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Risks in Construction Projects: An Analysis of Critical Factors in Small Brazilian Companies

Freitas, Andrey Pimentel Aleluia[1]; Santos, João Alberto Neves dos[2]; Netto, Joaquim Teixeira[3], Fonseca, Luciana Silva[4]; Oliveira, Nylvandir Liberato Fernandes de[5].

1 - PhD Researcher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
2 - PhD Teacher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
3 - PhD Researcher at Department of Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
4 – Master´s Degree at Department of Postgraduate in Production Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
5 - PhD Researcher at Department Postgraduate in Civil Engineering, Universidade Federal Fluminense. Niterói, Rio de Janeiro, Brazil
Corresponding Author: Freitas, Andrey Pimentel Aleluia

ABSTRACT
Risks related to the construction sector result from instabilities in the external environment that, associated with the complexities of internal processes, affect the compliance with project schedules. Although risk management is part of project management, few companies apply it, especially small ones. This article aims to identify and rank the main risk factors that affect the project schedules of small national construction companies. Based on the literature, 43 risk factors associated with the construction environment were identified, but only 26 were directly related to project delays. A survey was conducted on a non-probabilistic sampling, characterized by 133 professionals and specialists working in small construction companies. The data obtained made it possible to check the content validity, consistency of the instrument and the normality of the distribution. Through exploratory factor analysis, six risk factors critical to the schedules were identified and ranked according to their levels of relevance. The results presented aim to contribute to the effectiveness of simple risk management structures, controlling factors that may lead to delays in small construction projects. It is also hoped that this research can contribute to future work that seeks to adopt new risk management models to the needs of small businesses.

Keywords - Construction, Exploratory Factor Analysis, Project Delays, Risk Factors, Risk Management.

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I. INTRODUCTION

Delays are characteristic and recurring phenomena in construction projects and are caused by various factors internal or external to the construction environment. They can directly affect projects in two ways: a. compromising the sequence of internal stages of the construction processes, reflecting on the process flow of the other areas involved, as well as the service schedule of suppliers; B. impacting the delivery of the product to the customer, which may result in fines or damage to the company's image in the market.

Although a common problem in many countries, the magnitude of the impacts generated by delays may vary according to the characteristics of each project [1]. Given this understanding, actions are needed to proactively identify, evaluate and mitigate any factors that may compromise the results of construction sector project schedules [2].

Importantly, during the planning phase of a project, two aspects are addressed: 1. the generation of cash flows to meet the needs of the internal stages; 2. analyzes of economic and financial availability, which do not include qualitative impacts that risks may represent in the early stages of the processes. In the execution and monitoring phases, also understood as the operational aspect of the construction processes, there is a need to develop a culture of proactive actions that anticipate the emergence of factors harmful to the operational processes.

In general, construction companies are vehemently opposed to adopting risk management processes in their projects. In the case of small businesses, several factors collaborate to choose to conduct their operations according to the traditional flow of other companies. These factors are often associated with the general understanding that project planning already includes all risks, leaving aside the operational part that represents the execution and delivery of products. In this sense, a specific approach that identifies the main risk factors that affect the production processes defined by the projects, allowing the response actions to be carried out in a shorter time, at a lower cost, may represent an increase in the process effectiveness, with satisfactory results for both customer and contractor.
Through a quantitative approach, generated from a Survey research, applied to professionals and specialists working in small companies in the national construction sector, we sought to identify and rank the main factors that affect the effectiveness of deadlines. Defined by the construction projects. Through a statistical approach, we sought to answer the following questions:
Q1: What are the main operational risk factors that affect the project schedules of small construction companies in the national construction sector?
Q2: How relevant are the key risk factors that affect the project schedules of small construction companies in the national construction sector?

In short, the approach to risk factors in construction projects starts with the objective of identifying and prioritizing factors according to their level of occurrence, so that monitoring and control processes are continuous and effective in meeting deadlines. Thus, this research aims to assist small construction companies in Brazil and direct focus and efforts on specific actions to achieve their goals without compromising their costs.

II. LITERATURE REVIEW

2.1 Size of construction companies

The size or size of a company is defined, according to the Brazilian Micro and Small Business Support Service – SEBRAE [3], by two aspects: invoicing and active employees. This survey considered the number of active employees, given the difficulty in obtaining data related to invoicing. Thus, aiming to understand the size of each size classification within the sector, using data from the Brazilian Chamber of Construction Industries - CBIC, we sought to identify the percentages of quantitative participation of companies and labor, according to presented by Table 1 [3].

