

Journal of World Architecture

Editor-in-Chief

Monsingh David Devadas

Anna University, India

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

(619 649 400)

Level 10

50 Clarence Street

SYDNEY NSW 2000

Copyright © 2021. Bio-Byword Scientific Publishing Pty Ltd.

Complimentary Copy



ISSN (ONLINE): 2208-3693
ISSN (PRINT): 2208-3685



Journal of Clinical and Nursing Research

Focus and Scope

Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine

About Publisher

Bio-Byword Scientific Publishing is a fast-growing, peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavors to be the world's leading independent academic and professional publisher. To realize it, it keeps creative and innovative to meet the range of the authors' needs and publish the best of their work.

By cooperating with University of Sydney, University of New South Wales and other world-famous universities, Bio-Byword Scientific Publishing has established a huge publishing system based on hundreds of academic programs, and with a variety of journals in the subjects of medicine, construction, education and electronics.

PublisherHeadquarter

BIO-BYWORD SCIENTIFIC PUBLISHING PTY LTD

Level 10

50 Clarence Street

Sydney NSW 2000

Website: www.bbwpublisher.com

Email: info@bbwpublisher.com

Table of Contents

1	Application of Building Material Testing Technology <i>Jing Sun</i>
5	Establishment of European Regional Ionosphere Model Based on Spherical Harmonic Functions <i>Mingze Zhang</i>
10	Application and Exploration of Overall Risk Management in Construction Enterprises <i>Hongyun Tian</i>
24	Public Space Demand and Adaptive Behavior of Residents in Old Residential Area of Ancient City: Based on Qingyi Garden of Beirenyi Hutong in Kaifeng <i>Shu Zhao, Zhe Wang</i>
34	Management Method and Intelligent Technology Analysis of Construction Management <i>Jingjing Sun</i>
38	Analysis on Construction Technology and Reinforcement Technology of Building Foundation <i>Hua Guo</i>
42	Research on Progress Control of Overseas Cement EPC General Contracting Project <i>Jianke Gu</i>
47	Spatial Pattern of Housing Sales Vacancy in Guangzhou's Urban District, China <i>Xiaoli Yue, Yang Wang, Yabo Zhao, Hong'ou Zhang</i>
52	"Data Hegemony": Reflections for the Application and Development Direction of Metaverse Technology in Urban Design based on Digital <i>Qinyu Feng, Renjie Cai</i>
62	Green Construction: Status and Prospects of Shenzhen Construction Industry's "Double Carbon" Goal <i>Hongzhou Chen</i>
67	Analysis on Construction Technology of Reinforced Concrete Tied Arch Bridge <i>Zhongyu Wang</i>

Call for papers – Journal of World Architecture

ISSN (Online): 2208-3499

ISSN (Print) : 2208-3480

Submission open for January - 2022

Dear Researchers,

The *Journal of World Architecture* is a peer-reviewed international journal, which offers an avenue for researchers and practitioners to present the latest progress associated with architecture, occupants and related policies. It aims to encourage academic exchange and enhancing professional development in this field.

The Journal Publishes in both online and print version. *Journal of World Architecture* publishes research and review paper in the field of:

- Architecture theories and practices of design, technology and construction;
- Impacts of architecture on society, economy and environment;
- Analysis of occupants physically and psychologically and the application of new technologies, materials to meet their needs;
- Formulation of public policy as well as organisational structures and networks.

All relevant papers are carefully considered, vetted by a distinguished team of international experts, and rapidly published. Original articles, short communications, case studies and comprehensive review articles can be submitted online via the journal's submission and peer review site.

The *Journal of World Architecture* is published by Bio-Byword Scientific Publishing Company, it is a fast growing peer-reviewed and open access journal publisher, which is located in Sydney, Australia. As a dependable and credible corporation, it promotes and serves a broad range of subject areas such as medicine, construction, education and electronics for the benefit of humanity. By informing and educating a global community of scholars, practitioners, researchers and students, it endeavours to be the world's leading independent academic and professional publisher.

All Bio-Byword journals are free from all access barriers, allowing for the widest possible global dissemination of their manuscripts and highest possible citations. Bio-Byword publisher online submission will go through a rapid peer review and production, making the process of publishing simpler and more efficient, which benefit from its user friendly online submission system that reduces the overall time from submission to publication.

Acceptance Notification: Within 21 days from the date of manuscript submission

Send your manuscript to the editor at: **info@bbwpublisher.com**

With Warm Regards,

Editor-in-Chief

Dr. Monsingh David Devadas

Journal of World Architecture

Application of Building Material Testing Technology

Jing Sun*

Chongqing Energy College, Chongqing 402260, China

*Corresponding author: Jing Sun, 757809546@qq.com

Abstract: The article analyses the application of building material testing technology, concludes that though the application of building material testing technology, the quality of the material can be tested, and unqualified materials can be found in time, and removed from the construction, to prevent the impact of the construction effect, and ensure the quality of the construction project.

Keywords: Testing; Construction projects; Materials

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

Material is an important structure of the main part of the project. In order to ensure the quality of the main part of the project, the quality of construction materials needs to be guaranteed first. Through the application of building material testing technology, the quality of the material can be tested, and unqualified materials can be found in time, and removed from the construction, to prevent the impact of the construction effect, and ensure the quality of the construction project.

2. The important role of building engineering material testing technology application

Building materials are important substances in the construction of construction projects. In order to ensure the quality of construction projects, the quality control of materials needs to be done first. If there are problems in the quality of materials in the construction of construction projects, it is very easy to cause hidden dangers in the construction of construction projects, and even cause life risks, so it is necessary to strengthen the detection of building materials.

2.1. Improve the safety of construction projects

Safety is the primary management goal in the construction of construction projects. Through the testing of construction materials, it is conducive to ensuring the safety of construction projects and effectively avoiding the mixing of inferior materials in construction that will affect the construction quality^[1]. In order to promote the smooth development of construction projects, construction enterprises need to do a good job in the initial stage of construction, testing of materials, including the stability, safety and deflection of materials, to ensure that the strength and safety of construction materials can meet the requirements of engineering construction.

2.2. Ensure the materials meet the construction requirements of the construction project

In the construction of construction engineering, in order to ensure the waterproof, seismic, compressive and other effects of the project, a large number of prefabricated components need to be used, and if these

prefabricated components do not meet the requirements of engineering construction, the quality of engineering construction will be affected, which is not conducive to the later use. Through the quality inspection of prefabricated components before construction, the problems existing in prefabricated components can be found in time, and the components can be replaced in time, so as to improve the overall quality of the project.

2.3. Improve the durability of construction projects

The application quality and application of materials in construction directly affect the service life of building materials. In engineering construction, the main body and most of the prefabricated components need to be exposed to the external environment for a long time, and be subjected to the weather for a long time, which will affect the service life. Therefore, it is necessary to test the durability of the prefabricated components before the construction of the construction project, so that the prefabricated components can meet the requirements of the building environment. Through the testing of construction materials in the construction of engineering projects, the overall cost of engineering construction can be reduced and the economy of the project can be improved.

3. Application of Building Material Testing Technology

3.1. Testing of cement materials

With the development of construction industry, the application scope of cement materials is more and more extensive. In the construction of building engineering, cement material is not only a common material, but also a common material for engineering construction quality and service life. Cement is used most in the construction of reinforced concrete structures. If there are problems in the quality of cement materials, it will inevitably increase the safety risks of construction projects, which are not conducive to the quality control of construction projects and the safety management of personnel. In the test of cement materials for construction engineering, the standard of “General Portland Cement” is mainly adopted, and the test work is carried out in strict accordance with standards such as experiment, process and use method [2]. First of all, do a good job of on-site acceptance of materials, mainly on the cement package integrity inspection. At the same time, the strength grade, grade and stability of cement are tested. In order to ensure the quality of cement, it is also necessary to check the production date of cement and ensure that the date of cement is within three months. And the cement performance and indicators need to be checked, so that the cement can meet the standards and indicators. After the basic performance inspection, it can enter the construction site. In the process of testing, the qualification of the manufacturer and the quantity of cement should be tested to ensure that the sampling quantity and frequency of testing meet the standard requirements. For bagged cement, it is generally tested every 200 tons, and bulk cement is tested every 500 tons. In the sampling of cement, it is necessary to ensure the sampling of the same batch and different positions. The detection sample points of each batch shall be controlled at least 20, and the weight of mixed sampling shall be more than 12 kg.

3.2. Testing of sand and gravel materials

Sand and gravel material is also an important part of building materials. Thus, the detection of sand and gravel materials is also necessary. In the process of sampling sand and stone, it is necessary to take random samples of materials in the sand and stone pile to ensure the uniformity of sampling. At the same time, in the process of sampling the sand pile, the surface layer of sand and gravel should be removed first and sampled at different locations. Sand and stone can be sampled separately. Eight samples are generally selected for the sampling of sand material, and 16 samples are generally selected for the sampling of stone material, and then mixed after the sampling is completed. In the screening process, if the test results are

unqualified, it is necessary to increase the sampling times and reinspect the sand and stone materials. In addition, the materials can also be processed by four-point method. The specific operation is to place the sand and gravel sampling material on the flat plate and stir it evenly, form the material into a round cake shape with a paving thickness of about 20cm, and then divide it into four samples with similar quality for re mixing. In the inspection of sand and stone, it is necessary to carry out multiple tests and parallel tests combined with the requirements of building construction to ensure the quality of sand and stone.

3.3. Testing of reinforcing steel materials

Reinforcing steel material is equivalent to the skeleton of the main body of the building. In the process of reinforcing steel bar detection, the main aim is detecting the mechanical properties of steel bar. The specific detection process is as follows: First, material sampling should be carried out reasonably. Due to the special properties of reinforcing steel materials, there are certain differences with cement and sandstone in sampling. The sampling work shall be carried out in strict accordance with the reinforcing steels. First, a section of reinforcing steel with a length of 500 to 1000 mm shall be intercepted. Generally, 5 reinforcing steels shall be selected for interception in the sample extraction, and the key deviation of reinforcing steel shall be detected first. Second, carry out cold drawing test on the reinforcing steel, and conduct batch inspection on the reinforcing steel according to the national requirements for reinforcing steel products. The inspection quantity of reinforcing steel in the same batch needs to be controlled within 30 tons, and the diameter and grade of reinforcing steel must be the same. Third, inspect the quality of reinforcing steel, the types of reinforcing steel in reinforcing steel welding are different, and there will be some differences in welding methods. Current welding methods include arc welding, spot welding, butt welding and so on. It is necessary to combine the specific welding with corresponding operation requirements for detection ^[3]. For example, if the spot welding is used, the rationality of the welding project needs to be tested. Spot welding testing is carried out strictly according to the operational requirements. The length of the spot inspection steel bar is generally controlled in 500 to 650 mm, and it can be tested by means of shear test and stretching test.

3.4. Testing of concrete strength

The concrete strength test during construction is also an important test content in the pouring of construction engineering. During the test, random samples can be taken in the pouring area. According to the mechanical characteristics and standards of concrete, the cube specimen with a size of generally 150 mm square can be selected for curing the concrete block. Each group can select 3 specimens, The mixture of each group of test pieces shall be sampled from the same batch of concrete, and the curing must be carried out in combination with specific curing conditions and standards during the curing process. In the curing of concrete test blocks, if the standard curing method is adopted, the curing time needs to reach 28 days. If the same conditions are used for curing, it shall be calculated according to the cumulative curing age of the daily average temperature. The cumulative total temperature shall reach 600°C, and the curing age shall reach more than 14 days, but less than 60 days. In the compressive strength test of concrete test block, the corresponding test block experiment scheme can be formulated, the appearance of the test block can be checked, the temperature, humidity and date of the test block can be recorded. After the press is cleared, the test block can be placed in the press plate, and the constant speed test can be carried out. Until the failure of the specimen, the computer automatically collects data and records the maximum failure load of the specimen.

4. Conclusion

To sum up, the application of material test and detection technology in building engineering construction

is conducive to the detection of building material quality, which is particularly important for the development of China's construction industry. From the application of testing technology of engineering building materials in China, each material has its own testing method. However, some testing methods are not scientific and normative, so it is necessary to strengthen the improvement of testing technology standards, effectively reduce the error probability of testing technology, and rationally select testing technology in combination with the needs of different engineering buildings to improve the efficiency of construction engineering and ensure the standardization of testing technology. Lay the foundation for the improvement of construction engineering quality through the testing of materials, so as to promote the better development of the construction industry.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Xu W, 2021, Discussion on the Testing Technology of Building Engineering Materials. Brick & Tile World, (1): 59.
- [2] Li S, 2021, Application Analysis of Testing and Detection Technology for Building Engineering Materials. Brick & Tile World, (1): 94.
- [3] Wang Y, 2020, Discussion on Test and Testing Technology of Building Engineering Materials. Value Engineering, 39 (6): 181-182.

Establishment of European Regional Ionosphere Model Based on Spherical Harmonic Functions

Mingze Zhang*

School of Geomatics, Liaoning Technical University, Fuxin 123000, Liaoning, China

*Corresponding author: Mingze Zhang, 641375496@qq.com

Abstract: In order to study the temporal and spatial variation characteristics of the regional ionosphere and the modeling accuracy, the experiment is based on the spherical harmonic function model, using the GPS, Glonass, and Galileo dual-frequency observation data from the 305th-334th day of the European CORS network in 2019 to establish a global ionospheric model. By analyzing and evaluating the accuracy of the global ionospheric puncture points, VTEC, and comparing code products, the test results showed that the GPS system has the most dense puncture electricity distribution, the Glonass system is the second, and the Galileo system is the weakest. The values of ionospheric VTEC calculated by GPS, Glonass and Galileo are slightly different, but in terms of trends, they are the same as those of ESA, JPL and UPC. GPS data has the highest accuracy in global ionospheric modeling. GPS, Glonass and Galileo have the same trend, but Glonass data is unstable and fluctuates greatly.

Keywords: Global ionosphere; VTEC; Spherical harmonic function model

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

The composition of the near-Earth space environment includes the middle and upper atmosphere (troposphere, stratosphere), ionosphere, and magnetosphere. The middle and upper atmosphere is located 60 km from the ground to the upper layer of the earth. The ionosphere is an important part of the near-Earth space environment. The molecules and atoms in the atmosphere located between about 60-2000km in the upper earth are ionized by the sun's ultraviolet rays, X-rays and high-energy particles, forming a plasma region, which is called the ionosphere ^[1]. The area from the top of the ionosphere to tens of thousands of kilometers above the top is the magnetosphere. The free electrons and ions in the ionosphere are one of the main sources of errors in electromagnetic wave propagation, which will cause delay errors in navigation and positioning. The ionospheric delay is generally about a few meters, but when the sunspot activity is strong, the ionospheric electron density will increase, and the ionospheric delay will increase, reaching 10 meters or even tens of meters ^[2]. Therefore, weakening and eliminating the impact of ionospheric delay on navigation and positioning has become an urgent problem in the field of global navigation satellite system (GNSS) ^[3]. Related scientific research on the ionosphere (for example, ionospheric storms, ionospheric scintillation, geomagnetic storms, and abnormal changes in earthquakes and tsunamis) also requires permanent and continuous monitoring of the state of the ionosphere. Therefore, how to best obtain a continuous accurate ionospheric model with high spatial and temporal resolution on a global scale is a popular direction for precise positioning and space weather applications ^[4].

2. Modeling method

When modeling the regional ionosphere, the experiment adopted the fifteenth-order spherical harmonic

function (SHF) model, because it has an excellent mathematical structure and can better reflect the temporal and spatial distribution of the total electron content. The expression of the VTEC spherical harmonic function model is:

$$\text{VTEC}(\varphi, \lambda) = \sum_{n=0}^N \sum_{m=0}^n \left(\tilde{A}_{nm} \cos(m\lambda) + \tilde{B}_{nm} \sin(m\lambda) \right) \cdot \tilde{P}_{nm}(\cos \varphi) \quad (1)$$

In the above formula, VTEC is the electron content in the vertical direction, \tilde{A}_{nm} and \tilde{B}_{nm} is the spherical harmonic function coefficient, φ is the IPP geographic latitude, λ is the IPP geographic accuracy, n is the degree of the spherical harmonic function, m is the order of the spherical harmonic function, $\tilde{P}_{nm}(\cos \varphi)$ is the normalized adjoint Legendre polynomial, Where N=15-order spherical harmonic function model is used to describe the ionosphere.

3. Data sources and experimental procedures

This paper selects 240 CORS stations with a global uniform distribution for 30 days from the 305th day to the 334th day of 2019 as reference stations. The experiment uses GPS, Glonass, and Galileo observations to model the global ionosphere, and compares them with UPC, JPL, ESA and other institutions. The sampling interval of the observation data is 30 seconds, and the elevation mask angle of satellite is 10° . The height of the thin ionosphere is chosen to be 450km, the time resolution is 1h, and the spatial resolution is $5^\circ \times 2.5^\circ$. The broadcast ephemeris is provided by IGS. In this experiment, the European region ionosphere modeling adopts the fifteenth-order spherical harmonic function model, and the output is performed according to the standard format of ionospheric grid.

4. Analysis of ionospheric pierce point

When the electromagnetic wave source propagates from outer space to a certain point on the earth, the intersection of the electromagnetic beam entering the ionosphere is called the Ionospheric Pierce Point (IPP). This paper analyzes the characteristics of IPP and the accuracy of the ionospheric observable values of Global Positioning System, Glonass and Galileo. **Figure 1** shows the IPP distribution of the three systems within 2 hours (UT00:00-02:00) on November 4, 2019. As shown in **Figure 2**, the IPP distribution of the GPS system is the densest, covering most of the continents of the world. Because the GPS system has 24 GPS satellite constellations with global coverage rate as high as 98%, more than 4 satellites can be observed at any place and any time in the world, and the navigation information can be pre-stored in the satellites. GPS has a large number of tracking stations around the world, covering most parts of the world. With the completion of the Glonass restoration work, it has a good IPP distribution in most areas, but compared with the GPS system, although the puncture point distribution is roughly the same, the density is significantly lower than that of the GPS system. One of the main reasons for this is that there are currently only 13 satellites in operation, 5 of which are geostationary satellites, which cannot improve the spatial resolution of IPP distribution over time. In addition, the monitoring stations for tracking Beidou satellites are relatively limited and unevenly distributed, resulting in the number of IPP being much smaller than GPS. Due to the limitation of the number of satellites, the Galileo system has fewer independent positioning satellites than the Beidou system on a global scale. There is no doubt that with the increasing in the number of Beidou and Galileo satellites and the upgrading of the IGS tracking network, there will be more and more MGEX stations and Beidou and Galileo satellites in orbit; this means that the distribution of IPP will become very dense in most parts of the world. In addition, ionospheric monitoring capabilities will also be further strengthened.

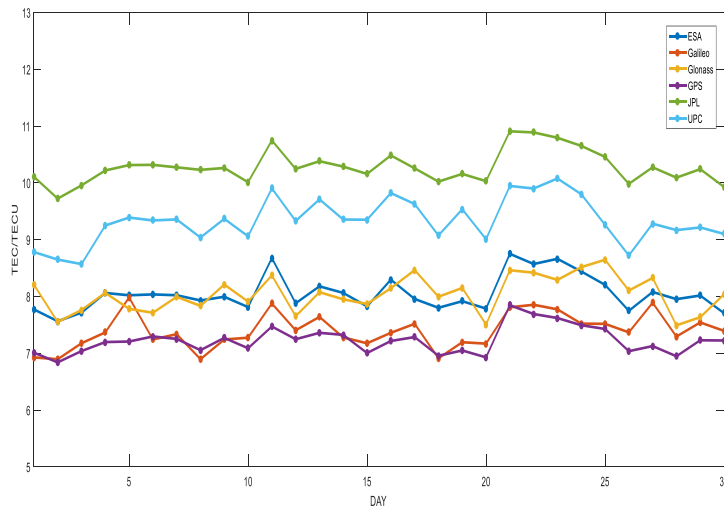


Figure 1. Daily average of global TEC

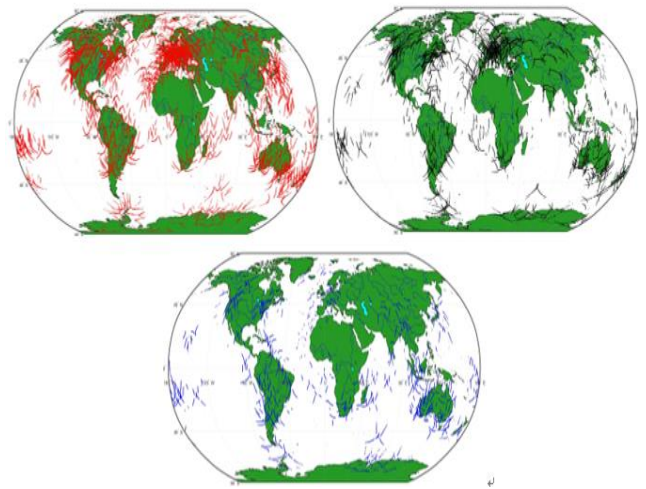


Figure 2. Distribution of pierce point

5. VTEC accuracy analysis

Figure 2. shows the daily average values of GPS, Glonass, Galileo, ESA, UPC and JPL global VTEC from the 305th to the 334th day of 2019, and the actual values for 30 days are shown in **Table 1**. **Table 2** shows the correlation coefficient between the daily average of TEC of the three different systems and the daily average of TEC of ESA, UPC, and JPL.

Table 1. Detailed VTEC values of multi-system and multi-agency

Time	G	R	E	ESA	JPL	UPC	Time	G	R	E	ESA	JPL	UPC
1	7.01	8.21	6.93	7.77	10.11	8.78	16	7.22	8.14	7.36	8.29	10.48	9.82
2	6.84	7.55	6.89	7.56	9.72	8.65	17	7.28	8.46	7.52	7.96	10.26	9.63
3	7.04	7.76	7.18	7.71	9.95	8.57	18	6.96	7.99	6.91	7.80	10.02	9.07
4	7.20	8.06	7.37	8.06	10.22	9.25	19	7.05	8.15	7.19	7.92	10.16	9.53
5	7.21	7.78	7.98	8.02	10.31	9.39	20	6.93	7.51	7.17	7.79	10.03	9.01
6	7.29	7.71	7.24	8.04	10.32	9.34	21	7.85	8.46	7.81	8.75	10.91	9.95
7	7.25	7.99	7.33	8.02	10.27	9.36	22	7.69	8.42	7.85	8.57	10.89	9.90
8	7.05	7.83	6.89	7.93	10.23	9.04	23	7.62	8.29	7.77	8.66	10.79	10.08
9	7.27	8.21	7.24	7.99	10.26	9.37	24	7.49	8.51	7.52	8.44	10.65	9.80
10	7.09	7.91	7.27	7.81	10.01	9.06	25	7.43	8.65	7.52	8.20	10.46	9.26
11	7.47	8.37	7.87	8.68	10.75	9.90	26	7.04	8.10	7.37	7.75	9.98	8.72
12	7.25	7.65	7.40	7.88	10.25	9.33	27	7.13	8.33	7.89	8.08	10.27	9.28
13	7.36	8.07	7.64	8.18	10.38	9.71	28	6.95	7.49	7.29	7.95	10.09	9.17
14	7.32	7.95	7.28	8.06	10.29	9.35	29	7.23	7.63	7.54	8.02	10.24	9.21
15	7.00	7.87	7.17	7.82	10.16	9.35	30	7.22	8.04	7.39	7.70	9.93	9.10

Table 2. Correlation coefficient table

Correlation coefficient	ESA	JPL	UPC
GPS	0.94	0.91	0.94
GLONASS	0.72	0.74	0.73
GALILEO	0.72	0.71	0.77

From **Figure 2** and **Table 1**, it can be seen that GPS-GIM, Glonass-GIM and Galileo-GIM have the closest global TEC daily average values, but there are still differences between them. The possible reason is that the number of satellites observed by different systems is different, and in different systems the number of pierce points and the quality of the observed data are also different, which leads to differences in the average value. JPL-GIM has the largest global daily average values of TEC, which is about 3 TECU larger than GPS-GIM, because the modeling method used in this experiment is also different from the JPL-GIM modeling method. The former uses a 15x15-order spherical harmonic function model; the latter uses a spherical bicubic spline model. The reason for the large difference between UPC-GIM and GPS-GIM is that UPC-GIM uses a spherical double-layer uniform grid model. The variation trend of GIM global TEC daily average values of different analysis centers tends to be the same, and the mutual difference is about 0~3.0TECU. ESA-GIM and GPS-GIM are similar in value, because they both use 15x15-order spherical harmonic function models to model the global ionosphere.

It can be seen from **Table 2** that the generated GPS-GIM, Glonass-GIM and Galileo-GIM are correlated with the global TEC daily average values of different analysis centers. Among them, the correlation between GPS-GIM and other analysis centers is extremely strong and all are greater than 0.91. The correlations between Glonass-GIM and Galileo-GIM's other analysis centers are very strong, which are all greater than 0.7. These prove that there is a correlation between different ionospheric modeling, but the correlation is weaker than that of GPS-GIM. The result is consistent with the conclusion of **Figure 2**.

6. Conclusion

This paper uses the GPS dual-frequency observation data of the European CORS station from the 326th day to the 332th day in 2019 to establish a global ionosphere model, and analyzes the reliability and stability of the established global ionosphere model, and draws the following conclusions.

- (1) The IPP of the GPS system is the most densely distributed, covering most of the world's land. Compared with the GPS system, Glonass has roughly the same distribution of pierce point, but the density is significantly lower than that of the GPS system. The Galileo system has the smallest distribution of pierce point.
- (2) Although the values of the ionospheric VTEC calculated by GPS, Glonass, and Galileo are slightly deviated, they have the same trend in terms of trends.
- (3) The ionospheric products of multiple systems and various institutions have a strong correlation.

Funding

Key Research and Development Program of Liaoning Province (2020JH2/10100044); National Natural Science Foundation of China (41904037); National Key Basic Research and Development Program (973 Program) (2016YFC0803102)

Disclosure statement

The author declares no conflict of interest.

References

- [1] Xie Y, Wu J, Chen J, et al., 2014, Global Ionospheric TEC Modeling Using Measured GPS and GLONASS. *Geomatics and Information Science of Wuhan University*, 39(08): 930-934.
- [2] Liu J, Wang Z, Wang H, et al., 2008, Modeling Regional Ionosphere Using GPS Measurements over China by Spherical Cap Harmonic Analysis Methodology. *Geomatics and Information Science of*

Wuhan University, 2008(08): 792-795+814.

- [3] Wang Z, Wang K, Li H, et al., 2018, Characteristics of the Antarctic Ionosphere by Utilizing Spherical Cap Harmonic Analysis. *Science of Surveying and Mapping*, 43(10): 33-38.
- [4] Kou R, 2019, Regional Ionospheric TEC Modeling and Spatio-temporal Variation Characteristics Analysis. Lanzhou Jiaotong University.

Application and Exploration of Overall Risk Management in Construction Enterprises

Hongyun Tian*

China First Metallurgical Group Co., Ltd., China

*Corresponding author: Hongyun Tian, 296106509@qq.com

Abstract: This paper mainly starts from the perspectives of management and economics, combined with the characteristics of the construction industry, conducts qualitative and quantitative analysis of the risks involved, studies various factors that cause construction enterprise risks from multiple angles, and uses scientific and effective methods to identify and evaluate risks, as well as determine the risk level. Through the overall risk management response strategies and empirical research of construction enterprises, this paper analyzes the general theory and main avoidance strategies of risk response of construction enterprises, and lays the foundation for follow-up risk management response in the form of cases through the implementation of technical route and innovation points.

Keywords: Overall risk management; Construction enterprises; Empirical risk control and countermeasures

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

1.1. Research background and significance

According to the statistics of the American Loss Control Association, enterprises without risk management are more likely to go bankrupt after a huge disaster. Zhuopu Wang believes that the construction project is a systematic project, which generally has different subsystems, and each subsystem will have some procedural standards and specifications. These standards and specifications often have been tested in practice for a long time and are relatively mature^[1]. The realization of overall risk management is not only the need of the country, but also the need of the development of their own enterprises.

1.1.1. Requirements of national policies

For China's construction industry, it has long relied on the active fiscal policy for many years and the rapid growth of fixed asset investment scale, and has taken the road of denotative and extensive development. Many enterprises have a debt ratio of more than 80%, and the profits of construction enterprises are getting thinner and thinner and the risks are getting bigger and bigger. In 2006, SASAC issued the Guidelines on Overall Risk Management for Central Enterprises, which is divided into 10 chapters and 70 articles, and puts forward clear requirements for overall risk management of central enterprises. Therefore, the implementation of the sustainable development strategy of overall risk management in the construction industry is the only way for central enterprises to adapt to the competition of economic globalization and narrow the management gap with large international companies.

