*, 32(2), 277-288. <https://doi.org/10.1016/j.eswa.2005.11.037>
- Burez, J., & Van den Poel, D. (2009). Handling class imbalance in customer churn prediction. *Expert Systems with Applications*, 36(3), 4626-4636. <https://doi.org/10.1016/j.eswa.2008.05.027>
- Burnham, T. A., Frels, J. K., & Mahajan, V. (2003). Consumer switching costs: A typology, antecedents, and consequences. *Journal of the Academy of Marketing Science*, 31(2), 109-126. <https://doi.org/10.1177/0092070302250897>
- Callon, M., Courtial, J. P., & Laville, F. (1991). Co-word analysis as a tool for describing the network of interactions between basic and technological research - The case of polymer chemistry. *Scientometrics*, 22(1), 155-205. <https://doi.org/10.1007/bf02019280>
- Callon, M., Courtial, J. P., Turner, W. A., & Bauin, S. (1983). From translations to problematic networks - An introduction to co-word analysis. *Social Science Information Sur Les Sciences Sociales*, 22(2), 191-235. <https://doi.org/10.1177/053901883022002003>
- Carrizo-Moreira, A., Freitas-da Silva, P. M., & Ferreira-Moutinho, V. M. (2017). The effects of brand experiences on quality, satisfaction and loyalty: An empirical study in the telecommunications multiple-play service market. *Innovar*, 27(64), 23-38. <https://doi.org/10.15446/innovar.v27n64.62366>
- Chen, P. Y., & Hitt, L. M. (2002). Measuring switching costs and the determinants of customer retention in Internet-enabled businesses: A study of the Online brokerage industry. *Information Systems Research*, 13(3), 255-274. <https://doi.org/10.1287/isre.13.3.255.78>
- Cobo, M. J., Lopez-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). Science mapping software tools: review, analysis, and cooperative study among tools. *Journal of the American Society for Information Science and Technology*, 62(7), 1382-1402. <https://doi.org/10.1002/asi.21525>
- Coussement, K. (2014). Improving customer retention management through cost-sensitive learning. *European Journal of Marketing*, 48(3-4), 477-495. <https://doi.org/10.1108/ejm-03-2012-0180>
- Coussement, K., & Van den Poel, D. (2009). Improving customer attrition prediction by integrating emotions from client/company interaction emails and evaluating multiple classifiers. *Expert Systems with Applications*, 36(3), 6127-6134. <https://doi.org/10.1016/j.eswa.2008.07.021>
- De Caigny, A., Coussement, K., & De Bock, K. W. (2018). A new hybrid classification algorithm for customer churn prediction based on logistic regression and decision trees. *European Journal of Operational Research*, 269(2), 760-772. <https://doi.org/10.1016/j.ejor.2018.02.009>
- de Haan, E., Verhoef, P. C., & Wiesel, T. (2015). The predictive ability of different customer feedback metrics for retention. *International Journal of Research in Marketing*, 32(2), 195-206. <https://doi.org/10.1016/j.ijresmar.2015.02.004>
- Eck, N. J. v., & Waltman, L. (2009). How to normalize co-occurrence data? An analysis of some well-known similarity measures. *Journal of the American society for information science and technology*, 60(8), 1635-1651. <https://doi.org/10.1002/asi.21075>
- Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? *Scientometrics*, 105(3), 1809-1831. <https://doi.org/10.1007/s11192-015-1645-z>
- Eshghi, A., Haughton, D., & Topi, H. (2007). Determinants of customer loyalty in the wireless telecommunications industry. *Telecommunications Policy*, 31(2), 93-106. <https://doi.org/10.1016/j.telpol.2006.12.005>
- Ferreira, F. A. F. (2018). Mapping the field of arts-based management: Bibliographic coupling and co-citation analyses. *Journal of Business Research*, 85, 348-357. <https://doi.org/10.1016/j.jbusres.2017.03.026>
- Fischbach, K., Putzke, J., & Schoder, D. (2011). Co-authorship networks in electronic markets research. *Electronic Markets*, 21(1), 19-40. <https://doi.org/10.1007/s12525-011-0051-5>
