



The knowledge management and librarian's role in the big data analysis

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Abstract

Big Data analysis provides the opportunity to process data and to generate information that culminates in new knowledge, which can leverage innovation and competitive advantage for the business. In this context, Knowledge Management processes can enhance the flow of information generated from data analysis and transform individual knowledge into organizational knowledge. This paper focused on understanding if the published literature discusses librarians' performance in the corporate environment regarding Knowledge Management in the context of Big Data. Through a literature review, this paper presents some reflections on how Knowledge Management can be accomplished in the context of Big Data. Furthermore, it checks which competencies are assigned to librarians so that they can act in an organizational context to work with Knowledge Management in a Big Data approach; and finally, it tries to find how librarians can address Knowledge Management in the context of Big Data.

Keywords: Big Data; Data Librarian; Data Literacy; Knowledge Management; Academic Libraries

Introduction

Once considered crucial in strategic management and competitive intelligence, information has seen the valorization of its raw state, the data. Data has become the “new oil” and its correct use has been discussed and explored, leading companies to collect and explore large volumes of data, so that they can extract the true input of their actions.

The organizational environment has invested in technologies that are able to capture, process and analyze large volumes of data, trying to make the most of it in terms of innovation and competitive advantage. Given the rise of the term and the use of Big data in the corporate environment, the generation of knowledge from the analysis of data has attracted high investments in technological resources. These allow to create effective means to filter useful information amidst the large volume of data, so that the knowledge generated can be used in the innovation of processes and products.

In this sense, Knowledge Management emerges as another tool that can contribute to the organizations in this process. With the information generated by Big Data and the effective use that is made of it, professional experts on Knowledge Management can contribute to making the informational flows feasible for the rest of the organization. In view of the above, the human factor has never been so highly valued. Personal, interpersonal and technological skills, among others, are only some of the variables considered when searching for professionals capable of handling, organizing, interpreting and communicating the information originating/coming from these processes to those who really need it.

Among the information professionals able to perform this kind of work, the Librarian, especially the data librarian, is the one who “helps people find data, which can be used by a computer to help people answer questions. The data librarian also helps people work with the data, collect data, create visualizations, describe the data, etc.” (Johnson, 2018:3). Librarians, whose professional skills allow them to work and manipulate data, information and, above all, knowledge, can make Knowledge Management in a Big Data context a promising result, since this knowledge arises from data and needs to be worked and shared, so that it can generate new knowledge.

It is known that effective Knowledge Management generates promising results, according to the context in which it is applied. Therefore, this study aims to identify in the literature, elements that allow discussion of the librarian role in the context of Big Data, giving preference to an organizational context, being necessary, as a starting point, to recognize the relationship between the themes and their possible application, as shown below.

Literature review

When discussing Knowledge Management, a distinction is usually made between the triad data, information and knowledge. Davenport and Prusak (1998) believe that this distinction is clearly imprecise and that it is not an easy task, but, even so, they define them as:

- *data*: simple observations of the state of the world; easily structured, easily obtained by machines, often quantified, easily transferable;
- *information*: data with relevance and purpose; requires analysis, requires consensus on meaning and requires human mediation;



- *knowledge*: the valuable information of the human mind, which includes synthesis, analysis, context; difficult to structure, difficult to capture in machines and challenging to transfer.

The authors above stress the fact that data itself does not supply any relevance whatsoever, even though it is the raw material of decision-making: it does not tell people what to do, but is essential to create information, which is the main purpose of data processing in the search for valuable assets. Choo (1996) defines strategic uses for information, one of its applications being when organizations create, organize and process information to generate new knowledge through organizational learning. The new knowledge is then applied to design new products and services, enhance existing offerings and improve organizational processes.

Information, therefore, would be converted to knowledge once it is processed in the individual's mind (tacit knowledge) and this knowledge, in turn, would become information again, when presented in the form of texts, graphs, tables (explicit knowledge). This would cease to be individual knowledge to become organizational, returning to it, thus generating a new cycle - Knowledge Spiral (Nonaka and Takeuchi, 2008). In a context of Big Data the great challenge is to transform the entire volume of data into information in order to generate knowledge with value for organizations, to bring competitive advantage to them.

Therefore, it would be up to them the work of selecting, processing, analyzing and choosing the data that will generate the information with veracity and opportunity (Erickson and Rothberg, 2014). In the knowledge-creating company, inventing the new knowledge is not a specialized activity – it is the domain of the R&D, marketing or strategic planning departments. It is a form of behaviour, indeed a way of being, in which everyone is a knowledge worker (Nonaka and Takeuchi, 2008:41).