1.1.2. Requirements for the development of the construction industry

During the Eleventh Five Year Plan period, the number of domestic construction enterprises reached 68283, the output value profit margin of construction enterprises always hovered between 1% ~ 2%, the

homogenization competition was becoming increasingly fierce, the profits of construction enterprises were seriously squeezed, and they had entered a “low profit era” and “no profit era.” As of September 2010, China’s foreign contracted projects had accumulated an operating revenue of US \$400 billion, and the scale of participating in international competition has increased, but the quality is not high, the development mode is extensive, the profitability is weak, and the business structure needs to be further optimized. By implementing the sustainable development strategy of overall risk management, it is necessary to correctly identify and evaluate all risks faced by the enterprise, provide the basic basis for the enterprise’s strategic decision-making, and make the enterprise develop healthily.

1.2. Review of research status at home and abroad

Since CAS (Casualty Actuarial Society) proposed Enterprise Risk Management or Enterprise wide Risk Management (ERM) in 2001, this theory has developed rapidly in western countries. Its core idea is: Risk comes from many aspects, and it is often not a single aspect but a combination of multiple risks that can ultimately have a risk effect on the enterprise. Therefore, only comprehensive risk management is the most effective way.

The events of Enron and WorldCom in 2001 made risk management get the attention and thinking of all sectors of society. The National Anti-Fraud Financial Reporting Council Committee of Sponsoring Organization (COSO) launched Enterprise Risk Management -- Integrated Framework in 2004, which focused more on enterprise risk management, and gradually become the national and world standard.

In China, the practice and theoretical research of risk management can be traced back to the 1930s. After decades of development, the current risk management research is becoming more and more mature. Especially in the aspect of engineering construction project risk assessment methods and technologies, many risk assessment methods have been developed, such as expert scoring method, fuzzy mathematics method, probability statistics method, decision tree method, sensitivity analysis, Monte Carlo simulation, RBI method, analytic hierarchy process, CIM model and impact diagram ^[2, 3].

In the 1980s, the risk management theory was introduced into China by the Kailing Duan, a Chinese living in the United States. Subsequently, a large number of scholars have invested in the research of risk management theory, of which the typical representative is Zhongwei Guo. After systematic research and summary, he published Risk Analysis and Decision Making in 1987, which is the first work on risk management in China and has milestone significance.

In general, the lack of risk management in construction enterprises has attracted the attention of scholars at home and abroad. However, the relevant theoretical and practical research is just beginning, and the systematically theoretical system is not perfect. From the research results, we have done a lot of research on contract risk and investment risk, but mainly introduce the theory of risk management abroad, and the theory of local innovation is relatively small. VaR (Value at Risk) model; TRM (Total Risk Management) theory; ERM (Enterprise Risk Management) theory; GRM (Global Risk management). As VaR, TRM and GRM are generally only used in the financial sector, while ERM is applicable to most enterprises and has attracted great attention, central enterprises and listed companies must use the Enterprise Risk Management framework. As a pillar industry of the national economy, the construction industry has gradually extended to the high-end of the value chain with the transformation and development of general construction contracting to general engineering contracting. Design business drives the rapid development of construction business, construction general contracting (EPC), project management general contracting (PMC), construction engineering management (CM), construction-operation-transfer (BOT) and other businesses continue to expand, which brings many risks such as market supply and demand change, capital advance, default, exchange rate fluctuation, project delay, quality and safety accidents, joint liability of project subcontracting and personnel appointment. Enterprises have more and more clear concept of risk

control, and the demand is more and more urgent. It is necessary to strengthen the risk management ability of construction enterprises.

1.3. Research objectives and contents of this paper

The research goal of this paper is to comprehensively summarize and refine the risk management theory of construction enterprises, deeply analyze various potential risks faced by construction enterprises, put forward risk identification methods, effectively evaluate the risks of construction enterprises, and finally provide guidance and help for overall risk management of construction enterprises. The research methods mainly include literature method, expert investigation method, case analysis and empirical research method, follow the research ideas from theory to demonstration, and gradually analyze the risk identification and risk control methods of construction enterprises. The specific research route is shown in **Figure 1**.

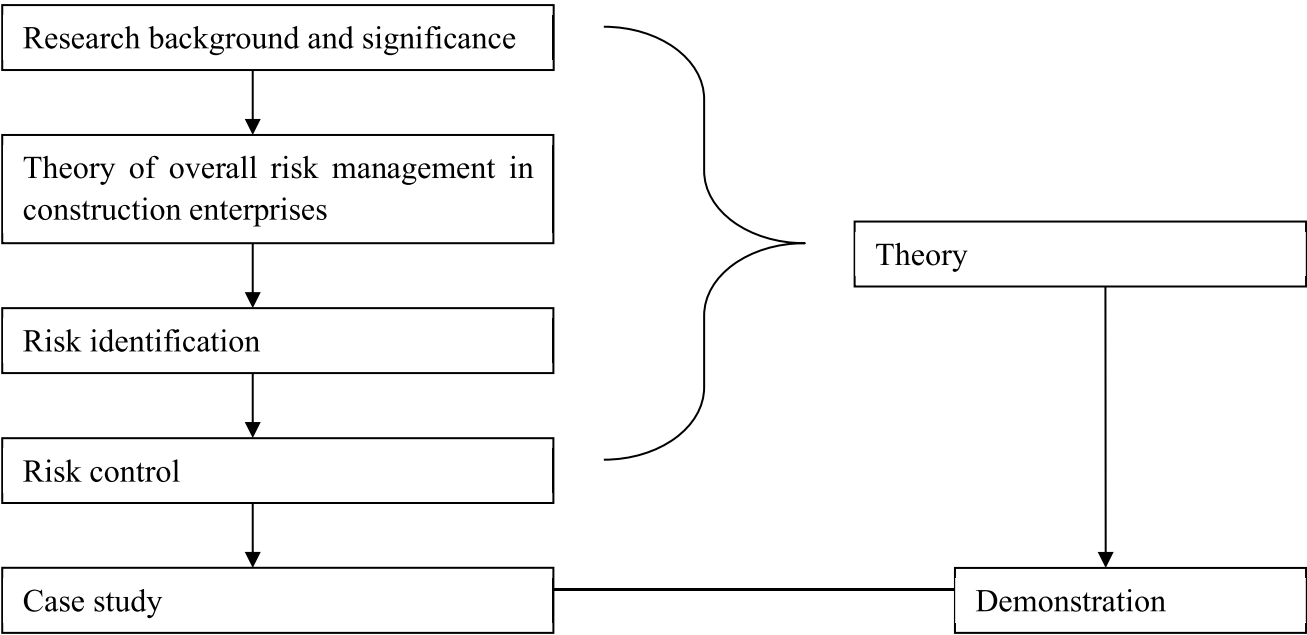


Figure 1. Technical route of research in this paper

2. Theoretical basis of overall risk management in construction enterprises

2.1. Main types of construction enterprise risks

With the development of risk theory, especially for the needs of risk management, people have conducted in-depth research on the types and characteristics of risk, and summarized the types of risk mainly from the perspective of risk nature, risk source, risk subject preference, risk object and technology. See **Table 1**. For details.

The development of technology is also an important factor to promote the development and progress of construction enterprises. The common technical factors include survey and design, drawing design, construction technology and so on. There still are many specific events causing technical risks, as shown in **Table 2**.

Table 1. Classification of general risks

Classification method or basis	Risk type	Characteristic
Classification by risk nature	Pure risk	It will only bring damage, not opportunities or benefits
	Speculative risk	It may bring opportunities and gain benefits, but it may imply threats and cause losses
Classification by risk source	Natural risk	Property damage or casualties due to natural forces
	Human risk	The risk caused by human activities is man-made risk, which can be divided into behavioral risk, economic risk, technical risk, political risk, organizational risk and so on.
Classification by risk event bearing capacity	Acceptable risk	Risk limited to a certain degree
	Unacceptable risk	The risk of exceeding the maximum loss that can be borne or huge deviation from the target
Classification by risk object	Property risk	Risk of loss, damage or depreciation of property
	Personal risk	Risks caused by disease, disability and death
	Liability risk	The behavior of legal person or natural person violates the provisions of law, contract or morality, causing property loss or personal injury to others
Impact of technical factors on risks Impact classification	Technical risk	The risks caused by technical reasons are man-made risks
	Non-technical risk	Risks due to non-technical reasons

Table 2. Examples of technical risk events

Risk factor	Typical risk events
Feasibility study	The basic data is incomplete and unreliable; The analysis model is unreasonable; Prediction results is inaccurate, etc
Design	Design content is incomplete; Design wxits flaws, errors and omissions; Selection of specifications and standards is improper; Selection of safety factor is unreasonable; Address data is insufficient or unreliable; The possibility of construction is not considered.
Construction	Construction technology is backward; Construction technology and scheme is unreasonable, and construction safety measures is improper; Application of new technologies and methods fails; The actual situation of the construction site is not considered.
Other	The process design does not meet the advanced indicators and reasonable process flow department, as well as the project quality inspection and acceptance do not meet the specified requirements

The non-technical risks of construction enterprises are mainly various uncertainties and possible losses caused by management factors in the process of construction. Such as fund management, cost control, schedule management, construction organization management, etc. Common non-technical risk events are

shown in **Table 3**.

Table 3. Examples of non-technical risk events

Risk factor	Typical risk events
Project organization management	Lack of project management ability; Improper organization, frequent replacement of personnel in key positions, inappropriate project objectives and poor control; Improper project planning or arrangement; Lack of project management and cooperation.
Schedule	The construction period is delayed due to poor management; Schedule adjustment rules is inappropriate; Lack of labor or low labor productivity, and the supply of materials cannot keep up; The supply of design drawings lags behind; Site conditions is unforeseen; The construction site is too small or the traffic route does not meet the requirements.
Cost control	Construction delay; Inappropriate engineering changes; Inappropriate engineering payments; Contractor's claim; Low budget; Lack of management experience; Inappropriate procurement strategies; Changes in external conditions of the project.
Other	Construction disturbance; Shortage of funds; Insolvency

From the perspective of objectives, the risks of construction enterprises mainly include construction period risk, construction quality risk and investment cost risk.

2.2. Overall risk management of construction enterprises

The Guidelines on Overall Risk Management for Central Enterprises ^[4] defines overall risk management, comprehensively examines the meaning and characteristics of risk, especially the essence of risk management. The author believes that overall risk management of construction enterprises is to comprehensively identify the possible risks in each link based on the comprehensive analysis of the environment of construction enterprises and around the goal. Through scientific evaluation, a comprehensive construction enterprise risk management system is established. Its essence is risk identification and control. The core contents include: risk identification, estimation, evaluation and control of construction enterprises. See **Figure 2**.

In terms of time, the risk of construction enterprises runs through the whole process of construction projects. From the perspective of management objects, there are many contents. The objects and focus should focus on the projects with new processes, large investment scale, large impact (political, economic and social), strict administrative and financial requirements and special contracts. The following links are the key links with various risks and need to be paid high attention, as shown in **Figure 3**. The supervision of these links is of great significance to the implementation of comprehensive risk management of construction enterprises.

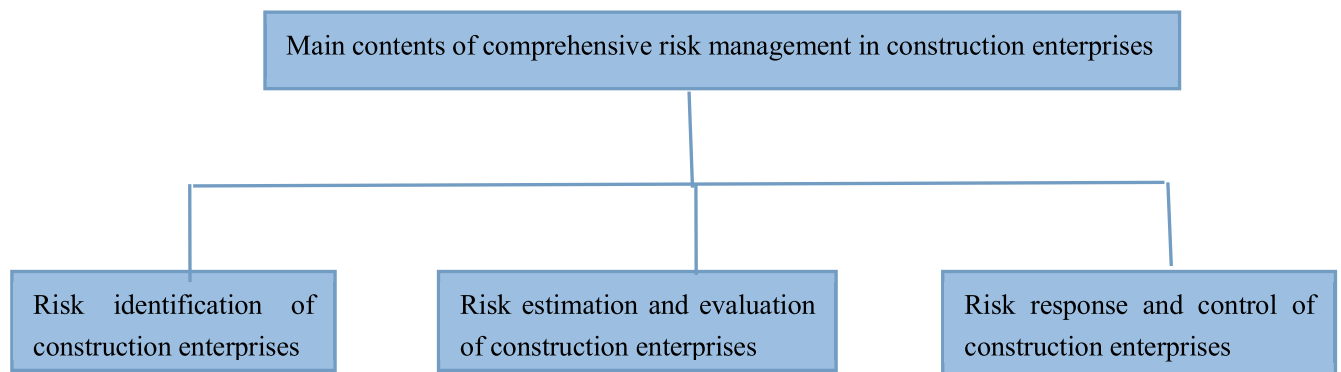


Figure 2. The main content of the overall risk management of construction enterprises

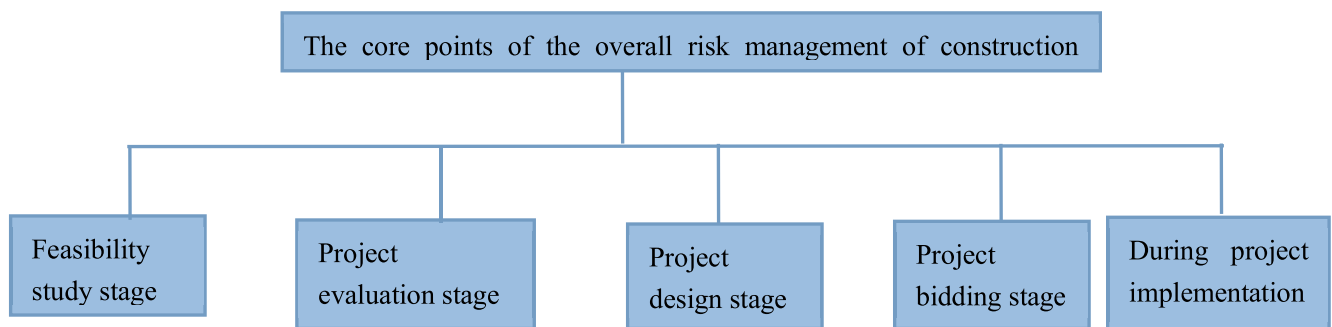


Figure 3. The core points of the overall risk management of construction enterprises

2.3. Risk identification, estimation and evaluation of construction enterprises

Construction enterprises face three main objectives: quality, schedule and cost. The key to realizing comprehensive risk theory lies in risk identification. The main methods include: historical experience analysis method, expert interview method, analysis tool method, analytic hierarchy process, checklist method, decomposition analysis method and graphic method. Risk identification mainly includes four links, and the specific process is shown in **Figure 4**.

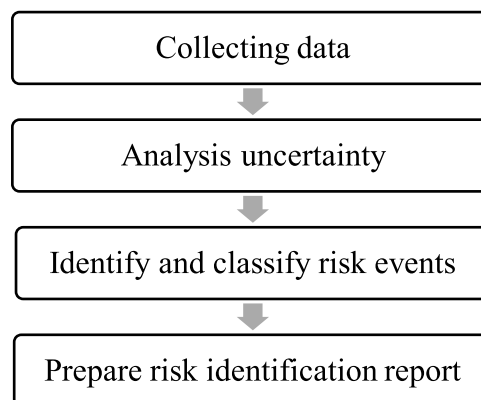


Figure 4. General process of risk identification

Construction enterprise risk estimation is to analyze the probability, time, possible loss and impact of risk in the construction process, and estimate and measure it through scientific methods. Its main function is to serve risk management decision-making. Generally, it includes several stages such as data collection,

model establishment and risk evaluation ^[5], as shown in **Figure 5**.

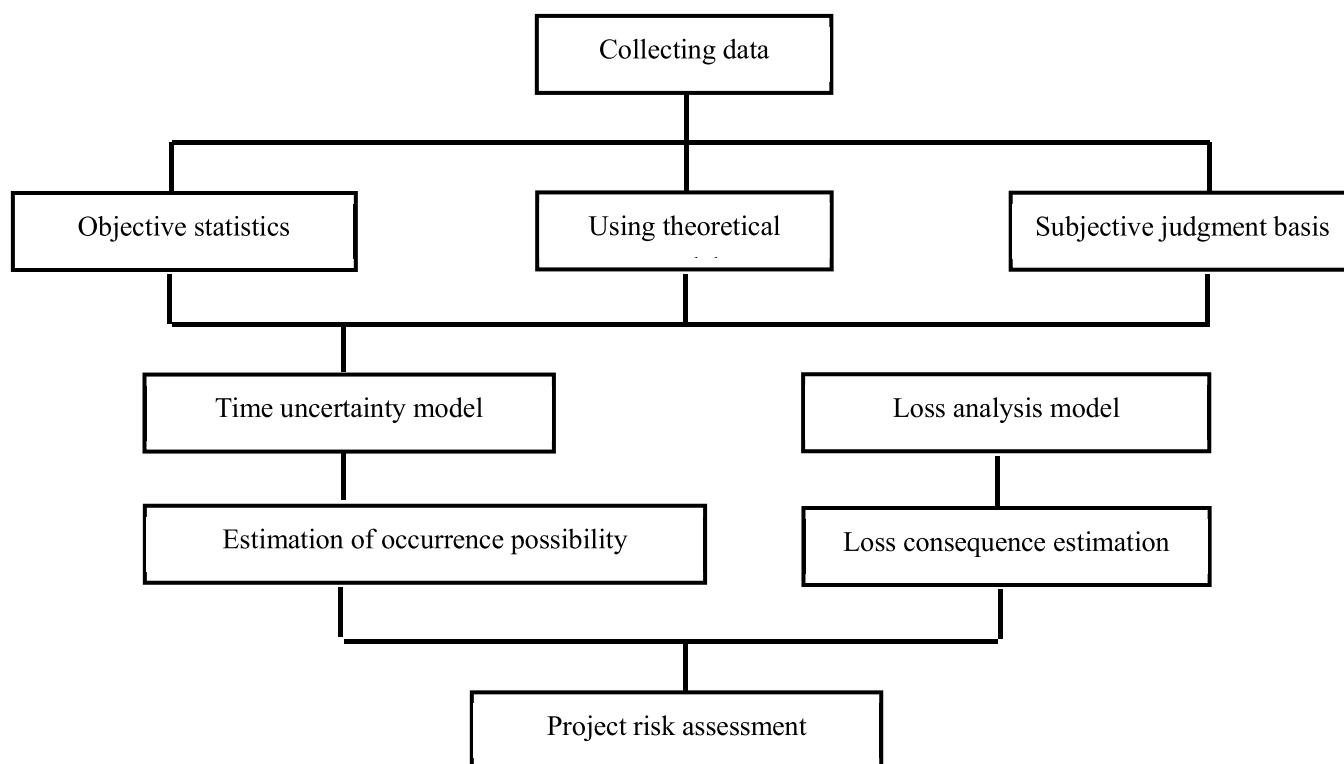


Figure 5. General process of construction enterprise risk estimation

Generally, the risk evaluation can be completed according to the following three steps ^[6]:

- (1) Different risk evaluation criteria are determined according to the risk preference and affordability of construction enterprises.
- (2) Determine the risk level of the risk of the construction enterprise that has occurred, and estimate the loss of risk consequences through the measurement of the risk level.
- (3) Evaluate and compare different risk events and risk losses, so as to provide basis for what risk response measures to take.

3. Countermeasures and empirical research on comprehensive risk management of construction enterprises

3.1. Risk response strategy of construction enterprises

In the face of various risks, the commonly used response strategies include risk avoidance, risk mitigation, risk transfer, risk retention and risk utilization. At the same time, the combination of the above strategies will also be adopted. In fact, due to the different risk preference and risk tolerance of construction enterprises, the risk avoidance strategies adopted in practical activities are also different. In order to better guide construction enterprises to resolve various risks, Shengqiang Lei, in his book *International Engineering Risk Management and Insurance*, listed risk management strategies commonly used by construction enterprises and their countermeasures in detail ^[7].

3.2. Case study of overall risk management of construction enterprises

Taking the comprehensive risk management implemented by Industrial Furnace Engineering Company of China First Metallurgical Group Co., Ltd. in the process of transformation and development as an example,

according to the basic idea of comprehensive risk management of “overall planning, highlighting key points, step-by-step promotion and integrated operation,” combined with the development status of main business segments, this paper defines the main processes and operation methods of risk management, The construction of internal control system for basic comprehensive risk management has been completed (**Figure 6**). The achievement won the second prize of the innovation achievement of modern management of national construction enterprises in 2012.

Specifically, the risk of an enterprise comes from many aspects. What ultimately affects the enterprise is not a certain risk, but the result of the joint action of all risks. Therefore, only the risk management from the overall perspective of the enterprise is the most effective. “Sustainable development strategy of implementing comprehensive risk management” is a management concept suitable for its own development summarized and refined by industrial furnace engineering company of China First Metallurgical Corporation on the basis of absorbing and learning from the essence of advanced management at home and abroad. Its connotation is to link risk preference with enterprise strategy; Ensure that the risk management strategy is consistent with the development strategy of the enterprise; Provide tools for identifying and assessing risks to facilitate the identification and assessment of risks faced by the organization; Provide tools for scientific classification of risks, use the concept of risk optimization, and explore risk issues based on portfolio view; Integrate enterprise risk management with basic business activities to avoid additional costs. And it was put into management practice in January 2012. Through the implementation of control environment, risk assessment, control activities, information and communication, internal supervision and other activities, the construction of the internal control system of basic comprehensive risk management has been completed, and the sustainable development of the enterprise has been promoted. The main methods are:

3.2.1. Widely collected the internal and external initial information related to the company’s risk, and formulate the enterprise development strategy suitable for the sustainable development of comprehensive risk management

According to the basic principle of “risk concentration and hierarchical management,” and based on the existing organizational system and management structure, the group has established a comprehensive risk management organization system composed of the company’s office (including the legal and discipline inspection commission), finance and asset management department, operation management department, audit and supervision department, human resources department, engineering department and other functional departments. Collect information through network, books, periodicals, newspapers and association exchanges, and analyze the current situation and development trend of the company’s field. Combined with the company’s existing technical equipment level, personnel skills and comprehensive resource holdings, the development strategies of the three main business sectors are determined to form an industrial development pattern with complementary industries, reasonable structure, and harmonious and unified operation quality, profitability and anti-risk ability. According to the strategic development objectives formulated by the enterprise, as well as the supporting strategic objectives, business objectives, reporting objectives and compliance objectives, the general objectives and annual objectives of ERM system construction are formulated.

3.2.2. It has established an internal control system with the organic combination of corporate governance, risk management and internal audit

Reorganized and defined the business process and business level process, reasonably adjusted the organization, allocated resources, reengineered the management process, reformed the organization of the original departments and entities, redefined the staffing and posts, established an independent audit and

supervision department, and transferred the construction function of comprehensive risk management system to the company's Office (including corporate planning function). As the third line of defense of risk management, the audit and supervision department is responsible for supervision, inspection and evaluation. According to various documents and new businesses formed in the enterprise business in the past, a total of 48 business processes are proposed, standard flow charts are drawn and standardized with systems to prevent cross and duplication of departments and clear interface management. According to the Basic Norms for Internal Control of Enterprises, the Manual for Internal Control of Corporate Risks was prepared (including risk summary table, process map, job list with incompatible responsibilities and risk control matrix), and defined the internal control system architecture. The management is responsible for organizing and leading the daily operation of the internal control system of risks. The audit department shall specifically organize and coordinate the establishment, implementation and daily work of the risk internal control system, as well as supervise and inspect the effectiveness of internal control. It has promoted the standardization and normalization of the construction of risk internal control system. At the same time, the relevant systems involved in the company's business processes have been supplemented and revised, and the company's system platform has been built with the combination certification of quality, environment, occupational health and safety management system as the framework, which has solved the problems of fuzzy process, unclear interface, unclear responsibility and so on in the enterprise's operation and management, especially in the project cost control, so that the connotation of standardized management of the company can be effectively extended(**Figure 7**).

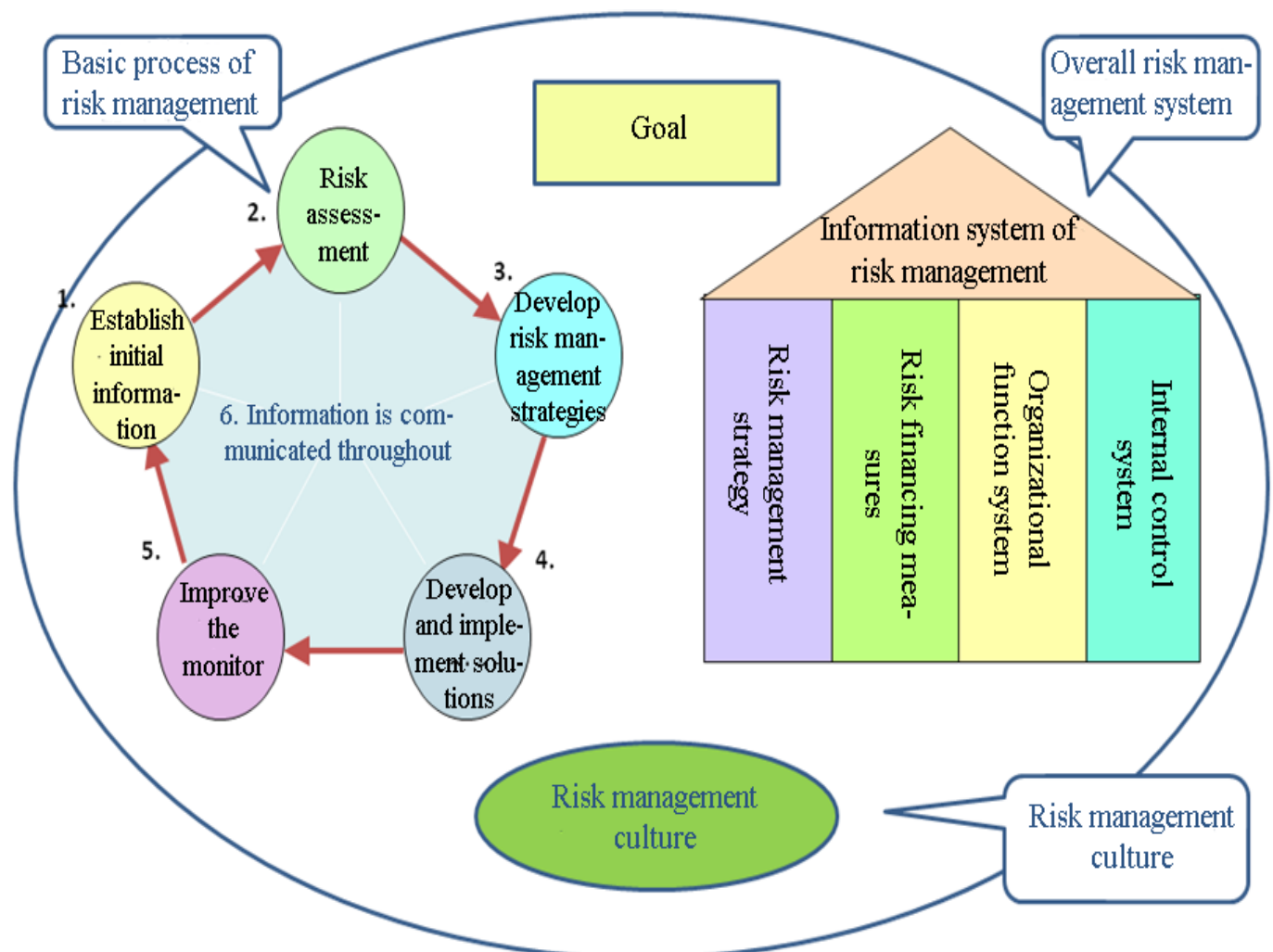


Figure 6. Risk management system of industrial furnace company

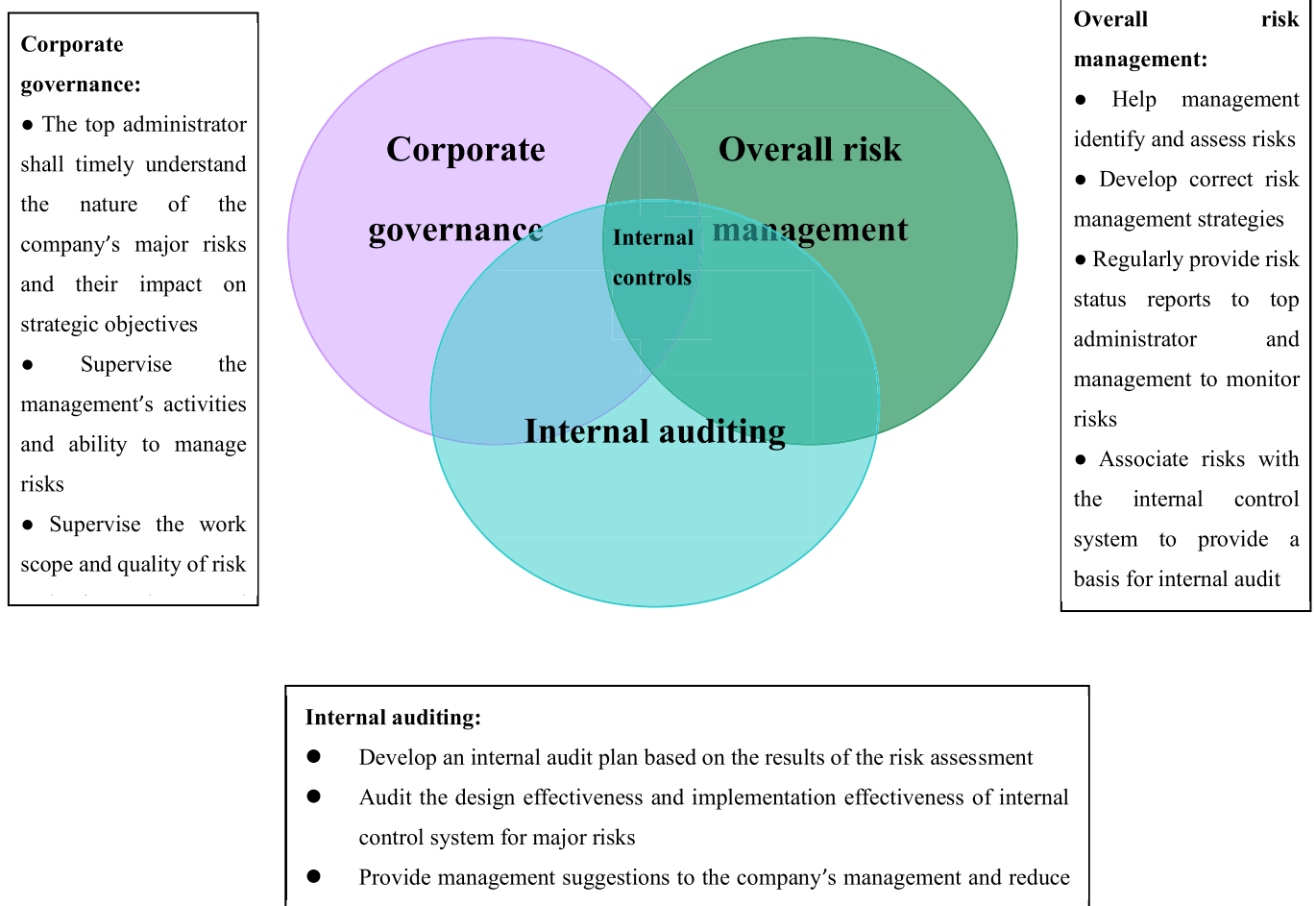


Figure 7. Risk management oriented internal control system

3.2.3. Actively carry out comprehensive risk assessment of basic process management and formulate scientific and objective risk treatment strategy combination

In the process of operation, enterprises will face various risks from external business environment, internal operation, management, finance, credit and transaction, forming the risk universe of enterprises. According to the diagnosis of the possibility and impact of various risks, an enterprise's risk map can be formed.

