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Revitalizing industrial heritage: participatory reuse of Zitomlin silos in Belgrade

Revitalização do património industrial: reutilização participativa dos silos Zitomlin, em Belgrado

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Abstract

Post-industrialization is a turning point that revealed the heritage value of industrial buildings belong to the "industrialization period" that had lost their function. The variety of industrial heritage buildings and prevailing architectural paradigms has led to an increase in reuse techniques. Furthermore, within a particular context, reuse has resulted in the creation of distinct meanings. Various application examples have resulted in innovative, inventive, and unconventional experimental implementations carried out as labs, like silos. The study highlights the significance of engaging users in transforming the silos' former industrial role into a cultural hub that aligns with public and social needs, particularly in developing countries like Serbia. As an example of the adaptive reuse movement, the "Silosi Beograd" demonstrates how participatory design and production methods can address contemporary social and cultural demands while preserving historical identity. By connecting the past with the present, the study proposes a sustainable framework for guiding similar initiatives.

KEYWORDS
Adaptive reuse
Silos
Cultural identity
Social sustainability
User-participation

Resumo

A pós-industrialização é um ponto de viragem que revelou o valor patrimonial dos edifícios industriais pertencentes ao "período da industrialização" que perderam a sua função. A variedade de edifícios patrimoniais industriais e os paradigmas arquitetónicos predominantes aumentaram as técnicas de reutilização. Além disso, num contexto específico, a reutilização criou interpretações distintas. Vários exemplos resultaram em implementações experimentais inovadoras, inventivas e não convencionais, como os silos. O estudo destaca a importância de envolver os utilizadores na transformação da antiga função industrial dos silos num centro cultural que se alinhe com as necessidades públicas e sociais, particularmente em países em desenvolvimento como a Sérvia. Como exemplo do movimento de reutilização adaptativa, o "Silosi Beograd" demonstra como os métodos participativos de design e produção podem responder às exigências sociais e culturais contemporâneas, preservando simultaneamente a identidade histórica. Ao ligar o passado ao presente, o estudo propõe um quadro sustentável para orientar iniciativas semelhantes.

PALAVRAS-CHAVE
Reutilização adaptativa
Silos
Identidade cultural
Sustentabilidade social
Participação do utilizador

Introduction

In the post-industrialization period, new technologies often lead to the establishment of new industries and the closure of older ones. Abandoned industrial structures hold historical, social, and architectural significance, forming part of our industrial heritage that should be preserved for future generations. In particular, silos have been symbols of the mechanisms of the production system. Originally constructed for storing things, silos have been creatively turned into residences, social centers, and cultural spaces [1]. This change is especially visible in cities like Buffalo, Chicago, and Cape Town, where historical values are kept alive and silos serve as powerful reminders of the past [2].

This study examines Serbia's efforts to revitalize "Zitomlin" silos into "Silosi Beograd" while transforming its industrial and commercial identity into a cultural one. As the capital of a developing country, Belgrade's growing tourist appeal and developing economy make it an ideal location for preserving and reevaluating industrial heritage as a means of reflecting cultural identity. Particularly from the perspective of developing nations, this research aims to explore how such transformations align with changing public values and socio-cultural identities. Furthermore, the reuse of the industrial heritage site depends largely on viewing the study through the lens of participatory design and production techniques. At every stage of the process, community members, designers, and other participants are involved. This collaborative approach not only ensures that the design reflects local needs and values but also empowers communities to take ownership of the transformation process. They generate these structures in places that are significant to communities and bridge the gap between the past and the future.

The objective of this research is to investigate how to repurpose silo structures as industrial heritage sites using participatory design and production methods. The potential for the sustained growth of this approach is examined using Iverson and Dindler's four forms of sustainability: maintaining, scaling, replicating, and evolving [3]. For this approach to be properly assessed and contextualized, data obtained from interviews with users of the "Silosi Beograd" structure are analyzed to identify the presence of four types of user participation – doing, adapting, making, and creating [4] – as indicators of an existing framework that supports the continuity of the participatory process approach. Then, the results are examined through these sustainability lenses to come up with an overall strategy to encourage the long-term use of these industrial heritage sites.

This study aims to explore long-term, user-centered strategies for transforming iconic industrial structures like silos, as demonstrated by the "Silosi Beograd" case, showing how such methods can help developing countries adapt their identities to today's social and cultural needs.

Revitalizing industrial heritage in the post-industrial era

The Industrial Revolution had a major impact on port cities, which were important hubs in global trade networks. Because of increased economic activity and advances in technology, these cities had to construct additional structures to meet the needs of new manufacturing and storage operations [5]. Large-scale, mechanized operations such as the construction of silos, tank farms, and warehouses were initiated, along with the development of new port extensions [6].

However, as economic models shifted and industrial activities decentralized, many once-vital buildings like silos and warehouses gradually lost their primary functions. This change marked the start of a period of transition in which these structures became less beneficial.

Following that, in the post-industrialization period, advances in transport, shifts in global trade, and new storage methods rendered many of these structures obsolete, until

contemporary urban redevelopment restored them in alternative ways. The modification of these storage structures is part of a broader urban development trend that aims to improve the appearance of waterfronts by transforming abandoned docks and industrial sites into new ones. This plays a significant role in port city revitalization [7-11]. By blending the historical and architectural importance of these sites with modern city life and making sure they still benefit the community, this reuse of old industrial buildings helps keep the cultural identity of the city.

