**Appendices**

# Appendix A: Initial Potential MPs (Source: Authors own work)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Proposed Managerial Practices** | **Description** | **PPPT Framework** | **Source** |
| MP1 | Vaccination of experts | Vaccination is an effective way to guarantee safety and a healthy environment for experts to continue carrying out QA activities amid the COVID-19 pandemic. This helps the bodies of experts to create antibodies that help to fight off the pandemic infections. When construction experts are vaccinated, an adequate QA process can be achieved as the “fear of infection” could be eliminated among experts. As such, experts are likely to perform their responsibilities fully relating to the pre-stated requirements of a project. These may include effective on-site supervision and quality auditing via travelling across regions/economies/borders/countries. | Policy | Yuan et al. (2022) |
| MP2 | Ensuring social distancing among experts | Social distancing is a measure to minimise the spread of COVID-19 infections at workplaces, such as construction. This ensures the continuity of construction activities, including the QA activities, where workers are supposed to communicate and collaborate effectively to achieve quality projects. Social distancing, as a tool, provides a safe working environment for experts and ensures adequate QA by minimising the number of experts at the workplace. Though it may impact the QA processes negatively, the positivity is the assurance of a safe environment for experts throughout the QA processes. | Policy | Elabd et al. (2020); Assaad and El-adaway (2021); Lee et al. (2022); Salami et al. (2021) |
| MP3 | The use of prescribed nose and face masks | The use of prescribed nose and face masks also guarantees a safe environment for experts to assure quality throughout the QA process. This minimises the spread of the pandemic among the experts if they are carefully followed. QA can be adequate if experts also protect themselves by adhering to the rule of wearing prescribed nose and face masks provided by organisations. This is encouraged throughout the processes in QA process in the study’s context. | Policy | Assaad and El-adaway (2021); Zamani et al. (2022); Seresht (2022) |
| MP4 | Adequate health and safety policies to protect experts | Improving organisations’ health and safety policies protect workers from the severe impacts of the pandemic throughout the QA process. In addition to the government protocols, organisations formulate health and safety policies to enable the experts and active participation in the QA processes, which requires concerted efforts of all experts in an organisation, though there may be front liners such as quality engineers, quality auditors, etc., to verify the quality of works and services. Improving the health and safety policies tends to strengthen the health and safety management of organisations in the construction industry for the post-pandemic era and endure the risks of future pandemics. The adequacy of the health and safety further smoothens the QA processes, and experts are guaranteed safe and healthy environments during QA. This can be regarded as an organisation-based approach. | Policy | Simpeh and Amoah (2021); Simpeh and Amoah (2022); Nnaji et al. (2022); Davies and Metzler (2021) |
| MP5 | Smart remote monitoring, supervision and reviewing of works from a remote location | Regarding the QA of cross-border projects, verifying works and services from a remote location is highly encouraged. This tends to prevent physical interactions on site, which may contribute to the spread of the pandemic. For instance, smart monitoring amid the pandemic can assist experts, including quality auditors, engineers, etc., to supervise the workers from a remote location, such as across countries/regions/borders. Overall, smart monitoring could assist all experts in monitoring one another effectively with fewer physical interactions amid the pandemic. | Technology | Luo et al. (2020); Elabd et al. (2020), Messi et al. (2021); Pi et al. (2021); Zhang et al. (2021) |
| MP6 | Smart and efficient coordination among experts and workers during works review | Efficient coordination and communication are necessary for the QA. In the COVID-19 pandemic era, where such traditional communication and coordination are disrupted, digital technology has become an innovative solution. For example, during the review of works and services, digital technologies, such as the use of BIM, IoT, etc., can be engaged to provide smart and efficient coordination among experts and workers. Data can be retrieved from the construction sites from different borders/regions for analysis without necessarily being physically on sites for QA. This then reduces the risks of contracting the COVID-19 virus in travelling amid the pandemic. Overall, smart and efficient technology using digital technologies ensures the continuity of the QA process amid the pandemic toward achieving the best project quality. | Technology | Subramaniam et al. (2021); Zhou et al. (2020); Peiris and De Silva (2021); Assaad and El-adaway (2021) |
| MP7 | Assuring transparency in collected data | Data transparency is crucial in the QA. In the pandemic era, where coordination, site monitoring, and supervision are done smartly from a remote location, there is likely to encounter the issue of a “single source of truth” and data transparency. However, the emergence of digital technologies promotes the use of blockchain technology to monitor and ensure data transparency from one source to another with no interference. This helps to retrieve information/data regarding the quality of a project from the appropriate sources for verification of the quality of works and services, hence, ensuring adequacy through the QA process. | Technology | AlHanaee and AlHanaee (2021); Lu et al. (2022) |