In this sense, Amante (2014) understands that librarians should be understood and understand themselves as knowledge workers, as they do not just store information, thus participating in the processes of knowledge management that occur in the organization. As for knowledge management, the author refers to the processes of creation, storage, sharing and reuse to enable the organization to achieve its goals. For the author, "librarians have always been considered as members of the support teams that quietly organize information to enable what users have access to" (Amante, 2014:246).

Bem and Ribeiro Junior (2006) consider as tasks and the essence of the Librarian's work in Knowledge Management support teams, the modeling, the search for information sources, the specification, the contextualization and the content structuring. They also pay attention to the fact that all members of the organization should be involved in this practice, because knowledge is in each one of the employees.

Fraser-Arnot (2014) believes that moving from a librarian role to a knowledge manager role may be a natural transition, and for such, the author cites the competencies that fit the knowledge managers, as explained in table 1.

Table 1. Competencies of the Knowledge Manager

Technical Competences (Metadata and Information Retrieval)	• Document Management
	• Classification
	• Codification
	• Database Management
	• Indexing & Abstracting
	• Information Architecture
	• Information Technology Literacy
	• Metadata
	• Records Management
	• Taxonomies / Thesauri / Controlled Vocabulary Building
Interpersonal Competencies (Reference Services)	• Change Management
	• Coaching
	• Collaboration
	• Communication
	• Leadership
	• Mentoring
	• Negotiation
	• Networking
	• People Skills
	• Teaching & Training
Analytical Competencies (Collections Formation and Development)	• Analytical Thinking
	• Business Judgment
	• Business Intelligence
	• Innovation
	• Judgment
	• Strategic Thinking
Knowledge (Performance in accordance with the Institutional Typology)	• The organization's business processes
	• The organization's strategy and goals
	• The organization's culture
	• Trends and developments in the organization's sector
	• Organizational learning principles and procedures
	• Knowledge management principles and practices
• Knowledge sharing tools and techniques	

Source: Adapted from Fraser-Arnott (2014, p. 4-5).



Librarians would be able to act as knowledge managers in three dimensions: 1) managing knowledge repositories; 2) facilitating the flow and communication of knowledge; 3) leveraging the ability to generate value (Amante, 2014:247).

For knowledge management in the context of Big data, Affelt (2015:130-131), in turn, states that three roles should be played by librarians and information professionals: curator (to determine where and from whom data should be obtained); data cleaner and data archive manager. Kabir and Carayannis (2013:60) believe that knowledge, insights, patterns, indicators and pointers embedded in Big Data are a form of tacit knowledge that are waiting to be extracted. The knowledge that resides in Big Data is indeed tacit and in most cases open to explicability. Once extracted, this new knowledge can be transferred, used and shared like any other explicit knowledge. This new and unique knowledge has all the potential to create economic value for an organization and enhance innovation, productivity and growth. Thus, it is also a possible major source of competitive advantage.

As the area of Big Data is still new in professional and academic terms, there is no formal training field for these professionals. The positions in the area are usually occupied by people from the areas of Computer Science, Mathematics or Engineering due to its technical nature (Reis and Sá, 2020). It is necessary to consider the development of people with capacity to work with this [Big Data]. One need is the so-called “data scientists”. These professionals should have refined logical reasoning, in-depth knowledge of statistics and software in this area, modeling, expertise on computer systems and knowledge of the business and market in which they will operate. In addition, they should be capable of communicating their insights to a staff with a non-technical background (Davenport et al., 2012).

Taurion (2013:95) presents three basic profiles of professionals engaged in Big Data:

- *Data scientists*, as we described before. Professionals trained in statistics, computer science and/or mathematics able to analyze large volumes of data and extract insights from it that create new business opportunities;
- *Business analysts* with good knowledge of the business in which they operate and able to formulate the right questions; analyze the answers and make strategic and tactical decisions that leverage new business or increase the company’s profitability. This role tends to be coupled with the duties of the data scientist;
- *Technology professionals* who will take care of the infrastructure and its technical support to manage Big Data. The technological apparatus of Big Data is not very common in typically commercial companies, as it demands expertise in managing hardware in high-performance clusters (Hadoop is massively parallel) and to think of data volumes significantly larger and much more varied than commonly used in traditional systems.