Table 1. Classification of the company size for the number of employees.

Size	**Employee Board**	**Market share in 2017**	
		Amount (%)	**Labor (%)**
Little	**to - 99**	**98,61%**	**58,55%**
Average	100 - 499	1,23%	24,43%
Great	above - 500	0,16%	17,02%

The results presented in Table 1 show the relevance of small construction companies in the national construction scenario, since they represent 98.61% of the total companies and 58.55% of the total stock of the active labor force in the sector.

2.2 Risk of delays in the construction sector

The literature presents several approaches, with several concepts associated with the term risk. In this sense, many similarities are verified about the authors' perception of this phenomenon, especially when they are related to damages of any nature.
The term risk is associated with the complexity of factors that require managers' multidisciplinary skills to perform preventive and corrective actions. [5].
Although many research highlights the difficulties of companies in the construction sector to meet the deadlines defined in their projects, there is still a need for a dedicated approach specifically to identify and standardize the main factors that impact the schedules elaborated for the conduct of internal processes and for the definitive closure of the projects, thus making the product available to customers. It is also perceived that this issue is potentialized in countries with economies in development, because the coverage of unwanted factors makes difficult the elaboration of a reference that allows companies to take effective actions to reduce their delays in projects, which directly reflect the survival in the market [6].

Most of the risk factors associated with the delays in the process stages schedules are due to inconsistencies in the preliminary phases of project planning that, in order to meet inconsistent contract deadlines, underestimate the stages of construction processes. In this sense, the need to balance the time constraints in essential steps, results in damages to the natural flow of the following stages, generating changes and impacts in the scheduling of internal and external processes of organizations. This imbalance has a direct impact on the productive chains and the prediction of the availability of financial resources, generating an increase in the probability of uncertainties in order to follow the steps defined by the projects [7,8].

The PMI associates the presence of factors that cause delays in construction projects to a set of

elements developed in the planning, execution and monitoring / control phases [9]. In addition, it proposes the implementation of a risk approach aimed at identifying, analyzing and classifying the different risk factors, thus generating subsidies that enable preventive actions. In this context, the relevance of identifying and prioritizing the factors that characterize higher degrees of risk to the processes sequenced by the steps defined in the projects is highlighted [10, 11, 12].

Although risk management presents tools that aim to ensure control and immediate response to the emergence of unwanted factors, its implementation is still understood by most construction companies as a matter that raises costs and compromises financial results, especially in small businesses that need to reduce their profit margins to ensure market competitiveness.

The search for concepts and information on a given topic is essential for the researcher to have a theoretical basis for elaborating arguments and adopting appropriate analysis processes to support the results of his research [13]. In this sense, this research begins with a theoretical basis, through a qualitative approach, obtained by literature reviews, to verify aspects that cause the delays of the construction projects. The literature review enables the researcher to identify, describe and interpret data from previous research to substantiate the structure of his work [14].

Through research on scientific bases, national and international surveys were identified that deal with themes related to risk, its factors and its management in construction. Table 2 shows the criteria used to search the scientific databases.

Table 2. Characteristics of the research for literature review**.**

Data Base	**Keywords**
ASCE	Risks management; Risk factors in construction; Risks in construction projects; Risks of delay; Delays in construction; Delays in projects.
Emerald	
Google Scholar	
Science Direct	
Web of Science	

The research results point to 43 risk factors related to the construction environment that generate, directly or indirectly, impacts on project schedules. The identified factors were classified into nine categories of risk, as highlighted in Table 3.

Table 3. Risk categories associated with the productive environment of the construction sector.

