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Impacts of the COVID-19 Pandemic on the Philippine Construction Industry: Problems, Opportunities, and Risk Management Methods of National Capital Region-based Contractors

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Abstract — *The COVID-19 pandemic not only threatened the health and safety of individuals but also affected economies and industries worldwide. Considered one of the drivers of economic development, the construction industry suffered from the impacts of the pandemic. Therefore, documented pandemic impacts are crucial to preparing for the next health emergency. With this, the study aims to investigate the impacts through an online survey with respondents of 50 project managers, executives, and project staff from contracting companies based in the National Capital Region. These professionals offered information on the construction industry during the pandemic, including the prominent impacts encountered, risk management methods implemented, opportunities experienced, and their willingness to apply construction technologies. The most prominent impacts included the financial burden due to additional health and safety requirements, project suspension and delays, reduced productivity, and material and equipment procurement difficulties. The opportunities experienced involved increased demand for healthcare and infrastructure projects. The implemented risk management methods included the health and safety protocols such as using personal protective equipment, temperature checks, and mandatory RT-PCR testing on suspect cases, among others. Furthermore, other innovative strategies implemented were the use of digital technologies, workforce transformation through the work-from-home set-up, and policy responses. Lastly, respondents were most interested in applying prefabrication and modular construction technologies in their construction process. Overall, the study aims to be a reference for the construction industry's stakeholders who wish to understand the impacts of the pandemic and to determine possible pandemic risk management strategies for a safe and productive construction process..*

Keywords — pandemic, impacts, safety guidelines, Philippine construction industry, contractors

I. INTRODUCTION

The unexpected scale and severity of the coronavirus disease (COVID-19) prompted the World Health Organization to declare the COVID-19 outbreak as a global pandemic on March 11, 2020 [1]. With the virus transmitted through person-to-person contact (e.g., respiratory fluids), face-to-face interactions were limited to the point that outdoor activities were reduced by 50% during the height of the pandemic [2].

With this, economies and industries were severely affected. The construction industry, in particular, experienced several challenges. One major consequence of the pandemic was the delay in the completion of construction projects. According to a survey conducted by the

Associated General Contractors of America [3] 78% of the contractors experienced project delays and even cancellations. Manpower issues were also observed during the pandemic period. King et al. [4] stated that reverse migration was an issue among workers while Lingard et al. [5] emphasized the effects of the pandemic on the workers' mental health. All these problems eventually led to financial problems [6-7] and increased contractual disputes due to incomplete project deliverables. It did not help that there were contracts that only contain vague provisions in the event of a major health emergency [8]. Eventually, the industry's stakeholders were challenged to adjust and develop their project management strategies to incorporate necessary health and safety protocols [6].

The Philippines was not spared with the first confirmed case recorded on January 30, 2020 [9], and as the number of confirmed cases continued to rise, the Philippine government eventually declared a state of public health emergency throughout the country on March 9, 2020 [10]. The construction industry in the Philippines also suffered serious effects with the Philippine Statistical Authority (PSA) [11] recording the lowest number of approved building permits when the strictest lockdowns were implemented in the second quarter of 2020. There were only 16,004 approved building permits with an alarming equivalent annual growth rate of -65.5%. The former Philippine Constructors Association Inc. President Will Dacena even expressed his concerns about the shortage of skilled workers caused by travel restrictions and the workers' fear of infection [12].

Even though data on the impacts of the COVID-19 pandemic on the Philippine Construction Industry exists, there are still some unexplored aspects. Therefore, this study focused on compiling useful information regarding the impacts of the COVID-19 pandemic on the Philippine construction industry. It should be noted that this paper acknowledges that there are several types of risks, both internal and external, developed in the construction industry. However, the study shall only focus on the risks specifically brought by the pandemic, and the influence and impacts of risks outside this category were not tackled in the paper. To be more particular, the problems encountered, opportunities experienced, and risk management methods implemented by Philippine Contractors Accreditation Board (PCAB) licensed contractors based in Metro Manila were compiled and analyzed. As a culmination of all the obtained results, a proposed framework for achieving pandemic resilience in the construction industry was developed as the final output of this paper. [please explicitly state the main and specific objectives of the study]

The findings may be used as a reference for prevalent impacts, opportunities, and trends by the construction industry as it adapts and recovers from the impacts of the COVID-19 pandemic. Also, the different health and safety strategies presented in the study may be used as a guide for incorporating pandemics into the existing risk management strategies of contracting companies and other relevant stakeholders.

In order to ensure the generalizability of the acquired results, an ample amount of time (4 months) was dedicated to distributing the online survey to contractors from different parts of the Philippines. However, with more than 4,000 invitations sent, not including the follow-ups, only 67 contractors were able to submit valid responses. Therefore, to consider the current pool

of respondents, it was ultimately decided that the scope of the study be limited to the National Capital Region where 50 valid responses were obtained.

II. METHODOLOGY

2.1 Study Area

The National Capital Region was the selected area for this study. In particular, project managers, project staff, and executives affiliated with Philippine Contractors Accreditation Board (PCAB) licensed contractors were asked to participate in the online survey. The respective contracting companies of the respondents were verified through the Philippine Contractors Accreditation Board (PCAB) License Verification Portal (access here: https://pcabgovph.com/verify/). The filter function was used to identify NCR-based contractors.

2.2 Sampling Techniques

Stratified random sampling was the sampling method for this research paper. To develop the framework for measures to achieve pandemic resilience in the construction industry, respondents were obtained from different contracting companies with specific contractor license categories defined by the Philippine Contractors Accreditation Board (PCAB). Each contractor license category was considered as a group or strata. The study collected sufficient responses from 67 respondents from different regions of the Philippines, among them were 50 NCR-based contractors.

2.3 Data Collection

The primary data was obtained through an online survey containing structured (multiple-choice questions such as semantic differential scale and Yes/No questions) and unstructured questionnaires (open-ended questions). This online survey was done to determine the prominent problems encountered, establish the different opportunities experienced, identify the leading risk management methods implemented by the contractors, and solicit opinions on the willingness of the respondents on applying construction technologies such as remote monitoring, prefabrication, and modularization to help alleviate the limitations on the construction process during and after the pandemic. Additionally, the secondary data was obtained through academic journals.

2.4 Data Analysis

2.4.1 Survey Response Quality Checks

Before analyzing the data, quality checks were done to determine the validity of the responses. The first step was the removal of duplicated responses since the study focused on gathering one respondent per contracting company. The second part was based on the screening questions wherein respondents who were confirmed to be employed in PCAB-licensed contracting companies, and whose jobs either involve being present at the project site during the pandemic (e.g. site engineer, project manager) or those who are executives in their respective companies were deemed as valid respondents. Lastly, the respondents' answers to the closed-ended and open-ended questions were examined to identify who selected the same answers to the semantic differential scale questions and gave illogical answers in the

mandatory open-ended questions. With this, out of the 73 responses obtained during the 4-month-long administration of the survey, only 67 responses (50 from NCR) were considered valid.

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2.4.2 Relative Importance Index

The Relative Importance Index (RII) was applied in this study to determine and rank each factor's contribution to the contractors' experiences during the pandemic period based on their relative importance. The data analyzed and ranked were the problems encountered by the contractors, the implemented risk management policies of their respective companies, and current infrastructure projects. The index has used a 5-point semantic differential scale: 1, 2, 3, 4, and 5 to quantify the relative importance. Table 1 and Table 2 describes the scale with the corresponding ordinal number and description.

