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O ENSINO DE GESTÃO DE PROJETOS NOS CURSOS DE GRADUAÇÃO EM ENGENHARIA CIVIL NO BRASIL: COMPARATIVO ENTRE 2018 E 2023

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Resumo

O gerenciamento de projetos tem se consolidado como uma metodologia essencial para a gestão de empreendimentos em diversas áreas, incluindo a construção civil. Este estudo teve como objetivo avaliar o alinhamento entre a formação profissional do engenheiro civil e as demandas do mercado de trabalho em termos de gestão de projetos, cinco anos após a identificação de uma lacuna nesse alinhamento em 2018. A metodologia consistiu na análise das grades curriculares de cursos de graduação em engenharia civil no Brasil, com foco na inclusão de disciplinas de gestão de projetos. Os resultados indicam que a lacuna identificada diminuiu significativamente, a concentração regional relativa da oferta dessa disciplina foi ligeiramente reduzida e que a concentração em Instituições de Ensino Superior (IES) privadas não é mais predominante.

Palavras-chave: Ensino de engenharia civil; Gestão de projetos; Formação do engenheiro civil; Grade curricular engenharia civil

TEACHING PROJECT MANAGEMENT IN UNDERGRADUATE CIVIL ENGINEERING COURSES IN BRAZIL: COMPARISON BETWEEN 2018 AND 2023

Abstract

Project management has become an essential methodology for managing endeavors across various fields, including civil construction. This study aimed to assess the alignment between civil engineering education and market demands for project management skills five years after a gap in this alignment was identified in 2018. The methodology involved analyzing the curricula of civil engineering undergraduate programs in Brazil, focusing on the inclusion of project management courses. The results indicate that the previously identified gap has significantly narrowed, the relative regional concentration of these courses has slightly decreased, and there is no longer a predominance of such offerings in private Higher Education Institutions (HEIs).

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Keywords: Civil engineering teaching; Project management; Civil engineer training; Civil engineering curriculum

1 Introduction

Project management methodologies consist of a set of practices that help in the search for efficiency in the management of all types of projects, regardless of their size and area of application (PMI®, 2022). This means that both a graduation party organization project and a nuclear power plant installation project need to efficiently manage budget, schedule, and several other resources.

The most famous and globally accepted methodology is that of the Project Management Institute - PMI®, which was registered in the Project Management Body of Knowledge (PMBOK®). This is a guide, revised every four years, which provides the best practices for project management according to managers of large projects with proven experience (PMI®, 2022).

Projectization is one of the most striking characteristics of the construction sector. Each construction consists of a unique project, that is, it has a unique schedule, team, budget and acceptance criteria. In this context, the civil engineer's role ends up being much more of a project manager most of the time, managing budgets, teams and deadlines, quality and various resources. (Souza, 2019).

There are several characteristics in a construction project that require solid knowledge in project management: the mobilization of large amounts of specialized resources (Walker, 2007); most construction projects are carried out in a complex, dynamic and uncertain environment (Kern; Formoso, 2006); great complexity in assessing the project's risk level (Liu; Zhu, 2007; Zeng; An; Smith, 2007); many stakeholders involved, with different or even conflicting opinions and stances (Hoffmann, Procopiak, Rossetto, 2008; Yang, Peng, 2008).

Taking that to accounting, the PMI® methodology is perfectly suited, as it is developed to deal with complex projects, with multiple suppliers and with different delivery dates (Griffin; Thomas; McMurtrey, 2022).

Construction companies have been giving more importance to project management practices to improve strategic decision-making, the quality of their works and their competitiveness (Winter; Checkland, 2003). It is common to find job for civil engineers requiring PMP® (Project Management Professional) certification. To obtain this credential, professionals must pass a rigorous PMI® certification exam, with a test that assesses theoretical knowledge of the methodology and analysis of documents that prove professional experience in project management (Souza, 2019).

