International Journal of
Science and Engineering Investigations vol. 7, issue 82, November 2018
ISSN: 2251-8843

Selection and Analysis of Bibliographical Research Set of Disaster Risk Assessment Using ProKnow-C

Carolina dos Santos Martins[1], Rogério Cabral Azevedo[2]
[1,2]Graduate Program in Civil Engineering, CEFET, Minas Gerais, Belo Horizonte, Brazil
([1]carolsmartins22@yahoo.com.br, [2]cabral.razevedo@gmail.com)

***Abstract*-** Disasters are the results of adverse events that cause disruption in an environment. Prevention and relief actions based on a proper risk assessment of these disasters can provide a reduction in their impacts and even, in some cases, minimize their occurrence. The use of models for risk assessment is a recurring practice and, in most cases, a decision support methodology is used for its construction. The objective of the article is to verify how the construction of this type of model is being carried out and what criteria and methods should be replicated for an objective model of disaster risk assessment. For this, the article elaborates an overview of the literature, using the methodology Knowledge Development Process - Constructivist (ProKnow-C). This view is obtained through the selection of a bibliographic portfolio and, based on it, analyzes of relevance and gaps are carried out on the different approaches to the construction of risk assessment models. The conditions found in the portfolio and that should be replicated in this model would be: constructivist approach in a singular context, data collection with decision maker, accomplishment of the analysis of the independence of criteria, use of cardinal scale and use of contribution rate for each criterion, application of the built model and the monitoring of this application.

***Keywords*-** *Risk Assessment, Disaster, Decision-Making and ProKnow-C*

I. INTRODUCTION

Disasters are results of adverse events over a vulnerable scenario causing severe disruption in an environment. The consequences of a disaster can be human, economic, social and in some cases environmental (NATIONAL SECRETARY OF CIVIL DEFENSE, 2007).

Disasters can have their consequences mitigated and some may have their occurrence minimized. This result is obtained, in most cases, by means of preventive and / or corrective actions based on a correct evaluation of the risks of these disasters. This risk assessment is carried out, in general, through the use of models and these are constructed according to decision support methodologies.

Decision support methodologies present various approaches and methods of data collection. The choice of these forms and methods is based on the selection of who will make the decision (decision maker), characteristics of the context, capacity of involvement of this decision maker in the data collection among other aspects.

The present article consists in carrying out a systemic search for already done researches related to the subject allowing a greater acquisition of knowledge on the subject.

The systemic search was guided by the following research question: "What forms and methods of approach within decision support methodologies are most used today for disaster risk assessment? And which ones would be the most suitable for this kind of evaluation? "

The objective of the article is to gain a greater knowledge on the subject by identifying how disaster risk assessment models are constructed. A systemic review of the literature helps the researcher to: identify the current state of knowledge about a specific theme, guide the construction of hypotheses and questions used in the study of the chosen theme, generate a detailed philosophical justification for the methodological framework used and develop skills for a critical analysis of the literature and for the treatment of extensive and dispersed information (DE AZEVEDO, ENSSLIN, JUNGLES, 2014).

The methodology chosen to carry out this systemic research was the ProKnow-C that consists of the steps: (i) selection of a portfolio of articles on the research theme; (ii) bibliometric analysis of the portfolio; and (iii) systemic analysis of portfolio articles (ESSLIN L, et al., 2010).

II. METHODOLOGY

The ProKnow-C methodology provides, through delimitations elaborated by the researcher's knowledge, a selection of bibliographic portfolio that represents the state of the art on the proposed theme. This methodology was chosen because it has already been used and validated by several researchers (ROCHA et al., 2017, REAL et al., 2017, LUZ et al., 2016, DE OLIVEIRA et al., 2016, DE AZEVEDO et al. 2014).

A. Selection of the portfolio of articles

The selection of the article portfolio is divided into: search definitions, preliminary investigation and selection of articles that will compose the portfolio.

1) Search Settings

For the definitions of the research, the research axes were first chosen as: the disaster risk assessment and decision-making methodologies.

