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COVID-19 opportunities in construction projects: the case of Perú

Oportunidades del COVID-19 en la construcción proyectos: el caso del Perú

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Abstract
The Covid pandemic has been an unprecedented event in the construction sector, which has generated a series of impacts, for which many researchers have developed studies to identify them. However, many of these studies have focused on the negative impacts and have not focused on collecting the opportunities generated. For this reason, the following study aims to identify the opportunities generated in the medium term because of the COVID-19 pandemic in construction projects, considering the case of the Peruvian construction sector. To this end, the study begins with a literature review where the main opportunities are identified, which are validated by expert judgment. In the next stage, Peruvian professionals were surveyed; the results were processed and categorized using the RII (Relative Importance Index), and finally, the results were discussed. The main opportunities generated by COVID-19 are greater emphasis on hygiene programs, the use of remote work technology, and the acceleration of digitalization in projects. This research will help professionals in the construction sector to exploit the opportunities of disruptive events like COVID-19 that may arise in the future.

Keywords: *Covid; construction; opportunities; RII; Peru.*

Resumen
La pandemia de Covid ha sido un hecho sin precedentes en el sector de la construcción, que ha generado una serie de impactos, por lo que muchos investigadores han desarrollado estudios para identificarlos. Sin embargo, muchos de estos estudios se han centrado en los impactos negativos y no se han centrado en recoger las oportunidades generadas. Por tal motivo, el siguiente estudio tiene como objetivo identificar las oportunidades generadas en el mediano plazo a raíz de la pandemia COVID-19 en proyectos de construcción, considerando el caso del sector construcción peruano. Para ello, el estudio comienza con una revisión de la literatura donde se identifican las principales oportunidades, las cuales son validadas mediante juicio de expertos. En la siguiente etapa se encuestó a profesionales peruanos; los resultados fueron procesados y categorizados utilizando el RII (Índice de Importancia Relativa) y finalmente se discutieron los resultados. Las principales oportunidades generadas por el COVID-19 son un mayor énfasis en los programas de higiene, el uso de tecnología de trabajo remoto y la aceleración de la digitalización en los proyectos. Esta investigación ayudará a los profesionales del sector de la construcción a explotar las oportunidades de eventos disruptivos similares al COVID-19 que puedan surgir en el futuro.

Palabras clave: Covid; construcción; oportunidades; RII; Perú.

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1. Introduction

The COVID pandemic has been an unprecedented event in different industries of the world economy, one of the most affected industries has been the construction industry (Stiles et al., 2021), as it has suffered various impacts, such as effects on field workers (Pamidimukkala and Kermanshachi, 2021), project delays, cost overruns (Araya and Sierra, 2021). Although the impacts have been documented, most of them are focused on developed countries such as the United Kingdom (Uchehara et al., 2020), and the United States (Alsharef et al., 2021), among others, and few studies have focused on developing countries (Al-Mhdawi et al., 2022). Developing countries were the most affected at this stage, due to the high number of cases that affected the labor force in the construction sector; also, governments redirected the budget to address COVID-19 and thus impacted infrastructure projects, financial problems in projects such as exchange rates, inflation, among others (Al-Mhdawi et al., 2022).

Therefore, this research was conducted in a developing country like Peru. Peru presents specific characteristics that make it a relevant case study. Compared to industrialized countries, Peru has a significantly lower level of industrialization and a high dependence on labor in the construction sector (Verán-Leigh and Brioso, 2021). Before COVID-19, the Peruvian labor market was characterized by a low unemployment rate and sustained growth, with an unemployment rate in Metropolitan Lima of 6%, and informality covering 70% of the workforce (Banco Central de Reserva del Perú, 2024). The fragility of the labor market, a result of informality, was tested by COVID-19, which completely altered the structure and sustained growth figures that had been presented until then (Sociedad de Comercio Exterior del Perú, 2021). Among the most promising sectors was construction, of vital importance for the Peruvian economy, representing between 6% and 7% of GDP (Céspedes et al., 2016). This sector had a moderate growth trend in productivity, benefiting from and being propelled by investments in infrastructure and real estate projects (Sociedad de Comercio Exterior del Perú, 2021). Although it focused on traditional methods, there was a growing adoption of modern technologies that integrated more efficient techniques, such as prefabricated and sustainable practices (Verán-Leigh and Brioso, 2021).

Moreover, Peru was one of the countries most affected by the pandemic (UNICEF Perú, 2021) and it was one of the last sectors to reactivate economically (Verán-Leigh and Brioso, 2021). The largest reduction in employment in percentage terms was recorded in the construction sector (67.9%) (Casavilca & Sarmiento, 2024). In terms of the sector's productivity, COVID-19 reduced it by 15.6% in 2020 (Diario La Republica 2019), (Veran-Leigh et al. 2019). This greatly affected the Peruvian construction sector, registering a drop in the Gross Domestic Product (GDP) of 11.1% in 2020, after 21 years of uninterrupted growth (INEI, 2022).