Table 1. Rating Scale of Problems Affecting Contractors during the Pandemic Period

Ordinal Number	Description
5	severe experience
4	substantial experience
3	moderate experience
2	minor experience
1	negligible experience

Table 2. Rating Scale of Risk Management Methods Implemented by Contractors during the Pandemic Period

Ordinal Number	Description
5	strongly applied
4	substantially applied
3	moderately applied
2	slightly applied
1	not applied

The Relative Importance Index was calculated based on frequency to analyze the rating of each measure using the following formula [13]:

$$Relative\ Importance\ Index\ (RII) = \frac{5n_5+4n_4+3n_3+2n_2+n_1}{5(n_5+n_4+n_3+n_2+n_1)} \quad (1)$$

where n_5, n_4, n_3, n_2, n_1: the number of respondents who answered a particular ordinal scale for a specific factor (e.g., n5 is the number of respondents who answered 5)

2.4.3 Qualitative Analysis

Thematic analysis was applied to determine, analyze, and interpret patterns of meaning within the gathered qualitative data. The data obtained were from the open-ended questions and were processed to generate themes representing the new insights and concepts on the

impacts of the COVID-19 pandemic on the Philippine construction industry, particularly on the problems encountered, opportunities experienced, and implemented risk management guidelines.

2.5 Development of Framework on Strategies towards Achieving Pandemic Resilience

The findings from the different sections of this research were collated and organized. In particular, the three main elements determined in this paper; namely, the problems encountered, opportunities experienced, and risk management guidelines or methods implemented by different contractors in the Philippines, were the basis to formulate a framework for the overcoming impacts of the COVID-19 pandemic on the Philippine construction industry. The framework is composed of three different milestones. A cyclical format emphasized how each milestone could happen simultaneously and are not mutually exclusive. The pandemic brought challenges, and the industry could only adapt by constantly improving. Therefore, it is crucial to note that building pandemic resilience involves complex processes requiring excellent knowledge, skills, and perseverance. This framework may be used as a reference for the construction industry's stakeholders as they progress towards pandemic recovery.

III. RESULTS AND DISCUSSION

Survey administration lasted for four months before the target sample size of 50 NCR-based contractors was obtained. Each respondent has first-hand experience with the pandemic's impacts and is extensively involved in their respective company's pandemic planning and response. Shown in Figure 1 is the distribution of the companies in terms of contractor type and PCAB License Categories.

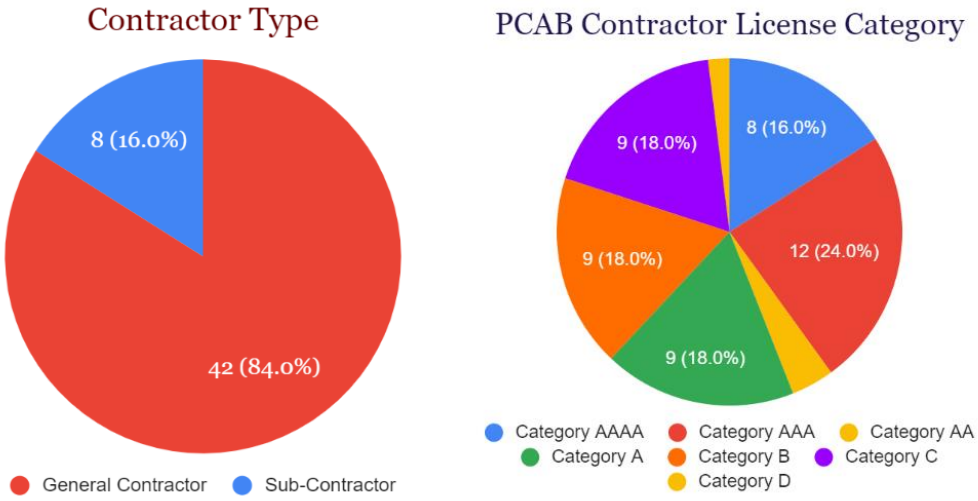

Figure 1. Distribution of Respondents based on Contractor Type and PCAB License Category

3.1 Problems Encountered during the Pandemic

The first section of the survey involved the different problems experienced by the respondents during the pandemic. A literature review composed of both international and local sources [4,6,8,14-16] was first executed to compile fifty (50) different problems as stated in Table 3. The nature and extent of these impacts largely depended upon the type, location, and people behind the construction projects. Direct effects have ranged from the disruption of supply chains, suspensions, delays, and, in some instances, cancellation of projects. Construction activities remained difficult as more restrictions were implemented to prioritize health and safety. The full magnitude and scope of the impacts arising from the pandemic that is needed to be addressed are still unknown. This paper offers the most general results, and the analysis may change as the construction industry moves forward and adapts.

Table 3. List of Problems Encountered during the Pandemic*

Category	Problems Encountered during the Pandemic
Project Delay, Suspension, and Cancellation	Delayed start of new construction projects.
	Suspension of ongoing projects.
	Increased delays and/or cancellations of commercial infrastructure projects.
	Decrease in retail/business space demand.
	Cancellation of ongoing projects.
	A surge of design modification requests.
	Reevaluation of plans on air filtration and ventilation systems.
	Decrease in warehouse construction projects.
	Increased delays and/or cancellations of oil and gas sector-related projects.
Financial Difficulties	Additional operational costs due to health and safety requirements.
	Payment delays due to lack of funds or cash flow issues.
	Decrease in profit margins.
	Additional budget constraints on ongoing/impending projects due to client requests.
	Additional costs due to delays caused by lack of supplies.
	Additional costs on the cancellation or continuation of projects.
	Bidding for projects despite the lower profit.
	Additional costs from liquidated damages.
Materials and Equipment	Difficulty in procuring material and equipment from other countries due to travel restrictions.
	Material or equipment delivery delays.
	Disrupted material supply due to non-operational local manufacturers.
	Shifting to an alternative supplier.
Manpower and Productivity	Reduced workforce due to health and safety requirements.
	Workers' absence due to personal reasons
	COVID-19 infection-induced anxiety among the workers.
	Staggering of work operations to decrease people onsite at the same time.
	Workers have difficulty adjusting to the new safety protocols.
	Workers are getting sick or infected.
	Increased demands for sick leaves.
	Reduced hiring opportunities for skilled and unskilled workers.
	Workers have difficulty adjusting to long workdays due to staggering.
	Workers have difficulty doing work due to a lack of materials and/or equipment.

Category	Problems Encountered during the Pandemic
Workplace Issues	Difficulty in implementing social distancing due to the collaborative nature of construction work.
	Subcontracting personnel has higher risks of infection due to workplace transfers.
	High infection risk due to possible asymptomatic cases.
	Difficulty in providing workers' accommodations while ensuring social distancing.
	Temporary shutdown of site for quarantine and disinfection due to positive cases.
	High infection risk due to delivery workers and suppliers.
	Non-site personnel struggling to transition to work-from-home set-up.
	Lack of health workers staying onsite.
	Difficulty in acquiring COVID-19 test kits.
	Shortage of personal protective equipment (PPEs) like masks and face shields.
Contractual Issues and Disputes	Delayed payments and commitments due to lack of cash flow.
	The contractor invokes force majeure provisions.
	Disputes due to delays in material and equipment delivery.
	Owner-contractor dispute due to continuous delay.
	The client enforces liquidated damages provisions due to a lack of sufficient output.
Permit Procurement and Site Inspections	Difficult to obtain permits due to the remote set-up of government agencies.
	Government agencies lack sufficient technology to process permits during the transition to remote setup.
	Schedule delay due to inability of the client to obtain certification of work.
	Delayed site inspections.