The temporal delimitation was defined as being for articles published between 2007 and 2017. For the research of these articles was used the Portal of Periodicals of CAPES and selected the area of knowledge "Engineering" and the subarea "Civil Engineering". From the databases returned by this research, some were excluded because they were not related to journals.

For the search filter, some key words were used within each selected database: Risk, Management, analysis, assessment, Disaster and Decision Model. The following combinations were made: "risk management" AND "disaster" AND "decision model"; "risk analysis" AND "disaster" AND "decision model"; Each combination was applied one by one for searches within each base in the fields of "TITLE", "ABSTRACT" and "KEYWORDS".

2) Preliminary Investigation:

In the preliminary investigation, all keywords combinations were applied, returning a total of 2093 items. Ordering the bases by increasing order of the returned items number and selecting the set of foundations representing 80% of the total articles, the chosen bases were: Springer Link Science Direct Wiley Online Library and ProQuest (Technology Collection) which totaled 1774 articles.

3) Portfolio Selection of articles:

In order to facilitate the selection of the articles to compose the portfolio, these 1774 articles were imported into the Mendeley application and from that importation the filtrations presented in Table 1 below were made.

TABLE I. FILTERING BANK OF ARTICLES

Exported articles	1774
Deleting duplicate articles	824
Alignment Title	148
Scientific recognition	42
Alignment Summary	21
Re-analysis by author	27
Full Text Alignment	8

From the 1774 articles imported, duplicates were excluded, reducing the total number of articles to 824. After excluding the articles whose titles were not aligned with the research objectives, led to a total of 148 articles.

The selection of articles with greater scientific recognition was made by the number of citations obtained in Google Scholar. For this selection was adopted a representativity of 85% of the sum of the citations of the articles. The total citations found for the 148 papers were 2855 citations. Among these, 42 articles were selected that obtained the minimum representativity.

After this stage, the articles were excluded based on the identification of the abstracts of articles not aligned with the research theme. This has resulted in a total of 21 articles.

As the scientific recognition phase can exclude new articles aligned to the research theme (recent articles, few cited), ProKnow-C indicates the reanalysis of the articles excluded in this step, considering articles of authors already present in the selected group and articles published in the last two years. This reanalysis resulted in the integration of 6 articles.

In the last stage of the selection, a total reading of the 27 articles was performed to verify the total alignment of the article with the research theme. Thus, it reached the final number of 8 articles composing the bibliographic portfolio. These 8 articles are listed in Table 2 below:

TABLE II. SELECTED ARTICLES FOR BIBLIOGRAPHIC PORTFOLIO

1. Hiete, Michael, MirjamMerz, Tina Comes, and Frank Schultmann. "Trapezoidal Fuzzy Dematel Method to Analyze and Correct for Relations between Variables in a Composite Indicator for Disaster Resilience." OR Spectrum 34, no. 4 (2012): 971-95.
2. Ishizaka, Alessio, and Ashraf Labib. "A Hybrid and Integrated Approach to Evaluate and Prevent Disasters." [In English]. The Journal of the Operational Research Society 65, no. 10 (2014): 1475-89.
3. Yang, Xiao-ling, Jie-hua Ding, and Hui Hou. "Application of a Triangular Fuzzy Ahp Approach for Flood Risk Evaluation and Response Measures Analysis." [In English]. Natural Hazards 68, no. 2 (2013): 657-74.
4. Levy, Jason K., Jens Hartmann, Kevin W. Li, Yunbi An, and Ali Asgary. "Multi-Criteria Decision Support Systems for Flood Hazard Mitigation and Emergency Response in Urban Watersheds1." [In English]. Journal of the American Water Resources Association 43, no. 2 (2007): 346-58.
5. Dillon, Robin L., Catherine H. Tinsley, and William J. Burns. "Near-Misses and Future Disaster Preparedness." Risk Analysis 34, no. 10 (2014): 1907-22.
6. Minciardi, Riccardo, Roberto Sacile, and Eva Trasforini. "Resource Allocation in Integrated Preoperational and Operational Management of Natural Hazards." Risk Analysis 29, no. 1 (2009): 62-75.
7. Wood, Matthew D., Ann Bostrom, Todd Bridges, and Igor Linkov. "Cognitive Mapping Tools: Review and Risk Management Needs." Risk Analysis 32, no. 8 (2012): 1333-48.
8. Nappi, Manuela Marques Lalane, and João Carlos Souza. "Disaster Management: Hierarchical Structuring Criteria for Selection and Location of Temporary Shelters." Natural Hazards75, no. 3 (2015): 2421-36.

