

Article

Exploring the Influence of Construction Companies Characteristics on Their Response to the COVID-19 Pandemic in the Chilean Context

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Abstract: The COVID-19 pandemic was a significant disruption to the construction industry around the globe with multiple impacts, such as workforce limitations and contractual conflicts. Multiple studies have explored the impacts of the pandemic in the construction sector so far. However, little is known about how construction companies responded to the pandemic and what companies' characteristics may have influenced their responses. The objective of this study is to explore the impacts of COVID-19 and how construction companies responded to the pandemic. To do so, semi-structured interviews with experienced professional working in Chile are qualitatively analyzed to leverage their experience. Furthermore, characteristics of construction companies that influenced how companies responded to the pandemic, namely, size, experience, and financial standing, are explored. The results obtained suggest that the focus in responding to the pandemic was taking care of workers' safety, improving the planning of projects under highly uncertain conditions, and dealing with the financial stress of developing construction projects. When looking at the influence of companies' experience, size, and economic capacity, experienced and large companies' responses were related to implementing teleworking and dealing with a limited workforce. Regarding the economic capacity of construction companies, the focus was placed on responding to the pandemic using multiple sources of financing. Differences identified in how construction companies responded to the pandemic emphasizes the importance of understanding attributes that led companies to having better responses to the pandemic and being prepared for the post-pandemic context.

Keywords: COVID-19; Chilean construction; qualitative analysis; construction companies



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1. Introduction

The pandemic due to COVID-19 was a global disruption that affected our society and how we lived and interacted [1–3]. In fighting the spread of COVID-19, social distancing was implemented, as well as quarantines, to minimize interactions among people, thus disrupting many industries that rely on the physical presence of their workers, such as the construction industry [4]. The construction industry was affected mainly during the pandemic, facing limited worker availability, delays in construction projects, impacts on workers' productivity, financial stress for construction companies, and legal issues related to force majeure clauses [5–7].

In Chile, the context of this study, the pandemic began in March of 2020 with the first person affected by COVID-19. In response, the country implemented the “step-by-step”

program that restricted the mobility of people and limited economic activities, impacting multiple industries, especially in the construction sector [8]. The impacts of COVID-19 on the financial stability of construction companies were influenced by internal reasons (e.g., how companies are managed) and the economic environment during the pandemic [7,9]. For instance, the restricted access to materials, safety, and health mandates to be implemented in construction sites influenced workers' productivity [8]. Other issues were increasing prices of materials and transportation and supply chain problems [10]. Notably, the construction sector plays a significant role in the Chilean economy by representing approximately 6.5% of GDP and generating 8.5% of jobs in Chile [11]. In this context, the role of the construction industry in economic recovery is undoubtedly relevant, and as such, it is fundamental to understand how construction companies responded to the COVID-19 pandemic, namely their organization characteristics [12,13].

The effects of the COVID-19 pandemic in the construction sector have illustrated that it is fundamental for construction managers and companies to have contingency plans to mitigate the consequences of disruptive events such as the pandemic. In the literature, multiple researchers related to the construction industry focused on studying the impacts that the COVID-19 pandemic had on construction projects and companies, for instance, by exploring the construction sector's effects, challenges, and standard practices and proposing potential solutions for emerging problems [13,14]. Other researchers have analyzed multiple management practices in construction, such as workforce education, digitalization, safety, and workers' healthcare [15–18]. Similarly, existing studies have analyzed the impact of the economic response of small and medium-size construction companies [19,20]. Additionally, authors have focused on the consequences on construction projects, such as delays in the schedule, production rates, and workforce management [6,21–24].

In summary, literature related to the consequences of COVID-19 in the construction industry has focused on multiple dimensions, which generates a holistic understanding of the problem. However, it is crucial to study the impacts and practices implemented during the pandemic and how construction companies adapted and overcame them. In doing so, this study focused on exploring characteristics of construction companies that influence how companies responded to the COVID-19 pandemic, such as size, experience, and financial standing.

2. Literature Review

2.1. Construction Industry Response to COVID-19

The COVID-19 pandemic generated severe impacts among multiple sectors, the construction sector being one of the most affected [25,26]. The construction sector faced unprecedented challenges that required adjustments and adaptations in various areas, such as the financial impact placed on construction companies due to additional spending of companies to adapt to new safety and health protocols, delays in payments, and reduced income levels [8,27]. In this context, construction managers have implemented a wide range of strategies to maintain the operations of construction projects to ensure the financial feasibility of construction companies [28–30]. Such strategies have led to the elaboration of plans focused on adjusting construction processes and reducing the exposure to risks of construction workers [14]. As such, construction companies have had to adopt new technologies to improve their decision-making processes and the remote inspection and monitoring of construction sites [31–33]. Implementing these strategies has led to the need for training construction workers, more detailed planning, more flexibility with workers, and new safety protocols [34].

The COVID-19 pandemic challenged the construction industry's supply chain, with significant delays and materials shortages that disrupted construction projects [35,36]. This situation was critical as construction projects require a large variety and quantity of materials [37]. To mitigate this challenge, multiple alternatives were explored, for instance, exploring alternative materials, diversifying the supply chain, and adopting digital tools to manage construction projects [38,39]. A strategy that has sparked a significant interest is

integrating recycled materials from construction waste and demolition [40]. However, to implement this type of strategy, more dissemination is required about their implementation. Of note, the pandemic has presented an opportunity to move forward regarding implementing more sustainable practices in the industry [41]. Challenges due to the pandemic have incentivized the collaboration of the construction industry, government, and communities in seeking alternatives that promote innovation and sustainability in construction organizations and projects.

In response to the COVID-19 pandemic, the construction industry implemented significant changes in multiple areas of projects, such as communication, costs and finance of projects, safety, interactions with suppliers and subcontractors, workforce management, and implementing new technologies [42]. Although these changes have brought benefits such as better planning and workforce efficiency, their implementation in the long term may represent a challenge for construction stakeholders. Factors influencing this challenge include significant capital investments, the extension of project duration, and the need for new knowledge and skills among workers [14,43]. Additionally, construction companies typically experience resistance to changes within their organizations, especially when adapting new technologies and work methods [44].

The construction industry has faced a rapid and sudden challenge to adapt due to the COVID-19 pandemic context. Despite these challenges, multiple construction companies were capable of modifying their processes to respond and adapt to the pandemic context and, as such, improving their ability to adapt. This response and adaptation to the pandemic context were vital to ensuring the survival and continuity of the industry. Therefore, it is fundamental to study the characteristics of construction companies that responded and adapted to the pandemic context and, as such, provide a valuable guide for the construction industry on moving forward in a post-pandemic context.

2.2. Characteristics of Construction Companies

Construction projects are inherently diverse, allowing multiple companies to work on different types of projects and stages during the lifecycle of a project. As such, a wide range of company sizes exists in the construction industry [45]. Smaller construction companies tend to focus on specific tasks or projects [46], while larger companies can manage multiple projects simultaneously or large projects such as bridges, highways, and skyscrapers. As such, the classification of construction companies can be based on various parameters, such as the number of workers, the size of the business, the type of projects, or the skills required. Additional factors discussed in the literature include the workforce, political exposure, and the project's variety of land [47]. Other elements that can contribute to characterizing construction companies may consist of the management approach used by the company, net value, workforce rotation, level of skills development among workers, and profitability of the company, among others [47–49]. This large set of characteristics to classify construction companies reinforces the complexity and dynamic aspect of the construction industry.