*Sources:
King S, Rahman R, Fauzi M, Haron A. (2021)
Alsharef A, Banerjee S, Uddin S, Albert A, Jaselskis E. (2021)
Casady C, Baxter D. (2020)
Assaad R, El-adaway I. (2021)
Associated General Contractors of America (2020)
Philippine Constructors Association Inc. (2020)

These problems were rated by respondents from 1 to 5, as stated in Table 1. Afterwards, the relative importance index (RII) was calculated to determine the most prominent problems encountered by the contractors. Indicated in Figure 3 are the Top 11 problems with RII ranging from 0.74 to 0.91. The additional costs due to health protocols topped the list with an RII of 0.91. Other prominent impacts include workforce-related issues like those with an RII of 0.79, such as reduced workforce due to the requirements, and workers' absence due to personal reasons. COVID-19-induced anxiety among workers is also prominent with an RII of 0.74.

Next on the list pertain to project suspension (RII = 0.74) and delay (RII = 0.78); these events are evident during the initial implementation of ECQ on March 17, 2020, after the Department of Public Works and Highways (DPWH) Secretary ordered the suspension of "all construction projects in Luzon" to ensure strict compliance with the Enhanced Community Quarantine (ECQ) health and safety guidelines [17]. Another prominent consequence of the lockdowns was the disruption of the supply chain in the country, specifically the procurement of materials from other countries (RII = 0.76). Finally, financial difficulties were eventually encountered due to adjustments and issues. In particular, cost-related issues were prominent among the contractors. Other than the costs due to protocols, payment delays (RII = 0.77), decreased profit margins (RII = 0.77), budget constraints (RII = 0.75), and costs due to delays

in supplies (RII = 0.74) were largely experienced by the contractors during the pandemic period.

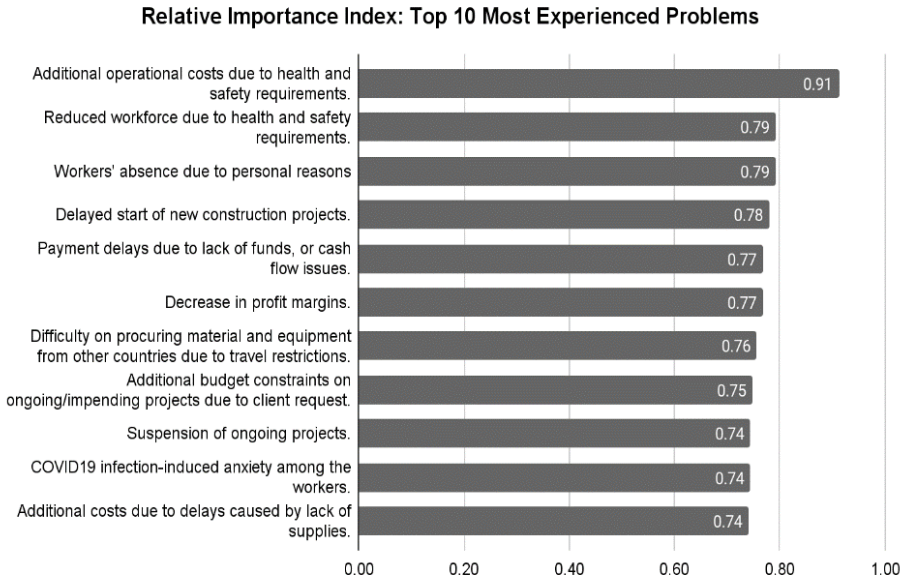

Figure 3. Relative Importance Index: Top 11 Most Experienced Problems

3.1.1 Project Delay, Suspension, and Cancellation

Figure 4 showcases the Relative Importance Index of all problems under Project Delay, Suspension, and Cancellation. Project suspension and delays were apparent to all contractors. The survey included specific types of projects such as those that fall under commercial, retail, warehouse, and oil and gas sector-related projects. With limited respondents whose company handles oil projects, the impact fell at the bottom of the list with an RII of 0.40. Those who consider the delays of these specific projects as severely experienced were large contractors. However, with the oil demand decreasing due to a drop in travel demand and the oil price in the global market hitting the negative due to oversupply last 2020 [18], projects in the oil and gas sector were affected.

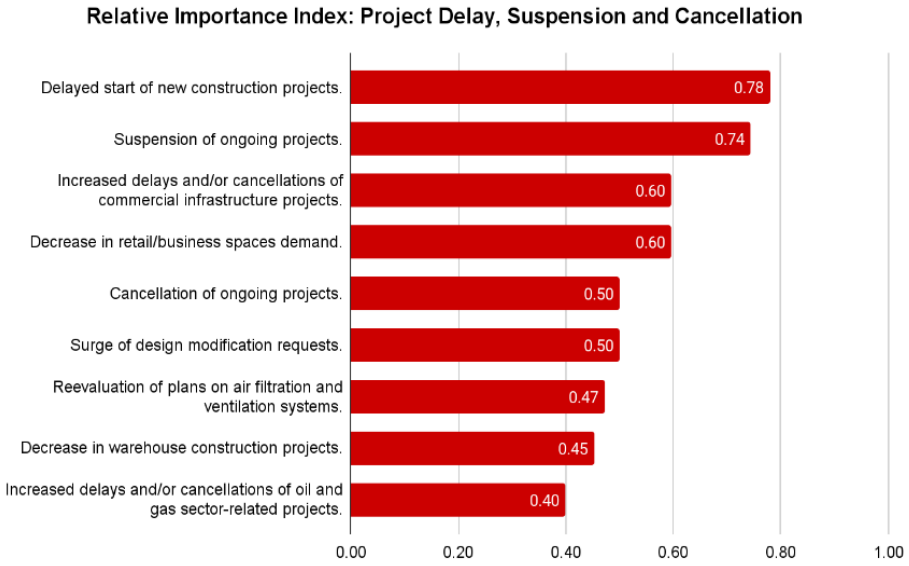

Figure 4. Relative Importance Index: Project Delay, Suspension, and Cancellation

3.1.2 Financial Difficulties

In this sub-section are the problems involving the financial stability of the contractors during the pandemic. The implementation of pandemic health and safety guidelines, the lockdowns, and travel restrictions added numerous burdens to contractors in terms of new expenses. As seen in Figure 5, this includes additional costs due to health and safety requirements (RII = 0.91), delays of materials and equipment (RII = 0.74), and cancellation and suspension of projects (RII = 0.71). A particular insight made by a respondent explained a possible reason why the cost of health and safety protocols obtained a high RII of 0.91. The contractor expressed their grievances since expenses during a public health emergency are part of the operations cost and thus paid by clients. To elaborate, it was stated in the Construction Guidelines for Project Implementation during the period of Public Health Emergency [19] that according to Section 21 of DOLE D.O. 198, s. 2018, "The total cost of implementing an OSH (Occupational Safety and Health) program shall be an integral part of the operations cost. It shall be a separate pay item in construction and all contracting or subcontracting arrangements." Thus, implying that the project owner will cover costs inflicted during a public health emergency. These costs include testing kits, personal protective equipment, workers' barracks, quarantine facilities, isolation rooms, disinfectants, etc. Possible lax in implementing guidelines on the responsibilities and obligations of the client and contractor during this pandemic may be taking place for it is clearly stated that the project owners shoulder such costs.

