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Post-industrial transformation under the pressure of heritage, water, and gentrification: a comparative study of Gdańsk, Rome, and Rotterdam

Abstract: This article examines the factors influencing the adaptive reuse of post-industrial waterfront areas, emphasizing the strategic role of culture and water-related location contexts in revitalization processes. The study aims not only to identify enabling and inhibiting conditions of post-industrial transformation, but also to develop recommendations for planning, governance, and policy-making that support socially inclusive and sustainable regeneration.

Using a comparative qualitative analysis of three European case studies – the Gdańsk Shipyard (Poland), the Ostiense district in Rome (Italy), and the Van Nelle Factory in Rotterdam (the Netherlands) – the research explores the role of governance models, planning instruments, heritage protection regimes, ownership structures, cultural and creative industries.

The findings show that waterfront location alone does not guarantee successful or inclusive transformation. Effective regeneration depends on integrated governance, long-term planning frameworks, institutional continuity, and active public-sector involvement, while fragmented ownership and market-driven development intensify gentrification and limit social accessibility. The article contributes to debates on heritage-led regeneration and offers transferable recommendations for post-industrial waterfront redevelopment under conditions of increasing development pressure and climate change.

Keywords: post-industrial regeneration, waterfront redevelopment, urban governance, creative industries, industrial heritage

Introduction

The adaptive reuse of post-industrial waterfronts increasingly relies on culture and creative industries to transform degraded urban areas. Cultural narratives and heritage-based identities are mobilized to reintroduce these areas into the

urban fabric. However, existing research indicates that culture-led regeneration does not automatically ensure social inclusivity or environmental sustainability (Nyström 2015, Power 2018).

Rivers has historically played a crucial role in urban development, supporting industrial growth through transport, energy, and technological innovation. In contemporary cities, waterfronts function as both spatial and symbolic assets, shaping urban identity, public space systems, and climate adaptation strategies. In the context of climate change, rising water levels, and urban heat stress, integrating water into redevelopment processes requires balancing accessibility, ecological performance, and cultural continuity.

This article examines the factors influencing the adaptive reuse of selected post-industrial waterfront areas, with particular emphasis on the strategic role of cultural relations and water-related spatial contexts. It explores how culture and water can be integrated into spatial planning and policy-making to support adaptive reuse while mitigating negative social and environmental effects.

Despite extensive research on post-industrial regeneration, there remains a gap in understanding how water-related contexts and cultural governance jointly influence transformation processes. This study addresses this gap by combining spatial, cultural, and institutional perspectives.

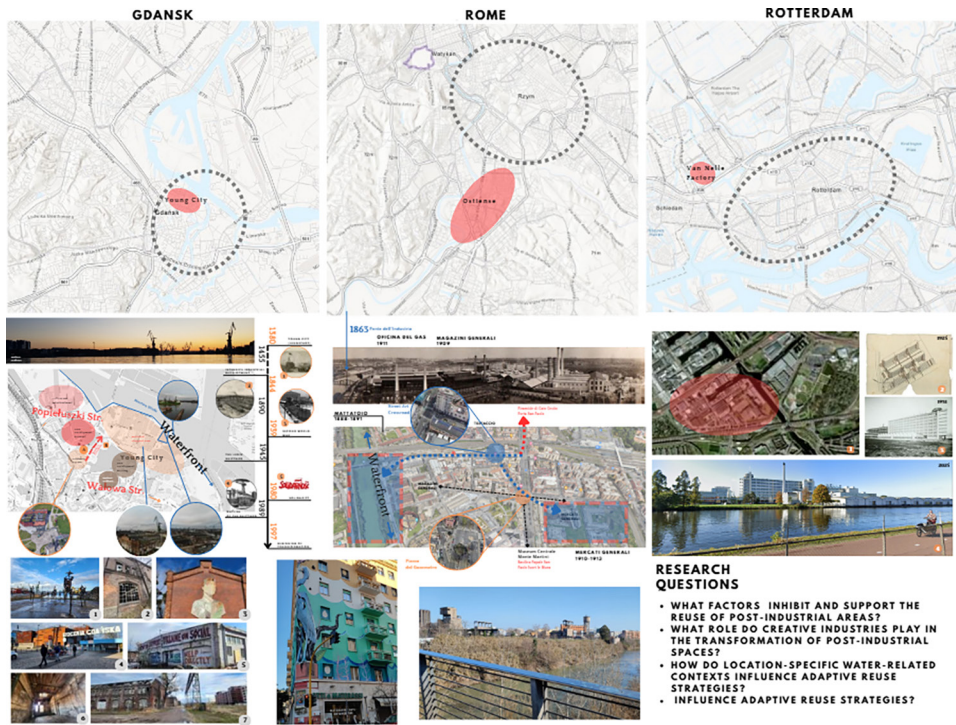


Fig. 1. Research mood board of Gdańsk, Rome and Rotterdam case studies
Source: own elaboration.