Firstly, the 48 project management departments under construction issued a notice to collect risk cases of projects under construction, collected 76 risk cases, and put forward the countermeasures to be taken to control and resolve risks. At the same time, in combination with the annual internal control inspection, project patrol inspection, system internal audit, small treasury inspection and other work, understand the cognition of the project management department on risk and risk management, the uncertain factors and urgent problems faced by various functional departments in the business management process, and comprehensively grasp the basic risk information.

Secondly, functional departments were organized to fill in professional risk event cases on the front, 69 risk identification items and 22 risk cases were collected, 10 major risks and internal control defects were collected, and improvement measures and countermeasures were put forward, involving coke oven construction, heating furnace construction and dry quenching system engineering, among which, the major internal risk inspection items involve 5 first-level risk items, including strategy implementation risk, project decision-making risk, business collaboration risk, project implementation risk and contract management risk, and 38 minor items. Risk identification and risk case database are preliminarily collected and built.

Through the analysis of the existing operation strength, main financial data and operation indicators, the risk assessment standards at the company level are determined. The risk is assessed from two dimensions: the possibility of risk occurrence and the degree of impact. The possibility of risk occurrence is divided into five levels: very low, low, medium, high and very high (**Figure 8**). The degree of impact of risk is divided into five levels: slight, small, medium, serious and very serious. According to the impact areas of main risks, it is further subdivided into financial, safety, health and environmental protection target and operation, as well as the company's reputation. Through the collection of risk cases, it is found that some management processes of the functional departments are not implemented in place, the comprehensive unit price of the project management department is low, the subcontracting funds exceed the contract payment, the market material price rises, the settlement of completed projects lags behind, the funds collection is difficult, and the delivery file handover is not complete; Conduct a comprehensive and in-depth analysis on the collected risk distribution, risk characteristics, risk causes, risk impact and existing control measures, put forward directional suggestions on major risk management, prepare for the response to major risks, and formulate risk coordinates.

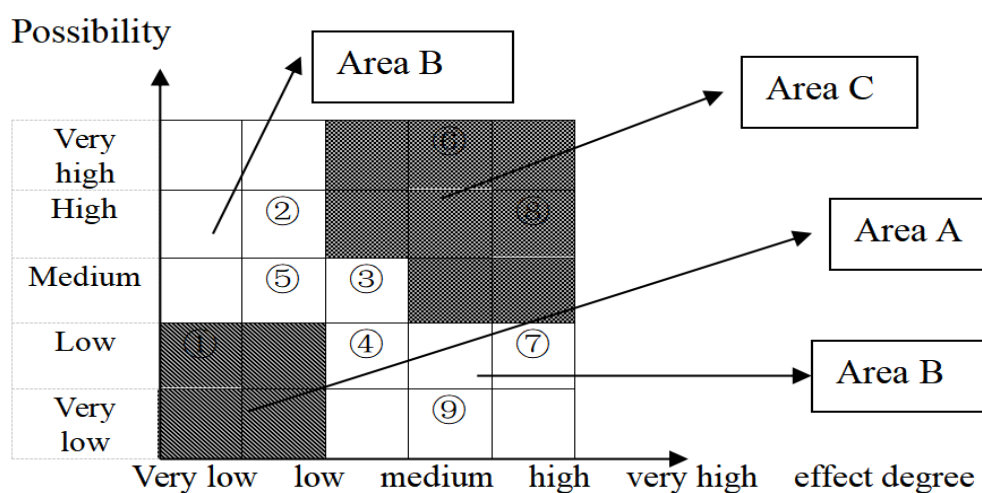


Figure 8. Risk coordinates

As shown in **Figure 8**, the chart is divided into three areas A, B and C. The risk control team decides to assume all risks in area A and will not add control measures; Strictly control various risks in area B and specially supplement and formulate various control measures; Ensure to avoid and transfer various risks in area C, and give priority to the implementation of various preventive measures.

Establish and improve the risk management evaluation index system, strengthen the supervision function of risk management evaluation, deeply integrate with daily operation management, and determine the risk evaluation index system at the company level and business level (**Figure 9**).

3.2.4. Implementation effect of sustainable development strategy of basic overall risk management

The company's capital management and control, marketing and other major business activities have been strengthened. The systems of business performance assessment, budget management, property right management and asset management have been continuously improved. Under the platform of modern enterprise system, the enterprise strategy transfer has been smoothly completed, and the core competitiveness of the enterprise has been fully reflected in the reform of dynamic adjustment system. The output value and profit are increasing year by year. The company has been approved as the "furnace building technology research and direction base" of China Metallurgical Group Corporation, and the "7.63m coke oven masonry method" has won the national construction method. "New energy-saving and environment-friendly coking system engineering construction technology" was listed as a national key

construction new technology research and direction project by the ministry of finance, and was allocated 1 million yuan by the ministry of finance. Coking System Engineering of Section A of Coking System Engineering of New District of Handan Iron and Steel Co., LTD. won the first prize of the third national excellent project management achievement of construction engineering. Please see **Table 4.** for details.

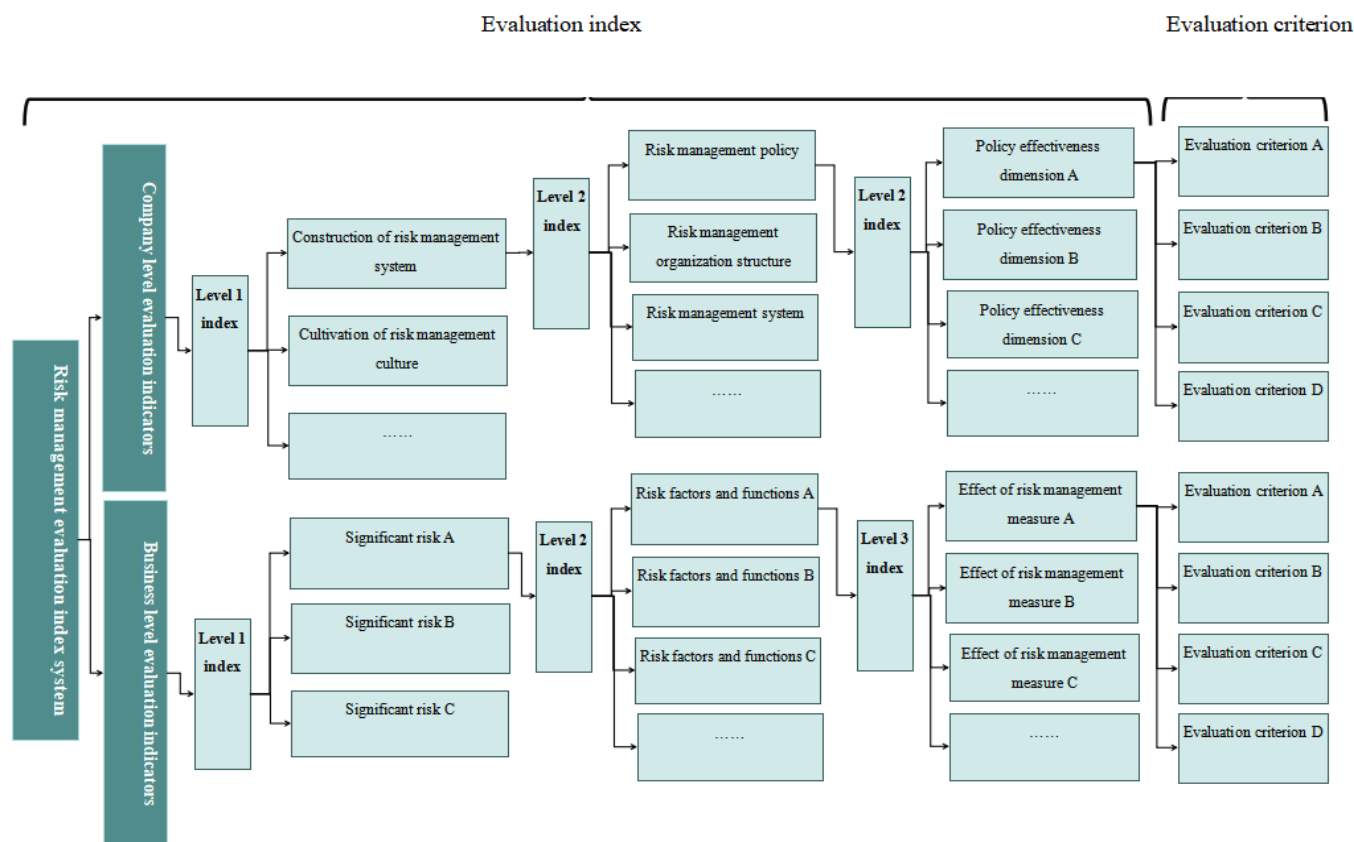


Figure 9. Risk management evaluation index system

Table 4. Comparison of technical innovation indicators before and after the implementation of achievements

Indicator name	2010, the year before the implementation of the results	2011 to 2012, the year when the implementation of the results accumulates
Number of patent applications	17	131
Number of provincial and ministerial achievements	4	11
Number of provincial and ministerial construction method	2	6
Number of editor-in-chief and participating editors of standards and specifications above the ministerial level	0	4
Number of papers published above provincial and ministerial level	4	11
Investment in science and technology research and direction (10000 yuan)	195	680

4. Conclusion and prospect

This paper is a research and exploration on the application of total risk management theory in Chinese construction enterprises. In the immature stage of the formation of risk management theory, through the response to the application of a state-owned enterprise's overall risk management theory, the formulation, risk identification, risk control and risk strategy of risk strategies as well as the comprehensive improvement of the enterprise's internal control system, risk control ability, market share and other aspects after the implementing of overall risk management, it verifies the effectiveness of overall risk management theory in Chinese construction enterprises. In particular, it makes a more in-depth analysis on the identification and control of risk and the improvement of enterprise internal control system. According to the analysis and research results, the following conclusions are drawn:

- (1) By summarizing and refining the risk management theory of construction enterprises and deeply analyzing various potential risks faced by construction enterprises, it can be concluded that for the enterprises that have established enterprise risk management system, they will have greater competitive advantage in the face of loss accidents, and the integrated comprehensive risk management system can fundamentally improve the risk management ability of construction enterprises, enhance the core competitiveness of enterprises in the market, so as to realize the sustainable development of enterprises.
- (2) This paper puts forward the methods of risk identification, including historical experience method, expert interview method, analysis tool method, analytic hierarchy process, checklist method, decomposition analysis method and graphic method. Through these methods enterprises can correctly identify and evaluate various risks faced by them, which can provide basic basis for enterprise strategic decision-making;
- (3) In project level and enterprise level risk management cases, different risk response strategies such as risk retention, risk transfer, risk control and risk avoidance are formulated for the degree of risk control by using typical risk events, systematic risk database and risk coordinate map, so as to avoid the serious consequences of organizational strategic risk and project level system risk, which has achieved a good situation in which the enterprise development is sustained, healthy and stable, the market share is continuously improved, and the project life cycle is fully controlled in terms of construction period, quality, safety and cost. The research results provide reference and basis for maintaining the vitality of the construction market.
- (4) Through the analysis of empirical cases, it is proved that connecting risk preference with enterprise strategy can ensure that the risk management strategy is consistent with the development strategy of the organization and the value of shareholders. At the same time, it provides tools for identifying and evaluating risks, which is conducive to identifying and evaluating the risks faced by the organization.

To sum up, there is a big gap between China and foreign countries in terms of theory and practice in the research of comprehensive risk management of construction enterprises. The main manifestations are:

- (1) The research on the risk of construction enterprises mainly focuses on the project level risk management.
- (2) Lack of understanding of ERM's position in enterprise development, without management and control rise to the strategic level.
- (3) ERM cannot be highly integrated with enterprise management, and its operability is not strong in the process of system formulation.
- (4) The construction of risk management organization is not perfect, there is no separate risk management department, and there is no soul department to promote strongly.
- (5) A good risk management culture has not been formed and cultivated, and senior management and

employees lack risk management awareness.

In view of these five problems, the application of comprehensive risk management in construction enterprises has a long way to go, especially the scientificity, systematicness and operability of risk identification technology need further research and discussion.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Xie C, 2012, Discussion on Project Management Risk and Its Prevention in Construction Enterprises. *Contemporary Economics*, 2021(8): 20-21.
- [2] Zeng X, 2011, Analysis on Risk Management of Highway Bridge Construction. *Theoretical Research in Urban Construction (Electronic Version)*, (29).
- [3] Wu H, 2009, Application of Monte Carlo Method Considering Variable Correlation in Construction Risk Management. *Beijing University of Technology*.
- [4] Zhang W, Hu Q, Zhang A, 2007, Research on Comprehensive Risk Management of Electric Power Enterprises. *Electric Power Technologic Economics*, 02:61-65.
- [5] Huang H, Ning Z, 2008, Research on Dynamic Risk Control of Shanghai Rail Transit Construction. *Proceedings of 2008 Cross-Straits Rail Transit Construction and Environmental Engineering Advanced Technology Forum*. 167-171.
- [6] Reza A, Azari K, Mousavi N, et al., 2011, Risk Assessment Model Selection in Construction Industry. *Expert Systems with Application*, 38(8): 9105-9111.
- [7] Lei S, 2002, *International Engineering Risk Management and Insurance*. Communication and space. China Architecture Publishing.

Public Space Demand and Adaptive Behavior of Residents in Old Residential Area of Ancient City: Based on Qingyi Garden of Beirenyi Hutong in Kaifeng

Shu Zhao*, Zhe Wang

Henan University, China

*Corresponding author: Shu Zhao, 785539380@qq.com

Abstract: The majority of the literature on the transformation of cultural promotion space in old residential areas in the United States and abroad is written from the top-down perspective of God, such as architects, planners, developers, and even government officials, and only a few of them examine the designer's work from the perspective of aborigines. To sample life and gain insight into human nature, find another means to be as near to the public as possible, listen to the voice of users, and conduct an in-depth examination of the freestyle works altered by the old residential districts through the "people's architectural planner."

Keywords: Old residential areas; Public space; People's building planner; Freestyle works; Micro update; Empirical data

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

Ministry of Housing and Urban-Rural Development: during the "14th Five Year Plan period," China will complete the transformation of 219,000 old residential area in cities and towns.

When the social function of the old residential area cannot meet the needs of users, and this situation cannot be fundamentally changed in the short term, how do residents accommodate on the existing hardware conditions of the residential area. They can often make full use of the corners of sporadic space and upgrade it to become a public space carrying market culture. Through the in-depth analysis of the Freestyle works of people's architectural planners, we may be able to re-understand architecture, residential area and even life from a new perspective ^[1].

2. Empirical analysis

2.1. Basic information

Qingyi Garden is located in the north section of Renyi Hutong, north of Longting District. It is a government led affordable housing project with limited price. It was completed in 2002. The building area is 36,000 square meters, the total investment is 23.8 million yuan, the plot ratio is 2.75, the greening rate is 25%, the total number of buildings is 6, and the total number of houses is 222. The base is square, with three rows of buildings side by side, without central centralized green space, supporting leisure facilities and property management houses. The only public facilities are the entrance guard and gate access control system. The residential area was built at the beginning of this century and its basic positioning is not high. It belongs to affordable housing in the traditional sense. When the residents' living hardware conditions cannot meet the normal social needs, how to use the leftover space to "micro update" the environment according to local

conditions. In this paper, various types of public space levels are sorted out in order to build a space system and achieve the purpose of reconstruction.

3. Environmental observation and analysis

The observation method is used to classify the public space in the original design environment of the residential area according to its physical location, which is as follows: intersection, front and rear buildings, side-by-side buildings, residential area boundary and square boundary. On this basis, the representative secondary public space is further divided. (Figure 1) [2].

	Scatter space plan ^{①②}	Number of people ^③	Use pattern ^③	The type of activity ^③	Active period ^③	Typical scattered spatial points ^③	Scatter space instance photos ^③	Spatial features ^③
		5 ^③	Set up tables and chairs ^③	Drink tea, sit around, chat, play mahjong ^③	All day long ^③			Traffic is dense, creating small, small-scale sales and social venues. ^③
Intersection ^③		3 ^③	Place the camera ^③	Population, vehicle access ^③	Morning, mid and evening peaks ^③			Mainly for pedestrians and vehicles to pass by, at the same time, the space is larger, so vehicles can be parked. ^③
		2 ^③	Place utility poles ^③	Population, vehicle access ^③	Morning, ^④ mid and evening peaks ^④			The buildings at the end of the dingo provide a sense of security to rely on. ^③
Between the front and back housing buildings ^③		5 ^③	Plant green belts ^③	Chat, sit, ^④ dry, plant, ^④ feed rabbits ^③	midday ^④ Afternoon ^④			Located in the middle of the building, there is a larger space where residents can socialize and the green belt is planted to divide the space. ^③
Between the front and back housing buildings ^③		1 ^③	Hang the clothesline ^③	dry clothes, park motor vehicles, non-motor vehicles ^③	midday ^④ Afternoon ^④ At night ^③			The space between buildings is large, you can park motor vehicles and non-motor vehicles, when there is sunshine, you can dry clothes. ^③
		3 ^③	Plant green belts and hang clotheslines ^③	Chat, sit around, dry, plant potted plants ^③	midday ^④ Afternoon ^④			Located between residential buildings, it provides a place for residents to socialize, planting green belts and separating roads from residential buildings. ^③
Between the front and back housing buildings ^③		2 ^③	Hang the clothesline ^③	Chat, sit around, dry, park your car ^③	midday ^④ Afternoon ^④			Large space, noon sun can shine in front of the house, for residents to dry clothes, sit around, social entertainment activities. ^③
Between the left and right housing buildings ^③		1 ^③	Place the seat ^③	for residents to walk ^③	Morning, mid and evening peaks ^③			Here the space is mainly used for road use, the road side of the fragmented space is mainly used to park motor vehicles. ^③
Between the left and right housing buildings ^③		2 ^③	Place bulletin board ^③	To publicize the core values of socialism ^③	Morning, mid and evening peaks ^③			Located in the middle of the community location, large space, can park motor vehicles and set up bulletin boards, but also residents for social activities. ^③
Between the left and right housing buildings ^③		5 ^③	Place seats, fire cabinets ^③	rest ^③	Morning, mid and evening peaks ^③			The space is relatively close to each other and is used to place fire boxes and seats for residents to relax in. ^③
Community boundaries ^③		10 ^③	Park motor vehicles and set up security booths ^③	Stop the car and find out the population ^③	Morning, mid and evening peaks ^③			The space under the fence is relatively static, used to park motor vehicles, but also to dry clothes. ^③
		5 ^③	Plant trees, potted plants, idle open space ^③	Parking for non-motor vehicles ^③	Morning, mid and evening peaks ^③			Space is close to the boundary of the community, less traffic, mainly used to park non-motorized vehicles. ^③
Square boundary ^③		9 ^③	Install fitness equipment ^③	Fitness, exercise, drying quilts ^③	morning ^④ Afternoon ^④ At night ^③			

The scattered spaces of Qingyi Garden are classified by physical location^④

Figure 1. The Scattered Spaces of Qingyi Garden are classified by physical location.

Classify the spontaneous transformation projects of the residential area environment in order to find the essence behind this phenomenon, such as residents’ behavior, living habits, ideology and other deep-seated reasons. (Figure 2, Figure 3).

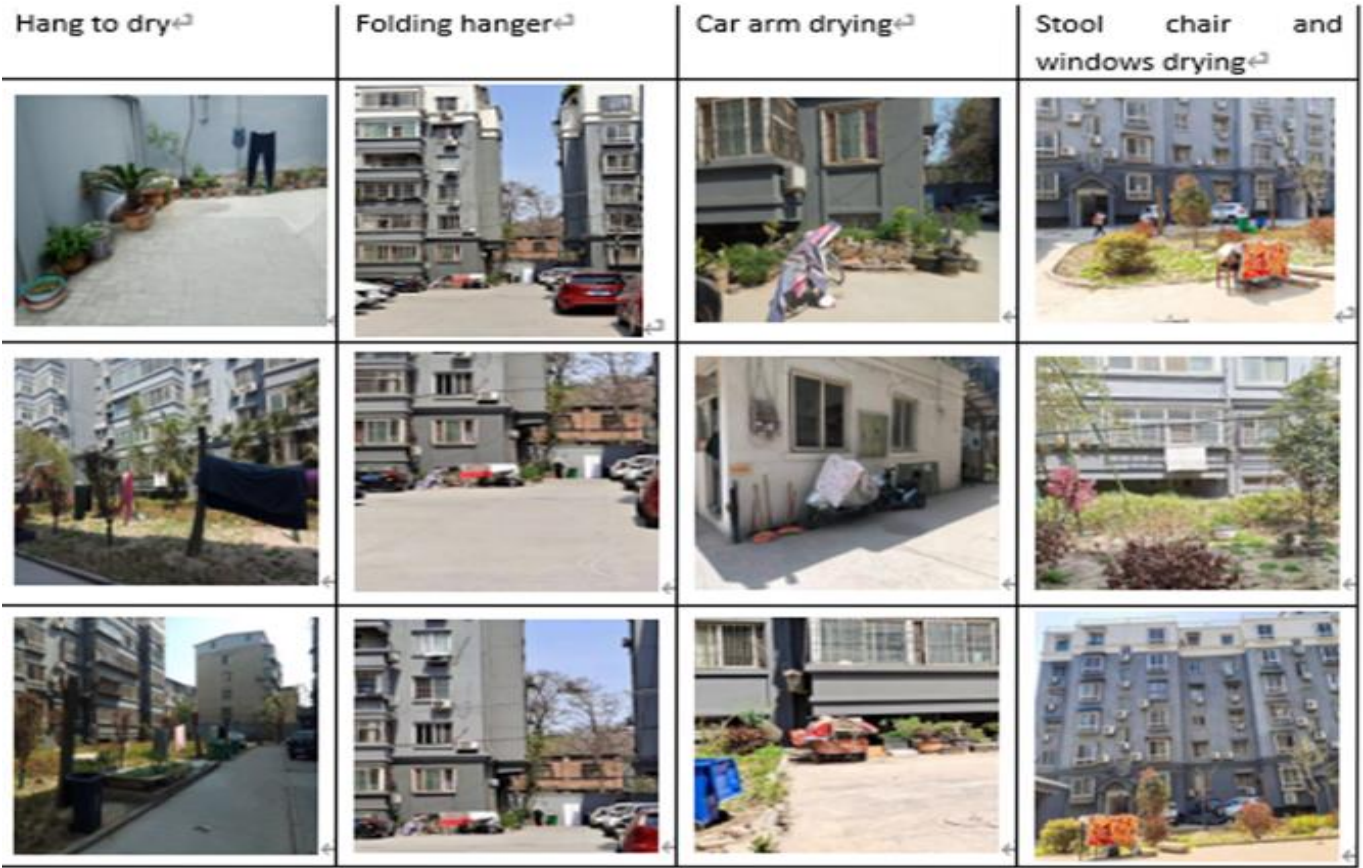


Figure 2. Drying method statistics

Summarize the main material elements in public space: street lamps, trees, seats, motor vehicles, non-motor vehicles, clothes hangers and potted plants. (Figure 4, Figure 5, Table 1)

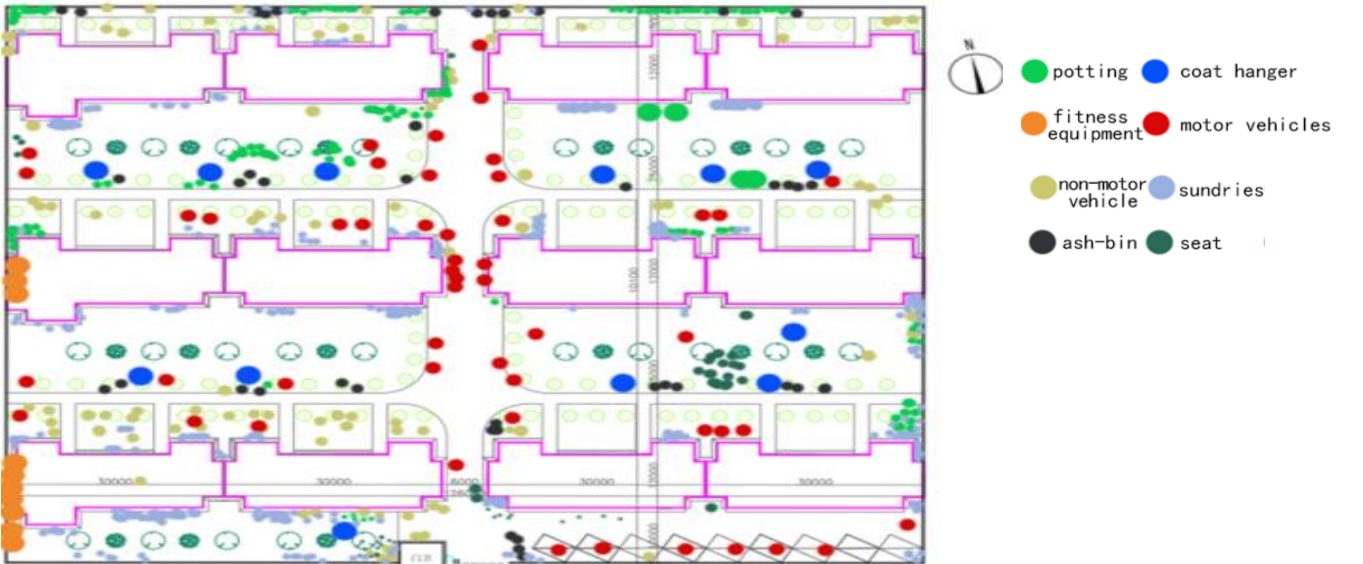


Figure 3. General layout [3]

