Social demand response mechanism and optimization path in public building design

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Abstract: Firstly, this paper analyzes the "triple fracture" problems faced by public building design at present, that is, cognitive fragmentation index, insufficient participation in the process and neglect of social performance in evaluation. Then, the paper puts forward the idea of constructing social demand response mechanism, including demand identification mechanism, collaborative design mechanism and dynamic evaluation mechanism, aiming at transforming social demand into operational technical parameters and promoting the transformation of public buildings from functional carriers to social governance tools. Finally, from the aspects of system, technology and management, the paper puts forward optimization paths and practical strategies, such as perfecting the top-level design of demand response, innovating the tools and methods of demand capture, optimizing the organizational process of demand response, etc., in order to realize the benign interaction between public building design and social demand and promote the sustainable development of the city.

1. Introduction

Under the background that the new urbanization rate has exceeded 65%, public buildings are changing from a single functional carrier to a "nerve hub" of the city, and their design logic faces three changes: the transformation from spatial attributes to elastic inclusion, the technical empowerment to reshape the interaction between people and space, and the value-oriented pursuit of spatial justice. However, in reality, the lack of barrier-free facilities leads to the low utilization rate of the elderly and the functional paralysis caused by the lack of emergency space, which reveals that the neglect of social needs is seriously weakening its core value. At present, the design of public buildings faces the structural contradiction of "triple fracture" [1-2]. Cognitive, the design specification is limited to functional partition, and the social demand only stays in the fragmentation index, lacking systematic analysis; In the process, the participation of stakeholders is a mere formality, and it is difficult for user research to touch the deep demands of vulnerable groups such as disabled people and floating population; In evaluation, the post-evaluation system focuses on architectural form and ignores social performance, and subjective indicators such as "spatial satisfaction" account for a low proportion in post-use evaluation, which leads to the lack of data support for optimization, and the overall design system is seriously out of touch with the real needs of society.

2. Construction of social demand response mechanism

As shown in Figure 1, different mechanisms transform social needs into operational technical parameters through systematic methods, and promote the transformation of public buildings from functional carriers to social governance tools. Its core is to establish a multi-scale response system from micro-individual experience to macro-urban development, so that architecture can truly become an intelligent node connecting social needs.

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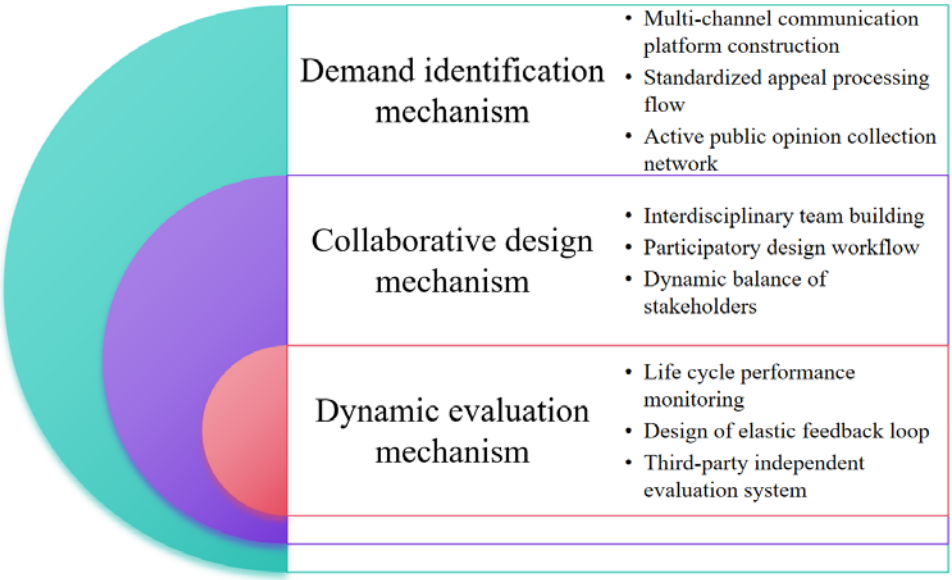