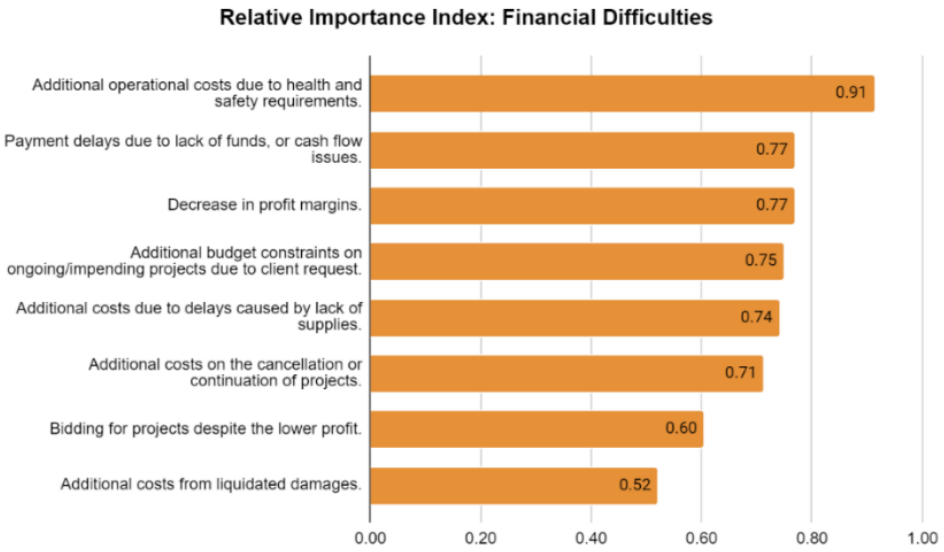

Figure 5. Relative Importance Index: Financial Difficulties

3.1.3 Materials and Equipment

With the implementation of community quarantine, strict travel restrictions were imposed to control people's mobility, and thus control the spread of the virus. However, one serious consequence was the disruption of the supply chain in the country. Some specific problems included the decreased capacity of local manufacturers due to their internal management and workforce-related issues due to the pandemic. Also, delivery delays and procurement difficulties due to lockdown restrictions were experienced. As illustrated in Figure 6, the most prominent among the problems under material and equipment was the procurement of materials from international suppliers with an RII of 0.76 followed by delivery delays (RII = 0.73), disrupted material supply due to non-operational manufacturers (RII = 0.70), and shifting to other suppliers (RII = 0.66).

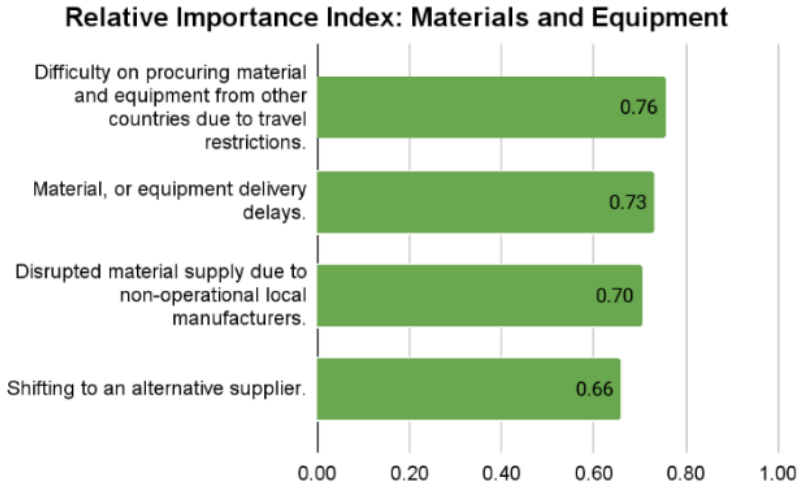

Figure 6. Relative Importance Index: Materials and Equipment

3.1.4 Manpower and Productivity

Next are problems involving manpower as exhibited in Figure 7. With the health and safety limiting the number of workers on-site, the capacity and productivity of the entire construction operation are affected. In particular, the highest RII of 0.79 shows some of the reasons behind the reduced manpower within the site, namely, social distancing requirements, and workers' personal decisions to be absent. In terms of personal reasons, no contractor offered any specifics. Aside from that, some contractors pointed out that the workers experienced anxiety and depression due to fear of being infected. This was mirrored by the RII of 0.74. Other workforce issues are also indicated, such as the infection of workers with an RII of 0.70, difficulty adjusting to safety protocols with an RII of 0.71, and many more. On the difficulty in hiring skilled and unskilled workers (RII = 0.68), it was stated by a contractor that some of the interested workers backed out due to commuting difficulties.

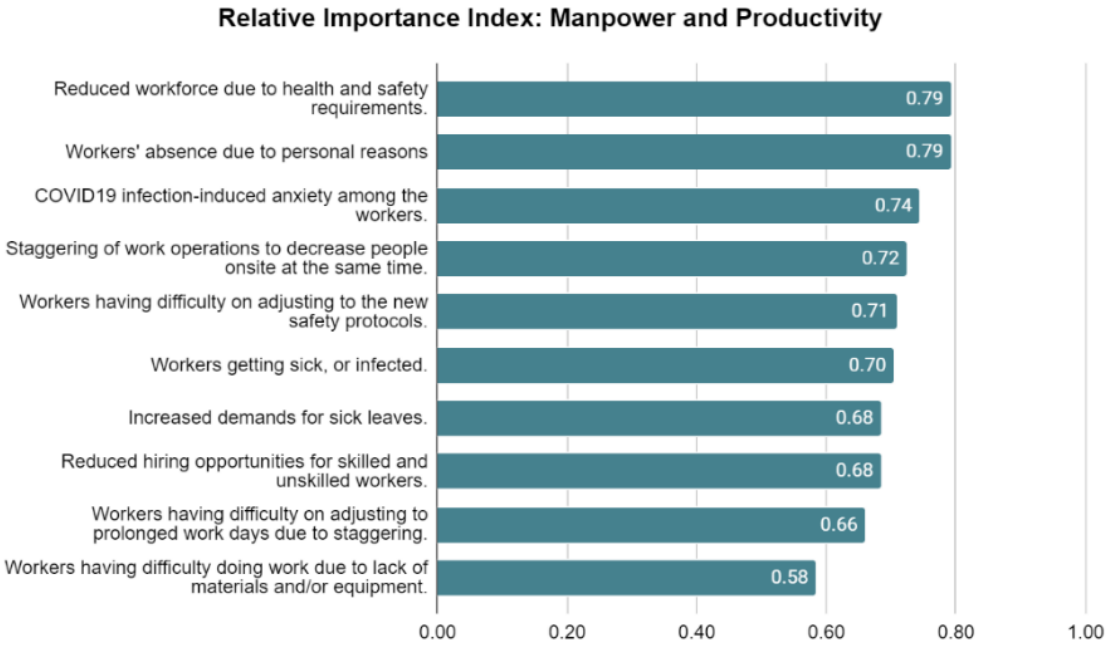

Figure 7. Relative Importance Index: Manpower and Productivity

3.1.5 Workplace Issues

The problems indicated in Figure 8 involve those that occur within the site and office. The most prominent impact involves the difficulty in implementing safety protocols during the initial phases of the pandemic with an RII of 0.70. This was when risk management strategies were still in the planning phase, and the duration of the lockdowns was still unknown. Other impacts are relatively less experienced with the difficult procurement of test kits (RII = 0.51) and PPEs (RII = 0.43) at the bottom of the list.