| MP8 | Modification of contract to cater uncertainties | In the pandemic era, changes are likely to occur, which may affect the project contract. Scholars have regarded COVID-19 as a force majeure, and as such, most organisations never planned for that. Construction activities have been affected, including the QA process, which may, one way or the order, cause delays and cost overrun. This later causes project delays and an increase in the project cost. However, due to its uncertain nature, a contract may be modified accordingly to cater for delays and the extra cost. Coming into a unified agreement on the contract modification among the relevant stakeholder is important in ensuring business continuity toward the quality of projects. Accepted modification of contracts due to the pandemic may also ensure smooth QA processes, which considers the delays and extra costs incurred due to quarantine, travelling documentation and restrictions, etc. | Process | Khalef et al. (2021); Salami et al. (2021); Assaad and El-adaway (2021); Castelblanco et al. (2022) |
| MP9 | Adherence to safety precaution measures for QA practices | Adhering to safety precautions is very important to ensure a safe environment to protect experts throughout the QA processes. As organisations provide safety policies to ensure the continuity of QA, it also relies on the individual experts to obey the precaution given. This is the personal responsibility of the experts, though organisations may institute stringent measures to adhere to the safety protocols. Effective adherence to the safety protocols among the experts during the QA processes may contribute to the effective quality management of cross-border construction projects per the pre-stated quality requirements. | Policy | Bou Hatoum et al. (2021); Briggs et al. (2022); Jones et al. (2022); Olukolajo et al. (2022) |
| MP10 | Keeping up to date on travelling regulations and policies in both countries. | The experts, updating themselves with the travelling regulations and policies due to the pandemic is crucial in this context. During the QA, experts need to know the current travelling regulations and policies of the countries/regions involved. Understanding these before travelling can help avoid delays and extra costs in the QA processes. Hence, make the QA process adequate and free from delays and extra costs. | Policy | - |
| MP11 | Planning ahead the period of QA with the quarantine days in host countries | This practice helps to be proactive with the QA process with respect to the impacts of the pandemic by making plans considering the quarantine days and the cost incurred. | Process | - |
| MP12 | Understanding the spread of COVID-19 | Knowledge of the spread of COVID-19 is essential among experts during the execution of construction works and services in the QA processes. Experts must understand the spread and avoid being infected by adhering to the safety protocols. This understanding contributes to creating a safe environment to workers/experts to execute works and services in accordance with the pre-stated quality requirements of cross-border construction projects. As such, organisations must contribute by providing adequate information on the pandemic and orientations to facilitate the QA practices. | Policy | - |
| MP13 | Implementing a centralised digital document and issue management system | This practice is crucial in obtaining accessible and reliable data on work and services throughout the QA process. This relies on using digital technologies, such as BIM, cloud computing, etc., to centralise the information on project quality, hence, making the information accessible to experts from remote locations. This minimises the travelling options during the pandemic era. It also ensures data transparency on information on the services and works on the quality of projects. This may contribute to making the QA adequate amid pandemics. | Technology | Lu et al. (2022); AlHanaee and AlHanaee (2021) |
| MP14 | Implementing digital collaborative inspections with subcontractors and trades. | Digital collaborative inspections adopted among experts can ensure effective collaboration and communication while minimising physical-onsite interactions. In the pandemic era, this ensures adequate QA by making experts, such as quality auditors, quality engineers, etc., verify the quality of works and services from remote locations across borders/regions. This heavily relies on digital technologies, such as BIM, IoT, 5G technology, blockchain technology, etc., throughout the QA processes. | Technology | Lu et al. (2022) |
| MP15 | Assigning tasks to the most efficient and experienced quality expert. | Individuals performing tasks are very important to achieving the quality of a construction project. Tasks must be assigned to well-qualified experts or workers to ensure pre-stated quality requirements are followed during work services and executions. In the pandemic era, to make the QA adequate, tasks could be assigned to qualified and experienced experts. This can minimise the reworks and quality verification rate, which may require travelling across regions/borders amid the pandemic. Hence, reducing the risk of experts being infected by the pandemic. | People | Araya (2022) |
| **Keywords used for the literature search** | | “Managing construction activities”, “managing construction quality”, “COVID-19 pandemic”, “construction quality assurance”, and “manage quality activities during COVID-19” | | |