Figure 1 Social demand response mechanism

2.1 Demand identification mechanism

Collect public opinions through the official website message board, hotline, mobile government APP and other digital tools to solve the problem of information asymmetry. At the same time, the offline hearing system and big data analysis system are combined to capture social public opinion hotspots in real time [3]. Carry out the evaluation of people's livelihood satisfaction every quarter, and use data mining technology to accurately locate user demand preferences. Formulate the "Regulations on Handling Public Appeal" to clarify the whole chain operation norms from acceptance to feedback. Use big data monitoring technology to track the focus of social media discussions, and regularly organize community workshops or design salons to invite residents to participate in spatial planning discussions. This dual mode of "passive reception+active detection" can effectively cover hidden needs, such as the pain points in the actual use of barrier-free facilities for special groups.

2.2 Collaborative design mechanism

Collaborative design mechanism breaks down professional barriers by setting up interdisciplinary teams including architects, sociologists, engineers and community representatives, and combines BIM visualization and VR immersive experience to realize the deep participation and feedback of non-professional public on design schemes [4]; At the same time, by constructing the weight distribution model of stakeholders, the game theory algorithm is used to seek a dynamic balance between government supervision, investment cost and public demand. For example, modular prefabricated components are used to give consideration to economy and future scalability, thus promoting the design process to be integrated, democratic and sustainable.

2.3 Dynamic evaluation mechanism

The dynamic evaluation mechanism continuously monitors the usage data of the whole life cycle of the building by deploying the sensor network of the Internet of Things, and uses AI algorithm to analyze the space utilization efficiency, identify peak hours and inefficient areas, and provide data support for operation optimization; At the same time, an elastic feedback loop of "design-implementation-feedback-iteration" is constructed, and the user behavior data is fed back to the design end to realize adaptive control such as automatic adjustment of illumination with reading duration [5]; In addition, by introducing a third-party organization to carry out post-project evaluation, using comparative experiments to evaluate social benefit indicators such as energy consumption and satisfaction, an industry benchmark database is established to promote continuous iteration and optimization of design and operation.

3. Optimization path and practical strategy

3.1 Institutional level——Improve the top-level design and long-term mechanism of demand response

System is the baton to guide the social demand response of public buildings. It is necessary to clarify three core issues: whose demand is responded, how to respond and who will supervise.

3.1.1 Improve the statutory embedding mechanism of social needs

Promote the revision of laws and regulations such as the Urban and Rural Planning Law and the Standards for the Construction of Public Buildings, and incorporate social demand investigation, public participation procedures and fairness evaluation into the legal process [6]. It is stipulated that "life cycle demand analysis" must be carried out for public building projects invested by the government, and the demand response conclusion should be taken as the precondition for scheme approval; For vulnerable groups, the design documents are required to include "inclusive design articles", and the allocation standards of barrier-free facilities and inclusive service spaces are defined [7].

3.1.2 Constructing a dynamically updated demand feedback standard system

Traditional building standards often lag behind social changes. It is necessary to establish a two-tier system of "basic standards+elastic guidance": basic standards remain rigid constraints; Flexible guidelines include emerging needs through regular revision, and encourage local governments to formulate supplementary rules according to regional characteristics.

3.1.3 Strengthen the cooperative governance system of multiple subjects

Break the one-way mode of "government leading-designer implementation" and establish a co-governance platform of "government-users-professional institutions-social organizations" [8]. Require large-scale public building projects to set up a "demand response Committee" to participate in key node decisions from project establishment to acceptance; Clarify the participation role of social organizations through legislation, and trace the responsibility of projects with poor response effect.

3.2 Technical level——Innovative tools and methods for demand capture and accurate transformation

Technology is a bridge between "abstract requirements" and "concrete design". It is necessary to improve the objectivity and operability of demand response through digital tools, scientific analysis methods and interdisciplinary cooperation.