The study aims to identify enabling and inhibiting conditions shaping post-industrial transformations, focusing on governance models, planning instruments, heritage protection regimes, ownership structures, and the role of creative industries.

The research, graphically presented in Figure 1, is guided by the following questions:

1. What factors combination inhibit and support the reuse of post-industrial areas?
2. What role do creative industries play in the transformation of post-industrial spaces?
3. How do location-specific water-related contexts influence adaptive reuse strategies?

The article is structured as follows: Section 2 presents the state of the art, Section 3 outlines the research methodology, Sections 4–6 discuss the case studies, followed by Section 7 presents contextual comparative analysis and synthesis, finishing with conclusions.

State of the art

The examined literature addresses key issues related to historical and contemporary development policies, cultural industries, and the cultural dimensions of water use in urban revitalization processes. It provides important insights into the specific characteristics of post-industrial locations and their transformation trajectories.

The decline of industrial functions in centers of cities in the late twentieth century was associated with transformation of environmental degradation, inefficient resource use, and high social costs, often resulting in the so-called “ugly cities” effect. Urban economies were largely based on non-renewable fossil fuels, mass production, and the overexploitation of natural resources. In response, contemporary urban planning has shifted toward regeneration strategies that emphasize reuse, sustainability, and resilience (Nyström 2015, Power 2018). It is also worth noting the significance of global processes, such as the relocation of production to countries with lower labor costs, market liberalization, and the growing importance of the service sector and knowledge-intensive industries. These factors, combined with local spatial and urban policies, determined the pace and character of deindustrialization, especially in developed countries (Vu et al. 2021).

Industrial heritage, particularly in relation to water-based technologies, has played a crucial role in shaping urban development over the past two centuries. Even after the cessation of their original functions, industrial buildings continue to influence the spatial and cultural identity of cities. However, regeneration processes grounded in cultural values do not automatically lead to socially inclusive outcomes. In many cases, culture-led regeneration contributes to increased investment attractiveness, which may intensify gentrification processes and

contradict the original social objectives of revitalization. Unfortunately, there's a noticeable trend in Poland of converting former sugar factory industrial areas into hotels or conference centers. This approach doesn't enhance the productive potential of the space, creating the effect of excluding this part of the city from use by average residents.

The narrative dimension of industrial heritage – encompassing its social, cultural, and technological significance is increasingly recognized as a key factor in successful regeneration (Bruttomesso 2001, Czyżewska 2009, Lorens 2009, Nyka 2013, Kamrowska-Zaluska 2014, Burda, Nyka 2016). At the same time, water-related heritage remains relatively underrepresented in conservation discourse, despite its historical importance for urban development and spatial structuring.

Cultural and creative sectors play an increasingly important role in contemporary urban development, contributing to economic growth, social cohesion, and identity formation (European Commission 2024). Their role in regeneration processes, however, remains ambivalent. While they can support heritage preservation and activate post-industrial spaces, they may also accelerate socio-spatial inequalities by increasing development pressure and property values.

Recent research highlights the growing importance of placemaking strategies in shaping the quality and functionality of waterfront open spaces, particularly in post-industrial contexts. Well-designed waterfront environments can significantly contribute to improving mental, physical, and social well-being (urban areas, where the climate is modified by human activities, leading to the urban heat island effect, combined with a deficiency of greenery and other natural elements, are less comfortable than nearby rural areas). The integration of natural elements, especially blue-green infrastructure, facilitates social interaction, reduces isolation, and enhances overall quality of life (Bell 2012, Babalis 2024).

Comparative Methodological Framework and Research Design

The study is based on a comparative qualitative analysis (comparative case study) aimed at identifying the factors shaping transformation processes. The research is based on the assumption that the adaptive reuse of post-industrial waterfronts is not determined by single variables, but emerges from configurations of inter-related spatial, institutional, and socio-cultural factors. Consequently, the analytical focus is placed on relationships, interactions, and tensions between key dimensions such as governance, heritage, water context, and cultural dynamics. The selection of cases follows a theoretical sampling strategy and is guided by analytical logic rather than statistical representativeness. The selected locations – Gdańsk, Rome, and Rotterdam – constitute diverse yet comparable examples of post-industrial transformations in relation to water.

Case Selection Strategy

A “most different cases” strategy is applied, in which the analyzed cases differ in terms of historical, institutional, and cultural contexts, while maintaining shared structural characteristics. This approach enables the identification of both context-specific conditions and more generalizable mechanisms across diverse urban settings. The key common features include:

- the location of post-industrial areas in direct proximity to water,
- the loss of original industrial functions and transition into a transformation phase,
- the presence of investment pressure and regeneration processes,
- the growing role of service functions and the creative sector.