In addition to this, most studies have focused on the negative impacts, and risks generated (Ayat et al., 2023), and very few address the opportunities generated by COVID-19 in construction projects. During this period, several opportunities have emerged given the fact that the pandemic has allowed organizations to change their usual practices and embark on innovation and transformation (Bouziri et al., 2020). Some of these opportunities include increased technology adoption, more effective collaboration between the requested parties of the project, cleaner work environments, and increased reliance on local and diversified suppliers and manufacturers, among others (Assaad and El-adaway, 2021). Due to the few studies that address the opportunities generated by COVID-19, this paper seeks to identify and provide a list of opportunities generated that can be leveraged in the construction sector in future events like the COVID-19 pandemic.

This research is divided into a first section where the methodology developed in the study is explained, a literature review and validation with expert judgment is developed, and then a survey of 110 Peruvian professionals is carried out. The second section discusses and compares the results with previous studies conducted in other countries.

2. Methodology

For the development of this research, the steps detailed in (Figure 1) have been considered, as well as the tools, activities, and deliverables obtained throughout the research.

In the first stage, a literature review of the opportunities associated with covid in construction projects was carried out, and the Scopus database was consulted, following the keywords: ("covid" and "construction industry" and "opportunity") and ("covid" and "construction industry" and "benefit"). The Scopus database was used in the following research for the following reasons: (1) Under construction, it has a wider range of coverage than other databases (Mongeon and Paul-Hus, 2016); (2) Inclusion of conference papers; and (3) larger number of recent publications compared to other databases (Meho and Rogers, 2008).

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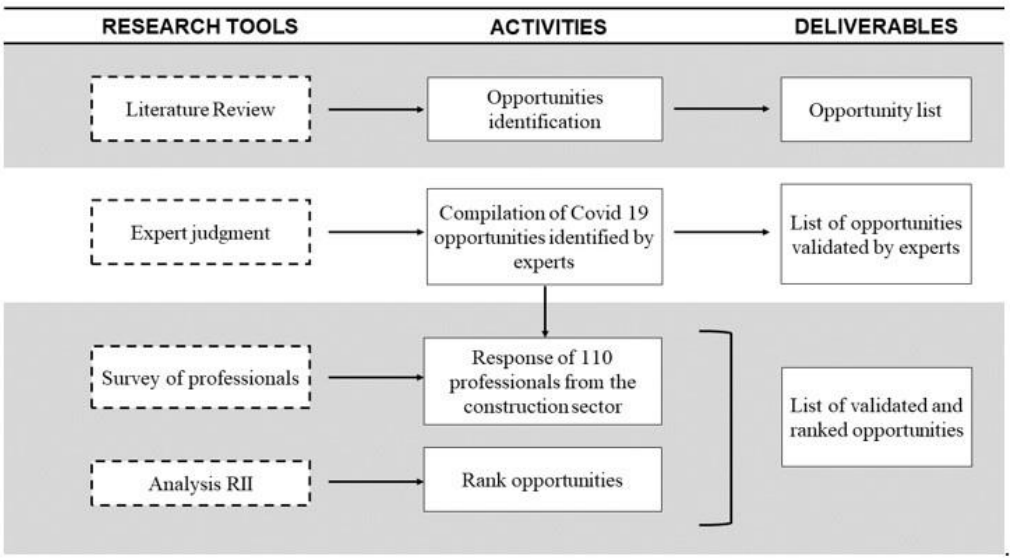

Figure 1. *Diagram showing the main stages of the research*

After the literature review and interviews with experts, a list of 15 opportunities associated with COVID-19 in the construction sector was obtained. The experts were selected according to the following criteria: (1) Professionals related to the construction industry (2) Experience of at least 10 years in the construction sector (3) Participated in the elaboration of a project that was affected by COVID-19. The criteria established are similar to previous studies of COVID-19 opportunities, such as (Dobrucali et al., 2022) in the USA. In addition, the experts are managers and heads, who can make strategic decisions regarding COVID-19 and identify the opportunities generated at this stage. Also, the experts have experience in industry and academia, which generates a broader view of the opportunities. The role and experience of the experts are detailed in (Table 1)

