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Artificial Neural Networks in Risk Management: A Bibliometric Study

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ABSTRACT

This study presents a bibliometric analysis of Artificial Neural Networks in Risk Management. The study considered articles from the I.S.I. Web of Knowledge and Scopus databases, Identification of publishers, countries, periodicals and the keywords most frequently cited. We used the CiteSpace® software to analyze this material, which provides a set of features to support bibliometrics, including the reference maps. This study provides data collection on Artificial Neural Networks applied to risk management. The number of works identified in this study is significant, and in the last ten years, the number of citations has increased. We did not identify the increase in paper count within the same period.

1. Introduction

Risk management (RM) is a process that deals with risk identification, as well as analysis, response, monitoring, and control of these events^[23]. RM aims to increase the probability and impact of positive events and reduce the likelihood and impact of adverse events^[23].

The qualitative analysis aims to rank the identified risks, which considers their probability and impact. The quantitative analysis aims to provide detailed information for risks that require further investigation. The most common tools for performing quantitative analysis are the

Monte Carlo simulation technique and Decision Tree^[23].

However, the application of Artificial Neural Networks as quantitative risk analysis can bring benefits, such as minimizing the effects of dependence on experts and the possibility of performing an agile and efficient risk assessment^[7].

This paper offers a review of the academic publications on the subject of Artificial Neural Networks in RM and discuss the key characteristics identified in the bibliometric analysis. We carried out this research through bibliometrics, which analyzes the creation of a science field to determine its characteristics^[36]. There are five sections to this article. The first section presents the study subject,

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and the second section presents the concepts of RM and Artificial Neural Networks. The third section provides the method of research used in this paper, while the fourth section describes the findings of the bibliometric analysis. The Fifth section finally shows the conclusions.

2. Related Work

2.1 Risk Management

RM is the field with the most considerable lack of management awareness. After this report, the question about RM increased^[15]. However, few organizations applied widely to RM^[24]. RM's goals are to increase the likelihood and impact of positive events and to minimize these factors in adverse events^[23]. The RM cycle consists of all the activities required to identify risks that could potentially affect the project^[31]. Whatever its scope, RM is one of Project Management's neglected areas^[15,24]. The RM methods are still not commonly used by firms^[24], and their use is below expectations^[11].

RM has several strategies, of which it is worth emphasizing the PMBOK (Project Management Body of Knowledge)^[23], CMMI (Capability Maturity Model Integration)^[28] and the S.E.I. (Software Engineering Institute)^[13]. There are several RM strategies, but there is unity among the principal activities that make up this phase^[19].

Evaluation and rating of threats are critical, determining the likelihood of their occurrence and effect on the project^[14]. Notwithstanding this suggestion, few tools exist to support project managers in identifying and categorizing risk factors^[35].

2.2 Artificial Networks

Artificial Neural Networks (ANN) are computational structures inspired by living beings nervous system and offer a mathematical model based on the natural processing of neurons^[29]. They are made up of several processing units which are easy to operate^[12].

Among the features supporting the use of Artificial Neural Networks in complex applications can be mentioned: the ability to adapt over experience, the ability to learn, the ability to generalize, the organization of data, the tolerance to faults and the ease of prototyping^[29].

There are many applications where artificial neural networks can be used, for example in process control, in which, through the mapping relationship between the input and output variables of a particular control system, a network can be created which can generalize such a relationship^[1].

The use of Artificial Neural Networks to enhance RM processes can be found in several studies^[7,8,9,21]. One of RM's weaknesses is its failure to assess the risks identi-

fied for closed project performance^[27]. The authors suggest using Artificial Neural Networks in RM to predict the probability of present risks using historical bases^[27]. The use of Artificial Neural Networks also allows the authors to answer the following questions concerning RM: I what is the probability of project success? How to determine whether the threats affecting the project targets?

3. Research Method

Bibliometric research is a quantitative analysis technique developed at the end of the 1960s by Pritchard^[30]. It is a field of information science research that plays a vital role in the study of scientific production^[10,17].