B. Bibliometric Analysis of the Portfolio of Articles

Bibliometric analysis aims at the quantitative presentation of statistical data for the scientific knowledge of a subject. This statistical analysis is performed by counting data on the articles in the portfolio. Among these analyzes, we present here the analysis of the degree of relevance of the journal and the scientific recognition of the articles.

1) Degree of relevance of periodicals

For the degree of relevance of the journals two evaluations were carried out: (i) Relevance of the periodicals of the

Bibliographic Portfolio and (ii) Relevance of the Periodicals according to Journal Citations Reports (JCR).

The relevance of the period was made by counting articles published by each periodical that appears in the portfolio. The result is shown in Table 3.

TABLE III. RELEVANCE OF PERIODICALS

JOURNAL	ARTICLES IN JOURNAL
Risk Analysis	3
Natural Hazards	2
OR Spectrum	1
Journal of the American Water Resources Association	1
Journal of the Operational Research Society	1

The relevance according to the JCR indicator was performed by analyzing the impact factor of each periodical according to the Web of Science database, of which the JCR indicator belongs. The result is shown in Table 4.

TABLE IV. RELEVANCE OF PERIODICALS ACCORDING TO JCR

JOURNAL	JCR
Risk Analysis	2,518
Natural Hazards	1,833
Journal of the American Water Resources Association	1,717
Journal of the Operational Research Society	1,077
OR Spektrum	0,608

2) Scientific recognition of articles

The scientific recognition of the articles was made based on the number of citations that each article of the portfolio has had since its publication. This survey was based on Google's academic quotations until the date of the survey (10/19/2017). The result is shown in Table 5.

TABLE V. NUMBER OF CITATIONS OF THE ARTICLES

ARTICLE	CITATIONS
LEVY, J. K. *et al.*, 2007	71
WOOD, M. D. *et al.*, 2012	47
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	25
YANG, X.; DING, J.; HOU, H, 2013	23
HIETE, M. *et al.*, 2012	21
ISHIZAKA, A.; LABIB, A, 2014	20
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	17
NAPPI, M. M. L.; SOUZA, J. C, 2015	15

C. Systemic analysis of articles

The Systemic Analysis proposed by ProKnow-C (ENSSLIN, et al., 2010), consists of a scientific process carried out on a representative sample of articles of a certain subject. The researcher seeks to define the lenses that portray his worldview. For each of these lenses, the strengths and weaknesses evidenced in the sample of articles analyzed are highlighted.

The lenses defined by the researcher for performing this analysis are described in Table 6 below:

TABLE VI. RESEARCH LENSES USED IN SYSTEMIC REVIEW OF THE LITERATURE

LENS	QUESTION
Types of Disasters	Does the model assess natural, human, or mixed disaster?
Approach used	What kind of approach was used for risk assessment?
Model building base	Was the Model built on a specific context?
Data collection process	Which method is used to collect data?
Analysis of the criteria	Do you analyze whether the evaluation criteria are independent?
Scale type	Does the model take into account the use of cardinal scales for the transformation of quantitative risk assessment from qualitative to quantitative?
Contribution of the criteria	Does the model take into account the contribution of each criterion? If so, how is the contribution determined?
Consolidation of the model	Is the method applied or has it already been applied in any case study or example?
Side dish	If so, is this case study based on events that have already occurred or fictitious cases?

Each of the 8 articles selected for the Bibliographic Portfolio was analyzed according to these research lenses. The following topics present the result of this analysis according to the lenses described in Table 6 above.

1) Types of disasters analyzed

According to the factors that condition them, disasters are classified as: natural, human or mixed. Within the human disasters there are: Human Disasters of Technological Nature, Human Disasters of Social Nature and Human Disasters of Biological Nature.