Participation for sustainable adaptive reuse

Adaptive reuse of historic industrial structures plays a crucial role in balancing the preservation of cultural and communal significance with ensuring their ongoing functionality. The preservation of industrial heritage has gained increasing international attention, particularly within the framework of heritage conservation charters and specialized organizations. The ICOMOS Burra Charter [12] emphasizes that heritage sites should be conserved in ways that respect their historical significance while allowing for adaptive reuse. Within this framework, the International Committee for the Conservation of Industrial Heritage (TICCIH) plays a central role by advocating for the protection and revitalization of industrial sites. As a key advisory body to ICOMOS, TICCIH contributes expert guidance to UNESCO World Heritage nominations, ensuring that proposals align with the foundational principles of the Venice Charter.

Complementing these efforts, the Nizhny Tagil Charter and the Dublin Charter [13] serve as significant initiatives specifically focused on industrial heritage. These charters underscore the importance of interpreting industrial sites within their broader social, cultural, and historical contexts. They highlight the role of such sites in sustaining collective memory and community identity and provide concrete frameworks for their conservation and reintegration into contemporary urban and social life [14]. Together, these charters and institutional collaborations underscore the critical importance of safeguarding industrial heritage not only as physical remnants of the past, but as active components of cultural continuity and social engagement.

Redevelopment of port areas leverages strategic locations to create citizen-friendly, socially sustainable spaces, fostering inclusivity and community engagement [15]. In this changing framework, the definition of heritage includes a sustainability aspect as well. This makes it necessary to rethink how heritage conservation efforts can be in line with sustainable development [16].

A critical yet often overlooked dimension of this process is the role of heritage sites in preserving collective memory and cultural identity. Industrial and port-related heritage sites are deeply embedded in the historical narratives of local communities; they serve as spatial anchors for shared experiences, labor histories, and socio-economic transformations. When these spaces are erased or redeveloped without consideration of their cultural meanings, communities risk losing vital connections to their past. Conversely, adaptive reuse strategies that integrate elements of memory, storytelling, and public engagement can reinforce a community's sense of belonging and continuity.

Thus, heritage conservation in post-industrial urban areas should not only be seen as a tool for physical or economic revitalization, but also as a social practice that sustains intergenerational memory. Preserving the material traces of the past, such as silos, warehouses, or port structures, becomes a way to reframe these spaces as living parts of the city's collective narrative – spaces that can educate, inspire, and foster identity in the context of rapid urban change. This perspective supports a more holistic approach to sustainability, in which cultural continuity is considered as essential as environmental or economic resilience.

Effective public participation in production and managing industrial heritage sites enhances their long-term relevance and sustainability by promoting more profound engagement with historical and communal values. This participatory approach fosters ownership, strengthens social cohesion, and activates users as collaborative partners in site

transformation, rather than passive observers [3]. In turn, this inclusive model reinforces adaptive reuse strategies and contributes to more equitable, resilient, and socially grounded urban environments.

From mechanical production to intuitive use: the transformation of silos

The transformation of the mechanical infrastructures of port cities, including silos and warehouses, into social spaces represents a shift in urban redevelopment. Historically, silos stored plant feed, grain, or cement, enabling large-scale trade and contributing to port city growth. These buildings eventually became symbols of their industrial past. These silos were some of the first to use reinforced concrete technology, which was a big step forward for building things in both agriculture and industry all over Europe, as Giuliani et al. points out [17]. These "mechanical miracles" are still important parts of the cityscapes that they help define the skyline [1], even though they are not functioning as storage anymore.

The "incredible mountain-like" grain elevators of Buffalo and Chicago, famously described by architect E. Mendelsohn in the early twentieth century, underscore the considerable urban planning and architectural value of these structures [18]. Since the early 2000s, there has been a discernible movement towards community-led reuse of industrial heritage sites, including abandoned port areas in Europe and America. This "grassroots" approach – rooted in the active involvement of ordinary people at the local level – represents a "bottom-up" process in which initiatives originate within communities and work upward to influence broader urban redevelopment strategies, policies, and social norms [19]. By challenging traditional top-down commercial redevelopment methods, it critiques capitalist economics and the privatization of public spaces, while fostering genuine and enduring connections between communities and their environments [19-22]. Furthermore, this bottom-up mode of engagement offers an alternative to approaches dominated solely by expert control, instead promoting a model in which expert guidance actively supports and facilitates the inclusion of users in the planning and production processes, enabling local stakeholders to play a decisive role in redefining the functions and meanings of these heritage sites [23].

One of the earliest notable examples of silo reuse involved the transformation of a Barcelona cement factory into a corporate headquarters named La Fabrica (Figure 1). More recent adaptations have repurposed grain elevators into student housing and residences, such as the 1961 silo in Fuentes de Andalucia, Spain, which was converted into a cultural facility [17]. While both individual initiatives and public funding have driven conventional redevelopment efforts, local community-based reuse plays a crucial role in fostering social significance and acting as a catalyst for regeneration, compared to conventional adaptive reuse practices [24].

The concept of adaptive reuse is increasingly coming to the forefront as a means to redefine buildings with symbolic significance but no current function, facilitating their engagement with potential users. Silos, as vertical industrial structures, not only exemplify monumental or symbolic figures but are also showing how they can be reintegrated through new uses. In this context, participatory design methods are gaining traction as a viable methodology for reinvigorating such structures, reflecting a growing emphasis on collaborative approaches in heritage sites.

