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Managing risk in commercial property development projects during the COVID-19 pandemic: Evidence from China

ABSTRACT

The COVID-19 pandemic is the biggest global health crisis in years. China is the first market primarily affected by the COVID-19 pandemic, with unprecedented lockdown measures bringing real estate and other economic activities to a standstill. This study has two objectives: (1) to identify the risks critical to the risk management of commercial real estate (CRE) development projects based on the project life cycle stages and (2) to identify the stages most affected by the

empirical study
real estate

COVID-19 pandemic and the risk factors at different stages. Three rounds of the Delphi study were conducted with nine experts involved in the construction project. The findings indicate that the construction, lease and sale phases are prone to significant risks. Additionally, the analytic hierarchy process (AHP) identified 'health and safety risk' as the most critical risk factor during the construction phase and 'marketing and payback risk' as the most critical risk factor during the lease and sale phase. This study enhanced the effectiveness of risk management practices for implementing CRE development projects in China.

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1. INTRODUCTION

A significant decline in economic activity brought on by the COVID-19 pandemic has created severe vulnerabilities in the world's commercial real estate (CRE) market (Pence 2022). The COVID-19 pandemic was considered a black swan occurrence that spread quickly throughout the globe. It severely affected China's CRE industry, including shopping centres, office buildings and long-term leasing. The involuntary measures implemented to combat the COVID-19 pandemic are the main reason for the impediment to economic growth (Taylan et al. 2022). Local governments have curtailed commercial operations through the adoption of lockdown measures, compelling individuals to go out less or stay at home to curb the spread of the virus. Data from China's National Bureau of Statistics show a considerable decline in social consumption levels of around 21.4 per cent in early 2022, indicating that the lockdown policy has unavoidably decreased citizens' consumption intents and purchasing capacity (Li et al. 2022).

Real estate development projects significantly contribute to investment growth and job creation in China's economy (Glaeser et al. 2017). There are various risks involved in the CRE development process, including shifts in supply and demand, labour shortages, prolonged building cycles and consumer preferences for policy adjustments, all of which impact the project's return on investment to some extent. Pandemic conditions exacerbate the difficulties the industry has already faced, including the risk of virus transmission being increased by building operations, problems with contracts and the law, lack of equipment and raw materials, and logistics and transportation issues (Ayat et al. 2021). Regarding profitability, developers must pay high financial costs and wages during the outbreak. It is challenging to predict when staff with lower pay will return in the near future. This has an adverse effect on developers' capacity to control costs. However, to ensure the execution and oversight of site conditions, property development activities invariably call for the engagement of project participants on-site. If these risks are not properly handled, they could raise project costs and compromise project delivery and quality goals. There has been limited research on how COVID-19 risks affect commercial property development projects due to China's strict epidemic control policies and developers' immature risk management knowledge system (Qian et al. 2021). As a result, it is critical to comprehend how the commercial property industry is reacting to this unforeseen crisis.

The ZJ project in Shanghai is used as an example in this study to investigate the risks posed by the COVID-19 pandemic in commercial property development operations and risk management measures implemented by the project management team. The study considers the risks associated with each phase of the project's life cycle and identifies the primary players involved in

each risk element. The findings contribute to research on risk evaluation and identification in CRE projects. In addition, they may provide possible perspectives on project development management during the pandemic in the context of Chinese practice.

2. LITERATURE REVIEW

The study is primarily motivated by risks related to COVID-19 and risk management processes. The prominent issues covered are sub-risk factors in the real estate industry due to the COVID-19 pandemic outbreak, CRE development and risk management measures.

2.1 COVID-19-related risks in the real estate industry

Risks within the real estate sector are often defined as events that impact the primary goals of a project, which are cost, time and quality (Arukala and Pancharathi 2020). For example, the real estate sector was the first to be affected when the 2019 COVID-19 pandemic began in the Asia-Pacific region and spread worldwide. Evidence from the real estate market in European markets (Hoesli and Malle 2022) and the United States (Alsharef et al. 2021) shows comparable tendencies. For instance, limitations on the movement of people and capital have resulted in a decline in revenues and transactions in the current real estate industry, adding additional operating costs as well as a decreasing trend in the value of investments (Hoesli and Malle 2022). The pandemic has produced legal complications for the real estate indus- try, including contractual risks and issues relating to project participants' relationships. The contractual risk stems primarily from disagreements about whether the impact of the pandemic constitutes a force majeure clause. The force majeure phrase is used in construction contracts to manage the events, consequences and relationships between parties in a force majeure scenario (Hansen 2020). However, it is worth noting that most contracts do not directly address the COVID-19 pandemic in their force majeure clauses, and some have poorly crafted contract language (Asuquo et al. 2020). This makes determining whether project disruptions induced by the COVID-19 pandemic are force majeure events challenging, which can cause disagreements and disputes between the parties. Consequently, the resolution of claims and disputes during and after the outbreak is insufficient and must consider country-specific variances in practice and culture (Asuquo et al. 2020).

Real estate construction projects rely on construction material producers and suppliers. However, according to Marshall et al. (2021), several projects under development are encountering construction material shortages, such as roofing supplies and timber. Due to the intricacy of the supply channels, material outages might be caused by supplier closures or supplier labour shortages. As a result, material delivery timetables have yet to be met, negatively harming domestic and international supplies and projects.

In contrast, the need for CRE, like retail, hotels and offices, has decreased. Tenants, particularly small and medium-sized firms facing short-term financial difficulties, may assume that they do not require 100 per cent of their employee space but rather 75 or 60 per cent of their staff area. This is demonstrated in the quick reaction of market rents: Allan et al. (2021) estimated that market rents in the Asia Pacific dropped by about 15 per cent in the first two quarters of 2020, with the retail real estate sector collapsing by more than 30 per cent, implying weakening capital values in the retail real estate sector.