The purpose of bibliometrics is to quantify the performance of scientific research through statistical analysis in the form of papers, documents, references, patents, among other indicators so that scientists, institutions and countries can be assessed^[20]. Using quantitative methods to analyze scientific literature using bibliometric measures systematically is the central point of bibliometrics^[2,4].

The bibliometric analysis offers an understanding of the past and current situation of the research field. It offers opportunities for researchers and others interested in the subject to enrich the discussion of potential paths taken by science and scientific developments^[36].

4. Data Collection

We scanned papers on 10/10/2019 for the conduction of bibliometric analysis, and we only found papers published between 2009 and 2019. Another filtering criteria were to find only papers with particular keywords in the field. For each of the indexes, we carried out three searches according to the following keywords:

- (1) Risk Management;
- (2) Artificial Neural Networks;
- (3) Artificial Neural Networks Risk Management.

We carried out the study's production in two stages:

(1) Data collection: the related data was obtained from the I.S.I. Web of Knowledge and Scopus.

(2) Bibliometric study: analysis of data obtained through the use of database tools and bibliometrics assistance using the CiteSpace® software.

A valuable tool for the diagnosis of scientific output is the I.S.I Web of Knowledge database since it is considered to be the most extensive and multidisciplinary critical bibliographic data for scientific information^[32,34]. The I.S.I Web of Knowledge has a limited number of scientific journals that set strict standards for those magazines that are included in the index. Scopus is a website supported by Elsevier that covers journals and academic conferenc-

es^[34]. Scopus has more indexed journals and has greater coverage of open access journals than the I.S.I. Web of Knowledge^[3]. For bibliometric review, this research utilizes the I.S.I. Web of Information and Scopus databases. The use of the I.S.I. Web of Knowledge and Scopus together is more beneficial than using just one because it facilitates the recognition of specific references^[18].

In addition to the CiteSpace® software, we used the statistical features and illustrations of I.S.I. Web of Knowledge and Scopus databases to help bibliometric analysis, which helps to examine the relations between writers, organizations, nations, keywords, publishing sources or references in the scientific literature^[5,25]. Many software tools support bibliometrics, but one of the best is CiteSpace®^[6,25].

5. Results

In the first search of the I.S.I. Web of Knowledge and Scopus databases, which collected 19,509 and 55,845 papers, we used the word “Risk Management”. The results obtained over the past ten years are presented in Figure 1. The number of documents listed in Scopus is more significant than those found in the database of the I.S.I. Web of Knowledge.

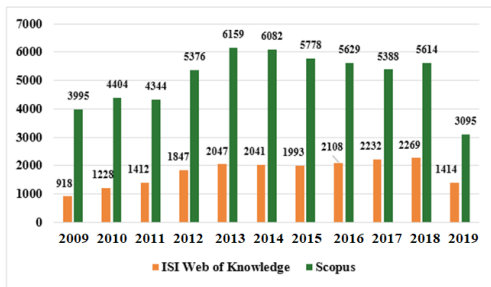


Figure 1. Number of papers per year of Risk Management

We looked in the repositories also for the word Artificial Neural Networks. We identified 20,462 papers from the I.S.I. Web of Knowledge and 60,429 from Scopus Database. Figure 2 presents the results collected in both repositories from this search over the last ten years. There is a higher number of items found at Scopus.

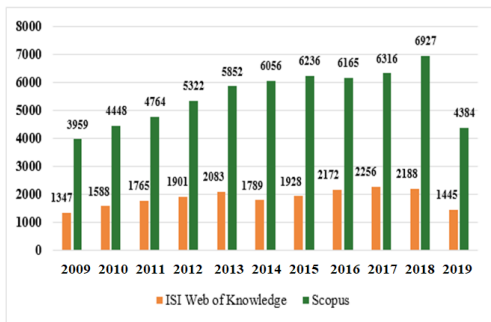


Figure 2. Number of papers per year of Artificial Neural Networks

Based on these observations, the sheer volume of publications relating to the terms: Risk Management and Artificial Neural Networks. This research, however, aims to perform a bibliometric study of the two terms together, considering only risk management papers from Artificial Neural Networks.