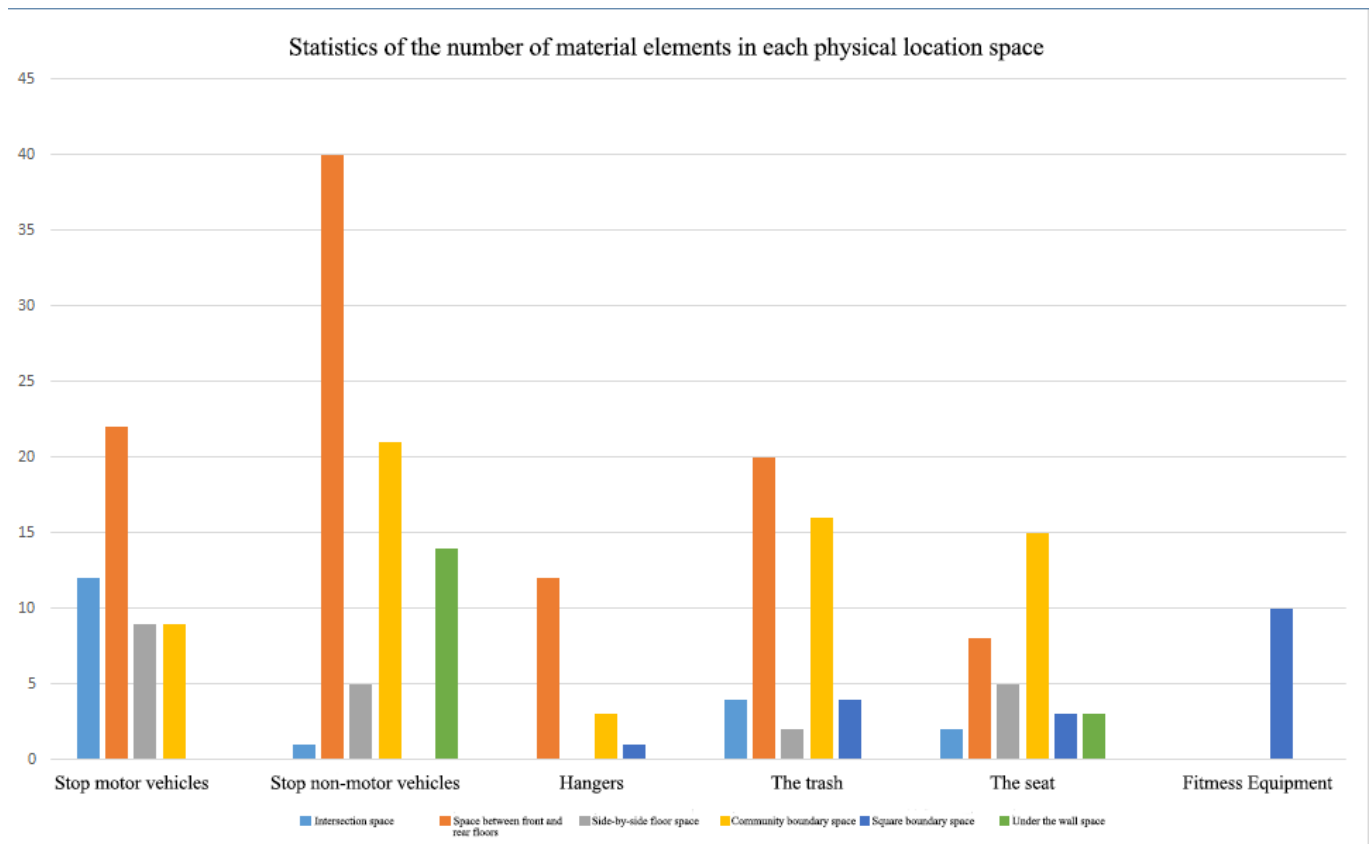


Figure 4. Statistics of the number of material elements in each physical location space

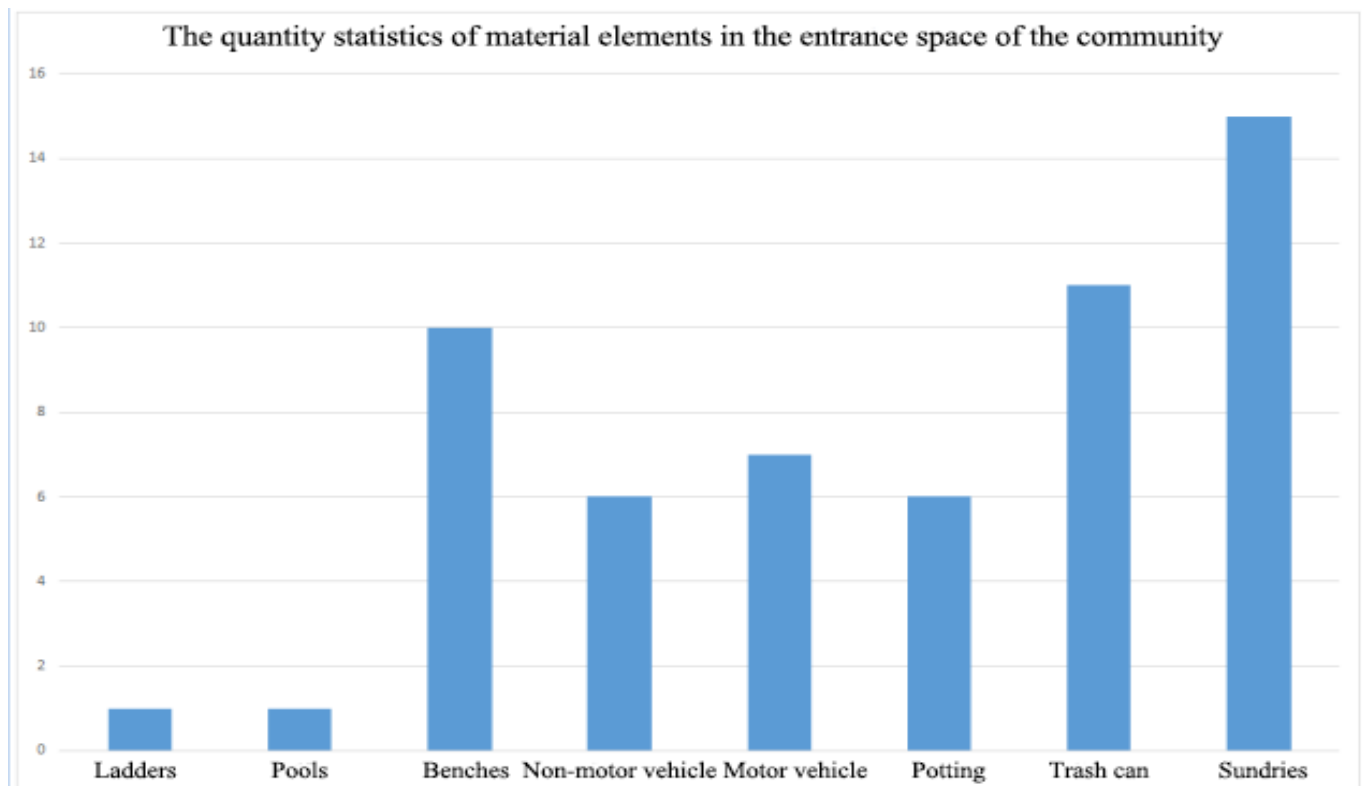


Figure 5. The quantity statistics of material elements in the entrance space of the community

Table 1. Statistical table of space material elements in front and back of residential buildings

The quantify statistics of material elements in each physical imitation space						
	Stop motor vehicles	Stop non-motor vehicles	Hangers	Trash can	Seat	Fitting equipment
Intersection space	12	1	0	4	2	0
Space between front and rear floors	22	40	12	20	8	0
Side-by-side floor space	9	5	0	2	5	0
Community boundary space	9	21	3	16	15	0
Square boundary space	0	0	1	4	3	10
Under the wall space	0	14	0	0	3	0
The quantity statistics of material elements in the entrance space of the community						
Ladders	1					
Pools	1					
Benches	10					
Non-motor vehicle	6					
Motor vehicle	7					
Potting	6					
Trash can	11					
Sundries	15					

4. Results and discussion

In the final analysis, the above various “upgrading” is ultimately a manifestation of the lack of life function, and the essence of any social phenomenon is still human after all. Only by thoroughly analyzing the users of these long-term relatively stable material elements can we really grasp their distribution rules and constituent factors. By analyzing and summarizing the active place, active time and activity content of residential area residents in a day, we can get the coupling law between various material factors. Through the figure below, we can get the daily adaptive activities of residents and the areas where the design needs to be improved. (Figure 6)

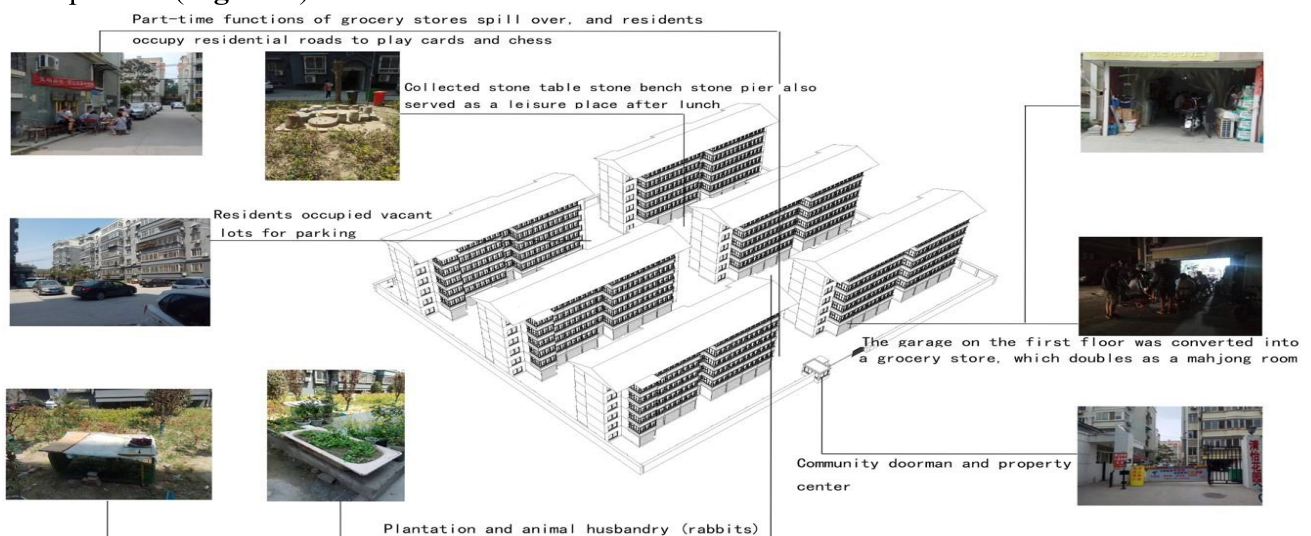
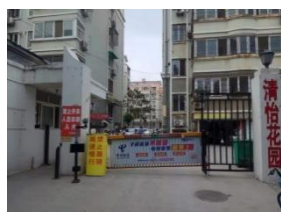


Figure 6. The works of people’s architecture ^[3,4]

Finally, it is worth mentioning that the space originally designed to be used as a garage has been creatively transformed into a canteen by residents. It can be said that although the sparrow is small, it' may have all its internal organs, which basic cover every aspect of life (It have a business license to work with). Less than ten square meters of “cultural spots” serve as part of the functions of non-motor vehicle garages, shopping centers, community centers and even administrative centers (parliaments) to a considerable extent. Many “major events” related to each residential area resident take place here (**Table 2**) ^[5].



(Figure 7)
Cape of good hope
“cultural point”~1



(Figure 8)
Cape of good hope
“cultural point”~2



(Figure 9)
Cape of good hope
“cultural point”~3



(Figure 10)
Cape of good hope
“cultural point”~4



(Figure 11)
Cape of good hope
“cultural point”~5



(Figure 12)
Cape of good hope
“cultural point”~6



(Figure 13)
Cape of good hope
“cultural point”~7



(Figure 14)
Cape of good hope
“cultural point”~8

Table 2. The state table of “culture point”

Title	Place	Time	Activity	State
Figure 7	Residential area gate	09:00	None	Daily business
Figure 8	Cape of good hope “cultural point”	12:00	None	Close down
Figure 9	Cape of good hope “cultural point”	15:00	Mahjong	Weekend and holidays
Figure 10	Cape of good hope “cultural point”	15:00	Mahjong	Weekend and holidays
Figure 11	Residential area trunk road (cultural point function overflow)	16:00	Chinese chess	Weekend and holidays
Figure 12	Cape of good hope “cultural point” (outdoor)	21:00	Chinese chess	Weekend and holidays
Figure 13	Cape of good hope “cultural point” (outdoor)	21:00	Chinese chess	Non-holiday
Figure 14	Cape of good hope “cultural point” (outdoor)	22:00	Chinese chess	Non-holiday (Rainy)

Note: The cape of good hope “cultural point” is covered almost all-day through observation

5. Conclusion

The difference between urban and rural places is reflected not only on a material level, but also on a spiritual level. The current residential area has been unable to return to the ancient notion of “neighborhood” due to the city’s massive individualization and heterogeneity, but the public spirit, which is similar to the concept of residential area, is vitally needed by contemporary people. It’s an intangible bond that may bring people of all skin colors, races, beliefs, ages, and origins together to form “people on one boat.” Based on literature review, this paper carries out empirical data collection and case analysis to provide reference for the reconstruction of new living areas, especially old residential areas in the future. It is suggested to make active use of the existing conditions, increase cultural communication space and supporting living facilities, beautify the environment as well as organically renew it, so as to make it spend its old age in peace for the rest of its life of 50 years.

6. Attachments

6.1. Attachment 1: Permanent responsibility monument of the project (Figure 15)

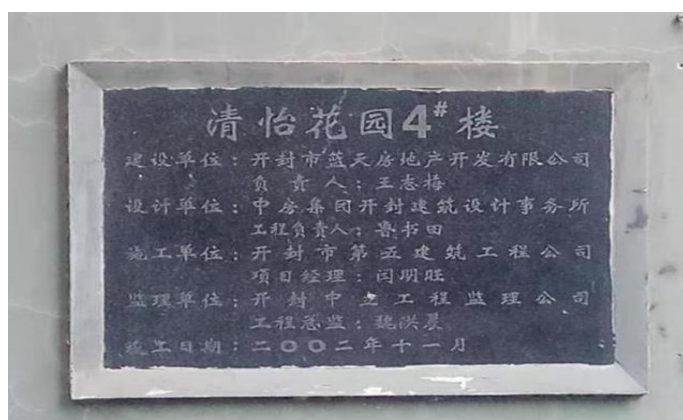


Figure 15. Permanent responsibility monument of the project

6.2. Attachment 2: Interview method (covering all levels of the residential area) ^[6,7]

6.2.1. Interviewee A: Cape of good hopenstore manager and culture point manager

- (1) Author: What time do you open these days? Point manager: It’s usually from 7:00 to 10:00 in the evening. It’s not necessarily during the day.
- (2) Author: Your shop has been open for years, isn’t it? Point manager: It was there when the residential area is completed.
- (3) Author: How long has our Chinese chess stand been going on? Point manager: At least ten years.
- (4) Author: Why did the stall break up before nine last night? Point manager: Because the people on the second floor have a problem, saying that too much movement affects the rest.

6.2.2. Interviewee B: Elderly housewives of residential area residents

- (1) Author: How to evaluate the environment and public facilities? Housewives: Not perfect, there is not enough public green space, and there is no place for activities in the residential area, let alone public facilities
- (2) Author: What would you like to do after dinner? Housewife: Either watch TV or go out and walk around the residential area. The municipal environment outside is pretty good
- (3) Author: Do you have any expectations for the residential area? Housewife: Improve the environment and add more places where everyone can go

6.2.3. Interviewee C: Elderly guard of the residential area

- (1) Author: Why does the cape of good hope leave work so early today?
- (2) Guard: Usually after 10 o'clock, I don't know why it closed early at 9 o'clock today. Maybe the shopkeeper has something to do.
- (3) Author: What time does it usually open?
- (4) Guard: About 7 p.m.
- (5) Author: Where is the real estate management in our resident area? I've lived so long that I don't know.
- (6) Guard: Right behind you (an old wooden table full of parcels) the real estate management is combined with the guard.

6.2.4. Interviewee D: Senior chess player

- (1) Author: What time do you usually open your stall? Do you basically come every day? Senior chess player: Usually at six or seven in the evening.
- (2) Author: Do you usually have no other activities after work? Senior chess friends (looking left and right): There is no place to go in our community.

6.2.5. Interviewee E: Residential area architect and designer (online chat)

- (1) Author: I have a question to ask you. Did the specification not require relevant supporting utilities when you designed it?
- (2) Architect: The design of the design institute is based on the control regulations.
- (3) Author: Is it positioned as affordable housing? In 2002, very few residential buildings will set up project responsibility monument, and generally the key large-scale projects can enjoy this treatment.
- (4) Architect: I can't remember this clearly.

6.2.6. Interviewee F: Residential area police (telephone interview)

- (1) Author: If the residential area I live in is transformed, I'd like to hear your suggestions as a local regional policeman from the perspective of a manager?
- (2) Local regional police: First of all, of course, we should start from ensuring the safety of residents in the residential area, and then we can talk about others. From the point of view, safety is the most basic
- (3) Author: In the previous questionnaire survey, although residents have a negative opinion on the environment and supporting facilities of the community, they generally evaluate the public security of the residential area well.
- (4) Local regional police: (Laughter) Our work starts from the safety of the residential area. Your residential area should be built into a smart residential area. This is the future development direction. For example, residential area access control face recognition, unit access control face recognition, and even entry. The wall at the intersection of the residential area is equipped with camera and other measures, and the unit organizes us to study in the developed provinces of the south.

6.2.7. Interviewee G: Real estate developers (telephone interview)

- (1) Author: Qingyi Garden is just a residential area. Why did you set up a project responsibility monument in 2002? At that time, this was generally the only treatment for super large projects.
- (2) Developers: The residential area is an affordable housing and a government project, so a monument must be erected according to the official requirements. At that time, it was to reduce the selling price as much as possible, because it was a limited price project (1200 yuan / m²)

- (3) Author: Yeah, I remember when I moved here, I heard it was a little over 1,000, but now it's several times that.
- (4) Everyone's response to housing quality and residential area security is still good, but what we are talking about now is the residential area environment and supporting facilities.
- (5) Developers: At that time, affordable housing was basically like this. People would consider others only when they were satisfied with their living.

6.2.8. Interviewee H: Planning Bureau

- (1) Author: The only public facility in Qingyi Garden where I live is a guard. Even the property is shared with the guard. What is the reason?
- (2) Planning Bureau: There was no urban and rural planning law in 2002. At that time, it should be constructive detailed planning.
- (3) Author: Now the country is carrying out the transformation of old residential areas. Do you have any specific suggestions for Qingyi Garden?
- (4) Planning Bureau: Starting from water, electricity and heating infrastructure, the green space environment should be well done to meet the basic needs of the doormen, proper consideration should be given to parking, and additional construction is not recommended

6.3. Attachment 3: Questionnaire method

From the ten A4 valid responses, it is concluded that: Residents are generally dissatisfied with the existing environment, and the older they are, the more they care about public supporting facilities, and the higher their requirements are.

6.4. Attachment 4: Factor induction ^[9]

- (1) If the environmental elements in general residential areas are extracted and stripped out, they can be roughly classified into 17 categories: 1. Flat ground, 2. Seats, 3. Ceiling, 4. Children's entertainment facilities, 5. Bushes, 6. Trees, 7. Lawn, 8. People, 9. Sports venues, 10. Trails, 11. Waterscape, 12. Sports facilities, 13. Community avenue, 14. Spatial area, 15. Spatial location, 16. Pedestrian and vehicle go separately, 17. Residential structure. Under different activity modes, the demand levels for environmental elements are different.
- (2) Rest and leisure interaction space model: The necessary elements are 1, 2, 3, 8, 15, 16, 17; The secondary elements are 4, 5, 6, 9, 10, 11, 14; Unnecessary elements are 7, 12, 13.
- (3) Parent child space mode: The necessary elements are 1, 2, 3, 4, 5, 16; The secondary elements are 6, 7, 8, 9, 10, 12, 14, 15, 17; Unnecessary elements are 11, 13.
- (4) Exercise space mode: The necessary elements are 1, 2, 3, 9, 14, 16, 17; The secondary elements are 5, 6, 8, 9, 10, 12, 15; Unnecessary elements are 7, 11, 13.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Pang LB, Tian N. 2020, "Discussion on The White Pagoda Temple" 2020 Theme Activity: "Old City, New Street," World Architecture, 11(024).

- [2] Sun Y, Zhu Y, 2020, A Preliminary Study on Scattered Space in Old Residential Areas from the Perspective of Daily Life ----- Taking Nanjing Wangfuyuan Community as an Example. *Huazhong Architecture*. 38(07), 62-68.
- [3] Zhao XM, Guo WW, Shi JR, 2017, Aging Appropriate Configuration Mode of Outdoor Environmental Elements in Residential Areas Based on the Types of Daily Activities of the Elderly *Architecture Journal*; February 2017, 48-52.
- [4] Jan Gail, 2002, *Communication and Space*. Communication and space. China Architecture Publishing. October 2002.
- [5] Jacobs J, 2005, *The Death and Life of American Big Cities*. Yilin Press; May 2005.
- [6] Maslow, 2007, *The Theory of Human Motivation*. China Renmin University Press.
- [7] Li B, 2008, Environmental Behavior Theory of Environmental Behavior and Its Extension. *Architecture Journal*, (2): 30-33.

Management Method and Intelligent Technology Analysis of Construction Management

Jingjing Sun*

Chongqing Energy College, Chongqing 402260, China

*Corresponding author: Jingjing Sun, SunJing@cqny.edu.cn

Abstract: The construction industry is a critical lifeline for China's national economy's development. The growth of the building business has piqued the interest of a variety of industries. To ensure the quality of construction engineering, it is necessary to improve the technical level of construction engineering management by strengthening construction engineering management through various effective methods, following the development of The Times, and strengthening the introduction of intelligent technology. The author investigates and analyses the importance of incorporating intelligent technology into construction project management, and proposes effective strategies for incorporating intelligent technology into construction project management in the hopes of improving the quality of construction project management.

Keywords: Constructional engineering; Management method; Intelligent technology

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

The building of construction projects necessitates not only a longer construction cycle, but also a higher investment in terms of price and technical requirements. As a result, construction engineering management work must be given sufficient attention during the building construction engineering process. The management must strengthen the application of intelligent technology in construction project management, especially given the rapid development of intelligent technology today, in order to efficiently manage construction engineering and effectively improve the social and economic benefits of construction engineering.

2. The important significance of the introduction of intelligent technology in construction project management

2.1. It is helpful to the effective prediction of construction risk

At present, various new construction techniques and technical means are constantly introduced into the construction industry, and with the continuous development and progress of the society, there are more and more requirements for the performance of construction engineering. The application of intelligent technology in construction engineering management can effectively predict the various risks hidden in construction engineering. Especially in the construction link with greater risk, it is more necessary to effectively predict the construction risk in advance, so as to better avoid the occurrence of risks and reduce the occurrence of risks resulting in more losses as far as possible.

2.2. It is helpful to improve the scientific nature of complex construction project management

With the continuous development of the construction industry, the whole construction process of the construction project has become more complex, which puts forward higher requirements for the

construction project management work. And the construction period of construction engineering is generally very long, during the whole construction period, it is likely to encounter a variety of factors that cannot be accurately predicted, and these factors are likely to have a great impact on the quality and progress of engineering construction. The application of intelligent technology in the administration and management of construction engineering can timely find the problems existing in the construction process of construction engineering, so as to timely formulate feasible solutions according to the problems, and then implement the administration and management of construction engineering better, and improve the effect and efficiency of administration and management.

2.3. It is helpful for the follow-up scientific management of construction projects

For the current construction project administration and management work, the completion of the construction project does not mean the end of the administration and management work. In the construction project completion stage, the administration and management work also need to be done well. The application of intelligent technology in the construction engineering management can realize the follow-up scientific management of the construction project. After the construction project is completed and put into use, it is likely that there will be quality problems after a period of use. At this time, it is necessary to carry out effective treatment according to various resources during the construction of the construction project. However, in the past, in the process of carrying out the construction administration and management work, there may be problems such as the collection of construction data is not complete enough, and even there is the loss of construction data. The application of intelligent technology can realize the comprehensive and efficient collection and collation of various construction data, and can safely save various data for subsequent reference, which is very beneficial to the improvement of the scientificity of the subsequent administration and management of construction projects.

3. The effective strategy applied in the intelligent technology construction project management method

3.1. Strengthen the consciousness of intelligent administration and management

Nowadays, the development of intelligent technology is very rapid, and has been widely used. The construction industry should also keep pace with the times, realize the important advantages of intelligent technology, strengthen the application of intelligent technology in construction engineering management methods, and strengthen the awareness of intelligent management ^[1]. Only after management personnel establish a strong awareness of intelligent management, can they better promote the intelligent development of construction engineering management and give full play to the important application value of intelligent technology. As an enterprise management and management class, we must recognize the important advantages of intelligent technology in engineering administration and management methods, and understand the important and prominent role of intelligent technology in the process of building a smart city and digital society, firm enterprise's self-confidence and determination in the application of intelligent technology in the construction engineering administration and management method, so as to better promote the development of construction engineering intelligent administration and management.

3.2. Pay attention to the improvement of the administration and management system of intelligent buildings

There is close relationship between management method adopted in the implementation of construction management work and construction quality and construction procedure of construction management. It also affects the benefits of construction projects themselves, including both social benefits and economic benefits. In order to improve the effect and efficiency of construction engineering management, we must

follow the pace of the times' development, constantly improve the intelligence level of construction engineering management, so as to guarantee construction progress and construction quality of construction engineering. Therefore, construction engineering must build up intelligent construction engineering management system, and pay attention to strengthen the perfection of the system. The construction of the administration and management system can well regulate and restrict the development of the administration and management of intelligent building engineering. At the same time, it is also necessary to ensure that the construction management system covers the whole construction process, including the early construction, the construction process and the completion stage. In each construction link, we need a perfect and unified administration and management system to guide, and clear the responsibilities of each job. In addition, the reward and punishment mechanism corresponding to the intelligent construction project management system should also be constructed. Staff with outstanding performance in management and certain contributions to intelligent management should be given appropriate rewards, including spiritual encouragement and material rewards, and also should be given space for further development ^[2]. The staff who often appear negligent in the management work should be given corresponding punishment, so as to fully mobilize the enthusiasm of the staff to apply intelligent technology to carry out the construction project management.

3.3. Establish a high-quality team of Intelligent construction engineering administration and management talents

If we want to give full play to the important role of intelligent technology in the construction engineering administration and management, we need to establish a high-quality intelligent construction engineering administration and management talents team to make strong support in human resources ^[3]. Construction enterprise needs to realize that the construction situation of high-quality intelligent construction engineering administration and management talents team is directly related to the effect of intelligent construction engineering administration and management. Therefore, on one hand the construction enterprise should organize the staff with certain potential in the internal intelligent construction engineering administration and management. On the other hand, the construction enterprise can select from the interior process talents, and also recruit some high-quality administration and management talents from the outside, so as to inject new vitality into the administration and management work of intelligent construction engineering. Enterprise can promote management staff to use intelligent technology more flexibly through the one to one and supporting measures.

3.4. Establish an all-round intelligent monitoring system for building engineering

In the process of applying intelligent technology to carry out construction project management, construction enterprises should actively establish a full range of intelligent monitoring system. In order to ensure the smooth development of the administration and management of intelligent construction engineering, it is necessary to strengthen the supervision and administration and management of various infrastructure equipment, so as to lay a good foundation for the smooth application of intelligent technology in the administration and management of construction engineering. Through the establishment of a comprehensive intelligent monitoring system, not only can we give full play to the important role of intelligent technology in the administration and management of construction engineering, but also can improve the efficiency of the administration and management of construction engineering ^[4]. Therefore, the construction enterprises must increase the capital investment on the application intelligent technology in the administration and management of construction engineering, so as to ensure that the establishment of the monitoring system has enough financial support. Although the establishment of all-round monitoring system cannot bring direct economic benefit to enterprise, through the establishment of the system, it can

well control the construction cost of the construction project, so as to realize the improvement of the economic benefit of the enterprise. In the process of building a comprehensive monitoring system, construction enterprise can learn from the monitoring system of other enterprises, but it should make corresponding improvement and optimization according to its own actual situation, so as to ensure that the establishment of the system in line with the requirements of intelligent building engineering management.