While a labour shortage has always been an issue in the construction business, the COVID-19 pandemic has aggravated the situation. Employees in real estate operations that include face-to-face encounters, such as construction workers, are at high risk of infection with the COVID-19 pandemic. Alsharef et al. (2021), for instance, showed how the collaborative aspect of construction site activity and the transient nature of the workforce involved considerably increases the risk of infection. According to King and Lamontagne (2021), the COVID-19 pandemic's economic and labour market shocks resulted in a confluence of circumstances that may have significantly worsened the risk of suicide among construction workers.

The outbreak and preventive or lockdown measures also elevate real estate financial market risks such as liquidity and capital risks. Milcheva (2021) revealed that the correlation between real estate stocks and the general stock market had grown dramatically throughout the pandemic, with significant disparities between the real estate and the retail sectors exhibiting the most excellent sensitivity. This is because the real estate industry is capital-intensive, and its investors are usually leveraged and intimately linked to financial institutions. Rogoff and Yang (2020) expressed that the significant decline in real estate transaction activity has strained developers' cash flows and resulted in bankruptcies. Given the significance of the sub-risk factors, it is critical to evaluate the risk management strategies used in the real estate sector.

2.2 CRE development risk management

CRE includes retail, office, self-storage, hotel, mobile home, land, industry, production, logistics and flex space (Kaklauskas et al. 2021). CRE is highly linked and interdependent, with significant investment volumes and long development cycles, and is vulnerable to various interconnected risk factors (Cao and Keivani 2008). Consumer preferences, fluctuations in supply and demand, regulatory adjustments and variations in prices and interest rates are key risk factors, concentrating on integrating the real estate cycle with the complete economic cycle (Kaklauskas et al. 2021). With the advancement of society's economy, people's consumption ideas and demands have changed considerably, which is represented by an increase in residents' purchasing power, leading to a rise in demand for commercial services.

Risk management, as an effective project management tool, aids in project control and avoids scenarios that could result in cost overruns, schedule delays or failure to meet the required performance. Although each project is distinct, there is widespread agreement on four basic steps in risk management: risk identification, risk analysis, risk response and risk monitoring (Perera et al. 2014). Risk identification is crucial in risk management because it attempts to determine the sources and types of hazards and serves as the foundation for risk assessment and control (Banaitienė et al. 2011). As a result, solid knowledge sources are critical to the success of the risk identification phase, and the viewpoints of experts with extensive experience should be considered (Perera et al. 2014). Various actions of risk response include risk avoidance, risk transfer, risk mitigation and risk acceptance, which can be taken individually or as a group. Meanwhile, certain risks appear challenging to eradicate, and each party to a contract in building activities must accept a certain level of risk and contemplate losses (Perera et al. 2014).

1.   Current research shows that real estate developers took risk management
2. methods to mitigate the detrimental impact of the COVID-19 pandemic in
3. various countries and regions. For instance, Alsharef et al. (2021) revealed how
4. real estate firms comply with social distance rules to minimize health hazards,
5. which include COVID-19-related training and facility and space sanitiza-
6. tion. Ayat et al. (2021) proposed a five-dimensional risk mitigation system
7. that comprises safety guidelines implementation, process and methodologi-
8. cal improvements, psychological support, government interventions and tech-
9. nological applications. In addition, tenants and other entities get a variety
10. of assistance measures, including rent freezes, rent reductions, extensions of
11. tenants' leases and landlord mortgage payment assistance (Kaklauskas et al.
12. 2021).
13.   Additionally, some real estate market development projects are actively
14. adapting to changes in real estate operational methods and processes in the
15. context of the pandemic while anticipating considerable future changes. For
16. example, according to Cheng et al. (2021), Hengda, a renowned Chinese real
17. estate developer, encourages online marketing through the Hengfangtong
18. platform, which offers one-click services such as virtual reality visits and
19. online property selection. Meanwhile, remote communication technologies
20. such as Skype or FaceTime are progressively being employed in project work-
21. flows to facilitate knowledge sharing and efficient communication between
22. project teams and stakeholders, ultimately lowering the risk of virus transmis-
23. sion (Pamidimukkala and Kermanshachi 2021).

2.3 The research gap

Many real estate industry experts are currently concerned about the COVID-
19 pandemic. Some studies focused specifically on the changes and impacts of
the COVID-19 pandemic on the construction industry (Ayat et al. 2021), while
others demonstrated that COVID-19 influenced construction investment in
various types of real estate in distinct manners (Kaklauskas et al. 2021), and
some studies explored how the COVID-19 disease outbreak impacted tenants
as well as the real estate supply chain (Uchehara et al. 2020). However, it has
been discovered that these studies combine CRE with real estate or construc-
tion, overlooking that CRE's response to the pandemic differs from other
categories of real estate. Besides, the innovative approaches presented for
identified risks are rarely viewed as a continuous, dynamic risk management
process and frequently represent fragmented perspectives. In addition, most
studies in the literature review are based on data and evidence from various
countries and regions. This research addresses the following questions: *What
are the main risks of the COVID-19 pandemic to commercial real estate develop-
ment projects in China? How to analyse and prioritize different risk factors and use
effective risk management methods to control risks in the context of a COVID-19
pandemic?* This study not only contributes to the body of knowledge in the
field but can also provide risk management techniques for long-term reac-
tions to any unforeseen pandemic in the CRE development environment, with
ramifications for other countries.