Therefore we conducted a search in these libraries for these two terms combined. The results obtained using concepts, risk management and artificial neural networks are presented in Figure 3. This search concentrated, like the previous search, on finding papers published in the last 10 years and 43 papers were found at the I.S.I. Web of Knowledge and 183 at Scopus, for a total of 226 papers. The number of papers in both collections is smaller than the terms searched separately.

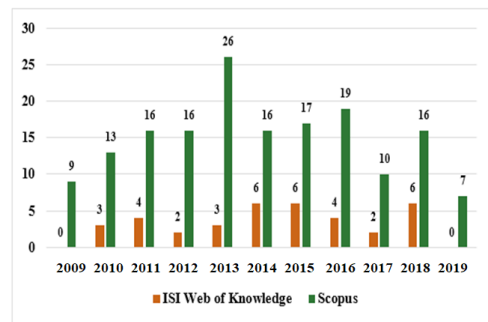


Figure 3. Number of papers per year of Risk Management Artificial Neural Networks

To ensure their relation to the application of Artificial Neural Networks in Risk Management, we reviewed the abstract of the 226 papers. All articles addressed this subject, and so we used them to do the bibliometric study. The following research was carried out: (1) citation analysis, (2) analysis of relevant references to the publication, (3) identification of the critical authors, (4) identification of top countries, and (5) citation map formation.

Using the database citation analysis function, over the years, we defined the quote as shown in Figure 4. In the last ten years, there has been an improvement in both datasets.

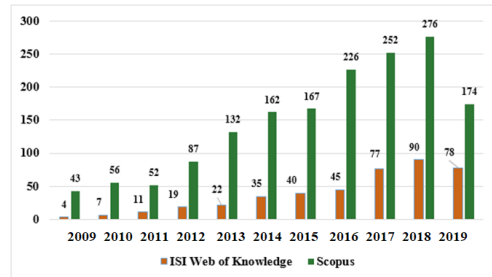


Figure 4. Number of citations per year

The I.S.I. Web of Knowledge and Scopus repositories also

have a feature to identify written sources, including articles, conferences, books, among other references. We identified the primary publication sources that discussed this issue. Table 1 presents the sources in each of the repositories, which received the most significant number of publications.

Table 1. Major publication sources

I.S.I. Web of Knowledge	
Source publication	Publications
<i>Advances in Neural Networks - Lecture Notes in Computer Science</i>	3
Scopus	
Source publication	Publications
<i>Neurocomputing</i>	3

The journal *Advances in Neural Networks - Lecture Notes in Computer Science* does not have Impact Factor (IF) by J.C.R. (Journal Citation Reports)^[33]. However, the *Neurocomputing* journal has 2,083 IF the J.C.R.^[33].

We used a feature provided by the repositories to classify the principal authors of the 226 articles. Table 2 provides the author with the most significant number of publications in the two databases studied.

Table 2. Main authors in I.S.I. Web of Knowledge and Scopus databases

I.S.I. Web of Knowledge	
Author	Publications
Norman R. Swanson	3
Scopus	
Authors	Publications
Adnan Khashman, Kinkeung Lai, Xiaohua Jin, Hiroyuki Mori	3

The repositories have provided a resource for identifying countries that discuss the topic more and track it more. Country-by-country review of publications helps you to discover if the conduct of sources depends on the internationality of the work and understand whether different knowledge and actions might be available to writers of different nationalities^[22]. As shown in Figure 5, the United States is the leading country on the I.S.I. Web of Knowledge website for the number of publications.