# Appendix B: Detailed References to Table 1 (Source: Authors own work)

|  |  |  |
| --- | --- | --- |
| **Serial number** | **References** | **Detail Reference** |
| 1 | Elabd et al. (2020) | Elabd, N.M., Mansour, Y.M. and Khodier, L.M. (2020). Social distancing in construction: investigating the role of technologies in supporting remote management. Journal Of Engineering and Applied Sciences, 67(8), pp.2073-2091. |
| 2 | Assaad and El-adaway (2021) | Assaad, R. and El-Adaway, I.H. (2021). Guidelines for responding to COVID-19 pandemic: Best practices, impacts, and future research directions. Journal of Management in Engineering, 37(3), p.06021001. |
| 3 | Lee et al. (2022) | Lee, B., Ahn, S. and Ahn, C.R. (2022). Understanding Occupants’ Physical Distancing Behavior for Safer Facility Operation under COVID-19 in the Context of Educational Facilities. Journal of Management in Engineering, 38(3), p.04022007. |
| 4 | Salami et al. (2022) | Salami, B.A., Ajayi, S.O. and Oyegoke, A.S., 2022, Coping with the Covid-19 pandemic: an exploration of the strategies adopted by construction firms, Journal of Engineering, Design and Technology, 20(1) pp. 159-182. https://doi.org/10.1108/JEDT-01-2021-0054. |
| 5 | Yuan et al. (2022) | Yuan, Z., Hsu, S.C., Cheung, C. and Asghari, V. (2022). Effectiveness of Interventions for Controlling COVID-19 Transmission between Construction Workers and Their Close Contacts. Journal of Management in Engineering, 38(3). |
| 6 | Zamani et al. (2022) | Zamani, S.H., Rahman, R.A., Fauzi, M.A. and Mohamed Yusof, L. (2022), Government pandemic response strategies for AEC enterprises: lessons from COVID-19, Journal of Engineering, Design and Technology, Vol. ahead-of-print No. ahead-of-print. |
| 7 | Seresht (2022) | Seresht, N.G. (2022). Enhancing resilience in construction against infectious diseases using stochastic multi-agent approach. Automation in Construction, 140, p.104315. |
| 8 | Bou Hatoum et al. (2021) | Bou Hatoum, M., Faisal, A., Nassereddine, H. and Sarvari, H. (2021). Analysis of COVID-19 concerns raised by the construction workforce and development of mitigation practices. Frontiers in Built Environment, p.66. |
| 9 | Davies and Metzler (2021) | Davies, T. and Metzler, S.E. (2021). Keeping Construction Going during the COVID-19 Pandemic. In Pipelines 2021 (pp. 341-350). |
| 10 | Simpeh and Amoah (2021) | Simpeh, F. and Amoah, C. (2021). Assessment of measures instituted to curb the spread of COVID-19 on construction site. International Journal of Construction Management, pp.1-19. |
| 11 | Simpeh and Amoah (2022) | Simpeh, F. and Amoah, C. (2022), COVID-19 guidelines incorporated in the health and safety management policies of construction firms, Journal of Engineering, Design and Technology, Vol. 20 No. 1, pp. 6-23. |
| 12 | Nnaji et al. (2022) | Nnaji, C., Jin, Z. and Karakhan, A. (2022). Safety and health management response to COVID-19 in the construction industry: a perspective of fieldworkers. Process Safety and Environmental Protection, 159, pp.477-488. |
| 13 | Briggs et al. (2022) | Briggs, B., Friedland, C.J., Nahmens, I., Berryman, C. and Zhu, Y. (2022). Industrial construction safety policies and practices with cost impacts in a COVID-19 pandemic environment: A Louisiana DOW case study. Journal of Loss Prevention in the Process Industries, 76, p.104723. |
| 14 | Jones et al. (2022) | Jones, W., Gibb, A.G.F. and Chow, V. (2022). Adapting to COVID-19 on construction sites: what are the lessons for long-term improvements in safety and worker effectiveness? Journal of Engineering, Design and Technology, 20(1), pp. 66-85. |
| 15 | Olukolajo et al. (2022) | Olukolajo, M.A., Oyetunji, A.K. and Oluleye, I.B. (2022). Covid-19 protocols: assessing construction site workers compliance, Journal of Engineering, Design and Technology, 20(1), pp. 115-131. |
| 16 | Zhou et al. (2020) | Zhou, M., Chen, Y., Su, X. and An, L. (2020). September. Rapid construction and advanced technology for a Covid-19 field hospital in Wuhan, China. In Proceedings of the Institution of Civil Engineers-Civil Engineering, 174(1), pp. 29-34). Thomas Telford Ltd. |
| 17 | Luo et al. (2020) | Luo, H., Liu, J., Li, C., Chen, K. and Zhang, M. (2020). Ultra-rapid delivery of specialty field hospitals to combat COVID-19: Lessons learned from the Leishenshan Hospital project in Wuhan. Automation in Construction, 119, p.103345. |
| 18 | Messi et al. (2021) | Messi, L., de Soto, B.G., Carbonari, A. and Naticchia, B. (2021). Addressing COVID-19 Spatial Restrictions on Construction Sites Using a BIM-Based Gaming Environment. In ISARC Proceedings of the International Symposium on Automation and Robotics in Construction, 38, p. 521-528. IAARC Publications. |
| 19 | Pi et al. (2021) | Pi, Y., Nath, N.D., Sampathkumar, S. and Behzadan, A.H. (2021). Deep learning for visual analytics of the spread of COVID-19 infection in crowded urban environments. Natural Hazards Review, 22(3), p.04021019. |
| 20 | Zhang et al. (2021) | Zhang, F. and Li, D. (2019). Multiple linear regression-structural equation modelling based development of the integrated model of perceived neighbourhood environment and quality of life of community-dwelling older adults: A cross-sectional study in Nanjing, China. International journal of environmental research and public health, 16(24), p.4933. |
| 21 | Subramaniam et al. (2021) | Subramaniam, C., Ismail, S., Durdyev, S., Wan Mohd Rani, W.N.M., Bakar, N.F.S.A. and Banaitis, A. (2021). Overcoming the project communications management breakdown amongst foreign workers during the COVID-19 pandemic in biophilia inveigled construction projects in Malaysia. Energies, 14(16), p.4790. |
