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Authors:

Zahraa Atha
Snehal Avhad
Shekhar Damaria
Sudha Dwivedi
Naishal Gajjar
Deepanshi Jaiswal
Odette Jin
Faris Aijaz Ahmed Khan
Shashwati Khawale
Purav Kothiya
Aksha Pandya
Kavin Rao
Advika Shetty
Alexandra Teran Rubio
Wei-Ni Ting
Shannon Utama
Junqi Wang
Tanisha Yelaka

EDITORS:

JOSHUA D. LEE, PHD
TANNAZ AFSHAR

Please do not distribute this report without written permission from Joshua D. Lee.

Email: jdlee2@andrew.cmu.edu

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EXECUTIVE SUMMARY

This report is the culmination of a 14-week coordinated research project conducted by 18 Master of Science in Architecture-Engineering-Construction Management (MS AECM) students at Carnegie Mellon University. Each fall semester, all graduating MS AECM students enroll in the *AECM Synthesis Project* course under the direction of Assistant Professor Joshua D. Lee and Tannaz Afshar, PhD in AECM Student. The course applies the diverse knowledge and skills that AECM students have acquired during their program to a critical public interest issue related to the built environment and the topics vary from year to year. In 2019 we focused on analyzing the environmental inequities in Pittsburgh schools. In the fall of 2020, we investigated the impact of COVID-19 on vulnerable communities. In 2021, we focused our efforts on understanding how deconstruction (as opposed to demolition) might reduce waste and provide new economic opportunities. In 2022, we explored a variety of ways Pittsburgh's design and construction industry might move towards a Circular Economy.

This year we conducted six distinct investigations specifically centered around the concept of adaptive reuse within the City of Pittsburgh. Our explorations encompassed diverse aspects of adaptive reuse, ranging from adaptive reuse potential of specific building typologies, such as roundhouses, bank buildings, and churches, to strategies from owners' perspectives, social impacts of adaptive reuse, and formulating a robust rating system tailored for existing buildings. **Chapter 1** focuses on the lessons learned from the economic, technical, and cultural aspects of the Hazelwood Green Railroad Roundhouse conversion to understand the construction and economic challenges while preserving its historical significance. **Chapter 2** offers a detailed market analysis using GIS and an economic feasibility analysis to repurpose the Wilksburg Bank Building as a restaurant incubator to further catalyze community revitalization. **Chapter 3** explores the process of converting a former church in the Southside Flats into the 22nd Street Condos by calculating their economic viability, market impacts, and construction challenges, exploring conversion details, and analyzing crime-vacancy impacts. Through GIS mapping, case studies, and interviews, **Chapter 4** examines the social impacts of Pittsburgh's new Downtown Conversion Program (PDCP), which provides incentives for converting vacant office space into mixed-income residential. **Chapter 5** gathered valuable data on why owners invest in adaptive reuse, their motivations, and how this is significant to AEC practitioners in Pittsburgh and beyond. The final chapter, **Chapter 6**, provides a comparative analysis and highlights many gaps between existing Environmental Rating Systems (LEED) and several Adaptive Reuse Models (AdaptStar, PAAM, & ARP) and provides a new tool that uses a pre-design and post-occupancy analysis to judge the efficacy of adaptive reuse projects that could lead to a "Certified Adaptive Reuse" designation in order for projects to receive public funds.

By exploring the diverse dimensions of repurposing structures, we aim to contribute meaningfully to the sustainable evolution of the urban landscape and play a role in shaping the future of our city. Together these reports provide preliminary but valuable insights that could aid stakeholders in the City of Pittsburgh in making better decisions informed by the goals of ecological preservation, social benefits of reuse, as well as economic feasibility through enhanced public conversation.

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CHAPTER 1: ADAPTIVE REUSE STRATEGIES FOR RAILROAD ROUNDHOUSES: LESSONS LEARNED FROM HAZELWOOD GREEN

AKSHA PANDYA, SHANNON UTAMA, SHEKHAR DAMARIA

CHAPTER SUMMARY

Roundhouses, initially designed for locomotive service, hold profound historical importance and represent a unique architectural legacy. Yet, merely about 5 percent of the initial 3,000 roundhouse buildings across the United States remain. The diminishing number of intact roundhouses poses a threat to the loss of significant historic structures. Through an in-depth case study, this research aims not only to safeguard these structures for society but also to guide economic considerations in their preservation.

Our literature review covers cost analysis, building typologies, and the distinctive challenges and opportunities posed by roundhouses. Cost analysis reveals a substantial reduction in construction expenses for adaptive reuse compared to new construction, emphasizing the advantages of maintaining building components. Building typologies underscore the importance of aligning structural form with prospective functionality. Roundhouse projects, however, face challenges such as structural instability and limited adaptability.

Despite numerous abandoned roundhouses in the United States, there is a lack of understanding regarding adaptive reuse projects tailored to railroad roundhouses. The Hazelwood Green Roundhouse serves as an intriguing case study, prompting questions about the applicability of similar abandoned roundhouses. Our research will focus on the lessons learned from the economic, technical, and cultural aspects of the Hazelwood Green Railroad Roundhouse that may serve as a reference for other roundhouses.

