

Revitalizing Industrial Heritage from the Perspective of Social Capital: A Case Study of Baotou Sugar Refinery

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Abstract:

Urban industrial heritage revitalization has long focused on architectural renovation techniques and functional implantation models, with insufficient attention paid to social dimensions such as social network repair, community trust cultivation, and local identity shaping. This paper introduces social capital theory and constructs a “structural-relational-cognitive” three-dimensional analytical framework to explore socially-oriented design strategies for industrial heritage revitalization. Taking the Baotou Sugar Refinery in Inner Mongolia as a case study, systematic investigation and diagnosis reveal the triple dilemmas it faces: structural fragmentation, trust loosening, and memory loss. Accordingly, a multi-level revitalization strategy system is proposed: focusing on network repair at the overall structural level, trust cultivation at the district relational level, and identity shaping at the node cognitive level. The study argues that social capital theory provides an explanatory framework for industrial heritage revitalization that transcends mere physical renewal. Its core lies in reconstructing the “trust-based connections” between people and place, among individuals, and between people and community through spatial design, thereby achieving a paradigm shift from physical renewal to social regeneration and from spatial production to relational production.

Keywords:

Social Capital Theory, Industrial Heritage, Design For Revitalization, Baotou Sugar Refinery, Participatory Design

1. Introduction

As historical testimonies of the industrialization process and stock spatial resources, the adaptive reuse of urban industrial heritage has become a critical issue in urban regeneration [8]. Since the promulgation of the Nizhny Tagil Charter in 2003, the conservation and revitalization of industrial heritage have gained widespread attention globally [11]. In China, since the 13th Five-Year Plan period, the protection and utilization of industrial heritage have also been integrated into the urban regeneration strategy, with a number of landmark projects emerging successively, such as Beijing Shougang Park, Shanghai Yangpu Riverside, and Chengdu Eastern Suburb Memory [10].

However, a review of existing research reveals a prevalent issue: current achievements predominantly focus on architectural renovation techniques, functional program implantation, or cultural tourism development models, exhibiting a distinct “spatial bias” and “technological orientation”—structural reinforcement, facade renovation, and functional replacement have become the focal points of discussion, while social dimensions such as social network repair, community trust cultivation, and local identity shaping in the revitalization process receive insufficient attention [8,9]. From the perspective of bibliometric analysis, the theoretical resources and knowledge base of existing research are primarily concentrated within the field of “industrial heritage studies,” with limited integration with other disciplines, and a systematic social theory framework has yet to be established [5,8].

This state of “technological divergence” has engendered numerous problems at the practical level: while the success of Beijing’s 798 Art District has captured global attention, its surrounding communities have not benefited accordingly; an invisible wall stands between the prosperity of the art district and the daily lives of the original residents [10]. In Shanghai’s Tianzifang, under the impact of tourism and commerce, the living space of indigenous residents has been compressed, and community identity faces dissolution [18]. Although Chengdu’s Eastern Suburb Memory has achieved functional transformation, research indicates issues such as weak mutual synergy, insufficient promotion efforts, and poor spatial integration [10]. These phenomena reveal a deeper problem: physical renewal can create “usable space,” but it does not necessarily create “space that belongs to the community” [18].

The revitalization of industrial heritage cannot stop at architectural renovation and program implantation; it must respond to the profound inquiries of “for whom is the space intended” and “how can the space be sustained” [14]. The former pertains to spatial justice—whom does the revitalized space ultimately serve? Are the memories of former workers respected? Are the needs of surrounding residents incorporated into the design? The latter concerns the temporal dimension—how can the vitality of the space be sustained? Can the community become co-stewards of the space? This is precisely the domain where social capital theory can intervene [3].

Social capital theory emphasizes the crucial role of trust, norms, and networks for community cooperation and social efficiency. Its “structural-relational-cognitive” three-dimensional framework precisely corresponds to the three core propositions in industrial heritage revitalization: spatial network repair, community trust cultivation, and local identity shaping [3][4]. This paper takes the Baotou Sugar Refinery in Inner Mongolia as a case study to explore design strategies and methods for industrial heritage revitalization from the perspective of social capital [20].

2. The Three-Dimensional Connotation of Social Capital and Its Architectural Translation

2.1. The Structural Dimension and Its Architectural Translation

Social capital theory was pioneered by French sociologist Pierre Bourdieu, who, from the perspective of individual resources, defined social capital as the aggregate of actual or potential resources that an individual can access through institutionalized social networks [1]. American scholar James Coleman expanded the theory from a functionalist perspective, emphasizing that social capital exists within social structures and facilitates actions for individuals pursuing specific objectives [2].