- Ganesh, J., Arnold, M. J., & Reynolds, K. E. (2000). Understanding the customer base of service providers: An examination of the differences between switchers and stayers. *Journal of Marketing*, 64(3), 65-87. <https://doi.org/10.1509/jmkg.64.3.65.18028>
- Garfield, E., & Sher, I. H. (1993). KEYWORDS-PLUS(TM) - Algorithmic derivative indexing. *Journal of the American Society for Information Science*, 44(5), 298-299. [https://doi.org/10.1002/\(sici\)1097-4571\(199306\)44:5<298::aid-asi5>3.0.co;2-a](https://doi.org/10.1002/(sici)1097-4571(199306)44:5<298::aid-asi5>3.0.co;2-a)
- Gentile, C., Spiller, N., & Noci, G. (2007). How to sustain the customer experience: An overview of experience components that co-create value with the customer. *European management journal*, 25(5), 395-410. <https://doi.org/10.1016/j.emj.2007.08.005>
- Gerpott, T. J., & Ahmadi, N. (2015). Regaining drifting mobile communication customers: Predicting the odds of success of winback efforts with competing risks regression. *Expert Systems with Applications*, 42(21), 7917-7928. <https://doi.org/10.1016/j.eswa.2015.05.011>
- Haddaway, N. R. A. U. P. C. C., & McGuinness, L. A. (2021). PRISMA2020: R package and ShinyApp for producing PRISMA 2020 compliant flow diagrams (Version 0.0.2): Zenodo. Retrieved from <http://doi.org/10.5281/zenodo.5082518>
- Hadden, J., Tiwari, A., Roy, R., & Ruta, D. (2007). Computer assisted customer churn management: State-of-the-art and future trends. *Computers & Operations Research*, 34(10), 2902-2917. <https://doi.org/10.1016/j.cor.2005.11.007>
- Iglesias, O., Singh, J. J., & Batista-Foguet, J. M. (2011). The role of brand experience and affective commitment in determining brand loyalty. *Journal of Brand Management*, 18(8), 570-582. <https://doi.org/10.1057/bm.2010.58>
- Jahromi, A. T., Stakhovych, S., & Ewing, M. (2014). Managing B2B customer churn, retention and profitability. *Industrial Marketing Management*, 43(7), 1258-1268. <https://doi.org/10.1016/j.indmarman.2014.06.016>
- Jones, M. A., Mothersbaugh, D. L., & Beatty, S. E. (2000). Switching barriers and repurchase intentions in services. *Journal of Retailing*, 76(2), 259-274. [https://doi.org/10.1016/s0022-4359\(00\)00024-5](https://doi.org/10.1016/s0022-4359(00)00024-5)
- Keaveney, S. M. (1995). Customer switching behavior in-service industries - An exploratory-study. *Journal of Marketing*, 59(2), 71-82. <https://doi.org/10.2307/1252074>
- Keaveney, S. M., & Parthasarathy, M. (2001). Customer switching behavior in online services: An exploratory study of the role of selected attitudinal, behavioral, and demographic factors. *Journal of the Academy of Marketing Science*, 29(4), 374-390. <https://doi.org/10.1177/03079450094225>
- Kessler, M. M. (1963). Bibliographic coupling between scientific papers. *American Documentation*, 14(1), 10-25. <https://doi.org/10.1002/asi.5090140103>

- Kumar, V., Leszkiewicz, A., & Herbst, A. (2018). Are you back for good or still shopping around? Investigating customers' repeat churn behavior. *Journal of Marketing Research*, 55(2), 208-225. <https://doi.org/10.1509/jmr.16.0623>
- Kyei, D. A., & Bayoh, A. T. M. (2017). Innovation and customer retention in the Ghanaian telecommunication industry. *International Journal of Innovation*, 5(2), 171-183. <https://doi.org/10.5585/iji.v5i2.154>
- Lemmens, A., & Croux, C. (2006). Bagging and boosting classification trees to predict churn. *Journal of Marketing Research*, 43(2), 276-286. <https://doi.org/10.1509/jmkr.43.2.276>
- Lemon, K. N., & Verhoef, P. C. (2016). Understanding customer experience throughout the customer journey. *Journal of Marketing*, 80(6), 69-96. <https://doi.org/10.1509/jm.15.0420>
- Mahajan, V., Misra, R., & Mahajan, R. (2015). Review of data mining techniques for churn prediction in telecom. *Journal of Information and Organizational Sciences*, 39(2), 183-197.