3. METHODOLOGY

A multi-step approach is used in this study to identify and evaluate the risks
of a COVID-19 pandemic for CRE development projects in China. Each stage
is described in depth in the sections that follow.

3.1 Case study area

Shanghai is China's economic centre and one of the international megacities. Shanghai has a well-developed commercial market and a thriving economy, making it an attractive location for a shopping centre. Commercial and business property investment was roughly double that of office buildings. However, total investment was lower than that in the same period in 2021. Since March 2022, Shanghai has been China's most seriously hit by the COVID-19 pandemic, which has significantly influenced the city's consumer and CRE markets. Among the many CRE projects in Shanghai, ZJ Property Development Company's project in Yangpu District is chosen for its location, type of development and convenience to the researcher. The ZJ project is an excellent choice for a retail and office complex. It comprises 10,830 m² of commercial space and 97,375 m² of office space, including various public service facilities. The land is in a great location with easy access to transportation. It is 3 km from the Lujiazui CBD and 20 km from the Shanghai Hongqiao transportation hub. The project's contract period is from 15 October 2018 to 15 September 2023. In October 2021, the ZJ project launched its investment process. Meanwhile, the project was halted for over three months in the first half of 2022 due to the pandemic, resulting in an additional expenditure of approximately USD 269 million for the developer because of the need to prevent and manage the infection.

3.2 Risk identification

Given the dynamic and complicated nature of the issues involved, the Delphi method was utilized in this study to assess the risks posed by the COVID-19 pandemic in the CRE market (Archontakis and Anastasiadis 2019). The Delphi technique collects data from respondents through numerous rounds of questionnaires until the panel members involved in the procedure reach a consensus on a specific topic (Ameyaw et al. 2016). In the management field, the multiple aspects when considering a risk issue could increase the complexity of the problem and could lead to difficulty (or even impossible) in assessing the effectiveness of techniques for managing risk. To overcome this challenge, the Delphi method was applied to prioritize issues and build a risk framework. The Delphi analysis conclusions are based on the experts' pooled knowledge and extensive experience (Ameyaw et al. 2016). Even if an expert's collective judgement is subjective, it is more dependable than individual comments, resulting in more objective findings. There are no set restrictions regulating the number of respondents who must participate in data collecting. For instance, Murry and Hammons (1995) recommend using 10–30 experts for data collection, while Hallowell and Gambatese (2010) believe that a reasonable Delphi study requires at least eight experts. Additionally, the Delphi method could be time-consuming due to the need for many rounds of surveys. To overcome these limitations, we take careful steps in selecting the experts. These steps ensure the reliability and validity of the outcomes. The team of experts for this research included nine practitioners in the CRE industry from design agencies, development companies, construction firms and supervisory organizations, who are employed in various fields like technology, management, marketing and finance and have no less than ten years of experience in the field. Experts had engaged in the ZJ project, and these experts' outcomes of the ZJ project's risk identification can be more reliable (Table 1). This study includes three data-gathering phases. In the first phase, specialists were asked to complete a risk

Table 1: *Demographic information of the panellists.*

Expert sources	Expert's profession	Expert academic qualifications	Year of work experience
Design company	Architect	Ph.D.	10–15 years
	Structural engineer	M.Sc.	>15 years
Consulting company	Consultant	B.S.	10–15 years
Development company	Project manager	B.S.	>15 years
	Engineering director	M.Sc.	>15 years
	Finance manager	M.Sc.	10–15 years
	Marketing manager	M.Sc.	10–15 years
Construction company	Construction engineer	M.Sc.	10–15 years
Contracting company	Project director	B.S.	>15 years

prediction questionnaire to collect as many hazards associated with the CRE development process as possible. The expert group members did not meet or communicate during the questionnaire procedure. Based on their knowledge and experience and what they had discovered about the actual situation during their engagement in the ZJ project, the experts wrote as extensively as possible about the risk factors that may be encountered in the ZJ project. The risk factor questionnaire was prepared in the second phase based on the first round of collation and summarization. Expert panel members were obliged to analyse each of them again. The experts were asked to identify the primary risk factors confronting the ZJ project, and the questionnaire was compiled to create a new one. The risk factor questionnaire requires screening the proportion of risk factors selected in the third round, with risks selected at less than 50 per cent considered not to be a significant risk factor, thus creating a list that all respondents agree on. After three rounds of analysis, the primary risk variables that were screened encompassed the entire life cycle of commercial property development. These risk characteristics were utilized to build a risk assessment framework. The next section discusses the method to assess the risk of a project based on this risk framework.

3.3 Risk analysis

An analytic hierarchy process (AHP) model is utilized in this study to assess the risks of CRE development projects in China during the COVID-19 pandemic. This approach found highly affected risk factors by prioritizing critical risk factors.

The AHP has become the primary method for evaluating criterion weights in a wide range of multi-criteria decision-making (MCDM) concerns (Saaty 1991). It can convert intangible and difficult-to-quantify themes into quantifiable and tangible values (Hyun et al. 2008). According to the AHP method, the aspects of the analysed problem are distributed in a hierarchy, with the overall objective at the top of the hierarchy to the criteria and sub-criteria at the appropriate levels (Yadav et al. 2015). The risk hierarchy model used in this study was organized into three levels. The overarching purpose (level 1) is 'to assess the risks of the commercial real estate development project affected by the COVID-19 pandemic'. To assess the influence of the life cycle on

COVID-19 risk, CRE development operations were divided into four phases: (1) development decision phase, (2) pre-development phase, (3) project construction phase and (4) project lease and sale phase. As a result, this aim is affected by four risk variables at the first level and sixteen risk factors at the second level. It is noted that the AHP method is not suitable when having a large number of policies or variables (Duong et al. 2018). However, this is not the case in this research.