At the same time, the analyzed cases represent distinct transformation models:

- Gdańsk Shipyard – a post-socialist Central and Eastern European context characterized by complex ownership structures and a strong socio-political heritage dimension,
- Ostiense district – an example of transformation within a historically dense urban fabric with a relatively fragmented governance model,
- Van Nelle Factory – a model of planned and institutionally coordinated adaptation of modernist heritage.

This configuration enables the identification of both context-specific factors and more universal mechanisms influencing transformation processes.

Analytical Procedure

The study employs a comprehensive range of methods to investigate the transformation of post-industrial areas, particularly focusing on the Gdańsk Shipyard, the Ostiense district in Rome, and the Van Nelle Factory in Rotterdam. The methods used include:

- Analysis of Strategic and Planning Documents: Examining local development plans, urban strategies, and local policies to understand the formal frameworks guiding transformations.
- Review of Academic Literature: Studying existing research to identify relevant theories, concepts, and findings related to post-industrial transformation, waterfront development, and urban regeneration.
- Analysis of Expert Reports: Utilizing expert reports to gain insights into development conditions. This is supplemented by free interviews with experts, such as Tullia Valeria Di Giacomo from Sapienza University, to deepen understanding and contextualize the data.
- Morphological and Functional Analysis: Conducting an in-depth analysis of the physical and functional characteristics of the studied areas to assess spatial potential, identify constraints, and understand how these areas can be adapted for new uses.
- Site Visits: Conducting research visits to key locations. A study visit to Rotterdam in 2014 and a one-month research visit to Rome in 2023 (as part of the

“Horizon 2020 – SOS Climate Waterfront” project) provide firsthand observations and insights into the transformations occurring in these cities.

- **Observational Study:** Systematically observing and recording the changes in the Gdańsk Shipyard over time (since 1999). This long-term observation allows for the capture of gradual transformations and the documentation of key events and developments.
- **Comparative Cross-Case Analysis (Contextual Analysis):** Analyzing the three case studies in comparison to identify common themes, differences, and factors influencing their transformations. This approach helps in drawing broader conclusions about post-industrial regeneration and the role of waterfronts, heritage, and gentrification.

The analysis focuses on identifying relationships between:

- governance models,
- planning instruments,
- ownership structures,
- methods of heritage protection and reinterpretation,
- the role of creative industries in transformation processes.

The study is qualitative and analytical in nature; therefore, its aim is not statistical generalization but the identification of mechanisms and relationships that may be applicable in other spatial contexts. The selection of cases is selective and does not exhaust the full spectrum of possible transformation models of post-industrial areas.

The analysis is based on the assumption that successful post-industrial transformation is not determined by single factors but rather by a specific configuration of interrelated spatial, institutional, and socio-cultural conditions. Consequently, the research seeks to identify recurring combinations of factors that increase successful and socially inclusive regeneration outcomes.

Conceptual Model of Transformation

The study develops a configurational model of post-industrial transformation, in which outcomes are understood as the result of interactions between three groups of factors:

- Structural conditions (waterfront location, industrial heritage, urban morphology),
- Institutional configurations (governance models, planning frameworks, ownership structures, public-sector involvement),
- Cultural and socio-economic activators (creative industries, placemaking practices, cultural narratives)

The relationships between structural conditions, institutional configurations, and transformation outcomes are synthesized in a configurational model (Fig. 2), which conceptualizes waterfront areas, and its strong heritage, as spatial potential activated through governance mechanisms and mediated by cultural dynamics.

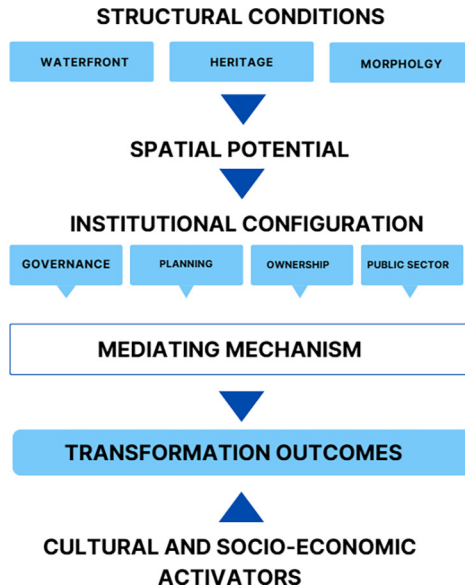


Fig. 2. Conceptual model of transformation
Source: own elaboration.