Figure 1. Adaptive Reused Barcelona Cement Factory as La Fabrica: *a)* exterior; *b)* interior (photo: Kristina Avdeeva) [25].

Reproduction of new values for silos through participatory design

Sustaining social value is essential to mitigating gentrification, the socio-economic transformation that can displace existing communities and lead to monopolization by specific groups [26]. Cizler highlights the role of civil initiatives in countering gentrification [27]; however, paradoxically, these well-intentioned efforts may unintentionally accelerate it by increasing the social and economic attractiveness of an area. The adaptive reuse of industrial sites – initially driven by political and critical motivations aimed at challenging dominant urban development models and reclaiming underused spaces [15] – has expanded beyond these goals to emphasize social and functional revitalization. The transformation of the Franciszek Ramisch factory in Łódź by Fabrykancka (Figure 2b) – a collective of artists and students – exemplifies this shift, using art as a means of fostering community engagement and strengthening local identity through exhibitions, concerts, and workshops inviting residents to shape the site's cultural life. However, while enriching social value, it inadvertently contributed to gentrification, displacing the original initiators as the area was transformed into a tourism-oriented market space. Plevoets and Sowińska-Heim [24] highlight the need for sustainable social value in such projects to mitigate displacement. Similarly, Amsterdam's NDSM-Werf (Figure 2a) has seen its former shipyards revived by an artist community via low-cost upkeep, modest renovations, and affordable rentals, reinforcing the delicate balance between revitalization and retaining the social fabric.

Figure 2. Vernacular adaptive reuse of industrial heritage sites: *a)* NDSM-Werf (Photo: Alf van Beem); *b)* Franciszek Ramisch Factory (photo: Autorstwa Zorro2212) [28-29].

An example in Mostar, Bosnia and Herzegovina demonstrates a commitment to social sustainability with a project involving 24 silos of Zipotromet Factory (Figure 3) with participatory activities engaging diverse community groups. Martinović and Ifko note that the project combined heritage preservation with creative community use by organizing cultural programs, art workshops, and open public discussions, transforming the silos into a focal point for post-conflict urban regeneration [15]. Another example is the reuse of Buffalo's early grain elevators, now known as Silo City (Figure 3), which are actively used by the local community for cultural events, public gatherings, and artistic projects. They operate outside traditional markets, often without major funding. Unlike mainstream preservation projects, Silo City's privately owned model does not prioritize inclusion in local or national registry listings. Instead, a diverse group carries out significant projects without relying on traditional preservation funding. This approach is characterized by cost-effective, community-led restoration efforts and "flexible outcomes" – results that are not rigidly predetermined but evolve over time in response to community needs – prioritizing public arts and cultural events over permanent modifications aimed at generating higher revenue.

A similar focus on community connection and cultural value can be seen in Montreal's New Harbour-front initiative, which rehabilitates five Port of Montreal properties (Figure 3b), including Silo No. 5 [1]. In this project, activities such as architectural tours and a dedicated website are used not primarily for tourism, but as tools to increase public awareness of the site's history and significance [16]. By framing these activities as educational and cultural experiences, the project avoids the pitfalls of tourism-driven gentrification and instead strengthens the link between heritage, community engagement, and inclusive public access. This approach shows how adaptive reuse can bridge the historical identity of port structures with new, socially sustainable uses.

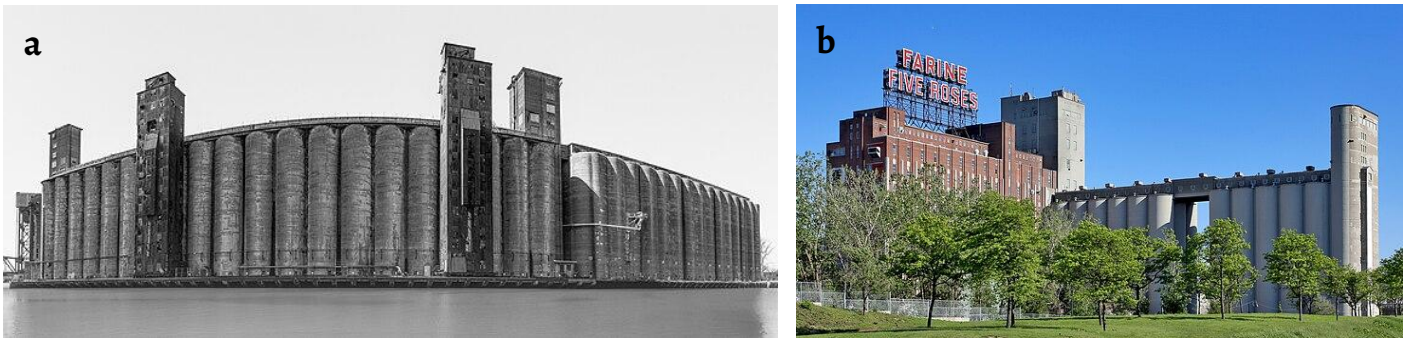

Figure 3. Silos: *a)* Silo City in Buffalo (photo: Flickr-sagesolar [30]); *b)* Silo No.5 in Montreal (photo: Denis Tremblay [31]).