Through a two-decade comparative study of different regions in Italy, Robert Putnam completed the theoretical shift from the individual level to the collective level, defining social capital as “features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions” [3], thereby establishing three analytical levels: macro, meso, and micro [4].

Building on this foundation, the academic community further refined the “structural-relational-cognitive” three-dimensional framework [3,4,6]. Structural social capital refers to social networks, organizational associations, and institutional frameworks; relational social capital refers to trust relationships, norms of reciprocity, and interpersonal interactions; cognitive social capital refers to shared values, local identity, and collective memory [5]. These three dimensions are interdependent and synergistic—networks provide the setting for cultivating trust, trust provides the impetus for adhering to norms, and norms provide the guarantee for maintaining networks [7].

Introducing this framework into the study of industrial heritage revitalization requires a deep translation from sociological concepts to the language of architecture [9]:

Structural social capital in industrial heritage revitalization is manifested in the accessibility of transportation networks, the interconnectivity of functional spaces, and the collaborative networks of multiple stakeholders [8]. It addresses the question of “can people come?”—Is the space accessible? Are functions interconnected? Are organizations connected? The restoration of structural capital means breaking the boundaries long formed by industrial heritage, re-embedding it into the urban spatial network and social network [10].

2.2. The Relational Dimension and Its Architectural Translation

Relational social capital in revitalization design is manifested in neighborhood interactions promoted by public spaces, trust relationships accumulated through community participation, and reciprocal behaviors cultivated by shared facilities [9]. It addresses the question of “are people willing to stay?”—Does the space facilitate interaction? Can interaction accumulate trust? Can trust lead to reciprocity? Activating relational capital requires providing spatial carriers for daily interactions, participation channels for collective action, and settings for reciprocal behaviors [27].

2.3. The Cognitive Dimension and Its Architectural Translation

Cognitive social capital in heritage revitalization is manifested in the respect for and presentation of industrial history, the extraction and dissemination of cultural symbols, and the continuation and innovation of local spirit [16]. It addresses the question of “do people identify?”—Is memory respected? Is culture perceived? Is spirit continued? Shaping cognitive capital requires preserving the physical carriers of memory, transforming the symbolic language of culture, and activating the narrative expression of history [15,19].

The three dimensions progress layer by layer: the structural dimension is the foundation—without physical connection, subsequent social interactions cannot unfold [17]; the relational dimension is the key—only by activating interpersonal interactions can space truly come alive [18]; the cognitive dimension is the soul—only when people establish emotional connections with place does revitalization gain

lasting vitality [15]. This framework provides a systematic analytical tool and design guidance for integrating social dimensions into industrial heritage revitalization [8][9].

3. Case Diagnosis: A Three-Dimensional Analysis of Social Capital at Baotou Sugar Refinery

The Baotou Sugar Refinery, established in 1952, was a key national construction project during the First Five-Year Plan period and the earliest modern sugar refinery in Inner Mongolia Autonomous Region [24,25]. The plant covers an area of approximately 24 hectares, preserving building clusters including the sugar production workshop (1952), power workshop (1950s), Office Building No. 1 (1950s), raw material warehouse, and staff canteen, along with industrial remains such as core production equipment and a dedicated railway line [22]. Leveraging the surrounding beet cultivation advantages, the refinery once made significant contributions to sugar supply in North China, carrying the industrial memories of several generations in Baotou [24]. Following industrial upgrading, the old plant faced closure and relocation. In 2024, Baotou City proposed the construction of a “Baotou Industrial Expo Park” on the original site, making its conservation and revitalization a focus for local government and academia [23].

This study employs the three-dimensional framework to conduct systematic research on the refinery and its surrounding communities, diagnosing the loss of social capital through methods including in-depth interviews, participant observation, and spatial analysis [20].

3.1. The Structural Dimension: Network Fragmentation

The plant is surrounded by complete physical walls, approximately 2.5-3 meters high, creating physical isolation from neighboring communities. Only three entrances and exits exist, with the eastern entrance leading to the community remaining closed year-round. Internal roads within the plant are completely disconnected from the urban road network, blocking urban roads that could otherwise provide through access [20]. The functions are singular and have long been idle, creating a stark contrast with the public service needs of surrounding communities—there is a lack of public cultural spaces, community commercial formats are monotonous, and public green spaces are scarce [22]. Management authority is singular, with community organizations having no right to intervene, and a multi-stakeholder collaborative network is completely absent [10]. The structural social capital exhibits a state of “fragmentation,” representing the primary obstacle to revitalization [8]. (Figure 1, Figure 2)