4. Conclusion

To summarize, the use of intelligent technology in the administration and management of construction engineering is critical, as it not only aids in the effective prediction of construction risk, but also aids in the improvement of the scientificity of complex construction engineering administration and management, as well as the subsequent scientific administration and management of construction engineering. To accomplish construction project management work more efficiently, construction enterprises must recognize the significant benefit of intelligent technology methods and improve their application in construction engineering administration and management.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhao X, 2020, Administration and Management Problems and Technology Application Research of Intelligent Building Engineering. *Management and Technology of Small and Medium-size Enterprises* (Medium Issue), 2020(09): 186-187.
- [2] Yang J, 2020, Application of BIM Technology in Construction Management of Intelligent Building. *Equipment Maintenance Technology*, (02): 270.
- [3] Xiao K, 2019, Application of Intelligent Engineering Administration and Management Technology in Construction Engineering Administration and Management. *China Construction*, (05): 78-79.
- [4] Yang X, 2017, Research on Construction Management Method and Intelligent Technology Application. *Doors & Windows*, (7): 72.

Analysis on Construction Technology and Reinforcement Technology of Building Foundation

Hua Guo*

Weinan Branch of Shaanxi Land Engineering Construction Group Co., Ltd., Shaanxi Province, China

*Corresponding author: Hua Guo, 865702953@qq.com

Abstract: In the field of construction engineering, foundation engineering plays a critical role. In actual construction, we must first effectively regulate the foundation construction to ensure the safety and stability of the entire building in order to improve the overall quality of the project. It's also important to look into the technologies that go into building foundations. The construction technology and reinforcing technology of building foundations are examined in this study as a reference.

Keywords: Architecture; Foundation; Construction technology; Reinforcement technology

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

One of the most critical links in construction engineering is foundation engineering. Foundation work is a type of work that is hidden from view. Accidents and unforeseeable repercussions may arise if they are not inspected in a timely manner after construction. Many elements influence the foundation's building effect, such as structural deformation, self-instability, and etc. As a result, judicious use of reinforcement technologies is required to assure the safety and stability of foundation construction. As a result, it is critical to examine building foundation construction technology and reinforcing technology.

2. Foundation construction

In construction engineering, the foundation is the bottom layer of the building which is located below the building and plays the role of support and stability. It is of great significance in the dispersion of building load. The building foundation is one of the important components of the whole building. Its main function is to transfer the load downward. It is a building structure in direct contact with the foundation. The design work and construction work of foundation need to effectively avoid deformation, instability and other adverse conditions of foundation, so as to ensure the safety of buildings.

3. Foundation technology

3.1. Complete set of composite foundation technology

The complete set of composite foundation technology can be divided into two aspects, namely "cement - fly ash - stone pile" and "rammed soil-cement pile." The former needs to use aggregate, fly ash and cement to mix with water to form a pile with high viscosity, and then form a composite foundation with soil layer, cushion layer, pile foundation and pile block. It has good bearing effect, is not prone to deformation and has a wide range of application. The rammed soil-cement pile is made of a single material with reasonable proportion according to relevant regulations. Then, it is perforated by machine, made into cement soil outside the soil pile, and then backfilled into the hole according to corresponding steps to form a soil pile with uniform texture. In this process, the compaction process needs to be applied to improve the density of

cement soil so as to improve its bearing capacity. At present, it is widely used. On the whole, the complete set of composite foundation technology has the advantages of fast construction speed and is not easy to be disturbed by various factors, so the construction efficiency is high and the economic value in use is high ^[1].

3.2. Construction technology of static pressuring pile foundation

The application of pile driver can produce large noise. If the construction site is close to the residential area, mute technology shall be used to control the noise. The construction technology of static pressuring pile foundation mainly applies the technique of static pressure entering the soil. The basic procedures are as follows:

- (1) Precast piles in sections
- (2) Press-in in sections
- (3) Gradually extend

In fact, the height of pile frame is closely related to the length of soil pile. Generally speaking, it should be about 7m. Anchoring method, welding method and other methods can be used to connect soil piles. In addition, on the whole the construction technology of static pressuring pile foundation is conducive to reduce the use of reinforced concrete, so it can reduce the construction cost to a certain extent and protect the social environment.

3.3. Compaction technology

During the foundation construction, the foundation shall be rolled to effectively discharge the excess water and gas. The technology applied in this process is compaction technology. The main purpose of applying this technology is to promote the mixed arrangement of fillers, reduce the number of gaps as much as possible, and improve the density between objects, which is conducive to improving the construction quality of foundation.

3.4. Vibration pile driving technology

In the implementation of vibration pile driving, the vibrator needs to be placed on the pile top first to ensure that it can carry out a new round of arrangement and combination, and promote the vibration and displacement of soil particles through strong vibration force. The application process of this technology is relatively simple, only ordinary vibration equipment is required, and generally, the equipment has small volume and light weight, which is conducive to transportation and can improve the overall construction efficiency. Therefore, the current vibration pile driving technology has been widely used in the construction of building foundation, and can be applied to various types of foundation such as loose sand and soft soil ^[2].

4. Foundation reinforcement technology

4.1. Foundation widening and strengthening technology

If the foundation area is insufficient or the foundation bearing capacity does not meet the engineering requirements, it is necessary to appropriately expand the foundation bottom area to alleviate the foundation load pressure, which can also reduce the additional stress of the foundation soil, so as to avoid unnecessary settlement. When the site conditions permit and the foundation buried depth is relatively shallow, the foundation bearing capacity can be improved through foundation widening and reinforcement technology. Foundation widening and reinforcement technology is a mature and simple reinforcement technology, which can be directly applied in reinforced concrete. It can not only increase the bottom of the foundation, but also ensure the connection effectiveness between the old and new foundations. However, in the process of applying this technology, the strength of the original foundation must be fully considered. If the service

life of the original foundation exceeds a certain standard, its strength must be greatly reduced. At this time, it should be properly unloaded according to the actual situation to alleviate the stress of the original foundation.

The main process of application of foundation widening and strengthening technology is as follows:

- (1) Excavation.
- (2) Implement ground pressure construction on both sides of the widened part together with the original foundation, and pave the same thickness of filler on it.
- (3) Improve the chiseling and cleaning of the original foundation, and pave high-strength cement slurry on it to strengthen the bond between the new foundation and the original foundation.
- (4) Configure concrete.
- (5) Pouring Concrete.
- (6) At the position where the new foundation is connected with the original foundation, set anchor rods with fixed height and spacing to provide guarantee for the stability improvement of the foundation connection.
- (7) Carry out quality inspection work ^[3].

4.2. Strengthening technology of deepening foundation method

Applying the deepening foundation method, it is necessary to set the pier foundation under the original foundation and ensure that the soil layer at the location of the foundation is good. In simple terms, this means digging a hole under the foundation and placing concrete piers into the hole to reinforce it. Generally speaking, it should be applied when the groundwater level is low or has good gravity holding capacity.

Concrete piers can be divided into two types, namely “continuity” and “stage.” Discontinuous concrete piers shall be applied first in the construction process. If the weight of discontinuous concrete piers cannot be borne, continuous concrete piers shall be applied in time. In general, the process of applying the deepening foundation method reinforcement technology is as follows: First, a 1.3m long and 0.8m wide pilot pit shall be excavated next to the building, with a depth of 1.4m and a concrete pouring height of 70mm. Then, the maintenance work shall be carried out for two consecutive days, the accelerator and expansion agent shall be mixed and poured into the concrete to improve the fullness of the cement slurry.

4.3. Grouting reinforcement technology

The main process of applying grouting reinforcement technology is as follows: First, the drilling rig is used to drill holes into the foundation up to the soil layer that needs to be reinforced, and then the cement slurry is poured into the soil layer that need to be reinforced through the grouting equipment. With the help of extrusion and splitting, the cement slurry and the soil layer are fully mixed to make corresponding chemical and physical changes, so as to realize the purpose of cementation between the two. Thus, it can strengthen the foundation.

4.4. Reinforcement technology of static bolt-pile

The anchor bolt technology is combined with the static pressuring pile, the anchor bolt hole and pile pressing hole are drilled for the foundation, and the adhesive is used to make the anchor bolt smoothly embedded in the anchor bolt hole, and then the pile frame installation is completed according to the construction sequence. In this process, it should be noted that the prefabricated pile is pressed into the pile hole with the help of the reaction force generated by the jack and the gravity of the existing building. Generally speaking, the pile needs to be bonded with sulfur mastic. Thus, the application of static bolt-pile

reinforcement technology is completed. When the pile pressing force and depth are consistent with the design requirements, concrete pouring method can be used to connect the pile and foundation, so as to improve the bearing capacity of the foundation and control the settlement ^[4].

5. Conclusion

According to the above, the foundation is a critical component of the building structure that can have a significant impact on the project's overall quality and safety, and the construction technique and reinforcing technology used can also have a significant impact on the foundation. As a result, it is vital to actively improve the construction scheme in accordance with the current construction site situation. To improve the project's quality, construction technology and reinforcement technology must be used in a reasonable manner.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhang L, 2020, Brief Analysis on Application of Construction Technology in Building Foundation Reinforcement Engineering. *The Farmers Consultant*, 646(04): 199-199.
- [2] Xu W, 2019, Technical Discussion on Foundation Construction and Reinforcement Based on Building Foundation. *City Stories*, (5): 0362-0362.
- [3] Cao L, 2020, Research on Key Points of Construction Technology of Foundation Engineering of House Building. *Engineering Management*, 1(1): 97-98.
- [4] Zhou Y, 2020, Research on the Application of Civil Construction Technology of High-rise Building Foundation and Pile Foundation. *Housing and Real Estate*, 564(05): 186 + 198.

Research on Progress Control of Overseas Cement EPC General Contracting Project

Jianke Gu*

Suzhou Sinoma Construction Co., Ltd., Suzhou 215300, Jiangsu Province, China

*Corresponding author: Jianke Gu, chenfu0425@163.com

Abstract: The purpose of Engineering Procurement Construction (EPC) general contracting project schedule management is to ensure that the project meets its deadlines, and it plays a critical role in contract performance. In comparison to the domestic general contracting model, project management and coordination are more complex for the general contractor of international EPC projects. As a result, scientific project schedule process control is critical to effectively ensuring project duration, saving project costs, improving project management level, and project quality, and ensuring that the project achieves the promised advantages for both the contractor and the owner. Through the research and analysis of the status of the schedule management of the Indonesia B Project Phase II cement project, corresponding optimization measures are proposed for the project schedule process control.

Keywords: EPC cement engineering; Project management; Schedule management; Process control

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

At present, the “Going Abroad” and “One Belt One Road” initiative of China has reached broad consensus in various industries and regions around the world, and has achieved fruitful achievements. The cement engineering industry is one of the earliest industries in China that to go abroad. As the domestic cement engineering contracting market gradually becomes saturated, more and more cement engineering companies are looking at overseas markets, which increases competition in overseas cement engineering projects. To gain a foothold in the fierce competition, cement engineering contracting companies must strengthen the study and research of overseas engineering project management theory, make full use of the knowledge of project planning, schedule management, resource management, etc., and accumulate project management experience through practice ^[1].

This article takes the Indonesia B Project Phase II cement project EPC project ^[2] as a case, and uses scientific and advanced schedule management related theories and technologies to study the project schedule control process, find out the key factors affecting the project schedule and propose corresponding measures.

2. Project overview

The Indonesia B Project Phase II cement project is a 10,000t/d clinker cement production line. The project site is located in the LEBAK district, Banten, southwest of Java Island, Indonesia. The topography of the factory site is seaside hills, which is about 50 hm² and could accommodate two 10,000t/d production lines. This project is the second 10,000t/d production line. The contract period is 22 months. The raw materials and fuels of the project are different from conventional standards. The raw materials have high moisture content and are prone to blockage, which requires high quality equipment. The local dry season is from

April to November each year, and the rainy season is from November to March of the following year. The project construction period lasts 3 rainy seasons.

3. Difficulties in project schedule management

The Indonesia B Project Phase II cement project is a large-scale project with a huge amount of work. The the main structure concrete is more than 70,000 cubic meters, the steel structure is more than 6,000 tons, the slope protection is more than 160,000 square meters, the weight of process equipment is more than 12,000 tons, and the length of cable exceeds 600 kilometers. The construction period is very tight. The final effective construction period of this project is less than 18 months due to the owner's twice advance requirements for the construction period. The delivery period of main equipment of the project is long, some process equipment is difficult to install, construction operations are crossed, and the coordination workload is large and difficult, which request the high organization and coordination ability of the project schedule management team. In addition, there are also difficulties in the project as follow:

- (1) Overseas engineering projects generally belong to the “three-ing” projects, which means designing, bidding, and constructing carry out simultaneously, which is inefficient and slow in progress ^[3].
- (2) Due to the special production raw materials, the use of the limestone round stacker and reclaimer equipment in Indonesia B Project Phase I cement project is not as good as expected, and higher costs were spent on transformation in the mid-term, which resulting in partial cost overruns of the project. Therefore, the equipment supplier of Indonesia B Project Phase II cement project is replaced by European manufacturers, and the delivery time of equipment is quite long.
- (3) In order to avoid taxes reasonably, the owner requires all equipment and materials imported from China for this project must take the exemption procedures. However, the owner did not fully understand the customs' new requirements for exemption list and were often returned and revised by the local customs authorities repeatedly, which affected the progress of logistics shipments.
- (4) The plans for the main links of design, procurement, logistics, and on-site construction did not form an effective combination. The overall project schedule is not good enough.
- (5) There were a lot of new technologies, new materials, and new equipment taken in Indonesia B Project Phase II cement project during the implementation. Many construction workers are also exposed to such new technologies and new technologies for the first time, and it is difficult to grasp the technical points for a while.

In addition, due to local government certificate restrictions and project cost reduction and efficiency requirements, the Phase II of the project has a higher degree of localization engineering than the Phase I. By reason of the technical level of the local workers, the construction efficiency inevitably decreased, which brought great challenges to the implementation of the project schedule as planned.

4. Strengthening measures for project schedule process control

4.1. Strengthen the progress control of the design and procurement process

From the perspective of the entire implementation process of the EPC project, the design work and procurement work are at the beginning and intermediate stage of the project, which are also the key links that restricts whether the project could be performed on schedule. Design, procurement, and construction works like chains that one leads to another. Delays in design drawings, delays in equipment delivery, quality problems in design drawings, and equipment quality problems will inevitably cause the effective construction period to be shortened. It results in a situation that the schedule is loose at the beginning of the project, as well it is tight at the end, which increases additional risks during the construction phase ^[4].

- (1) Design: pay attention to the information exchanging among departments such as processing, structure, architecture, electrical, HVAC, etc., especially pay attention to the information providing

of processing, and also pay special attention to the input of external design conditions.

- (2) Purchasing: the information and data proving of the manufacturer is the key to affecting the design progress, especially the information of the host equipment data needs to be paid serious attention to. Equipment manufacturing and logistics delivery are the keys to the construction schedule. Equipment that affects the on-site construction schedule should be planned and prepared in advance.
- (3) Interface management between design and procurement: in order to avoid delays due to communication failures, in the early period of the EPC project, it is necessary to pay special attention to the communication of the design and procurement interface, the flow chart of interface between design and procurement is shown in Figure 1. In order to achieve the best management effect, it is necessary to formulate a special management process to minimize the cost of information communication between design, procurement and equipment suppliers; and to simplify the management interface between design and procurement from the organizational structure, and finally achieve seamless connection. The interface between design and procurement of Indonesia B Project Phase II cement project is as follow.

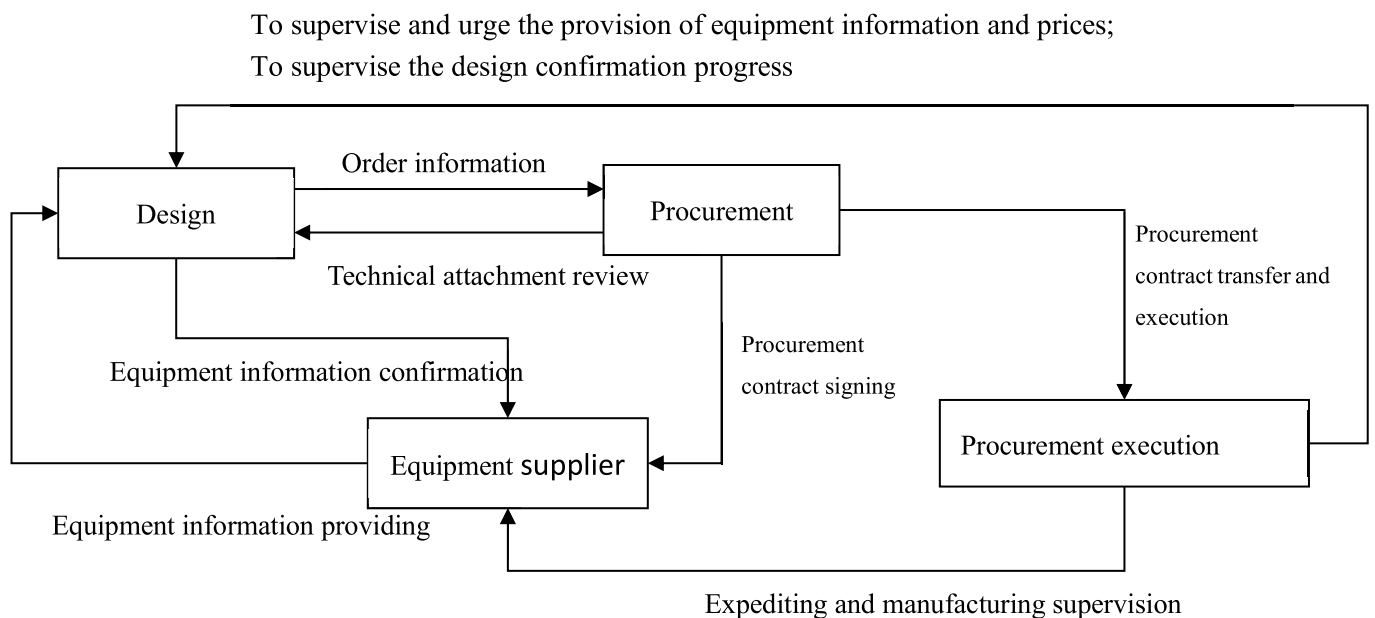


Figure 1. The flow chart of interface between design and procurement

4.2. Strengthen the management of construction subcontractors

4.2.1. Strengthen subcontractor contract management measures

A subcontract is a responsibility and scope agreement between the general contractor and the construction subcontractor. It is a basic way to use market mechanisms to achieve the purpose of performance. The subcontracting contract stipulates the scope of project, quantity, quality requirements, construction period requirements, special construction technical requirements of the subcontractor, and also payment methods for the project. The overall goal of the project could be detailed and decomposed into each stage node goal. Taking the Indonesia B Project Phase II cement project as an example, there are cross-installation nodes of the furnace end frame foundation, nodes of frame capping, etc., and pay part of the progress payment as a node reward. On one hand, the payment schedule of the project progress payment is more accurate and clearer. On the other hand, it can effectively improve the enthusiasm of the construction subcontractor, actively optimize the organization plan, and increase the personnel and machinery to promote the project progress.

4.2.2. Strengthen the organization and management of subcontractors

During on-site construction, the subcontractor is the specific implementer of the project schedule. The smooth progress of the project schedule depends on the overall coordination and management of the general contractor on the one hand, and must also be actively cooperated by the subcontractor. The quality and ability of the personnel assigned by the construction subcontractor is very important. The main purpose is to achieve the goal of effectively controlling the construction progress by strengthening active control to synchronize the actual progress with the planned progress.

4.2.3. Introduce incentive measures that combine rewards and punishments

Economic stimulus has always been an effective means to promote the development of things for the better, and it is also effective when applied to the progress control of engineering projects. For a long time, the general contractor has imposed punishment on the subcontractor's time limit always, but from the perspective of actual implementation, the effect has not been great. Regardless of the owner or the general contractor, the purpose of project execution is to perform the contract on time rather than to punish. Under the conditions of rewards, subcontractors will more actively cooperate with the progress management of the general contractor to promote the realization of project progress goals.

4.3. Balance the tripartite relationship of quality, cost and schedule

In the process of project implementation, schedule, cost, quality, and safety are the four main elements of project management, of which safety is the unconditional first element. The three elements of quality, cost, and schedule restrict and promote each other. How to balance the impact of quality and cost on the schedule is an important topic for the smooth progress of the project schedule. If blindly sacrificing cost and quality for the sake of project progress is not advisable, it may lead to serious consequences. Reasonably focusing on a certain factor at different stages may be more in line with the actual situation of the project. For the Indonesia B Project Phase II cement project, strengthening quality management under controllable costs is undoubtedly an important means to ensure the progress of the project and reduce unnecessary waste of investment.

In terms of quality, laws and regulations on quality management should be strictly implemented. To establish a quality management organization system for the project department, to clear goals and unify coordination. To implement the quality management responsibility system, clarify the quality management responsibilities of the various departments of the project department and their managers and operators. To establish a quality management education and training system to improve the quality of personnel management. To organize relevant personnel to compile construction organization design or special construction plan, and clarify the key points of quality control and corresponding measures. To organize all professional management personnel to conduct review of drawings to eliminate hidden quality hazards and rework from the source. To complete the technical clarification, work according to the approved construction plan and other documents. To ensure that all the site operators understand the quality requirements very clearly. To complete self-inspection, mutual inspection, handover inspection and special inspection successfully, and strengthen the acceptance of concealed engineering. The main equipment should be installed with a dedicated person to check the whole process to ensure that there is no mistake in the installation. To carry out monthly quality inspection activities, with the participation of the project leaders, technical leaders and main quality management personnel of the general contractor and subcontractor, rewarding the good and punishing the bad, and strengthening the management and control of the project quality. To organize the technical experts or industry experts to give lectures and training on site regularly, to learn and master advanced technical management knowledge and innovative ideas, in order to promote the progress of project quality management.

In terms of cost, it is necessary to make a cost control plan at the beginning of the project. To control costs by planning control measures in advance to ensure progress.

4.4. Strengthen safety management to ensure progress management

In the process of project construction, safety work always comes first. The safety issues often occur in the period of on-site construction and commissioning. Starting from the overall situation of ensuring the long-term healthy and stable development of the enterprise and protecting the life and safety of workers, it is necessary to increase investment in safety costs, improve infrastructure protection capabilities, increase employee training and education, and further enhance employees' awareness of safety and quality, so that employees can learn from a deeper level and recognize the relationship between safety, quality, progress and development and benefits, and firmly establish a sense of responsibility that safety, quality, and progress are closely related to operations. In the safety work, it is necessary to force the work permit, always focus on safety observation and communication and work safety analysis, reduce the unsafe state of things, put an end to unsafe behavior of people, build a safe construction environment, and ensure the normal construction progress. In terms of the safety management of subcontractors, the general construction contractor must effectively control the qualifications and personnel quality of the subcontractors, strictly control the safety system of the subcontractors, implement dynamic safety management, and strengthen supervision.

5. Conclusion

The purpose of EPC general contracting project progress control is to guarantee that the project meets its expected progress goal. This paper analyses and studies the progress control in the cement engineering general contracting project management by combining the case of the engineering general contracting project of Indonesia B Project Phase II cement project. A variety of realistic progress management improvement strategies were proposed, which were combined with the project's actual circumstances, to handle the problem of progress management in a targeted manner. The Indonesia B Project Phase II cement project's project schedule management level was eventually improved, and the project plan objectives were effectively controlled. The four key goals of progress, quality, cost, and safety were all met on time, and the progress targets were accomplished two and a half months ahead of schedule. The general contractor's execution efficiency and quality for an international project were also significantly enhanced.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Kirzner H, 2014, Project Management-A Systematic Approach to Plan Schedule and Control. Beijing: Publishing House of Electronics Industry, (06).
- [2] Li J, 2014, EPC Cement Engineering Project Schedule Management Research and System Development. Concrete Engineering, 4(26): 3459-3460.
- [3] Liu L, 2018, Analysis of Progress Management of Overseas Cement Plant Projects. Architectural Engineering Technology and Design, 24: 3073.
- [4] Cao W, 2017, Analysis of Progress Control and Restrictive Factors of International EPC Engineering Projects. Project Management Technology, (12):46-50.

Spatial Pattern of Housing Sales Vacancy in Guangzhou's Urban District, China

Xiaoli Yue^{1,2}, Yang Wang^{3*}, Yabo Zhao², Hong'ou Zhang¹

¹Key Lab of Guangdong for Utilization of Remote Sensing and Geographical Information System, Guangdong Open Laboratory of Geospatial Information Technology and Application, Guangzhou Institute of Geography, Guangdong Academy of Sciences, Guangzhou 510070, Guangdong Province, China

²School of Architecture and Urban Planning, Guangdong University of Technology, Guangzhou 510090, Guangdong Province, China

³Faculty of Geography, Yunnan Normal University, Kunming 650500, Yunnan Province, China

*Corresponding author: Yang Wang, wxykwy@163.com

Abstract: Housing vacancy can reflect the destocking degree of the real estate market. Based on the data of 57 opened residential quarters (46,622 units) from 2015 to 2018, this paper constructs a calculation formula of the sales vacancy rate and then analyzes the spatial pattern in Guangzhou's urban district. The results show that there is obvious differentiation in the spatial pattern of housing sales vacancy in Guangzhou's urban district, showing a higher spatial pattern in the old area and urban district and a lower spatial pattern in the core area. Subdistricts with high vacancy rates are mainly located in the east of the old area, the south and east of the urban district and near Baiyun Mountain in the north.

Keywords: Housing vacancy; Sales vacancy; Guangzhou's urban district; Spatial pattern

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

The subject of home vacancy has gotten a lot of attention in recent years. Scholars have analyzed the housing vacancy pattern in different cities using nighttime light data ^[1], geographic national conditions monitoring data ^[2], power consumption data ^[3], municipal water consumption data ^[4], and other data, and have observed different vacancy pattern characteristics, but most cities show the characteristic that the central urban area is constantly extending to the outer suburbs ^[2,5]. However, there is currently no research on the sales vacancy pattern in China or elsewhere.

This work builds on domestic and international housing vacancy research and experimentally studies the spatial pattern of home sales vacancy in Guangzhou's urban district. This paper examines the spatial distribution pattern of sales vacancy of opened residential quarters using data from opened residential quarters as the research object, which can help concerned departments propose effective solutions based on the vacancy rate in different regions, rationally regulate housing quantity, and support the healthy operation of the real estate market.

2. Methods and data

2.1. Data

In this paper, the housing vacancy in Guangzhou's urban district is studied from the perspective of sales, and the data used to calculate the housing sales vacancy rate come from the data of residential quarters on sale in the NetEase Data Center (Guangzhou). Considering that the sales cycle of commercial housing in

China is generally 2-5 years, this paper selects 2015-2018 opened residential quarters with 70-year property rights in Guangzhou's urban district as sample data, and after optimization, 57 residential quarters (46,622 houses in total and 37,025 sold houses) are retained.

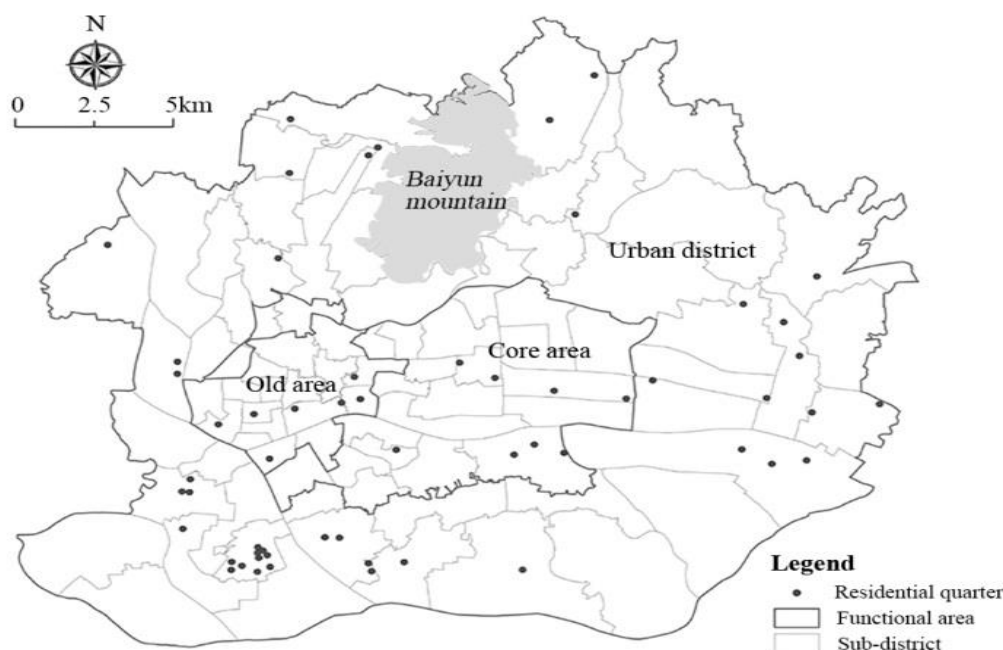


Figure 1. Study area and distribution of opened residential quarters

In this paper, Guangzhou's urban district is taken as the study area, with the boundary of Guangzhou administrative region in the west, the administrative boundary of Haizhu District in the south, Qianjin Subdistrict, Huangcun Subdistrict, Xintang Subdistrict, and Longdong Subdistrict in Tianhe District in the east, Jingxi Subdistrict, Tianhe Subdistrict, Huangshi Subdistrict, Xinshi Subdistrict, Tangjing Subdistrict and Songzhou Subdistrict in Baiyun District in the north. According to the actual situation of Guangzhou's urban construction and development, this area can be roughly divided into three regional functional categories from inside to outside: old area, core area and urban district area [6]. The distribution of the 46,622 houses in our sample is 4891 in the old area, 3,181 in the core area and 38,550 in the urban district area. There are 88 subdistricts in Guangzhou's urban district, among which 57 opened residential quarters are distributed in 33 subdistricts (**Figure 1**).