Case studies characteristics

The post-shipyard area in Gdańsk: Historical and contemporary context

The post-shipyard area in Gdańsk (north of Wałowa Street), covering over 150 hectares and extending into the Polish Hook, was historically dominated by shipbuilding and industry. Its development began in 1380 with Jungstadt (German for “Young City”) and expanded in the 19th century with the Royal Corvette Workshop (1844) and Schichau Shipyard (1890), producing warships and submarines. After 1945, under communist rule, the Lenin Shipyard became a symbol of resistance (e.g., 1970/1980 uprisings), but declined post-1989 due to market transition, leading to bankruptcy.

Since 1999, the area has been revitalized as Young City, a dynamic urban district blending industrial heritage with modern functions (cultural venues, galleries). Despite EU funding opportunities, many historical structures remain neglected. Coordinated development is critical to preserve its distinctive identity while meeting contemporary urban needs (Adamowicz et al. 2013, Januszajtis 2017).

The redevelopment of Gdańsk’s post-industrial area began in the 1990s, following the shipyard’s economic decline. Initial studies (1994–1995) proposed infrastructure upgrades, including a waterfront promenade extension and new public space systems connecting the city center to the Imperial Shipyard. Subsequent

plans – such as Synergia 99 (1999), Sasaki Associates (2000), and R. Loegler’s 2002 proposal – culminated in the 2004 local plan, which formalized property restructuring, historic structure removal, and new infrastructure development.

The process gained momentum with EURO 2012, which spurred touristification, and the 2014 opening of the European Solidarity Center, symbolizing the area’s urban transformation. Over two decades, comprehensive planning efforts have focused on establishing a Central Business District, though challenges such as fragmented ownership and the need for integrated cultural, social, and urban solutions persist (Lorens, Bugalski 2021).

The 2022 consultative process led by Architekt Miasta Gdańska refined Young City’s developmental objectives, emphasizing heritage preservation (especially post-industrial sites tied to the Solidarity movement) and public access to green and waterfront areas. Participants advocated for democratic waterfront access, unobstructed pedestrian/cycling pathways, and a cohesive aesthetic, despite pressures from private development. The area, long a hub for artistic activities, remains a contested space where gentrification conflicts with community needs. Cultural industries here both preserve shipyard heritage and enhance its dynamic, culturally rich character, transforming post-industrial zones into contemporary agoras for social and political commentary.

Ostiense in transition: Urban regeneration and the challenges of Tiber waterfront revitalization

Originally a rural area outside Rome’s Aurelian Walls, Ostiense transformed into an industrial and residential district after Italy’s unification (1861) and Rome’s designation as capital (1870–71). Its development was driven by strategic infrastructure, including Via Ostiense – an ancient Roman road linking the city to the port of Ostia (Carmen, Escobar 2022) – and the 19th-century railway line, which crossed the district horizontally. The Ponte dell’Industria (1863) and the 1873 General Plan further facilitated industrialization, leading to the establishment of factories like Molini Biondi, the River Harbour, Montemartini power station, and Gas Power Station (Borello, Ermili 2017, ETICity Association 2017, Gomellini, Toniolo 2017).

The “Pro Roma Marittima” committee promoted industrial growth, though Paolo Orlando’s 1896 port proposal remained unrealized. Under the Fascist regime, industrial focus waned, and Ostiense declined post-WWII. Revitalization began in the 1990s with the establishment of Roma Tre University, preserving industrial structures that now define the district’s unique urban identity (Conolly et al. 2007).

Today, Ostiense is one of Rome’s most dynamic districts, centered around Via Ostiense and Piazza Ostiense, a modern transport hub. The Tiber River forms its western border with the residential Portuense district, while the Eur 1960 Campus and Roma Tre University anchor its southern area. To the east, Ostiense

borders the working-class neighborhoods of Garbatella and Testaccio, with Via Cristoforo Colombo marking its eastern boundary, beyond which lies Ardeatino.

The Ostiense-Marconi Urban Project (PUOM), initiated in 1995 and formalized in 1999–2000, aimed to revitalize the district through comprehensive redevelopment, including new urban functions (e.g., universities), service locations, and integration with the Southern Tiber Park. Updates in 2003–2005 introduced key interventions: a new road layout, the Ostiense-Garbatella program, and General Markets redevelopment, alongside private sector proposals for public-interest projects (Roma S.P.Q.R. Urbanistica, 2024). The plan prioritized Viale Marconi and Via Ostiense as local redevelopment axes, underground construction of Lungotevere Papareschi, a pedestrian bridge over the Tiber, and road infrastructure reorganization. Further updates (2010–2013) included feasibility studies for a new Lungotevere (Ponte Sublicio to Ponte Marconi) and redevelopment forecasts for the Italgas-Enel-Acea sector (Società Risorse per Roma).