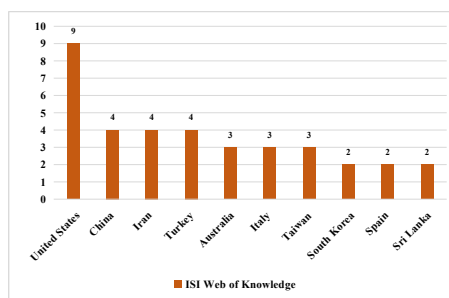


Figure 5. Countries with a more significant number of works on the I.S.I. Web of Knowledge

The countries with the largest number of publications at Scopus are shown in figure 6. China is the country with the most publications.

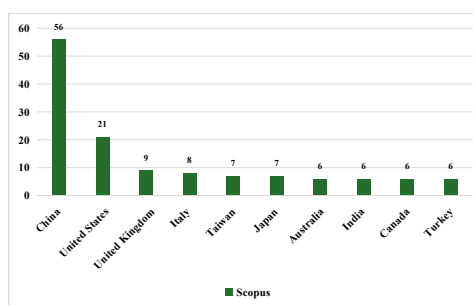


Figure 6. Countries with a higher number of papers published at Scopus

The last research that we conducted using the I.S.I. Web of Knowledge and Scopus services was the creation of the list with quotations. A quote map is a tool used to align the articles with their respective cited papers, and the most cited paper appears at the center of the map. Based on the data in Figure 4, I.S.I. Web of Knowledge Database paper with the largest number of citations is *Drought forecasting artificial neural using networks and time series of drought indices*, by the authors Saeid Morid Vladimir Smakhtin and K. Bagherzadeh. The authors published this in 2007 at the *International Journal of Climatology* journal and received 39 citations in the I.S.I. Web of Knowledge.

In the Scopus database, the article with the largest number of citations is *Neural networks for credit risk evaluation: Investigation of different neural models and learning schemes*, by the author Adnan Khashman, published in 2010 in the *Expert Systems with Applications* journal. This paper received 51 citations in Scopus and is the second most cited in the I.S.I. Web of Knowledge with 30 citations.

The CiteSpace® software citations map tool allows to view and examine trends and patterns in a research field or domain within a specified period^[16]. We built the chart to classify the writers who are most cited. Figure 7 shows the authors listed in at least four of the analyzed studies at

I.S.I. Web of Knowledge.

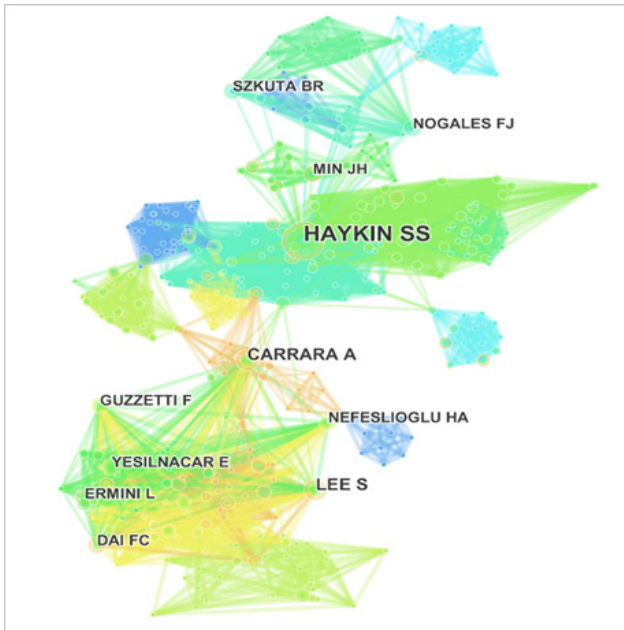


Figure 7. Citation map of the papers from I.S.I. Web of Knowledge

Table 3 presents the authors and their total number of citations, considering only the papers identified by this research.

Table 3. Main authors at I.S.I. Web of Knowledge

Total	Citations from papers of this research	Authors
1.226	9	Haykin, S.
872	4	Nefeslioglu, H. A.
586	4	Dai, F. C.
371	4	Yesilnacar, E.
346	4	Ermini, L.
323	5	Carrara, A.
298	5	Lee, S.
225	4	Min, J. H.
180	4	Szkuta, B. R.
5	4	Nogales, F. J.
4	4	Guzzetti, F.