Table 1. *Expert judgment information*

Professional Expert	***Years of experience***	***Role***	***Project Experience***
Expert 01	*Master of Science and Civil Engineer with more than 17 years of experience in project management in the engineering and construction sector.*	*Lecturer, Head of Project Controls*	*Buildings, industrial plants and infrastructure projects*
Expert 02	*Master's Degree and Civil Engineer with more than 19 years of experience in project management in the engineering and construction sector.*	*Lecturer, Contract Administrator*	
Expert 03	*Master of Science and Civil Engineer with more than 23 years of experience in project management in the engineering and construction sector.*	*General Manager*	
Expert 04	*Master's Degree and Civil Engineer with more than 19 years of experience in project management in the engineering and construction sector.*	*Lecturer, Consultant*	
Expert 05	*Master's Degree and Civil Engineer with more than 10 years of experience in project management in the construction sector.*	*CEO*	*Buildings*
Expert 06	*Civil Engineer with more than 16 years of experience in project management in the construction sector.*	*Project Coordinator*	

2.1. Research design and data collection

In the third stage of the research, with the list of opportunities validated by expert judgments, a survey of 110 professionals in the construction sector was conducted between August 2022 and February 2023, using a web-based format to reach the largest number of professionals without the restriction of geographic space or working from home due to the

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pandemic (Raoufi and Fayek, 2022). The survey was designed to collect data on opportunities encountered in the respondents' projects, and the degree to which each opportunity has benefited the Peruvian construction sector.

The first part of the survey consisted of questions to collect information about their professional experience, projects and company where the respondents worked. In the second part, respondents rated on a Likert scale the extent to which opportunities have arisen in the construction sector. A score of 1 was used, to consider that the opportunity has been very little perceived by the professionals, and a score of 5, in which the perception of the opportunity has been very high.

2.2. Population and sample

Given the impossibility of determining a population that perceives the opportunities and thus a probability sample, the researchers established the sample by employing the non-probabilistic snowball method.

The snowball method is a valuable technique in exploratory, qualitative, and descriptive research. In this methodology, an individual initially called a "seed" provides the researcher with the name of another subject, who in turn suggests the name of another and so on (Atkinson and Flint, 2001). Although in theory the initial "seeds" in this type of demonstration are chosen randomly, in practice it is complicated to carry out and instead, they are selected through a convenience method (Baltar and Brunet, 2012). This type of sample has been used by different researchers in the COVID-19 stage (Dobrucali et al., 2022) in the USA and (Leontie et al., 2022) in Romania, who used snowballing techniques to obtain a sample of 74 and 30 participants respectively.

Through snowballing, 280 professionals were identified, questionnaires were distributed virtually, and 110 questionnaires were obtained as responses. This represents a response rate of 39%, like the (Dobrucali et al., 2022) research on challenges and opportunities in the U.S.A. construction industry, where a response rate of 37% was obtained.

The data of the professionals surveyed are shown in (Figure 2), which describes the demographic characteristics of the population of respondents in Peru. It is observed that 71.81% (79 participants) of the sample have work experience of less than 10 years. In addition, 65.5% of the respondents are part of contractors and 21.8% are part of supervision and consulting firms.

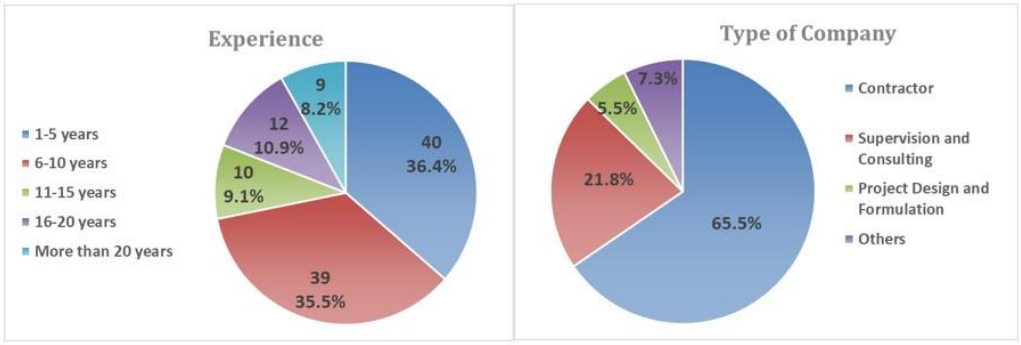

Figure 2. *Experience and type of company*

(Figure 3) shows the respondents by type of company and company size. Regarding the type of project, 50% of the respondents work in building projects, 28.2% in infrastructure projects, and the remaining 21.8% work in mining projects and other types of projects. In relation to the type of company, 29.1% corresponds to large companies and 70.9% corresponds to micro, medium, and small companies. Also in (Figure 4), 83.6% of the respondents correspond to the private sector and 16.4% correspond to the public sector.