Participatory production process in adaptive reuse

User participation, enriched by participatory democratic ideals, is crucial for the sustainable development of communities, encompassing design and production processes that enhance user experiences. Participatory design and production directly involves end-users to understand their needs and integrate feedback throughout the process [4]. User involvement can be implemented through various methods and targets integrating user feedback at every stage of design.

This approach requires balancing economic, social, and preservation factors while addressing historical, technological, and symbolic values within a community framework [17]. Active citizen involvement is central to this process, as it fosters a sense of belonging and strengthens community ties. As demonstrated by Martinović & Ifko [15] through experimental site studies, such participation plays a vital role in the long-term regeneration of neighborhoods – particularly in post-conflict areas – by promoting cultural identity, collective memory, and place attachment.

Participatory design and creation approaches encourage users to engage with varying levels of creativity – doing, adapting, making, and creating – within a unified process [4]. "Doing" refers to users actively engaging with the design in its current state – through direct use, testing, and observation – thereby providing experiential feedback that can inform immediate improvements. "Adapting" involves users modifying existing designs to better suit their specific needs or contexts, personalizing the solution. "Making" represents a deeper level of involvement where users actively contribute by constructing or assembling parts of the design themselves, integrating their own ideas. "Creating" is the highest level of creative involvement, where users collaborate equally with designers to develop new concepts and solutions from scratch. According to Sanders & Stappers [4], engaging users across these levels not only enriches the design process but also ensures that the final product more effectively meets real-world needs.

Although this participatory process – covering every stage of production and use – may initially seem slow and labor-intensive compared to a user-focused design approach based solely on feedback, it ultimately leads to products and initiatives that are more readily embraced by their intended audience. This leads to the development of longer-lasting, more satisfying, and advanced products, enhanced through participatory design discussions [32]. Participation encompasses various forms of decision-making among involved groups and is most effective when designed to meet specific community needs. Successful community participation requires commitment from initiating local governments or agencies, which must be open to and value citizen input [33-34].

The participatory design process is a methodology in which users are directly involved and play an active role at every stage of the design. It is particularly valuable in the adaptive reuse of industrial heritage sites, such as silos, because it engages individuals who already have a cultural, historical, or emotional connection to these spaces. By enabling them to articulate their needs, ideas, and experiences, this approach fosters a sense of ownership and strengthens the relationship between the site and its community. Rather than imposing top-down solutions, participatory design ensures that the transformation reflects local values and expectations, leading to outcomes that are more meaningful, sustainable, and widely accepted. Instead of traditional top-down management, adopting a bottom-up, grassroots approach that enables users to create solutions based on their own needs and expectations enhances sustainability and fosters stronger community acceptance in such projects [19]. The creative contributions of users not only make the design process better but also strengthen the engagement and functionality of the final product within the community. Thus, historical structures like silos are not only preserved but also transformed into vibrant and functional spaces that serve the needs of modern society. This process shapes the future by focusing on its users while continuing to value the past.

Case study: social adaptation of Zitomlin silos in Belgrade as a community-driven model of participatory design

The Zitomlin Silo structures, landmarks in the Danube River Industrial Zone's Dorćol port, represent Belgrade's industrial heritage and have been revitalized into "Silosi Beograd," a dynamic center for art, education, sports, and environmental activities [35]. This transformation, a local example of user oriented adaptive reuse, contrasts with the commercial redevelopment of Belgrade's Sava riverfronts. The evolution of the Zitomlin Silos within this context marks a significant phase in Belgrade's urban transformation.

Adaptive reuse of Zitomlin silos as "Silosi Beograd" cultural center

Located in the Lower Dorćol area along the Danube River, the Danube Industrial Zone hosts the Zitomlin silos, a landmark of ongoing adaptive reuse. These silos, part of the region's first industrial area linked to rail and ship traffic, stand beside the ICOMOS-recognized Snaga i Svetlost power plant (Figure 4 and Figure 5). While the power station is included in the Marina Dorcol transformation project, the silos are part of a general urban development plan aiming to utilize this historical industrial area [36].

Built in 1955, the four monumental concrete silos – each standing 28 meters tall and featuring 64 honeycomb-like cells – gained prominence during the 2011 Mikser festival, where they served as a backdrop for projections and cultural events [40]. In 2021, these silos were revitalized by the Gaia movement into "Silosi Beograd, a community hub hosting artistic and educational activities". The site includes exhibition spaces in silos along the riverbank and a "beegarden" for beekeeping behind the silos (Figure 6).