Given this, it is considered a positive point that the analysis covers more than one type of disaster (both natural and human disaster), making the risk management model more comprehensive, capable of being used to assess more than one type of disaster. On the other hand, the over-coverage presented by the model makes it less specific and, as a consequence, may not correctly evaluate a specific disaster due to the excess of evaluation factors involved.

According to the portfolio analyzed, as indicated in Table 7, four of the eight portfolio articles deal with natural disasters. The other articles deal with mixed disaster.

TABLE VII. TYPES OF DISASTERS ANALYZED

ARTICLE	Type of approach
HIETE, M. *et al*., 2012	Mixed
ISHIZAKA, A.; LABIB, A, 2014	Mixed
YANG, X.; DING, J.; HOU, H, 2013	Natural
LEVY, J. K. *et al*., 2007	Natural
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Mixed
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Natural
WOOD, M. D. *et al.*, 2012	Natural
NAPPI, M. M. L.; SOUZA, J. C, 2015	Mixed

2) Approach used

According to De Azevedo (2013 apud ROY, 1994): The decision support methodologies list some approaches that can be used, they are:

-Descriptive: In which a description of events occurs, that is, the human decision is not taken into account. They are used for cases in which human perception is not very valuable.

-Normative: The normative approach uses already established models, that is, they use pre-established models that fit the analyzed reality. In these cases, only the decision maker's action is required when choosing the model.

-Prescriptive: In this approach the construction of the model is customized for a given situation. In this case, the entity provides information to build the model and the results are suggestions for actions for managers.

-Constructivist: This approach seeks to instill in the manager himself the skills for his own decision-making.

For the case of disaster risk assessment, a prescriptive or constructivist approach is recommended since each case has its peculiarities and with that, it is necessary to adopt specific models and practices for each situation. Linked to this, in the constructivist methodology, during the construction of the model, the knowledge of the professionals involved is stimulated.

According to Table 8, seven of the eight portfolio articles propose models that use a prescriptive approach. A single article in the portfolio proposes a model with a normative approach because it presents models that could be used in some context.

TABLE VIII. TYPES OF APPROACHES

ARTICLE	Type of approach
HIETE, M. *et al*., 2012	Prescritivist
ISHIZAKA, A.; LABIB, A, 2014	Prescritivist
YANG, X.; DING, J.; HOU, H, 2013	Prescritivist
LEVY, J. K. *et al*., 2007	Prescritivist
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Prescritivist
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Prescritivist
WOOD, M. D. *et al.*, 2012	Normative
NAPPI, M. M. L.; SOUZA, J. C, 2015	Prescritivist

3) Model building base

An evaluation model may or may not be specific to a context, as seen in the previous item. When the model is constructed based on the evaluated context and considering the opinion and knowledge of the decision maker, the model is considered singular.

When this occurs, the model becomes more specific to the context evaluated and better reflects the preferences of the decision maker and consequently of the analyzed situation, since it represents more faithfully the criteria considered most relevant to the decision maker.

According to Table 9, seven of the eight articles recommend or approach a specific view for a given context, since they use the opinion of the decision makers to construct the model or questionnaire. A single article escapes the rule because it does not take into account a context but presents model alternatives.

TABLE IX. MODEL BUILDING BASE

ARTICLE	CONTEXT
HIETE, M. *et al*., 2012	Specific
ISHIZAKA, A.; LABIB, A, 2014	Specific
YANG, X.; DING, J.; HOU, H, 2013	Specific
LEVY, J. K. *et al.*, 2007	Specific
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Specific
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Specific
WOOD, M. D. *et al*., 2012	Nonspecific
NAPPI, M. M. L.; SOUZA, J. C, 2015	Specific

4) Data collection process

As for the data collection process, each article adopts a specific type. As highlighted in previous lenses, for disaster risk analysis, it would be more prudent to collect data directly with the managers of the organization under review. This is justified by the fact of the need to build a specific model for each situation analyzed.

According to Table 10, three articles use the AHP method and the others present or use different methods.