For Reis and Sá (2020), among the professional profiles presented, the Librarian could occupy the position of Business Analyst, given the proximity of the role that librarians already play in academic research fields. Bem and Ribeiro Junior (2006) state that knowledge management involves several activities inherent to the so-called “information analysts”, activities which, according to the authors, may very well be performed by librarians.

For the authors, the information organization is a key piece for knowledge management practices and, according to Teixeira Filho (2000), glossaries’ structuring and content indexing are excellent opportunities to map

steps and concepts that exist in the institution. Therefore, the most suitable professional would be the Librarian considering that they are already used to this type of activity.

Barrientos (2021:10) also reinforce this point of view, arguing that the Librarian as an essential role in data and information processing. As an organizer of new knowledge, the Librarian has an extremely important role in the identification of knowledge management processes that occur in organizations. This professional is immersed in organizations that do not, therefore, is to seek to acquire technical making and communication. Semeler (2017:78) discusses the importance of Data Science with its practices and technical skills that contribute to the development of Data Librarianship and, consequently, to the professional making of the data librarian. For the author, the work of a data librarian is related not only to data manipulation but also to the human work of data interpretation, decision making and communication. "The fundamental role of data librarians, therefore, is to seek to acquire technical expertise for data acquisition, analysis and interpretation".

For analysis of the expressive volume of data, specific software is used to allow extraction and visualization. As important as its processing, is the mind that interprets it, and, according to Bem and Ribeiro Junior (2006) the Librarian would be one of the professionals able to perform the analysis and interpretation of data. However, multidisciplinary teams should be formed so that each professional can contribute with his or her expertise, given the different knowledge and skills that each one has. Knowledge managers need to know how these teams work to be able to identify the knowledge needs and propose solutions that fit the existing workflows. This knowledge can be obtained partly through library work [...] especially if librarians are working in a collaborative model. It can be expanded by encouraging librarians to work with the registry and information management team in conducting information audits and especially in participating in process mapping activities (Semertzaki, 2011: 8).

Therefore, librarians are able to act as knowledge managers in the corporate environment and, in the context of Big data, they can act as members of multidisciplinary teams, or even seek specialization in the area, to obtain more autonomy in their work.

Research methods

The overall purpose of this study is to discuss the performance of librarians in the corporate environment regarding Knowledge Management in the context of Big Data. It is known that the data processing aims at generating and using information. Proper processing and management may culminate in knowledge and competitive advantage for organizations. Therefore, is it possible to state that the Librarian is a professional capable of developing Knowledge Management in a context of Big Data?

As specific objectives it was sought: to check in the literature the presence of the Librarian professional in the organizational context; to ascertain how Knowledge Management can happen in the context of Big Data; and finally, to identify how the Librarian can act in the Knowledge Management in context of Big Data.

The research is of quali-quantitative and exploratory type, which, according to Gil (2008:27) has "as main purpose to develop, clarify and modify concepts and ideas". Such approach is essential for this study in view that it seeks a greater familiarity with the theme (Kauark et al., 2010), making it feasible so that it gives the opportunity to establish possible relationships between the themes involved in the research.



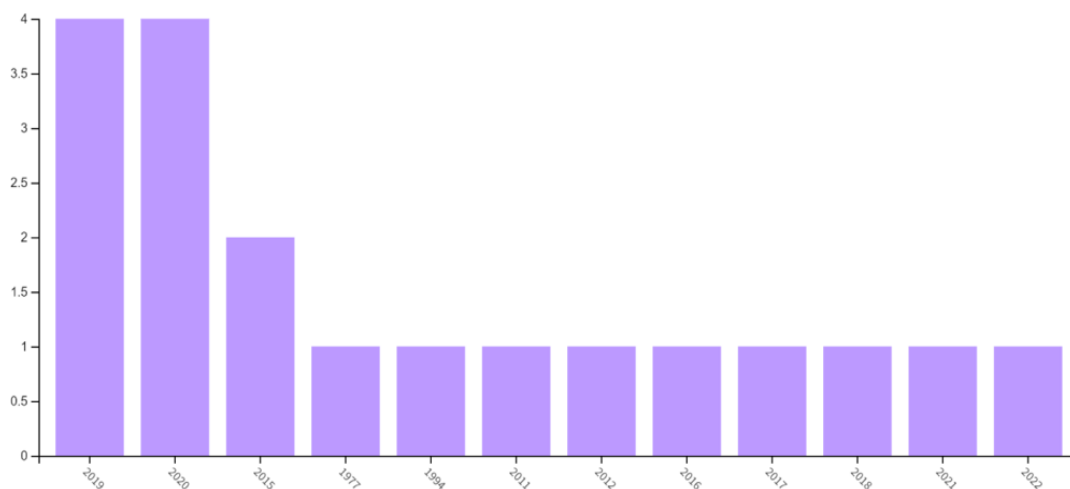
The study used a bibliographical research as the main strategy to collect literature on Knowledge Management, Big Data and the librarian role.