Research employs a case study approach, focused on examining the construction process, conducting interviews, and analyzing data. Findings from the Hazelwood Green Roundhouse emphasize the cost-effectiveness of adaptive reuse, particularly with tax credits, and advocate for the retention of existing materials for economic and environmental benefits. Thorough site visits, early consideration of hazards, and consistent Value Engineering practices, especially in material selections, are also crucial for successful projects.

To conclude, the significance of this research is to understand the construction and economic challenges, while preserving historical significance, serving as a reference for future initiatives. In adaptive reuse, existing conditions account for 20.20% of hard construction costs, while new construction allocates only 0.40%. Contrary, concrete

dominates new construction expenses at 17.44%, compared to 5.80% in adaptive reuse. These variations underscore the unique cost dynamics between the two approaches. This research acknowledges limitations, focusing predominantly on economic and constructability aspects, neglecting social and environmental considerations. To enhance future research on roundhouse projects, a broader scope beyond Hazelwood Green is essential, providing a comprehensive understanding of influencing factors and practical insights for diverse project planning and execution.

INTRODUCTION

The broad issue addressed in this research pertains to the preservation and economic considerations of the adaptive reuse of roundhouses, specifically those associated with the steam locomotive era between 1840 and 1950. The distinctive semi-circular shape of roundhouses served a functional purpose, housing a turntable at its center. The turntable allowed for the rotation of locomotives, to change direction, facilitating access to individual maintenance bays. Roundhouses were crucial for the repair, inspection, and storage of locomotives, providing a centralized facility for railway operations. The core problem involves the dwindling number of intact roundhouses, as only approximately 5 percent of the original 3,000 structures across the United States have survived.¹ This decline is attributed to the transition from steam to diesel locomotives, rendering many roundhouses obsolete and leading to their demolition, resulting in a significant loss of historical and cultural assets. Amongst the roundhouses and turntables in Pennsylvania, there are 17 roundhouses that are at least partially intact, 18 turntables with or without a roundhouse, 11 turntables where a roundhouse may have once existed, and 39 demolished roundhouses where an aerial view still shows the visual remains.² This further helps us understand the existing conditions of several roundhouses, even in Pennsylvania itself, and how we can try to preserve them by reusing the spaces available.

Railroad roundhouses are tangible historical artifacts that bear witness to the transformative era of steam locomotives, reflecting the technological and industrial advancements of the past. Western Pennsylvania played a significant role in the development of the steel industry, and railroads were integral to transporting raw materials and finished products. This has a rich industrial heritage, and the preservation of roundhouses can help maintain a connection to this heritage. By conserving them, society retains a connection to its railway heritage, fostering a sense of identity and continuity. The importance of addressing the preservation and adaptive reuse of roundhouses extends beyond mere historical preservation. Adaptive reuse projects for railroad roundhouses also contribute to economic revitalization and community development. Repurposing these structures into innovative spaces, such as coworking hubs or cultural centers, can generate jobs, attract businesses, and enhance the overall quality of life in the surrounding area. This not only preserves the physical integrity of the roundhouses but also infuses them with new life and purpose.

¹ Starr, T. (2022). *Stables of the iron horse: A definitive history of the American roundhouse* [online]. Available at: <https://www.nycshs.net/stables-of-the-iron-horse--a-definitive-history-of-the-american-roundhouse.html> [Accessed Nov. 29 2023]

² Steam Locomotive. (n.d). *Surviving roundhouse and turntables in Pennsylvania* [online]. Available at: <https://www.steamlocomotive.com/roundhouse/?state=PA> [Accessed Nov. 29 2023]

In summary, society's interest in preserving these structures reflects a commitment to maintaining a diverse and meaningful built environment, by analyzing economic considerations that contribute to the well-being and identity of communities.

LITERATURE REVIEW

Railroad roundhouses have a historical significance as they were an essential element of the railroad business. To protect their distinctive architectural and cultural history, these buildings should be utilized in an adaptable manner. Railway roundhouse preservation and adaptive reuse ultimately honor the past while fostering a more sustainable and engaging future for the communities. In the evolving landscape of adaptive reuse initiatives, the focal point of this literature review revolves around three key aspects through which we try to understand any gaps: cost analysis, building typologies, and the unique challenges and opportunities presented by Roundhouses. This may provide us with a reference for broader applicability in other roundhouses across the country, and thus help us identify gaps in framing our research question.

Cost Analysis for the Adaptive Reuse Project

The goal of the study by Sanchez et al. (2019) is to fill a significant gap in the literature, which frequently overlooks the financial implications of adaptive reuse projects, in general, specifically in the context of sustainability and the circular economy. The development and validation of a technique for assessing the cost performance of the adaptive reuse of building structures is the main goal of the Sanchez study.