| 22 | Peiris and De Silva (2021) | Peiris, S. and De Silva, N. (2021). RE-engineered factory acceptance testing under the new normal, Built Environment Project and Asset Management. 12(5), pp. 754-774. |
| 23 | AlHanaee and AlHanaee (2021) | AlHanaee, N. and AlHanaee, T. (2021). Smart Contract Using Blockchain in Construction and Infrastructure Sector in the COVID-19 Pandemic. In ISARC. Proceedings of the International Symposium on Automation and Robotics in Construction, 38, pp. 1018-1024). IAARC Publications. |
| 24 | Lu et al. (2022) | Lu, W., Wu, L., Xu, J. and Lou, J. (2022). Construction E-Inspection 2.0 in the COVID-19 Pandemic Era: A Blockchain-Based Technical Solution. Journal of Management in Engineering, 38(4), p.04022032. |
| 25 | Khalef et al. (2021) | Khalef, R., Ali, G.G., El-adaway, I.H. and Gad, G.M. (2022). Managing construction projects impacted by the COVID-19 pandemic: a contractual perspective. Construction Management and Economics, 40(4), pp.313-330. |
| 26 | Salami et al. (2021) | Salami, B.A., Ajayi, S.O. and Oyegoke, A.S. (2021). Tackling the impacts of Covid-19 on construction projects: An exploration of contractual dispute avoidance measures adopted by construction firms. International Journal of Construction Management, pp.1-9. |
| 27 | Castelblanco et al. (2022) | Castelblanco, G., Guevara, J. and Mendez-Gonzalez, P. (2022). In the name of the pandemic: A case study of contractual modifications in PPP solicited and unsolicited proposals in COVID-19 times. In Construction Research Congress 2022 (pp. 50-58). |
| 28 | Araya (2022) | Araya, F. (2022). Modelling the influence of multiskilled construction workers in the context of the covid-19 pandemic using an agent-based approach. Revista de la Construcción. Journal of Construction, 21(1), pp.105-117. |
| 29 | Koopmans (2020) | Koopmans, R., 2020. A virus that knows no borders? Exposure to and restrictions of international travel and the global diffusion of COVID-19 (No. SP VI 2020-103). WZB Discussion Paper. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7128681/. |
| 30 | Ramadan et al. (2021) | Ramadan, A.M., Ibrahim, K.M., Belaid, S.M., Abusanina, M.S., Ben Elfghi, M., Abughnia, E., Elkikkli, A., Alhudiri, I.M. and Elzagheid, A., 2021. Travel during COVID-19 pandemic in Libya: reasons of travel, disease importation and travel regulations. Libyan Journal of Medicine, 16(1), p.1994740. |
| 31 | Le et al. (2022) | Le, T.M., Raynal, L., Talbot, O., Hambridge, H., Drovandi, C., Mira, A., Mengersen, K. and Onnela, J.P., 2022. Framework for assessing and easing global COVID-19 travel restrictions. Scientific Reports, 12(1), p.6985. |
| 32 | Villacé-Molinero et al. (2021) | Villacé-Molinero, T., Fernández-Muñoz, J.J., Orea-Giner, A. and Fuentes-Moraleda, L., 2021. Understanding the new post-COVID-19 risk scenario: Outlooks and challenges for a new era of tourism. Tourism Management, 86, p.104324. |
| 33 | Chtourou et al. (2020) | Chtourou, H., Trabelsi, K., H'mida, C., Boukhris, O., Glenn, J.M., Brach, M., Bentlage, E., Bott, N., Shephard, R.J., Ammar, A. and Bragazzi, N.L., 2020. Staying physically active during the quarantine and self-isolation period for controlling and mitigating the COVID-19 pandemic: a systematic overview of the literature. Frontiers in psychology, 11, p.1708. |
| 34 | Gray et al. (2022) | Gray, L., MacDonald, C., Puloka, A., Bocock, C., Gwyther, R., Rushton, A., Puloka, V., Becker, J.S., Kvalsvig, A. and Baker, M.G., 2022. The lived experience of hotel isolation and quarantine at the Aotearoa New Zealand border for COVID-19: A qualitative descriptive study. International Journal of Disaster Risk Reduction, 70, p.102779. |
| 35 | Lv et al. (2022) | Lv, Z., Chen, D. and Lv, H., 2022. Smart city construction and management by digital twins and BIM big data in COVID-19 scenario. ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM), 18(2s), pp.1-21. |
| 36 | Abdel-Tawab and Abanda (2021) | Abdel-Tawab, M. and Abanda, F.H., 2021. Digital technology adoption and implementation plan: a case of the Egyptian construction industry. In 4th International Conference on Building Information Modeling. |
| 37 | Alwee et al. (2023) | Alwee, S.N.A.S., Zolkafli, U.K. and Salleh, H. (2023), "Contract administration practices on building information modelling (BIM)-based construction project – an exploratory study", Facilities, Vol. 41 No. 11/12, pp. 742-766. https://doi.org/10.1108/F-10-2021-0094. |
| 38 | Qiao et al. (2024) | Qiao, Q., Cheung, C., Yunusa-Kaltungo, A., Manu, P., Cao, R. and Yuan, Z., 2023. An interactive agent-based modelling framework for assessing COVID-19 transmission risk on construction site. Safety Science, 168, p.106312. |
| 39 | Cao et al. (2023) | Cao, R., Cheung, C., Yunusa-Kaltungo, A., Manu, P., Liu, C. and Qiao, Q., 2023. The transmission of COVID-19 in construction: A systematic review of findings from statistical and modelling techniques. Construction Safety, Health and Well-being in the COVID-19 era, pp.15-27. |
| 40 | Ogunnusi et al. (2021) | Ogunnusi, M., Omotayo, T., Hamma-Adama, M., Awuzie, B.O. and Egbelakin, T. (2021), “Lessons learned from the impact of COVID-19 on the global construction industry”, Journal of Engineering, Design and Technology, Vol. 20 No. 1, pp. 299-320. https://doi.org/10.1108/JEDT-05-2021-0286. |
| 41 | Olanrewaju et al. (2021) | Olanrewaju, A., AbdulAziz, A., Preece, C.N. and Shobowale, K., 2021. Evaluation of measures to prevent the spread of COVID-19 on the construction sites. Cleaner engineering and technology, 5, p.100277. |
| 42 | Bennett and Mayouf (2021) | Bennett, K. and Mayouf, M., 2021. Value management integration for whole life cycle: Post covid-19 strategy for the UK construction industry. Sustainability, 13(16), p.9274. |