Interestingly, construction companies' characteristics influenced the impact suffered due to the COVID-19 pandemic context. Recent literature indicates that small and medium-size construction companies typically have limited resources—i.e., money and workers—these companies have experienced significant disruption due to the pandemic. The decreasing demand for construction projects reduced profits for small and medium companies, generating challenging financial conditions [27,50]. Financial difficulties sometimes cause delays and the halting of construction projects. This context has been influenced by multiple factors, such as the financial assistance provided by governments, the pre-pandemic financial status of companies, relationships with suppliers, the number of employees, and perceptions toward the potential impacts of the pandemic [9]. For instance, the supply chain interruption generated a significant challenge for construction companies, exacerbated by concerns over future financial obligations. Furthermore, international transportation interruptions complicated the efficient procurement of equipment

and materials [35]. Challenges in having access to construction materials have primarily impacted small and medium-sized construction companies, as suppliers tend to prioritize large companies due to the large orders placed by such companies. This context resulted in challenges to achieving schedules and budgets for construction projects due to the increases in the price of materials [36]. Conversely, large companies were affected by social distancing policies to prevent the spreading of COVID-19 among workers, which slowed down large projects and reduced the number of workers on the field [27]. Ultimately, it is emphasized that to manage future disruptions faced by the construction industry, it is fundamental to learn from the response of construction companies during the COVID-19 pandemic, accounting characteristics such as company experience, company size, and financial solvency. Therefore, research is required to understand better how construction companies responded to the pandemic, accounting for their characteristics.

2.3. Chilean Construction Industry and COVID-19

Before the pandemic in Chile, the macroeconomic context of financial conditions was favorable for construction sector activity. There was an increase in labor hiring, growth in construction materials sales, and dynamism in the areas approved for non-housing construction. In addition, Chile had an expansive monetary policy in 2019 [51]. In the MACH report (Macroeconomics and Construction of Chile) of May 2019, the result of the Monthly Construction Activity Index (IMACON) registered a variation of 1.3% during the first quarter of the year, a moderate growth compared to the evolution of 2018, while a construction unemployment rate of 8.3% at the end of 2019 and a construction investment of 3.3% of annual variation were forecast [51].

The arrival of the COVID-19 pandemic in Chile in March 2020 translated into a series of restrictions and government policies to deal with the pandemic that disrupted the construction sector [7,52,53]. Given this context, the Chilean Chamber of Construction proposed a safety and health protocol for construction projects to allow the continuity of projects. Then, even when most of the country was in a lockdown to prevent the spread of COVID-19, construction projects, namely infrastructure, were classified as fundamental for the country and were allowed to keep functioning. Despite these efforts, the construction sector experienced a decrease in its operations, leading to lower levels of construction projects and employment and a lower contribution to the country's GDP [11]. The pandemic also led to shortages and delays in the supply of materials, which increased the prices of such materials and construction projects [11]. Generally, the construction industry contributes around 6.6% of GDP annually. In 2020, this percentage was only 5.7%. This was due to the stoppage of projects in execution for almost six months due to the pandemic. The Monthly Construction Activity Index (IMACON) had, in July 2020, the most significant annual percentage drop in its history, with a decrease of 16.5%. However, the yearly variation as of May 2021 was 16.2% [11]. In addition, the Monthly Construction Activity Index (IMACON) rebounded in the last part of 2021. Still, it fell again in 2022 with the uncertainty generated in the sector and the increase in interest rates, reaching a value of −10.4% [54]. Other essential data highlights the investment in construction, where in 2020 and 2021, this annual variation was −8.8% and 11.2%, respectively [55]. However, due to the continuation of sanitary competition, it dropped drastically to 2.5% per year by 2022 [56]. Unfortunately, since January 2020, the INE (National Institute of Statistics) no longer considers the question that until 2019 allowed identifying unemployment by economic sector. Thus, there is no information on construction unemployment and, therefore, on the sector's unemployment rate. Therefore, the information for January and February is an estimate made with partial information from the INE, which projected a 9.6% unemployment rate in the construction sector for February [57]. The Chilean government implemented multiple public policies to minimize the impacts of the pandemic in the country. Among the relevant procedures for the construction sector, there was the provision of an emergency income for families affected by the pandemic. A temporal law was approved to protect employment during the pandemic and public funding for small and medium companies (i.e., funding of guarantee

for small companies (FOGAPE)) to maintain the country's economy. In this context, the construction sector experienced increases in the salary of construction workers to attract more workers to construction projects to show the industry's flexibility and resiliency [54]. The construction industry has faced a significant challenge during the COVID-19 pandemic. Although some mitigation strategies were implemented to alleviate the challenge, the complete recovery may still need to be completed. This context emphasizes the need for studies to understand better the impact of the pandemic on the construction sector and how its companies responded.

Unfortunately, after the end of the COVID-19 health emergency in Chile, the recovery of post-pandemic sectoral investment lost strength due to various phenomena, such as the increase in the price of construction inputs, the rise in inflation, and higher interest rates, in addition to the political-regulatory uncertainties that are still present. The balance of the year 2023 showed a negative annual variation in construction investment of 4% concerning the previous year [56].

The Monthly Construction Activity Index (IMACON) also showed a downward trend. In April 2023, the IMACON had an annual variation of -7.9% ; in December; it ended the year with a slight variation of -6.7% . The IMACON indicators with the most significant declines were retail sales of materials (22%) and non-housing building permits (-28.3%) [58]. For 2024, better economic conditions are expected, mainly due to lower inflation and interest rates and significant public investment. However, they cannot prevent construction from experiencing a second consecutive year with negative investment figures of approximately -0.4% [57].

3. Methods

3.1. Sampling and Data Collection

This study aimed to incorporate multiple viewpoints on how construction companies responded to the COVID-19 pandemic. As such, semi-structured interviews were selected as a data collection method due to their flexibility and interaction with interviewees, which facilitates the exploration of construction companies' characteristics and government strategies in responding to the pandemic. The interview design was supported by organizational characteristics found in the literature review and information about strategies implemented by construction companies during the pandemic. Then, the interview was reviewed by three experts related to construction engineering and management to validate the questions included. The questions were open-ended and were aimed at identifying how construction companies responded to the pandemic and characteristics that were relevant while responding to the pandemic. Furthermore, questions incentivized the discussion about the interviewees' experience during the pandemic. All questions used during the interviews are shown in Appendix A. Examples of questions formulated during the interviews are the following:

- How has the financial situation of the construction company in which you are working changed since the pandemic began?
- Concerning the strategies implemented by the government—e.g., social distancing—how have these affected the productivity of projects? How were these effects mitigated?
- Regarding subcontractors, have you noticed changes in your interactions with them due to restrictions due to the pandemic?

Experienced professionals interviewed in this study occupy a wide range of positions in construction, such as project engineer, project manager, and contract manager, and worked at private and public companies. Of note, this study focused on professionals at the engineering and management level as they are in jobs that involve decision-making processes related to the companies in which they were working. In so doing, their opinions were more likely to capture how construction companies responded to the pandemic. Based on availability, experienced professionals were contacted by email and phone; interviews were performed online or in person between September and November 2022.

Interviews ranged from 30 to 45 min, and all interviews were recorded with the approval of the interviewees.

Experienced professionals were selected based on their experience in construction using a minimum of 4 years and having worked since the beginning of the pandemic to the interview date. In so doing, they have experience in the response of construction companies to the pandemic in its entirety. In total, 19 interviews were collected for this study; interviewees had an average experience of 18 years, which emphasizes the value of the responses collected in our study. The size of the sample is within the range of existing literature using qualitatively analyzed interviews in the field of construction engineering and management (e.g., $n = 5$, Wang et al. [12]; $n = 6$, Quilia [59]; $n = 18$, Carlander and Thollander [60]; $n = 25$, Halder et al. [61]). Important to note, the referenced literature used interviews to collect experts' opinions and explore and understand a topic. Results obtained from interviews are exploratory in nature and do not aim to be generalized. The sampling process was developed until the saturation point was achieved [62–64]. The concept of saturation refers to the point at which no new information emerges from new interviews [64]. Of note, existing literature suggests the saturation point might be typically reached approximately with 12 interviews [65]. Therefore, the sample size used in this study is supported by theory and comparable literature. Table 1 shows the interviewees' characteristics.