CATEGORY	**RISK FACTORS**	**AUTHORS**
Politics	Political instability	[15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37]
	Lack of government incentives	
	Fragmented political structure	
	Holding of elections	
Laws	Legislation changes	
	Excessive bureaucracy	
	Complexity of the Legal System	
Economics	Interest fluctuation and inflation	
	Economy Instabilities	
	Currency value fluctuation	
Financial	Taxes	
	Difficulty accessing insurance	
	Difficulty accessing credit	
	Corruption	
	Limited financial capacity of the developer	
	Contractor's reduced financial capacity	

	Low financial capacity of subcontractors	
Social	Interpersonal conflicts (wars, disorder, riots, etc.)	
	Intrapersonal conflicts (mentality, education, civility, communication, culture, etc.)	
Market	High competition	
	Low capacity for technological innovation	
	Reduced quality of building materials	
	Low quality and high labor cost	
	Reduced quality of construction equipment	
	Unavailability of subcontractors	
Environmental	Adverse weather conditions	
	Unforeseen soil conditions	
	Floods and floods	
	Fires	
	Earthquakes and earthquakes	
Contractual	Contract Type and Reduced "Base Price"	
	Short deadline	
Technical	Little experience from the Designer team	
	Deficiencies and / or communication failures between parties (contractor designers; contractor designers; contractor contractor)	
	Delays in project and regulatory approval	
	Design errors	
	Successive project changes	
	Incomplete Information	
	Deficiencies in information for proposal preparation	
	High project complexity	
	Lack of experience in similar projects	
	Claims at critical points in the execution phase	
	Recovery or successive renovations	

Table 3 shows the authors who take advantage of their projects, according to the perception that the types of investments generate delays in the construction projects of the countries,

highlighting as political, legal, economic, social, market, environmental, contractual and technician. In smaller cases, factors related to lack of team leadership, customer relationship difficulties and communication providers between teams and stakeholders were characterized as managerial but understanding the needs of detailing and anamnesis of category, aiming to obtain each one of its objectives [35, 36, 37].

III. METHODOLOGY

This research was carried out in the period between March and November 2018, aiming to identify the maximum risk factors that affect the timing of the projects of the small Brazilian construction companies and, through an exploratory approach, define the level of relevance for mitigating actions can be more effective.

The first phase of the research is characterized by the definition of the general reference, through bibliographical analysis of recent literature topics that address corporate risks associated with construction projects.

The second phase aims to define the requirements and the development of the methodology, through the characterization of the samples, the elaboration of the research instruments and the preliminary analysis of the experimental data.

In the third and fourth phases, developed within the methodology, a definitive questionnaire is elaborated and presented to professionals who work in small Brazilian construction companies. The data obtained are analyzed by a multivariate statistical approach, where the levels of content consistency and reliability of the instrument are verified to guarantee the application of the exploratory factorial analysis (EFA).

The fifth phase of the research presents the analysis of the results.

3.1 Sample definition and profile of respondents

Sampling is a set of individuals from a population with specific characteristics [38]. Sampling can be probabilistic when the elements of the population have the same possibility of being chosen; or non-probabilistic, where the characteristics and information define the elements of the population needs that they can provide.

This research adopted a non-probabilistic sampling, characterized by 133 professionals with experience in small construction companies operating in the Brazilian market, according to the characteristics presented in Table 4.

Table 4. Characteristics of respondents

Companies - Country Regions		
Southeast	68	51,13%
South	26	19,55%
Midwest	18	13,53%
Northeast	13	9,77%
North	8	6,02%
Professionals - Education		
Civil Engineering	62	46,62%
Architecture	37	27,82%
Other Engineering	26	19,55%
Others	8	6,02%
Professionals - Experience in construction		
Above 10 years	71	53,38%
From 5 to 10 years	54	40,60%
Less than 5 years	8	6,02%

From the definition of the sample size, the standards were identified for the analysis of the variables that should be considered according to the sample size. As this study uses a sample with 133 respondents, it was considered 0.50 the minimum value for the load factors of the variables [39].

3.2 Elaboration of questionnaires and data collection

The processes of analysis of variables begin with the data collection, resulting from the questionnaires [40]. The structure of the questionnaires will depend on the approach adopted by the research, being it quantitative or qualitative. Where the results of the qualitative approaches may be appropriate to form a new questionnaire designed for a quantitative application. The application of these procedures allows statistical tools to be used in data evaluation [41].

The research instrument was based on two distinct stages that had the following aspects:

Phase 1 - preparation and application of an open questionnaire structured by guidelines, which was sent to a defined sample. The objective of this initial questionnaire was to verify, among the risk factors designated by the literature review, which presented a direct relationship with delays in project schedules.

The questionnaire was applied to a group of 16 professionals with extensive experience in companies in the construction sector and with consistent performance in micro and small size companies.

The results pointed out that 26 risk factors (variables), among the 43 identified in the literature, have characteristics related to delays in construction projects.