# Appendix C: Informed Consent Form

**Questionnaire/Interview**

Dear Sir/Madam,

**Quality Assurance of Cross-border Construction Logistics and Supply Chain in the Covid-19 Pandemic Era: Evidence from the Hong Kong – Mainland China Links**

You are invited to participate in an ongoing study that forms part of a PhD research by XXXXX in the Department of XXXXXXXX, the University of XXXXXXXXXXXXXXX.

I hope to collect data based on your knowledge and experience regarding the implications of COVID-19 on the quality assurance of construction projects. The survey/interview will only take you about 15-20 minutes to complete. I would like to stress that all information collected will remain strictly confidential. Individual details will not be disclosed or identifiable from this survey.

It is important for you to consider if you fall in the following criteria before responding to the questionnaire:

1. You have extensive experience and were theoretically versed in the construction QA processes;
2. You have sufficient direct hands-on experience in construction QA;
3. You have been involved in at least QA processes in their organization; and
4. You must be in either Hong Kong or Mainland China.

If you have any questions about the research, please feel free to contact Mr. XXXXXXXXXXX. If you have questions about your rights as a research participant, please contact the Human Research Ethics Committee (HREC), XXXXXXXXX.

HREC Reference Number: EA210435

I understand the procedures described above and agree to participate in this study (tick the box and proceed to Part II).

|  |
| --- |
|  |

# Appendix D: The questionnaire adopted for the study

**A. Demographic Data Section**

**Kindly respond to the questions by carefully ticking [√] the appropriate box OR typing in the appropriate space for each item based on your valuable knowledge and experience.**

1. Please state your country of origin?........................................................

2. Which sector do you belong?

a. Industry [ ] b. Academia [ ]

3. What is your designation?

a. Academician [ ] b. Quality Auditor [ ] c. Quality Engineer [ ] d. Quality Assurance/Control Manager [ ] e. Authorised person from the government [ ] f. Client representative [ ] g. Other [ ] Please specify………………………………………………………….

4. How long have you been working in the organisation?

a. Less than 5 years [ ] b. 5-10 years [ ] c. 11-20 years [ ] d. 21-30 years [ ] e. More than 30 years

**B. Main Questions**

**Kindly respond by carefully ticking [√] the appropriate section of the tables based on your valuable knowledge and experience.**

**Question 1**

1. What is your level of agreement on the following areas of quality assurance practice of Cross-border Construction Logistics and Supply Chain? Please answer using the Five-point Likert Scales: **1= Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Quality Assurance Practices | Level of Agreement | | | | |
| **1** | **2** | **3** | **4** | **5** |
| 1 | Clearly defining responsibilities based on the quality requirements. |  |  |  |  |  |
| 2 | Assigning clear responsibilities to qualified workers. |  |  |  |  |  |
| 3 | Understanding requirements, norms, and standards of quality. |  |  |  |  |  |
| 4 | Keeping close contact with clients to realise their demands. |  |  |  |  |  |
| 5 | Providing quality training for workers toward project execution. |  |  |  |  |  |
| 6 | Maintaining quality standards. |  |  |  |  |  |
| 7 | Recording and documenting work processes, steps, project routine, and seamless implementations. |  |  |  |  |  |
| 8 | Communicating and coordinating with other workers to obtaining information about the project. |  |  |  |  |  |
| 9 | Strategic planning based on client requirements and corporate capability. |  |  |  |  |  |
| 10 | Analysing results of work operations and quality records. |  |  |  |  |  |
|  | **Other, please state clearly and rank** |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Question 2**

1. With lessons learned from COVID-19 pandemic, what is your level of agreement with the following practices on carrying out quality assurance of cross-border construction logistics and supply chain amid future pandemics? Please, rate using the Five-point Likert Scales: **1= Strongly disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly agree.**
2. How effective do you think of the managerial practices in managing the risk of COVID-19 on the Quality Assurance of Cross-Border Construction Logistics and Supply Chain Amid the Pandemic? Kindly rate using the Five-point Likert Scale: **1=Not at all effective; 2=Slightly effective; 3=Moderately effective; 4=Very effective; 5= Extremely effective.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Managerial practices (MPs) | Level of Agreement | | | | | Level of effectiveness | | | | | |
| 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| 1 | Strict observance to government regulations, including vaccination of workers, social distancing, use of prescribed nose masks, etc. |  |  |  |  |  |  |  |  |  |  |
| 2 | Adherence to updated adequate occupational health and safety policies to protect workers. |  |  |  |  |  |  |  |  |  |  |
| 3 | Smart remote monitoring, supervision, coordination and reviewing works from a remote location. |  |  |  |  |  |  |  |  |  |  |
| 4 | Modification of contract to cater for uncertainties. |  |  |  |  |  |  |  |  |  |  |
| 5 | Keeping up to date on travelling regulations and policies in host countries. |  |  |  |  |  |  |  |  |  |  |
| 6 | Planning ahead the period of quality assurance with the quarantine days in host countries. |  |  |  |  |  |  |  |  |  |  |
| 7 | Implementing a digital centralized document and issue management system. |  |  |  |  |  |  |  |  |  |  |
| 8 | Implementing digital collaborative inspections with subcontractors and trades. |  |  |  |  |  |  |  |  |  |  |
| 9 | Assigning quality assurance tasks to multi-skilled expert/workers to avoid frequent change of persons on work. |  |  |  |  |  |  |  |  |  |  |
| 10 | Cost cutting. |  |  |  |  |  |  |  |  |  |  |
|  | **Other, please state clearly and rank** |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |

# Appendix E: Interview Questions

**A. Demographic Data Section**

1. What is your country of origin?

2. What is your designation?

3. What is your qualification?

4. How long have you been working in the firm?

**B. Main Question**

How do you successfully “manage the quality” of your project amid the COVID-19 pandemic?

# Appendix F: Results of the Normality Test and Disparity Test (Source: Authors own work)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Kolmogorov-Smirnova (K-S)** | | | **Mann-Whitney test** | | | |
| **K S value** | **df** | **Sig., P-value** | **U stat.** | **W** | **Z-score** | **Sig. (2-tailed)** |
| MP1 | 0.344 | 52 | 0.000 | 216.000 | 1036.000 | -0.593 | 0.553 |
| MP2 | 0.280 | 52 | 0.000 | 203.500 | 1023.500 | -0.876 | 0.381 |
| MP3 | 0.250 | 52 | 0.000 | 229.000 | 307.000 | -0.257 | 0.797 |
| MP4 | 0.245 | 52 | 0.000 | 236.000 | 1056.000 | -0.093 | 0.926 |
| MP5 | 0.316 | 52 | 0.000 | 230.000 | 308.000 | -0.239 | 0.811 |
| MP6 | 0.319 | 52 | 0.000 | 165.000 | 985.000 | -1.819 | 0.069 |
| MP7 | 0.331 | 52 | 0.000 | 173.500 | 993.500 | -1.652 | 0.098 |
| MP8 | 0.322 | 52 | 0.000 | 168.000 | 988.000 | -1.789 | 0.074 |
| MP9 | 0.255 | 52 | 0.000 | 160.000 | 980.000 | -1.841 | 0.066 |
| MP10 | 0.216 | 52 | 0.000 | 221.000 | 1041.000 | -0.431 | 0.667 |

W=Wilcoxon, df=degree of freedom, P-value significant at ≤0.05

# Appendix G: Results of the Rank Agreement Analysis (Source: Authors own work)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** |  | **Industry** | | |  | **Academia** | | |  | **Agreement Analysis** | | |
|  | **Mean** | **SD** | **Rank** |  | **Mean** | **SD** | **Rank** |  | **Ri** | **∣(Ri1 – Ri2)∣** | **∣Ri – Rj2∣** |
| MP1 |  | 4.35 | 0.893 | 4 |  | 4.42 | 1.165 | 5 |  | 9 | 1 | 1.9 |
| MP2 |  | 4.18 | 0.781 | 8 |  | 4.33 | 0.888 | 6 |  | 14 | 2 | 3.1 |
| MP3 |  | 4.22 | 0.733 | 6 |  | 4.08 | 0.996 | 8 |  | 14 | 2 | 3.1 |
| MP4 |  | 4.20 | 0.758 | 7 |  | 4.00 | 1.348 | 9 |  | 16 | 2 | 5.1 |
| MP5 |  | 4.38 | 0.740 | 3 |  | 4.25 | 0.965 | 7 |  | 10 | 4 | 0.9 |
| MP6 |  | 4.28 | 0.847 | 5 |  | 4.75 | 0.452 | 1 |  | 6 | 4 | 4.9 |
| MP7 |  | 4.43 | 0.501 | 1 |  | 4.67a | 0.651b | 2 |  | 3 | 1 | 7.9 |
| MP8 |  | 4.40 | 0.496 | 2 |  | 4.67a | 0.651b | 2 |  | 4 | 0 | 6.9 |
| MP9 |  | 3.93 | 0.997 | 9 |  | 4.50 | 0.798 | 4 |  | 13 | 5 | 2.1 |
| MP10 |  | 3.75 | 1.056 | 10 |  | 3.92 | 0.996 | 10 |  | 20 | 0 | 9.1 |
| Total | | | | | | | | |  | Rj = |  |  |

aEqual mean; bEqual SD, wherein resultant impacts with equal SD are ranked the same; also, resultant impact with low SD is ranked higher.