The construction industry needs this expertise in project management. The job market in this sector demands professionals trained in project

management. However, despite this scenario, such knowledge is not included in the curriculum of most undergraduate civil engineering courses in Brazil. A real gap between the knowledge demanded by the job market and the knowledge offered by Higher Education Institutions (HEIs) (Souza, 2019).

In 2018, only 20% of undergraduate civil engineering courses offered in Brazil had the project management discipline in the curriculum. Only 2.6% of the Brazilian HEIs offering this discipline in the civil engineering undergraduate course were public in 2018. From a geographical perspective, of the total number of Brazilian HEIs with the subject of project management in the civil engineering undergraduate course: 60.8% are in the Southeast; 28.3% in the South; 8.7% in the Northeast; and 2.2% in the Midwest. None of the undergraduate courses in civil engineering offered in 2018 in the North of Brazil had the project management discipline in the curriculum (Souza, 2019).

In this context, in 2018, the very low percentage of undergraduate courses in civil engineering that provided students with knowledge in project management was highlighted. The gap observed between the supply of this knowledge in the curriculum of undergraduate civil engineering courses in Brazil and the job market demand for this professional can be considered alarming. It was also highlighted that in 2018 private institutions were those that best met the market demand for civil engineers with knowledge in project management. Moreover, it is observed observed that the most developed regions of the country are also those that best met market demand.

2 Theoretical framework

The objective here is to search the literature for cases of use of project management methodology, specifically in the civil construction segment, to verify its applicability and relevance for construction management.

The PMI® project management methodology, in addition to being accepted and respected, is the most used around the world. This methodology includes processes for managing 10 areas that cover projects of all types: integration, scope, acquisitions, communications, time, costs, quality, stakeholders, risks and human resources. (PMI®, 2018). Therefore, this literature review seeks to identify the relevance and applicability of the aforementioned project management processes in construction, according to the PMI® methodology.

Due to the growth of construction demand in the market, better management of projects and their execution helps to make strategic decisions, improve the quality of works and their competitiveness (Winter; Checkland, 2003; Arrotéia; Amaral; Melhado, 2014).

In this context, according to Keeling (2002), out of every 100 projects, 37 are not completed, 34 are completed with changes in projected objectives, with losses in costs, deadlines and quality and only 29 are completed as originally established. Therefore, according to Morioka and Monteiro de Carvalho

(2016), there is a great need for Project Management professionals, focusing on three sustainability restrictions: economic, social and environmental. Regarding the importance of sustainability in civil engineering education, there is a study by Ramos-Gavilán et al. (2024), reporting the work done at the University of Zamora, in Spain.

The civil construction segment involves projects that represent around 25% of the world's GDP, something around US$ 10 trillion, employing around 16.5 million workers globally (Rabenchinni; Carvalho, 2006). The evolution of software in civil engineering intensifies the need for project management knowledge for this professional. Building Information Modeling (BIM) has an interface with features and vocabulary that is very familiar to the PMI® project management methodology. There are already several academic works referring to the joint use of the PMI and BIM methodology in various software. Among them, we can mention Fazli *et al.* (2014), Alnaggar and Pitt (2018) and Almuntaser, Sanni-Anibire and Hassanain (2018).

Every construction project involves several areas, all of which are covered by the 49 aspects of the PMI® methodology, namely: use of large amounts of resources; uncertainties and complexity of the execution environment; many stakeholders involved; risks that need to be understood and managed, needs for modernization and attention to environmental requirements (Brasil, 2005; Kern, Formoso, 2006; Walker, 2007; Liu, Zhu, 2007; Zeng, An, Smith, 2007; Hoffmann, Procopiak, Rossetto, 2008; Yang, Peng, 2008; Griffin, Thomas; McMurtrey, 2022).