Interviews using guidelines present some degree of structuring and are structured according to the researcher's interest. This procedure seeks to stimulate the interviewees to discuss their

perceptions related to the theme freely and is usually associated with qualitative approaches [42, 38].
Phase 2 - elaboration and application of a survey type survey, through a structured questionnaire, composed of the 26 variables identified in phase 1.
The questionnaire used in this phase was formed by questions measured using the Likert scale.

The use of scalar analysis confers simplicity to the instruments and objectivity to the answers [43]. Thus, the variables were measured based on semantic scales, where the respondents identified the indices that represented their opinions, as described in Table 5.

Table 5. Staggered evaluation of variables.

It does not occur	Rare to occur	Unlikely	Possible to occur	Very likely	Always occurs
0	1	2	3	4	5

In the scale used, the answers varied from 0 (zero) to 5 (five), making a total of six points, where the lowest value indicated the lack of the degree of perception of the respondents. This phase aimed to obtain data for the application of statistical procedures. Table 6 describes the variables (Var) identified by step 1 that were addressed by the research instrument in phase 2.

Table 6. Variables identified from the application of the first questionnaire

Var	**Risk factors**
V1	Changes to Legislation
V2	High bureaucracy
V3	Fluctuation of Inflation and the Interest Rate
V4	Taxes
V5	Corruption
V6	Reduced Financial Capacity of the Owner of Work
V7	Interpersonal conflicts (wars, disorder, revolts)
V8	Intrapersonal conflicts (mentality, education, communication, culture, religion)
V9	Weakness and Lack of Communication Between Parties
V10	High labor cost
V11	Reduced Capacity for Technological Innovation
V12	Diminished Quality of Construction Materials
V13	Compressed Financial Capacity of Subcontractors
V14	Reduced quality of the work force
V15	Low-quality construction equipment
V16	Indemnity of Subcontractors
V17	Adverse Climate
V18	Difficulty in access to insurance
V19	Earthquakes
V20	Project Errors
V21	Little team experience
V22	Reduced Term
V23	Successive changes in projects
V24	Little experience in similar projects
V25	Incomplete project information
V26	High Complexity of the Project

After the final tabulation of the data obtained by the questionnaire, the research followed the preliminary exploratory analysis of the data.

IV. RESULTS

4.1 Preliminary data analysis

Any statistical procedure must begin by verifying the distribution and validity of the data. In this sense, the data were tested, and the presence of

the normal distribution was confirmed in all the present variables, resulting in the rejection of the null hypothesis (H_0: The data do not present a normal distribution) [44].

From the normality check, the basic premise for multivariate factorial analysis, the number of correct answers and their respective percentages of representativity were analyzed.

The statistical validity to the degree of consistency evidence [45,]. The internal consistency should be considered as a measure of the reliability of the questionnaire, because it indicates the degree of difference that the items measure the same concept. In this case, its validity is usually considered from the validations of content and construct [45, 46].

Using the results of the Kaiser-Meyer-Olklin test, the Cronbach's alpha coefficient and the Bartlett sphericity test were checked, respectively, for content reliability and objectivity of the research instrument, according to the results presented in Table 7 [47, 48, 49, 50].

Table 7. Synthesis of preliminary tests.

Number of valid responses	**133**
Number of items - questions	**26**
Cronbach's Alpha coefficient	0,917
Kaiser-Meyer-Olkin measure of	0,868
Bartlett sphericity test — Chi-square	1985,421
Bartlett sphericity test — df	325
Bartlett sphericity test — Sig.	0

According to the data presented in Table 7, Cronbach's alpha exceeded the minimum acceptable value of 0.70, characterizing a high internal consistency in the evaluation scale. The Kaiser-Meyer-Olkin test was used to verify the suitability of the sample and presented a satisfactory result, exceeding the minimum value of 0.60. The Bartlett sphericity test, which verifies the null hypothesis that the variables are not correlated, was considered valid because it presented a level of statistical significance lower than 0.05 [47, 45, 48, 49].

4.2 Application of exploratory factorial analysis

The factor analysis adopted by this research has an exploratory character and sequence of actions can be understood from the synthesis of the stages presented in Table 8.

Table 8. Synthesis of the steps of applying the factor analysis.