The methodology used for the Sanchez study entails a thorough Life Cycle Assessment (LCA) of consequential substitutions together with cost analysis and a case study methodology. This method makes it easier to identify particular building parts, enabling a detailed breakdown of environmental effects. Notably, the findings show a significant decrease in construction costs for the adaptive reuse scenario when compared to the construction of a new structure, with a notable 70% decrease in the cost of the structural system (Sanchez, Esnaashary Esfahani, and Haas, 2019). Additionally, the cost distribution shows a decrease in material costs, highlighting the preservation of construction components in accordance with Circular Economy principles. The study also emphasizes that the adaptive reuse of non-structural parts may result in increased costs due to factors like unanticipated situations, physical complexity, and the requirement for adherence to building rules and regulations.³

Understanding Building Typologies

Adaptive reuse is emerging as a method for urban revitalization, especially when older structures still have a significant physical lifespan or possess cultural and historical value. Tracing back to the 1970s, adaptive reuse has grown as a distinct discipline, with various approaches providing different insights into the process. Cantacuzino (1975)

³ Sanchez, B., Esnaashary Esfahani, M. & Haas, C. (2019). *A methodology to analyze the net environmental impacts and building's cost performance of an adaptive reuse project: a case study of the Waterloo County Courthouse renovations*. *Environ Syst Decis* 39, pp.419-438. Canada: Springer Link

significantly contributed to this field in the 1970s, highlighting in his books the historical progression of adaptive reuse and presenting examples based on building typologies.⁴ Notably, the typological approach, one of the four methods outlined by Plevoets & Van Cleempoel (2013), links potential new uses to the original purpose of a building.⁵ Subsequent research has delved into various building types, emphasizing the connection between building form, typology, and potential functionality.

Langston (2011) has developed an Adaptive Reuse Potential (ARP) model that facilitates the assessment and prioritization of renovation projects.⁶ Archetypes have been created for ten fundamental facility categories to comprehend the potential benefits and risks of adaptive reuse efforts. The results indicate that each type of facility possesses a distinct profile, which helps inform early-stage strategic decisions. It becomes evident that the classification of a facility plays a pivotal role in the success of adaptive reuse. Categories of facilities like landmarks, healthcare, and retail tend to be more attractive for potential adaptive reuse initiatives compared to facility categories such as residential or religious buildings (Langston, 2011).

Exploring the Challenges and Opportunities of Roundhouse Projects as Adaptive Reuse Initiatives

Through the studies by Yazar (2013) and Engeman et al. (2002), we understand the industrial significance of railway roundhouses and its importance in contributing to the boom of the industrial economy. A roundhouse is a specialized structure made for maintaining and refueling locomotives.⁷ It has a semicircular shape, bays along the inside wall, and a central turntable providing simple access to the locomotives. Due to their specialized use and locomotive-specific design, these buildings were widespread during the golden era of railroads but became extinct when rail transportation dwindled in the middle of the twentieth century.⁸

The development of roundhouses throughout history and its potential for adaptive reuse are woven together in a complex web of innovative design ideas. The semi-circular shape has long been a universal metaphor for the interconnection of all things, leading 20th-century architects like Charles Deaton to design roundhouses.⁹ The

⁴ Cantacuzino, S. (1975). *New uses for old buildings* [online], Vol. 7, pp. 90-91. Available from: JSTOR [Accessed Nov. 29 2023]

⁵ Plevoets, B., & Van Cleempoel, K. (2013). Adaptive reuse as an emerging discipline: An historic survey. In G Cairns (Ed.), *Reinventing architecture and interiors: a socio-political view on building adaptation*. London: Libri Publishers. pp.13-32

⁶ Langston, C. A. (2011). *On archetypes and building adaptive reuse*. pp.1-12. Gold Coast: In Proceedings of the 17th Annual Pacific Rim Real Estate Society (PRRES) Conference

⁷ Yazar, N., E. (2013). Railway Heritage of Roundhouses in Turkey. *Ironbridge 2013 Conference: "Rust, Regeneration, Romance"*. Available at: https://www.academia.edu/37648697/Railway_Heritage_of_Roundhouses_in_Turkey [accessed 29 November 2023]

⁸ Depperman, W., & Engeman, R. H. (2002). Oregon Places: The Brooklyn Roundhouse. *Oregon Historical Quarterly* [online], 103(2), pp. 234-249. Available from: JSTOR [Accessed 29 Nov. 2023]

⁹ Mandala Custom Homes. (n.d). *Round House Living: The History and the Healing* [online]. Available at: <https://www.mandalahomes.com/custom-home/round-house-living-the-history-and-the-healing/> [Accessed Nov. 29 2023]

reason for this obsession with round shapes in architecture is that they represent harmony and balance (Depperman and Engeman, 2002).¹⁰

A study by Heritage Toronto (2022) demonstrates that due to the smaller surface area exposed to bad weather, roundhouses also excel in energy efficiency. Their aerodynamic design reduces temperature swings and draughts, which results in decreased heating and cooling costs.¹¹ Roundhouses possess a more condensed structure in contrast to conventional dwellings, leading to a reduced amount of outer surface area that is susceptible to severe weather conditions. The curved structure of roundhouses also possesses inherent aerodynamic properties. This design facilitates unidirectional airflow around the structure, mitigating the effects of wind pressure on the walls and minimizing the forces that can lead to thermal transfer.

Yazar (2013) provided a SWOT analysis for conversions of several roundhouses in Turkey and pointed out a few of the barriers. Because roundhouses are frequently situated on property owned by railroad companies, it can be difficult to negotiate land use and ownership rights. Additionally, structural instability is a major problem because roundhouses were initially built to sustain the weight of locomotives and need expensive changes to allow changing applications. Roundhouse's limited practical adaptability, combined with their semi-circular design and distinct historical purposes, makes it challenging to convert them for contemporary demands without jeopardizing their utility and architectural integrity.¹²

Conclusion

In conclusion, the literature review has identified certain gaps that warrant further exploration. While existing research, as highlighted in the mentioned papers, has provided insights into the economic implications of any adaptive reuse, there is a need for more comprehensive studies that consider diverse contexts, specifically railroad roundhouses. The unique economic challenges of the Hazelwood Green Railroad Roundhouse necessitate a tailored analysis. Additionally, though some papers only touch upon the obstacles and advantages of roundhouse projects, a more in-depth examination of the construction challenges faced by specific roundhouses and their successful economic solutions is needed.