In order to understand the Librarian's work in a context of Big Data, it was decided at first to check in the interdisciplinary databases Web of Science and Scopus, retrieving documents under the term "Data Librarian", considering that this refers to the librarian professional who works with data, therefore, being the most suitable to work with Big Data. The information search was performed in December 2021 and repeated in September-October 2022.

Considering that the professional term "Data Librarian" is recent, as much as the term "Data Scientist", we chose only to use this term in the topic field. Later, from the retrieved papers, we proceeded with the analysis in order to identify among the subjects if Knowledge Management is related to the role of librarians in this context, as presented below.

Findings

In WoS, 40 results were retrieved, among which 35 related to the area of Library and Information Science. For greater consistency, among these, it was decided to analyze only the works from this area (LIS) and under the "article" typology, which totaled 19 works. Of these, 6 correspond to the USA, followed by England and Germany with 2 articles each and the remaining countries Australia, Hungary, Italy, Brazil, New Zealand, Canada, Nigeria with only 1. The publication period is ranging from 1977 to 2022, as shown in the graph 1.



Graph 1. Publication year of articles on Data Librarian WoS

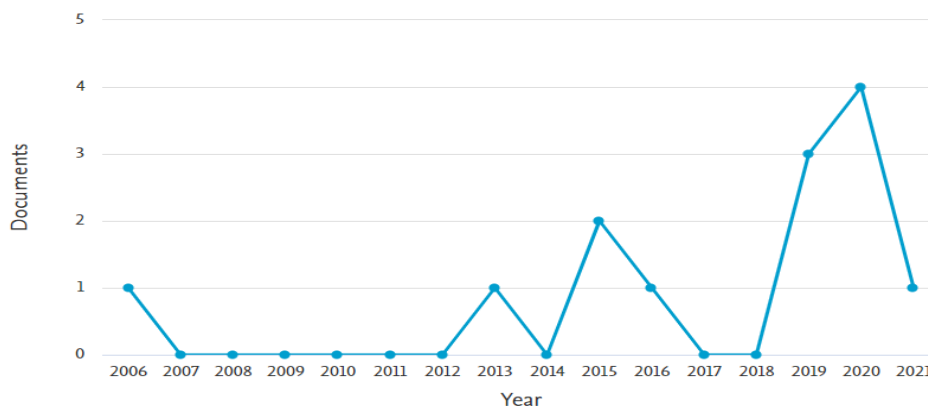
Source: Web of Science

The 1977 article, although included in the graph, was not considered for the analysis of the results. Although its title “*formação profissional librario de dados*” leads us to the idea that it addresses the topic as we know it today, it does not have an abstract and text for us to verify the content to analyze how it addresses the topic.

It could be observed that the years with greater representativity of publications correspond to the years 2015, 2019 and 2020. Among the topics addressed, are mainly the performance of the Librarian professional in relation to research data management, where only 2 papers use the term “data librarian” in their title and focus on their work in academic and research libraries. The only article from 2017 is about the “Data Librarian”, which discusses their education and academic training so that they can act as such. The other articles are focused on understanding research data, literacy and data librarianship. Therefore, of the 18 articles analyzed, although they presented “data librarian” in the topic field, it can be stated that only 3 were really focused on this theme and the others addressed subthemes related to it, where this also configured as secondary and not as main subject.

In the Scopus database the same search criterion was used, which retrieved 18 documents, 13 of which corresponded to the typology “articles”, indexed in the area of Social Sciences, this being the one adopted in the search, in view of the fact that there was no specific category LIS, which did not cause damage to the study. Only 1 article was also indexed in WoS. Therefore, this was disregarded in the analysis of the results.

Unlike the WoS, Scopus presented a smaller period of publications, which comprised the years from 2006 to 2021, having a more expressive number of publications in the year 2020, like WoS, as shown in the following graph.