Griffin, Thomas and McMurtrey (2022) highlight the origins of Project Management, when the recently created PERT methodology was developed to manage the Polaris ballistic missile project, in the 1950s. It is worth noting that the missile project involved the management of multiple resources and suppliers, varying delivery times, diverse customers, both in the public and the private sector, different technologies, development in multiple locations, integration of this whole and much more. The evolution of PERT for Project Management brought new dimensions of complexity, aiming to meet the multiplicity of aspects of very complex projects. In this context, the management of a construction project, from design to delivery, from a single popular house to a hydroelectric plant, will certainly benefit from the methodology. Another contribution of the methodology to civil construction is the management of multiple projects. According to Frej and Alencar (2010), the construction sector is projectized and an organization in this segment commonly manages multiple projects simultaneously.

Due to space restrictions and scope of this work, it is not intended here to discuss all aspects of PMI®, highlighting only those most relevant to civil construction. With regard to cost management, several authors highlight its importance and the need for economic-financial management, such as Roy (1996), Lopes, Librelloto and Ávila (2003), Tas and Yaman (2005), Kern and Formoso (2006), Kern, Soares and Formoso (2006), Marchiori and Souza (2006), Liu and Zhu (2007), Marchiori (2009) and, Jacomit and Granja (2011) with Waqar (2024) bringing the issue to the sphere of Artificial Intelligence.

There is still another aspect in which Project Management would be useful in construction, which would be measuring the performance of the project's added value. Neto, Farias Filho and Quelhas (2014) point out that controlling performance through indicators becomes a valuable instrument, as it offers precise measures for evaluating management.

Another aspect of the usefulness of using PMBOK® is in the development of new products, as flaws, gaps and repressed demands can be identified, according to Sapuchay, Silveira and Sbragia (2013) and Zhang *et al.* (2019), although the latter mention the relationships between Project Management and BIM, without mentioning the PMI® methodology specifically.

Britto and Ferreira (2015) also refer to the use of BIM and variations, despite what the cited authors say, the BIM methodology has already been used in Brazilian universities and tends to establish itself as predominant, as observed in the rest of the world according to Agrawal *et al.* (2024).

A recent news article, authored by André Lopes, published online in Exame Magazine (2024), informs that the government of the state of São Paulo will test, in a pilot project for three million students, an Artificial Intelligence product. It is expected that this initiative will make it easier for future engineering students to use more sophisticated tools such as PMI® and BIM.

As mentioned, there are multiple clients, both internal and external, on a construction project. Therefore, requirements management, linked to managing the scope of the project, is necessary. Baldauf, Formoso and Miron (2013) mention the importance of managing these processes, aiming at stakeholder satisfaction and final quality.

Melhado (2001), in his Free Teaching Professor thesis at the Polytechnic School of USP (EPUSP), recommends teaching Project Management at undergraduate level and highlights the importance of quality management in projects, adding that the latter is already incorporated into the practices of the construction sector, noting, however, that quality requirements tend to become more complex and sophisticated.

According to Melhado (2001), EPUSP has already been incorporating mandatory or optional subjects, including the subjects "Production Management in Civil Construction", "Building Construction Technology", "Project Management and Coordination" and "Quality Management and Certification", pointing out that there is a setback in training in Human Sciences, particularly regarding interpersonal relationships in group work (Melhado, 2001).

Regarding teaching project management at undergraduate level, there is the work of Lopes and Martins (2017) who suggest the Problem Based Learning (PBL) method. According to the authors (2017), the PBL method was covered in the Knowledge Synthesis and Integration (SIC) discipline, which is part of the fourth year of the Civil Engineering Course curriculum at a private Higher Education Institution (HEI) in Brazil. The subject aims to integrate the study of several different subjects from the fourth year, as well as most of the subjects

studied in previous years, aiming to familiarize the student with the area of project management, facilitating their future insertion into the market.

Lopes and Martins (2017) used the action research method during the 2013 academic year in two fourth-year classes with 38 students. The PBL method in the discipline occurred through a simulation, creating a scenario in which the students developed as their final work the integration of all projects necessary to carry out a two-story residential project.