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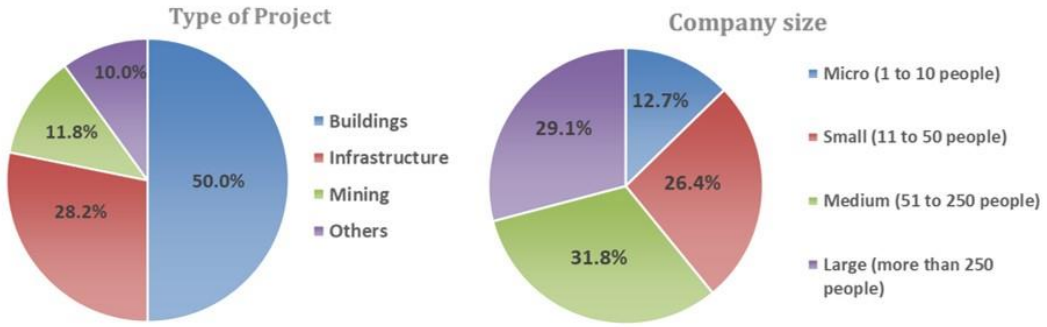

***Figure 3**. Type of project and company size.*

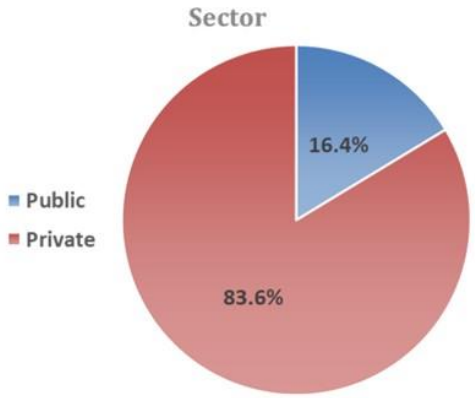

Figure 4. Sector of the professionals.

2.3. Validation test and data analysis

In the fourth stage of the research, a Cronbach's alpha analysis was performed to validate the survey, and a data analysis was conducted to identify the most influential opportunities for the benefit of the Peruvian sector by using the relative Importance Index (RII) for each variable. Cronbach's Alpha is an index used to measure the reliability of the internal consistency of a scale, that is to determine to what extent the items of an instrument are correlated with each other (Bland and Altman, 2002). When the test was performed, α = 0.871 was obtained, a value between 0.80 and 0.90, so it is affirmed to have a satisfactory level of reliability (Netemeyer et al., 2003).

To find the most important opportunities in the Peruvian sector, the Relative Importance Index (RII) will be used. By applying it to each variable, the opportunities can be structured and classified, identifying those that are of greater relevance or have a significant influence, as well as those that are less relevant or have a lesser influence (El-Razek et al., 2008). The RII (Equation 1) value is calculated with (1), where N is the total number of respondents, A is the value of the highest importance (5 belonging to the very high option), and W is the sum of the multiplications of the importance of each factor by the number of times it was chosen (Aibinu & Odeyinka, 2006). All the latter are based on the Likert scale

$$RII = \frac{\sum w}{N * A} \quad (1)$$

Where opportunities of greater importance will be reflected in an RII close to or equal to 1, those of lesser importance will have values close to 0 (Doloi et al., 2012). In this research, the criterion followed by (Kamaruddeen et al., 2020) was used to classify the level of importance, according to the authors; the level of importance is classified into five categories, "High importance" to the opportunities that have an IIR greater than 0.8, "High-medium importance" to opportunities with an RII lower than 0.8 and higher than 0.60, "Medium importance" with an RII lower than 0.60 and higher than 0.40, "Medium to low importance" with an RII lower than 0.40 and higher than 0.20 and finally the last category of "Low importance" for values lower than 0.20. Moreover, RII has been used in research in the construction sector to categorize

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critical factors influencing construction labor productivity during COVID-19 (Dy et al., 2021) and to identify the most significant effects of COVID-19 in the construction industry in Bangladesh (Ahmed et al., 2022).

Using the values found with the RII, it was possible to develop a ranking of the main opportunities generated by COVID-19 in Peru. Finally, a comparison was made of the main opportunities obtained, versus the opportunities mentioned in the literature.

3. Results and discussion

The following section discusses the results of the literature review and the survey conducted to identify opportunities.

3.1. Literature Review of COVID-19 Opportunities

Then, from the literature review, 15 opportunities associated with the pandemic were obtained, The opportunities can be detailed in (Table 2), these have been classified into three categories: technological, health and safety, and educational opportunities for workers.