Graph 2. Documents about data librarian by year Scopus

Source: Scopus

In the articles indexed in Scopus, the nomenclature “Data Librarian” was not specifically found in their titles, although they addressed the subject of the Librarian in the context of data, namely in the management of research data and skills that he/she should develop to perform this work/perform these tasks.

As for the libraries’ approach, it was observed a protagonism of academic libraries in the support for research and data management activities, as well as discussions regarding Data Science, Big Data, Data Literacy and Data Librarianship.

The 2006 article was also disregarded from the analysis for dealing exclusively with government statistical data, which was not considered in the initial proposal of the research. It was intended in a first moment to perceive the presence of the Data Librarian in Literature and consequently verify its performance in the organizational environment in the context of Big Data.

Thus, the predominant issues in the 11 articles considered addressed topics around the library, usually academic ones in a research context; the Librarian acting in research data management; and data librarianship that starts to receive influence from Data Science, making it necessary, therefore, skills in data literacy, a theme also addressed. The subjects are presented in the analysis of the bases' keywords, as shown in figure 1:



Figure 1. Word cloud of keywords in WoS and Scopus articles

Source: Prepared by the authors.

The most frequent words are data, research, Librarian, management and science, followed by services, literacy, and librarianship, among others. Although the words “Management” and “Information” appear with some frequency, the presence of the word “knowledge” was not observed, probably because the context in which management is addressed refers to information management.

Discussion

From the frequency of the topics, it can be observed the evolution of Librarianship now oriented to data and under strong influence of the research context, whose fourth paradigm points to a science that works with large volumes of data, e-science, both in the research process and in the dissemination of its results (Gray, 2009).

Even though the presence of the data librarian is shy in the research results, the discussions regarding data literacy, research data management, data librarianship and the protagonism of academic libraries focused on data and research, reveal that the Librarian professional needs to be prepared to act in this context.

About this, Koltay (2016:309) points out data governance and data literacy like fundamentals to information professionals involved in supporting data-intensive research, to the author “although being familiar with data governance did not receive a lot of attention in academia, it brings substantial knowledge to the work of the data librarian” including some skills are already possessed by librarians and also have applications in big data.

Even if it has not been found a reference on the Knowledge Management performed by the Librarian in the context of Big Data, the literature review has shown that nothing prevents this professional to perform it. The Librarian must only be prepared and able to deal with the tools of data analysis, have training and ability to act in a new market that is not necessarily restricted to libraries. Although present in the other typologies, academic libraries in particular have shown high demand for the data librarian, in view of the Open Access movement and the requirements of research data management both by universities and by funding agencies.

For Semeler (2017:75-76) “a librarian who works all or part of the time with data [...] in most cases, that librarian will be working in some kind of institutional library, be it academic, school, public or business” although there are also “librarians who work with data outside libraries, for example, creating corporate taxonomies or working with researchers outside the library”.

Once inserted in this context, the data librarian must work the data so that the shared information has the potential to become knowledge, generate new data and thus, repeat the whole process, as occurs in the model of the spiral of knowledge presented by Nonaka and Takeuchi, cited above.

Knowledge as an intangible asset, which is difficult to manage, needs not only tools that enable its management, but also professionals who convey to the community they serve the importance of sharing it, since it is not exhausted in itself, on the contrary, it multiplies (Davenport and Prusak, 2003).

Thus, the work of the data librarian can not be limited only to the organization and processing of data. Data librarian needs to create means so that the information circulates and encourage the sharing and dissemination of data. Thus, it will create an adequate background, so that individuals can interpret it, transform it into information and knowledge, thus generating new data that will be again worked, shared, influenced by the culture of the institution that learns and uses knowledge in its favor.

Conclusion

Data has assumed great importance in the business environment and organizations are investing in technologies for capturing and processing the large volumes of data produced daily. Thus, this study sought, through bibliographic, exploratory and qualitative research, to present concepts that involve Knowledge Management, Data Literacy, Big Data, and to explore the professional skills of the Librarian so that he or she can act in Knowledge Management in a context of Big Data. The retrieved papers, although discussing about the importance of the Librarian to be established in this new context strongly influenced by the use of data, mostly focused on the management of research data in the academic context. Papers related to the librarians' performance in the organizational context, or to the Knowledge Management were not retrieved. However, other works suggest that, once trained to data processing, the data librarian can act in any information unit that works with data, therefore, their professional path would not be restricted to the academic or research. In this way, it is up to this professional not to limit himself to the data processing



and information organization, but to create ways to streamline them and share them, so that, from the generated knowledge, it can be managed, regardless of the context in which they are.