It is worth highlighting here that at UFMS – Federal University of Mato Grosso do Sul, Campo Grande campus –, in the Technology in Building Construction course, PBL (Problem Based Learning) was also used in its management disciplines and carried out the integration in all their disciplines in the area. Thus, the students throughout the subjects had to build the various projects necessary to carry out work on a six-story residential building, 4 apartments per floor, 55 square meters each, 2 bedrooms, living room, kitchen and bathroom.

In the Building Construction Planning discipline, students developed an initial construction project based on a model of residential unit provided, consisting of a 55m2 apartment. From there, the construction product was developed, first considering construction standards, that is, popular, medium and luxury, consisting of one or more 6-story buildings, four apartments per floor, requiring, by law, one or more elevators. The standard decision by default impacts the choices of materials, finishes, garages, etc.

It was also requested to implement on the ground, the project of the construction site with warehouses, offices and planning for the movement of vehicles, machines and people, with the respective descriptive memorial and a basic project. In the next subject, Cost Control in Construction, the descriptive memorandum was improved, assigning values to the listed items, also requesting a physical-financial schedule and a disbursement schedule according to the different phases of the work. In this discipline, the project was improved, including electrical, hydraulic, etc. projects, so that a clear notion of cost was developed. An additional learning from the discipline was the development of a Gantt chart to manage the processes and phases of the work.

The subject of Economic Evaluation of Projects in Civil Construction helped in making decisions regarding financial aspects of projects and the subject of Humanities brought concepts from the human sciences to the development of products for civil construction. Finally, the last management discipline of the course presented the PMI® project management methodology and had as its final work the integrated construction of the Project Management Plan for the building composed of the various management sub-plans produced in the previous disciplines and added the management plans for other areas that had not yet been worked on in previous disciplines, such as quality management plans, risks, human resources, stakeholders, communications, among others. In the specific case of UFMS, exemptions from subjects for students entering in the diploma holder modality and the absence of prerequisites to take management subjects often broke the proposed pedagogical cycle. The civil engineering

degree at UFMS does not have a specific mandatory subject to work in project management.

3 Methodology

Regarding the approach, this research is quantitative, in which a sample of 366 Higher Education Institutions (HEIs) was analyzed from a population of 675 institutions in which there is an active civil engineering course. Concerning nature, research is applied, as it aims to generate knowledge for practical application, aimed at solving a specific problem that is a possible gap between the need for civil engineer training in project management and the offering of this discipline in courses degree in civil engineering in the country. In relation to the objectives, our research is exploratory to raise some hypotheses and provide greater familiarity with the problem, with the intention of making it more explicit.

As for procedures, the research is both bibliographic and a survey. Bibliographical because it was made from the survey of theoretical references already analyzed, and published in the form of scientific articles, extracted from the Capes Periodicals Portal (Government funded research repositories), using the key words: "project management in civil construction", "teaching project management in civil engineering", "building construction project management", "importance of civil engineering project management" and "project management in civil construction", which generated 1385, 468, 342, 495 and 504 results respectively. Given that there was a need for more recent texts and a more international view of the topic, the same keywords were used, translated into English, generating 39 results between 2020 and 2024.

The survey resource was also used because a sample of 366 courses was used from a survey of 426 civil engineering courses with a grade equal to or above 3 in the Preliminary Course Concept (CPC) index, evaluated by the Ministry of Education (MEC), present in a population of 675 existing and active courses, already explained previously in this research.

3.1 Criteria and research universe

3.1.1 Population identification criteria

Initially, all undergraduate courses in civil engineering authorized by the MEC were listed. However, it was observed that some higher education institutions have more than one civil engineering course registered. In some cases, this duplication happens because one course was being closed and a new one was already underway. In this case, only the most recent courses registered by the HEIs were considered.

Ending and uninitiated courses were excluded from the research population. Duplicity was also observed due to some HEIs having carried out different registrations for civil engineering course offerings in different shifts, campuses and different modalities. In this case, when the curricula were different, they were counted as different courses, when the curricula were similar, they were a single course. Applying these criteria, a total population of 675 undergraduate courses in civil engineering existing in Brazil was identified.