Table 2. *List of opportunities*

Opportunity type	Code	Description	Reference
Technological Opportunities	OT1	Use of remote work technology	(Raoufi & Fayek, 2022), (Lingard et al., 2021), (Adhikari & Poudyal, 2021), (R. Assaad & El-adaway, 2021), (Ebekozien & Aigbavboa, 2021), (Ogunnusi et al., 2021), (Stride et al., 2023)
	OT2	Acceleration of digitization in projects	(Raoufi & Fayek, 2022), (Lingard et al., 2021), (Adhikari & Poudyal, 2021), (R. Assaad & El-adaway, 2021), (Ebekozien & Aigbavboa, 2021), (Dobrucali et al., 2022), (Ayat et al., 2023)
	OT3	Increase in remote operations	(Raoufi & Fayek, 2022), (Majumder Soumiand & Biswas, 2021)
	OT4	Increased investment in new technologies	(Adhikari & Poudyal, 2021), (Majumder Soumiand & Biswas, 2021), (Adhikari & Poudyal, 2021)
	OT5	Digitization of administrative procedures	Expert Judgment
	OT6	Increased interaction between project agents through digital media	(Dobrucali et al., 2022)
Health and Safety Opportunities	OS1	Improved working conditions for workers	(R. Assaad & El-adaway, 2021), (Ogunnusi et al., 2021), (Alsharef et al., 2021), (Ayat et al., 2023)
	OS2	Improved safety standards	(Raoufi & Fayek, 2022), (Lingard et al., 2021), (Ayat et al., 2023)
	OS3	Increased emphasis on hygiene programs	(Dobrucali et al., 2022), (Raoufi & Fayek, 2022), (Majumder Soumiand & Biswas, 2021)
	OS4	Improved waste management	(Dobrucali et al., 2022)
Educational Opportunities for Workers	OE1	Academic collaboration opportunities	(Dobrucali et al., 2022)
	OE2	Development of leadership programs for crisis management.	(Dobrucali et al., 2022)
	OE3	Improved knowledge management	(Dobrucali et al., 2022)
	OE4	Increased productivity of office workers and staff members	(Dobrucali et al., 2022), (Ogunnusi et al., 2021), (Ayat et al., 2023)
	OE5	Increased adoption of building information modeling (BIM)	(Adhikari & Poudyal, 2021), (R. Assaad & El-adaway, 2021), (Wenshun Wang Shulei Gao & Xu, 2021)

Each of the opportunities identified in the literature is detailed below. Regarding the technological opportunities, they involve the following impacts:

3.1.1 Use of remote work technology (OT1)

Due to the isolation and policies generated by COVID-19, several companies in the United States implemented remote work (Raoufi & Fayek, 2022), which allowed workers greater flexibility (Ogunnusi et al., 2021) and allowed them to continue to perform their jobs. Today, several companies in the United States have adopted hybrid work (Raoufi & Fayek, 2022).

3.1.2 Acceleration of digitization in projects (OT2)

This opportunity originated from the disruptive nature of COVID-19, which has generated companies to innovate and transform by incorporating digital technologies, communication platforms, and information systems (Kamal, 2020). Examples of these adaptations have been presented in the United Kingdom and include conducting virtual meetings between members or stakeholders to share information, implementing virtual tours to monitor progress on the job site (Jones et al., 2020), as well as using virtual and augmented reality to improve safety in construction sites and strengthen worker training (Adhikari & Poudyal, 2021).

3.1.3 Increase in remote operations (OT3)

This opportunity has arisen in response to the need to maintain physical distance and isolation while ensuring the continuity of construction projects (Lagat et al., 2023). In the United Kingdom, on-site work planning has been improved to minimize task overlap and reduce employee presence, ensuring employee safety, improving efficiency in task execution, and increasing overall productivity (Jones et al., 2020).

3.1.4 Increased investment in new technologies (OT4)

In the post-pandemic context, investment in new technologies has become a critical factor for project continuity and competitiveness in the construction market. An example of this trend is found in the United Kingdom, where the construction industry has chosen to leverage sophisticated technologies as an option to build a culture of sharing and creating practical knowledge that strengthens organizational connectivity and resilience in the face of any eventuality (Adhikari & Poudyal, 2021).

3.1.5 Digitization of administrative procedures (OT5)

This opportunity arose with the interview with the expert judgment and is specific to the Peruvian context, due to the pandemic and isolation, the Peruvian state was digitalized to generate the economic reactivation of the construction sector, and the construction projects had to send all the information to reactivate their activities through the website of the Ministry of Housing (Verán-Leigh and Brioso, 2021).

3.1.6 Increased interaction between project agents through digital media (OT6)

This opportunity arose in the context of the pandemic, where many workers were forced to work remotely for their health and safety, encouraging the use of digital tools and platforms for collaboration and communication in the workplace. There are technological tools, such as Zoom video conferencing, small group meetings, and video calls via Internet connections that have proven effective in communicating with team members in Nigeria (Ebekozien and Aigbavboa, 2021).

The second group of opportunities is related to health and safety opportunities, which involve the following impacts:

3.1.7 Improved working conditions for workers (OS1)

This opportunity represents an effort to create a more favorable working environment in response to the measures implemented to counter COVID-19 in Peru. In particular in the construction industry, (Ogunnusi et al., 2021) found that a greater awareness of the importance of strengthening worker health and safety has emerged. As a result, construction sites are expected to become safer and cleaner (Assaad and El-adaway, 2021).