Despite the Tiber River's historical role in industrial transport, Ostiense's waterfront remains underutilized. Pedestrian connectivity to Marconi and Trastevere is limited to narrow vehicle bridges and Ponte della Scienza, while the Riva Ostiense linear park is poorly managed. Key landmarks like the Gasometer, Mercato Generali, and Magazzini Generali lack pedestrian access, and potential public spaces are occupied by parking. Unlike post-industrial waterfronts in Hamburg (Hafencity) or Rotterdam (Koop Van Zuid), Rome's riverside lacks iconic water-centric structures. The Gazometro, though hosting cultural events, underuses its architectural potential. Waterfront heritage is reflected in street art and adaptive reuse projects, such as "Industrie Fluviali" – a revitalized Sonnino wool factory transformed into a co-working and cultural hub with four functional zones (Industrie Fluviali, 2023).

Van Nelle Factory: Modernist heritage and adaptive reuse in Rotterdam

The Van Nelle Factory, built between 1925–1931 for the Van Nelle family (producers of coffee, tea, and tobacco), stands in Rotterdam's Spaanse Polder, a trapezoidal site bordered by the Delfshavense Schie and Schuttevaerweg. Designed by Johannes Brinkman and Leendert van der Vlugt, the factory became an icon of modernist industrial architecture, featuring a steel-framed structure, curtain walls, and expansive windows for natural light. Its innovative layout integrated production, transport, storage, and recreational spaces, including a garden (redesigned by Mien Ruys in 1942–43) and green areas, creating a transparent, park-like complex. Strategically positioned, it remains a visible landmark (Kingdom of the Netherlands 2013).

The factory embodies 20th-century avant-garde industrial design, where architects treated factories as aesthetic and functional models (Rappaport 2018). After production ceased in 1998, the site was transformed into the Van Nelle Design Factory (Van Nelle Ontwerp Fabriek), a creative hub preserving its State

Monument status. The UNESCO-listed ensemble – including the factory street, production buildings, bridges, and warehouses – exemplifies successful adaptive reuse, merging industrial heritage with contemporary functions.

Rotterdam's post-industrial regeneration, driven by a 1970s economic crisis, reconnected declining inner-city areas with suburbs through iconic architecture and public space redevelopment, modernizing the city's maritime identity (van der Borg, Russo 2008). The Van Nelle Factory's transformation reflects this broader trend, proving how historical integrity and modern needs can coexist.

The Van Nelle Factory, situated on a polder in Rotterdam, exemplifies a unique industrial complex where its location on the polder plays a significant role in its historical, geographical, and environmental context. The visual effect of the building complex is heightened by the reflection of the structures in the waters of the Delfshavense Schie (van der Borg, Russo 2008). Various episodes in the development of "man's made land" demonstrate that the Urban Fine Dutch Tradition is a dynamic practice of creating urban plans by efficiently integrating parameters of the natural system, linking the hydrological cycle, technology, and opportunities for urban development. However, after the Industrial Revolution, this perspective shifted toward a cultural system, reaching its peak in the post-war era (1945–1970) and diminishing in significance since the 1970s. (Hooimeijer, 2014).

Contextual comparative analysis

The contextual analysis synthesizes environmental, historical, social, and urban factors influencing transformation processes. It also examines governance models, planning practices, and heritage protection mechanisms. The analytical procedure was based on a structured comparison using a set of predefined criteria, including environmental conditions, governance models, planning in Table 1 to enable cross-case comparison. The role of creative industries is integrated across thematic categories rather than presented as a separate column, enabling clearer comparison between case studies (column named "Universal role of creative industries for selected factor").

The review of literature and expert reports is complemented by the author's expert knowledge, developed through long-term research, field observation, and analytical work on post-industrial and waterfront transformation.

The attributes in Table 1 were assigned based on a multi-step qualitative analysis, integrating the following sources and methods:

1. Analysis of Strategic Documents and Local Plans:
 - Gdańsk: Local Spatial Development Plan for Young City (2004, 2022), Gdańsk Development Strategy 2030, and public consultation reports (Architekt Miasta Gdańska 2022).
 - Rome (Ostiense): Ostiense-Marconi Urban Project (Roma S.P.Q.R. Urbanistica, 2024), Rome General Regulatory Plan.