In knowledge management in the context of Big Data, it is observed that the Librarian's informational skills are necessary, especially in stimulating the sharing of data and its transformation. The performance of the data librarian in relation to knowledge management, therefore, is a gap still little explored in the literature and with great potential because it addresses the management of data, so that it culminates in knowledge, whether scientific data or not. The possibility of librarians' work, on the other hand, presents itself more extended, given that it can take place beyond academic libraries and in different contexts, not only the research one.

Therefore, when contributing to Knowledge Management in a Big Data context, it is suggested that the Librarian should be part of multidisciplinary teams being able to develop not only activities related to Knowledge Management practices, but also those related to the processing of large volumes of data, depending on their training and experience.

Having in mind the great volume of data that are processed in Big Data analysis, it is more and more essential to include in the work teams, professionals skilled and trained to work with such a great flow. The "novelty" of Big data is already part of the dynamics of organizations, therefore, it is suggested the discussion and production of new works that address how Information Science and their professionals can contribute and obtain optimal results in this area.

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Appendix – Articles Used in the Research

WEB OF SCIENCE		
Authors	Article Title	Year
Rowe JS, Geda CL	Training professional data librarian*	1977
Rockwell RC	An integrated network interface between the researcher and social-science data resources - in search of a practical vision	1994
Kellam LM, Peter K	Data librarianship: a day in the life	2011
Hoebelheinrich NJ	An Aid to Analyzing the Sustainability of Commonly Used Geospatial Formats: The Library of Congress Sustainability Website	2012
Brown RA, Wolski M, Richardson J.	Developing new skills for research support librarians	2015
Meyer-Doerpinghaus U, Neuroth, H.	The Strengthening of Information Literacy in the Context of Research Data Management: a Challenge for Universities and Political Institutions	2015
Koltay T.	Data governance, data literacy and the management of data quality	2016
Robinson L, Bawden D.	The story of data A socio-technical approach to education for the data librarian role in the CityLIS library school at City, University of London	2017
Federer L.	Defining data librarianship: a survey of competencies, skills, and training	2018
Ohaji IK, Chawner B, Yoong P.	The role of a data librarian in academic and research libraries	2019
Eclevia MR, Fredeluces JCLT, Maestro RS, Eclevia CL.	What Makes a Data Librarian?: An Analysis of Job Descriptions and Specifications for Data Librarian	2019
Foster AK, Rinehart AK, Springs GR.	Piloting the Purchase of Research Data Sets as Collections: Navigating the Unknowns	2019
Fuhles-Ubach S, Schaer P, Lepsky K, Seidler-de Alwis R.	Data Librarian - A New Study Focus for Academic Libraries and Research Institutions	2019
Lima JS, Bentes V, Farias MGG.	The role of the Librarian in research data management: a systematic review	2020
Morriello R.	Birth and Development of Data Librarianship	2020
Wheatley A, Chandler M, McKinnon D.	Collaborating with faculty on data awareness: A case study	2020

Deja M, Januszko-Szakiel A, Korycinska P, Deja P.	The Impact of Basic Data Literacy Skills on Work-Related Empowerment: The Alumni Perspective	2021
Shin EJ.	Embedded librarians as research partners in South Korea	2021
Modiba M.	Legislation Used to Apply Artificial Intelligence for the Management of Records at the Council for Scientific and Industrial Research in South Africa*	2022
SCOPUS		
Authors	Article Title	Year
Tipton JT.	Government statistical data: Changes impacting access and service*	2006
vo Schmidt N.	Research data management and libraries. Localization in cooperative networks	2013
Marta_nez-Uribe L, Fernandez P.	Data services: A strategic function of 21st century libraries	2015
Brown RA, Wolski M, Richardson J.	Developing new skills for research support librarians	2015
Koltay T.	Data governance, data literacy and the management of data quality	2016
Semeler AR, Pinto AL.	The different concepts of research data in the approach to data librarianship	2019
Sales LF, Sayão LF, Maranhão AMN, Drumond GM, Silva MHFX.	Librarians' competencies in research data management	2019
Koltay T.	Accepted and Emerging Roles of Academic Libraries in Supporting Research 2.0	2019
Thomas A, Martin ER.	Developing a Community of Practice: Building the Research Data Management Librarian Academy	2020
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*Not Considered in results analysis