3.1.8 Improved safety standards (OS2)

This opportunity arose in recognition of the importance of the safety of each team member, especially during the development of the COVID-19 pandemic. This implies that safety measures have been strengthened both in the comprehensive review and in the incorporation of new safety protocols, as was the case in the United Kingdom (Adhikari and Poudyal, 2021). Certain common and fundamental safety measures to address COVID-19 and that will remain relevant for day-to-day situations or future pandemics include constant supervision, employee training, as well as administrative policies and corresponding actions (Anderson et al., 2020).

3.1.9 Increased emphasis on hygiene programs (OS3)

This opportunity involves developing site-specific health standards to ensure the health of, as in the case of the

United States, which emphasized the cleaning and disinfection of the workplace, and the use of disinfectants (Dobrucali et al., 2022). Also, every worker should learn to take care of their hygiene and take importance on hand washing. (Majumder and Biswas, 2021), in their study in India, mention that all these rules are guidelines to ensure the health and safety of construction workers and should be maintained even after the reopening of construction sites.

3.1.10 Improved waste management (OS4)

This opportunity implies that construction companies can reduce their construction waste in the post-pandemic period due to an improvement in waste management during the COVID-19 stage. Due to technologies implemented, in the United States, it was possible to reduce 80% of the total waste compared to the traditional method (Dobrucali et al., 2022).

Concerning education opportunities, they involve the following impacts:

3.1.11 Academic collaboration opportunities (OE1)

This opportunity in the United States involves organizations partnering with universities to teach construction practitioners about where the industry is headed and prepare them for similar work situations (Dobrucali et al., 2022). In addition, it is proposed to take advantage of this opportunity and follow the recommendation of (Jallow et al., 2020) about adding risk management courses to the curriculum that can prepare future professionals for situations such as those experienced by the pandemic.

3.1.12 Development of leadership programs for crisis management (OE2)

This opportunity for American companies involves motivating employees and supporting them continuously as employees struggle with health and safety issues (Dobrucali et al., 2022). In times of crisis and uncertainty, leadership plays a very important role in keeping the project team motivated and maintaining their performance.

3.1.13 Improved knowledge management (OE3)

This opportunity for the United States implies that its companies can manage the knowledge that has been generated during the pandemic, to avoid repeating the mistakes, that construction projects generate programs for crisis management associated with the pandemic or similar events, and better risk management (Dobrucali et al., 2022).

3.1.14 Increased productivity of office workers and staff members (OE4)

It implies that the construction sector had an increase in productivity due to the pandemic, as happened in the United States (Ayat et al., 2023). According to the questionnaire of (Ogunnusi et al., 2021), where there were 76 responses from five continents excluding South America, this increase is attributed to remote work and the elimination of commuting time to the job site, which allowed workers more time to rest and plan their next day's activities.

3.1.15 Increased adoption of building information modeling (BIM)

Due to the critical challenges generated by the pandemic, the use of technologies such as BIM, in various organizations and government entities, has increased (Assaad and El-adaway, 2021), both to further monitor the project and to help develop collaboration between the various project stakeholders, which are necessary aspects in this context (Adhikari and Poudyal, 2021).

3.2. Covid's Categorization of Opportunities in Peruvian Projects

The opportunities were classified using the RII and are listed in (Table 3).

***Table 3**. Categorization of opportunities with RII*

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Code	Mean	RII	RII%	Rank	Level of Importance
OS3	4.159	0.832	83.2%	1	High Importance
OT1	4.084	0.817	81.7%	2	
OT2	4.065	0.813	81.3%	3	
OT6	4.047	0.809	80.9%	4	
OT5	3.944	0.789	78.9%	5	High-Medium Importance
OS4	3.925	0.785	78.5%	6	
OT3	3.841	0.768	76.8%	7	
OT4	3.692	0.738	73.8%	8	
OS2	3.682	0.736	73.6%	9	
OE5	3.533	0.707	70.7%	10	
OS1	3.430	0.686	68.6%	11	
OE3	3.402	0.680	68%	12	
OE1	3.121	0.624	62.4%	13	
OE4	3.112	0.622	62.2%	14	
OE2	3.093	0.619	61.9%	15	

3.2.1 Increased emphasis on hygiene programs (OS3)

From (Table 3), it can be noted that the main opportunity perceived by respondents has been OS3, with a RII of "0.830". A company would see this measure as an opportunity to strengthen the health and well-being of its employees, which can result in a reduction in sickness absences, greater productivity, and better morale in the workplace, making the construction site more efficient and safer to work. The results are similar to previous work carried out by (Dobrucali et al., 2022) in the US, which leads us to infer that this opportunity is a result of the protocols that were adopted during the COVID stage and that construction companies continue to adopt them to take care of their workers. It should be noted that maintaining high hygiene standards can improve the company's reputation and its attractiveness to future workers and clients, who value a safe and healthy environment.