3.1.2 Sampling Criteria

Regarding the sampling criteria, these were based on meeting requirements and the availability of information. The sample selected courses that have a grade equal to or greater than 3 on the MEC's CPC (Preliminary Course Concept) index, which is a quality indicator that evaluates undergraduate courses, with grades ranging between 1 and 5. Its calculation and dissemination take place in the year following the ENADE (National Student Performance Examination), based on the evaluation of student performance, the value added by the training process and inputs relating to the conditions of supply – teaching staff, infrastructure and didactic-pedagogical resources, according to technical guidance approved by the National Commission for the Assessment of Higher Education (CONAES).

A sample of 426 civil engineering courses in Brazil that meet this requirement were found in the population. Of these, only 366 made the civil engineering course curriculum available on the HEI website. Courses that did not make such information available on its website were excluded from the sample.

3.1.3 Data Analysis Criteria

To ensure comparability with the results found in 2019, based on data collected in 2018, the information collected in 2023 was analyzed using the same criteria. Therefore, only the project management subjects that are part of the mandatory curriculum of the courses were considered.

Furthermore, when the course did not offer the project management discipline, management and/or planning and/or control disciplines were sought, considering that these syllabi usually address at least in part project management knowledge. In these cases, the syllabus was evaluated on a case-by-case basis in order to identify whether the content of the syllabus was sufficient to be considered equivalent.

3.1.4 Research Universe

The quantitative research was carried out in 366 civil engineering courses out of the 426 with a grade equal to or greater than 3 in the MEC's CPC index. In other words, the research includes almost 86% of courses with a satisfactory evaluation within the expectation of training for a higher education course in the area, which makes the number of courses surveyed very representative in the universe of civil engineering courses in Brazil.

4 Results and Discussions

To establish a comparison between the offer of the project management discipline in the curricula of undergraduate civil engineering courses in Brazil in the years 2018 and 2023, the total offer of civil engineering courses was initially observed. In 2018, there were 229 bachelor's degrees in civil engineering in the country with a grade equal to or greater than 3 on the CPC. In 2023, this number rises to 426, which represents an increase of 86% in the period.

Regarding the availability of information about the course curriculum, there was no change. In 2018, 14% of all civil engineering courses did not publish the current curriculum on their websites. In 2023, the unavailability of this information occurred in 14% of courses.

In terms of offering the project management discipline in civil engineering undergraduate courses, it is possible to identify a very significant increase. In 2018, only 20% of civil engineering courses in Brazil offered the project management discipline. In 2023, our sample presented 66% of courses offering this discipline. In other words, supply in the country increased by 46 percentage points in the period. These results can be seen in figure 1 below:

Figure 1 - Presence of the project management discipline in undergraduate civil engineering courses in Brazil, compared between 2018 and 2023.

