# Research on Risk Factors of Smart Community Construction Based on WSR-ISM

Liting Yang

(School of Business Administration, Liaoning University of Engineering and Technology, Huludao 120105, Liaoning, China)

email:627925549@qq.com

**Abstract.** To ensure the smooth progress of smart community construction, it is necessary to identify the risk factors of smart community construction and clarify the mechanism of interaction between the factors. Based on the WSR methodology, the risk factors of smart community construction are identified from the three dimensions of "physical-physical-human", and based on 130 questionnaires, the multilevel correlation between the factors and the transmission paths between the levels is constructed by using the explanatory structure model. The results show that among the risk factors of smart community construction, the main ones are risk elements including demand risk, product testing program risk, collaboration risk, human resource risk, execution strength risk, technology effectiveness risk, target perception risk, power, and knowledge. Based on the results of the analysis, the smart community project construction puts forward suggestions to strengthen the control of each risk factor, prevent and control the risks at all levels, and increase the importance of risk factors, which ultimately promotes the construction of the smart community smoothly.

**Keywords:** WSR methodology; smart communities; explanatory structural modeling; risk factors

## 1 Introduction

Smart community is the "last kilometer" of fine urban governance, the basic unit of a smart city, and a fundamental project for providing residents with precise and refined services. The "14th Five-Year Plan" and the 2035 Vision and Goals Outline propose to promote the construction of smart communities, rely on community digital platforms and offline community service organizations to build a smart service circle for the convenience and benefit of the people, and provide online and offline integration of community life services, community governance and public services, smart neighborhoods, and other services. However, there are still some potential risks in the process of smart community construction. For example, the platform construction process may face technical risks, such as network security hazards, system failures, etc.; at the same time, the platform may also face management risks, such as information leakage, data mismanagement, and other problems. Therefore, it is necessary to analyze the risk


T. Yao et al. (eds.), *Proceedings of the 2024 3rd International Conference on Engineering Management and Information Science (EMIS 2024)*, Advances in Computer Science Research 111,
https://doi.org/10.2991/978-94-6463-447-1_3

factors of community wisdom platform construction based on WSR methodology, which can help the project team to identify, analyze, and respond to the potential risk factors at the early stage of the project, so as to reduce the risk of project failure, which is of great practical significance.

With the continuous progress of science and technology, intelligence and informatization have profoundly affected people's lifestyles, and smart communities have also received attention from scholars at home and abroad. Abdoullaev et al[1].pointed out that through smart communities, residents can enjoy more convenient life services, while community management can respond to the needs of the residents more efficiently and provide more accurate services.Chen et al[2]The development of smart communities needs to Fully consider privacy and security issues and avoid technology abuse and inequality. While smart communities bring much convenience and innovation, they also raise privacy and security concerns. Large amounts of personal data are being collected and shared, which may lead to the risk of privacy leakage and misuse of personal information. In the process of promoting the development of smart communities, data privacy protection measures need to be strengthened to ensure the security of personal information.Liujun[3].proposed development strategies based on integrated planning to realize resource sharing; establishing standards and evaluation systems related to smart community services; researching and developing community service platforms and products based on emerging information technologies; practically carrying out demonstration and promotion of smart community applications; and cultivating and reserving specialists for smart community services. Huang Chunlin et al[4].conducted a preliminary sorting of the smart community management and service system and constructed a smart community management and service platform system to further meet the diversified construction needs of smart community construction, to provide reference and significance for the work of smart community construction.

To summarize, existing research focuses on the operation, management, and application of smart communities and the development of their service functions, and few studies focus on the exploration of risks in the process of smart community construction. Secondly, there is insufficient comprehensive consideration of multi-dimensional factors such as physical, technological, social, and policy, which leads to a need to improve the comprehensiveness of risk factors. Therefore, this study takes smart community construction as an object, constructs its index system based on the physical (Wuli)-example (Shili)-humanistic (Renli) methodological perspective, introduces the explanatory structural model (ISM) to analyze the risk factors, and builds a multi-layered hierarchical structural model to determine the logical relationship between the risk factors of smart community construction, with a view to providing references to the construction of smart communities.