Table 1. Interviewees' characteristics.

Id	Position	Profession	Years of Experience	Organization Category
1	Facility Manager	Civil Engineer	19	Public Organization
2	Project Manager	Construction Engineer	4	Building Construction
3	Senior Project Engineer	Construction Engineer	19	Real Estate
4	Facility Manager	Civil Engineer	35	Faculty
5	Project Manager	Construction Engineer	17	Building Construction
6	Project Manager	Construction Engineer	21	House Building
7	Senior Project Engineer	Construction Engineer	30	Industrial Assembly
8	Supply Chain Manager	Construction Engineer	12	Building Construction
9	Project Manager	Construction Engineer	12	Building Construction
10	Project Manager	Construction Engineer	28	Building Construction
11	Project Manager	Construction Engineer	21	Technical Inspection
12	Project Manager	Construction Engineer	24	Building Construction
13	Field Engineer	Construction Engineer	12	Building Construction
14	Project Manager	Civil Engineer	14	Building Construction
15	General Manager	Construction Engineer	7	Building Construction
16	Contract Manager	Civil Engineer	11	Design
17	Owner Representative	Architect	24	Technical Inspection
18	Construction Manager	Construction Engineer	21	Building Construction
19	Bidding Manager	Civil Engineer	20	Industrial Assembly

3.2. Qualitative Analysis

Qualitative methods provide a high level of flexibility in understanding emerging phenomena and problems. As such, multiple researchers have used these methods to explore and understand the impacts of the COVID-19 pandemic on the construction sector (e.g., [8,13,29]). Construction professionals faced and managed most of the effects and consequences of the pandemic on construction companies and projects. To leverage those experiences into scientific knowledge, in this study, information from construction professionals was collected through semi-structured interviews that were qualitatively analyzed. Important to note, the purpose of using a qualitative analysis is to explore and understand how construction companies responded to the pandemic. The focus is on the quality of the information analyzed rather than the quantity; that is why so much work is put into looking for interviewees with experience that can provide valuable and informed opinions about the subject under study. As such, results obtained in this study provide a baseline of

how companies responded to the pandemic in the Chilean context, yet our results are not generalizable to the entirety of the Chilean construction industry.

The qualitative analysis involves transcribing, reviewing, and coding emerging topics identified from the interviews. Once the interviews are transcribed, the coding process involves researchers reading and examining the interviews in detail to determine the main ideas and topics emerging from the interviews, following an inductive approach [64]. The main ideas and topics from the interviews are highlighted as excerpts to be classified into categories and corresponding subcategories. The coding process of excerpts into categories and subcategories followed an iterative approach that led to the development of a coding dictionary (see Table 2). Fifty-four subcategories were identified and classified into ten categories, of which eight were related to the response of the companies, and two categories were related to recommendations. Due to space limitations, Table 2 shows only the categories and corresponding subcategories. A more complete and detailed coding dictionary can be seen in the table in Appendix B of this document.

Table 2. Categories and subcategories of construction companies' responses to the COVID-19 pandemic.

Id	Categories	Id	Subcategories
C ₁	Companies' initiatives	R ₁	Teleworking
		R ₂	Communication with owner
C ₂	Initiatives for workers	R ₃	Use of alcohol gel
		R ₄	Emotional support to workers
		R ₅	Active listening
		R ₆	Proper use of mask
		R ₇	Use of multiple working shifts
		R ₈	Shifts to use bathrooms at work
		R ₉	Coordination for lunch breaks
		R ₁₀	Temperature control
		R ₁₁	Washing hands
		R ₁₂	Signatura at the entrance and exit of the work
		R ₁₃	PCR test
		R ₁₄	Vaccination plan
C ₃	Companies' adaptation capabilities	R ₁₅	Traceability of workers
		R ₁₆	Private transportation
		R ₁₇	Social distancing
C ₄	Project management	R ₁₈	Crowd control
		R ₁₉	COVID testing (i.e., antigen)
		R ₂₀	Experience
		R ₂₁	Company size
C ₅	Financing	R ₂₂	Economic support
		R ₂₃	Payment statements
		R ₂₄	Budget increases
		R ₂₅	Projects' duration delayed
C ₆	Social assistance	R ₂₆	Construction projects demand
		R ₂₇	Own capital
		R ₂₈	Loan from bank
		R ₂₉	House loan
C ₇	Subcontractors	R ₃₀	Early payments
		R ₃₁	Banking restrictions
		R ₃₂	Public resources
		R ₃₃	Law to protect jobs during COVID-19
C ₈	Recommendations	R ₃₄	Emergency family income (IFE in Spanish)
		R ₃₅	Funding to support small companies (FOGAPE in Spanish)
		R ₃₆	Unqualified workforce
C ₉	Recommendations	R ₃₇	Limited workforce
		R ₃₈	Salary increases

Table 2. Cont.

Id	Categories	Id	Subcategories
C ₈	Suppliers	R ₃₉	Materials prices increase
		R ₄₀	Transportation costs increase
		R ₄₁	Limited stock
		R ₄₂	Overstock
		R ₄₃	Delays in delivery
		R ₄₄	Buying materials in advance of projects
REC ₁	Recommendations to companies	R ₄₅	Respect sanitary protocols
		R ₄₆	Buying materials in advance of projects
		R ₄₇	Planning based on objectives
		R ₄₈	Apply teleworking
		R ₄₉	Manage to take PCR and antigen tests
		R ₅₀	Permanent communication with the owner
REC ₂	Recommendations to workers	R ₅₁	Respect and commitment to sanitary restrictions
		R ₅₂	Emotional support and active listening
		R ₅₃	Promote self-caring
		R ₅₄	Incentivize vaccination

Excerpts are then counted to generate the frequencies for each category and subcategory. Of note, two types of frequencies are developed: the number of times an excerpt was mentioned during an interview (i.e., repetitions) and the number of interviewees that mentioned an excerpt (i.e., respondents). The aim of reporting these frequencies is to illustrate not only the level of awareness for topics and ideas by interviewees but also how many interviewees mentioned such topics and ideas. This study aims to explore and understand the characteristics of construction companies that influenced their responses to the COVID-19 pandemic. It also seeks to compare how the categories and subcategories' frequencies varied for three construction companies' characteristics: company size, experience, and financial standing. These characteristics were chosen for the following reasons. First, previously discussed literature about COVID-19 and construction recognized the influence that these characteristics had on how construction companies were able to manage their response to the pandemic. Furthermore, these characteristics are available for the large majority of construction companies. As such, they may facilitate the comparison and transferability of our results with studies from other geographical regions. Ultimately, interviewees discussed them in the subcategories influencing how construction companies adapted during the pandemic (see C3 in Table 2). Of note, this comparison was not performed for recommendations identified during the qualitative analysis, as the study focuses on analyzing the influence of such characteristics during the response to the pandemic.

The proposed characteristics are applied using the following criteria. The company size was defined using Chilean law to classify the size of companies (see Table 3), which depends on the volume of companies' sales. Micro, small, and medium-size companies are those with sales under 100,000 UF, and large companies are those with over 100,000 UF (see Table 3). UF is a Chilean economic unit used to capture inflation. This classification captures the difference between large and small/medium companies. The economic capacity was defined based on the response from interviewees related to the company having the economic capacity to respond to the pandemic (see Appendix A). Ultimately, based on experience, companies are classified as having less than ten years of experience and ten or more years of experience. This is expected to capture companies that have faced challenges and have adapted before the occurrence of the pandemic and those for whom the pandemic might be their first big disruptive event to be managed.