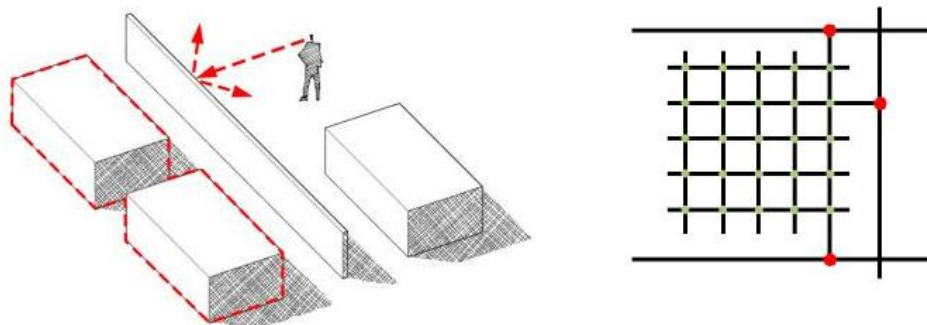


Figure 1. Research analysis chart.



Figure 2. *Functional Analysis Diagram.*

3.2. The Relational Dimension: Trust Loosening

The community to the east is the former staff and workers' family quarters of the refinery, with 40% of residents being retired employees or their family members. The population is markedly aging, with those over 60 accounting for more than 30% [20]. Certain informal connections persist among the former worker community—retirees of the same age gather regularly for meals, maintain communication through WeChat groups, and visit each other during festivals—but these connections are gradually weakening over time [9]. Trust levels between long-term and newer residents within the community are relatively low. Residents know little about the revitalization project and adopt a wait-and-see attitude. Traditional community reciprocity practices—such as elderly neighbors looking after each other's children, sharing vegetables, and mutual care—persist mainly among the elderly, with low participation from the younger generation [18]. The relational social capital exhibits a state of “loosening,” urgently requiring activation and cultivation [27].

3.3. The Cognitive Dimension: Memory Loss

The architectural heritage within the plant is generally well-preserved. The sugar production workshop retains core equipment including presses, evaporators, and crystallizers; some equipment bears Russian inscriptions, witnessing the historical context of Sino-Soviet cooperation [22]. However, collective memory mainly resides in the minds of former workers—they remember the roar of machinery in the workshop, the laughter and conversation in the canteen, the waiting under the big trees—but these memories lack systematic recording and organization [16]. The middle-aged generation has blur memories, while the younger generation has almost no awareness, having “heard of it but not knowing what it specifically was”; intergenerational identity fault has already formed [21]. Cultural symbols such as factory badge, slogans, and old photographs have yet to be systematically excavated and transformed [13]. The cognitive social capital exhibits a state of “loss,” urgently requiring salvage conservation and creative transformation [15,19].

These three dilemmas interact and mutually reinforce each other: network fragmentation exacerbates trust loosening—residents do not enter the plant, naturally failing to establish emotional connections [8]; trust loosening accelerates memory

loss—lacking sustained community interaction, the transmission of collective memory loses its carrier [9]; memory loss, in turn, deprives network repair of social impetus—without the support of local identity, even if physical boundaries are opened, people may not truly “enter” the plant [15]. This provides clear problem orientation for subsequent revitalization strategies [20].

4. Strategy System: Revitalization Design Based on the Three-Dimensional Framework

In response to the above diagnosis, this study proposes a revitalization strategy system based on the three-dimensional framework of social capital, with the three dimensions progressing layer by layer and mutually supporting each other [20]. (Figure 3)



Figure 3. Master Plan.

4.1. The Overall Structural Level: Network Repair

With “network repair” as the core, this level addresses the fundamental question of “can people come” [8]. Transportation Network Remediation: Partially demolish walls on the eastern and northern sides and add three new community entrances, allowing residents’ daily life trajectories to naturally extend into the plant area. Transform the original dedicated railway line into a community slow-trail path, connecting the plant area with community public spaces to form a continuous interaction network [20]. Optimize bus stop layouts to enhance public transportation accessibility [17]. Functional Space Weaving: Based on a diagnosis of surrounding community needs—lack of cultural spaces, insufficient community services, absence of public green spaces [22]—transform the sugar production workshop into an industrial museum, the power workshop into a community cultural center, the raw material warehouse into a creative market, and the staff canteen into a community canteen. This forms a functionally composite district integrating “museum-culture-commerce-services,” creating complementary relationships with surrounding community functions [10]. Multi-Stakeholder Collaboration: Establish a “Community Co-construction Council” involving government departments, community organizations, former worker representatives, market entities, and expert teams. Create an institutionalized platform for consultation, clarifying the rights and responsibility boundaries of each party—the government provides policy support, market entities are responsible for operation, community organizations participate in supervision, and former worker groups serve as cultural advisors [28]—thereby

achieving structural connectivity among multiple stakeholders at the organizational level [6].