Stage	**Process**		**Var**	**Excluded**
1	CA 1	1ª Community Analysis	26	1
2	CA 2	2ª Community Analysis	25	0
	FL 1	1ª Analysis of Factorial Loads	25	5
3	CA 3	3ª Community Analysis	20	1
4	CA 4	4ª Community Analysis	19	0
	FL 2	2ª Analysis of Factorial Loads	19	6
5	CA 5	5ª Community Analysis	13	1
6	CA 6	6ª Community Analysis	12	2
7	CA 7	7ª Community Analysis	10	0
	FL 3	3ª Analysis of Factorial Loads	10	0
	CM 1	1ª Analysis of Correlation Matrix	10	4
8	CA 8	8ª Community Analysis	6	0
	FL 4	4ª Analysis of Factorial Loads	6	0
	CM 2	2ª Analysis of Correlation Matrix	6	0

Tables 9 to 12 present the results obtained in each step of the application of the factorial analysis, according to their processes and their actions, followed according to the behaviour of the variables addressed.

Table 9. Analytical result of the first two stages of the application of factorial analysis.

	Stage 1	**Stage 2**						
Var	**CA1**	**CA2**	**FL1**					
V1	0,71	0,71		0,7				0,34
V2	0,57	0,68				0,79		
V3	0,75	0,78						0,85
V4	0,65	0,64	**0,41**	**0,62**				
V5	0,73	0,71			0,37	0,65		
V6	0,65	0,65				**0,57**		**0,41**
V7	0,66	0,65	0,62	0,3				
V8	0,62	0,62		0,63		0,34		
V9	0,6	0,61			0,72			
V10	0,68	0,68			0,74			
V11	0,54	0,54	0,32	0,62				
V12	0,76	0,75					0,84	
V13	0,68	0,67	0,35	0,39			0,6	
V14	0,7	0,71			**0,53**	0,33	**0,55**	
V15	0,74	0,74		0,75				
V16	0,62	0,62	0,34	0,55			0,38	
V17	**0,39**	Excluded						
V18	0,71	0,71	**0,41**	**0,53**	**0,49**			
V19	0,69	0,67	0,38	0,56	0,33			
V20	0,72	0,72	0,74					
V21	0,66	0,67	**0,41**		**0,62**			
V22	0,77	0,76	0,81					
V23	0,76	0,77	0,83					
V24	0,7	0,7	0,72	0,34				
V25	0,81	0,81	0,83					
V26	0,73	0,73	0,78					

Table 10. Analytical result of the third and fourth stages of the application of factorial analysis.

	Stage 3	**Stage 4**					
Var	**CA3**	**CA4**	**FL2**				
V1	0,71	0,69	**0,44**				**0,69**
V2	0,63	0,62				0,76	
V3	0,71	0,74					0,84
V5	0,65	0,65	0,31		-	0,67	
V7	0,63	0,63	0,75				
V8	**0,47**	Excluded					
V9	0,58	0,59			0,66	0,35	
V10	0,74	0,75			0,84		
V11	0,6	0,6	**0,49**		**0,44**		**0,35**
V12	0,74	0,75		0,79			
V13	0,68	0,68	**0,41**	**0,67**			
V15	0,76	0,74	**0,46**	**0,47**		-0,34	**0,43**
V16	0,61	0,63	**0,45**	**0,57**			
V19	0,68	0,69	**0,56**		**0,48**	**-0,35**	

V20	0,72	0,73	0,79				
V22	0,73	0,73	0,81				
V23	0,68	0,68	0,77				
V24	0,72	0,72	0,82				
V25	0,8	0,8	0,84				
V26	0,74	0,74	0,82				

Table 11. Analytical result of the fifth, sixth and seventh stages of the application of factorial analysis.

	Stage 5	**Stage 6**	**Stage 7**				
Var	**CA5**	**CA6**	**CA7**	**FL3**			**CM1**
V2	0,62	**0,44**	Excluded				
V3	0,94	0,93	0,96			0,98	**Low correlation**
V5	0,58	0,64	0,72		0,79		**Low correlation**
V7	0,64	0,55	0,55	0,74			**Low correlation**
V9	0,71	0,51	0,7		0,81		**Low correlation**
V10	0,67	**0,46**	Excluded				
V12	**0,43**	Excluded					
V20	0,72	0,72	0,71	0,79			0,79
V22	0,74	0,74	0,75	0,81	0,31		0,81
V23	0,77	0,73	0,75	0,85			0,85
V24	0,72	0,66	0,65	0,8			0,8
V25	0,82	0,81	0,81	0,87			0,87
V26	0,75	0,74	0,75	0,85			0,85

Table 12. Analytical result of the last stage of the application of factorial analysis.