Table 3. Chilean stratification of companies. Source: Ministerio de Economía de Chile [66].

Company Size	Classification According to Sales	Classification According to the Number of Employees
Micro	0–2400 UF	0–9
Small	2400.01 UF–25,000 UF	10–25
Medium	25,000.01 UF–100,000 UF	25–200
Large	100,000.01 UF or more	200 or more

3.3. Research Limitations

As with any study, this is subject to limitations that must be recognized and discussed. The first limitation might be related to the data collection process used, which was convenience sampling. This method was selected to aim for interviews with experienced professionals who worked during the pandemic context at engineering and management levels so as to qualitatively analyze responses from professionals with experience and exposure to the pandemic context under study. In doing so, one limitation is that our study was focused on professionals involved in decision-making processes in construction companies and, as such, did not include interviewees from other positions, such as onsite workers. This profile of interviewees was chosen as professionals at the engineering and management levels were closer to decisions made by construction companies during the pandemic.

Another limitation of this study is related to the relatively small sample size. The sample collected in this study heavily represents large construction companies with the participants being in management positions and in building construction (see Table 1). These limitations mean our findings may not be applicable to small construction companies and in infrastructure or industrial projects. Of note, the study reached theoretical saturation (i.e., saturation point) among the interviewees, and as such, suggests that contributions can be made to knowledge of construction engineering and management with what can be considered a small sample size. What is more, existing studies with qualitative methodologies and comparable sample sizes have made contributions to construction engineering and management as well (e.g., [8,12,60,61]). In doing so, they reinforce the notion of qualitative analyses in which the primary focus is the quality of the information analyzed versus pure quantity and the exploratory nature of qualitative studies where the main purpose is to understand better a problem instead of purely quantifying some variables of a problem.

Another limitation relates to the country in which this study is developed (i.e., Chile), so our results might not be directly transferable to other countries. Nonetheless, these results shed light on the impact of the pandemic in one country of the Latin American region, where limited studies exist about the consequences of the pandemic in the construction sector. Even though it covers only one country, the study still moves forward the limited understanding of how construction companies of this region of the globe responded to the pandemic.

Ultimately, we emphasize that our study aims to provide further understanding of how construction companies responded to the pandemic by looking at some of their characteristics that were identified from the same interviewees. However, our findings are not generalizable to the Chilean construction industry.

4. Results

Table 4 shows the frequencies in which each subcategory was mentioned ($n = 679$) and the number of interviewees that mentioned said subcategories ($n = 19$). Ten categories were obtained from the qualitative content analysis, eight categories referred to how companies responded to the pandemic, and two categories referred to recommendations for workers and companies about how to respond to the pandemic. Additionally, Table 5 shows the frequencies of categories and subcategories of how companies responded to the pandemic, accounting for the influence of experience, company size, and economic capacity of companies.

Table 4. Frequency of categories and subcategories from the qualitative analysis.

Id	Categories	Id	Subcategories	Repetitions		Respondents	
				Frequency	%	Frequency	%
C ₁	Companies' initiatives (8.1%)	R ₁	Teleworking	44	6.5%	19	100.0%
		R ₂	Communication with owner	11	1.6%	8	42.1%
C ₂	Initiatives for workers (29.9%)	R ₃	Use of alcohol gel	8	1.2%	7	36.8%
		R ₄	Emotional support to workers	9	1.3%	7	36.8%
		R ₅	Active listening	5	0.7%	4	21.1%
		R ₆	Proper use of mask	21	3.1%	10	52.6%
		R ₇	Use of multiple working shifts	20	2.9%	11	57.9%
		R ₈	Shifts to use bathrooms at work	6	0.9%	6	31.6%
		R ₉	Coordination for lunch breaks	19	2.8%	13	68.4%
		R ₁₀	Temperature control	18	2.7%	11	57.9%
		R ₁₁	Washing hands	6	0.9%	6	31.6%
		R ₁₂	Signature at the entrance and exit of the work	2	0.3%	2	10.5%
		R ₁₃	PCR test	25	3.7%	15	78.9%
		R ₁₄	Vaccination plan	21	3.1%	9	47.4%
		R ₁₅	Traceability of workers	3	0.4%	3	15.8%
		R ₁₆	Private transportation	10	1.5%	8	42.1%
		R ₁₇	Social distancing	11	1.6%	9	47.4%
		R ₁₈	Crowd control	16	2.4%	10	52.6%
		R ₁₉	COVID testing (i.e., antigen)	3	0.4%	3	15.8%
C ₃	Companies' adaptation capabilities (3.7%)	R ₂₀	Experience	15	2.2%	13	68.4%
		R ₂₁	Company size	6	0.9%	6	31.6%
		R ₂₂	Economic support	4	0.6%	4	21.1%
C ₄	Project management (13.8%)	R ₂₃	Payment statements	23	3.4%	19	100.0%
		R ₂₄	Budget increases	30	4.4%	15	78.9%
		R ₂₅	Projects duration delayed	22	3.2%	14	73.7%
		R ₂₆	Construction projects demand	19	2.8%	18	94.7%
C ₅	Financing (7.2%)	R ₂₇	Own capital	12	1.8%	10	52.6%
		R ₂₈	Loan from bank	16	2.4%	14	73.7%
		R ₂₉	House loan	4	0.6%	2	10.5%
		R ₃₀	Early payments	7	1.0%	7	36.8%
		R ₃₁	Banking restrictions	9	1.3%	8	42.1%
		R ₃₂	Public resources	1	0.1%	1	5.3%
C ₆	Social assistance (6.5%)	R ₃₃	Law to protect jobs during COVID-19	15	2.2%	9	47.4%
		R ₃₄	Emergency family income (IFE in Spanish)	27	4.0%	18	94.7%
		R ₃₅	Funding to support small companies (FOGAPE in Spanish)	2	0.3%	2	10.5%
C ₇	Subcontractors (8.1%)	R ₃₆	Unqualified workforce	17	2.5%	11	57.9%
		R ₃₇	Limited workforce	35	5.2%	14	73.7%
		R ₃₈	Salary increases	23	3.4%	12	63.2%
C ₈	Suppliers (12.4%)	R ₃₉	Materials prices increase	36	5.3%	12	63.2%
		R ₄₀	Transportation costs increase	10	1.5%	7	36.8%
		R ₄₁	Limited stock	13	1.9%	8	42.1%
		R ₄₂	Overstock	12	1.8%	9	47.4%
		R ₄₃	Delays in delivery	7	1.0%	6	31.6%
		R ₄₄	Buying materials in advance of projects	6	0.9%	4	21.1%

Table 4. Cont.

Id	Categories	Id	Subcategories	Repetitions		Respondents	
				Frequency	%	Frequency	%
REC ₁	Recommendations to companies (5.2%)	R ₄₅	Respect sanitary protocols	13	1.9%	13	68.4%
		R ₄₆	Buying materials in advance of projects	2	0.3%	2	10.5%
		R ₄₇	Planning based on objectives	3	0.4%	2	10.5%
		R ₄₈	Apply teleworking	6	0.9%	5	26.3%
		R ₄₉	Manage to take PCR and antigen tests	8	1.2%	8	42.1%
		R ₅₀	Permanent communication with the owner	3	0.4%	3	15.8%
REC ₂	Recommendations to workers (2.2%)	R ₅₁	Respect and commitment to sanitary restrictions	4	0.6%	4	21.1%
		R ₅₂	Emotional support and active listening	5	0.7%	5	26.3%
		R ₅₃	Promote self-caring	2	0.3%	2	10.5%
		R ₅₄	Incentivize vaccination	4	0.6%	3	15.8%
Total				679		19	

Table 5. Frequency of responses from the Chilean construction industry to COVID-19.