Second, to determine the relative importance of the project risk aspects, the primary risk and sub-risk factors were compared in pairs using a questionnaire distributed among the panel of experts. Respondents were asked to complete the risk factor importance questionnaire, contrasting the risk factors in the risk level evaluation index system two by two and employing the two-by-two comparison method to build a comparative judgement matrix between risk factors of the same level. A basic one to nine scales of absolute numbers were utilized in this process (Table 2). The obtained judgements were then compiled in a $n \times n$ comparison matrix, for instance R, where W_i is the weight of risk factor i and W_j is the weight of risk factor j (Equation 1) (Saaty 1991).

$$R = [r_{ij}]; \qquad r_{ij} = \frac{W_i}{W_j}; \qquad r_{ij} = \frac{1}{r_{ij}}; \qquad r_{ii} = 1. \tag{1}$$

Third, the weights of the priority vectors were computed using the appropriate eigenvector approach $W = (w_1, \ldots, w_n)$. Finally, the comparison matrix R was increased to sufficiently large powers by boosting the powers of k, where e is the unit vector (Equation 2).

$$W = \lim_{k \to \infty} \frac{R^k e}{e^T R^k e}. \tag{2}$$

Finally, the consistency of the produced comparison matrix was checked. Saaty (1991) recommended a method for measuring inconsistency by calculating three indicators: (1) the consistency index (CI), which is defined as the deviation from consistency (Equation 4); (2) the average random consistency index (RI), which implies the average consistency index determined from randomly generated matrices of the same order utilizing a scale of 1–9; and

Table 2: Scale of relative significance.

Scale	Definition	Explanation
1	Equal significance	Two elements contribute equally to the object
3	Moderate significance	Slightly prefer one element over another
5	Strong significance	Strongly prefer one element over another
7	Demonstrated significance	Superiority of the demonstrated significance
9	Absolute significance	Favouring one element over another incontrovertible
2, 4, 6, 8	Intermediate	When to make a compromise

Source: Saaty (1991).

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Table 3: RI: Average random consistency index.

						n					
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

Source: Saaty (1991).

(3) consistency ratio (CR), the ratio of CI to RI for matrices of the same order (Equation 5), representing the likelihood of respondents making pairwise comparison judgements at random. Table 3 shows how RI can be valued.

$$Rw = \lambda_{\max} w. \tag{3}$$

$$CI = \frac{\lambda_{\max} - n}{n - 1}. \tag{4}$$

$$CR = \frac{CI}{RI}. \tag{5}$$

The results are considered trustworthy if CR ≤ 0.1; otherwise, the two-comparison results should be rejected (Saaty 1991). This is regarded as one of the primary benefits of AHP. Since it reflects the requirement to make judgements based on a range of factors while also combining qualitative and quantitative concepts, the AHP technique is considered to be one of the complete systems (Ho 2008).

Based on the AHP method to calculate the weights of each factor, a fuzzy comprehensive evaluation can be applied. A fuzzy thorough evaluation is a method that uses the principle of fuzzy relationships to calculate the fuzzy complete score of each factor and determine the affiliation degree of each evaluation level. Theoretically, fuzzy comprehensive evaluation requires creating a fuzzy set to measure the evaluation objective (Yuan et al. 2020). However, with the development of technology, complex fuzzy mathematical calculations can be simplified using yaahp software. In this research, the evaluation level was divided into five levels according to the risk level, which is very low, low, medium, high and very high, corresponding to the values 1, 2, 3, 4 and 5, respectively, with a higher number representing a higher risk.

4. RESULTS AND DISCUSSION

4.1 Pandemic risk identification

The responses of participating experts are collated after three rounds of surveys, and any results are coded and examined using content analysis tools. To guarantee the accuracy of the results, the analysis process was repeated. A total of 30 risks are identified, and then narrowed down to sixteen significant risk variables. Table 4 categorizes the identified risks according to the four stages of CRE development.

4.2 Application of risk analysis method

4.2.1 Construct the ZJ project risk hierarchy structure model

A risk assessment model was created using the yaahp software. Figure 1 depicts the AHP model for the ZJ CRE development project.

Table 4: Experts forecast risk factors in ZJ real estate project.

Risk types	Risk factors	Explanation
R_1. Development decision phase	R_{11}. Policy risk	The government's land supply strategy is postponed or delayed in the short term, slowing the pace of developers' investment in land acquisition.
	R_{12}. Development timing risk	Due to the project's long development cycle and the unpredictability of the commercial market's recovery time under the impact of the pandemic, the appropriate timing of development must be addressed further.
	R_{13}. Investment property type risk	The traditional commercial shopping mall model is insufficiently inventive, and there is a cautious trend about investing in this project.
R_2. Pre-development phase	R_{21}. Capital risk	The industry's capital strain has intensified, and developers' financing options have become more limited.
	R_{22}. Bidding risk	The pandemic has had an impact on the bidding process, which involves traditional face-to-face communication, and there is a risk of bid information leakage for online bid openings.
	R_{23}. Design risk	Whether the project positioning and architectural design fulfil the current client criteria for hygienic, healthy, green and sustainable buildings.
	R_{24}. Contractual risk	Contract disputes emerge during contract implementation between real estate developers and construction companies over the extension of the construction term under COVID-19, the project's cost, the sharing of relevant expenses and damages, and whether the contract is terminated.
R_3. Project construction phase	R_{31}. Cost risk	Since vehicle mobility is limited during the pandemic, the construction firm transfers some of the cost risks of increased construction materials, labour and equipment prices to the project developer, as well as the additional expenses generated by the acquisition of pandemic prevention materials.
	R_{32}. Quality risk	The rush after the resumption of construction may cause operational deformation, raising the likelihood of quality hazards and project violations.
	R_{33}. Schedule risk	Project shutdowns, disruptions in the supply of necessary raw materials, and labour control pose challenges to the project's schedule and delivery during COVID-19.
	R_{34}. Health and safety risks	Workers and professionals on construction sites are at a high risk of infection due to the labour-intensive nature of building operations; many temporary workers hired under labour shortage conditions do not adhere to strict safety rules.
R_4. Project lease and sales phase	R_{41}. Market risk	People's consumption habits and preferences have altered due to the pandemic's influence, and the squeezing effect of online consumption on the offline retail market is palpable.