3.2.1 Digital requirements collection and analysis technology

Digital demand collection and analysis technology breaks through the limitations of traditional questionnaire survey by integrating big data and spatial information technology, and realizes accurate capture of users' real behavior patterns [9]. This technology integrates multi-source data, such as mobile phone signaling data, to analyze the temporal and spatial distribution of people flow, social media comments to mine the public's emotional feedback on existing public buildings, and Internet of Things sensors to monitor the actual use frequency of space, so as to identify high-demand areas and use pain points; At the same time, with the help of the integration of BIM and GIS, virtual simulation is carried out to predict the impact of different design schemes on social equity, such as the potential effect of hospital location on the time for remote residents to seek medical treatment or the school layout on the school district housing price; In addition, by developing low-threshold participatory design platforms, such as VR immersive experience and online 3D model annotation system, non-professional public can intuitively express their preferences for spatial form and functional layout. For example, community residents can mark and add children's play areas or elderly activity corners in virtual scenes, thus enhancing the inclusiveness and public participation of design.

3.2.2 Technical integration method of inclusive design

According to the "differentiated needs" (age, ability and cultural background), the technical framework of "universal design+customized adaptation" is established (as shown in Figure 2). Upgrade the barrier-free design from "meeting the minimum standards" to "active and friendly"; For the elderly with cognitive impairment, hearing-impaired groups and visually impaired people, the research results of medicine and psychology are transformed into specific spatial design parameters; Through anthropological field investigation, the regional cultural symbols are transformed into the shared space language of modern public buildings.

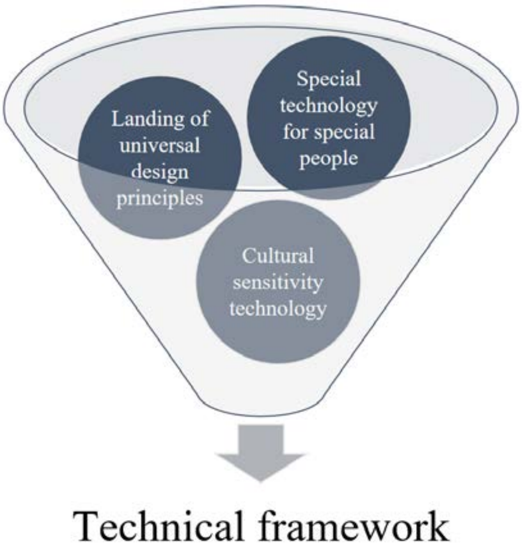

Figure 2 Technical framework of "universal design+customized adaptation"

3.2.3 Life cycle performance evaluation technology

Break through the limitation of "design completion is the end point", and use digital twin technology to dynamically monitor the long-term social benefits of buildings. For example, the use efficiency of public space is tracked in real time by implanting sensors, and the transformation strategy in the operation stage is optimized in reverse by combining the survey data of user satisfaction; At the same time, the evaluation results are fed back to the subsequent project design, forming a closed-loop iteration of "demand response-design implementation-effect feedback".

3.3 Management level——Optimize the organizational process and implementation efficiency of demand response

Management is the "implementation guarantee" for putting the system and technology on the ground, and it needs to ensure that social needs are truly transformed into design results through process reconstruction, capacity improvement and supervision strengthening.

3.3.1 Project management process reengineering driven by demand response

In order to overcome the formalization of demand investigation in the traditional linear process, public building project management needs to turn to the circular mode of "demand pre-design-collaborative design-dynamic calibration" (Figure 3). Conduct in-depth research for 1-3 months before the project is established, and form a Social Needs Analysis Report covering quantitative and qualitative data; Carry out concurrent engineering in the design stage, organize designers, user representatives and operators to participate in the workshop together, and deduce the rapid verification scheme through the model; In the implementation stage, flexible space is reserved, such as flexible partition, which is convenient to transform idle areas into functional spaces such as old-age classrooms according to actual use feedback, and realize full-cycle demand response and dynamic optimization [10].