Also, we developed the Scopus database citation map. Figure 8 presents the authors cited by at least five of the studies analyzed from this database.

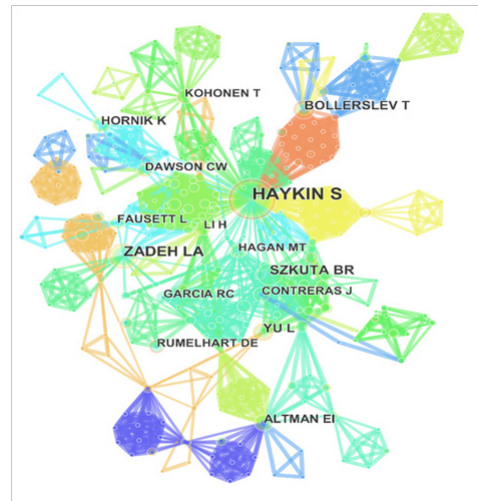


Figure 8. Citation map of the papers from Scopus

Table 4 presents the authors and their number of citations. The author Loft A. Zadeh has the highest number of citations at Scopus. Simon S. Haykin has, however, more citations from papers identified in this study, taking a leading position in both databases examined.

Table 4. Main authors at Scopus

Total	Citations from papers of this research	Authors
29.694	10	Zadeh, L.A.
20.800	6	Hornik, K.
19.777	7	Bollerslev, T.
13350	7	Yu, L.
12.588	5	Rumelhart, D. E.
10.339	5	Contreras, J.
8.540	6	Altman, EI.
4.133	5	Hagan, M. T.
3.579	5	Garcia, R. C.
2.180	16	Haykin, S.
312	5	Kohonen, T.
259	8	Szkuta, B. R.
197	5	Li, H.
5	5	Dawson, C. W.
5	5	Fausett, L

The final analysis in this study includes identifying the keywords of the papers analyzed via the CiteSpace® software. Keywords are the most essential paper identifiers which allow the identification of the topics that are the most discussed in a research area^[26]. Identifying the main keywords also strengthens the bibliometric study’s search strings. Figure 8 shows the keywords discussed in five or more articles analyzed at I.S.I. Web of Knowledge. In Figure 9, the word “neural-networks” stands out because it’s

the most listed.

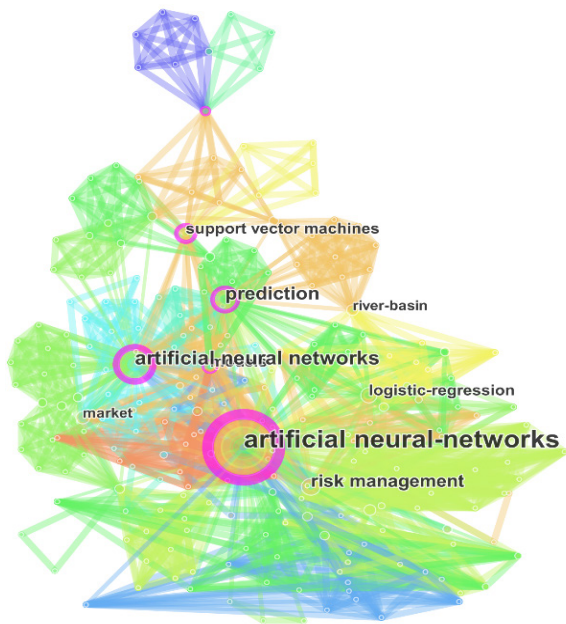


Figure 9. Map of the main keywords cited by the papers from I.S.I. Web of Knowledge

This analysis is crucial because it allows us to find that other terms may be used in the search for papers related to this theme. For example, the terms “neural-networks” and “neural networks” showed differences in their use.

Table 5 presents the keywords from Figure 9 and their citations. We observed that the term “neural-networks artificial” was the most cited.