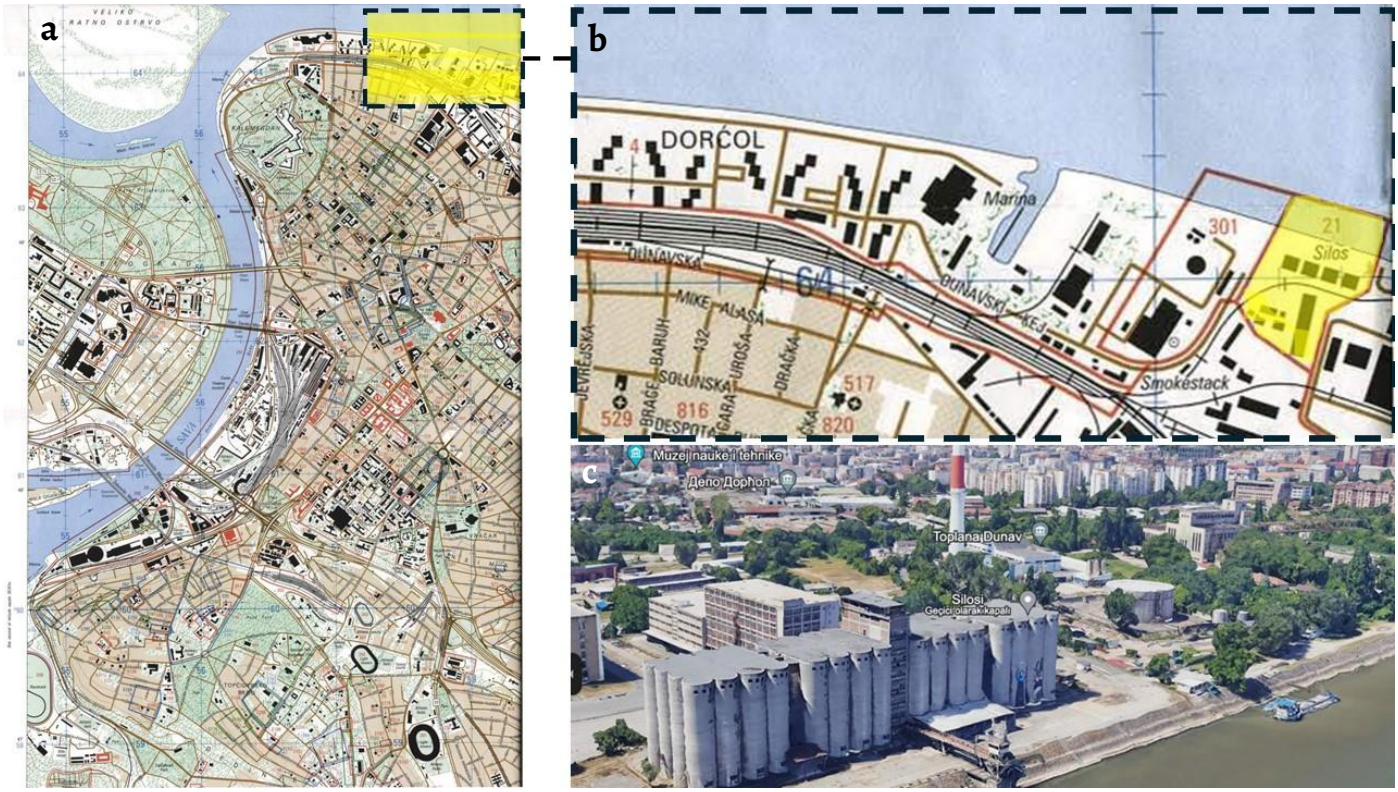

Figure 4. Silosi Beograd: *a-b)* City location map diagram (map source: U.S. National Imagery and Mapping Agency, 1999) [37]; *c)* Google earth view [38].

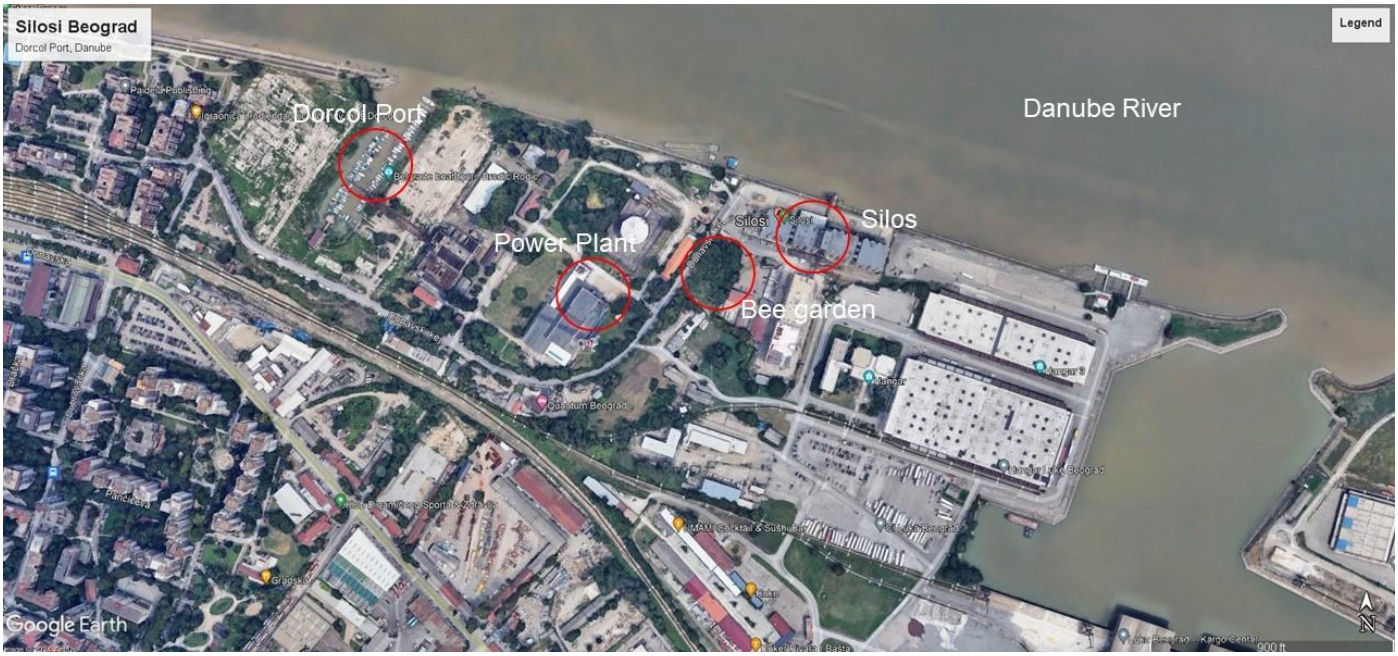

Figure 5. Silosi Beograd location map on Lower Dorcol Area (produced from Google Earth [39]).