TABLE X. DATA COLLECTION PROCESS

ARTICLE	DATA COLLECTION
HIETE, M. *et al*., 2012	Fuzzy and Damatel
ISHIZAKA, A.; LABIB, A, 2014	AHP
YANG, X.; DING, J.; HOU, H, 2013	AHP Fuzzy triangular
LEVY, J. K. *et al.*, 2007	MCDA
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Likert scale
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Mathematical - Resource Allocation
WOOD, M. D. *et al*., 2012	Cognitive Map
NAPPI, M. M. L.; SOUZA, J. C, 2015	AHP

5) Analysis of the criteria

In constructing a model, the analyzed criteria may be independent of each other or not. Independent criteria are those that have no direct or indirect influence on others (DE AZEVEDO, 2013).

According to Table 11, five of the eight articles in the portfolio use models that evaluate the independence of the evaluation criteria or recommend this evaluation. For the other three articles this analysis of independence does not apply because they use other methods or simply propose only one use.

TABLE XI. MODEL BUILDING BASE

ARTICLE	INDEPENDENCE OF CRITERIA
HIETE, M. *et al*., 2012	Independent
ISHIZAKA, A.; LABIB, A, 2014	Independent
YANG, X.; DING, J.; HOU, H, 2013	Independent
LEVY, J. K. *et al*., 2007	Independent
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Not applicable
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Not applicable
WOOD, M. D. *et al.*, 2012	Does not apply
NAPPI, M. M. L.; SOUZA, J. C, 2015	Independent

6) Quantitative analysis

After identifying the criteria for risk assessment, it is necessary to analyze how the measurement scales of these criteria are constructed. Cardinal scales are more recommended, to the detriment of ordinals, since cardinal scales can be integrated facilitating the comparison between the various options (DE AZEVEDO, 2013).

According to Table 12, seven two eight portfolio articles recommend or adopt models that use the cardinal scale to transform the risk measurement criteria. Only one article adopts ordinal scale because it uses Likert scale.

TABLE XII. MEASUREMENT SCALES

ARTICLE	TYPE OF SCALE
HIETE, M. *et al*., 2012	Cardinal
ISHIZAKA, A.; LABIB, A, 2014	Cardinal
YANG, X.; DING, J.; HOU, H, 2013	Cardinal
LEVY, J. K. *et al*., 2007	Cardinal
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Ordinal
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Cardinal
WOOD, M. D. *et al.*, 2012	Cardinal
NAPPI, M. M. L.; SOUZA, J. C, 2015	Cardinal

7) Contribution of the criteria

In a model for risk assessment decision-making it is important to consider the contribution of each criterion to the whole analyzed. This is due to the fact that certain criteria contribute more significantly to risk assessment than others.

According to Table 13, five two two articles recommend or take into account the contribution of each criterion. Two articles do not calculate this contribution, and for an article, it does not apply this consideration since it only proposes the use of a method.

TABLE XIII. CONTRIBUTION OF THE CRITERIA

ARTICLE	CONTRIBUTION OF THE CRITERIA
HIETE, M. et al., 2012	Yes
ISHIZAKA, A.; LABIB, A, 2014	Yes
YANG, X.; DING, J.; HOU, H, 2013	Yes
LEVY, J. K. et al., 2007	Yes
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Not
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Not
WOOD, M. D. et al., 2012	Does not apply
NAPPI, M. M. L.; SOUZA, J. C, 2015	Yes

8) Consolidation of the model

The consolidation of the model takes place from its application in the context on which it was built. This application can be made for disasters that have already occurred, based on documented information, or for fictitious contexts.

According to Table 14, six two eight articles apply the model constructed in a specific context or the one recommends this application and two do not apply.

TABLE XIV. CONSOLIDATION OF THE MODEL

ARTICLE	CONSOLIDATION OF THE MODEL
HIETE, M. *et al*., 2012	Yes
ISHIZAKA, A.; LABIB, A, 2014	Yes
YANG, X.; DING, J.; HOU, H, 2013	Yes
LEVY, J. K. *et al*., 2007	Yes
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Yes
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Yes
WOOD, M. D. *et al.*, 2012	Not
NAPPI, M. M. L.; SOUZA, J. C, 2015	Not

9) Follow up

After the adoption of the model and risk assessment, the entities must propose response actions to the risks identified and measured in the evaluation. These actions are based on decisions that both seek to mitigate risk and post-disaster actions aimed at reducing the consequences of it.