- Meyer, C., & Schwager, A. (2007). Understanding customer experience. *Harvard Business Review*, 85(2), 116-26,157.
- Moreira, A. C., Silva, P., & Moutinho, V. (2016). Differences between stayers, switchers, and heavy switchers: A study in the telecommunications service market. *Marketing Intelligence & Planning*, 34(6), 843-862. <https://doi.org/10.1108/MIP-07-2015-0128>
- Mozer, M. C., Wolniewicz, R., Grimes, D. B., Johnson, E., & Kaushansky, H. (2000). Predicting subscriber dissatisfaction and improving retention in the wireless telecommunications industry. *Ieee Transactions on Neural Networks*, 11(3), 690-696. <https://doi.org/10.1109/72.846740>
- Neslin, S. A., Gupta, S., Kamakura, W., Lu, J. X., & Mason, C. H. (2006). Defection detection: Measuring and understanding the predictive accuracy of customer churn models. *Journal of Marketing Research*, 43(2), 204-211. <https://doi.org/10.1509/jmkr.43.2.204>
- Newman, M. E., & Girvan, M. (2004). Finding and evaluating community structure in networks. *Physical review E*, 69(2), 026113. <https://doi.org/10.1103/physreve.69.026113>
- Orman, G. K., & Labatut, V. (2009). *A comparison of community detection algorithms on artificial networks*. Paper presented at the International conference on discovery science. https://doi.org/10.1007/978-3-642-04747-3_20
- Peters, H. P. F., & Vanraan, A. F. J. (1991). Structuring scientific activities by coauthor analysis - An exercise on a university-faculty level. *Scientometrics*, 20(1), 235-255. <https://doi.org/10.1007/bf02018157>
- Polo, Y., & Sese, F. J. (2009). How to Make Switching Costly The Role of Marketing and Relationship Characteristics. *Journal of Service Research*, 12(2), 119-137. <https://doi.org/10.1177/1094670509335771>
- Pons, P., & Latapy, M. (2005). *Computing communities in large networks using random walks*. Paper presented at the International symposium on computer and information sciences. https://doi.org/10.1007/11569596_31
- Prince, J., & Greenstein, S. (2014). Does service bundling reduce churn? *Journal of Economics & Management Strategy*, 23(4), 839-875. <https://doi.org/10.1111/jems.12073>
- Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of documentation*, 25(4), 348-349.
- Rajan Sachdeva, R. R. S. (2017). Evaluating prediction of customer churn behavior based on artificial bee colony algorithm. *International Journal of Engineering and Computer Science*, 6(1). <https://doi.org/10.18535/ijecs/v6i1.32>
- Ramos-Rodriguez, A. R., & Ruiz-Navarro, J. (2004). Changes in the intellectual structure of strategic management research: A bibliometric study of the Strategic Management Journal, 1980-2000. *Strategic Management Journal*, 25(10), 981-1004. <https://doi.org/10.1002/smj.397>
- Reichheld, F. F., & Sasser, W. E. (1990). Zero defections - Quality comes to services. *Harvard Business Review*, 68(5), 105-111.