Figure 6. Adaptive reused: *a)* outdoor and *b)* indoor spaces of silos (photo: Sadko [41]).

The Zitomlin Silos along Belgrade's Danube River exemplify how industrial heritage can be reimagined through community-driven initiatives. Managed by the company named "Port of Belgrade" and leased to the "Gaia Movement" for eight years, the site transformed into a vibrant hub with public amenities, murals, and open spaces. Today, it hosts over 300 events annually – 90 % of which are free – drawing more than 35,000 visitors. The initiative prioritizes inclusivity, serving seniors, families, and the Romani community, with funding from sponsors and additional revenue from space rentals. Unlike market-driven projects, Silosi Beograd's grassroots model strengthens local identity and redefines the waterfront.

Methodological approach

This study examines how the silo area meets the criteria of a sustainable participatory design and production (PD) model, emphasizing the role of industrial heritage in promoting social sustainability within Belgrade's urban planning. It explores how participatory processes intersect with the silo as an industrial heritage resource and new adaptive reuse approaches for sustainable development. The research is guided by two main questions:

- What benefits does participatory design and production bring to the reuse of silos as industrial heritage?
- Does the reuse process of the Zitomlin silos in Belgrade as the "Silosi Beograd" cultural center have a decisive impact on determining the sustainability of the area or facilitating the process itself?

In the initial phase of the research, the benefits of reusing the Zitomlin silos as Silosi Beograd (SB) will be analyzed. The second phase will focus on the participatory community of founders, experts, and volunteers. To explore this dynamic, semi-structured interviews will be conducted with two of the seven members – an SB founding member and an expert who served as a co-designer during the design phase. Finally, the project's methodologies will be assessed within the framework of the four forms of sustainability, based on the participatory creation model proposed by Sanders & Stappers [4].

The objective is to identify participants involved in planning, and decision-making processes through semi-structured interviews, and to determine those who can apply different creativity levels – creating, making, adapting, doing [4]. In line with this goal, the "Silosi Beograd" is intended to be tested and assessed as a participatory design model, examining participant profiles, type, degree, and duration of participation [42]. Additionally, the research will discuss which forms of PD method the cultural center meets in terms of social sustainability, as they provide a framework to evaluate the long-term viability, adaptability, and impact of participatory initiatives. Iversen propose four forms of sustainability that can guide community initiatives: maintaining, scaling, replicating, and evolving [3].

The "maintaining" form investigates how initiatives developed during participatory processes are integrated into existing post-project practices to preserve them in the same context. The primary factor affecting this form is the degree to which the sense of ownership and stakeholder engagement is successfully embedded within the community structure. The "scaling" form allows participants beyond the core designers and researchers to take significant roles, transitioning initiatives from small communities to larger organizations. "Replicating" involves adapting initiatives to different contexts of similar sizes, keeping the system or method constant but altering content. Lastly, the "evolving" form signifies a transformation in the ideas, systems, and practices of initiatives or catalyzing new processes.

The investigation will assess whether "Silosi Beograd" functions as a maintainable, scalable, replicable, and evolvable participatory design (PD) model [3]. Within this framework, participants in the semi-structured interviews were asked on the three key topics:

- Identification of site planning and decision-making processes across four different levels of creativity: creating, making, adapting and doing;
- Assessment of PD sustainability forms: maintaining, scaling, replicating, and evolving;
- Perspectives on the transformation process of the Dorcol port area where SB is located.

To implement this methodological framework, the study began with an on-site visit to observe the silo area's physical and spatial qualities, with field notes taken. This was followed by a review of the site's historical background and operational structure to understand its institutional and social context. From this analysis, key stakeholders – coordinators and active users – were identified. Semi-structured interviews were conducted with representatives from both categories: an SB founding member and an early-phase co-designer. These interviews, carried out online and lasting approximately two hours each, providing insight into user engagement, planning dynamics, and participatory production. The qualitative data obtained were subsequently analyzed in relation to the design and use practices observed at the site, allowing for a comparative assessment of how the participatory design model has been implemented in Silosi Beograd.

Findings and synthesis

Based on interviews with participants, data gathered highlighted that the initial principle of the creation process, "creating", prominently involves the founding members of the team. This is supported by statements from Participant 1 and Participant 2 during the interviews.

Participant 1:

> *I proposed repurposing existing buildings to the Port of Belgrade authority, which led to them renting these spaces under an eight-year contract. Alongside my brother, who oversees musical events, we transformed the adjacent Silosi property into a community space and established a bee garden in response to the decline of bees in Belgrade. Furthermore, we reimagined the silos as an outdoor art district, where artists create murals that express global issues such as climate change, education, and heritage, embodying our movement's pillars: agriculture, education, public health, and environmental protection.*

Participant 2:

> *I joined the organization last year at the founder's invitation to help establish the beegarden. Now, my brother and I manage it. After clearing the site with the founder and his brother, we introduced bees as part of an urban beekeeping experiment to observe their adaptation to the urban environment. The following year, we began creating a honey garden.*

These statements indicate that during the "creating" phase of the development, individuals in founding member positions within the community have a greater say, but the same individuals also contribute to the "making, adapting, and doing" phases along with others. These insights also inform about the involvement of three other participant profiles in the community in these initiatives (Table 1).