# Appendix H: Spearman’s Correlation Matrix (Source: Authors own work)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** |  | **MP1** | **MP2** | **MP3** | **MP4** | **MP5** | **MP6** | **MP7** | **MP8** | **MP9** | **MP10** |
| MP1 | *ρ* | 1.000 |  |  |  |  |  |  |  |  |  |
|  | P-value |  |  |  |  |  |  |  |  |  |  |
| MP2 | *ρ* | 0.616\*\* | 1.000 |  |  |  |  |  |  |  |  |
|  | P-value | 0.000 |  |  |  |  |  |  |  |  |  |
| MP3 | *ρ* | 0.436\*\* | 0.685\*\* | 1.000 |  |  |  |  |  |  |  |
|  | P-value | 0.001 | 0.000 |  |  |  |  |  |  |  |  |
| MP4 | *ρ* | 0.675\*\* | 0.753\*\* | 0.621\*\* | 1.000 |  |  |  |  |  |  |
|  | P-value | 0.000 | 0.000 | 0.000 |  |  |  |  |  |  |  |
| MP5 | *ρ* | 0.859\*\* | 0.626\*\* | 0.544\*\* | 0.740\*\* | 1.000 |  |  |  |  |  |
|  | P-value | 0.000 | 0.000 | 0.000 | 0.000 |  |  |  |  |  |  |
| MP6 | *ρ* | 0.809\*\* | 0.695\*\* | 0.505\*\* | 0.730\*\* | 0.782\*\* | 1.000 |  |  |  |  |
|  | P-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |  |  |  |  |  |
| MP7 | *ρ* | 0.257 | 0.664\*\* | 0.636\*\* | 0.512\*\* | 0.313\* | 0.467\*\* | 1.000 |  |  |  |
|  | P-value | 0.066 | 0.000 | 0.000 | 0.000 | 0.024 | 0.000 |  |  |  |  |
| MP8 | *ρ* | 0.227 | 0.683\*\* | 0.596\*\* | 0.528\*\* | 0.279\* | 0.433\*\* | 0.964\*\* | 1.000 |  |  |
|  | P-value | 0.106 | 0.000 | 0.000 | 0.000 | 0.045 | 0.001 | 0.000 |  |  |  |
| MP9 | *ρ* | 0.212 | 0.554\*\* | 0.566\*\* | 0.533\*\* | 0.161 | 0.388\*\* | 0.724\*\* | 0.734\*\* | 1.000 |  |
|  | P-value | 0.132 | 0.000 | 0.000 | 0.000 | 0.255 | 0.004 | 0.000 | 0.000 |  |  |
| MP10 | *ρ* | 0.364\*\* | 0.418\*\* | 0.397\*\* | 0.482\*\* | 0.434\*\* | 0.461\*\* | 0.491\*\* | 0.486\*\* | 0.687\*\* | 1.000 |
|  | P-value | 0.008 | 0.002 | 0.004 | 0.000 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 |  |

ρ= Correlation coefficient value; \*\* Correlation is significant at the 0.01 level (2-tailed) = P-value; \* Correlation is significant at the 0.05 level (2-tailed) = P-value

# 

# Appendix I: Results of the exploratory factor analysis (EFA) (Source: Authors own work)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Code** | **Component** | | **CA** | **Mean Score** |
| **1** | **2** |  |
| **Policy-Process related (PP)** | |  | **0.918** | **4.27** |
| MP1 | 0.908 | **-** | 4.35 |
| MP2 | 0.769 | **-** | 4.18 |
| MP3 | 0.631 | **-** | 4.22 |
| MP4 | 0.737 | - | 4.20 |
| MP5 | 0.957 | - | 4.38 |
| MP6 | 0.767 |  | 4.28 |
| **People-Technology-Process related (PTP)** | - |  | **0.841** | **4.13** |
| MP7 | - | 0.907 | 4.43 |
| MP8 | - | 0.913 | 4.40 |
| MP9 | - | 0.873 | 3.93 |
| MP10 | - | 0.641 | 3.75 |
| Eigenvalue | 5.602 | 1.913 | **-** | **-** |
| Variance explained | 56.023 | 19.13 | **-** | **-** |
| Cumulative variance (%) | 56.023 | 75.155 | **-** | **-** |
| Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy | | |  | 0.747 |
| Bartlett's Test of Sphericity Approx. Chi-Square | | |  | 492.558 |
| Degree of freedom | | |  | 45 |
| Significance | | |  | 0.000 |

Extraction method: Principal component analysis; Rotation Method: Varimax with Kaiser Normalization; CA=Cronbach’s Alpha