Table 5. Main keywords cited by the papers from I.S.I. Web of Knowledge

Number of citations	Keywords
17	artificial neural-networks
9	Artificial Neural Networks
7	Prediction
6	risk management
5	Models
5	support vector machines
5	logistic-regression
4	river-basin
4	market

Also, we developed the Scopus database citation map. Figure 10 presents the keywords listed in four papers or more. The terms “artificial neural-networks” and non-hyphen “artificial neural networks” stand out in Figure 10 as they are among the most frequently cited keywords.

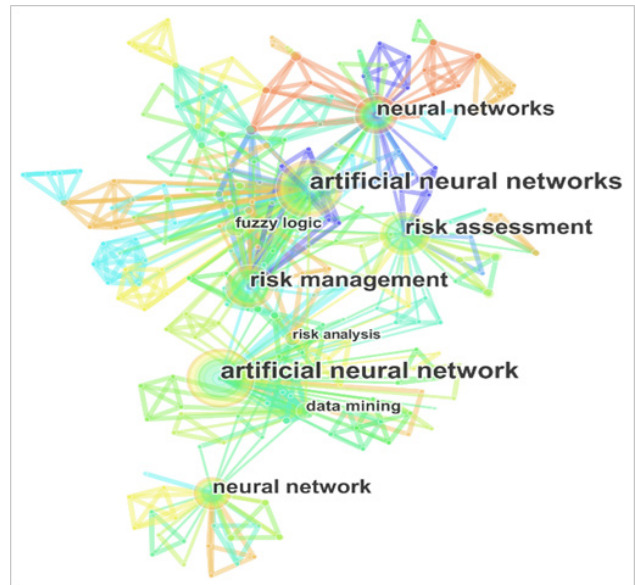


Figure 10. Map of the main keywords cited by the papers from Scopus

Table 6 presents the main keywords with their respective number of citations.

Table 6. Main keywords cited by the papers from Scopus

Number of citations	Keywords
18	artificial neural networks
17	artificial neural network
13	risk assessment
13	risk management
12	neural networks
10	neural network
5	data mining
5	fuzzy logic
4	risk analysis

The term “neural-networks artificial” with the hyphen was the most often cited at I.S.I. Web of Knowledge and without the hyphen, the most often cited at Scopus.

6. Conclusions

This paper presented a study of scientific publications on Artificial Neural Networks in RM, and the main features of this subject were discussed. The bibliometrics-based research, which helps to examine the creation of a science field to identify its features.

Initially, we did two surveys: one on RM; the other on Artificial Neural Networks. In these two studied repositories, we observed a significant number of papers on these subjects: the I.S.I. Web of Science and the Scopus. Nonetheless, the use of the two topics together in the quest

resulted in fewer papers at I.S.I. Web of Knowledge and Scopus, 43 and 183, respectively. The search was limited to articles from 2009 to 2019.

From the identified papers, we performed a bibliometric study using the resources of the I.S.I. Web of Knowledge and Scopus. For both repositories, we conducted the following analyzes: analysis of publications and references, identification of essential sources of reporting, writers and countries, creation of quotation maps.

With the help of the CiteSpace® program, we created the citation maps, enabling identification of the primary authors mentioned in the papers analyzed, in addition to the most common keywords. The author Simon Haykin is the most widely cited in the reviewed 226 studies.

This study allows researchers to know the core features of Artificial Neural Networks publications in RM. The results indicate that there is a significant number of papers on the subject, but we have not seen a significant increase in the number of papers in the last ten years. However, at the same time, there is an increase in the number of citations.

The countries with the highest number of publications on this subject are China and the United States. The study also identified some potential sources of publications and inquiries that could help state of the art, highlighting the journals *Advances in Neural Networks - Lecture Notes in Computer Science* and *Neurocomputing*.

Finally, this work provides research opportunities and contributes to the understanding of the Artificial Neural Networks bibliographic context in RM. The realization of this bibliometric study is crucial as it provides the theoretical and practical foundation for the construction of the logical thinking built on this topic.