Regarding the production of spaces in the initiative, Participant 1 states:

> *My brother and I cleaned up the area, brought in electricity, and initially tried to create a cafe with his friends focusing on a modest, comfortable setup. We minimized resource use to revitalize the space, with major investments in plumbing and heating systems. Insulating the 700m^2 silo structures was a significant task. Starting with limited personnel and financial resources, we heavily relied on our personal funds.*

Since the opening of the space, the roles of community members have evolved across various phases of the creation process:

> *After setting up the initial operations two and a half years ago, the project gradually evolved into a more participatory system as word spread and more people joined. A friend took on the role of program coordinator and began selling his own brand products, designing his sales area. Meanwhile, her brother transformed one of the silos into a climbing wall. My brother's team, including three waitresses, launched their brand and opened their own business within Silosi.*

Table 1. Participant inputs categorized by forms of creativity.

Form of Creativity	Definition	Participant Profile / Example Activity	Quote / Summary
Creating	Generating new ideas and initiating the design process	Founding members	"I proposed repurposing existing buildings… we reimagined the silos as an outdoor art district…" (P1)
Making	Physically implementing ideas	Founders + volunteers	"We cleaned up the area, brought in electricity… invested in plumbing and heating…" (P1)
Adapting	Modifying existing spaces or ideas to meet new needs	Expert members, artists	"We brought in a landscape architect… turning into a health center…" (P2)
Doing	Day-to-day operations, event organization, and maintenance	Program coordinator, students, visitors	"Hosted 320 events, including performances, exhibitions, and workshops…" (P1)

From this, it is evident that over time, the number of people involved in the production process has increased, their profiles have diversified, and they have become influential in shaping the spaces through all the creative phases.

Participant 2 describes a process involving experts from various fields with the following words:

> *We brought in a landscape architect to help design our beegarden, aligning them with our vision. Meanwhile, my brother and I are working on a new section of the honey garden that we're turning into a health center where people can come and breathe in the air from the bees. We've already found a doctor, and a therapist will be joining us soon. We also produce our own brand of honey and sell it, with all the proceeds going back into the garden to support our initiatives.*

The following statements by Participant 2 respectively indicate that the spatial formation has been supported by new programs, and that there has been an increase and diversification in the number of users. This can be considered an indicator of "evolving" a form of sustainability from statement of Participant 1:

> *Last year, we attracted over 200,000 visitors and hosted 320 events, including performances, exhibitions, and university collaborations, involving over 300 artists. We're constantly innovating; after redesigning our honey garden, we're planning new workshops and transforming concrete lots into vibrant gardens. Our site, open until 11 PM in the summer, is human and pet friendly and caters to a younger audience with modern music. We offer free use to universities and are preparing an augmented reality app for virtual tours to enhance visitor engagement.*

In addition, Participant 1 uses the following expressions for the initiative as a whole:

> *This is my first pioneering project, inspired by successful developments like NDSM Werf in Amsterdam and a silo project in South Africa, transforming abandoned urban areas. Last year, we supported Serbian projects advocating for clean water, hosted a festival for the Danube region, and implemented a no-plastic policy to address environmental concerns.*

Participant 1's statements indicate that this project was the community's pioneering initiative, drawing inspiration from existing projects as examples of "replicating," and that the creation of partnerships with different projects meets the "evolving" form of sustainability. Thus, when viewed as a participatory initiative, it can be stated that the project exemplifies various forms of sustainability within its framework, serving as a model of effective sustainable practice (Table 2).

Table 2. Participant inputs categorized by forms of sustainability.

Form of Sustainability	Definition	Participant Profile / Example Activity	Quote / Summary
Maintaining	Preserving project outputs in the existing context over the long term	Founders, regular volunteers	"Continuous programming… embedded ownership…"
Scaling	Expanding from small communities to larger audiences	Diverse participant typologies, universities	"Expansion to diverse participant typologies… inspiring similar initiatives…"
Replicating	Applying the model to similar contexts	Founders' collaborations	"Inspired by NDSM Werf… supporting Serbian projects…"
Evolving	Transforming through new programs and ideas	Experts, artists	"Planning new workshops… AR app for virtual tours…"

Discussion

While the spatial creation process was originally shaped by the founders' ideas during the "creating" phase, it later evolved to include expert members and gained additional support from external professionals during the "adapting" and "making" phases. Throughout this process, a diverse range of participants – including paid student volunteers, artists, hired professionals from various disciplines, and regular visitors – became involved at different stages, reflecting the layered and evolving nature of participation within Silosi Beograd (SB)'s Participatory Design (PD) model. The direct involvement of end-users, particularly artists and students through exhibitions, workshops, and various social events, is quite evident. Founders and expert members often participate as cooperative design partners, while hired experts contribute as informational resources. Some expert members engage both as cooperative project and design partners, and artists also partake as design partners. Students, serving as paid volunteers, participate in diverse roles, contributing to programs for youth, biennials, and university-organized workshops. Regular visitors, a crucial component of the end-user profile, significantly enhance the social value of SB by fostering a sense of continuity, community interaction, and informal knowledge exchange within the space.