Id	Categories	Id	Subcategories	Experience (Years)				Company Size (UF)				Economic Capacity (Yes/No)			
				Repetitions *		Respondents **		Repetitions *		Respondents **		Repetitions *		Respondents **	
				≤10	>10	≤10	>10	≤100,000	>100,000	≤100,000	>100,000	Yes	No	Yes	No
C ₁	Companies' initiatives	R ₁	Teleworking	3	41	2	17	15	29	6	13	9	35	4	15
		R ₂	Communication with owner	2	9	1	7	5	6	4	4	1	10	1	7
			Total	5	50	2	17	20	35	6	13	10	45	4	15
C ₂	Initiatives for workers	R ₃	Use of alcohol gel	0	8	0	7	3	5	3	4	0	8	0	7
		R ₄	Emotional support to workers	2	7	1	6	1	8	1	6	3	6	3	4
		R ₅	Active listening	0	5	0	4	1	4	1	3	1	4	1	3
		R ₆	Proper use of mask	1	20	1	9	3	18	2	8	3	18	2	8
		R ₇	Use of multiple working shifts	4	16	1	10	5	15	3	8	1	19	1	10
		R ₈	Shifts to use bathrooms at work	0	6	0	6	2	4	2	4	2	4	2	4
		R ₉	Coordination for lunch breaks	3	16	1	12	5	14	5	8	2	17	2	11
		R ₁₀	Temperature control	2	16	1	10	5	13	3	8	1	17	1	10
		R ₁₁	Washing hands	1	5	1	5	1	5	1	5	1	5	1	5
		R ₁₂	Signature at the entrance and exit of the work	0	2	0	2	1	1	1	1	0	2	0	2
		R ₁₃	PCR test	1	24	1	14	9	16	5	10	5	20	3	12
		R ₁₄	Vaccination plan	4	17	1	8	2	19	1	8	6	15	2	7
		R ₁₅	Traceability of workers	0	3	0	3	1	2	1	2	0	3	0	3
		R ₁₆	Private transportation	0	10	0	8	1	9	1	7	1	9	1	7
		R ₁₇	Social distancing	0	11	0	9	1	10	1	8	2	9	2	7
		R ₁₈	Crowd control	0	16	0	10	5	11	3	7	3	13	2	8
		R ₁₉	COVID testing (i.e., antigen)	0	3	0	3	1	2	1	2	0	3	0	3
			Total	18	185	1	16	47	156	5	12	31	172	4	13
C ₃	Companies' adaptation	R ₂₀	Experience	1	14	1	12	5	10	5	8	2	13	2	11
		R ₂₁	Company size	0	6	0	6	3	3	3	3	0	6	0	6
		R ₂₂	Economic support	0	4	0	4	1	3	1	3	4	0	4	0
			Total	1	24	1	17	9	16	6	13	6	19	4	15
C ₄	Project manajement	R ₂₃	Payment statements	2	21	2	17	6	17	6	13	6	17	4	15
		R ₂₄	Budget increases	1	29	1	14	9	21	5	10	5	25	4	11
		R ₂₅	Projects' duration delayed	3	19	2	12	7	15	3	11	5	17	4	10
		R ₂₆	Construction projects demand	2	17	2	16	7	12	6	12	3	16	3	15
			Total	8	86	2	17	29	65	6	13	19	75	4	15

Table 5. Cont.

Id	Categories	Id	Subcategories	Experience (Years)				Company Size (UF)				Economic Capacity (Yes/No)			
				Repetitions *		Respondents **		Repetitions *		Respondents **		Repetitions *		Respondents **	
				≤10	>10	≤10	>10	≤100,000	>100,000	≤100,000	>100,000	Yes	No	Yes	No
C ₅	Financing	R ₂₇	Own capital	0	12	0	10	1	11	1	9	2	10	2	8
		R ₂₈	Loan from bank	1	15	1	13	4	12	3	11	3	13	3	11
		R ₂₉	House loan	0	4	0	2	3	1	1	1	3	1	1	1
		R ₃₀	Early payments	1	6	1	6	4	3	4	3	2	5	1	6
		R ₃₁	Banking restrictions	0	9	0	8	2	7	2	6	2	7	2	6
		R ₃₂	Public resources	0	1	0	1	0	1	0	1	1	0	1	0
			Total	2	47	2	17	14	35	6	13	13	36	4	15
C ₆	Social assistance	R ₃₃	Law to protect jobs during COVID-19	4	11	1	8	2	13	1	8	3	12	2	7
		R ₃₄	Emergency family income (IFE in Spanish)	3	24	2	16	9	18	6	12	6	21	4	14
		R ₃₅	Funding to support small companies (FOGAPE in Spanish)	0	2	0	2	0	2	0	2	0	2	0	2
			Total	7	37	2	16	11	33	6	12	9	35	4	14
C ₇	Subcontractors	R ₃₆	Unqualified workforce	1	16	1	10	7	10	4	7	2	15	1	10
		R ₃₇	Limited workforce	1	34	1	13	7	28	4	10	16	19	4	10
		R ₃₈	Salary increases	0	23	0	12	2	21	1	11	4	19	3	9
			Total	2	73	1	16	16	59	4	13	22	53	4	13
C ₈	Suppliers	R ₃₉	Materials prices increase	0	36	0	12	9	27	3	9	5	31	3	9
		R ₄₀	Transportation costs increase	0	10	0	7	2	8	2	5	4	6	2	5
		R ₄₁	Limited stock	0	13	0	8	2	11	1	7	5	8	2	6
		R ₄₂	Overstock	1	11	1	8	5	7	2	7	3	9	3	6
		R ₄₃	Delays in delivery	0	7	0	6	2	5	1	5	1	6	1	5
		R ₄₄	Buying materials in advance of projects	0	6	0	4	2	4	1	3	2	4	1	3
			Total	1	83	1	16	22	62	4	13	20	64	4	13

* $n = 585$; ** $n = 19$.

5. Discussion

5.1. Construction Companies' Responses to COVID-19

Among the eight categories that focused on how construction companies responded to the pandemic, initiatives for workers (i.e., C2 in Table 4) had the highest frequency, with roughly 30% of responses (see Table 4). This result may be explained due to the extensive list of subcategories included in such a category (i.e., R3 to R19). The most frequent subcategories referred to the PCR test, the vaccination plan for workers, and the proper use of masks. These subcategories are highly related to the sanitary strategies proposed by the Chilean Chamber of Construction (CChC), joined with the Ministry of Health for construction companies, which were shown to be effective in minimizing the spread of COVID-19 and the responses to the virus due to massive vaccination campaigns. Regarding the PCR test and properly wearing masks, these activities were commonly applied as recommended practices in response to the pandemic, for instance, being recommended by the Association of General Contractors (AGC) and the Occupational Safety and Health Administration (OSHA) in the United States [13,14]. Notably, most existing studies were developed in the early stages of the pandemic before massive vaccination was implemented globally. As such, limited studies exist discussing vaccination as a response to the pandemic in the construction sector. Conversely, in Chile, as soon as the COVID-19 vaccine was available, the government and the construction industry highly incentivized construction workers to get vaccinated to be protected against the virus. For instance, one interviewee reported, "For us as a construction company, it was fundamental that our workers were vaccinated to be protected against the virus. Furthermore, for hiring purposes, all workers were required to be vaccinated".