Table 1. Contextual analysis

Dimension (site/ factors)	Gdańsk Shipyard	The Ostiense district in Rome	The Van Nelle Factory in Rotterdam	Universal role of creative industries for selected factor
Environmental/waterfront condition (geographical location, threats related to the climate catastrophe, biodiversity)	flood protection-climate change (Martwa Wisła River), partial public access	Flood protection in regional context (River Tiber), weak spatial integration	Polder system-flood protection as the Fine Dutch Tradition, polder landscape-fully integrated, waterway, well maintained	Enhancing environmental aspects in art, ecological materials, and ecosystem services. Form and function built for urban resilience. Creating ecological identity. Exhibition field for art, flows, spatial connections.
History (complexity of industrial and cultural heritage)	Heritage management, tourism attractiveness, connection with the rest of the urban structure, new public spaces	Heritage management, tourism attractiveness, connection with the rest of the urban structure, new public spaces	Heritage management, tourism attractiveness, connection with the rest of the urban structure	Creative industries are respectful of built heritage. The function follows form.
Heritage Protection	Partial protection; mixed-legal status	Protected industrial monuments	UNESCO World Heritage Status	Architectural adaptation for creative industries can be an example of protection against the destruction of built heritage.
Ownership structure	Highly fragmented	Fragmented	Predominantly institutional	Integration among ownership
Governance model	Hybrid, conflict-prone	Weakly coordinated	Integrated, long-term	Cultural based policy, enhancing creative productivity
Planning framework	Selective local plans	Fragmentary interventions	Stable strategic planning	Strategy for enhancing local creative industries and sustainable development
Society (processes, bottom-up approach concepts, social cohesion)	Gentrification, "office city" developers pressure "collective memory place", forum of Gdańsk	University cooperation, cultural centers, art-street, vibrant district close to ancient center of Rome	Cultural center	The post-industrial space as an "urban agora" for expressing opinions and preventing gentrification. Supportive role of creative industries.
Contemporary culture	Street art, open space exhibitions, art-based interventions (sculptures)	Street art, youthful, fashionable urban center	Cultural function & offices	Strengthening spatial identity. Art in public spaces.

Dimension (site/ factors)	Gdańsk Shipyard	The Ostiense district in Rome	The Van Nelle Factory in Rotterdam	Universal role of creative industries for selected factor
Urban morphology, diversity of city functions	19th, 20th century post-industrial areas, shipyard+ new development	19th-20th century district development, post-industrial areas, fragmentation (new development+ abandoned areas+ re-development of old urban structure)	20th century concept, modernism, cultural landscape typical dutch polder area (the Fine Dutch Tradition)	Emphasizing compositional values, creating local, unique public spaces.
Urban resilience (strengthening among natural, cultural and societal aspects)	Complex interactions	Complex interactions	Complex interactions	Ecocultural identity
Architecture	Iconic post-industrial buildings and landmarks (cranes) + iconic new building of European Solidarity Center	Iconic post-industrial buildings and landmarks (Gasometro)	Iconic post-industrial buildings (factory)	Cultural function, resilient form. Water + culture in corelation.
Infrastructure	Under transformation	Under transformation	Customized	Post industrial infrastucture as inspiration for art.
Policies and practicies	Mixed-use development concept (to supplement existing structure with new types of buildings as new marinas)	Mixed-use development (lack of integration of Tiber River with district)	Mixed-use, flexibility (water as a composition of polder-tradition of cultural landscape)	Revitalization through art, urbcultural planning.
Model of adaptive reuse	<ul style="list-style-type: none"> related to heritage context commercial and non-commercial usage (diverse investors) 	<ul style="list-style-type: none"> related to heritage context commercial and non-commercial usage (diverse investors) 	<ul style="list-style-type: none"> related to heritage context commercial and non-commercial usage (diverse investors) 	The empowering role of creative industries.
Gentrification pressure	High	High	Controlled	Revitalization through art
Transformation outcome	Conflict-driven transformation	Market-driven transformation	Prolicy-driven transformation	Creative industries as catalizator/compensator of processes of transformation

Source: own elaboration based on Kaczorowska (2018), Lorens, Bugalski (2021).

- Rotterdam (Van Nelle): UNESCO World Heritage Nomination File (Kingdom of the Netherlands, 2013), Rotterdam Structural Vision 2030.
2. Literature and Expert Reports Review:
 - Academic articles (e.g., Lorens, Bugalski 2021, Connolly et al. 2007, van der Borg, Russo 2008, Kaczorowska 2018).
 - NGO reports (e.g., ETICity Association 2017, Industrie Fluviali 2023).
 - Expert interviews (e.g., Tullia Valeria Di Giacomo, Sapienza University).
 3. Morphological and Functional Analysis (photographic documentation and maps (e.g., Figure 1 mood board).

The analysis demonstrates that transformation processes are shaped by complex interactions between spatial conditions, institutional frameworks, and socio-cultural dynamics. Water and culture function as key integrative elements, supporting adaptive and resilient urban development. The comparative analysis indicates that post-industrial waterfront transformation cannot be explained by single-factor dependencies but rather by the interaction of multiple, interrelated conditions. In contrast to simplified interpretations, the findings demonstrate that waterfront location alone does not determine transformation outcomes; instead, it functions as an enabling spatial condition whose potential is either activated or constrained by institutional and socio-economic frameworks.