## 2 Identification oof Risk Factors for Smart Community Building Based on Wsr

### 2.1 Introduction to the WSR Methodology

Drs.GuJifa and ZhuZhichang proposed the "Wuli-Shili-Renli System Approach" (WSR Methodology) at HULL University in 1994[5]. Among them, physics refers to the objective existence faced by the personnel in the process of a system project and problem handling, which is the sum of the laws of material movement; matter theory refers to the mechanism of the subject's intervention in the face of the objective existence and its laws; humane theory refers to the interrelationships among organizations, institutions and individuals in the process of practice and its change process, based on "physics" and "matter" to play the role of "matter" and "physics", and "matter" to play the role of "matter" and "matter". Based on "physics" and "reason", the human subjective initiative is brought into play to achieve the intended goals with maximum effectiveness and efficiency[6]. WSR system methodology solves complex problems by practicing the logic of knowing the physics, understanding the reason, and understanding the reason of people, and emphasizes the importance of human beings in coordinating relationships and responding to things.

Risk identification of smart community construction is a complex process that includes many internal and external factors, which requires a comprehensive consideration of all aspects of the situation and a systematic analysis of risk management of smart community project construction[7]. It requires a comprehensive consideration of all aspects and a systematic analysis of the risk management of smart community project construction. The complexity of smart community construction makes its management risk also present complexity, so the scope of smart community construction management is relatively wide, the project from design to operation involves all kinds of information, including daily management documents and related technical specialized information, which increases the difficulty of risk management of smart community project construction. In order to avoid or reduce the risk of intelligent community project construction, it is necessary to analyze the construction risk from a more comprehensive point of view and implement "comprehensive", "full", and "full" control. In order to avoid or reduce the risk of smart community construction, it is necessary to analyze the construction risk from a more comprehensive perspective, implement "comprehensive", "whole process" and "full staff" control, and make systematic arrangements for the things, things and people involved[8]. The WSR system approach can use the concepts of synthesis and integration, system and decomposition to efficiently deal with the complexity of the problem, and provide specific methods and ideas for the construction of the smart community risk control.

### 2.2 Construction of Risk Factor Indicator System for Intelligent Community Construction

A questionnaire survey was adopted for the relevant staff and experts in the construction of smart communities. The content of the survey is mainly the risk factors in the construction of the smart community project, involving a variety of influencing factors in the physical dimension, matter-of-fact dimension, and humanistic dimension. Taking the form of online distribution of questionnaires, a total of 130 questionnaires were distributed, 130 copies were recovered, the recovery efficiency is 100%, the reliability test meets the standard (the Cronbach'sa value of the reliability test is above 0.7, the corrected items of the question items and the total correlation are all greater than 0.4, and the deleted items of the clone Bach's Alpha value are all above 0.8, the scale has a good degree of confidence). (The KMO value of the validity test is 0.864, which is greater than the minimum standard of KMO>0.5, indicating that the correlation between the variables is stronger, and the significant coefficient of Bartlett's sphere test is 0.000<0.01, which indicates that the validity of the questionnaire is better). Synthesizing the feedback from survey respondents and relevant experts, based on the WSR method, the risk factors of smart community construction are categorized from the physical dimension, matter-of-fact dimension, and humanistic dimension, as shown in Figure 1:

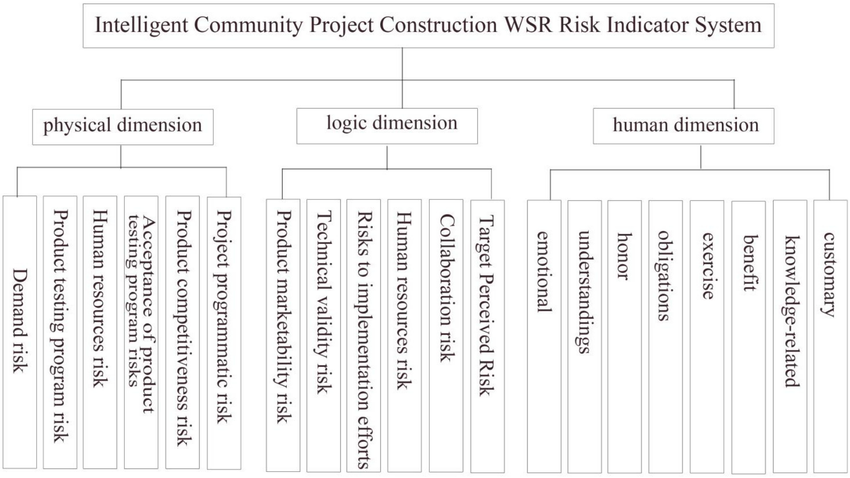


**Fig. 1.** Risk evaluation index system for the construction of the community intelligence platform project

## 3 Construction and Application of Risk Factor Model for Smart Community Project Construction Based on Wsr Methodology

Interpretive Structural Model method (Interpretive Structural Model, referred to as ISM) is a theory proposed by J.N. Warfield in the United States in 1973 for parsing the problems of a complex system, is a kind of graphical matrix is used to express the equations and logical operations to describe the structure of a complex system[9]. A directed hierarchical system with multiple levels of hierarchy can be constructed by this method if there are some problems in the system such as lack of clarity of the problems, interactions between the elements, and inconsistent judgments about important issues[10].

### 3.1 Constructing an Adjacency Matrix of Influencing Factors

The adjacency matrix mainly represents the relationship between various risk factors in the construction of smart community projects[11], based on the above risk evaluation index system of smart community project construction, the most important 10 risk factors are selected from physical risk, matter-of-fact risk, and humanistic risk, including demand risk, product testing program risk, collaboration risk, human resource risk, product competitiveness risk, technology effectiveness risk, target perception risk, responsibility, authority, and knowledge. These risk factors were selected based on their criticality and potential impact on the construction of smart community projects.

The process of constructing the adjacency matrix involves the interrelationships and roles of risk factors, and the adjacency matrix in this section can be determined primarily through the knowledge and experience of experts in the field of specialization, as well as through data analysis and evaluation of the relationships between these factors[12]. The expert may fill in the values of the adjacency matrix based on the degree of correlation between the factors, the strength of their interactions, and other factors. This process may involve expert discussions, questionnaires, data analysis, and other methods to ensure that the adjacency matrix accurately reflects the linkages between risk factors.

The obtained adjacency matrix can be used for subsequent risk analysis and modeling, helping the project team to better understand the interactions between the various risk factors, take targeted measures to mitigate potential risks and improve the probability of success of the smart community project. The construction and application of this model help in project management and decision-making to manage risks more effectively and ensure successful project implementation. The neighbor matrix is constructed as follows:

$$A = \begin{Bmatrix} 0 & 1 & 0 & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{Bmatrix}$$

### 3.2 Computing the Accessibility Matrix

The accessibility matrix M, as an important analytical tool, plays a key role in revealing the correlations between factors[13]. Its construction and interpretation are important for both research and decision-making processes. An element of the accessibility matrix M of 1 represents the existence of a accessibility path between factors, which means that within the scope of analysis, starting from one factor, one can reach another factor through a series of correlations. The existence of such correlation paths may provide important insights into problem-solving and the influence of factors. An element of 0 in the accessibility matrix M indicates that there is no correlation between factors. This can be used to exclude uncorrelated factors, thus simplifying the analysis of the problem and focusing on the truly correlated factors. In data analysis and model construction, this method of filtering out irrelevant factors can improve the accuracy and interpretability of the model.

The reachable matrix M is:

$$A+1=\begin{Bmatrix} 1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \end{Bmatrix}$$

### 3.3 Hierarchical Classification of Influencing Factors and ISM Model Construction

Based on the rules and methods of the ISM model, we can carry out in-depth analysis and hierarchical division of the relationship between factors, so as to construct a directed graph and finalize the ISM model[14]. According to the ISM model rules, we classify factors into reachable set, prior set, and common set. The reachable set is the set of those factors that are influenced by other factors, the prior set is the set of those factors that influence other factors, and the common set is the intersection of the reachable set and the prior set[15]. This step helps to identify the direct and indirect influence relationships between factors. The hierarchy of factors is determined based on the intersection of these sets and the relationship between the factors. In ISM modeling, hierarchy is used to represent the influence relationship, and importance between factors. Factors with the same reachable set and intersection are placed at the top level of the ISM hierarchy because they do not raise other factors above their level. These top-level factors are usually considered to be determinants and have a significant impact on the overall system.

Once the top-level factors have been identified, they will not be considered again and then the same process will be repeated to continue delineating the next level of factors. This process will continue until all factors have been assigned to the appropriate level. This process of stratification helps to build the hierarchical structure of the ISM model so that we can understand the hierarchical relationships between factors more clearly. Subsequently, the interactions between factors can be more fully understood, the main influencing factors can be identified, and the ISM model can be finalized.