The category with the second highest frequency was project management (i.e., C4 in Table 4), with 13.8% of excerpts. This category is related to the challenges and consequences of managing construction projects due to restrictions during the pandemic. Subcategories in this category referred to payment statements, which were discussed by 100% of interviewees (see Table 4). Of note, interviewees reported satisfaction with how payments were handled during the pandemic. This finding opposes existing literature discussing delays in processing payments to construction companies [8]; this difference may be due to the timing of the study. This study was developed during the final stage of the pandemic. In contrast, the study of Araya and Sierra [8] was done in 2021, in the middle of the pandemic context, when financial struggles were more frequent among owners and construction companies. Regarding the subcategory of construction projects' demand (i.e., R26 in Table 4), a large portion of interviewees discussed that construction companies aim to keep construction projects running despite the pandemic context limiting workers' transportation and workers allowed on the field. The main reason for this result may be related to construction companies trying to maintain their expectations about developing projects despite increasing materials and workforce costs. Along the same lines, the subcategory associated with a budget increase (i.e., R24 in Table 4) showed a high frequency. This result was expected as increased costs of materials and workforce were faced during the pandemic, thus increasing the budgets of construction projects. This result aligns with existing literature where increased costs of construction projects were among the challenges to successfully managing construction projects during the pandemic [8,9,35,36].

Regarding the recommendations (i.e., REC1 and REC2 in Table 4), it can be seen that the most frequent recommendations were related to respecting the sanitary protocols and managing to take PCR and antigen tests for construction workers (see Table 4), which are aligned with how construction companies responded to the pandemic. These results suggest that the response from construction companies in Chile may have been correct in terms of providing a safe working environment to construction workers.

Based on these findings and follow-up discussions with some of the interviewees, two recommendations that are highlighted as improvements due to the pandemic experience are working to do a better planning process and understanding the safety of workers beyond purely physical aspects. The pandemic emphasized the key role that an adequate planning process may have in construction projects facing highly uncertain environments. This is an aspect that has been improved by some of the construction companies that survived the pandemic and that continue doing in the current post-pandemic context. The second aspect that has been improved by the pandemic is that construction companies are understanding the safety of construction workers as something more complex than only the physical dimension of safety and expanding it to include personal or emotional aspects of workers in construction. For instance, it was discussed as a recommendation that emotional support to workers must be provided by construction companies as the pandemic was a stressful period for construction workers. The fear of becoming infected and spreading the disease to their families or losing their jobs during the pandemic was a very difficult situation faced by construction workers.

Although the results of this study are based on the Chilean construction context, the pandemic was a phenomenon that impacted all countries with their corresponding construction sectors. In this context, the authors of this study believe that some of the findings of this study still might be transferable to other countries; for instance, countries with a similar cultural context (i.e., Latin American countries) or also countries classified as developing nations. For example, construction companies located either in Latin American or developing nations may benefit from adapting some of the recommendations made in this study, for instance, recognizing the importance of planning construction projects in highly uncertain environments or providing emotional support to improve construction workers' safety. Of note, the recommendations may stand, but how these recommendations are implemented may differ among different countries.

5.2. Responses Based on Companies' Experience

By looking at the influence of construction companies' experience in how companies responded to the pandemic, this study aims to understand whether said experience contributed to companies being more prepared to face the pandemic. Table 5 shows the frequencies for the eight categories related to how construction companies responded to the pandemic according to the company's experience. Of note, most respondents indicated that teleworking was implemented in their construction companies due to construction projects being halted at the beginning of the pandemic (see R1 in Table 5) and due to the sanitary protocol proposed by the Chilean Chamber of Construction [51]. Furthermore, experienced and non-experienced companies implemented teleworking for activities that could be performed virtually, emphasizing this approach's value in developing activities in construction projects. For instance, an interviewee reported, "Teleworking was introduced when projects were halted. Currently, it is used for meeting in projects and with the owner. This approach is here to stay". Our results emphasize that the application of virtual platforms and tools will facilitate more connectivity among the stakeholders involved in construction projects [7,13].

When looking at the companies' adaptation capabilities, the company's experience was the most frequent subcategory. Most respondents (i.e., 12 out of 19; 63%) reported that experience from the construction company and their workers facilitated adapting to the challenges brought by the pandemic (C3 in Table 5). However, adapting to the pandemic meant dealing with multiple challenges identified in our results for construction companies, such as increased budgets (i.e., R24) and increased salaries of construction workers (i.e., R38). Interviewees emphasized that experienced construction professionals generated ideas and initiatives in companies that allowed a better response of construction companies to the pandemic, which is aligned with existing literature suggesting that companies' experience influenced construction companies' economic performance during the pandemic [9].

5.3. Responses Based on Companies' Size

Responses to the pandemic were organized by the construction companies' size as previously discussed in small/medium size and large size. This was done using the criteria used by the Chilean Ministry of Economy (see Table 3). It can be noticed by looking at Table 5 that both small/medium and large construction companies faced struggles during the pandemic. Among the primary responses to the pandemic, it was noticed that construction budgets increased (i.e., R24 in Table 5) due to the financial challenges existing during the pandemic, such as the limited availability of materials and workforce and limited workers allowed to be on the field. Notably, this subcategory was the most frequent from the financing category (see Table 5). This result emphasizes the financial struggles faced by small and large construction companies during the pandemic, which has been discussed by existing literature [54] and reports from the Chilean Chamber of Construction (CChC) (2020). Similarly, another subcategory that was found relevant was delay in project durations (i.e., R25 in Table 5), which both groups of companies also struggled with. Our results show that roughly 75% of respondents discussed projects being delayed, which is aligned with challenges faced by construction companies in Chile [8] and around the globe [12,13].

Another category that showed many responses was subcontractors (i.e., C7 in Table 5). Subcategories that interviewees highly discussed were limited workforce and salary increases (see Table 5). More than 70% of respondents identified a limited workforce as a challenge for companies in responding to the pandemic, most of them related to companies classified as significant. As discussed by Valladares and Jaque [54], this result can be explained as new skills and competencies were identified to work on construction projects during the pandemic. Along the same lines, interviewees identified salary increases as a challenge, probably in response to the limited workforce previously discussed. Of note, these results suggest that construction companies' response to the pandemic aimed to deal with multiple challenges during the pandemic.

5.4. Responses Based on Companies' Economic Capacity

Concerning the influence of the economic capacity of construction companies while responding to the pandemic context, a binary classification was used: companies either had the financial capacity or did not. This characteristic was discussed as a factor influencing how construction companies adapted to the pandemic (see Table 5). In doing so, this study focused on categories related to economic performance during the pandemic.

For the financing category in Table 5, the most frequently discussed subcategories were related to the source of financing for construction projects for companies without economic capacity (see Table 5). The most discussed sources of financing were own capital and obtaining a loan from a bank. Of note, respondents also discussed the presence of banking restrictions to finance construction projects (see Table 5). The high frequencies found for both financing sources may suggest that the financing of projects was a combination of own capital and loans provided by banks, which emphasizes that construction companies are not capable of fully financing a construction project, thus becoming exposed to uncertain and stressful economic environments such as the pandemic.

For the category of suppliers (i.e., C8), the most frequent response was related to the increased cost of materials (see Table 5). Of note, this study could identify some responses from companies to deal with such an increased cost of materials. For instance, interviewees discussed overstocking construction projects with materials (i.e., R42) and buying materials in advance of projects (i.e., R44). These responses were observed primarily on projects with no economic capacity, which makes sense as construction projects with a limited economic capacity had to seek multiple alternatives to reduce the financial impacts of the pandemic. Furthermore, the uncertainty of not knowing what would occur with the construction materials prices may have supported construction companies in doing so.

For the category of social assistance (i.e., C6), the most frequent subcategory referred to the emergency family income (i.e., R34 in Table 5), a one-time economic benefit from the Chilean government for families due to financial struggles during the pandemic. Despite this social assistance aimed at Chilean families, it had some consequences for the construction sector, such as reduced available skilled workforce and increased expected salaries of skilled workers in construction.