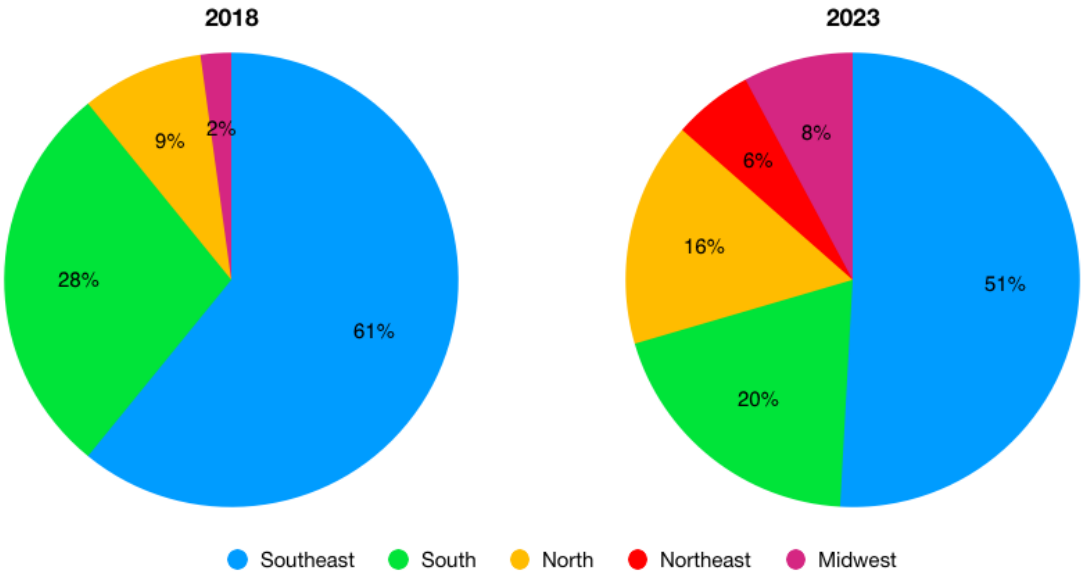
Region	Project management disciplines	2018		2023		Percentage change 2018-2023
		Courses	Share	Courses	Share	
South	Offer of project management	13	22%	55	63%	41%
	No offer of project management	32	55%	21	24%	-31%
	No information	13	22%	11	13%	-11%
	Total	**58**	100%	**87**	100%	
Southeast	Offer of project management	28	27%	143	72%	45%
	No offer of project management	55	54%	32	16%	-38%
	No information	19	19%	23	12%	-7%
	Total	**102**	100%	**198**	100%	
Midwest	Offer of project management	1	6%	22	58%	52%
	No offer of project management	14	82%	11	29%	-53%
	No information	2	12%	5	13%	1%
	Total	**17**	100%	**38**	100%	
North	Offer of project management	0	0%	16	62%	62%
	No offer of project management	10	91%	7	27%	-64%
	No information	1	9%	3	12%	12%
	Total	**11**	100%	**26**	100%	
Northeast	Offer of project management	4	10%	45	58%	49%
	No offer of project management	29	71%	14	18%	-53%
	No information	8	20%	18	23%	3%
	Total	**41**	100%	**77**	100%	
Brazil	Offer of project management	46	20%	281	66%	46%
	No offer of project management	150	66%	85	20%	-46%
	No information	33	14%	60	14%	0%
	Total	**229**	100%	**426**	100%	

Source: Elaborated by the author based on data from the Ministry of Education (MEC), 2018 and 2023.

In 2018, geographic trends were identified in the data collected. There was a clear concentration not only in quantities, but also in percentage terms of the project management discipline offered in civil engineering courses in the South and Southeast of Brazil. Of the 46 courses that offered the discipline in 2018, 28 were in the Southeast region and 13 in the South, as can be seen in figure 1.

In 2023, what can be observed is that this concentration begins to decrease. As already mentioned in this research, the offer of the project management discipline in civil engineering courses in Brazil increases by 46 percentage points between the years 2018 and 2023. However, the North, Northeast and Midwest regions increase above the national average, respectively 62%, 49% and 52%. While the South and Southeast regions increased by 41% and 45% respectively, below the 46% national average increase. This means that the offer of this discipline still remains strongly concentrated in the South and Southeast, but that this concentration is, albeit discreetly, decreasing as can be seen more clearly in figure 2:

Figure 2 - Concentration of the project management discipline offered in undergraduate civil engineering courses in the regions of Brazil in 2018 and 2023



Source: the authors, with data extracted from Ministry of Education and Culture (MEC).

As already mentioned, the offer of the project management discipline in civil engineering undergraduate courses in Brazil remains concentrated in the south and southeast regions. However, it is possible to observe that this concentration decreases in the period analyzed by this research. In 2018, 61% of civil engineering courses that offered this discipline were in the Southeast and 28% in the South. In 2023, these percentages fall to 51% and 20% respectively.