Table 4: Continued.

| Risk types	Risk factors	Explanation
	R_{42}. Price risk	Due to transition or cash flow turnover challenges, some merchants will surrender their leases and reduce their operational area, which will indirectly impact the project's rise in the vacancy rate, the fall in rent and the increase in the risk of holding the property.
	R_{43}. Investment risk (the risk of inviting merchants)	Tenants are unsure whether or not they will move in, and the project timetable delay has created concern about whether the project will be completed and accepted within the estimated scope.
	R_{44}. Marketing and payback risk	The pandemic's influence on the operating pressure and financial liquidity risk of SMEs (small and medium enterprises) has resulted in a drop in demand in the office leasing market, affecting lease sales and repayment.
	R_{45}. Network security risk	The level of big data and information technology in the real estate industry may need help to satisfy the current rise of business needs; online commercial transactions may be vulnerable to information security concerns.
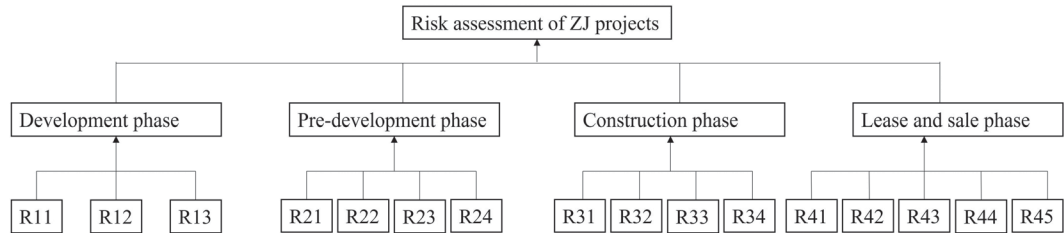
Figure 1 : Risk hierarchy structure.

4.2.2 AHP method assessment results

In this study, nine experts were invited to assess the risk of the ZJ project. The AHP method's outcomes are illustrated below, using the first expert as an example.

1. ZJ project risk judgement matrix

Table 5: Risk judgement matrix for the ZJ project.

ZJ project risks	R_1	R_2	R_3	R_4	W_i
R_1	1	0.3333	0.1429	0.2	0.0573
R_2	3	1	0.3333	0.2	0.1305
R_3	7	3	1	2	0.4633
R_4	5	5	0.5	1	0.3488

Consistency ratio: 0.0693; the weight of 'ZJ project risk': 1.0000; λ_{max}: 4.1849. CR = 0.0693 < 0.1, which has a good consistency.

2. ZJ Project development decision stage risk judgement matrix

Table 6: Risk judgement matrix for the ZJ project in the development decision stage.

Development decision phase	R_{11}	R_{12}	R_{13}	W_i
R_{11}	1	0.5	3	0.3338
R_{12}	2	1	3	0.5247
R_{13}	0.3333	0.3333	1	0.1416

Consistency ratio: 0.0517; the weight of 'ZJ project risk': 0.0573; λ_{max}: 3.0538. CR = 0.0517 < 0.1, which has a good consistency.

3. ZJ project pre-development stage risk judgement matrix

Table 7: Risk judgement matrix for the ZJ project in the pre-development phase.

Pre-development phase	R_{21}	R_{22}	R_{23}	R_{24}	W_i
R_{21}	1	5	5	3	0.523
R_{22}	0.2	1	1	0.2	0.0819
R_{23}	0.2	1	1	0.2	0.0819
R_{24}	0.3333	5	5	1	0.3132

Consistency ratio: 0.0579; the weight of 'ZJ project risk': 0.1305; λ_{max}: 4.1545. CR = 0.0579 < 0.1, with good consistency.

4. ZJ project construction phase risk judgement matrix

Table 8: Risk judgement matrix for the ZJ project in the construction phase.

Construction phase	R_{31}	R_{32}	R_{33}	R_{34}	W_i
R_{31}	1	1	0.2	0.1429	0.0752
R_{32}	1	1	0.3333	0.2	0.0911
R_{33}	5	3	1	0.3333	0.2691
R_{34}	7	5	3	1	0.5646

Consistency ratio: 0.0309; the weight of 'ZJ project risk': 0.4633; λ_{max}: 4.0826. CR = 0.0309 < 0.1, with good consistency.

5. ZJ Project lease and sales phase risk judgement matrix

Table 9: Risk judgement matrix for ZJ project in rental or sales phase.