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References

- [1] Lucas H. S. Andrade, Cristiano M. Agulhari and Alessandro Goedel. Controle pi-neural aplicado a um sistema de vazão. XII Simpósio Brasileiro de Automação Inteligente (SBAI), 2015.
- [2] C. A. Araujo. Bibliometria: evolução, história e questões atuais. Em *Questão*, Porto Alegre, 2006, 12(1):11-32.
- [3] Lutz Bornmann; Werner Marx; Hermann Schier, Erhard Rahm; Andreas Thor and Hans-Dieter Daniel. Convergent validity of bibliometric Google Scholar data in the field of chemistry - Citation counts for papers that were accepted by *Angewandte Chemie International Edition* or rejected but published elsewhere, using Google Scholar, Science Citation Index, Scopus, and Chemical Abstracts. *Journal of Informetrics*, 2009, 3(1): 27-35.
- [4] L. Bufrem, Y. Prates. O saber científico registrado e as práticas de mensuração da informação. *Ciência da Informação*, Brasília, 2005, 34(2): 9-25.
- [5] C. Chen. Searching for intellectual turning points: Progressive knowledge domain visualization. *Proceedings of the National Academy of Sciences*, 2004: 5303-5310.
- [6] M.J. Cobo, A.G. López-Herrera, E. Herrera-Viedma, F. Herrera. An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the fuzzy sets theory field. *Journal of Informetrics*, 2001, 5(1): 146-166.
- [7] Raphael José D'Castro, Cristine Martins Gomes Gusmão. Modelo de construção de uma ferramenta de avaliação de riscos utilizando Redes Neurais Artificiais. *International Conference on Engineering and Technology Education*, 2010: 07-10.
- [8] Jinghui Duan. Risk Identification and Evaluation of Customs Management Based on Fuzzy Neural Network Algorithm. *Applied Mechanics and Materials*, 2013, 291-294: 2924-2927, 2013.
- [9] Nadee Goonawardene, Shashikala Subashini, Nilupa Boralessa and Lalith Premaratne. A Neural Network Based Model for Project Risk and Talent Management. *7th International Symposium on Neural Networks*, Shanghai, China, 2010: 532-539, 2010.
- [10] M.W.C. Gumpenberger, J. Gorraiz. Bibliometric practices and activities at the University of Vienna. *Library Management*, 2012, 33(3): 174-183, 2012.
- [11] Cristine Martins Gomes Gusmão. Um Modelo de Processo de Gestão de Riscos para Ambientes de Múltiplos Projetos de Desenvolvimento de Software. Tese de Doutorado, Universidade Federal de Pernambuco, Recife, Brasil, 2007.
- [12] Simon Haykin. *Redes Neurais. Princípios e prática*. Porto Alegre, RS: Bookman, 2002.
- [13] R.P. Higuera, D.P. Gluch, A.J. Dorofee, R.L. Murphy, J.A. Walker and R.C. Williams. An Introduction to Team Risk Management. Technical Report, Software Engineering Institute, Carnegie Mellon University, U.S.A., 1994.
- [14] S-J. Huang, W-M. Han. Exploring the relationship between software project duration and risk exposure: A cluster analysis. *Information & Management*, 2008, 45(3): 175-182.