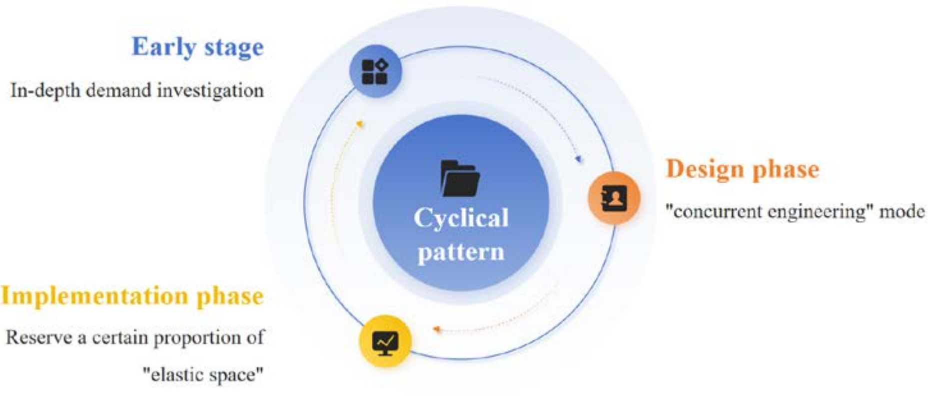

Figure 3 The cycle mode of "requirement pre-design-collaborative design-dynamic calibration"

3.3.2 Cultivation of social design ability of professional team

In order to improve the designer's social design ability, it is necessary to make concerted efforts in education, career and cooperation. Architectural colleges and universities should add courses such as social demand analysis and inclusive design, and combine case teaching with field research to cultivate empathy ability; Carry out the compulsory system of continuing education in professional practice, and incorporate the effect of social design into the qualification examination and award evaluation system; At the same time, architects, sociologists, psychologists and operational experts are encouraged to form interdisciplinary teams, so as to improve the ability to accurately identify and transform users' needs through the integration of multiple knowledge and promote the transformation of design thinking from "technology first" to "social care" [11].

3.3.3 Strengthening the whole process supervision and post-evaluation mechanism

In order to ensure that the demand response of public buildings is not just a "paper commitment", it is necessary to build a whole process supervision and post-evaluation mechanism of "commitment in advance-supervision in the process-evaluation afterwards". In the prior stage, the construction unit shall submit the Commitment Letter on Social Demand Response, which includes quantifiable indicators such as barrier-free facilities coverage and community participation rate, when the project is declared; In the middle stage, the supervision department verifies whether the design unit effectively implements the demand analysis results through on-site inspections and spot checks on public satisfaction; Afterwards, a "post-evaluation of social benefits" will be carried out within one year after the completion of the project, and the third-party organization will make quantitative evaluation from the dimensions of frequency of use, fairness and cultural identity, and link the evaluation results with the fund allocation of subsequent projects and the credit rating of design units, and impose bidding restrictions on teams with poor response, thus forming closed-loop management and strengthening responsibility implementation and continuous improvement.

4. Conclusion

At present, there are three structural contradictions in the design of public buildings, including cognitive fragmentation, formalism in the process and insufficient data support in the evaluation system. In view of these problems, this study puts forward the construction and optimization path of social demand response mechanism, covering three levels: system, technology and management, aiming at promoting the transformation of public buildings from functional carriers to social governance tools. Research shows that the establishment of a multi-scale response system from micro-individual experience to macro-urban development can effectively cover hidden needs, such as the actual use pain points of barrier-free facilities for special groups. At the same time, continuous iteration and optimization of design and operation are realized through dynamic evaluation mechanism and full life cycle performance evaluation technology. Finally, through the synergy of system, technology and management, public building design will better meet the social needs and enhance its core value as a "nerve hub" of the city.

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