Lease and sales phase	R_{41}	R_{42}	R_{43}	R_{44}	R_{45}	Wi
R_{41}	1	0.3333	0.2	0.2	1	0.0615
R_{42}	3	1	0.3333	0.1429	3	0.1283
R_{43}	5	3	1	1	5	0.3305
R_{44}	5	7	1	1	7	0.4227
R_{45}	1	0.3333	0.2	0.1429	1	0.0569

Consistency ratio: 0.0462; the weight of 'ZJ project risk': 0.3488; λ_{max}: 5.2069. CR = 0.0462 < 0.1, which has a good consistency.

Table 10 shows the weights of each indicator for the first expert after consistency testing.

Table 10: Weight of risk factors.

Risk type	Weight	Risk factor	Weight
R_1	0.0573	R_{11}	0.3338
		R_{12}	0.5247
		R_{13}	0.1416
R_2	0.1305	R_{21}	0.523
		R_{22}	0.0819
		R_{23}	0.0819
		R_{24}	0.3132
R_3	0.4633	R_{31}	0.0752
		R_{32}	0.0911
		R_{33}	0.2691
		R_{34}	0.5646
R_4	0.3488	R_{41}	0.0615
		R_{42}	0.1283
		R_{43}	0.3305
		R_{44}	0.4227
		R_{45}	0.0569

Table 11: Ranking of the influence weight of level 1 indexes on the target layer.

Ranking	Level 1 indicators	Weights
1	R_3	0.4693
2	R_4	0.2954
3	R_2	0.1634
4	R_1	0.072

The findings of the nine experts' evaluations are calculated independently once the nine consistency-tested questionnaires are entered into the yaahp software. The results of the nine experts' rating judgements are arithmetically averaged using the 'group decision' panel to determine the priority ranking of the weights for each risk factor. Tables 11 and 12 rank the impact of the levels 1 and 2 indicators on the target layer, respectively.

The statistical findings in Table 12 highlight two facts concerning the impact of critical risk categories on the goals of the ZJ CRE project. First, from a project life cycle viewpoint, COVID-19 influences the 'construction phase risk', followed by the 'lease and sale phase' risk. The second statistic shows that the top five risk variables investigated in the surveys are, in order, 'health and safety risk', 'marketing and payback risk', 'schedule risk', 'investment risk' and 'cost risk'. These are concentrated in the construction, leasing and selling phases. The following section explains the underlying reasons for the above key risk factors and how they can be effectively addressed.

4.2.3 Fuzzy comprehensive evaluation

The evaluation form of the FCE fuzzy comprehensive evaluation method combined with the AHP method does not require further input of the

Table 12: Ranking of the influence weight of level 2 indexes on the target layer.

Ranking	Level 2 indicators	Weights
1	R_{34}	0.2416
2	R_{44}	0.1159
3	R_{33}	0.0926
4	R_{43}	0.0839
5	R_{31}	0.0767
6	R_{24}	0.0672
7	R_{32}	0.0584
8	R_{21}	0.046
9	R_{42}	0.0445
10	R_{11}	0.0312
11	R_{22}	0.0311
12	R_{12}	0.0311
13	R_{45}	0.0298
14	R_{41}	0.0214
15	R_{23}	0.0190
16	R_{13}	0.0096

Table 13: Comprehensive evaluation report for the ZJ project.

Evaluation objective	Evaluation level	Evaluation score
ZJ project risk fuzzy comprehensive evaluation	Medium	2.74
Project construction phase		3.02
Project lease and sales phase		2.82
Pre-development phase		2.72
Development decision phase		2.29

Evaluation level	Value
Very low	1
Low	2
Medium	3
High	4
Very high	5

weight vector data, which can be obtained directly from the data calculated by the AHP method in the last step through the yaahp software. The comprehensive evaluation report of the ZJ project calculated by the software is as follows.

The fuzzy comprehensive risk assessment of the ZJ project has a score of 2.74, which indicates that the project has a medium level of risk. The project management team must be vigilant and plan risk control measures to minimize the level of impact of COVID-19 and its derived risks on the ZJ project.

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4.3 Managing the critical risks

4.3.1 Project construction phase

Studies showed that the risk factors determined during the project building phase, which COVID-19 impacts, ranked highest in the severity index. This is understandable, considering that construction activities are subjected to natural forces and human contact with technical and organizational complexities (Perera et al. 2014). Construction-related risks are frequently intertwined. For instance, 'project schedule risk' causes a rush of work, leading to quality issues and fraud, incurring higher labour and claims expenses. Such unreasonable schedules can significantly impact the achievement of project cost, quality and safety objectives. Project completion may be delayed further if there are concentrated illnesses or conflicts between non-parallel construction programmes. The conclusions of this study are consistent with the results of previous research (Alsharef et al. 2021; Hoesli and Malle 2022), which imply that a considerable number of internal and external risks influence project goals in terms of cost, time, quality and safety. To some extent, these risks are unavoidable, as COVID-19 is a severe worldwide concern, but risks affecting labour, materials and site conditions are relatively more manageable within the project.

The pandemic has heightened the inherent risks of construction operations. Since agriculture is the primary source of income for most Chinese rural households and has seasonal and demanding labour requirements, workforce shortages have been an issue for the Chinese construction industry (Perera et al. 2014). Furthermore, in China, it is required by the People's Republic of China Law on Work Safety to obtain safety insurance for employees (Zou et al. 2007). However, the law needs to be properly enforced due to a weakness in the Chinese regulatory framework. With the impact of the pandemic, workforce shortages are caused not just by government rules for social distancing and workers' fear of the COVID-19 pandemic but also by potential consequences at various stages of the project life cycle. Many organizations experienced financial challenges and the potential of contract cancellation during the pre-development phase, forcing some workers to be laid off. These variables contribute to more significant workplace stress (Pamidimukkala and Kermanshachi 2021). In addition, COVID-19 affected vendors shipping commodities across different regions to varying degrees, disrupting the delivery of crucial building materials and sanitary protection products. The project team had to negotiate and coordinate with emergency resource providers, causing them to pay higher prices (Wang et al. 2020). Since these risks are moved from the developer to the contractor during the construction phase, how the contracting business coordinates the numerous players in managing these risks during the project life cycle is crucial to the project's success.