2.2. Method

In this paper, the housing sales vacancy rate is defined as the ratio of the number of unsold houses to the total number of houses. Currently, there is no uniform international standard for the calculation unit of the vacancy rate. One method is based on the vacant area and calculated in square meters. The other method calculates the vacancy rate in units of sets. In this paper, considering that the "set" is generally used as the unit in housing sales in China, and based on the availability of data, the "set" is chosen as the unit to calculate the vacancy rate. In this paper, the housing sales vacancy rate is calculated by subtracting the ratio of the number of sold houses to the total number of houses, and its formula is as follows:

$$V = (N - M) / N * 100\% \quad (1)$$

In the formula, V represents the housing vacancy rate, N represents the total number of houses available in these 57 residential quarters, and M represents the number of houses sold in the sample residential quarters. All the calculations of the vacancy rate in this paper are based on this formula.

3. Results and discussion

The overall vacancy rate in Guangzhou's urban district is 20.58%, but there are obvious differences among different functional areas. As shown in **Table 1.** below, the sales vacancy rate in the urban district is the highest, reaching 21.79%, which is higher than the overall vacancy rate in Guangzhou's urban district. The old area comes second, with a sales vacancy rate of 18.34%. The core area has the lowest vacancy rate among the three areas, with only 9.43%, which is approximately 11% lower than the overall sales vacancy rate in Guangzhou's urban district. Generally, the vacancy rates in the three areas from inside to outside show a pattern of "high-low-high"; that is, the housing sales vacancy rates in the old area and urban area are too high, while the vacancy rates in the core area are low. Therefore, the housing sales are better and the vacancy rate is lower in the core area than in the old area and urban area.

Table 1. Housing vacancy of three areas in Guangzhou's urban district

	Sold	Unsold	Total	Vacancy rate
Old area	3994	897	4891	18.34%
Core area	2881	300	3181	9.43%
Urban district	30150	8400	38550	21.79%
All	37025	9597	46622	20.58%

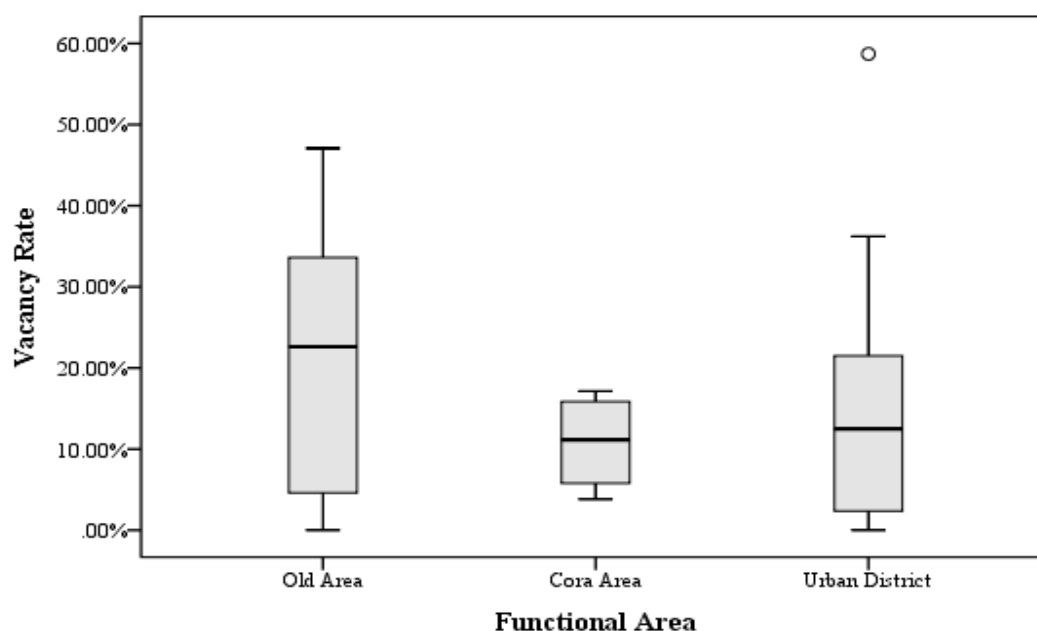


Figure 2. Vacancy rate data distribution of sub-districts in Guangzhou's urban district

Furthermore, we analyze the vacancy pattern of subdistricts in Guangzhou's urban district. First, **Figure 2.** shows the vacancy rate data distribution of subdistricts in three functional areas. Next, the vacancy rate is divided into four grades, with interval values of 5%, 10% and 20%, and low, medium, high and extremely high vacancy rates are defined in turn. As shown in **Figure 3.**, in the old area, subdistricts with high and extremely high vacancy rates are concentrated in the southeast, including Zhuguang, Datang, Renmin and Nanhuaxi Subdistricts, while subdistricts with low vacancy rates (< 5%) are distributed in the southwest part of this area. The overall vacancy rate in the core area is low, and two subdistricts with high vacancy rates are distributed on the east side of the area, namely, Meihuacun and Xiancun Subdistricts. Within the urban district, there are a large number of subdistricts with high and extremely high vacancy

rates (12), which are widely distributed, mainly in Xintang, Tangxia, Tianyuan and Qianjin Subdistricts in the east, Ruibao, Nanshitou and Baihedong Subdistricts in the south, Chajiao and Qiaozhong Subdistricts in the west, and Tonghe, Huangshi and Xinshi Subdistricts near Baiyun Mountain in the north, among which Xinshi Subdistrict is the subdistrict with the highest vacancy rate in Guangzhou's urban district, reaching 58.72%.

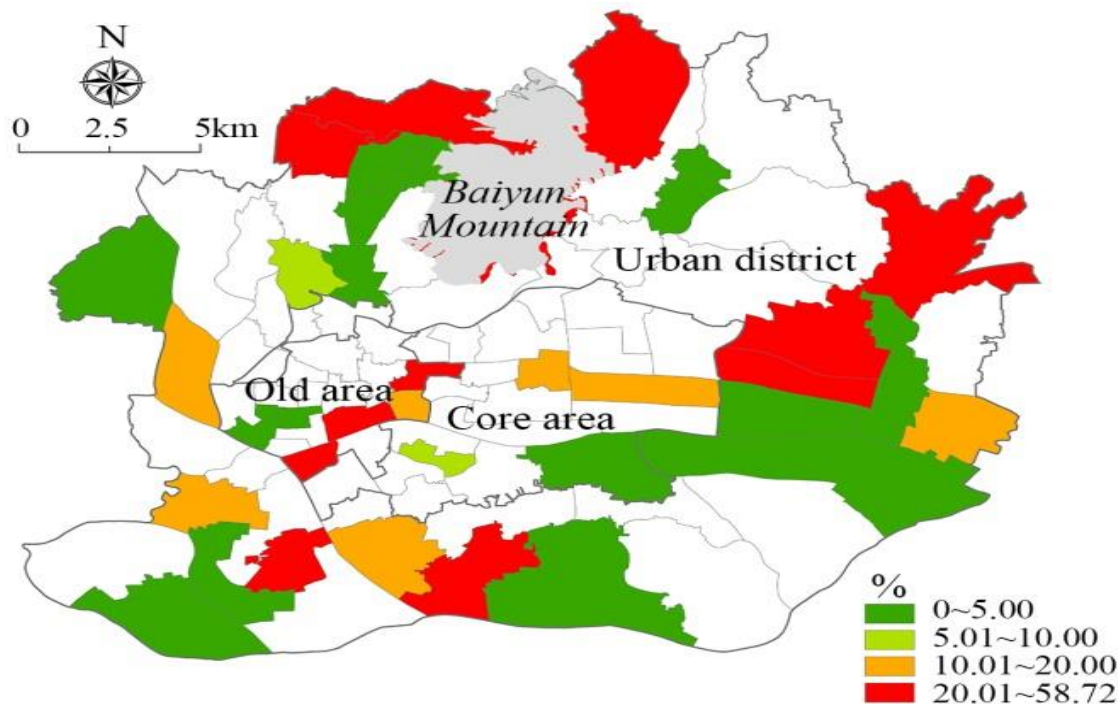


Figure 3. Spatial pattern of housing sales vacancy in Guangzhou's urban district

The old area is the old city of Guangzhou. Although it is located in the center of Guangzhou, the housing price here is too high, which makes it unpopular with buyers. The core area is the most prosperous central area in Guangzhou and is located in the CBD of Guangzhou, Zhujiang New Town, with numerous bustling commercial zones and convenient public transportation. In recent years, it has developed rapidly, and it has obvious location advantages that attract many buyers, with a high degree of housing destocking and a relatively low sales vacancy rate. Being located in the peripheral area of Guangzhou's urban district, far away from the city center, naturally has an impact on housing sales and leads to the high sales vacancy rate here.

4. Conclusion

The vacancy rate in this region's house sales has distinct regional characteristics. The vacancy rate in the urban district is generally the greatest, followed by the old area, and the vacancy rate in the core region is low, exhibiting clear "high-low-high" characteristics. Since the core area is in the heart of Guangzhou, the vacancy rate is low. The eastern half of the ancient area, as well as the southern, eastern, and northern parts of the urban district near Baiyun Mountain, have the highest vacancy rates. Perhaps this is because this article begins with a "sales-oriented" vacancy rate, and housing sales are influenced by a variety of factors, including real estate developers' marketing strategies, policies surrounding home purchases, commodities housing prices^[7], and buyer purchasing power. Housing sales are influenced by a variety of things. Because the causes that cause variances in housing sales vacancy might come from a variety of sources, future research will focus on analysing the influencing variables of the housing sales vacancy rate.

Funding

This research was funded by the National Natural Science Foundation of China (No.41871150; No.42101186), GDAS Special Project of Science and Technology Development (No.2020GDASYL-20200104001), National Key Research and Development Program (No. 2019YFB2103101), Natural Science Foundation of Guangdong Province (No.2019A1515011653).

Disclosure statement

The author declares no conflict of interest.

References

- [1] Pan JH, Dong LL, 2021, Spatial identification of housing vacancy in China. *Chinese Geogr Sci*, 31(2): 359-375.
- [2] Niu X, 2018, Estimating housing vacancy rate in Qingdao city with NPP-VIIRS nighttime light and geographical national conditions monitoring data. *ISPRS-International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-3:1319-1326.
- [3] Li J, Guo M, Lo K, 2019, Estimating Housing Vacancy Rates in rural China using power consumption data. *Sustainability*, 11(20):5722. <https://doi.org/10.3390/su11205722>
- [4] Pan YT, Zeng W, Guan QF, et al., 2020, Spatiotemporal Dynamics and the Contributing Factors of Residential Vacancy at a Fine Scale: A Perspective from Municipal Water Consumption. *Cities*, 103: 102745.
- [5] Bentley GC, McCutcheon P, Cromley RG, et al., 2016, Race, Class, Unemployment, and Housing Vacancies in Detroit: An Empirical Analysis. *Urban Geogr*, 37(5):785-800.
- [6] Wang Y, Wu KM, Zhang HO, 2021, The Core Influencing Factors of Housing Rent Difference in Guangzhou's Urban District. *Acta Geogr Sinica*, 76(8):1924-1938.
- [7] Liang SY, 2021, The Robust Influencing Factors of Urban Commercial Housing Vacancy Rate based on EBA Model-Taking Shenzhen as an Example. *World Sci Res J*, 7(2):378-388.

“Data Hegemony”: Reflections for the Application and Development Direction of Metaverse Technology in Urban Design based on Digital

Qinyu Feng*, Renjie Cai

The University of Sheffield, Sheffield S10 2TT, the United Kingdom

**Corresponding author:* Qinyu Feng, qfeng7@sheffield.ac.uk

Abstract: This paper is based on the phenomenon of Tittytainment and big data control. It discusses the ways in which working youths live and work in their large suburban communities in Beijing as well as their leisure and entertainment activities. Then develops a problem statement and research questions. In addition, the project explores this reality phenomenon dialectically through the analysis and speculation of the new virtual reality technology “Metaverse.” Based on a critical design approach, the phenomenon is explored through a detailed description and examination of reality, before critically suggesting the possibility of future social control by big data companies through the “metaverse” space. Furthermore, this paper alerts to the neoliberalism that dominates globalization through anti-utopian expressions, waking up young people who are compromised by big data control and addicted to Tittytainment.

Keywords: Urban design; Metaverse technology; Big data; Neoliberalism

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

Based on the new virtual reality technology “Metaverse,” this paper focuses on the control of big data and entertainment control in society, and critically projects the feasibility of new entertainment spaces in the community of the future. In Beijing, large suburban communities are dominated by a large number of university students and migrant workers, who are the city’s main workforce, a large consumer population, and a marginalized population. In Beijing, rising housing prices are pushing young people increasingly far away from the city center, with distances to live and work becoming more remote, fewer public spaces for cheap youth, and increasing social pressure to survive. This pressure to survive has led the “marginalized” to choose to numb themselves with cheap and comforting entertainment and products full of sensual stimulation (video games, virtual social networking, pornography, mass entertainment such as soap operas and reality shows). At the same time, big data companies (Alibaba, Tencent, etc.) have started to export entertainment products to young people through big data analysis, while acquiring massive amounts of related entertainment industries, products and companies to achieve a monopoly on entertainment. These entertainment products abound in every free time of young people and can be used to spend time in any place, although it brings them great pleasure.

This paper examines how big data businesses use data control and entertainment monopolies to manipulate society and individuals in order to establish digital hegemony. How big data is used to manipulate society digitally, how entertainment orientation is used to control society, how the new digital technological “Metaverse” integrates a monopoly on entertainment products, and how people will resist or submit to the new entertainment spaces created by large corporations. It is based on the Tittytainment

Theory and Pareto Principle neoliberal theories from 1995.

2. Neoliberal urbanism on digital hegemony

De-industrialization, re-industrialization, post-Fordism, internationalization, urban entrepreneurialism, and other terms have been used to define neoliberal urbanism (**Figure 1**), which has been endorsed and pushed by a generation of academics ^[1]. The neoliberal goal also includes decentralizing government from the federal to local levels, reducing macro-control, and promoting private enterprise and the free market.



Figure 1. Lies of Neoliberalism

2.1. Neoliberalism and the Two-Eight Principle

2.1.1. Two-Eight Principle

Today's urban crisis, with poverty and inequality, unemployment and underemployment, inadequate and unaffordable housing and public transport, traffic congestion, pollution of cities, etc., is largely due to the fact that neoliberalism has left governments without sufficient funds and powers to ensure that cities function and protect the underclass ^[2]. The economic and political elite agreed at the historic "State of the World Forum" in September 1995 that globalization would generate a big problem - the gap between rich and poor ^[3]. The world would be a place where 20% of the population controlled 80% of the resources and the remaining 80% were "marginalized" (**Figure 2**).

As a result, rather of solving contemporary capitalism's political and economic crisis trends, neoliberalism has deepened social fragmentation, expanded the wealth gap, and shattered social solidarity ^[4]. In developing countries, the development of the real estate market as a result of neoliberalism has caused the ratio of housing expenditure to per capita income to soar, leading to a worsening housing crisis.

Brzezinski, the former US National Security Advisor, said that no one has the power to change the future "Two-Eight Phenomenon" and that there is only one way to relieve the energy and discontent of the "marginalised" ^[6], and that is to introduce a new strategy of Tittytainment, which means putting a "pacifier"

in the mouth of the 80%.

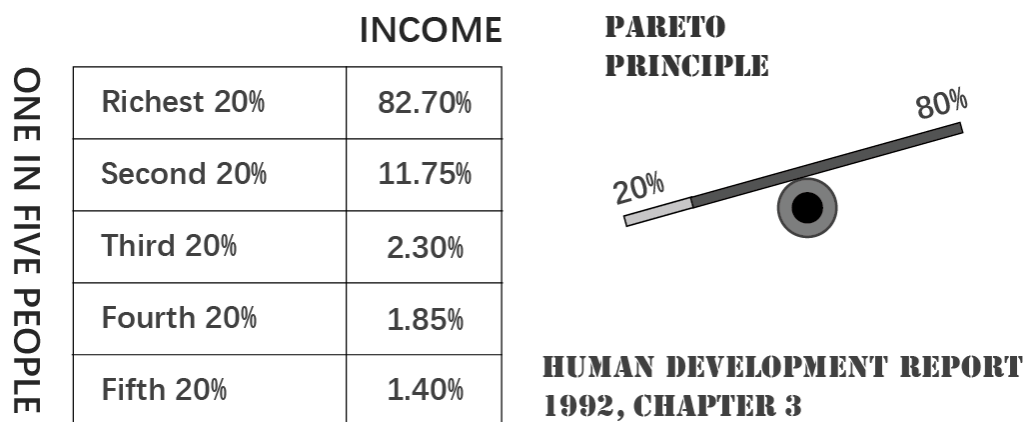


Figure 2. The two-eight phenomenon of social wealth distribution, World Bank and World development report 1992: Development and the environment [5].

2.1.2. Two-Eight Principle and Tittytainment

Tittytainment is a term describing the propaganda designed to protect the capitalist and neo-liberal principles that govern globalization. The essence of the two-eight principle and tittytainment is to protect economic globalization and neoliberalism [6], while ensuring the class status of the elite (20%).

Amusing Ourselves to Death, written by Postman, presents us with a scenario in which our politics, religion, journalism, sport, education and business are willingly made subservient to entertainment, without complaint, even silently, with the result that we have become a species of entertainment to death. In Technopoly: The Surrender of Culture to Technology, Postman also refers to the computer as the “quintessential, unparalleled, near-perfect” technology of the technological monopoly. It has established sovereignty over all areas of human experience [7].

To some extent the tittytainment is not a conspiracy theory, it is a necessary trend resulting from technological development. Culture bowing to technology. In a survey of young people in Beijing (**Figure 3**), it was found that in a high-pressure environment, increasing young people are actively or passively choosing to numb themselves with vulgar, fast and exciting forms of entertainment, “seeking pleasure to escape pain, hope to escape fear, identity to escape rejection.”

2.2. Tittytainment and big data

Behind the Tittytainment and Entertainment to Death is the monopoly of the big companies on media and entertainment, with the control of big data calculation engines.

2.2.1. Digital entertainment

The datafication of media and entertainment is the new megatrend. Large internet companies and media companies are integrating or collaborating. Media organizations around the world are using big data in an effort to compete in a globalized media market and to better tailor content for local audiences [8]. The convergence of big data and media entertainment has created new centers of power - not based on control of content, but on control of big data. With the help of big data calculations, these companies can tend to launch products with greater profit and gain greater efficiency [9].

2.2.2. Ethics of big data

However, in the neoliberal context of a lack of government regulation and control, large internet companies and media outlets are only concerned with data traffic and profits, not with the content of their products or the ethics and values of society ^[10]. With no relevant control, on the one hand, large companies use their absolute advantage over big data to constantly acquire new Internet companies, forming an absolute technological monopoly, while constantly upgrading their big data computing power to obtain more data from citizens. On the other hand, big data guides the products and content orientation of media and entertainment companies and the content becomes even more vulgarized ^[11]. Moreover, the vast majority of the public has no right to privacy, information, or participation in Big Data as the power of the Internet company giants, and the public is left to passively accept the rules of the digital world. As a result, most of the big data frameworks are clearly classist and biased, representing the profits and positions of the internet giants.

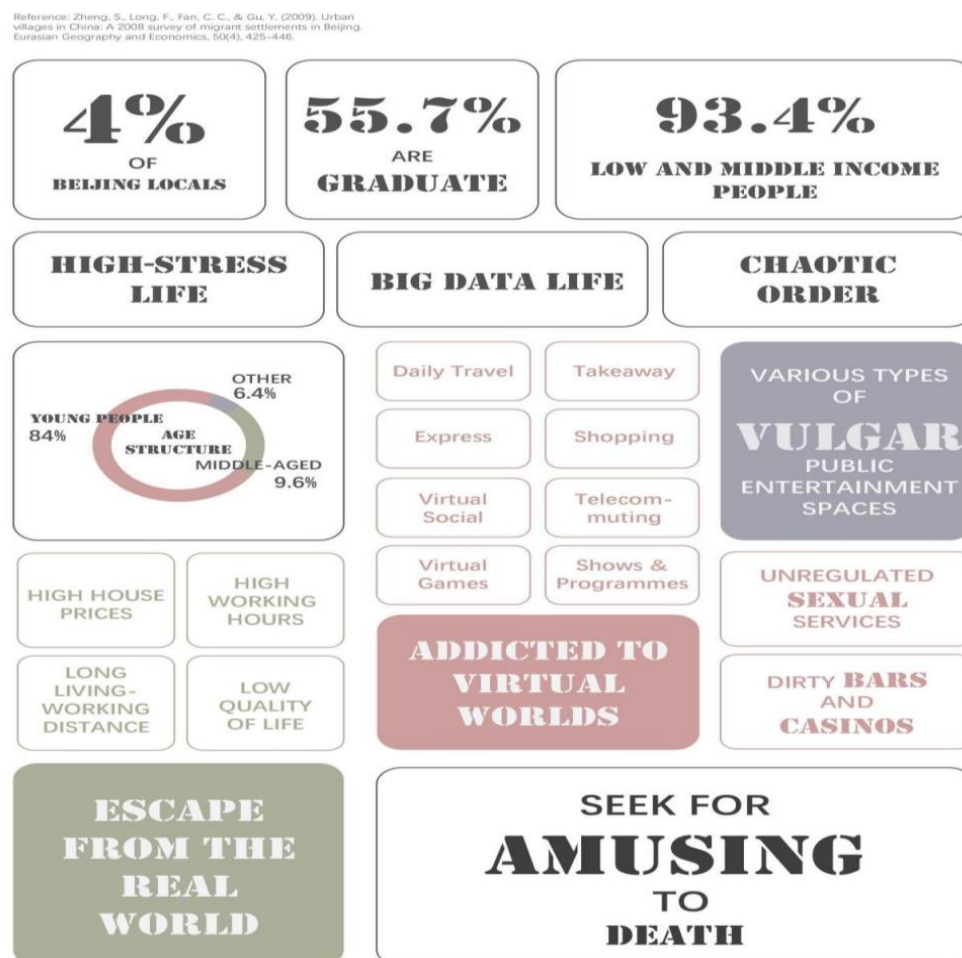


Figure 3. Beijing Urban Village Entertainment Survey

3. Metaverse technology

Metaverse, the term was coined in Neal Stephenson's 1992 science fiction novel *Snow Crash*, in which humans, as avatars, interact with each other and software agents in a three-dimensional space that uses the metaphor of the real world. The Metaverse is a collective virtual shared space made up of a fusion of virtually augmented physical reality and physically sustained virtual space, encompassing the sum of all virtual worlds, augmented reality and the internet ^[12]. Stephenson uses this term to describe a successor to the virtual reality-based Internet. It is a platform that can coordinate all media and electronic entertainment.

Today's internet giants are constantly innovating technology to make this vision a reality. Therefore, the application and development of mixed reality technologies will be a new challenge in future urban design projects.

On 23 June 2003, Second Life, the poster child for online virtual worlds, was launched in San Francisco. Users of Second Life, also known as residents, create their own virtual representations, called avatars, and are able to interact with locations, objects and other avatars ^[13]. Starting with the release of Second Life, the door has been opened to the virtual world, which is invading the real world. The Internet giants are continuing to innovate technology to realize the vision of the metaverse. The foundation of the metaverse is Big Data, which, as a digital phenomenon, allows the collection and use of vast amounts of data from people and machines. This data is characterized by its volume, variety, speed, authenticity, variability and complexity ^[14]. These companies maximize the productivity and efficiency of service and product delivery by rapidly capturing big data, analyzing and exploiting the information, with media and entertainment companies reaping the biggest profits.

3.1. Big data monopolies

The big data software (official software related to Alipay) in China, which is divided into four categories and 15 sub-categories, with a total of over 678 related software (APP), basically covering all aspects (**Figure 4**). The history of the Internet is a history of big companies pouring all their efforts into developing computing power, developing artificial intelligence algorithms and stealing ideas from people's brains before implanting them.

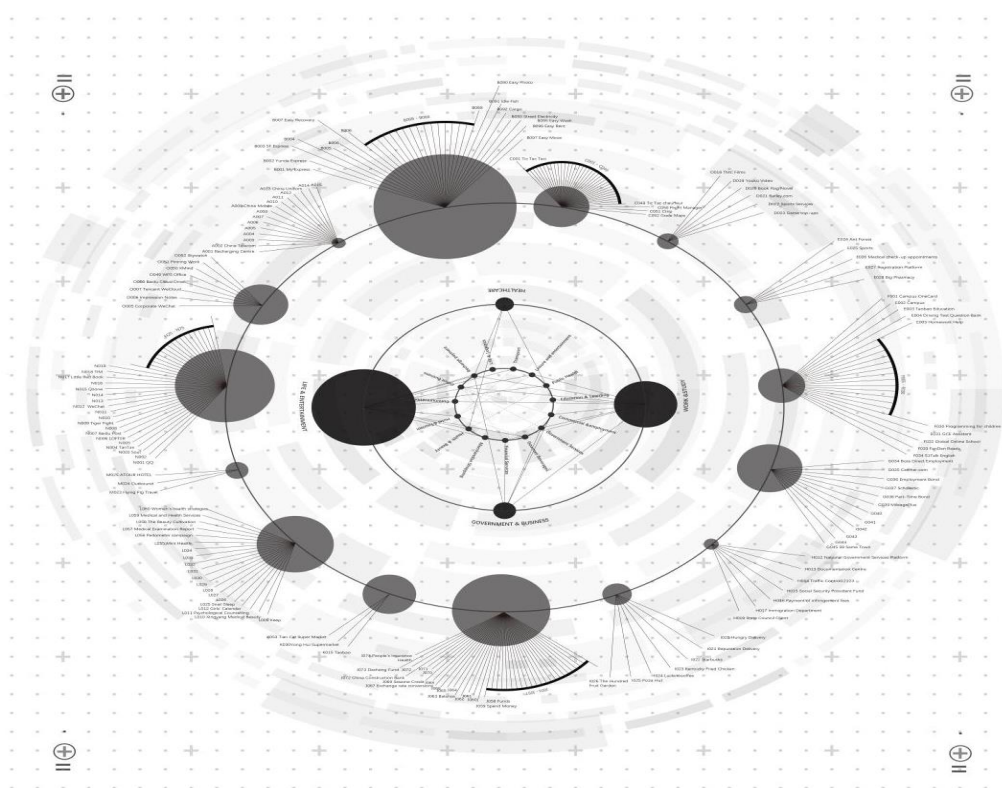


Figure 4. Big Data Software Network (official software related to Alipay)

These large companies will understand our needs better than we do ourselves (**Figure 5**), not only can they read our minds, offer us better services and products and profit from us, but they can also influence our minds, change our values and limit and change our behavior without us realizing it.

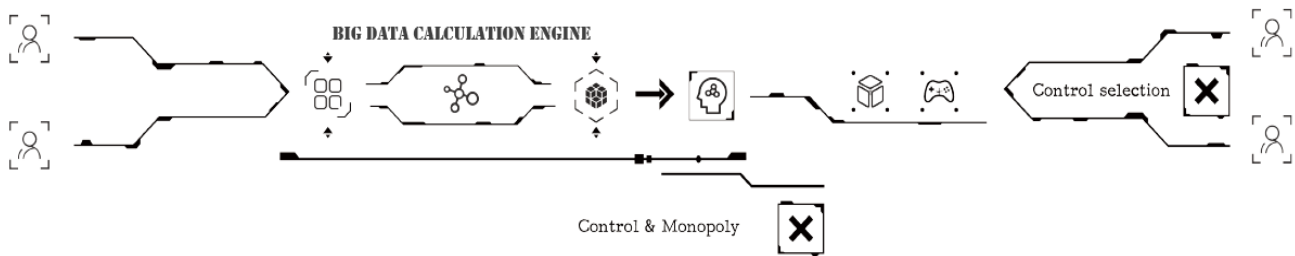


Figure 5. Big Data Calculation Engine

3.2. Technology and entertainment monopolies

The Metaverse is a collective virtual shared space, a fusion of virtually enhanced physical reality and physically persistent virtual space, encompassing the sum of all virtual worlds, augmented reality and the internet (**Figure 6**). Through Metaverse technology, big companies use big data to achieve an absolute monopoly and control over virtual worlds and entertainment orientation (**Figure 7**).