A key contribution of this study lies in identifying specific configurations of factors that shape transformation processes. In particular, the relationship between governance models, ownership structures, and planning frameworks emerges as decisive. The case of Rotterdam illustrates how integrated governance, institutional continuity, and coordinated planning enable a controlled and coherent transformation process. In contrast, Gdańsk and Rome demonstrate that fragmented ownership and weak coordination mechanisms lead to uneven development trajectories, increasing conflicts between public and private interests and limiting the effectiveness of regeneration strategies.

The role of cultural and creative industries also appears to be more complex than often assumed. While they contribute to the activation of post-industrial spaces, the preservation of heritage, and the strengthening of local identity, their impact is not inherently positive. In both Gdańsk and Rome, culture-led regeneration processes have increased the attractiveness of these areas, thereby intensifying investment pressure and contributing to gentrification. This confirms the ambivalent nature of creative industries, which can simultaneously support regeneration and exacerbate socio-spatial inequalities.

Synthesis

The analysis highlights the importance of water as a multidimensional factor in transformation processes. Beyond its environmental role, water functions as a spatial, social, and symbolic resource. Waterfronts provide opportunities for public space creation, climate adaptation, and the enhancement of urban livability. However, the comparative analysis demonstrates that these potentials are often

underutilized, particularly in contexts where planning frameworks are fragmented or lack strategic coherence, as observed in the case of Rome.

Importantly, the findings suggest that successful transformation depends on the alignment between spatial potential and institutional capacity. Even highly valuable locations, such as waterfronts, may fail to achieve inclusive and sustainable outcomes if governance structures are weak or inconsistent. Strong institutional frameworks can compensate for spatial or structural constraints, enabling more balanced development.

This perspective contributes to the ongoing debate on post-industrial regeneration by shifting the focus from individual factors to relational dynamics and systemic interactions. It also responds to the identified research gap by proposing an analytical approach based on the identification of recurring configurations of conditions rather than isolated variables.

Nevertheless, the study has certain limitations. The selection of cases, while theoretically grounded, does not represent the full diversity of post-industrial transformation models. Furthermore, the qualitative nature of the analysis limits the possibility of statistical generalization. However, the aim of the study is analytical generalization, providing insights into mechanisms and relationships that may be applicable in other spatial contexts.

Future research could expand this approach by including additional case studies or by integrating quantitative methods to test the identified relationships. An investigation into the role of policy instruments and governance innovations in managing gentrification processes would also be particularly valuable.

Key findings from the contextual analysis, which can be translated into recommendations for local policy, are as follows:

- Successful post-industrial transformation depends on the alignment of governance models, planning frameworks, and ownership structures, which together enable coordinated and long-term development.
- The UNESCO World Heritage Status provides protection for the original architectural and spatial functions of a site. When a property is inscribed on the UNESCO World Heritage List, it is recognized for its outstanding universal value, which may include its architectural integrity, historical significance, and spatial arrangement.
- Waterfront areas should be treated as strategic public assets, requiring policies that ensure accessibility, ecological integration, and multifunctional use.
- Integrated and stable governance systems are essential for balancing heritage preservation with new development, while fragmented institutional arrangements tend to limit the effectiveness of regeneration processes.
- Creative industries should be supported as catalysts of spatial activation and identity-building, but within policy frameworks that mitigate gentrification and ensure social inclusion.
- Adaptive and context-sensitive planning approaches are necessary to respond to changing environmental, social, and economic conditions, particularly in the context of climate change.

- The integration of blue-green infrastructure should be prioritized as a means of enhancing environmental resilience, public health, and spatial quality.
- Post-industrial areas should be developed as inclusive public spaces (“urban agoras”), supporting social interaction, cultural expression, and community engagement.
- Long-term regeneration strategies should combine environmental resilience, cultural continuity, social inclusion, and economic viability, rather than prioritizing single development goals.

The findings confirm that post-industrial waterfront transformation cannot be explained by single-factor dependencies but results from configurations of inter-related spatial, institutional, and socio-cultural conditions. The proposed conceptual model (Fig. 2) provides a framework for understanding these relationships.

A key insight is the role of governance configuration as a mediating mechanism between structural conditions and transformation outcomes. Despite similar characteristics – waterfront location, industrial heritage, and development pressure – the cases differ significantly due to variations in institutional capacity and coordination. Rotterdam demonstrates a policy-driven and integrated model, while Gdańsk and Rome illustrate how fragmented ownership and weak governance lead to conflict-prone or uneven development.

The analysis also shows that waterfront location functions as spatial potential rather than a determinant. Its successful activation depends on planning coherence and institutional capacity. In cases where these are lacking, such as Rome, water remains underutilized, while in Gdańsk its potential is constrained by fragmented development processes.