According to Table 15, seven of the eight articles recommend or follow the application of the model.

TABLE XV. FOLLOW UP

ARTICLE	FOLLOW UP
HIETE, M. *et al.*, 2012	Yes
ISHIZAKA, A.; LABIB, A, 2014	Yes
YANG, X.; DING, J.; HOU, H, 2013	Yes
LEVY, J. K. *et al.*, 2007	Yes
DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J, 2014	Not
MINCIARDI, R.; SACILE, R.; TRASFORINI, E, 2009	Yes
WOOD, M. D. *et al.*, 2012	Yes
NAPPI, M. M. L.; SOUZA, J. C, 2015	Yes

III. CONCLUSION

The article selected a set of articles totally associated to the objectives of the research and considered relevant to the theme. This portfolio was analyzed according to lenses, determined by the researcher, in order to present the most relevant focal points and to identify gaps about the state of the art of disaster risk assessment using decision-making methodology.

This lens portfolio analysis is summarized in Table 16.

According to Table 16, no specific type of disaster (four articles on natural disasters and four on mixed disasters) prevailed in the portfolio. Most of the articles presented or used methodologies to support the prescriptive decision on a specific context, analyzing the independence of the criteria. Most also used cardinal scale, compensation rate for each criterion with application of the model in a specific context and with monitoring of this application.

Regarding disaster risk assessment, the model for its measurement should treat each context according to its peculiarities and should provide the decision maker with the knowledge to understand it. With this, the constructivist approach would be more suitable for its construction.

According to Lacerda (2012), the singular model, based on the decision maker's knowledge, provides a tool recognized by the decision maker that represents its values and preferences. Consequently, decisions are made more assertively and swiftly. The use of the opinion of the decision makers to construct the model or questionnaire is considered a strong point and therefore, it must be replicated in the construction of models of evaluation of disaster risk.

Independent criteria are prerequisite for risk integration proposals. Thus, the disaster risk assessment model should suggest some method that analyzes this independence for a validation of the elaborated model

The cardinal scales are more recommended for this type of model, to the detriment of the ordinal ones, since the cardinal scales can be integrated facilitating the comparison between the disaster options to better prioritize the actions.

This type of model should consider the contribution of each criterion to the analyzed set as a whole because different criteria have different importance for the evaluation as a whole.

The application of the model is important because it shows how it behaves for different types of situations. Follow-up is also recommended because post-risk assessment actions are relevant to the continuation of risk management within the organization.

Therefore, a constructivist approach in a singular context is recommended for the construction of a disaster risk assessment model. Data collection should be done with decision maker, analysis of the independence of criteria, use of cardinal scale and use of contribution rate for each criterion should be performed. In addition, it is recommended the application of the built model and the monitoring of this application.

TABLE XVI. SUMMARY

	ARTICLES							
LENS	1	2	3	4	5	6	7	8
1	Mixed	Mixed	Natural	Natural	Mixed	Natural	Natural	Mixed
2	Prescritivist	Prescritivist	Prescritivist	Prescritivist	Prescritivist	Prescritivist	Normative	Prescritivist
3	Specific	Specific	Specific	Specific	Specific	Specific	Nonspecific	Specific
4	FUZZY and DAMATEL	AHP	AHP Fuzzy triangular	MCDA	Likert Scale	Mathematical - Resource Allocation	Cognitive Map	AHP
5	Independent	Independent	Independent	Independent	Not applicable	Not applicable	Does not apply	Independent
6	Cardinal	Cardinal	Cardinal	Cardinal	Ordinal	Cardinal	Cardinal	Cardinal
7	Yes	Yes	Yes	Yes	Not	Not	Does not apply	Yes
8	Yes	Yes	Yes	Yes	Yes	Yes	Not	Not
9	Yes	Yes	Yes	Yes	Not	Yes	Yes	Yes

ACKNOWLEDGMENT

The authors would like to thank to CAPES, CEFET-MG, CNPq and FAPEMIG for the financial and technical help provided for this work.