The contracting company is expected to communicate regularly with key suppliers. On the one hand, the contractor must examine the impact of COVID-19 on the ability of suppliers to perform, primarily in terms of the purchase price, delivery quantity and shipping period, and on the other hand, must track the physical status and estimated arrival of materials purchased in transit to change stocking and procurement plans. In terms of supply channels, one method is to develop a network of supply centres in easily accessible places that diversify supply channels and, if necessary, explore alternative local materials. Although local sources are typically more expensive, they remain competitive in the current market. Pooling is an excellent means of minimizing

raw material expenses when alleviating financial pressures. It is also critical to inform suppliers about the prospect of deferred payments on accounts payable and to relieve cash flow pressures by forming long-term partnerships.

The contracting company ensures a safe working environment and practices for its employees and construction workers. Safety measures include ensuring physical distance between workers and regular health screenings; sanitizing physical contact sites on equipment, machinery and infrastructure; and encouraging personal protective equipment. Besides, it may be necessary to minimize the number of workers on the job at any time. Approaches include implementing flexible work shifts to stagger workers' break times and limiting the number of people utilizing lifts simultaneously. For many temporary workers who are activated when there is a labour shortage, registration and filing processes should be enhanced promptly, and on-site safety training and qualified safety supplies should be provided.

Furthermore, to lessen the danger of anxiety and suicide on building sites, mental health support programmes should be implemented. Nevertheless, one issue that should be addressed is that focusing on COVID-19 dangers may divert frontline personnel and supervisors' attention away from everyday safety concerns (Stiles et al. 2021). The ZJ project is a 34-storey supertall skyscraper that necessitates using safety principles in all aspects, with safety management objectives at the forefront.

4.3.2 Project lease and sales phase

The project lease and sales phase risk is explained by the possibility of vacant space being absorbed in a slower-than-planned rate. In CRE, this manifests an excess of office or retail space inventory and a decrease in lease demand. CRE market rents are falling because of changes in supply and demand variables and vacancy rates caused by the pandemic. The primary risk faced by the real estate development company in multi-tenant buildings, such as the ZJ project, is marketing and repayment risk. Lowering the usage of office or retail space becomes an option for them to improve cash flow, particularly for SMEs (Kaklauskas et al. 2021). It is worth noting that while the pandemic has made 'working from home' a foregone conclusion, telecommuting cannot completely replace the office's role in providing physical space and infrastructural support for core business operations, and office space has significant advantages in boosting employee 'innovation', 'engagement' and 'teamwork'. The decline in capital values and rents in the retail sector has been more severe than in the office sector, partly due to structural changes within the industry.

Furthermore, due to the nature of shopping as a sensory experience and entertainment activity, consumer demand for physical retail will persist. Previous research indicates that some property development companies are exploring digital platforms to facilitate marketing (Correia et al. 2022; Pamidimukkala and Kermanshachi 2021), but when tenants have more bargaining power, simple internet viewing cannot speed up the lease process or facilitate marketing. Other information security issues may occur if there is a mismatch between the pandemic's surge in information technology needs and the degree of extensive data construction.

Inviting investment is another risk related to marketing and payback risk. The increasing difficulty in recruiting investment may have two outcomes. First, a delay in investment development may jeopardize the project's opening's success, significantly impacting the commercial interests and brand

effect. Second, the outbreak has made contract negotiations more challenging because of tenants' wait-and-see attitude. Tenants not only want lower leasing prices, but they also scrutinize the contract provisions more closely. The terms on delivery of the shop, fire inspection, the right to terminate the contract and the closing of the shop can become the subject of conflicts since they require the developer to take on more outstanding contractual obligations while reducing the tenant's liability for breach of contract. Illustrations from the literature review demonstrate that some developers offer rent discounts and arrange rent-free periods to minimize tenant loss (Ayat et al. 2021), but a limitless concession to catch up with the investment process is not ideal. As a result, the investing strategy must be adjusted over time. The developer should design commercial lease terms and contract review standards for tenants based on market position, business plan and partnership.

The relationship between the tenant and the developer is one of the two primary risk factors in the lease and sale phases. In the traditional model, the two are risk-separated, with the tenant focusing entirely on company development and the landlord concentrating solely on property services and capital preservation (Nanda et al. 2021). In a pandemic setting, changes in the CRE sector have produced a need for flexible space from tenants, posing a challenge to the traditional property management approach. Risk management measures for social distance and personal safety are insufficient since they are merely 'operational level' techniques; there is a need to investigate flexible risk sharing with tenants and adapt revenue creation tactics. For instance, with the growth of online retail platforms and changing consumer preferences, physical stores frequently serve as a showcase, with most revenue coming from online channels (Nanda et al. 2021). Therefore, a flexible rental strategy should be considered concerning the attributable retail income from in-store and online sales. Meanwhile, the project's lease competitiveness is represented in the availability of additional services, which drive the change from traditional physical space to agile and adaptable space in response to the new normal standards for sustainability and health.

4.3.3 Project decision phase and pre-development phase

Among the risk categories 6–10, 'policy risk' and 'contractual risk' are the essential hazards encountered during the project's decision-making and pre-development stages. Consequently, while not as visible as the other stages of the project life cycle, the vulnerabilities cannot be overlooked.