5.5. Contributions of This Study

This study contributes to theory and practice. Results of this study contribute to theory by identifying construction companies' characteristics that influenced their response to the COVID-19 pandemic. Namely, it was found that company size, experience, and economic capacity influenced how construction companies responded to the pandemic. Furthermore, this study revealed the reality of how construction companies responded in the context of a developing nation located in the Latin American region (i.e., Chile). There are limited studies (if any) in the literature that describe how construction companies in Latin America responded to the pandemic, and as such, this study provides valuable insights about how construction companies responded to the pandemic, consequently filling a gap in the existing literature. These findings also contribute to the literature by identifying characteristics from construction companies that were relevant in responding to a highly disruptive scenario (i.e., the COVID-19 pandemic). This knowledge may be valuable for the construction industry and companies to be prepared for potential future disruptive scenarios, for instance, future pandemics or disaster-like scenarios.

In practicality, this study contributes by providing specific characteristics that may assist construction companies in the industry to make better decisions in responding to future potential highly disruptive scenarios. Furthermore, this study emphasizes that differences identified in how construction companies responded to a disruptive scenario such as the pandemic are important to be studied to identify what led construction companies to having better responses and being prepared for future disruptive scenarios. Ultimately, alternatives to respond to disruptive scenarios must be tailored to the specific characteristics of each construction company.

6. Conclusions

This study explored the impacts of COVID-19 on how construction companies in Chile responded to the pandemic by qualitatively analyzing semi-structured interviews with experienced professionals involved in construction projects during the pandemic. The qualitative analysis resulted in eight categories related to how construction companies responded with their corresponding forty-four subcategories and two categories related to recommendations with their corresponding ten subcategories. Additionally, results of this study illustrated the influence of company experience, size, and economic capacity in how construction companies responded to the pandemic.

Additionally, results illustrated that the main topics related to how construction companies responded to the pandemic were associated with implementing teleworking for workers, managing to take PCR tests to workers, limiting the construction workforce and materials price increase, and managing increased construction budgets. These responses suggest that the focus in responding to the pandemic was taking care of workers' safety, planning construction projects under a highly uncertain context, and dealing with the financial stress of developing construction projects. Similarly, recommendations about how to respond to a pandemic context were highly aligned with the main initiatives used by Chilean construction companies, emphasizing taking care of the safety and health of workers from a physical and emotional perspective and dealing with the financial stress of projects due to the pandemic.

When looking at the influence of companies' experience, size, and economic capacity, it was found that the most common responses for experienced and large companies were related to implementing teleworking for workers and dealing with increased materials'

prices and a limited workforce. Regarding the economic capacity of construction companies, the main focus in responding to the pandemic was related to the source of financing construction projects. The financing of projects was a combination of obtaining a loan from a bank with the companies' capital. Other interesting results suggest that social assistance benefits to workers may have had an undesired effect on construction by increasing the salaries of skilled workers and reducing the available skilled workforce.

Ultimately, future work to build upon the findings of this study should evaluate whether good practices learned by construction companies during the pandemic continue to be implemented in the current post-pandemic context.

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Appendix A. Interview Questions

1. How many years of experience does your current company have?
2. In which regions is your company located?
3. What is approximately the annual billing of our current company?
4. What type of financing does your company use to finance current construction projects?
5. What is the average number of employees in your company?
6. How many subcontractors your company currently has?
7. What is the specialty of your company? It provides services to private owners, public owners, or both?
8. Since the start of the pandemic, how has the financial situation of your construction company changed?
9. How have you perceived the change in demand for your services since the pandemic began? If so, by how much?
10. Do you think the company experience contributed to adapting to the pandemic effects?
11. Based on your experience, how has the pandemic affected the payments made by the owner to the contractors?
12. Regarding subcontractors, have you noticed changes in your interactions with them due to restrictions due to the pandemic?
13. Regarding suppliers, have you noticed changes in materials stock, renting, or equipment leasing due to the pandemic?
14. Concerning teleworking, what role did it play in the company's adaptation to the pandemic?
15. Did your company receive assistance from the government during the pandemic as payments and loans? If so, how did this contribute to the company?
16. Concerning the strategies implemented by the government—e.g., social distancing—how have these affected the productivity of projects? How were these effects mitigated?
17. In your opinion, how has your company handled the pandemic? What good practices can you highlight?

Appendix B. Coding Dictionary with Definition of Codes and Sample Responses

Id	Criteria	Definition	Sample Response
Companies' initiatives			
C ₁	Teleworking	Statements about the performance of services assisted by technology or telecommunication for employees in construction projects.	"All meetings were online due to teleworking to avoid crowding in the field."
C ₂	Communication with owner	Statements related to communication with the owner due to problems during the pandemic.	"Quick decisions could be made due to the direct communication with the owner."
Initiatives for workers			
C ₃	Use of alcohol gel	Statements about the usage of alcohol gel to avoid getting infected with COVID-19.	"We had clean spots on key places in projects with alcohol gel to wash our hands."
C ₄	Emotional support to workers	Statements about emotional support to workers during the pandemic to deal with the uncertainty of health and personal issues.	"We permanently supported workers emotionally, encouraging self-care and support during the pandemic."
C ₅	Active listening	Statements about listening to workers, focusing on them, and providing emotional support.	"Emotional support was provided by showing workers that the company was taking all precautions to care for them."
C ₆	Proper use of mask	Statements about the proper use of masks, with the adequate size covering the nose and mouth of workers.	"I highlight that all workers respected safety measures related to the correct use of masks."
C ₇	Use of multiple working shifts	Statements about the use of multiple times for workers to enter and leave the construction work site to minimize the number of workers.	"Our shifts began at different times, namely, 7:30, 8:00, and 8:30 a.m. The same happened for lunch breaks and the time that work ended."
C ₈	Shifts to use bathrooms at work	Statements about using multiple times for workers to use bathrooms to minimize the number of workers in these places.	"The shifts to use the bathroom worked very well for us to spread the use of these facilities."
C ₉	Coordination for lunch breaks	Statements about multiple lunch breaks for workers to minimize the number of workers eating lunch.	"Time for lunch breaks was extended so all workers could eat their lunch according to the times they were assigned to eat lunch."
C ₁₀	Temperature control	Statements about the temperature control process using an infrared thermometer at the entrance and exit of the job site.	"At the job site entrance, temperature control points were installed on all projects."
C ₁₁	Washing hands	Statements related to workers washing their hands with water and soap frequently to avoid the spread of COVID-19.	"We tried to have as many washing points as possible on strategic points at the job site."
C ₁₂	Signature at the entrance and exit of the work	Statements about the process of signing to enter and leave the job site to manage traceability of workers.	"As an initiative, workers had to sign to enter and leave the job site to have traceability in case workers got infected."
C ₁₃	PCR test	Statements related to taking a PCR test to diagnose COVID-19 among construction workers.	"All workers permanently took PCR tests to discard that workers on the project were sick."
C ₁₄	Vaccination plan	Statements related to incentivizing construction workers to get vaccinated with the government plan.	"As vaccination could be taken to the construction field, workers were sent to public hospitals to be vaccinated during work hours."
C ₁₅	Traceability of workers	Statements related to the traceability of workers in contact with a sick worker.	"Workers showing symptoms were quickly tested to evaluate their health status and trace sources of COVID in the job site."