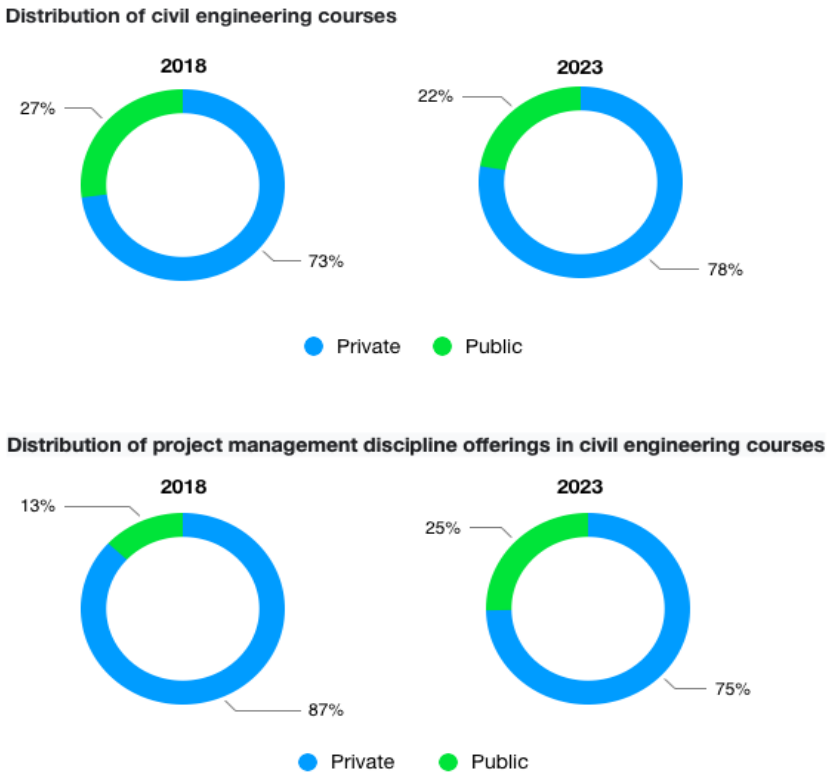
In addition to geographic distribution, another issue analyzed in this research was the distribution of the project management discipline offered in Brazilian civil engineering undergraduate courses between public and private higher education institutions. We sought to understand whether there was a significant concentration of this result in public or private institutions.

In 2018, when analyzing this aspect, concentration was found in private colleges. In other words, in a total of 46 courses that offered the subject in 2018, only 6 courses were offered by public educational institutions, that is, approximately 13%. However, this trend can only be observed when comparing the number of civil engineering courses offered by public institutions with the number by private institutions. In percentage terms, in 2018 approximately 27% of undergraduate courses in civil engineering were offered by public institutions. It is worth noting that 73% of undergraduate courses in civil engineering in Brazil in 2018 were offered by private higher education institutions. Furthermore, 87% of these courses that offered, in 2018, the project management discipline in their curricula were from private HEIs. Based on these data, it was observed that a

higher concentration of the offer of these subjects in civil engineering courses in the private sector in 2018.

In 2023, it was found that of the 281 courses that offered the discipline, only 71 were offered by public educational institutions, that is, approximately 25%. It is worth noting that of the total number of civil engineering courses in Brazil in 2023, only approximately 22% are offered by public HEIs. This year, the private sector, in turn, offered 78% of undergraduate courses in civil engineering in Brazil. Furthermore, 75% of the courses that offered, in 2023, the project management discipline in their curricula were from private HEIs. This data can be seen in figure 3:

Figure 3 - Distribution of civil engineering courses between public and private HEIs in Brazil, comparison between 2018 and 2023.



Source: the authors, with data extracted from Ministry of Education and Culture (MEC).

Based on the data shown in figure 3, it was possible to observe in 2018 that there was a greater concentration of civil engineering courses in the private sector. This scenario remained similar in 2023. If we observe the offer of the project management discipline in these courses, in 2018 it was more than proportionally concentrated in the private sector. However, in 2023, there will no longer be a concentration of this discipline's offering in the private sector. The offering of the subject is proportional to the availability of courses in the

public and private sectors. This means that although the general distribution of civil engineering courses between public and private HEIs remains similar between 2018 and 2023, the supply of the discipline is proportionally distributed.