Figure 4. Bird's-eye view.

4.2. The District Relational Level: Trust Cultivation

With “trust cultivation” as the core, this level addresses the key question of “are people willing to stay” [9]. **Public Space System Creation:** Construct a three-tier public space system centered around the original plant's central square, with pocket gardens as nodes and slow-trail paths as the connecting vein [17]. Preserve the original industrial pavement and some equipment in the central square, add rest facilities and shaded pergolas, serving as the main venue for community gatherings and festival activities [18]. Utilize vacant spaces between buildings to implant micro-spaces such as pocket gardens, children's play areas, and fitness corners [27]. Set up rest nodes along the slow-trail paths. Enhance the interaction-friendliness of spaces through design elements such as scale control, rest facilities, shading and weather protection, and nighttime lighting [18]. **Shared Facility Implantation:** Establish community gardens for residents to adopt and cultivate, fostering division of labor, cooperation, and mutual aid traditions through use [27]. Shared workshops provide spaces for handicrafts like woodworking and pottery, where users need to negotiate usage rules and coordinate schedules, cultivating public spirit through negotiation [29]. **Neighborhood service stations** provide convenience services and meeting spaces, recruiting volunteers for rotating shifts, accumulating community trust through service [30]. The community canteen prioritizes hiring community residents, becoming a place for daily encounters [9]. **Participatory Activity Programming:** Organize a monthly “Sugar Refinery Market,” inviting former workers to sell agricultural products and handicrafts, encouraging residents to exchange idle items. Hold quarterly “Sugar Refinery Storytelling Sessions”, inviting veteran workers to recount workshop years, love stories within the factory, and memories from the day of closure [16]. Annually host a “Sugar Refinery Cultural Festival”, combining experience activities with the beet harvest season [21]. Through regular activities, enable residents to accumulate trust in sustained interactions [26].



Figure 5. Creative market.

4.3. The Node Cognitive Level: Identity Shaping

With “identity shaping” as the core, this level addresses the fundamental question of “do people identify” [15]. Authentic Preservation of Memory Anchors: Renovate and preserve historical buildings such as Office Building No. 1, retaining original features like facades, doors, windows, and staircases, adhering to the principle of “minimal intervention” [22]. Conduct in-situ preservation of core production equipment in the sugar workshop, maintaining the spatial relationship between equipment and building, enabling visitors to understand the production process [20]. Reinforce and renovate iconic structures like the large chimney and sugar conveying gallery, preserving “age value” such as production traces and slogans on the walls [16]. Creative Transformation of Cultural Symbols: Extract elements such as beet forms, sugar crystal structures, and mechanical aesthetics, transforming them into visual identity systems, environmental artworks, and cultural creative products [21]. Convert industrial components like original pipes and valves into environmental artworks such as seating and lighting fixtures [13]. Develop “Baotou Sugar” brand cultural products—notebooks, postcards, canvas bags, replica badges of the original factory badge—bringing industrial culture into daily life [23]. Narrative Activation of Historical Stories: Establish a permanent exhibition “Beet·Sweetness·Sweet City” in the sugar workshop, systematically presenting the refinery’s story through old photographs, artifacts, oral histories, and video materials [16]. Install interpretive signs and QR code guides linking key historical nodes [19]. Transform former worker changing rooms into “memory spaces” solicit and exhibiting personal items [21]. Cultivate “little docents,” enabling children to transform from listeners to narrators [15].

Systematic Cultivation of Local IP: Develop cultural products under the “Baotou Sugar” brand, collaborate with local cultural tourism enterprises to develop “industrial study tour” routes, and plan science education courses on “The Life of Beets,” endowing industrial memory with sustained vitality [23]. Integrate the refinery into the city’s cultural tourism network, developing themed routes like “Industrial Memory Journey,” connecting industrial heritage sites such as Baotou Sugar Refinery, Baotou Steel, and “Baotou Cotton 1958” to create scale effects [20].



Figure 6. Participatory design information board.