PROBLEM STATEMENT & RESEARCH QUESTIONS

Our research helps to assess and understand the various considerations and lessons learned from a particular case study of a Roundhouse in Pittsburgh, and how that can assist as a reference for other roundhouses across the country. In the realm of adaptive reuse and preservation of historical structures, the abandoned roundhouses built between 1840 and 1950 stand as unique architectural remnants, particularly in

¹⁰ Depperman and Engeman, *Oregon Places*, 234-249.

¹¹ Heritage Toronto. (2022). Roundhouse Park [online]. Available at: <https://www.heritagetoronto.org/explore-learn/toronto-rail-lands-history-tour/roundhouse-park-history/> [Accessed 29 Nov. 2023]

¹² Yazar, *Railway Heritage of Roundhouses*.

industrial landscapes like Pittsburgh and across the United States. These once-vibrant hubs for locomotive maintenance now symbolize a historical legacy awaiting rediscovery.

Our research focuses on a specific case study, the roundhouse at Hazelwood Green in Pittsburgh, which has undergone an ambitious transformation into an innovation hub. By delving into this specific case, the study aims to establish a foundational reference for the formulation of adaptive reuse strategies applicable to similar railroad roundhouses. The detailed examination of this case not only promises valuable insights but also provides a reference for addressing potential challenges regarding those encountered in the Pittsburgh case study. Our research question will scrutinize the factors influencing the economic, technical, and cultural aspects and the respective lessons learned from this adaptive reuse project, where, further, we aim to offer insights applicable to the broader context of preserving and repurposing abandoned roundhouses. Through a comprehensive analysis of this case study, we aim to distill valuable insights that can guide similar projects, fostering the preservation and adaptive reuse of abandoned roundhouses across the country. Our findings and discussions will take into account aspects like renovation costs and technical construction challenges, as it is important to assess these for broader applicability in the future.

The outcomes of this research are expected to contribute substantially to the expanding body of literature on adaptive reuse. The suggestions derived from the study can offer practical guidance for bringing roundhouses back into functional existence, addressing economic challenges encountered during construction. Ultimately, this research aspires to play a pivotal role in promoting the successful adaptive reuse of roundhouses across the country.

Research Questions

What are the economic, technical, and cultural lessons from Hazelwood Green Railroad Roundhouse that can serve as a reference for the adaptive reuse of other roundhouses?

METHODOLOGY

The study employs a comprehensive approach to thoroughly investigate the economic consequences and practicality of adaptive reuse, with a specific emphasis on roundhouse construction. The selected methodology incorporates a wide range of approaches, each specifically tailored to offer a unique perspective on the issue. The first methodology utilizes a comprehensive case study approach, which includes observations and a thorough examination of the Roundhouse at Hazelwood Green. The purpose of this method is to provide detailed insights into how historical relevance and current utility can be integrated. The second approach entails conducting informal interviews with key stakeholders of the Hazelwood Green Roundhouse project, with a specific emphasis on gathering first-hand narratives of construction challenges faced by the individuals who are directly engaged in the project. The last approach employs 3D modeling and cost estimations to perform a comparative analysis and understand the economic variations that arise in the context of repurposing existing structures, as opposed to embarking on new construction. These methods aim to create a thorough understanding of the economic, technical, and cultural factors involved in the adaptive

reuse of roundhouse structures. They provide useful insights for future projects in Pittsburgh and beyond.

Method 1 - Case Study

An in-depth case study of Roundhouse at Hazelwood Green provides a thorough response to our research question. Site visits facilitated a firsthand exploration of the integrated old and contemporary structural elements, aiding in evaluating and understanding the complexities during the construction process and associated costs. We were able to evaluate the integration of new use (Innovation hub) with the preservation of historical essence (Roundhouse). This in-depth analysis of Roundhouse acts as an example, providing useful information and insights that can help to create a more nuanced understanding of the advantages and disadvantages of a roundhouse adaptive reuse from an economic perspective. As a result, this case study method, along with the other method, could assist in forming a reference case for a few or similar cases across the country.

Method 2 - Stakeholder Informal Interview

Another research method for this study involves conducting informal interviews with key personnel who were actively involved in the Hazelwood Green Roundhouse project in Pittsburgh, notably representatives from One Valley (the tenants), PJ Dick (the construction managers), and GBBN (the architects). Our primary objective is to gain a comprehensive understanding of the adaptive reuse of the Hazelwood Green Roundhouse project, with a specific focus on the transformation of old versus new structural elements, interior elements, and the overall reuse of the site in context to the constructability. This process serves as a crucial means to address our overarching research question. By engaging with the individuals who played pivotal roles in the renovation of this project, we unearth valuable insights that will contribute to a broader understanding of the economic implications and feasibility of adaptive reuse in the context of roundhouse structures and conduct gap analysis on the same, ultimately laying a reference for potential adaptive reuse initiatives of other roundhouses in Pittsburgh and beyond.