Id	Criteria	Definition	Sample Response
C ₁₆	Private transportation	Statements related to private transportation of construction workers from their homes to their job site and vice versa due to sanitary protocols to fight COVID-19.	“A private transportation service was hired to move our workers between the job site and their houses.”
C ₁₇	Social distancing	Statements related to limiting the distance around other workers according to sanitary initiatives to deal with COVID-19.	“Social distancing required workers to adapt, especially by limiting the zones of each one.”
C ₁₈	Crowd control	Statements about the number of workers allowed on different zones of the job site to minimize the spread of COVID-19.	“Safety talks were more extended to reinforce the crowd control policies on the field.”
C ₁₉	COVID testing (i.e., antigen)	Statements related to applying an antigen COVID-19 test to assess whether workers were infected with COVID-19.	“Antigen tests were frequently taken to workers directly on the field.”
Companies' adaptation capabilities			
C ₂₀	Experience	Statements about the importance of experience for construction companies to adapt to and deal with the pandemic.	“Experience from the company's owners helped quite a lot by planning for the pandemic.”
C ₂₁	Company size	Statements related to the influence of the company size in adapting to and dealing with the pandemic. Size was referred to as annual billing and number of workers.	“The size of the company helped us to respond to the pandemic economically.”
C ₂₂	Economic support	Statements about financial resources available to deal with and adapt to the pandemic.	“The economic capacity and support the company had allowed it to continue operating during the pandemic.”
Project management			
C ₂₃	Payment statements	Statements about the payments that owners make to contractors due to the physical advancement of construction projects.	“We did not have problems with owners with the monthly payments of construction projects.”
C ₂₄	Budget increases	Statements about the budget increase during a construction project due to materials, workforce, or administration.	“In two projects that we currently have, budgets have been updated with increases of roughly 15–20%.”
C ₂₅	Projects' duration delayed	Statements related to the extension of project duration due to the pandemic context.	“As companies were learning how to deal with the pandemic, project durations were extended approximately 10%.”
C ₂₆	Construction projects demand	Statements about the quantity of construction projects required in the industry.	“The number of projects demanded was maintained. In our case, it was between 20 to 30 projects simultaneously.”
Financing			
C ₂₇	Own capital	Statements about using companies' funding to manage and develop construction projects.	“We observed that the funding of construction projects was 80% with banks and 20% own capital.”
C ₂₈	Loan from bank	Statements related to companies asking for a loan from a bank to finance a construction project.	“Our company uses roughly 40% of bank loans and 60% own capital to fund construction projects.”
C ₂₉	House loan	Statement related to loaning money to people wanting to buy a house.	“At the pandemic's beginning, house loans were easy to get, facilitating our business.”
C ₃₀	Early payments	Statements about the role of early payments given by the owner to the contractor often at the beginning of the project.	“It depends on the project. [For our] own projects, we got funding from the bank. For private projects, we ask for early payments.”

Id	Criteria	Definition	Sample Response
C ₃₁	Banking restrictions	Statements related to requirements from banks to provide financing to construction companies.	“If your company had a good economic history, you could quickly access bank loans. Otherwise, the process was much slower.”
C ₃₂	Public resources	Statements about support from public resources to construction companies.	“Public funding was provided to construction companies to assist them with their economic situation by the public budget direction.”
Social assistance			
C ₃₃	Law to protect jobs during COVID-19	Statements related to procedures needed to be followed to access the law that protected jobs during the pandemic.	“Several projects were delayed and halted due to their application to the law that protected jobs during the pandemic.”
C ₃₄	Emergency family income (IFE in Spanish)	Statements about the economic assistance provided by the government (i.e., IFE) to alleviate the economic situation of Chilean families.	“IFE affected the presence of workers on the field as the assistance allowed workers to stay at home and not have to go to work.”
C ₃₅	Funding to support small companies (FOGAPE in Spanish)	Statements related to government programs that assisted small companies affected by the pandemic with financial help.	“The government provided the FOGAPE assistance to loan money to small companies at 0% interest and should be paid back in a couple of years. These help us to keep working in 2020.”
Subcontractors			
C ₃₆	Unqualified workforce	Statements about the presence of unqualified workers on construction projects during the pandemic.	“Unqualified workers began to be more common in construction projects, bringing problems with productivity and delays.”
C ₃₇	Limited workforce	Statements related to the limited qualified workforce in construction projects during the pandemic context.	“The problem was the lack of a qualified workforce in projects. Workers did not want to continue working or switched jobs during projects.”
C ₃₈	Salary increases	Statements about the increased salaries of workers due to the limited offer of qualified workers and high demand of projects.	“Subcontractors suffered with the salary increases of a qualified workforce. Workers did not want to work on the pre-pandemic salaries.”
Suppliers			
C ₃₉	Materials prices increase	Statements about the increasing cost of materials during the pandemic due to high demand and limited supply.	“The construction company was slow in reacting to the price increase.”
C ₄₀	Transportation costs increase	Statements related to the increasing cost of transportation of materials.	“We also had problems with transportation of materials due to importations and the increasing fuel cost.”
C ₄₁	Limited stock	Statements about the limited availability of construction materials due to all restrictions during the pandemic.	“As our project began in 2021, we expected limited stocks, so we prepared a large warehouse with materials.”
C ₄₂	Overstock	Statements related to the massive buying of construction materials to stock construction projects.	“We prepared our budget to overstock our project during the pandemic.”
C ₄₃	Delays in delivery	Statements about delays in delivering materials to construction projects during the pandemic.	“We had delays in the arrival of materials of approximately 1 or 2 months.”
C ₄₄	Buying materials in advance of projects	Statements related to companies’ strategy of buying construction materials in advance of projects to avoid delays.	“We always have bought materials in advance to have available all materials required on the field for construction projects.”

Id	Criteria	Definition	Sample Response
Recommendations to companies			
C ₄₅	Respect sanitary protocols	Statements about respecting the sanitary protocols established to deal with the COVID-19 pandemic.	“I highlight the instructions provided by protocols to deal with COVID-19 in construction projects. Also, the role of safety engineers enforcing it.”
C ₄₆	Buying materials in advance of projects	Statements related to buying materials in advance to avoid stock problems during construction projects.	“Buying materials in advance is recommended as a good practice to ensure availability. It is important to have multiple suppliers.”
C ₄₇	Planning based on objectives	Statements about planning for objectives in construction projects, especially when projects are subject to changes.	“I recommend planning based on objectives and considering costs and time as a strategy to deal with big changes, such as a pandemic.”
C ₄₈	Apply teleworking	Statements about the use of teleworking in construction projects, especially for administrative jobs that are not required to be on the field.	“I highlight the flexibility that teleworking provides to workers. Our company facilitated teleworking by providing all the equipment and software required to work from home.”
C ₄₉	Manage to take PCR and antigen tests	Statements related to the continuous checking of the health status of workers through PCR and antigen tests to minimize the spread of COVID-19.	“At the beginning, the PCR test was widely implemented in projects, and then, during 2021, the antigen test was used to avoid the spread of COVID-19.”
C ₅₀	Permanent communication with the owner	Statements about permanent interaction with the owner of projects to make joint decisions about the construction of projects.	“Following the budget with the corresponding costs and low productivity during the pandemic allowed [us] to talk with the owner to negotiate the contract cost directly.”
Recommendations to workers			
C ₅₁	Respect and commitment to sanitary restrictions	Statements about workers knowing how sanitary protocols contribute to COVID-19 and respecting sanitary protocols dealing with COVID-19.	“I emphasize that workers knew each other and took care between them; a team spirit existed in the projects to accomplish the sanitary protocols.”
C ₅₂	Emotional support and active listening	Statements related to construction professionals having to listen to and support workers on the field to alleviate the emotional burden and uncertainty during the pandemic.	“It is important to be conscious and have the patience to enforce sanitary protocols but that at the same time workers feel supported and listened to.”
C ₅₃	Promote self-caring	Statements about construction professionals promoting self-care among construction workers to deal with personal health, family, and coworkers.	“Insist in self-care of workers; the need to permanently convince workers was the most challenging during the pandemic.”
C ₅₄	Incentivize vaccination	Statements about incentivizing construction workers to get vaccinated against COVID-19.	“Our company was strict in requesting vaccinations to workers to prevent the spread of COVID-19 in our projects.”

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