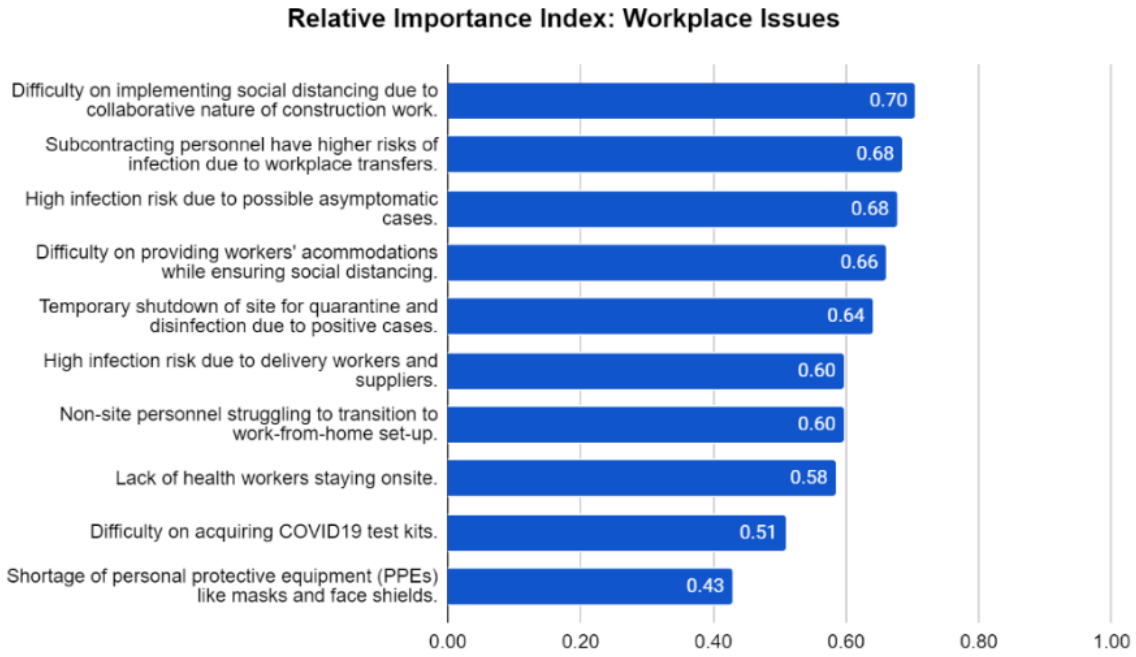

Figure 8. Relative Importance Index: Workplace Issues

3.1.6 Contractual and Legal Issues and Disputes

For this section, contractual disputes resulted from delays, restrictions, and the constant uncertainty of project construction. As illustrated in Figure 9, a relatively low RII of 0.62 was the highest among contractual issues. This involved delayed payment and commitments due to a lack of cash flow from the client and the contractors. One of the contractors stated their difficulty during billings was mostly due to the clients' financial problems. Eventually, they had to compromise by deferring their payments to their suppliers or issuing post-dated checks to extend the contractor's cash flow. Not only that, contractors experienced disputes with clients not giving full cooperation by rejecting to pay until the end of the project, thus increasing the contractor's losses. This would push some of the contractors to back out from the projects or invoke force majeure provisions.

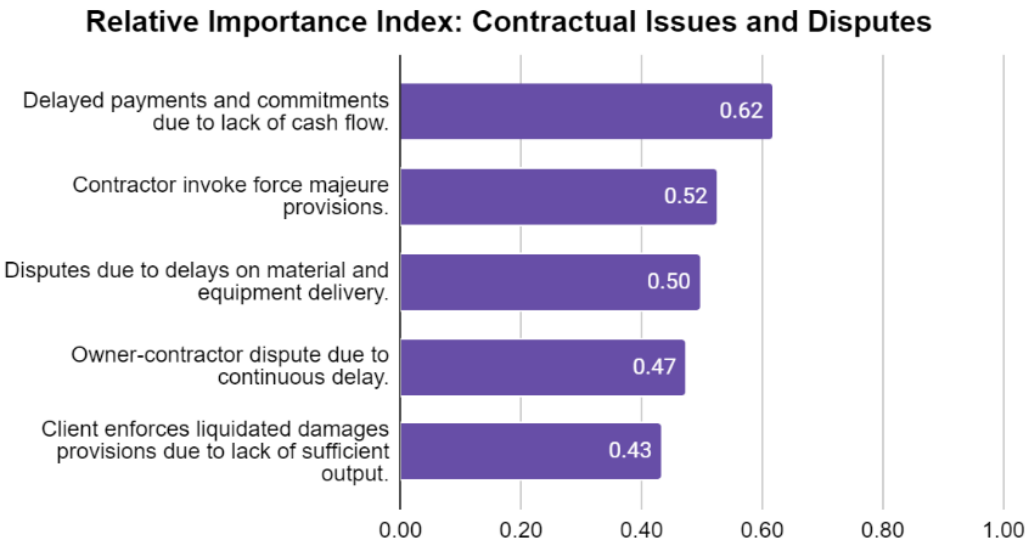

Figure 9 Relative Importance Index: Contractual Issues and Disputes

3.1.7 Permit Procurement and Site Inspections

For the final section under the problems encountered, permit procurement difficulty has the highest RII of 0.71 as observed in Figure 10. There was a difficult transition period where corporations and institutions raced to adapt to new restrictions imposed due to the pandemic. This included work-from-home set-up. and skeletal workforce. One contractor, in particular, stated that government agencies' transition to work online set-up required patience, and only after the situation stabilized could they closely available processing platforms. Furthermore, with an RII of 0.60, the contractors experienced delayed site inspections. Unlike the initial phase of the pandemic, where site inspections were halted entirely, inspections are now conducted while following guidelines. However, fewer site visits made it more challenging to ensure the construction process was carried out accurately and without delay.

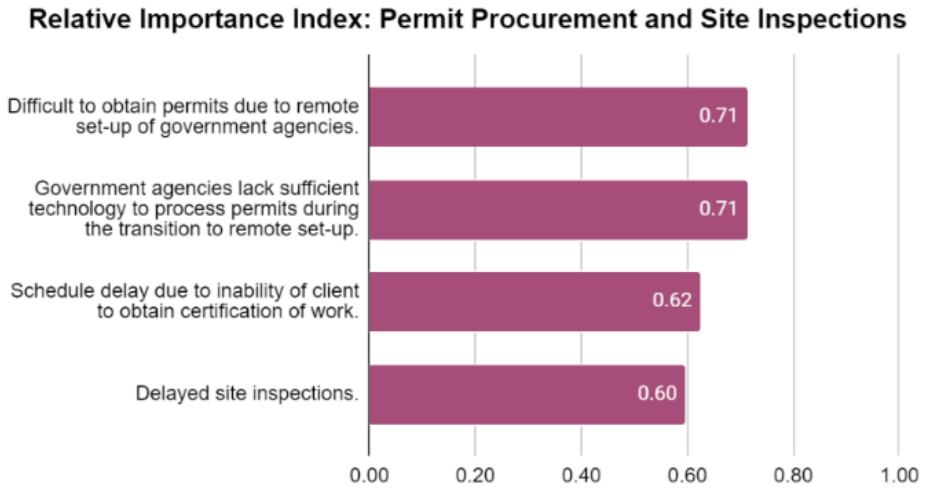

Figure 10. Relative Importance Index: Permit Procurement and Site Inspections

3.2 Risk Management Methods

As expounded in the previous section, a considerable number of impacts brought by the COVID-19 pandemic affected the construction industry to the point that its stakeholders felt a keen sense of urgency to address both the short-term and long-term business impacts, as well as formulate project-to-project strategies to adapt to the new environment brought by the health crisis.