Method 3 - 3D Model and Cost Estimations

After collecting data through the aforementioned methods, we identified the new and retained elements. Subsequently, a 3D model was created in Revit to assess the quantities and estimates of the retained or refurbished elements necessary for constructing a new building. This facilitated a comparative cost analysis between an adaptive reuse project and a new construction project. Using the Revit model, we performed a quantity take-off for retained and refurbished elements and utilized RS Means to determine the cost per unit, allowing us to estimate the expenses in new ground-up construction. This approach enhances our understanding and comparison of significant cost distinctions between adaptive reuse and new construction projects.

FINDINGS

About Hazelwood Green Railroad Roundhouse and Design Concept

The original 10-bay railroad roundhouse at Hazelwood Green, known for its distinctive semi-circular shape, featured a central turntable for rotating and directing locomotives during maintenance. Repurposed into an innovation hub and coworking center, the building leverages its unique design for a new functional identity.

- Building age: 136 years (built in 1887)
- Building size: ±26,000 sqft
- Renovation Cost: ±\$13.7 million¹³
- Construction duration: ±15 months (3-4 months delay, incl. 3 weeks stoppage due to Covid)

The building had been unoccupied for two decades before this renovation in 2020. A strong commitment was displayed by GBBN to preserve as much as possible of the original structure. The names of all the stakeholders associated with this piece of structure are listed below.¹⁴

- Former Owner: Jones & Laughlin Steel, LTV Steel
- Current Owner: Almono Ltd Partnership
- Originally built by: Monongahela Connecting Railroad
- Current Tenant: OneValley
- Present Investors: Richard King Mellon Foundation, The Heinz Endowments
- Design Team
- Project Architect: GBBN
- Landscape Architect: LaQuatra Bonci Associates
- General Contractor: PJ Dick
- Structural Engineer: WBCM
- MEP Engineer: Buro Happold
- Civil Engineer: KU Resources
- LEED Consultant: evolveEA

The roundhouse project is a vital component of the Hazelwood Green development, aligning with the evolving neighborhood initiated by the Mill 19 project. It addresses the demand for cost-effective shared spaces, catering to startups influenced by high-tech research and development led by Carnegie Mellon University and the University of Pittsburgh. The semi-circular building, constrained by limited land, presented challenges for residential and institutional typologies but proved ideal for providing shared spaces to accommodate startups. Its unique design, both distinctive and aesthetically appealing, creates a visually impactful and memorable environment conducive to the creative ambiance of innovation hubs.

¹³ Hazelwood Green. (2023). Development Roundhouse: *A historic space renovated for the innovators of today* [online]. Available at: <https://www.hazelwoodgreen.com/roundhouse> [Accessed Nov. 29 2023]

¹⁴ Montgomery, L. (2021, August 16). Insights from our tour of the Roundhouse [online]. Available at: <https://gba.org/blog/what-we-learned-on-our-tour-of-the-roundhouse/> [Accessed 29 Nov. 2023]

Outdoor space highlights: Garage doors in front of the open work area were replaced with large windows to enhance appreciation of the spacious, well-lit environment. The windows offer picturesque views of a new public area seamlessly integrating with industrial remnants like the turntable and an old shed's steel frame.

Indoor space highlights: In the transformation of the original single high-ceiling floor building, the architect integrated a partial second floor, complementing the structure's semi-circular shape. This addition brings forth an extra open work area, dedicated office spaces, and shared spaces such as conference rooms and meeting rooms. Notably, it also incorporates a glass-walled event space. Furthermore, industrial features like the crane serve as enticing elements in space, while simultaneously preserving its historical essence.

Space Occupancy: One Valley joined Hazelwood Green's tech community, aiming to connect Pittsburgh startups with global capital, talent, and customers. From our site visit and discussion with One Valley, we understand that they have leased space in the building, offering hot desks at \$125/month, dedicated desks at \$350/month, and office spaces for startups ranging from \$450 to \$3,401/month. Offices accommodate 1 to 8 people, varying from 70 to 475 sq ft, with 89.47% occupancy as of October 2023. Desk areas are at 29% occupancy. The high occupancy rate of office spaces reflects the significant demand for startup office space.