	Stage 8		
Var	**CA8**	**FL4**	**CM2**
V20	0,71	0,85	**High correlation**
V22	0,75	0,87	**High correlation**
V23	0,73	0,86	**High correlation**
V24	0,64	0,80	**High correlation**
V25	0,83	0,91	**High correlation**
V26	0,75	0,86	**High correlation**

At the end of the factorial analysis, six variables presented a high correlation value. as shown in Table 13.

Table 13. Critical variables identified by the exploratory factorial analysis.

Variables	**Factor Loadings**		
		1	**Ranking**
V2	Project Errors	0,91	1°
V2	Reduced Term	0,87	2°
V2	Little experience in	0,86	3°
V2	High Complexity of	0,86	4°
V2	Incomplete project	0,85	5°
V2	Successive changes	0,80	6°

The result of the factorial analysis presents six variables that are grouped in a single construct, corresponding to 73.46% of the total variance explained, as shown in Table 14.

Table 14. Total variance explained by the grouping of the resulting variables.

Construct	Initial eigenvalues		
	Total	of variance	cumulative
1	4,408	73,46%	73,46%

V. CONCLUSIONS

The results obtained by the application of the exploratory factorial analysis identified six variables, or risk factors, that presented high correlation in their data. In practice, this means that they were the highlights of the professionals who participated in the survey. Factorial loads were considered by the study to verify the importance ranking of each factor within the construct (Table 13).

The total final variance explained reached an excellent representative percentage, meaning that the six variables identified together represent 73.46% of the total weight contemplated by the study (Table 14).

Finally, the category of technical risks was identified as the one with the highest potential for impacts of delays in small construction projects in Brazil.

Based on the results obtained by this research, it is suggested that future studies that address the risk management in small-scale construction companies, lead to the identification and analysis of "elements of risk" that increase the appearance of critical factors in the construction sector. In this way, effective mitigating actions can be defined that reduce occurrences of delays in the construction projects of small construction companies.

Another suggestion arises from the premise that the exploratory approaches offer for future confirmatory research, validate or suggest adaptations in the presented findings.

REFERENCES

[1]. Sweis, G. et al. Delays in Construction Projects: the case of Jordan. International Journal of Project Management, v. 26, n. 6, p. 665–674, 2008.

[2]. Wong, K.; Vimonsatit V. (2012). A Study of The Factors Affecting Construction Time in Western Australia. Scientific Research and Essays Vol.7 (40), pp. 3390-3398, 23 October 2012.

[3]. Serviço Brasileiro de Apoio às Micro e Pequenas Empresas. SEBRAE (2014) Participação das micro e pequenas empresas na economia brasileira. Brasília, 2014. Disponível em: http://www.sebrae .com.br/Sebrae/Portal%20Sebrae/Estudos%20 e%20Pesquisas/Participacao%20das%20micro %20e%20pequenas%20empresas.pdf. Access in 20 jun. 2018.

[4]. Guia de Boas Práticas em Sustentabilidade na Indústria da Construção. CBIC: Câmara Brasileira da Indústria da Construção, Brasília: Fundação Dom Cabral, (2018). Disponível em: http://www.cbic.org.br/arquivos/Guia_ de_ Boas_Praticas_em_Sustentabilidade_CBICFD C.pdf Access in 19 mar 2019.

[5]. Klüppelberg C., Straub D., Welpe I. Risk: A multidisciplinary introduction. Springer, pp. 151-181. 2014.

[6]. Garvey, PR, Analytical Methods for Risk Management. CRC Press, Boca Raton, pp 1-12, 2009.

[7]. Bissacot, T. C. C.; Oliveira, S. M. A. C. Instrumento para o gerenciamento de riscos ambientais. Engenharia Sanitária Ambiental v.21 n.2. abr/jun 2016 | 227-232.

[8]. Alsehaimi, A., Koskela, L., Tzortzopoulos, P. (2013). Need for Alternative Research Approaches in Construction Management: Case of Delay Studies. Journal of Management Engineering, 10.1061/(ASCE) ME. 1943-5479.0000148, 407-413. 2013.