- [15] C. William Ibbs, Young Hoon Kwak. Assessing Project management maturity. *Project Management Journal*, 2000, 31(1): 32-43.
- [16] G. Liu, R. Jiang, Y. Jin. Sciatic nerve injury repair: A visualized analysis of research fronts and development trends. *Neural Regeneration Research*, 2014, 9: 1716-1722.
- [17] R. N. Machado. Análise cientométrica dos estudos bibliométricos publicados em periódicos da área de biblioteconomia e ciência da informação (1990-2005). *Perspectivas em ciência da informação*, 2007, 12(3): 2-20.
- [18] Lokman I. Meho, Kiduk Yang. Impact of data sources on citation counts and rankings of L.I.S. faculty: I.S.I. Web of Knowledge versus scopus and google scholar. *Journal of the American Society for Information Science and Technology*, 2007, 58(13): 2105-2125.
- [19] Sandra Miranda Neves, Carlos Eduardo Sanches Silva, Valéria Antonio Pamplona Salomon, Aneirson Francisco Silva, Bárbara Elizabeth Pereira Sotomonte. Risk management in software projects through Knowledge Management techniques: Cases in Brazilian Incubated Technology-Based Firms. *International Journal of Project Management*, 2014, 32(1): 125-138.
- [20] Y. Okubo. *Bibliometric indicators and analysis of research systems: methods and examples*. Paris: OECD, 1997.
- [21] A.R. Pearcel, R.A. Gregory, L. Williams. *Range estimating for risk management using Artificial Neural Networks*, 1996.
- [22] Olle Persson, Wolfgang Glanzel, Rickard Danell. Inflationary bibliometric values: The role of scientific collaboration and the need for relative indicators in evaluative studies. *Scientometrics*, 2004, 60(3): 421-432.
- [23] PMI - Project Management Institute. *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, 2013.
- [24] T. Raz, A.J. Shenhar. Dvir, D. Risk management, project success, and technological uncertainty. *R & D Management*, 2002, 32(2): 101-109.
- [25] Terry Lima Ruas, Luciana Pereira. Como construir indicadores de Ciência, Tecnologia e Inovação usando ISI Web of Knowledge, Derwent World Patent Index, Bibexcel e Pajek? *Perspectivas em Ciência da Informação*, 2014, 19(3): 52-81.
- [26] Saeed Samiee, Brian R. Chabowski. Knowledge structure in international marketing: a multi-method bibliometric analysis. *Journal of the Academy of Marketing Science*, 2012, 40(2): 364-386.
- [27] S.A. Sarcia, G. Cantone, V.R. Basili. A statistical neural network framework for risk management process - from the proposal to its preliminary validation for efficiency. In: ICISOFT (S.E.), INSTICC Press, 2007: 168-177.
- [28] S.E.I. Software Engineering Institute. *CMMI - Capability Maturity Model Integration. Version 1.3*, Pittsburgh, PA, Carnegie Mellon University, U.S.A., 2010.
- [29] Ivan Nunes Silva, Danilo Hernane Spatti and Rogério Andrade Flauzino. *Redes Neurais Artificiais para Engenharia e Ciências Aplicadas*. Artliber, USP, São Carlos, 2010.
- [30] J. Sun, M.H. Wang, Y.S. H.O. A historical review and bibliometric analysis of research on estuary pollution. *Marine Pollution Bulletin*, 2012, 64(1): 13-21.
- [31] P.K. Suri, Kanchan Narula. Simulating the Probability of Risk During Project Completion. *International Journal of Advanced Research in Computer Science and Software Engineering*, 2013, 3(7): 704-709.
- [32] M. das G. Targino, J. C. R. Garcia. *Ciência brasileira na base de dados do Institute for Scientific Information (ISI)*. *Ciência da Informação*, Brasília, jan/abr. 2000, 29(1): 103-117.
- [33] Thomson-Reuters. *Journal Citation Reports*. Disponível em: <http://about.jcr.incites.thomsonreuters.com> Acesso em: 12 Out. 2015.
- [34] Paula Vanessa Medeiros Vieira, Jacques Wainer. Correlações entre a contagem de citações de pesquisadores brasileiros, usando o ISI Web of Knowledge, Scopus e Scholar. *Perspectivas em Ciência da Informação*, 2013, 18(3): 45-60.
- [35] L. Wallace, M. Keil, A. R.A.I. How Software Project Risks Affect Project Performance: an Investigation of the Dimensions of Risk and an Exploratory Model. *Decision Sciences*, 2004, 35(2): 289-321.
- [36] C. R. Woszezenki, A. L. Gonçalves. Mineração de textos biomédicos: uma revisão bibliométrica. *Perspectivas em Ciência da Informação*, 2013, 18(3): 24-44.