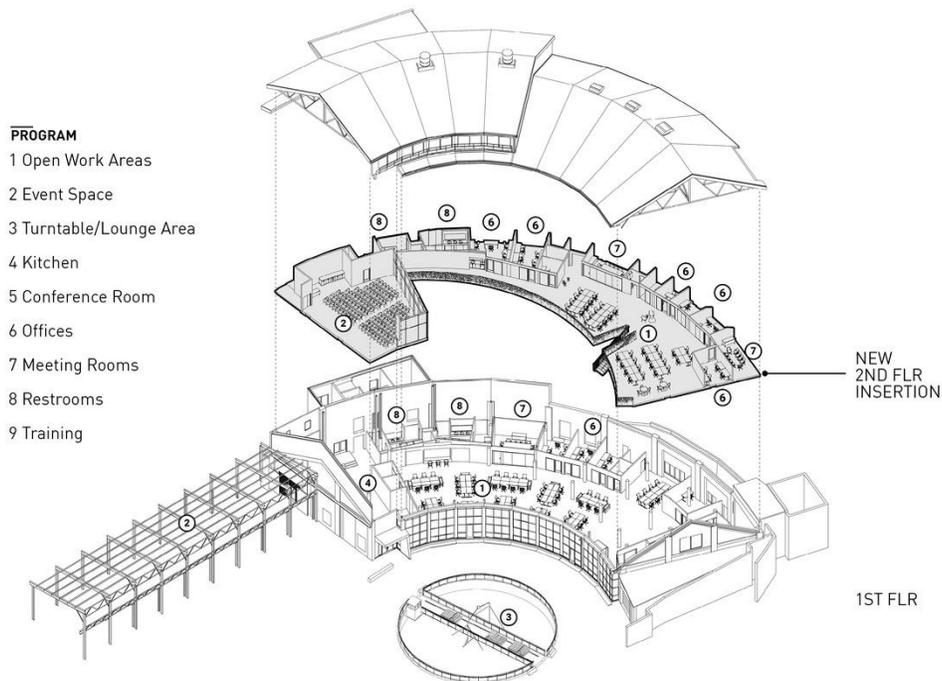


Figure 1. Building Axonometric View (Source: GBBN)

Construction and Its Technical Challenges

The interview with project stakeholders provided insights into the construction process and its technical challenges. Initially planned for March 2021 completion, the roundhouse faced a 3 to 4-month delay due to unforeseen events. Mobilization started in February 2020 but was briefly paused for 3 weeks due to COVID-19. Work resumed in mid-April. Contractors emphasized the vital role of thorough site visits in understanding current conditions. Unforeseen challenges, such as 40-foot-tall columns and concealed structural steel with narrow flanges, posed significant challenges and required strategic project changes for success.



Figure 2. The Deteriorated Conditions of the Steel Structure (Source: Almono Ltd Partnership)

Figure 3 (left) reveals severe corrosion in the steel structures. Additional support, new steel splices (middle), and two extra columns were added to support the original crane. To enhance stability, column bases were encased in concrete (right).

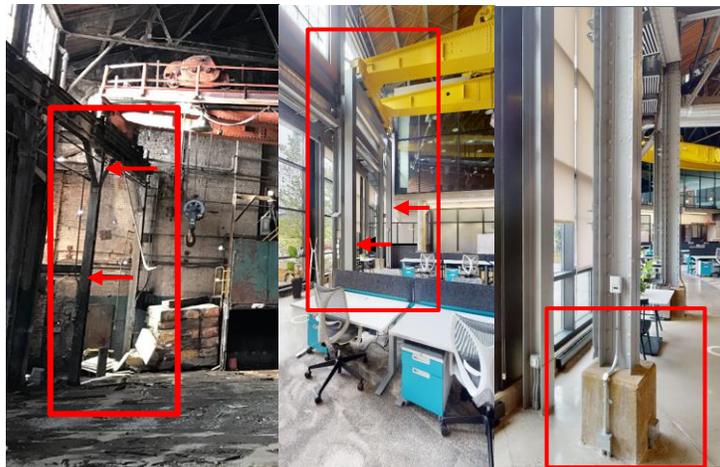


Figure 3. Steel corrosion: left image (Source: Almono Ltd Partnership); New columns to support the existing crane: middle image (Source: Ed Massery); New concrete base: right image (Source: Ed Massery)

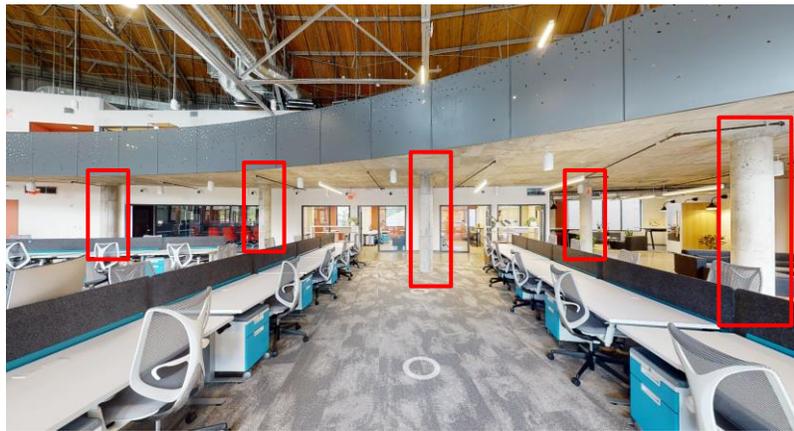


Figure 4. New second floor: top image (Source: Matterport); New columns for the second floor: bottom image (Source: Matterport)

Hazardous materials, contaminated soil, and locomotive remnants were found, prompting thorough excavation and analysis to mitigate risks in the early phases of construction. A specialized contractor assessed soil and subsurface conditions to address environmental concerns. Chemical issues, like the presence of lead paint, were also addressed.

The roundhouse's roofing refurbishment involved replacing the external roofing elements initially with metal roof and preserving the visually appealing wood roof underside decking. However, during a value engineering discussion, it was decided to use shingles for the external covering instead of metal roofing as per the original design. This choice reduced costs significantly. Figure 5 illustrates the prioritized careful cleaning of the deck. Additionally, a fire hazard in a section necessitated the procurement of wood boards with similar grains to the existing ones to safeguard the roof wooden deck. Unfortunately, this incident led to a one-month project delay.