Over time, participation expanded from founders to a wider range of users, making the process more inclusive. With the growing variety of participant typologies, the sustainability forms of scaling within the participatory initiative process are evident. Initially, the spatial creation process was driven by founders' ideas in the "creating" phase, which evolved to include expert members and further supported by external experts in the "adapting" and "making" phases.

The discussion on SB's social sustainability evaluates its viability as a maintainable, scalable, replicable, and evolvable PD model. Community members involved in the creation process, along with added experts, students undertaking temporary roles, and visitors, have shared different roles, highlighting SB's sustainability as a PD model, particularly in terms of the "scaling" principle. The initiative has evolved into a process supported by new programs, with increasing and diversifying user numbers, indicating "evolving" sustainability. It aligns with "maintaining" as a form of sustainability, considering its long-term participant design model plans. However, uncertainty arises due to the site's eight-year tenure of usage rights. Meanwhile, SB serves as a case study for community members, inspiring similar initiatives, which fulfills the "scaling" and "replicating" aspect of sustainability. Notably, the "evolving" and "scaling" principles prominently underscore the project's sustained community impact.

In light of the findings, the participatory design and production process implemented at SB evolved from a founder-led "creating" phase to a broader participant base that included experts, students, artists, and regular visitors. This shift facilitated the rapid activation of the abandoned silos, enhanced social interaction, and raised public awareness of industrial wastelands as heritage assets. When evaluated according to Sanders & Stappers' four forms of sustainability, maintaining is evident through continuous programming and embedded ownership, scaling is reflected in the expansion to diverse participant typologies and inspiring others as a case study, replicating emerges from the model's adaptability to similar contexts, and evolving is demonstrated by the ongoing addition of new programs (e.g., beekeeping-based health/learning initiatives, digital/AR applications). Thus, the process not only facilitated the acceptance of the design and the revitalization of the site but also contributed to the sustained social life of the area.

Table 3. Cross-tabulation of creativity forms and sustainability forms.

Creativity \ Sustainability	Maintaining	Scaling	Replicating	Evolving
Creating	Founders' initial repurposing idea sustained through long-term programming	Initial vision inspired larger community engagement	Inspiration from NDSM Werf & other silo projects	Introduction of new cultural themes (e.g., climate change art)
Making	Maintenance of constructed spaces (e.g., plumbing, heating)	Expansion of physical facilities for broader audiences	Application of construction/innovation model in other small-scale projects	Continuous upgrades (e.g., climbing wall, garden improvements)
Adapting	Adjustments to keep functions relevant	Adaptation of spaces to serve larger events and users	Modification of original designs in other community settings	Development of new hybrid uses (e.g., beekeeping health center)
Doing	Daily operations ensuring continuity	Increased events & participants over time	Replication of event formats in other contexts	Innovation in activities (e.g., AR tours, thematic festivals)

Table 3 cross-maps the four observed forms of creativity (creating, making, adapting, doing) in SB's participatory design process with the four sustainability forms (maintaining, scaling, replicating, evolving) proposed by Sanders & Stappers [4]. This structure illustrates which sustainability outcomes each creativity form supports and how the process unfolds in a multi-layered way. The findings indicate that the founder-led creating phase contributed not only to maintaining the project but also to scaling the community and evolving through new programmatic additions. Similarly, the making and adapting phases preserved the functionality of physical spaces while incorporating new user profiles, enabling the model's replication in other contexts. The doing phase sustained day-to-day operations and event management, supporting both continuity and the emergence of innovative applications. This cross-reading reveals how forms of creativity and sustainability objectives reinforce each other, demonstrating how a holistic participatory model was built in the case of Silosi Beograd. However, the eight-year tenure of usage rights remains the primary uncertainty for long-term stability.

Conclusion

In Belgrade, the privatization of riverfronts and the transformation of historical industrial sites into high-value properties pose a threat to industrial heritage. Despite this, e-democracy efforts in the city tend to be reactive, often spurred by government actions rather than proactive civic engagement. Nonetheless, as highlighted by Nikolić & Vukmirović [36], there is an awareness among citizens of the heritage value, and engagement tends to correlate with this recognition. Civic groups, nonprofits, and citizen-led projects are very important for bringing these areas back to life. They want to protect built heritage and find new uses for old industrial buildings.

The Zitomlin silos, which are now called Silosi Beograd (SB), is a successful example of bottom-up adaptive reuse. As a participatory design model where different users interact with the space in ways that grows slowly over time [4]. Instead of product-focused, experiential and transformative design shows how heritage sites can become lively social places that do more than just allow for physical reuse.

In addition, the structural flexibility of industrial structures enables different types of users make a wide range of functional changes, which leads to a design process that focuses on making spaces and social settings adaptable to the needs of users. Civic-led projects can raise property values, but they also may bring the risk of gentrification. So, it is important to balance these projects with ways for people to have a say in how things are done in community spaces to keep them socially sustainable.

As a commentary conclusion regarding the role of international institutions such as ICOMOS, TICCIH, and UNESCO should all agree that participatory design principles and the long-term effects of social adaptation on the adaptive reuse process are important issues that need to be addressed. In particular, local user-oriented examples that are specific to industrial heritage sites should be monitored, and research should be done on sustainable adaptation as models for different industrial heritage structures.

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