REFERENCES

[1] DE AZEVEDO, R. C. Um modelo para gestão de risco na incorporação de imóveis usando metodologia multicritério para apoio à decisão - construtivista (MCDA-C),p. 622. Thesis (Doctorate degree) - Graduate program in Civil Engineering, Universidade Federal de Santa Catarina, Florianópolis, 2013.

[2] DE AZEVEDO, R.; ENSSLIN, L.; JUNGLES, A. E. A Review of Risk Management in Construction: Opportunities for Improvement. Modern Economy, v. 5, n. April, p. 367–383, 2014.

[3] DE OLIVEIRA, L. V. et al. Decision Aid in Project Management: a bibliometric analysis. Revista de Gestão de Projetos, v. 7, p. 95, 2016.

[4] DILLON, R. L.; TINSLEY, C. H.; BURNS, W. J. Near-Misses and Future Disaster Preparedness. Risk Analysis, v. 34, n. 10, p. 1907–1922, oct. 2014.

[5] ENSSLIN, L.; ENSSLIN, S. R.; LACERDA, R. T. O.; TASCA, J. E. ProKnow-C, Knowledge Development Process – Construtivist. Processo técnico com patente de registro pendente junto ao INPI. Brazil, 2010.

[6] HIETE, M. et al. Trapezoidal fuzzy DEMATEL method to analyze and correct for relations between variables in a composite indicator for disaster resilience. OR Spectrum, v. 34, n. 4, p. 971–995, 13 out. 2012.

[7] ISHIZAKA, A.; LABIB, A. A hybrid and integrated approach to evaluate and prevent disasters. The Journal of the Operational Research Society, v. 65, n. 10, p. 1475–1489, oct. 2014.

[8] LEVY, J. K. et al. Multi-criteria decision support systems for flood hazard mitigation and emergency response in urban watersheds. Journal of the American Water Resources Association, v. 43, n. 2, p. 346–358, apr. 2007.

[9] LUZ, T. A. et al. Performance evaluation of information technology service> the state of the art recognition by a constructivist research process and bibliometric. Perspectivas em Ciência da Informação, v. 21, n. 2, p. 120-140, 2016.

[10] MINCIARDI, R.; SACILE, R.; TRASFORINI, E. Resource Allocation in Integrated Preoperational and Operational Management of Natural Hazards. Risk Analysis, v. 29, n. 1, p. 62–75, jan. 2009.

[11] NAPPI, M. M. L.; SOUZA, J. C. Disaster management: hierarchical structuring criteria for selection and location of temporary shelters. Natural Hazards, v. 75, n. 3, p. 2421–2436, 23 feb. 2015.

[12] REAL, R. P. et al. A Review on the Use of Rice husk Ash as a Mineral Admixture in High Performance Concrete: Research Opportunities. International Journal of Science and Engineering Investigation, v. 6, n. 65, p. 23-28, 2017.

[13] ROCHA, V, V., DE AZEVEDO, R. C.; LUDVIG, P. Selection Process and Analysis of Bibliographic Set for a Research involving Carbon Nanotubes Dispersin Using the ProKnow-C. International Journal of Science and Engineering Invstigations, v.6, n. 65, p. 68-73, 2017 available at: www.IJSEI.com

[14] SECRETARIA NACIONAL DE DEFESA CIVIL. Política Nacional de Defesa Civil. Brasília: Ministério da Integração Nacional, 2007. Available at: <http://www.mi.gov.br/c/document_library/get_file?uuid=6aa2e891-98f6-48a6-8f47-147552c57f94&groupId=10157>. Accessed: August 11, 2017.

[15] WOOD, M. D. et al. Cognitive Mapping Tools: Review and Risk Management Needs. Risk Analysis, v. 32, n. 8, p. 1333–1348, aug. 2012.

[16] YANG, X.; DING, J.; HOU, H. Application of a triangular fuzzy AHP approach for flood risk evaluation and response measures analysis. Natural Hazards, v. 68, n. 2, p. 657–674, sep. 2013.