3.2.1 Compliance with Health and Safety Protocols

There are several strategies to mitigate the impacts of the pandemic. One of which is the implementation of health and safety protocols by the government. In particular, the second part of the survey focused on the different guidelines included in the Department Order No. 30 Series of 2021: Revised Construction Safety Guidelines for the Implementation of Infrastructure Projects During the COVID-19 Public Health Crisis, Amending GC No. 39, Series of 2020 [20].

In this section, the respondents were asked to rate the implementation of these protocols in their respective companies and project sites. Again, the relative importance index was utilized to rank and determine the most applied among the 30 risk management methods indicated. The results showed high RII values that may imply how the contractors ensured that the protocols are followed for the safety of the personnel and the completion of the projects. What belongs to the top 10 are essential strategies found in any establishment.

As seen in Figure 11, the first method with the highest relative importance index was temperature checks with an RII of 0.93. The next three with an RII of 0.92 focused on the protocols for the suspect and positive cases. The next three with an RII of 0.90 focused on preparations before entering the site, such as personal protective equipment (PPEs), disinfection facilities, COVID-19 risk briefings, etc.

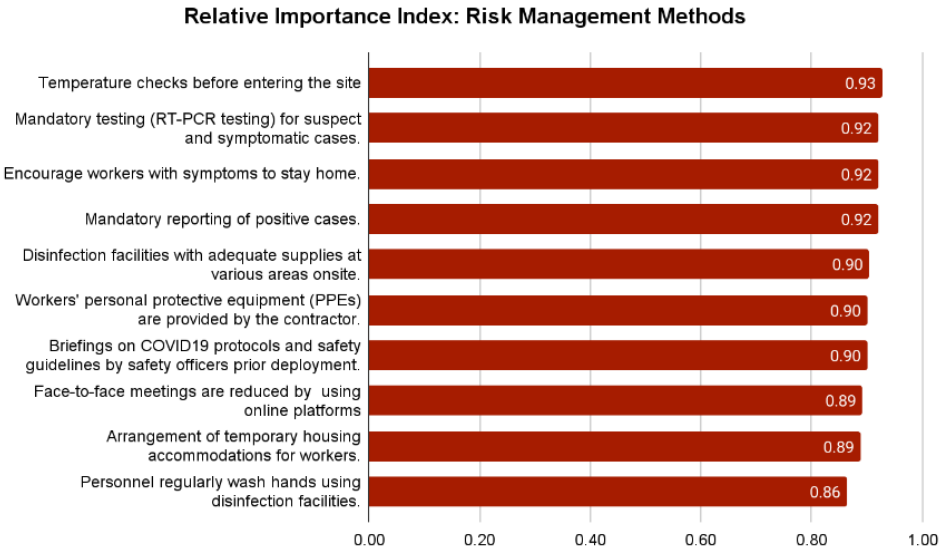

Figure 11. Relative Importance Index: Risk Management Methods (Rank 1 to 10)

Moving on to Figure 12, it indicated the methods with the lowest relative importance index, particularly those with an RII of 0.71, namely, mental health assistance and health workers on-site. Although relatively high in terms of RII, by examining the individual responses of the contractors, there were still those that do not prioritize these two strategies. However, what was alarming was that the DO. 30 of DPWH specifically stated that a health worker is available on-site to monitor the health and being of the workers. This could imply a lax in the implementation of the guidelines, specifically on having the presence of a health worker during the project implementation. This result was mirrored by a study done by Ibanez and Quezon [21]. They pointed out that the lack of healthcare workers on-site was the leading factor affecting the productivity of construction workers in Cagayan. This matter needs to be addressed since these health workers are crucial in ensuring the health and safety of the workers. On the other hand, mental health assistance was still not a priority to some contractors, for there were other more crucial guidelines to be implemented and prioritized.

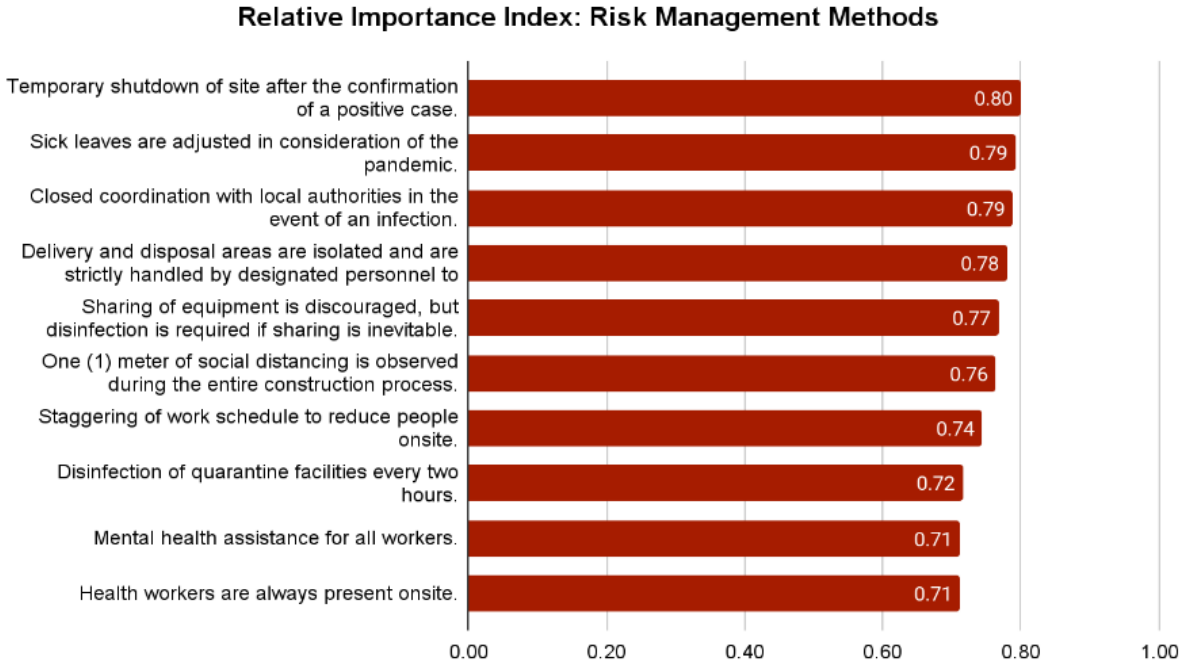

Figure 12. Relative Importance Index: Risk Management Methods (Rank 21 to 30)

3.2.2 Strategies to Protect the Workplace

3.2.2.1 Shift to Digital Technologies

A significant change experienced by the contractors was the shift to various digital technologies. These technologies allowed the companies to operate remotely, thus decreasing social interactions that could lead to the spread of COVID-19. One such example is the exchange of stakeholders' ideas during a construction project's planning and design stage. Instead of face-to-face meetings to discuss the details behind the project, they opted to meet using video conferencing software programs such as Zoom and Jitsi and messaging software applications like Viber and Facebook Messenger. Aside from these platforms, software

programs for aiding the construction process were increasingly utilized by contractors like Primavera and Building Information Modelling.