[9]. Maués, L. M. F.; Santana, W. B.; Santos, P. C. dos; Neves, R. M. das; Duarte, A. A. A. M. Construction delays: a case study in the Brazilian Amazon. Ambiente Construído, Porto Alegre, v. 17, n. 3, p.167-181, jul./set. 2017.

[10]. Silva, V. F. (2012) Análise de risco na construção: Guia de procedimentos para gestão. 2012. Dissertação (Mestrado em Engenharia Civil) – Faculdade de Engenharia, Universidade do Porto, Porto.

[11]. Project Management Institute – PMI (2017). A Guide to the Project Management Body of Knowledge PMBOK® guide 6th ed. Newton Square: Project Management Institute, Inc.

[12]. Zavadskas, E. K.; Turskis, Z.; Tamosaitiene, J. Risk Assessment of Construction Projects.pdf. Journal of Civil Engineering and Management, v. 18, n. 1, p. 33– 46, 2010.

[13]. Zou, P. X. W.; Zhang, G.; Wang, J. Understanding the Key Risks in Construction Projects in China. International Journal of Project Management, v. 25, n. 6, p. 601–614, 2007.

[14]. Chapman, R. J. The Controlling Influences on Effective Risk Identification and Assessment for Construction Design Management. International Journal of Project Management, v. 19, n. 3, p.147–160, 2001.

[15]. Sarmad, Z., Bazargan, A., Hejazi, E. (2003). Research methods in behavioral sciences. Publishers Agah Tehran. [In Persian].

[16]. Bing, L., Tiong, R. L. K. (1999). Risk Management Model for International Construction Joint Ventures. Journal of Construction Engineering and Management, 125(5), 377-384.

[17]. Bu-Qammaz, A. S., Dikmen, I., & Birgonul, M. T. (2009). Risk assessment of international construction projects using the analytic network process. Canadian Journal of Civil Engineering, 36(7), 1170-1181.

[18]. Chang, A. 2002. Reasons for cost and schedule increase for engineering design projects. Journal of Management Engineering. 18 (1): 29–36.

[19]. Couto, J. P. 2009. The public institutions performance is one of main Portuguese construction reasons for delays. In Proc., 13th Int. Congress on Project Engineering, 96–105. Valencia, Spain: Asociación Española de Ingeniería de Proyectos (AEIPRO).

[20]. Couto, J. P., J. C. Teixeira. 2007. The evaluation of the delays in the Portuguese construction. In Proc., CIB World Building Congress 2007, 292–301. Cape Town, South Africa: South African Institution of Civil Engineering.

[21]. Ellis, R. D., H. R. Thomas. 2002. The root causes of delays in highway construction. In Proc., 82nd Annual Meeting of the Transportation Research Board. Washington, DC: Transportation Research Board.

[22]. Fallahnejad, M. H. Delay Causes in Iran Gas Pipeline Projects. International Journal of Project Management, v. 31, n. 1, p. 136-146, 2013.

[23]. Fang, D., Li, M., Fong, P. S., Shen, L. (2004). Risks in Chinese Construction Market—Contractors' Perspective. Journal of Construction Engineering and Management, 130(6), 853-861.

[24]. Gad, G. M., Kalidindi, S. N., Shane, J., Strong, K. (2011). Analytical Framework for the Choice of Dispute Resolution Methods in International Construction Projects Based on Risk Factors. Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 3(2), 79.

[25]. Hastak, M., Shaked, A. (2000). ICRAM-1: Model for International Construction Risk Assessment. Journal of Management in Engineering, 16(1), 59-69.

[26]. Teixeira Netto, Joaquim, Oliveira, Nylvandir Liberato Fernandes de, Freitas, Andrey Pimentel Aleluia, Santos, João Alberto Neves dos. (2018). Utilização do valor agregado como ferramenta de gestão na construção civil: uma análise quantitativa. Ambiente Construído, 18(4), 237-257. https://dx.doi.org/10.1590/s1678-86212018000400303.

[27]. Liu, J., Zhao, X., Yan, P. (2016). Risk paths in international construction projects: Case study from Chinese contractors. Journal of Construction Engineering and Management.

[28]. Mccord, J., M. Mccord, P. T. Davis, M. Haran, W. J. Rodgers. 2015. Understanding delays in housing construction: Evidence from Northern Ireland. Journal Financial of Management Prop. Construction 20 (3): 286–319.