The role of creative industries is ambivalent. They contribute to spatial activation, identity-building, and heritage reuse, but also intensify investment pressure and gentrification, particularly in weakly regulated contexts. This confirms their dual function as both catalysts and risk factors within transformation processes.

The study identifies three ideal-typical configurations: an integrated (Rotterdam), fragmented (Rome), and hybrid conflict-driven model (Gdańsk). These should be understood as dynamic arrangements of interacting factors rather than fixed categories.

Overall, the findings support a configurational and relational approach, emphasizing that transformation outcomes depend on the alignment between spatial potential and institutional capacity, mediated by cultural dynamics. This perspective contributes to a more nuanced understanding of post-industrial regeneration and highlights the need for integrated governance and adaptive planning in waterfront redevelopment.

Conclusions

The comparative analysis of the Gdańsk Shipyard, the Ostiense district, and the Van Nelle Factory demonstrates that successful post-industrial waterfront regeneration is shaped by the interaction of environmental, cultural, social, and

institutional factors. While all three cases share waterfront locations and strong industrial heritage, their transformation trajectories differ significantly due to variations in governance models, planning frameworks, ownership structures, and heritage protection regimes.

The findings confirm that waterfront location alone does not ensure inclusive, sustainable, or resilient transformation. Rather, it functions as a spatial potential that must be activated through coherent spatial strategies, integrated governance, and long-term planning. In cases where coordination is limited, such as in Ostiense, the potential of water-related landscapes remains underutilized, particularly in terms of public accessibility and spatial integration.

Creative industries play a significant but non-autonomous role in regeneration processes. They contribute to identity formation, heritage preservation, and social engagement, supporting the transformation of post-industrial areas into spaces of cultural expression and public interaction. At the same time, their impact remains ambivalent, as culture-led regeneration can intensify investment pressure and contribute to gentrification, particularly in contexts characterized by weak institutional control.

The analysis highlights the importance of strong public-sector involvement, institutional continuity, and adaptive planning policies. The case of Rotterdam illustrates how integrated, policy-driven approaches can balance heritage preservation with new development, while fragmented ownership and selective planning, as observed in Gdańsk and Rome, tend to generate conflicts and limit the effectiveness of regeneration processes.

The most effective transformation models are those that integrate environmental resilience, cultural continuity, social inclusion, and economic viability. Post-industrial waterfronts, despite their functional obsolescence, retain significant spatial and symbolic value, particularly due to their capacity to accommodate diverse, multi- and intercultural environments. Their successful regeneration depends on the integration of ecological design principles with culturally embedded functions, leading to the emergence of a distinct ecocultural identity.

At the same time, long-term regeneration processes based on cultural values face significant challenges, especially in relation to gentrification and market-driven dynamics. In contexts of fragmented ownership and increasing development pressure, achieving a balance between competing interests remains particularly difficult.

Overall, the study demonstrates that successful post-industrial transformation is not determined by individual factors, but by specific configurations of interrelated conditions. This highlights the need for evolving urban policies that integrate culture, heritage, and water within a coherent and adaptive framework, supporting more sustainable and socially inclusive regeneration outcomes.

Conflict of interest

The author declares no conflict of interest and assures that the work is the result of her own creation.

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Transformacja obszarów poprzemysłowych pod presją dziedzictwa, wody i gentryfikacji: studium porównawcze Gdańska, Rzymu i Rotterdamu

Zarys treści: Artykuł analizuje czynniki kształtujące adaptacyjne ponowne wykorzystanie poprzemysłowych obszarów nadwodnych, ze szczególnym uwzględnieniem roli kultury oraz uwarunkowań lokalizacyjnych związanych z wodą w procesach rewitalizacji. Celem badania jest identyfikacja czynników sprzyjających transformacjom poprzemysłowym i hamującym je oraz wypracowanie rekomendacji dla planowania, zarządzania i polityki publicznej wspierających inkluzywną i zrównoważoną regenerację. Porównawcza analiza jakościowa trzech europejskich studiów przypadku – Stoczni Gdańskiej, dzielnicy Ostiense w Rzymie oraz Fabryki Van Nelle w Rotterdamie – koncentruje się na modelach zarządzania, instrumentach planistycznych, ochronie dziedzictwa, strukturach własności oraz roli sektorów kreatywnych. Wyniki wskazują, że o powodzeniu rewitalizacji decydują zintegrowane modele zarządzania, długofalowe planowanie i zaangażowanie sektora publicznego, a nie sama lokalizacja nadwodna.

Słowa kluczowe: regeneracja obszarów poprzemysłowych, rewitalizacja terenów nadwodnych, zarządzanie miejskie, przemysł kreatywny, dziedzictwo przemysłowe

Data przekazania tekstu: 17.12.2025; data zaakceptowania tekstu: 12.05.2026.

Article submitted: 17.12.2025; article accepted: 12.05.2026.