3.2.2.2 Workforce Transformation

As discussed in Section 3.1, reduced workforce due to health and safety requirements was among the most prominent impacts of the pandemic. And with less manpower, productivity would eventually decrease. Different strategies were used to maintain acceptable operational performance and productivity levels despite the fewer personnel. Flexible work arrangements were implemented to reduce the traffic inside the workplace without decreasing the necessary number of work hours. This included remote set-up, staggering work shifts, and a skeletal workforce.

3.2.2.3 Policy Responses to COVID-19

Additional costs put more financial burden on the contractors. Therefore, it was crucial to develop strategies to extend the cash flow and continue operations, such as careful monitoring and use of resources. One particular strategy focused on the policies implemented to mitigate the impacts of the pandemic in the Philippines. The Republic Act No. 11494 (Bayanihan to Heal as One Act) [22] offered leeway regarding existing and future loans. A 60-day grace period was given for the payment of all existing loans and the relaxation of the requirements for any business-related loans and financial accommodations. Furthermore, the Bayanihan Act also aided in the construction industry's recovery by prioritizing the budget for Local Infrastructure Programs (LIPs) of the Department of Public Works and Highways (DPWH). The law also directed DPWH to expedite existing infrastructure projects to generate jobs and aid in the recovery of the local economy.

3.3 Grasping Opportunities Brought by the Pandemic

Simply analyzing and addressing the impacts brought by the pandemic may be insufficient for the construction industry to emerge stronger from this health crisis. It is vital to develop a deep understanding of the changing market. To detect and assess these shifts, the first step is to lay out the consequences of new behavioral and economic trends to determine which specific structures or projects will most likely grow or contract in terms of demand. As an example, consider how the pandemic forced people to stay at home. This may increase demand for residential dwellings capable of essential facilities such as office space. For this section, the contractors were asked to describe the changes in project demand they experienced during the pandemic. This may be used as a reference and guide for the fluctuating construction market.

3.3.1 Healthcare Facilities

First among the most affected project types are the healthcare facilities. With the Philippine healthcare system challenged by the unexpected demands of the pandemic, medical facilities prioritized the diagnosis and treatment of COVID-19-infected patients. One instance was how the Philippine General Hospital temporarily stopped accepting non-COVID-19 patients when the cases hit a record high last August 2021 [23]. Quarantine facilities are crucial during the pandemic, especially to tackle asymptomatic and mild confirmed cases. These needs and demands highlighted the weaknesses of the country’s healthcare system and the need for accessible healthcare facilities and services with adequate resources. And to meet such continuous demands, the Philippine government focused on prioritizing the construction of

health and quarantine facilities. One particular project was when the Department of Public Works and Highways built quarantine facilities in Eastern Visayas using modular construction [24]. This continuous demand increase led to many contractors expressing their regrets about their lack of qualifications to construct these facilities and were working on increasing their abilities to bid for these projects.

3.3.2 Infrastructure Projects

Another upward trend observed by the contractors was infrastructure projects. These projects involve the development of essential structures, systems, and services like highways, bridges, airports, etc. This rise was due to the government prioritizing the implementation of the Build-Build-Build Program to stimulate the economy and provide employment opportunities. According to Presidential Communications Operations Office (PCOO) Secretary Martin Andanar, more than 29,000 road projects under the Department of Public Works and Highways, and 671 projects under the Department of Transportation have reached completion this 2021 [25]. Contractors especially expressed their interest in participating in projects under this program, describing them as "big-ticket projects."

3.3.3 Commercial and Residential Spaces

During the pandemic's peak in 2020, where strict lockdowns were implemented, workers and students were required to stay at home, and establishments such as malls and restaurants temporarily stopped providing services. These events rendered commercial spaces vacant for a couple of months. In particular, the Bangko Sentral ng Pilipinas Commercial Property Price Index showed decreased prices in the second half of 2020 [26]. On the other hand, the decline in demand for residential units was due to the lack of tenants and buyers, and other pandemic-related uncertainties. This was also illustrated by the Bangko Sentral ng Pilipinas Real Estate Price Index. The housing market fell during the second quarter of 2020, driven mainly by the downtrend of property prices in the NCR, especially condominium units. The fall in the price of condominium units may stem from how practical such structures were during the pandemic.

3.4 Contractors' Perception and Willingness in the Application of Construction Technologies

The COVID-19 pandemic prompted the outlook toward digital devices and accelerated decisions regarding investments in different technologies. Therefore, the technological transformation of the construction industry may continue to develop. According to the Philippine Constructors Association [17], one of the expected long-term trends in the industry is the investment in innovation and technology. That is why in this section, the contractors were prompted whether they were willing to apply different technologies to aid their construction process.

Observing Figure 13, more than 50% of the respondents were willing to apply the indicated construction technologies in their future projects. Prefabrication and Modularization have the highest percentage of willingness with 88%, for these are already being applied in the country. The advantage of these methods is the assembly of members or whole structures within a controlled environment. These methods are followed by Cloud-based Applications (86%), Data Analytics (80%), and Machine Learning (76%). Applying these technologies allow contractors to optimize their construction processes such as design, project management, and estimation. 3D scanning, on the other hand, has 78% of respondents willing to apply the

method. This technology can capture detailed and accurate information for every part of the site. Next are unmanned aerial vehicles (UAV) and 3D printing, with 74% agreeing. Finally, the technologies with the lowest willingness percentages are Artificial Intelligence (64%) and Virtual and Augmented Reality (60%).

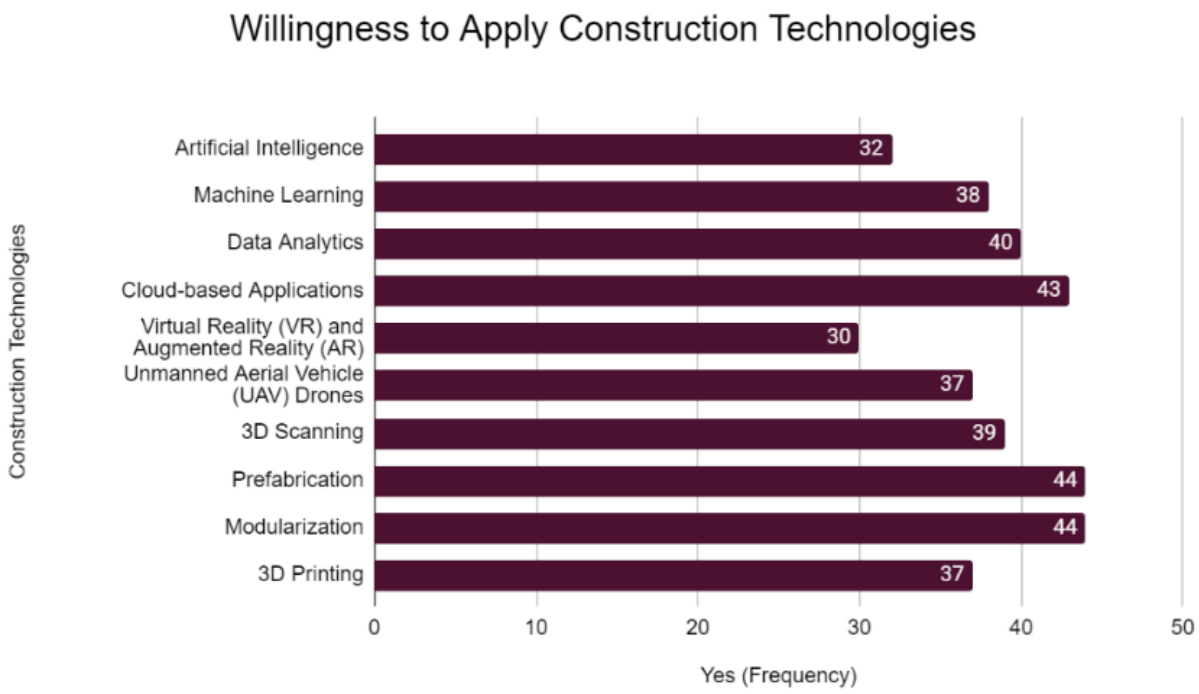

Figure 13. Contractors' Willingness to Apply Construction Technologies to Improve Their Construction Process