[29]. Moura, H. P., J. C. Teixeira, B. Pires. 2007. Dealing with cost and time in the Portuguese construction industry. In Proc., CIB World Building Congress 2007, 1252–1265. Cape Town, South Africa: South African Institution of Civil Engineering.

[30]. Ng, S. T., Skitmore, R. M. (2002). Contractors' risks in Design, Novate and Construct contracts. International Journal of Project Management, 20(2), 119-126.

[31]. Olawale, Y., M. Sun. 2010. Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. Construction Management Economics. 28 (5): 509–526.

[32]. Serrado, I. P., Santos, J. A. N. D., Oliveira, N. L. F. D., Freitas, A. P. A. (2019). Identification of Importance Levels of Market Risks in the Construction Sector. Journal of Engineering, Project, and Production Management. 9(2), 74-84.

[33]. DOI: 10.2478/jeppm-2019-0009 Shebob, A., N. Dawood, R. K. Shah, Q. Xu. 2012. Comparative study of delay factors in Libyan and the UK construction industry. Eng. Constr. Archit. Manage. 19 (6): 688–712.

[34]. Sullivan, A., F. C. Harris. 1986. Delays on large construction projects. Int. J. Oper. Prod. Manage. 6 (1): 25–33.

[35]. Tafazzoli, M. (2017), Investigating causes of delay in US construction projects, paper presented in the 53rd ASC Annual International Conference Proceedings, Associated Schools of Construction, TX.

[36]. Hwang, B.-G.; Zhao, X.; Ng, S. Y. Identifying the Critical Factors Affecting Schedule Performance of Public Housing Projects. Habitat International, v. 38, p.214-221, 2013.

[37]. Freitas, A. P. F.; Metodologia de Gerenciamento de Riscos na Indústria da Construção Civil: Aplicação em empresas de micro e pequeno portes. Tese de doutorado. Pós-Graduação em Engenharia Civil. Universidade Federal Fluminense, Niterói, 2018.

[38]. Muianga, E. A. D., Granja, A. D. e Ruiz, J.A. Desvios de custos e prazos em empreendimentos da construção civil: categorização e fatores de influência. Ambiente Construído. V. 15, No. 1, 2015.

[39]. Rosenfeld, Y. Root-Cause Analysis of Construction-Cost Overruns. Journal of Construction Engineering and Management v. 140, n. 1, p.04013039, 2014.
[40]. Guimarães, P. R. B. (2008). Métodos Quantitativos Estatísticos. Guimarães, Paulo Ricardo Bittencourt. — Curitiba: IESDE Brasil S.A., 2008. 245p.
[41]. Hair Jr., J. F.; Black, W. C.; Babin, B. J.; Anderson, R. E.; Tatham, R. L. (2011). Análise Multivariada de Dados. Porto Alegre: Bookman, 2011.
[42]. Martins, G. A.; Theóphilo, C. R. Metodologia da Investigação Científica Para Ciências Sociais Aplicadas. 2. ed. São Paulo: Atlas, 2009.
[43]. Maia, A. T.; Iarozinski Neto, A. Quais as Principais Características Organizacionais das Empresas dos Diferentes Segmentos da Construção Civil? Ambiente Construído, Porto Alegre, v. 16, n. 3, p. 197-215, jul./set. 2016.
[44]. Britto Júnior, Álvaro e Feres Júnior, Nazir. A utilização da técnica da entrevista em trabalhos científicos. Artigo na Revista Evidência, Araxá, Universidade do Araxá/MG, v. 7, n. 7, 2011.
[45]. Gil, A. C. Métodos e Técnicas de Pesquisa Social. 5. ed. São Paulo: Atlas, 1999.
[46]. Montgomery, D.C., Runger, G.C. (2003). Estatística Aplicada e Probabilidade para Engenheiros. 2ª ed. Rio de Janeiro: LTC, 2003.
[47]. Hayes, B. E. Measuring Customer Satisfaction. Milwaukee: Quality Press, 1992.
[48]. Nunnally, J. C. Psychometric Theory. New York: McGraw-Hill, 1967.
[49]. Streiner, D. L. (2003). Starting at the Beginning: An Introduction to Coefficient Alpha and Internal Consistency. Journal of Personality Assessment, 80 (1), 99–103.
[50]. Field, A. Discovering Statistics Using IBM SPSS Statistics. Thousand Oaks: Sage, 2013.

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