3.2.2 Use of remote work technology (OT1)

The second opportunity found from the RII analysis is OT1, which is part of the technological opportunities, ranked second, and was classified as highly important. The RII reached a value of "0.817". A company would view this opportunity as a way to increase operational flexibility and reduce costs associated with travel and in-person meetings. As (Ebekozien and Aigbavboa, 2021) indicate, zoom meetings, micro-team meetings, and video calls through internet connection mechanisms have proven to be efficient in communications with team members; even though the construction did not seem conducive to the implementation of virtual meetings and technological tools. That is, it allows better management of time and human resources, facilitating collaboration between geographically distributed teams. Additionally, in some regions of the United States, building departments are adopting remote technology to conduct inspections (Assaad et al., 2022).

3.2.3 Acceleration of digitization in projects (OT2)

OT2, which is part of the technological opportunities, ranked 3rd in terms of total opportunities and was classified as high importance. The RII reached a value of "0.813". Companies would see this acceleration of digitalization as an opportunity to optimize processes, since as (Pamidimukkala and Kermanshachi, 2021) point out, the industry has advanced in the technological field; this digitalization has even contributed to reducing uncertainty in projects by allowing a more complete and integrated vision of them. Furthermore, with the use of smart technologies to monitor health and safety in the workplace, as evidenced in North America, distancing between workers can be ensured, violations in the use of masks can be detected, and technical cameras can be used to identify possible infected people (Dobrucali et al., 2022) preventing disruptions and increasing employee and customer confidence in the company's ability to handle health crises.

3.2.4 Increased interaction between project agents through digital media (OT6)

This opportunity is present in the 4th ranking of this study with an RII of "0.809", classified as highly important. It is justified because the safety and health of the workers of all construction companies depend on social distancing and the regulatory measures taken by COVID-19. The ability to use digital tools to coordinate tasks, share information, and hold virtual meetings has become an invaluable resource to ensure the safety and health of workers. Then, digital media like virtual reality could be adopted by companies, which can improve the communication efficiency in the AEC applications (Shi et al., 2016).

According to research that covers the opportunities and challenges produced in the United States by the impact of Covid 19, this opportunity ranks third based on 74 respondents with a RII of 0.813 (Dobrucali et al., 2022). This shows that, in Peru and the United States, this opportunity is of great importance according to the survey data.

3.2.5 Digitization of administrative procedures (OT5)

This opportunity is present in ranking 5 of this study with an RII of "0.789" and is classified as medium-high importance. This opportunity is important in the Peruvian context because it was a provision of the Peruvian state that construction companies will send information through digital means (Verán-Leigh and Brioso, 2021). Digitalization should be considered as an opportunity to improve governance, through the restructuring of public services, using digital technologies and taking advantage of them to increase their effectiveness and efficiency to achieve the digital well-being of citizens and substantial savings (Huamán and Medina, 2022).

3.2.6 Improved waste management (OS4)

This opportunity is present in ranking 6th of this study with an RII of "0.785 and is classified as medium-high importance. Improving waste management can bring benefits to the companies, like cost saving and profit maximization, reduced demand for landfill spaces, improved resource management, image improvement, and productivity and quality improvement (Hwang and Bao, 2011).

According to the study conducted by (Dobrucali et al., 2022) in the USA, this opportunity is ranked second in group 2 of opportunities (O2) with an RII of 0.772 based on 74 respondents. We see that in the United States, this opportunity for improvement in waste management is quite like that obtained in Peru, it could be inferred that this opportunity is not influenced by the cultural context or development of the sector.

3.2.7 Increase in remote operations (OT3)

OT3 was ranked 7th, and the Relative Importance Index (RII) reached a value of "0.768". Most of the respondents fully agreed that this aspect plays a fundamental role, due to the coordination that was made using video calls, use of mobile devices, among others. This perspective is supported by the research conducted by (Lingard et al., 2021), which documents successful adaptations carried out by organizations in the construction industry to minimize negative impacts. These adaptations include the rapid transition to remote meetings to facilitate collaboration and information sharing. Some organizations have also implemented virtual site visits to monitor progress and conduct quality control. The rise of remote operations has become inevitable in this context due to the emergence of new technologies capable of real-time, automated tracking of employee health and human-to-human interactions. In addition, existing technologies such as automation, robotics, three-dimensional (3D) printing, and cloud-based applications are being further leveraged (Assaad et al., 2022).