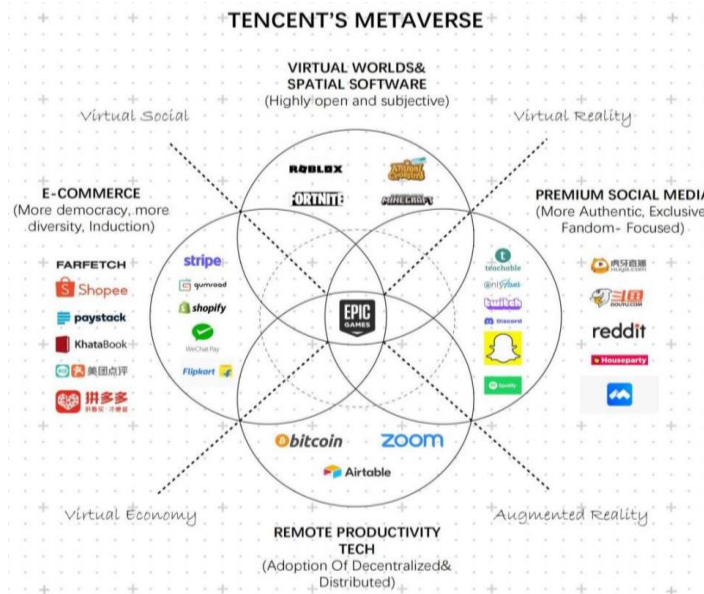


Figure 6. Tencent's Ambitions for The Metaverse ^[15]

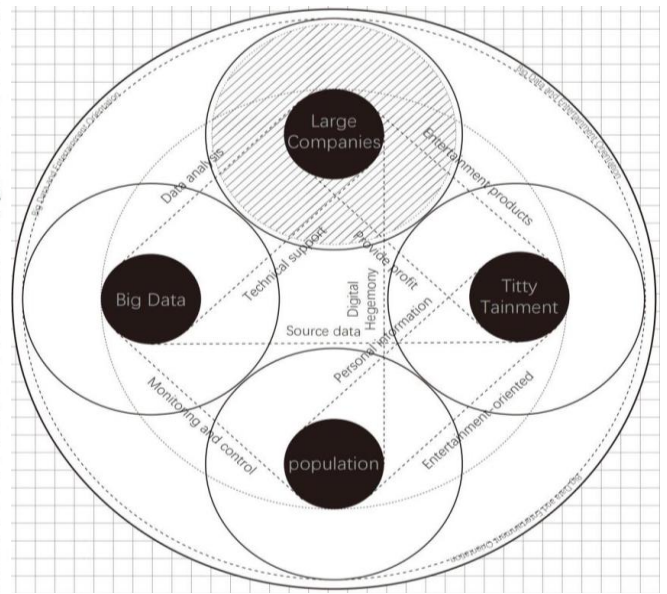


Figure 7. Big Data and Entertainment Orientation

Apart from WeChat, Tencent has made almost no research on any product or technology. This includes the virtual economy, social entertainment, VR technology, AR technology, office learning and more, with over nearly 30 acquisitions and investments in Internet companies. This huge company has acquired a large number of technology-based companies. There is no doubt that it controls almost all aspects of entertainment orientation.

4. Metaverse and urban communities

Realising speculation about future communities requires observation of existing communities. The main problems underlying this observation can be divided into three areas: Work and life, data and identity, and entertainment and space.

4.1. Big data and urban communities

Beijing Pixel is located in the middle of the 5th to 6th ring road in the Chaoyang district of Beijing. The entire community is a commercial and residential property, with a population of approximately 70,000 people living in the whole community, possibly more. Ninety-three per cent of the people living here are

low- and middle-income migrant workers. The high pressure of work and the low standard of living have led these young people to choose cheap and vulgar entertainment to stimulate and numb themselves. Small bars, sex establishments, internet cafes, nightclubs and casinos are hidden among neighborhood (**Figure 8**). The internet, games, celebrity hunting and reality shows are the main forms of entertainment. The necessities of life (**Figure 9**) such as takeaway, delivery, shopping, internet and media entertainment are almost monopolized by large corporations.



Figure 8. A Life without Choice

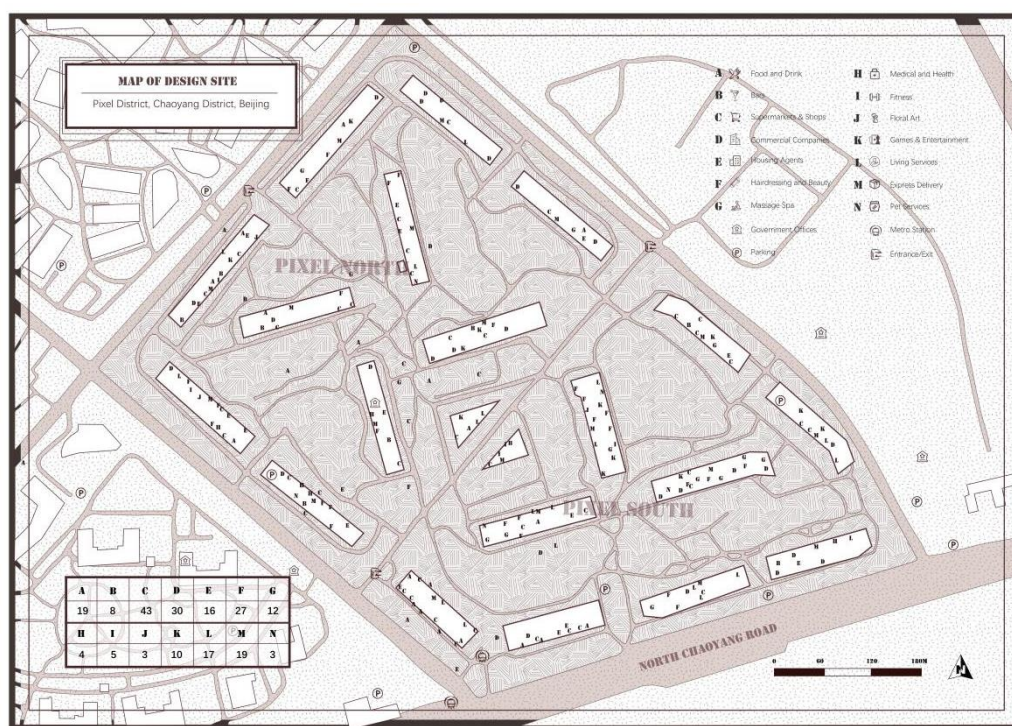


Figure 9. Site Function Mapping

Big data monitoring of community residents by large companies has permeated all aspects of the lives and work of young people, personal identity data is structured, and while personal information datafication has become a powerful phenomenon and big data calculations are capable of meeting a large amount of recreational demand ability, there is no orientation towards providing healthy and quality recreational content. One aspect of the community lacks adequate space and infrastructure, as well as a lack of positive entertainment values to guide it. More importantly, big companies will gradually dominate the community

entertainment culture by perfecting data computing and vulgar and stimulating entertainment will become the mainstream demand in the future, corrupting and destroying the willpower of young people.

4.2. Manifesto of metaverse

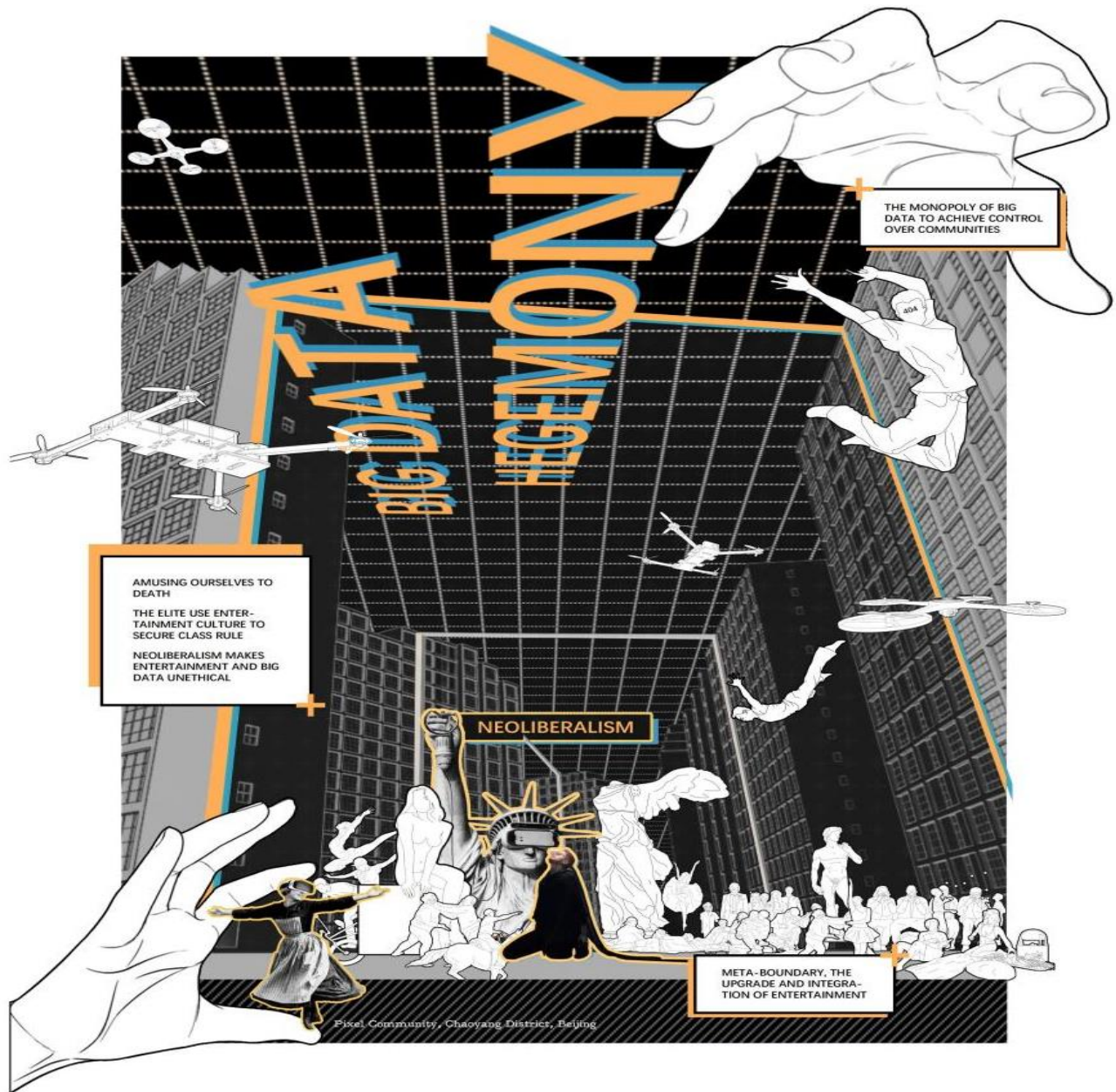


Figure 10. Thinking about digital technology and entertainment orientation

Discussing the economic development of virtual worlds and entertainment culture brought about by technological innovation deserves attention at a time when the rapid development of big data computing technology and internet technology is being noticed, but at the same time the ethical orientation of big data companies and big data entertainment needs more attention. From the perspective of urban designers and urban practitioners, we need to think forward about how big data manipulates society digitally, how entertainment orientation is used to control society, how the new digital technology “Metaverse” integrates the monopoly of entertainment products, and to think about how individuals will resist or submit to the new entertainment spaces created by big companies.

4.3. Metaverse in the future



Figure 11. Entertainment Empire

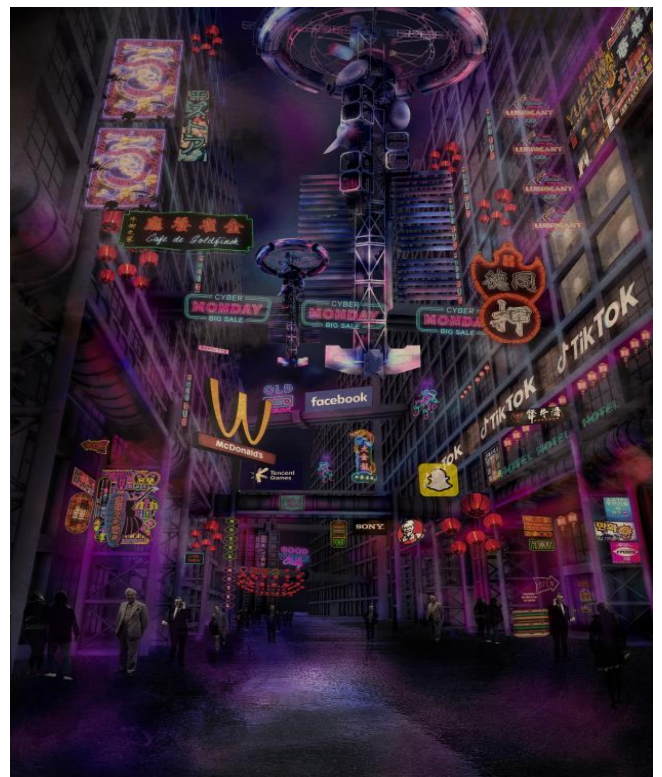


Figure 12. Digital Hegemony



Figure 13. Communities of the Future

5. Conclusion

In conclusion, the topic of “Digital Hegemony” is a unique and complex one. It involves theories not only related to urban design. It also involves knowledge from economic, political, social, digital and other subjects.

In fact that it makes more sense to ask a poignant question and challenge rather than a conventional formal project. The whole design is an expression of a new virtual reality model of living in the future,

which is of course based on particular communities and particular people. However, the heavily exaggerated, even frightening digital facilities in the design expression are a warning against the neo-liberalism that leads globalization through an anti-utopian expression, a questioning of the ethics of big data entertainment, and a questioning of the constant monopolization of technology and industry by big data companies to wake up young people who are damaged by the control of big data and addicted to Tittytainment.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Miraftab F, Wilson D, Salo K, 2015, *Cities and Inequalities in a Global and Neoliberal World*. Routledge.
- [2] Brenner N, Theodore N, 2005, Neoliberalism and the Urban Condition. *City*, 9(1): 101-107.
- [3] Brian K, 2015, *OECD Insights Income Inequality the Gap between Rich and Poor: The Gap between Rich and Poor*. OECD Publishing.
- [4] Berry M, 2014, Neoliberalism and the City: or the Failure of Market Fundamentalism. *Housing, Theory and Society*, 31(1): 1-18.
- [5] World Bank, 1992, *World development report 1992: Development and the environment*. The World Bank.
- [6] Martin P, Schumann H, 1997, *Die Globalisierungsfalle, Der Angriff auf Demokratie und Wohlstand*. Ich. Die Psychozeitung, Berlin (UVA), 8(2): 8-11.
- [7] Postman N, 2011, *Technopoly: The Surrender of Culture to Technology*. Vintage.
- [8] Arsenault AH, 2017, The Datafication of Media: Big Data and the Media Industries. *International Journal of Media & Cultural Politics*, 13(1-2), 7-24.
- [9] Hallur GG, Prabhu S, Aslekar A, 2021, Entertainment in Era of AI, Big Data & IoT. In *Digital Entertainment*. Palgrave Macmillan, Singapore, 87-109.
- [10] Zwitter A, 2014, Big Data Ethics. *Big Data & Society*, 1(2): 2053951714559253.
- [11] Zheng S, Long F, Fan CC, et al., 2009, Urban Cillages in China: A 2008 Survey of Migrant Settlements in Beijing. *Eurasian Geography and Economics*, 50(4): 425-446.
- [12] Herschel R, Miori VM, 2017. Ethics & big data. *Technology in Society*, 49: 31-36.
- [13] Dionisio JDN III, Gilbert R, 2013, 3D Virtual Worlds and the Metaverse: Current Status and Future Possibilities. *ACM Computing Surveys (CSUR)*, 45(3): 1-38.
- [14] Ludlow P, Wallace M, 2007, *The Second Life Herald: The Virtual Tabloid that Witnessed the Dawn of the Metaverse*. MIT Press.
- [15] Jurkiewicz CL, 2018, Big Data, Big Concerns: Ethics in the Digital Age, *Public Integrity*, 20(sup1), S46-S59.
- [16] Smart JM, Cascio J, Paffendorf J, 2007, *Metaverse Roadmap Overview*, Accelerated Studies Foundation. Retrieved 2010-09-23.

Green Construction: Status and Prospects of Shenzhen Construction Industry's "Double Carbon" Goal

Hongzhou Chen*

The Chinese University of Hong Kong (Shenzhen), Shenzhen 518172, Guangdong Province, China

*Corresponding author: Hongzhou Chen, hongzhouchen1@link.cuhk.edu.cn

Abstract: Shenzhen has extensive green construction experience as one of China's new green development pilot cities. Shenzhen has experienced substantial economic growth as a result of the reform and opening up, but it has also had to face the burden of urbanization problems and difficulties. This article looks at the history of green construction in Shenzhen and how the spirit of the city influenced it. The work then divides the procedure into two phases and examines the issues that arise. Suggestions for achieving the "Double Carbon" aim in the building industry are sought through this effort.

Keywords: Double Carbon goal; Green construction; Urbanization; Sustainable development; Shenzhen

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

2021 is the first anniversary of China's official "Double Carbon" goal (by 2030, China's carbon emission will arrive at its peak and, by 2060, will achieve its carbon neutrality). During this year, the government, enterprises, and scholars have conducted a lot of research and work focusing on energy supply and use and have achieved significant and long-lasting results. It is true that, among the carbon emissions of various industries in China, the power and energy industry still account for about 40% of the total emissions of the society and is the primary project and critical player in achieving the "Double Carbon" target. Still, it is also crucial and urgent to implement the "Double Carbon" in the construction industry.

According to the International Energy Agency (IEA) ^[1], the carbon emissions caused by the construction of buildings accounted for 10% of the total emissions of all industries. In comparison, the carbon emitted by facilities in use accounted for 28% of the global carbon emissions in 2019. In addition, the "Global Status Buildings 2020" report from the United Nations Environment Program (UNEP) shows that not only has the global construction industry barely reduced its total energy consumption in recent years, but its carbon emissions are setting new records consistently ^[2]. Globally, paying attention to the construction industry has become an integral part of achieving the "Double Carbon" goal.

Similarly, the situation in China's construction sector is not encouraging. According to studies, China's domestic construction industry may have to achieve its emission peak nine years later than the overall national "2030" target, making it the last of all significant production sectors in China to achieve the "Double Carbon" target ^[3]. With the global spreading concept of environmental protection and sustainable development in recent years, there is no doubt about the determination of China's Party and its government to achieve the "Double Carbon" target. This is an economic transformation and a revolutionary innovation from thought to practice to realize the concept of human destiny community and the great rejuvenation of the Chinese nation. Thus, the "Double Carbon" reform in China's construction industry is imminent.

The Ministry of Housing and Urban-Rural Development (MoHURD) of China, in its “Letter on Green Construction Pilot Work” issued in January 2021, clearly proposed to designate Shenzhen as one of the three pilot regions (the other two being Hunan Province and Changzhou City) to carry out green construction pilot work. Subsequently, the MoHURD prepared and released the “Green Construction Technology Guidelines (for Trial Implementation)” in March and the interpretation of the Guidelines in April. These policies propose “effectively reduce the consumption of resources and the impact on the ecological environment during the whole construction process, reduce carbon emissions, and improve the overall greening of construction activities,” and “integrate the concept of green development into the whole element and process of engineering construction, comprehensively enhance the green and low-carbon development of the construction industry, and promote the full implementation of the national “Double Carbon” major decisions in the construction industry ^[4].” This paper argues that compared with other green construction pilot sites, Shenzhen, as the first region in China to put forward “green and low-carbon construction” related decree documents and implementation, studying its prior experience and the problems it may face now has more potential to promote “green construction” in other regions and realize the “Double Carbon” goal in the whole construction industry.

2. Facing “Unsustainable,” the first to explore the search for a breakthrough

As China’s first special economic zone, Shenzhen has been the window and testing ground for China’s reform and opening up. But this achievement also means that Shenzhen will bear the brunt of many problems and difficulties in the urbanization process and has no predecessor to learn from.

Since its establishment in 1979, Shenzhen’s GDP had grown from 196 million yuan to 166.524 billion yuan in 2000, making it the fourth largest city in terms of GDP after Shanghai, Beijing, and Guangzhou, and shaping the pattern of China’s first-tier cities ^[5]. However, along with the rapid development of Shenzhen, “land space,” “energy and water resources,” “labor force,” and “ecosystem carrying capacity” ^[6] had become a severe dilemma in front of Shenzhen. Shenzhen Urban Planning and Design Institute statistics, around 2000, Shenzhen has been building land area of 467.3 square kilometers, accounting for 60.73% of the total building land resources (767.75 square kilometers). This data means that Shenzhen has entered a highly constrained stage of urban development. Also due to the building process and consumption and pollution from the consequent use of environmental resources, Shenzhen is expected to go forward to the most deteriorating rigid constraint stage of its development in 2008.

To avoid such results, the Shenzhen government issued the local standard for building energy efficiency in 2003. This design code innovatively combines “saving social resources and achieving sustainable development” with building design and construction and marks the first step in Shenzhen’s quest for a breakthrough in the face of the dilemma of natural resources and the ecological environment ^[7-8]. Subsequently, after serious discussion and analysis, Shenzhen took the initiative to lower gross domestic product (GDP) expectations and placed the “ecological environment” on the same level as “economic development” in urban construction ^[9].

At the same time, due to Shenzhen’s market environment and the city’s spirit of “pioneering and innovation,” Fraser Place Shenzhen was designed and built by the U.S. Green Building Council (LEED) standards. Newsweek hailed it as “China’s first green commercial building” ^[10] in 2005. The following year, Shenzhen first issued the “Special Economic Zone Building Energy Efficiency Regulations,” implementing the country’s strictest building “one ballot veto” system ^[11]. This system requires 100% of new buildings to meet energy efficiency standards. By now, Shenzhen, as the first urban area in the country to face a severe economic and natural dilemma, has achieved a transformation from a nascent start to self-exploration and then full implementation of green and low-carbon transformation in the building industry.

3. Affirming the “spirit of Shenzhen,” but period shortcomings are also imperative

It is undeniable that Shenzhen has been positioned as a testing ground for various national policies since its inception, and thus enjoys more financial support and opportunities to showcase. However, by reviewing the process of green transformation of buildings and construction industry in Shenzhen, we can find that the “Shenzhen spirit” of “daring to break new ground, openness and tolerance, pragmatism and law, and the pursuit of excellence” has always been the main line of green construction in Shenzhen. It is an important foundation and guarantee for the accomplishment of today’s results.

First of all, from 2003, Shenzhen began to incorporate environmental elements into urban construction. In the face of development problems, it is refusing to “sit back and wait” for instructions and help from the higher level, “dare to breakthrough.” Shenzhen explored a suitable path for its development, which is ahead of the other regions. Secondly, in the face of the fact that green building technology was developed earlier abroad, Shenzhen actively introduces foreign capital and technology to establish strategic cooperation. It also promotes convergence and mutual recognition with international green building standards.

“Pragmatism and law” are reflected in the green building standards and documents promulgated by Shenzhen. Take the Shenzhen “Public Housing Construction Standard” promulgated in July this year as an example. Based on the foundation of previous work, the standard incorporates the central government’s “green construction pilot” planning on “promoting BIM technology,” relying on “5G, Internet of Things, blockchain and artificial intelligence,” from 9 chapters and 128 items to clarify green construction’s requirements. Converting macro instructions into standard documents ensures rules to follow, avoiding the fuzzy governance environment ^[12]. Finally, since Shenzhen has achieved remarkable results after the reform and opening up, it’s often established as a benchmark in China’s governmental programs. Shenzhen has often chosen to take advantage of opportunities due to its spirit of “pursuit of excellence.”

While analyzing and learning from the experience of Shenzhen’s efforts to promote green construction, it should also see its problems. This paper believes that introducing the subsidy of green building in Shenzhen in 2012 as the boundary can be divided into two stages for separate analysis. In Phase I (2003-2012), although some policy documents have been issued, the public, the market, and the executive departments were not sufficiently aware of the concept of environmental protection. Moreover, developers blindly believed that the initial investment in building energy-efficient buildings was too high and the investment risk was too significant. Additionally, the documentary standards in this phase were mainly thermal parameters, which lack practical guidance for the architectural design and construction process. Furthermore, for a long time, the government’s long-standing “campaign-style” governance of non-GDP core projects has led to a “weakened prestige” and a “speculative mentality” in the market ^[13]. Hence, as of 2008, green projects had emerged in Shenzhen.

Phase II (2012-2020) is marked by the introduction of the Shenzhen Measures for the “Management of Special Funds for Building Energy Efficiency.” The Measures specify subsidies for the construction and operation of green building projects, both up to RMB 6.5 million/item. As seen from government data, the Measures have ushered in a rapid development phase for green building. By the end of 2018, Shenzhen had more than 100 million square meters of green building area and a total of more than 1,000 projects. Taking the Qianhai District as an example, its government has made an ambitious plan for all buildings in the district to be green. Therefore, compared with 2012, the city’s green construction area has expanded ten times.

However, the problems of phase II followed. Since 2018, Shenzhen has seen several enterprises give up green financial subsidies. In 2019, for example, the “abandonment rate” was 60%. The reason is that green buildings often cost more to build and operate than traditional buildings to achieve low-carbon or even carbon-neutral purposes, so many enterprises view green buildings as a burden. In addition, there has been a lot of research on the drawbacks of the governance model of relying on subsidies to promote projects

[14]. This development model not only breeds rent-seeking but also makes green buildings unsustainable. Finally, with the promotion of green building projects, how to solve the phenomenon that new buildings in new areas are “green,” but old buildings in old districts are difficult to “reform” is also urgent for Shenzhen to think about.

4. Relying on “city clusters,” the financial empowerment promotes “Double Carbon” goal

Combining China’s green construction program can be seen; the work is not only aimed at three pilot regions but to explore a viable approach to the construction industry’s “Double Carbon” goal. The central government encourages the pilot regions to integrate regional resources and actively expand the effect in this process. Combining the previous experience of Shenzhen, this work holds that the Shenzhen government should use “green finance” instead of “green subsidies” to play a market role and rely on “city clusters” of the Greater Bay Area to fulfill the “Double Carbon” goal.

Green finance mainly includes green credit, green bonds, carbon emission trading market, ESG investment, and green insurance. Among them, green credit is relatively mature, and also is the product with the earliest start and most comprehensive development in China. It is mainly invested in transportation and energy fields. Meanwhile, mortgage loans for green buildings in China are also gradually increasing. Green bonds are debt issued for the purpose of environmental projects. At present, the scale of global green bonds reaches nearly \$300 billion. After China releases its green bond standards this year, the domestic green bond market will enter a rapid growth stage. The carbon emissions trading market, also known as the carbon trading market, is a powerful tool to achieve the goal of “Double Carbon.” ESG investment is an internationally famous investment system. Currently, most domestic ESG products in China are based on a vague concept, and there is still much room for growth. Green insurance is a popular international tool to reduce the risk of enterprises in achieving the goal of “Double Carbon.” It is generally based on pollution mitigation liability insurance and is expanded to cover significant disaster insurance, green building insurance, and carbon insurance. At present, the innovation of green insurance in China is still in the exploration stage, and further development is needed.

The “Double Carbon” goal is challenging to achieve by the resources of a single city. Cement, for example, the primary raw material used in construction, is the most important source of carbon emissions in the building sector, accounting for 7% of global carbon emissions (in 2018). To solve this challenge, foreign research institutions and companies had developed carbon-negative cement that can absorb carbon dioxide and put it into use in 2014. However, take Tower Cement, one of the leading suppliers of cement for constructing China’s Great Bay Area, as an example. The company’s main environmental management objectives are still in the traditional areas of nitrogen reduction and denitrification. Therefore, to achieve the “Double Carbon,” it is necessary for the government to take the lead and integrate resources in the whole region for a comprehensive plan. This requires Shenzhen’s experience and the regional city cluster’s gathering effect.

Undoubtedly, the emergence of the city cluster is the inevitable product of the development of productivity and the gradual optimization of production factors [15]. Specifically, to green construction and the construction industry’s “Double Carbon” target on the ground, Shenzhen’s preliminary work has accumulated experience in the sustainable development of the construction industry. The establishment of Qianhai and Hengqin special zones and the institutional innovation of the supporting financial reform program will promote the development of green finance and empower the construction industry to achieve the green goal. It can be seen that if each city in the Greater Bay Area can base on its own geographical and industrial characteristics and take positive actions to promote integration, it will provide a more optimal spatial layout of industrial land, front-end upgrading of industry-research docking, and carbon reduction effect of transportation after optimizing infrastructure for the whole region. It is foreseeable that the pilot

work of “green construction” in Shenzhen and the Greater Bay Area will submit a satisfactory answer and valuable experience.