Figure 5. The current condition of the roof and roof vents which are now covered
(Source: Photos from site visit)

The original crane used for maintenance of locomotives inside the structure was retained due to its historical significance. The team successfully integrated the crane into the building's design as a decorative element, a notable challenge. The process included carefully removing the crane from the structure, stripping unnecessary mechanical components, addressing issues like lead paint, and reinstalling it on-site. Although the crane is now stationary and welded in place, its preservation was a crucial aspect of the design that everyone desired.



Figure 6. The preserved crane as a focal point inside the building (Source: Ed Massery)

Finally, the construction of The Roundhouse concluded in July 2021, slightly behind the initially scheduled completion date of March 2021. Notably, the project adhered to a Guaranteed Maximum Price (GMP) method. While the owner's budget was met, it is significant to highlight that nearly the entire contingency fund, constituting 20% of the project's budget, was utilized to address unforeseen challenges and necessary adjustments during construction.

Costs Associated with Construction and Its Detailed Breakdown

Through discussions with architects and contractors, we gained a comprehensive understanding of the project's financial components. Although they did not provide specific data on the total project cost, online sources indicate that it is \$13.7 million. However, we did acquire a detailed breakdown of the hard construction expenses associated with each project component from them. This dataset will serve as the

cornerstone for our next comparative analysis, facilitating a thorough comprehension of the economic factors involved in repurposing roundhouses. The goal is to understand the economic aspect that can serve as a reference for comparable roundhouse adaptive reuse projects.

Table 1. A detailed breakdown of hard construction costs from architect and contractor team in order of largest to smallest costs

Item	% of total construction costs
Demolition and Concrete Work	13.70%
Electrical	12.90%
HVAC	11.20%
Drywall/General Trades	9.70%
General Conditions	6.70%
Site Concrete and Earthwork	5.10%
Masonry, Interior Brick Repointing, Brick Cleaning, Lead Paint Removal	4.70%
Steel and Miscellaneous Metals	4.40%
Roofing	4.00%
Plumbing	3.40%
Micropiles	3.10%
Glazing	3.00%
CM Fee	2.80%
Construction Contingency	2.70%
Insurance and Bonds	2.00%
Landscaping	1.50%
Fire Protection	1.30%
Metal Panels	1.10%
Millwork	0.90%
Flooring	0.70%
Polished Concrete	0.60%
Painting	0.60%
Sponge Blasting	0.60%
Elevators	0.60%
Bridge Crane Relocation	0.50%
Asphalt	0.50%
Abatement	0.40%
Tiling	0.40%
Preconstruction and Exploratory Work	0.40%
Allowances	0.20%
Permits	0.20%
Overhead Doors	0.10%
Total	100.00%

Cost Comparative Analysis

Our goal is to evaluate the project's cost if it were implemented as a new ground-up construction. We compare these costs with the adaptive reuse cost to determine whether the adaptive reuse approach is more cost-effective than building from the ground up, or vice versa, specifically related to construction. This comparison is essential for understanding the project's feasibility for stakeholders. During stakeholder interviews, we identified that the Hazelwood Green Roundhouse adaptive reuse project included substantial demolition of the original structure while preserving specific elements, including:

1. Masonry wall - The external brick wall that was preserved.
2. Steel columns and beams - All steel columns and beams were retained.
3. Roof substrate - Comprising only the underside of the wood roof decking.
4. Steel structural components - Encompassing the roof trusses, bracings, and purlins.

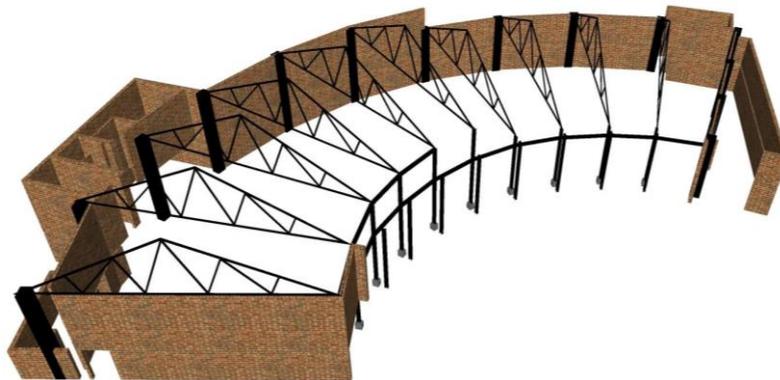


Figure 7. The retained structural steel and exterior masonry wall

To accomplish it, we generated a 3D model in Revit, as depicted in Figure 8, to determine quantities and estimations of the retained or refurbished elements required for constructing a new roundhouse. The 3D model was constructed using 2D drawings sourced from the internet, information gathered during our site visit to the roundhouse, and 3D images available online from Matterport that allowed for measurements. We made every effort to replicate the building as accurately as possible, given the constraints of the limited sources at our disposal.

Using the Revit model, we conducted a quantity take-off for various items mentioned earlier, as outlined in Table 2 below. Subsequently, we utilized RS Means to obtain the cost per unit for these items to estimate the cost of each individual item. For a consistent comparison, we utilized RS Means data from the first quarter of 2020 in Pittsburgh, aligning with the commencement of construction earlier that year. It is also important to highlight that we could not always find an exact match for all items in RS Means specifications. In such cases, we selected the closest available specification that could be applied to our project.