The real estate industry is heavily influenced by policy and is impacted by various factors such as land policy, financial policy, industrial policy and more. As a result of epidemic control strategies, numerous Chinese cities, including Shanghai, have delayed or postponed centralized land sales, resulting in fewer developers acquiring land. Although ZJ Group has the advantage of acquiring property as a vast state-owned firm, the complex process of land acquisition documents and other permissions has been a significant factor in the postponement of ZJ's project decision (Zou et al. 2007). In terms of financial policies, existing policies focus on credit support, supplemented by debt moratoriums and special funding assistance, which are insufficient to meet the needs of real estate development firms. This is due to the prevalence of COVID-19 shocks in the real estate sector, and bank credit is limited in scale (Didier et al. 2020). Although the government is crucial in providing an enabling climate for project development, policy risks are often beyond the

project stakeholders' control. To mitigate the risks caused by policy elements, the ZJ project development team should always maintain communication with the Yangpu District government and adapt their strategic plans to the features of the various policies. If necessary, the ZJ project developer may also consider utilizing the expertise of real estates' consulting firms such as Savills in land development and industry analysis.

Contractual risks stem primarily from contractual omissions and risks associated with enforcing contractual terms. Previous studies focused on determining the impact of COVID-19 on force majeure clauses in contracts (Asuquo et al. 2020), but the burden and the complexity of proof frequently influence the actual determination. In coping with the influence of the pandemic on contract performance, the developer should negotiate a more expansive force majeure clause from the standpoint of the project's overall interests by negotiating and signing a supplementary agreement on risk sharing to prevent the amplification of losses due to prolonged negotiations. For instance, the supplemental agreement's content considers cost escalation factors and epidemic prevention and control strategies. In addition, it establishes an appropriate contractual price adjustment mechanism based on the actual project scenario and market factors. Although ZJ Group, as a development firm, may prefer to pass the risk to the contracting company, unequal risk allocation is frequently at the foundation of disputes. On the other hand, it is vital to anticipate the danger of litigation and retain valid evidence promptly. It is also indisputable that while the pandemic may cause contractual conflicts to rupture current business relationships, urgent and short-term business often needs present opportunities to form new relationships.

5. CONCLUSION

The COVID-19 pandemic has had a significant worldwide impact, notably on the CRE industry. Like other types of real estate, CRE is vulnerable to macroeconomic volatility risks. This research examines the primary COVID-19 pandemic risks influencing China's retail real estate market using the ZJ CRE development project as an example. This study discovered the phase of a CRE development project that is most influenced by the pandemic: the project construction phase (0.4693), followed by the project lease and sale phase (0.2954). Through AHP, the identified hazards were analysed and prioritized based on a multi-criteria risk analysis model. As a result, the following five risks have the most significant effect on project development: (1) health and safety risk (0.2416); (2) marketing and payback risk (0.1159); (3) schedule risk (0.0926); (4) investment risk (0.0839) and (5) cost risk (0.0767).

Effective risk management techniques for the real estate development company are devised. The findings imply that overcoming the risky environment of a CRE project in a developing country like China necessitates an integrated approach that addresses the risks while collaborating closely with all parties to the project. Failure of any participant to recognize, analyse and respond to relevant risks might jeopardize project delivery and negatively influence other stakeholders. During the construction phase of a project, the contracting business bears a substantial amount of the key risks, and the main parties engaged also include suppliers and workers. The commercial property development company shares the risk with the tenant or retailer during a project's leasing and sale phases. An appropriate allocation of risk between the development firm and the contracting company during the pre-development

phase can help to reduce 'contractual risk'. The government, as a participant, plays a significant role in mitigating the impact of 'policy risk' during the relatively low-risk decision-making phase. A deeper examination of the identified risks reveals that local practices associated with the Chinese real estate industry, such as worker shortages, lack of awareness of construction safety, lengthy approval processes and failure to purchase insurance as required, exacerbated the impact of the pandemic on project objectives. It is concluded that it is crucial for the ZJ project developer to involve a contracting company with considerable management skills early in the construction phase to lessen health and safety, schedule and cost risks; during the leasing and sales phases, the ZJ project developer should explore new property management models and revenue generation tactics to generate broader, flexible risk-sharing patterns with tenants or retailers; and to successfully manage 'policy risk' and 'contractual risk' during the decision-making and pre-development phases. In addition, the developer of the ZJ project should maintain regular contact with the government and actively negotiate broader force majeure clauses with contractors.

Effective risk management is regarded as one of the most critical processes for meeting project objectives in terms of cost, time and quality. This article analyses significant risk stages and risk factors from a project life cycle viewpoint using three rounds of Delphi surveys conducted with nine industry experts. The investigation adds to the body of knowledge in this field by providing insights into the risk perception of CRE development operations in the context of the topical problem of COVID-19. In terms of practical application, the study assists Chinese real estate development firms in developing a risk management framework to adapt to the trend of pandemic normalization and minimize the impact of pandemic-derived risks in the industry.

This study is limited by several shortcomings that present opportunities for further investigation. One constraint is that the results of this study may be restricted to the case of the ZJ commercial property development project. However, the findings apply to similar-sized CRE projects. The recommendation is to increase the sample space and the diversity of data sources for future studies. If the dataset gathered could be extended to represent more projects in other Chinese cities, it could be genuinely representative of the Chinese commercial property market, as there are variances in practice and organizational culture between various projects in different regions.

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SUGGESTED CITATION

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