Disclosure statement

The author declares no conflict of interest.

References

- [1] 2021, International Energy Agency, <https://www.iea.org/data-and-statistics/data-browser/?country=WORLD&fuel=CO2+emissions>, www.iea.org/buildings
- [2] United Nations, 2020, “Global Status Report for Buildings and Construction.” Available at https://globalabc.org/sites/default/files/inline-files/2020%20Buildings%20GSR_FULL%20REPORT.pdf
- [3] Industrial and Financial Systems, 2021, “Towards Carbon Neutral 2060: Embracing New Opportunities for Low Carbon Development,” https://www.sohu.com/a/456519184_120661187
- [4] Ministry of Housing and Construction of the People’s Republic of China, Letter on Green Construction Pilot Work, 2021, http://www.mohurd.gov.cn/wjfb/202103/t20210319_249507.html
- [5] Interpreting the “Green Construction Technology Guidelines (Trial), 2021, http://www.mohurd.gov.cn/zxydt/202104/t20210415_249788.html
- [6] 2001, China Statistical Yearbook, China Statistics Press, 20.
- [7] Li HZ, 2005, Four “Unsustainable” into a Bottleneck, where is the Road for Shenzhen?, <http://news.gd.sina.com.cn/local/2005-05-17/1309573.html>
- [8] Ma XW, et al., 2006, Energy-Saving Design Practices for Residential Buildings in Shenzhen. PhD diss.
- [9] Shenzhen Housing and Construction Bureau, 2021, Green Building Column, <http://zjj.sz.gov.cn/xxgk/ztlz/jzjn/>
- [10] Wu L, Zhao DH, 2004, Insights from Shenzhen’s Delayed Modernization Schedule. Financial Information Reference, 6: 47-47.
- [11] Hu JX, Lin WS, 2007, Green Building and Harmonious Home - Energy-Saving Design of China Merchants Tiger Apartments, Journal of Architecture, 4: 17-19.
- [12] Shenzhen HCB, Green Building, 2021, <http://zjj.sz.gov.cn/xxgk/ztlz/jzjn/>
- [13] Jin B, 1998, A Political Science Examination of Selected Problems of Bureaucracy. Journal of the Institute of International Relations, 3: 46.
- [14] Feng ZF, 2007, The Definition of Movement-Based Governance in China and Its Characteristics. Journal of the Party School of the CPC Yinchuan Municipal Committee 9, 2: 29-32.
- [15] Mu XQ, 2017, Local Creation. Fuyukiya Press.
- [16] Su CM, 2017, The Strategic Significance and Realistic Challenges of Building the Guangdong-Hong Kong-Macao Greater Bay Area City Cluster. Guangdong Social Science, 4: 5-14.

Analysis on Construction Technology of Reinforced Concrete Tied Arch Bridge

Zhongyu Wang*

China Merchants Chongqing Communications Technology Research & Design Institute CO., LTD. Chongqing 400067, China

*Corresponding author: Zhongyu Wang, ccrdiyu@gmail.com

Abstract: Bridge construction has received a lot of attention as transportation continues to improve. Reinforced concrete linked arch bridges are a common bridge style in today's bridge construction. This type of bridge not only has a basic and generous shape, but it is also incredibly easy to construct, resulting in significant material and construction cost savings. This article analyzes the construction technology of a reinforced concrete linked arch bridge in order to achieve good construction and application. It is hoped that this analysis can provide a scientific reference for the guarantee of the construction quality and subsequent application effect of this kind of bridge.

Keywords: Reinforced concrete; Tied arch bridge; Construction technology

Publication date: November 2021; **Online publication:** November 30, 2021

1. Introduction

The proper application of construction technology during the construction of a tied arch bridge made of reinforced concrete is critical to ensuring the overall arch bridge's construction quality and safety. As a result, during the construction process, the construction unit must have a thorough understanding of its primary construction methods and be able to apply the appropriate construction technology to the real project. This approach, we can effectively secure the reinforced concrete tied arch bridge's construction effect and establish a firm foundation for its subsequent good application.

2. Analysis on the main construction methods of reinforced concrete tied arch bridge

During the construction of tied arch bridge in the form of reinforced concrete, there are two main construction schemes. The first is to set up scheduled installation, and the second is to cast the support in-situ. In the specific construction, the construction unit shall realize the reasonable selection of construction scheme according to the comprehensive consideration of the landform of the construction site, surrounding environment, actual construction conditions and construction cost ^[1-3]. The following is the comparison of the two construction schemes (**Table 1.**)

3. Analysis on the construction technology key point of reinforced concrete tied arch bridge

This study is the construction of reinforced concrete tied arch bridge in a highway crossing section of a high-speed railway. The type of tied arch bridge is 1-96m structure. The cast-in-place pile is used as the foundation, the bearing platform is in the form of double-layer, and the pier is T-shaped. The tie beam is arranged through an integral box girder. The total length of the beam is 100m, the calculated span is 96m, the arch rib is catenary, and its plane height is 19.2m. In the specific construction, through the comprehensive consideration of various factors, it is finally decided to adopt the method of cast-in-place support for construction, and the construction scheme of beam first and arch second is formulated. During

the construction, the cast-in-situ construction is mainly carried out through the full framing in the form of bowl buckle. The arch crown and end beam support at the top of the same main pier are constructed at the same time with the formwork. The arch seat and end beam on the same arch crown are poured by one-time pouring. The construction of tie bar and middle cross beam shall be carried out at the same time, and shall be erected as a whole. Tie bar pouring is carried out in two sections, and the sequence of arch assist pouring is from arch seat to arch crown. During the construction, the concrete pouring shall be carried out in strict accordance with the design steps. The concrete on the pouring surface is mainly transported by automobile pump. After pouring, the tie bar and working support will be connected into an integral structure. The following is the analysis of the main construction technologies during the construction of reinforced concrete tie arch bridge.

Table 1. Comparison of two main schemes in the construction of reinforced concrete tied arch bridge

Number	Project	Setting up scheduled installation	Casting the support in situ
1	Support installation requirements	Not high	Very high
2	Matters needing attention	After the support at the wet joint position is erected and stressed, the support height can be adjusted with the help of Jack, and the wet joint pouring can be carried out only after the height is adjusted to the design requirements ^[4] .	It is necessary to ensure that the support basically does not precipitate under the condition of bearing flow concrete, and it shall comply with relevant regulations in construction ^[5] . Therefore, in the process of designing this kind of support, we must comprehensively analyze the concrete weight of arch and the actual construction load.

3.1. Reinforcement construction technology

Because the construction cushion cap of reinforced concrete tied arch bridge has a large volume and there is a large amount of reinforcement in construction, most reinforcement needs to be processed in the processing yard and then transported to the construction site for direct installation, and the reinforcement fabrication and installation of each layer need to be completed at one time. Based on this, in the specific construction, the construction unit must reasonably apply the reinforcement construction technology. Firstly, the quality of reinforcement shall be controlled. All reinforcement shall be subject to quality acceptance before mobilization, and can be put into use only when the model and quality are fully consistent with the actual engineering standards. Secondly, during the loading and unloading of reinforcement, it is not allowed to throw it from a high place. Thirdly, when processing the reinforcement, it must be processed in strict accordance with the design drawings, especially when binding the reinforcement, the floor must be padded with square wood to prevent the plate surface from being scratched when the reinforcement is dragged. At the same time, the high-strength concrete cushion block shall be set between the reinforcement and the formwork to ensure the thickness of the reinforcement protective layer ^[6]. Finally, in the process of welding the reinforcement, isolation treatment must be done through the liner to avoid burning the plate surface by welding slag.

3.2. Support installation and construction technology

Before arranging the support, it is necessary to make a detailed stress calculation for each part of the whole reinforced concrete tied arch bridge, and take this as the basis to reasonably determine the safe layout distance of the support. In order to ensure the stress safety, the spacing between supports must be set reasonably with the specific stress changes of each part. During the specific erection of the support, the construction unit must control it in strict accordance with the designed support layout. In this process, it is necessary to ensure that the support design is consistent with the actual weight of concrete and the load requirements in specific construction. Especially for the support at the arch rib, the node support must be selected during installation, and the transverse and longitudinal connections need to be added between the supports. Only in this way can we effectively ensure the quality of support installation and construction and meet the quality and safety requirements of the whole project.

3.3. Arch foot construction technology

In the process of the arch foot construction of reinforced concrete tied arch bridge, the solid section shall be set within 8m in the general direction. If the width in the transverse direction is more than 17m, the corresponding transition section or chamfer shall be set at the gradual change position of its cross section. During the construction of arch foot, the concrete cast-in-situ can be carried out in two sections. Before the pouring construction, it is necessary to install these materials such as arch rib reinforcement, and then carry out the first concrete pouring. After the completion of phase II dead load construction, the second concrete pouring construction can be carried out. In this process, the reinforcement must be properly positioned, so as to effectively avoid the displacement of reinforcement during concrete pouring, so as to effectively control the position deviation of arch rib reinforcement and provide a good guarantee for construction quality and safety ^[7].

3.4. Cast in situ construction technology of soil beam

During the specific construction, the pouring and forming of arch seat and end beam shall be realized at one time, and each tie rod shall be poured according to both ends. Among them, the cast-in-situ construction of concrete shall be carried out in a horizontal layered manner. The concrete at the arch seat and the end beam shall be poured at the same time, and the concrete shall be pushed forward through the inclined plane layer by layer until it is poured to the top of the end beam. When the concrete is about to set initially, the remaining concrete shall be poured in layers ^[8]. In this process, the construction unit should arrange a special person in charge to track and inspect the actual situation of the support and template. If there is a normal situation, the concrete pouring construction should be stopped immediately. After the normal situation is found out and treated, the concrete pouring can be continued.

3.5. Arch rib installation and construction technology

During the installation and construction of the arch rib of this kind of arch bridge, its section is usually set in the form of dumbbell concrete-filled steel tube. After the tie bar tensioning is completed, the arch rib can be installed. In this process, it is necessary to pre-assemble the arch rib. During the construction, it is necessary to fix the edge section of the arch rib on the bed-jig to keep its positioning accurate. For each assembly stage, it is necessary to make corresponding assembly marks, so as to provide sufficient reference for the subsequent on-site docking and installation construction. In the arch assist section, both sides of the tie rod need to be supported with round logs, and the camber should be reserved according to the actual situation, so as to ensure the accuracy of construction. For the wooden square at the top of the support, it should be copied through the wooden wedge, and then the elevation at the bottom of the support should be detected by the level ^[9]. The fabrication and assembly of arch ribs can be carried out only after the above

work is completed and qualified. In this process, the construction unit must be in strict accordance with the actual design requirements to do a good job of opening the lifting point hole. At the same time, it should do a good job of the installation of the attached frame, and do a good job of opening cover plate number and storage. After the concrete pouring construction is completed, the hole cover can be covered and welded firmly.

3.6. Construction technology of concrete pouring in arch

After completing the construction of prestressed steel cable, the construction unit needs to check and reinforce the support, properly connect the vertical rod on both sides of the tie rod, and set the arch support to the top of the tie rod, and then the arch support can be used for concrete pouring construction. The arch support is usually erected with steel pipe in the form of bowl buckle. With the help of single arch support concrete, it is poured symmetrically from the arch seat to the arch crown until it is formed^[10]. After pouring and forming, it is necessary to carry out quality inspection with the help of ultrasonic inspection technology. If a void is found during the test, it needs to be treated by drilling and grouting technology.

4. Conclusion

To sum up, in the process of construction of reinforced concrete tied arch bridge, only by controlling its construction technology can the construction quality be effectively ensured. Therefore, in the specific construction process, the construction unit must reasonably formulate its construction scheme in strict accordance with the actual situation and combined with the actual needs, and reasonably apply the corresponding construction technology to the actual construction, including reinforcement construction technology, support installation construction technology, arch foot construction technology, soil beam cast-in-place construction technology, arch rib installation construction technology and arch concrete pouring construction technology, etc. In this way, the corresponding construction technology can give full play to the technical advantages in the construction of reinforced concrete tied arch bridge, meet the construction requirements of the actual project, ensure the overall project quality, and provide good quality and safety guarantee for the subsequent application of this kind of arch bridge

Disclosure statement

The author declares no conflict of interest.

References

- [1] Zhong S, 2021, Research on Construction Monitoring and Key Technology of Long-span Reinforced Concrete Tie Arch Bridge. Tutor: Feng Z, Chen Y. Lanzhou Jiaotong University.
- [2] Yu L, Yang J, 2020, Research on Construction Technology of Reinforced Concrete Side Arch Rib. Intelligent City, (09): 188-189.
- [3] Jin C, 2020, Research on Construction Technology of Long Span Concrete Filled Steel Tubular Tie Arch Bridge. Engineering and Technological Research, (03): 99-100.
- [4] Che X, 2019, Research on Reasonable Bridge Formation and Cable Force Optimization of Reinforced Concrete Tie Arch Bridge. Tutor: Du B. Guizhou University.
- [5] Yu Y, 2019, Dynamic Characteristics of Steel Box Tie Arch Bridge and Its Stability Analysis during Construction process. Tutor: Sun H, Qu G. Shenyang University of Technology.
- [6] Xing Y, 2019, Research on Key Problems of Design and Construction of Concrete Filled Steel Tube Simply Supported Arch Bridge. Tutor: Zhang C, Wang X. Tsinghua University.
- [7] Chen X, 2019, Analysis of Cable Force and Stability of Concrete-filled Steel Tubular Tie Arch Bridge.

Tutor: Ning X. Kunming University of Science and Technology.

- [8] Wu W, 2019, Research on the Application of BIM technology in Design and Construction of Underpass Tie Arch Bridge. Tutor: Cheng Y. Lanzhou Jiaotong University.
- [9] Bian C, 2018, Analysis of the Influence of Transverse Brace Arrangement on Seismic Response and Wind Load of Tie Arch Bridge. Tutor: Zhao Qing. Anhui Jianzhu University.
- [10] Qiao Y, 2018, Study on Construction Control of 64M Simply-supported Pole-arch Bridge of Yinxi Railway. Tutor: Ji W, Cao G. Lanzhou Jiaotong University.

Author Guidelines

Before your submission, please check that your manuscript has been prepared in accordance to the step-by-step instructions for submitting a manuscript to our online submission system. We recommend that you keep this page open for your reference as you move through the submission process.

If there are any differences in author guidelines between the print and online version, it is recommended that authors refer to the online version for use.

Manuscript Format

Journal of World Architecture accepts manuscript that is in MS Word or LaTeX format. All manuscripts must be written in clear, comprehensible English. Both American and British English are acceptable. Usage of non-English words should be kept to a minimum and all must be italicized (except for e.g. and i.e.) If you have concerns about the level of English in your submission, please ensure that it is proofread before submission by a native English speaker or a scientific editing service.

Cover letter

All submissions for *Journal of World Architecture* should include a cover letter as a separate file. A cover letter should contain a brief explanation of what was previously known, the conceptual advancement with the findings and its significance to broad readership. The cover letter is confidential and will be read only by the editors. It will not be seen by reviewers.

Title

The title should capture the conceptual significance for a broad audience. The title should not be more than 50 words and should be able to give readers an overall view of the paper's significance. Titles should avoid using uncommon jargons, abbreviations and punctuation.

List of Authors

The names of authors must be spelled out rather than set in initials with their affiliations footnoted. Authors should be listed according to the extent of their contribution, with the major contributor listed first. All corresponding authors (maximum 2) should be identified with an asterisk. Affiliations should contain the following core information: department, institution, city, state, postal code, and country. For contact, email address of only one corresponding author is expected within the manuscript. Please note that all authors must see and approve the final version of the manuscript before submitting.

Abstract

Articles must include an abstract containing a maximum of 200 words. The purpose of abstract is to provide sufficient information for a reader to choose either to proceed to the full text of the article. After the abstract, please give 3-8 key words; please avoid using the same words as those already used in the title.

Section Headings

Please number all section headings, subheadings and sub-subheadings. Use boldface to identify major headings (e.g. **1**, **2**, **3**, etc.) and subheadings (e.g. **1.1**, **1.2**, **2.1**, **2.2** etc.) For the sub-subheadings, please distinguish it further using non-boldface numbers in parenthesis (e.g. (1), (2), (3), etc.)

Introduction

Introduction should provide a background that gives a broad readership an overall outlook of the field and the research performed. It tackles a problem and states its importance regarding the significance of the study. Introduction can conclude with a brief statement of the aim of the work and a comment about whether that aim was achieved.

Materials and Methods

This section provides the general experimental design and methodologies used. The aim is to provide enough detail to for other investigators to fully replicate your results. It is also required to facilitate better understanding of the results obtained. Protocols and procedures for new methods must be included in detail to reproduce the experiments.

Ethics

Ethics information, including IACUC permit numbers and/or IRB name, if applicable. This information should be included in a subheading labelled "Ethics Statement" in the "Methods" section of your manuscript file, in as much detail as possible.

Results

This section can be divided into subheadings. This section focuses on the results of the experiments performed.

Discussion

This section should provide the significance of the results and identify the impact of the research in a broader context. It should not be redundant or similar to the content of the results section.

Conclusion

Please use the conclusion section for interpretation only, and not to summarize information already presented in the text or abstract.

Conflict of Interest

All authors are required to declare all activities that have the potential to be deemed as a source of competing interest in relations to their submitted manuscript. Examples of such activities could include personal or work-related relationships, events, etc. Authors who have nothing to declare are encouraged to add "No conflict of interest was reported by all authors" in this section.

Funding

Authors should declare all financial and non-financial support that have the potential to be deemed as a source of competing interest in relations to their submitted manuscript in this section. Financial supports are generally in the form of grants, royalties, consulting fees and more. Examples of non-financial support could include the following: externally-supplied equipments/biological sources, writing assistance, administrative support, contributions from non-authors etc.

Appendix

This section is optional and is for all materials (e.g. advanced technical details) that has been excluded from the main text but remain essential to readers in understanding the manuscripts. This section is not for supplementary figures. Authors are advised to refer to the section on 'Supplementary figures' for such submissions.

Text

The text of the manuscript should be in Microsoft Word or Latex. The length of the manuscript cannot be more than 50000 characters (inclusive of spaces) or approximately 7000 words.

Nomenclature for genes and proteins

This journal aims to reach researchers all over the globe. Hence, for both reviewers' and readers' ease in comprehension, authors are highly encouraged to use the appropriate gene and protein nomenclature. Authors may prefer to utilize resources such as <http://www.ncbi.nlm.nih.gov/gene>

Figures

Authors should include all figures into the manuscript and submit it as 1 file in the OJS system. Reference to the "Instructions for Typesetting manuscript" is strongly encouraged. Figures include photographs, scanned images, graphs, charts and schematic diagrams. Figures submitted should avoid unnecessary decorative effects (e.g. 3D graphs) as well as be minimally processed (e.g. changes in

brightness and contrast applied uniformly for the entire figure). It should also be set against a white background. Please remember to label all figures (e.g. axis etc.) and add in captions (below the figure) as required. These captions should be numbered (e.g. **Figure 1**, **Figure 2**, etc.) in boldface. All figures must have a brief title (also known as caption) that describes the entire figure without citing specific panels, followed by a legend defined as description of each panel. Please identify each panel with uppercase letters in parenthesis (e.g. A, B, C, etc.)

The preferred file formats for any separately submitted figure(s) are TIFF or JPEG. All figures should be legible in print form and of optimal resolution. Optimal resolutions preferred are 300 dots per inch for RGB coloured, 600 dots per inch for greyscale and 1200 dots per inch for line art. Although there are no file size limitation imposed, authors are highly encouraged to compress their figures to an ideal size without unduly affecting legibility and resolution of figures. This will also speed up the process of uploading in the submission system if necessary.

The Editor-in-Chief and Publisher reserve the right to request from author(s) the high-resolution files and unprocessed data and metadata files should the need arise at any point after manuscript submission for reasons such as production, evaluation or other purposes. The file name should allow for ease in identifying the associated manuscript submitted.

Tables, lists and equations

Tables, lists and equations must be submitted together with the manuscript. Likewise, lists and equations should be properly aligned and its meaning clear to readers. Tables created using Microsoft Word table function are preferred. Place each table in your manuscript file right after the paragraph in which it is first cited. Do not submit your tables in separate files. The tables should include a concise but sufficiently explanatory title at the top. Vertical lines should not be used to separate columns. Leave some extra space between the columns instead. All tables should be based on three horizontal lines to separate the caption, header and body. A few additional horizontal lines MAY be included as needed (example below). Any explanations essential to the understanding of the table should be given in footnotes at the bottom of the table. SI units should be used.

Supplementary information

This section is optional and contains all materials and figures that have been excluded from the entire manuscript. This information are relevant to the manuscript but remains non-essential to readers' understanding of the manuscript's main content. All supplementary information should be submitted as a separate file in Step 4 during submission. Please ensure the names of such files contain 'suppl. info'.

In-text citations

Reference citations in the text should be numbered consecutively in superscript square brackets. Some examples:

1. Negotiation research spans many disciplines ^[3, 4].
2. This result was later contradicted by Becker and Seligman ^[5].
3. This effect has been widely studied ^[1–3, 7].

Personal communications and unpublished works can only be used in the main text of the submission and are not to be placed in the Reference section. Authors are advised to limit such usage to the minimum. They should also be easily identifiable by stating the authors and year of such unpublished works or personal communications and the word 'Unpublished' in parenthesis.

E.g. (Smith J, 2000, Unpublished)

References

This section is compulsory and should be placed at the end of all manuscripts. Do not use footnotes or endnotes as a substitute for a reference list. The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should be excluded from this section.

For references in reference list, all authors must be stated. Authors referenced are listed with their surname followed by their initials. All references should be numbered (e.g. 1. 2. 3. etc.) and sequenced according to the order it appears as an in-text citation. References should follow the following pattern: Author(s) followed by year of publication, title of publication, full journal name in italics, volume number, issue number in parenthesis, page range and lastly the DOI (if applicable). If the referred article has more than three authors, list only the first three authors and abbreviate the remaining authors to italicized 'et al.' (meaning: "and others").

Journal

Journal article (print) with one to three authors

[1] Yao Y., Xia B. Application of Phase Frequency Feature Group Delay Algorithm in Database Differential Access. *Computer Simulation*, 2014, 31(12): 238-241.

Journal article (print) with more than three authors

[2] Gamelin F.X., Baquet G., Berthoin S., et al. Effect of high intensity intermittent training on heart rate variability in prepubescent children. *European Journal of Applied Physiology*, 2009, 105: 731–738.

Journal article (online) with one to three authors

[3] Jackson D., Firtko A., Edenborough M. Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: a literature review. *Journal of Advanced Nursing*, 2009, 60(1): 1–9,

Journal article (online) with more than three authors

[4] Hargreave M., Jensen A., Nielsen T.S.S., et al. Maternal use of fertility drugs and risk of cancer in children—A nationwide population-based cohort study in Denmark. *International Journal of Cancer*, 2015, 136(8): 1931–1939.

Book

Book with one to three authors

[5] Schneider Z., Whitehead D., Elliott D. Nursing and midwifery research: methods and appraisal for evidence-based practice. 3rd edn. 2009, Elsevier Australia, Marrickville, NSW.

Book with more than three authors

[6] Davis M., Charles L., Curry M.J., et al. Challenging spatial norms. 2013, Routledge, London.

Chapter or Article in Book

[7] Knowles M.S. Independent study. In Using learning contracts. 1986, Jossey-Bass, San Francisco, 89–96.

Others

Proceedings of meetings and symposiums, conference papers

[8] Chang S.S., Liaw L. and Ruppenhofer J. (eds). Proceedings of the twenty-fifth annual meeting of the Berkeley Linguistics Society, February 12–15, 1999: general session and parasession on loan word phenomena. 2000, Berkeley Linguistics Society, Berkeley.

Conference proceedings (from electronic database)

[9] Bukowski R.M. Prognostic factors for survival in metastatic renal cell carcinoma: update 2008. Innovations and challenges in renal cancer: proceedings of the third Cambridge conference. Cancer, 2009, 115 (10): 2273, viewed 19 May 2009, Academic OneFile database.

Online Document with author names

[10] Este J., Warren C., Connor L., et al. Life in the clickstream: the future of journalism, Media Entertainment and Arts Alliance, 2008. viewed 27 May 2009, http://www.alliance.org.au/documents/foj_report_final.pdf

Online Document without author name

[11] Developing an argument n.d., viewed March 30 2009, http://web.princeton.edu/sites/writing/Writing_Center/WCWritingResources.htm

Thesis/Dissertation

[12] Gale L. The relationship between leadership and employee empowerment for successful total quality management. 2000, University of Western Sydney.

Standard

[13] Standards Australia Online. Glass in buildings: selection and installation. AS 1288–2006. 2006, SAI Global database.

Government Report

[14] National Commission of Audit. Report to the Commonwealth Government, Australian Government Publishing Service, 1996, Canberra.

Government report (online)

[15] Department of Health and Ageing. Ageing and aged care in Australia, 2008, viewed 10 November 2008, <http://www.health.gov.au/internet/main/publishing.nsf/Content/ageing>

No author

[16] Guide to agricultural meteorological practices. 2nd edn, Secretariat of the World Meteorological Organization, 2010, Geneva.

Note: When referencing an entry from a dictionary or an encyclopedia with no author there is no requirement to include the source in the reference list. In these cases, only cite the title and year of the source in-text. For an authored dictionary/encyclopedia, treat the source as an authored book.

Submission Preparation Checklist

As part of the submission process, authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to these guidelines.

1. The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).
2. The submission file is in OpenOffice, Microsoft Word, RTF, or WordPerfect document file format.
3. Where available, URLs for the references have been provided.
4. The text is single-spaced; uses a 12-point font; employs italics, rather than underlining (except with URL addresses); and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.
5. The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines, which is found in About the Journal.
6. If submitting to a peer-reviewed section of the journal, the instructions in Ensuring a Blind Review have been followed.



Integrated Services Platform of International Scientific Cooperation

Innoscience Research (Malaysia), which is global market oriented, was founded in 2016. Innoscience Research focuses on services based on scientific research. By cooperating with universities and scientific institutes all over the world, it performs medical researches to benefit human beings and promotes the interdisciplinary and international exchanges among researchers.

Innoscience Research covers biology, chemistry, physics and many other disciplines. It mainly focuses on the improvement of human health. It aims to promote the cooperation, exploration and exchange among researchers from different countries. By establishing platforms, Innoscience integrates the demands from different fields to realize the combination of clinical research and basic research and to accelerate and deepen the international scientific cooperation.

Cooperation Mode



Clinical Workers



In-service Doctors



Foreign Researchers



Hospital



University



Scientific institutions

OUR JOURNALS



The *Journal of Architectural Research and Development* is an international peer-reviewed and open access journal which is devoted to establish a bridge between theory and practice in the fields of architectural and design research, urban planning and built environment research.

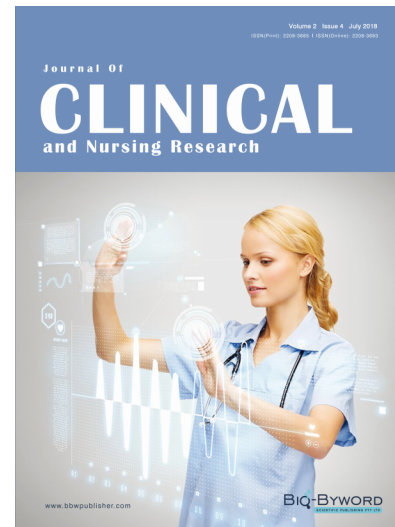
Topics covered but not limited to:

- Architectural design
- Architectural technology, including new technologies and energy saving technologies
- Architectural practice
- Urban planning
- Impacts of architecture on environment

Journal of Clinical and Nursing Research (JCNR) is an international, peer reviewed and open access journal that seeks to promote the development and exchange of knowledge which is directly relevant to all clinical and nursing research and practice. Articles which explore the meaning, prevention, treatment, outcome and impact of a high standard clinical and nursing practice and discipline are encouraged to be submitted as original article, review, case report, short communication and letters.

Topics covered by not limited to:

- Development of clinical and nursing research, evaluation, evidence-based practice and scientific enquiry
- Patients and family experiences of health care
- Clinical and nursing research to enhance patient safety and reduce harm to patients
- Ethics
- Clinical and Nursing history
- Medicine



Journal of Electronic Research and Application is an international, peer-reviewed and open access journal which publishes original articles, reviews, short communications, case studies and letters in the field of electronic research and application.

Topics covered but not limited to:

- Automation
- Circuit Analysis and Application
- Electric and Electronic Measurement Systems
- Electrical Engineering
- Electronic Materials
- Electronics and Communications Engineering
- Power Systems and Power Electronics
- Signal Processing
- Telecommunications Engineering
- Wireless and Mobile Communication