According to the above system of risk factors for the construction of the community intelligence platform project, the corresponding ISM hierarchical structure model can be constructed, as shown in Figure 2:

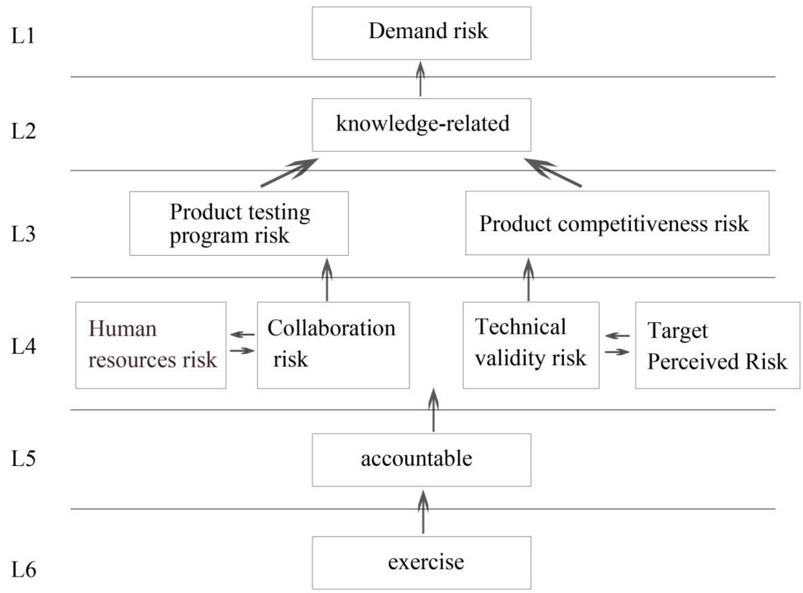


**Fig. 2.** ISM Hierarchy of Construction Risks for Community Intelligence Platform Projects

### 3.4 ISM Model Analysis

Smart community project construction is a complex task accompanied by a variety of potential risk factors. The ISM model of smart community project construction risk is analyzed as follows:

In the ISM model analysis, the above can be categorized into deep, medium, and shallow risks to reflect their importance and level of impact on the project.

(1) Deep Risks

① Requirements Risk - As a core factor in project decision-making, requirements risk is placed at the top level of the ISM model, indicating its decisive impact on the overall project. Requirements risk in smart community projects includes unclear or frequent changes in requirements, which may have far-reaching impacts on project goals and directions.

② Knowledge Risk - The risk of insufficient knowledge or irrational use of knowledge is a deep risk because of its importance in that it can lead to delays or instability in the project schedule.

(2) Mid-level risk

① Product Test Program Risk - The quality and effectiveness of the product test program are directly related to the viability of the project but are not as decisive as the deeper risks.

② Product Competitiveness Risk - The competitiveness risk of the project is related to the competitive environment of the market and may affect the success of the project, but it is at the middle-risk level.

(3) Superficial risk

① Human Resource Risks - related to the execution and management of the project and can affect the progress and success of the project, but usually do not have the same decision-making impact as deeper risks.

②Collaboration Risk - Collaboration risk refers to issues of teamwork and cooperation that affect the management and execution of projects but are at a relatively shallow level of risk.

③Technical validity risk - This risk is related to the technical feasibility of the project and may have an impact on the progress of the project, but is usually less important than the deeper risks.

④ Goal perception risk - The clarity of project goals is a shallow risk that may affect the management and execution of the project.

⑤ Responsible Risk - The decisions and responsibilities of project leadership or management may affect the direction of the entire project, but it is relatively shallow in the risk system.

⑥Power risk - the structure and distribution of power may trigger problems in the decision-making process and resource allocation and is a shallow risk.

### 3.5 Analysis of Results

(1) From the viewpoint of deep risks in the construction of smart communities, the successful construction of smart community projects requires a high degree of attention to the needs of community residents. Demand risks have a key position in the entire project, so the project team should maintain sensitivity to demand and communicate regularly with community residents to ensure the accuracy and stability of the project's direction. Knowledge risk in project construction needs to be fully emphasized, and the project team should have sufficient technical knowledge and industry background to address technical challenges and issues. Knowledge sharing and training programs should be incorporated into project management to improve the overall quality of the team.

(2) In terms of the mid-level risks of smart community construction, the product testing program risk and product competitiveness risk directly affect the feasibility and market competitiveness of the project. Therefore, the project team needs to formulate a perfect testing program to ensure that the quality and performance of the product meet the market standard and pay close attention to the competitive market environment to adjust the product strategy in time.