The three dimensions joint efforts: structural repair provides the material prerequisite for interaction [8]; relational cultivation enables spaces to be accepted and used by the community [9]; cognitive shaping endows spaces with enduring meaning [15]. Together, they point to the systematic restoration and incremental cultivation of social capital [6].

5. Conclusion and Discussion: Towards Social Regeneration of Industrial Heritage

This study introduces social capital theory into the field of industrial heritage revitalization, constructs a three-dimensional analytical framework of “structural-relational-cognitive,” and systematically applies it through design in the case study of Baotou Sugar Refinery [20]. The research draws the following core conclusions:

5.1. From Physical Renewal to Social Regeneration

First, industrial heritage revitalization should progress from “physical renewal” to “social regeneration” [8]. Physical renewal addresses the issue of “space usability”—enabling abandoned industrial buildings to accommodate new functions through engineering and technical means [10]; social regeneration responds to the deeper inquiries of “for whom is the space intended” and “how can the space be sustained” [14]—focusing on spatial justice and dynamic sustainability [18]. Physical renewal is the foundation—without safe buildings and a pleasant environment, all social objectives have no basis for attachment [17]; however, physical renewal cannot replace social regeneration—the former solves the problem of the “shell,” while the latter solves the problem of the “core” [15]. Genuine industrial heritage revitalization should take physical renewal as the means and social regeneration as the goal, activating social capital through spatial transformation and ensuring spatial sustainability through the value-added of social capital [6].

5.2. From Spatial Production to Relational Production

Second, industrial heritage revitalization should progress from “spatial production” to “relational production” [14]. Industrial heritage revitalization encompasses two interrelated levels: the reconstruction of physical space and the reorganize of social relationships [10]. Lefebvre warns that when spatial production is detached from the reproduction of social relations, space alienation into a tool of domination or a spectacle of consumption, rather than a place of lived experience [14]. Spatial design should create conditions for the repair of social networks, the cultivation of trust relationships, and the shaping of identity consciousness [8]—becoming spaces that can promote social interaction [18], spaces that can cultivate reciprocal trust [7], spaces that can carry collective memory [16], and spaces that can stimulate local identity [19]. From spatial production to relational production, industrial heritage revitalization elevates from a spatial renovation project to a social experiment in the regeneration of social relationships [9].

5.3. Institutional Guarantees and Participatory Design Synergy

Third, the activation of social capital requires the synergistic support of institutional guarantees and participatory design [6]. At the planning level, community service functions should be established as “standard configuration” for revitalization projects—public cultural spaces, community service facilities, shared activity spaces, public open spaces, etc. [10], ensuring that public interests are not eroded by commercial logic [11]. At the operational level, a multi-stakeholder co-governance mechanism should be established—a community co-construction council [28], diversified participation channels [26], clear allocation of rights and responsibilities [27], reasonable income distribution [30], and regular conflict mediation [29]—safeguarding the community's right to participate and benefit. Throughout the entire

process, the four-stage progressive path of participatory design—"investigation-design-implementation-operation"—should be run through [26], enabling residents to grow from "informed persons" to "advisors," "constructors," and ultimately "governors" [29], achieving the accumulation and regeneration of social capital through sustained participation [30]. Participation in the investigation stage cultivates cognitive capital—activating collective memory through storytelling and listening [16]; participation in the design stage cultivates structural capital—establishing collaborative networks through negotiation and decision-making [8]; participation in the implementation stage cultivates relational capital—accumulating trust and reciprocity through common labor [27]; participation in the operation stage achieves the comprehensive regeneration of all three types of capital—strengthening networks, deepening trust, and transmitting identity through sustained co-governance [30].

The core of industrial heritage revitalization from the perspective of social capital lies in reconstructing the "trust-based connections" between people and place, among individuals, and between people and community through spatial design [7], transforming industrial heritage from "relics of the past" into "living culture" [15], and returning it from "consumption space" to "living place" [18]. This is precisely the direction that industrial heritage revitalization should pursue in the era of stock renewal [8]. Of course, this study still has limitations: social capital measurement lacks quantitative tools [5]; design strategies have not yet undergone implementation verification [20]; the exploration of multi-stakeholder interaction mechanisms is insufficiently thoroughly [10]. Future research could develop social capital assessment indicator systems applicable to industrial heritage [6], conduct follow-up studies on case implementation [11], deepen the analysis of multi-stakeholder interaction mechanisms [28], expand comparative research perspectives [9], and explore the application of digital technologies in social capital cultivation [13], collectively promoting industrial heritage revitalization from physical renewal to social regeneration [8].

Conflicts of Interest

The author declares that there are no conflicts of interest related to the publication of this article.

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