3.5 Proposed Framework on Achieving Pandemic Resilience of the Philippine Construction Industry

As a culmination of this study, a conceptual framework for achieving a pandemic-resilient construction industry is demonstrated in Figure 14. This framework focused on specific strategies and methods to mitigate the effects of a pandemic. The contractors may integrate this process into their existing risk management systems not only to recover from the COVID-19 pandemic but also to prepare for the next possible health emergency.

3.5.1 Preparation Stage

Contractors must conduct risk identification and assessment procedures without any delays. The prediction and identification of risks during the early stages of the project will provide more opportunities for risk mitigation and avoidance techniques. Major types of impacts were indicated in the framework. Furthermore, a COVID-19 response team focused on formulating strategies is recommended for the company to have a specific workforce dedicated to understanding and mitigating the effects of the pandemic.

3.5.2 Response Stage

Contractors are recommended to adopt innovative approaches to mitigate the impacts of the COVID-19 pandemic and to take advantage of any opportunities. Some of these strategies include the shift to digital technologies, implementation of health and safety protocols, and the utilization of policy responses by the government like the Bayanihan Act. In terms of opportunities, assessment, and analysis of current market trends will give valuable insights into shifts in project demands, and the supply chain, among others.

3.5.3 Recovery Stage

Finally, long-term planning and preparation for the post-pandemic period are recommended for the industry's recovery and a more resilient construction process. It is recommended to focus on digital transformation through technologies like data analytics, drones, and cloud-based applications. And if proper resources are available, the adaptation of alternative construction methods such as prefabrication and modularization allows for more productivity without increasing the project costs.

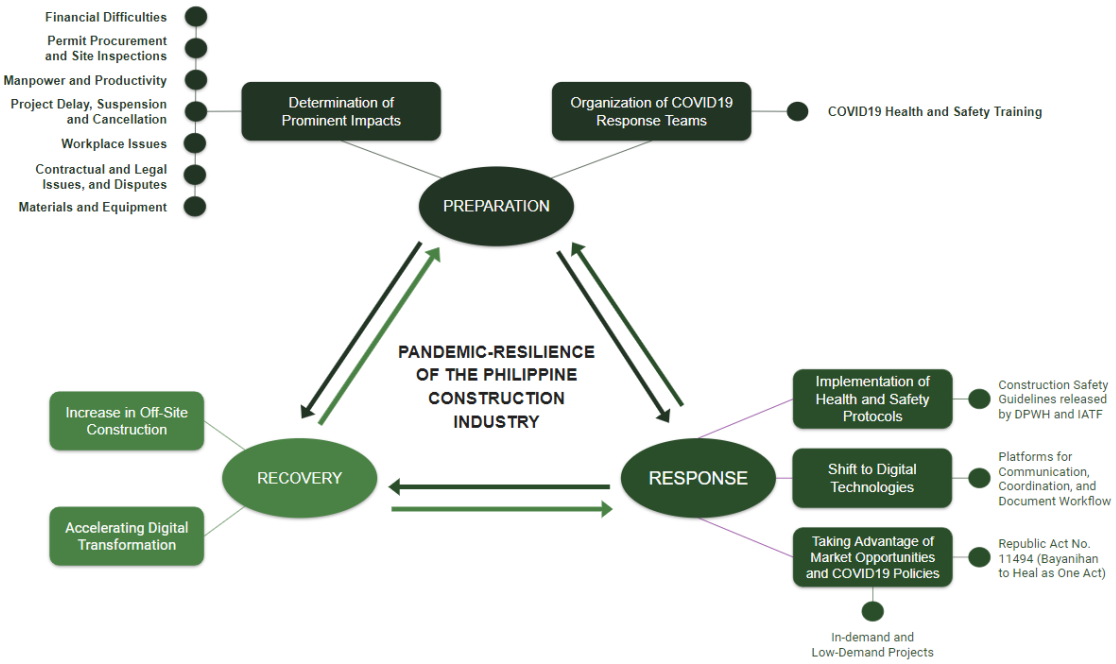

Figure 14. Proposed Framework on Achieving Pandemic Resilience

IV. CONCLUSION

The COVID-19 pandemic caused the emergence of numerous disruptions and challenges all over the country. Like other sectors such as restaurants, airlines, and tourism, the construction sector was affected in multiple ways. Through an online survey, this paper first focused on identifying the most prominent impacts of the pandemic from the perspective of NCR contractors. The construction industry experienced numerous problems in several aspects: project scheduling, finances, materials and equipment, manpower and productivity, workplace, contractual agreements, permit procurement, and site inspections. For all contractors, the most prevalent impact was the additional operational costs due to health and safety protocols. This was followed by a reduced workforce due to health requirements and workers' absences due to personal reasons, and so on.

This paper also examined the numerous efforts implemented to mitigate the problems caused by the COVID-19 pandemic. These included health and safety guidelines provided by the Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF) and the Department of Public Works and Highways (DPWH). Specific protocols that were most applied include temperature checks before entering the site and handling suspect and positive cases. Other risk management strategies implemented were the use of digital technologies, workforce transformations, and leveraging government policy responses.

There were also opportunities experienced due to the pandemic. Such instances helped in making contractors emerge stronger during this health crisis. By understanding the market, the contractor could focus on projects that could benefit their company, such as the demand increase in healthcare and infrastructure projects.

The construction industry's stance on the new normal was also examined by determining the willingness and perception of contractors on the application of construction technologies. Leading the list were prefabrication and modularization, followed by machine learning, data analytics, and cloud-based applications. Artificial intelligence and virtual and augmented reality were the technologies with the lowest willingness percentage.

These were also integrated into a framework aiming on achieving pandemic resilience. This proposed framework comprises three stages: preparation, response, and recovery. Each is vital to prepare and protect the contracting companies and their respective workers as they continuously adapt to all the changes brought by the pandemic.

This paper offers a general understanding of the impacts of the COVID-19 pandemic on the Philippine Construction Industry. The findings will be helpful to construction industry stakeholders as a reference to identify the risk management strategies that apply to their own companies and institutions. Furthermore, the impacts identified can be used as a guide in case a new health emergency occurs in the future and may provide insights on how the construction industry could still develop and improve. This study hopes to contribute to the fight of the construction industry against the COVID-19 pandemic, with the hopes that it emerges as a stronger and more resilient industry. Finally, with the results including one particular issue on

the possible lax in the health and safety protocols, this research recommends the stricter implementation of such guidelines to protect all stakeholders' health, safety, and interest.

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