(3) From the perspective of the shallow risk of smart community construction, the successful construction of a project requires stable human resources, effective collaboration, feasible technical solutions, and clear project goals. Team building, collaboration mechanisms, technology development, and goal management are key aspects of project management that require full attention and input. The leadership of a project is responsible for the risks, and its decision-making and leadership style may have a profound impact on the entire project. Therefore, the leadership should be highly alert to project risks, make wise decisions, and play an active leadership role in the project. For the power risk, the project team needs to establish an effective decision-making mechanism and resource allocation method to ensure the efficient progress of the project and avoid potential risks arising from power allocation issues.

## 4 Conclusion

In the construction of smart community projects, constructing a research system of risk factors is an important ring for the healthy development of smart cities, and the index system constructed in this study provides new ideas for the construction of smart community projects in the future, as well as theoretical guidance, which is conducive to the promotion of the standardization of the construction, management, and evaluation of smart communities. Smart community construction is the inevitable development direction of urban governance in China, and new technologies are emerging to meet the trends of the times in order to meet the needs of today's society. Despite the many difficulties faced in the construction process, it is foreseeable that, as the main development trend of China's urban modernization, promoting the construction of smart communities is an important focus of future urban development.

## References

1. Abdoullaev A. A Smart World: A Development Model for Intelligent Cities ［C］. The 11th IEEE International Conference on Computer and Information Technology ( CIT--2011), 2011
2. Chen L., Chen W. Intelligent City-Tianjin: The System Analysis of Intelligent Community Public Service ［C］. IEEE 18th International Conference on Industrial Engineering and Engineering Management, 2011
3. Liu Jun. Research on the Development Strategy of Smart Community Services[J]. Management Modernization, 2012(6): 46-48.

4. HUANG Chunlin, RONG Yanzhen. Object-oriented intelligent community management and service system construction[J]. Construction Engineering Technology and Design,2017(12): 6102.
5. TIAN Shuicheng, GAO Ling, FAN Binbin, SUN Wen, ZHAO Zhaoying, CAI Xinfu. Evaluation of coal mine emergency management capability based on WSR methodology[J]. Journal of Xi'an University of Science and Technology,2022,42(04):647-654.
6. JI Rongbin, HE Sha, YU Xiaozhong.Enterprise safety production emergency management under the perspective of WSR system methodology[J]. Journal of System Science,2018,26(04):112-117.
7. LIU Changsen, GUO Jianhua, JIN Hao, CHEN Jian. Research on enterprise safety risk control model based on WSR methodology - A case study of "11-22" Sinopec pipeline leakage and explosion accident[J]. Management Review,2017,29(01):265-272.
8. Gao Chang, Zhang Lingling, Xiong Ao, Lu Tao. Comparative Analysis of Domestic and International Research and Future Prospects of WSR Methodology Based on Four-Stage Theory of Scientific Development[J]. Management Review,2021,33(05):15-29.
9. DUAN Yonghui, ZHANG Yue, GUO Yibin, WANG Xiang. Risk evaluation and strategy suggestion of EPC project based on structural equation[J]. Friends of Accounting,2021(02):104-110.
10. Ge Tianren,Pei Linna. Smart community construction and agile governance change in high-risk society[J].Theory and Reform,2020(05):85-96.
11. Chen Li-Wen, Zhang Tian, Zhao Shi-Wen. Research on the risk transmission path of smart community projects based on SNA[J]. Management Modernization,2020,40(01):101-104.
12. MAOZijun,ZHAO Guojie,WANG Haifeng,ZHAO Mofei.A comparative study on the discovery and comparison of three generative paths of WSR methodology[J]. Management Review,2021,33(05):44-56.
13. ZHOU Huan, LIU Jianguo. Research on the WSR model of risk management of port hazardous chemicals logistics[J]. Management Review,2021,33(05):142-151.
14. CHEN Jindong, LIU Linlin, DU Yuxuan, QI Lin, ZHANG Jian. Evolutionary development of physical-matter-human system methodology and its implications[J]. Management Review,2021,33(05):30-43.
15. Xing-Sen Li, Lin Lu, Li-Bo Xu.Comparative analysis of WSR methodology and topology and research on matter-of-fact knowledge mapping model[J]. Management Review, 2021, 33( 5): 152-162.