Finally, an attempt was made to establish a correlation between the offering of the project management discipline in these courses and their respective performances in the CPC index. However, no statistical correlation was found between the offering of this subject and course performance. This lack of correlation must be attributed to the fact that the criteria that make up the CPC index consider factors such as performance on ENADE and the formation of the course's teaching staff. Market satisfaction with course graduates is not among the criteria that make up the CPC index.

On the other hand, to understand more about the causes and effects of the phenomena involved in this research, it was noted that there is a correlation between the offering of the discipline and the size of the civil engineering markets in the regions of Brazil. When comparing the results of this research shown in figure 1 with information from the CREA/CONFEA (Brazilian National Council of Engineering) civil engineering job market, it was observed that the larger the market, the greater the number of professionals and the greater the percentage offer of the project management discipline in the civil engineering courses in the region. This correlation was identified according to the data in figure 4.

Figure 4 - Project management discipline offer in civil engineering courses,

Region	Discipline Offer	Share	Course Places	Share	Professionals	Share
Midwest	22	8%	5.210	11%	46.937	9%
Northeast	45	16%	7.452	15%	86.564	17%
North	16	6%	3.157	7%	30.301	6%
Southeast	143	51%	25.171	52%	258.054	52%
South	55	20%	7.188	15%	75.694	15%
Total	281	100%	48.178	100%	497.550	100%

course places and professionals in the jobs market by regions.

Source: the authors, with data extracted from Ministry of Education and Culture (MEC) and Brazilian National Council of Engineering (CREA/CONFEA).

Although it is beyond the scope of this research, it is possible that the correlation presented in figure 4 can be explained by increased competitiveness in more economically developed regions which, in turn, have more mature markets. However, only with the data collected by this research it is not possible to make such a statement. To identify the causes of the correlation found, it would be interesting to develop future research.

5 Concluding Remarks

The results found in the literature review allow us to observe that the project management methodology remains widely applicable to civil construction works under different aspects such as: sustainability, improvement of added value performance, the most appropriate training of the project coordinator, the budgets elaboration process, in the integration of the teams involved in the project, in the management of multiple projects, in the construction of the necessary skills for managers in face of the technological evolution of the sector, in the identification and fulfillment of the requirements intended by consumers regarding the projects, in the elaboration of schedules and improvement of the time management, decision-making processes, among others.

Furthermore, the evolution of software in the sector, especially BIM, has intensified, in the last 5 years, the need for knowledge in project management in the civil engineer's daily life. Such knowledge has become indispensable. Furthermore, given all these changes, the increasing importance of project management for the civil construction sector is evident.

Quantitative research shows an increase of 46 percentage points in the offer of this discipline in civil engineering courses between 2018 and 2023. This allows us to conclude that if, on the one hand, the evolution of software has intensified the need for this specific knowledge, on the other hand, the courses have increased intensely offering such knowledge. In other words, it is possible to understand that this gap has been decreasing over time. This means that the courses adapt their curricula to the needs of the civil engineering job market.

Quantitative analysis also shows us that the relative concentration of the project management discipline offered by courses in the south and southeast is still a reality but has been discreetly decreasing. Likewise, the relative concentration of the project management discipline in civil engineering courses at private institutions decreased in analyzed period. In 2023, you can see that this relative concentration has disappeared. In other words, 22% of bachelor's degrees in civil engineering come from public HEIs and it is observed that 25% of civil engineering courses that offer the project management discipline come from public Institutions.

Finally, we can conclude that, during the period analyzed by this research, there was an increase in the need for knowledge in project management. But there was also an increase in the supply of this knowledge in the training of civil engineers in Brazil. In this way, the period from 2018 to 2023 the gap between the professional training of civil engineers and market demand in terms of project management decreased. Furthermore, the relative regional concentration of the supply of this knowledge decreased and the relative concentration in private HEIs ended.

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