# Appendix J: Results of the Normality Test, Descriptive Test, and Disparity Test (Source: Authors own work)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Kolmogorov-Smirnova**  **(Level of Effectiveness)** | | | **Mean** | **SD** | **Ns** | **Rank** | **Confidence level for mean** | | **Mann-Whitney Test (Level of Agreement)** | | | |
| **K S value** | **Df** | **P-value** | **Lower bound** | **Upper bound** | **U stat.** | **W** | **Z-score** | **Sig. (2-tailed)** |
| **Policy-Process related (PP)** | | |  |  |  |  |  |  |  |  |  |  |  |
| MP1 | 0.223 | 52 | 0.000 | 4.06a | 0.850 | 0.687 | 3 | 3.82 | 4.29 | 230.500 | 308.500 | -0.220 | 0.826 |
| MP2 | 0.331 | 52 | 0.000 | 3.73 | 0.888 | 0.577 | 7 | 3.48 | 3.98 | 230.000 | 308.000 | -0.240 | 0.810 |
| MP3 | 0.221 | 52 | 0.000 | 3.62a | 0.911 | 0.540 | 9 | 3.36 | 3.87 | 219.000 | 297.000 | -0.480 | 0.631 |
| MP4 | 0.267 | 52 | 0.000 | 3.67 | 0.967 | 0.557 | 8 | 3.40 | 3.94 | 203.500 | 281.500 | -0.839 | 0.402 |
| MP5 | 0.218 | 52 | 0.000 | 3.81 | 1.138 | 0.603 | 6 | 3.49 | 4.12 | 236.500 | 314.500 | -0.079 | 0.937 |
| MP6 | 0.235 | 52 | 0.000 | 4.04 | 0.928 | 0.680 | 4 | 3.78 | 4.30 | 217.000 | 1037.000 | -0.598 | 0.598 |
| **People-Technology-Process related (PTP)** | | | | |  |  |  |  |  |  |  |  |  |
| MP7 | 0.221 | 52 | 0.000 | 4.06a | 0.802 | 0.687 | 2 | 3.83 | 4.28 | 219.500 | 297.500 | -0.475 | 0.635 |
| MP8 | 0.249 | 52 | 0.000 | 4.10 | 0.891 | 0.775 | 1 | 3.85 | 4.34 | 228.000 | 306.000 | -0.277 | 0.782 |
| MP9 | 0.306 | 52 | 0.000 | 3.62a | 0.867 | 0.655 | 5 | 3.37 | 3.86 | 222.500 | 300.500 | -0.420 | 0.675 |
| MP10 | 0.292 | 52 | 0.000 | 3.15 | 0.998 | 0.538 | 10 | 2.88 | 3.43 | 221.500 | 299.500 | -0.436 | 0.663 |

Ns=Normalisation score= (actual mean–minimum mean)/ (maximum mean-minimum mean), only normalisation scores ≥0.5 are deemed critical by the experts; SD=Standard deviation; Rank based on Ns; aEqual mean, wherein resultant impact with equal SD are ranked the same; also, MP with low SD is ranked higher.

# Appendix K: Specific Interviewee Responses (Source: Authors own work)

|  |  |  |  |
| --- | --- | --- | --- |
| **Interviewee** | **Specific Response** | **Relation to the critical MPs** | **Key Factors Noted** |
| A | 1. *“The relevant national regulations on epidemic prevention and control should be strictly complied with.”* 2. *“Every link should be strictly implemented in accordance with the quality acceptance standards of construction projects.”* 3. *“Real-time quality testing should be carried out through the intelligent monitoring system.”* | MP1, MP3 | 1. Policy 2. Process 3. Technology. |
| B | *“Do their own work well, sort out the information, and do not add trouble to the organisation.”* | MP3, MP4 | Process |
| C | 1. *“Mind the key points, such as time, quantity, etc., dividing the whole task into phased small tasks, and complete it on time and quality.”* 2. *“We focus on checking where problems often show up.”* 3. *“Plan in advance, pay attention to the key issues of quality control, and improve efficiency.* | MP3, MP4, MP5 | Process |
| D | *“Online coordination on test results to reduce the intermediate process and personnel contact.”* | MP3, MP7, MP8 | 1. Process 2. Technology. |
| E | *“Timing, fixed-point and real-time monitoring need to be mentioned in the daily construction management, which is crucial to ensure the quality management of construction projects.”* | MP3, MP6 | 1. Process 2. Technology |
| F | 1. *“All offshore projects (offshore organisations) must effectively grasp the health status of their staff, arrange for dedicated staff to be responsible for daily temperature testing of staff (twice in the morning and twice in the evening) and keep abreast of the health status of absentees.”* 2. *“Implement a zoned differentiated management policy, implement relatively strict preventive and control measures within the buffer zone, and implement the requirement for normalised epidemic prevention and control outside the buffer zone.”* 3. *“Shift from one line of defence to two lines of defence to reduce the risk of spillover of the epidemic and achieve the maximum effect of epidemic prevention and control with minimal social impact and social cost.”* | MP1, MP2, MP5, MP10 | Policy |
| G | *“We do have a strict hierarchy. When we have finished the inspection, we have to report back to the team leader, who will continue to summarise the situation to the line manager. So really, we just need to do our part of the job. I do defect checking and I’m just responsible for defect checking.”* | MP3, MP9 | 1. People 2. Policy. |
| H | *“Investing more money, increasing staff input and planning ahead for quality monitoring.”* | MP6, MP9 | 1. People 2. Process. |
| I | *“We should actively cooperate with the government’s epidemic prevention and control policies, and on this basis, we should timely adjust the allocation of management personnel according to the needs of construction projects.”* | MP1, MP3, MP4, MP9 | 1. Policy 2. People 3. Process. |
| J | *“According to the requirements, quality management personnel need to cooperate with the epidemic prevention and control staff at a designated place.”* | MP1, MP5, MP9 | 1. Policy 2. People. |
| K | 1. *“In order to avoid the impact on the production task, we will reasonably purchase more raw materials.”* 2. *“In terms of cross-border prefabricated component logistics, a connecting system is adopted. E.g., Our truck is driven to the designated place of connecting by our driver, and then the driver returns, and the driver of the relevant overseas unit takes the components away.”* | MP3, MP6, MP7 | Process |
| L | *“In particular to the offsite fabrication factory/yard in China, extra staffs stationed in China were employed to perform the quality checking/supervision on behalf of us.”* | - | People |
| M | *“Zoom or online inspection have been introduced to the project.”* | MP8 | Technology |