3.2.8 Increased investment in new technologies

This opportunity is ranked 8th with an RII of 0.738 and classified with high-medium importance, due to the pandemic context. Due to regulatory measures and remote work resulting from Covid-19, companies saw the opportunity to increase and investigate the use of new technologies in their activities, for example, (Araya et al. (2024) mention that new technologies were applied in the context of communication in construction projects, where a lot of paperwork was previously used, but during the pandemic, organizations realized that all information can be digitized, which facilitates the flow of information between project members. This idea is supported by (Adhikari and Poudyal, 2021), who mentions that the post-pandemic construction era is expected to be different from today's industry as it will rely heavily on technology and virtual teams and considers it as one of the important impacts caused by the Covid 19 context.

3.2.9 Improved safety standards

The improvement of safety conditions, which is part of the opportunities around safety and health, ranked 9th in terms of total opportunities and was classified as of high-medium importance. The Relative Importance Index (RII) reached a value of "0.736". Furthermore, it is important to note that the worrying situation triggered by the COVID-19 pandemic led to health and safety measures in construction projects becoming of paramount importance globally (Dobrucali et al., 2022), also, it served as an opportunity for companies to become aware of how health and safety measures are in the face of complicated situations. An illustrative example of this approach is evidenced in Australia, where CPM21 stated that the

Australian construction industry experienced an increased awareness and emphasis on health and safety issues (Ogunnusi et al., 2021).

3.2.10 Increased adoption of building information modeling BIM

This opportunity is ranked 10th in this study, with an RII of "0.707" and classified as medium importance. The importance of this opportunity for the companies is because the pandemic forced developers to use this technology to mitigate context impacts. For example, the context limited collaboration among stakeholders, which also limited proper project performance and risk management. In addition, project monitoring had to be done in greater depth, needing to get real-time information, and with this information to visualize the progress of the project effectively, for which BIM was very useful (Adhikari and Poudyal, 2021).

3.3 Other Opportunities

In this section, the opportunities with an RII of less than 0.7 have been considered, and are as follows:

3.3.1 Improved working conditions for workers

In this current study, the importance of this opportunity is still classified as high-medium importance in Peru with an RII of "0.69". (Ogunnusi et al., 2021) conducted their research in all continents except South America and found evidence that in each of the continents studied, significant attention has been paid to health and safety measures. Integrating the two studies, it can be concluded that on all continents work has been done to improve the working conditions of workers.

3.3.2 Improved knowledge management

The importance of this opportunity is still classified as high-medium importance in Peru with an RII of "0.68". This crisis scenario was seen as an opportunity scenario in Peru because it sought to test and generate collaborative knowledge management environments for projects (Figueroa et al., 2021).

3.3.3 Academic collaboration opportunities

The importance of this opportunity is classified with an RII of "0.62". The results found in the study are like those found by (Dobrucali et al., 2022), where they had a mean of approximately 2 people in a survey of 74 professionals. It can be inferred that in Peru, as well as in the U.S. and European countries, academic collaboration due to the pandemic is not widely observed.

3.3.4 Increased productivity of office workers and staff members

This opportunity was the second least important according to Peruvian professionals, but still ranked as high-medium importance according to the calculated RII of "0.62". This importance is demonstrated by the study of (Ogunnusi et al., 2021), with a sample mostly from Africa, which also finds an increase in productivity due to the pandemic, mainly attributed to remote working and the flexibility of office workers. (Dobrucali et al., 2022) mentioned that exists an increase in productivity mainly in office work, but a large drop in productivity in fieldwork.

3.3.5 Development of leadership programs for crisis management

According to the data recorded in this study, the opportunity with the least importance is the development of leadership programs for crisis management with an RII of "0.619", classified as high-medium important for this study. (Dobrucali et al., 2022) do not reinforce this idea and consider this opportunity with an RII of "0.820", ranking second in group 1 of opportunities and with an average of 2.2 among 74 respondents.

4. Conclusions

The present study evaluated the impact of the COVID-19 pandemic on the Peruvian construction sector. The literature review and interviews with expert judgments identified 15 opportunities. According to the survey provided, the greatest opportunities have been: greater emphasis on hygiene programs, the use of remote work technology, the acceleration of digitization in projects, greater interaction between project agents through digital media and digitization of administrative procedures. It can also be noticed that COVID-19 has generated an acceleration in the adoption of new technologies in the Peruvian construction sector, generating an opportunity for digitization.

Also, the study has several limitations because the results obtained could change if the survey is conducted in another country, mainly because the opportunities will also depend on the digitization of the sector and the hygiene programs that the countries may have. In addition, the perception of opportunities may be affected by the measures taken by the countries during the pandemic. Additionally, results may vary with a larger sample size; in the case of the present study, 110 professionals were surveyed. The authors recommend conducting similar studies of opportunities in other countries so that

opportunities in different contexts can be compared and evaluated.,

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