- Rust, R. T., & Zahorik, A. J. (1993). Customer satisfaction, customer retention, and market share. *Journal of Retailing*, 69(2), 193-215. [https://doi.org/10.1016/0022-4359\(93\)90003-2](https://doi.org/10.1016/0022-4359(93)90003-2)
- Sirapricha, J., & Tocquer, G. (2012). *Customer experience, brand image and customer loyalty in telecommunication services*. Paper presented at the Int Conf Econ Bus Mark Manag.
- Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for information Science*, 24(4), 265-269. <https://doi.org/10.1002/asi.4630240406>
- Small, H. (1999). Visualizing science by citation mapping. *Journal of the American Society for Information Science*, 50(9), 799-813. [https://doi.org/10.1002/\(sici\)1097-4571\(1999\)50:9<799::aid-asi9>3.0.co;2-g](https://doi.org/10.1002/(sici)1097-4571(1999)50:9<799::aid-asi9>3.0.co;2-g)
- Team, R. C. (2021). R: A language and environment for statistical computing.
- Tsai, C. F., & Lu, Y. H. (2009). Customer churn prediction by hybrid neural networks. *Expert Systems with Applications*, 36(10), 12547-12553. <https://doi.org/10.1016/j.eswa.2009.05.032>
- Ullah, I., Raza, B., Malik, A. K., Imran, M., Ul Islam, S., & Kim, S. W. (2019). A churn prediction model using random forest: Analysis of machine learning techniques for churn prediction and factor identification in telecom sector. *Ieee Access*, 7, 60134-60149. <https://doi.org/10.1109/access.2019.2914999>
- Van den Poel, D., & Lariviere, B. (2004). Customer attrition analysis for financial services using proportional hazard models. *European Journal of Operational Research*, 157(1), 196-217. [https://doi.org/10.1016/s0377-2217\(03\)00069-9](https://doi.org/10.1016/s0377-2217(03)00069-9)
- van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538. <https://doi.org/10.1007/s11192-009-0146-3>
- Verbeke, W., Dejaeger, K., Martens, D., Hur, J., & Baesens, B. (2012). New insights into churn prediction in the telecommunication sector: A profit driven data mining approach. *European Journal of Operational Research*, 218(1), 211-229. <https://doi.org/10.1016/j.ejor.2011.09.031>
- Verbeke, W., Martens, D., Mues, C., & Baesens, B. (2011). Building comprehensible customer churn prediction models with advanced rule induction techniques. *Expert Systems with Applications*, 38(3), 2354-2364. <https://doi.org/10.1016/j.eswa.2010.08.023>
- Wei, C. P., & Chiu, I. T. (2002). Turning telecommunications call details to churn prediction: a data mining approach. *Expert Systems with Applications*, 23(2), 103-112. [https://doi.org/10.1016/s0957-4174\(02\)00030-1](https://doi.org/10.1016/s0957-4174(02)00030-1)
- Yan, E. J., & Ding, Y. (2011). Discovering author impact: A PageRank perspective. *Information Processing & Management*, 47(1), 125-134. <https://doi.org/10.1016/j.ipm.2010.05.002>
- Zeithaml, V. A., Berry, L. L., & Parasuraman, A. (1996). The behavioral consequences of service quality. *Journal of Marketing*, 60(2), 31-46. <https://doi.org/10.2307/1251929>
- Zhang, J., Yu, Q., Zheng, F. S., Long, C., Lu, Z. X., & Duan, Z. G. (2016). Comparing keywords plus of WOS and author keywords: A case study of patient adherence research. *Journal of the Association for Information Science and Technology*, 67(4), 967-972. <https://doi.org/10.1002/asi.23437>
- Zhao, D. Z., & Strotmann, A. (2008). Evolution of research activities and intellectual influences in information science 1996-2005: Introducing author bibliographic-coupling analysis. *Journal of the American Society for Information Science and Technology*, 59(13), 2070-2086. <https://doi.org/10.1002/asi.20910>
- Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429-472. <https://doi.org/10.1177/1094428114562629>