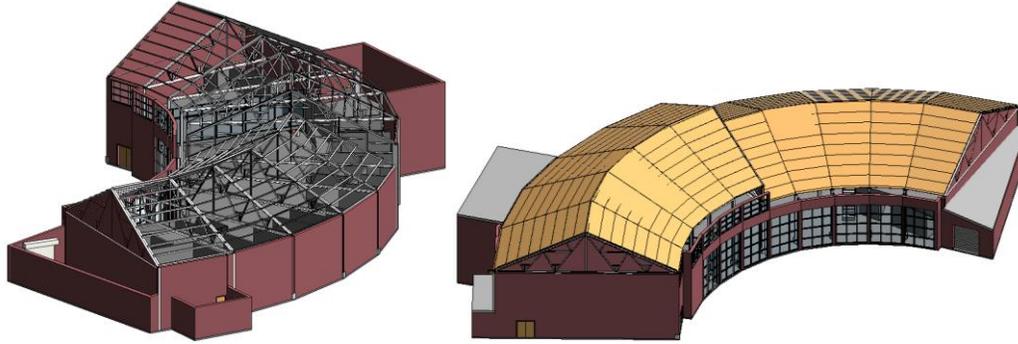


Figure 8. Revit Model Roundhouse at Hazelwood Green

Table 2. Summary of quantity take-off and RSMeans cost estimation (Source: Revit model and RS Means)

Item		Quantity	Unit	RS Means Specification	O&P Cost
Wall	Brick walls	13,745.51	SF	Common brick, 12" thick, incl. mortar, 3% brick waste, 25% mortar waste, vertical reinforcement and grout, excl. scaffolding & horizontal joint reinforcement	\$710,642.87
Structural Steel	Columns	675.19	LF	Structural, 2 tier, W10x45, A992 steel, incl. shop primer, splice plates, bolts	\$55,811.21
	Beams	576.17	LF		\$47,626.21
Roof	Wood plank	6,781.26	SF	Cementitious wood-fiber plank, beveled edge, 1" thick	\$37,229.12
Trusses	Framing	6,846.69	LF	Angle framing, structural steel, 3"x3"x3/8", field fabricated, incl. cutting and welding	\$346,990.25
	Purlin	3,455.98	LF	Girt/purlin, C/Z shapes, 6"x2-1/2"x2-1/2", 16 ga., 3.0 lb/LF, shop fabricated, incl. primer coat, clips and bolts, materials only	\$14,342.32
	Purlin installations	180	Ea.	Girts/purlins/eave struts, 16ga., 6" deep, installation only	\$9,842.40

Following this, we conducted a comparative cost analysis between adaptive reuse and new ground-up construction, using a total project cost of \$13.7 million for the Hazelwood Green Roundhouse as stated above. We assumed that 80% of this total cost accounted for the hard construction expenses, based on insights from stakeholders indicating that the hard construction cost typically falls between 75-90% of the total project costs. In this scenario, the total hard construction cost is approximately \$10,960,000. Using the detailed cost breakdown in Table 1 above, we estimated costs for each element by multiplying the total hard construction cost by the assigned percentage. Elements were categorized according to MasterSpec divisions to identify the division with the largest share of hard construction costs.

For new ground-up construction, we adopted the same costs as in the adaptive reuse approach for newly constructed items, not retained or refurbished. Retained and refurbished elements were cost-calculated using quantity take-offs and RS Means estimations, highlighted in red in Table 3. Reasonable assumptions were made for items that could not be directly calculated or estimated from the Revit model or RS Means. For permit fees in new construction, we assumed an average of the range, 0.5% - 2%, totaling 1.25% of the total construction cost.¹⁵ Foundation costs were assumed to be 12% of the total project cost.¹⁶ Regarding concrete work, it is understood that the team demolished the existing concrete floor due to damages and replaced it with new concrete. However, in the breakdown of costs, we were provided a total percentage for “Demolition & Concrete Work” from stakeholders, amounting to 13.7%. Based on that, we assumed 8.5% for demolition costs (within the range of 5%-10%)¹⁷ and the remaining 5.2% as the concrete costs, applicable to both adaptive reuse and new construction. Additionally, an average of 25%, which is a 12.5% Tax Credit/Benefit has been factored into our calculations for the overall project cost in the case of Adaptive Reuse.¹⁸ Conversely, for new construction, a 5% margin of error was incorporated to account for potential discrepancies in quantity take-offs and estimations.

Table 3. Comparative Analysis between Adaptive Reuse Roundhouse and New Construction (highlighted in Red)

Master spec	Item	Adaptive Reuse		New Ground-up	
		Total %	Total Costs	Total %	Total Costs
01	Allowances		\$21,920		\$21,920
	Construction Contingency		\$295,920		\$295,920
	Insurance and Bonds	7.90%	\$219,200	8.97%	\$219,200
	Permits		\$21,920		\$131,250
	CM Fee		\$306,880		\$306,880
02	Bridge Crane Relocation		\$54,800		-
	Abatement		\$43,840		-
	Micropiles		\$339,760		-
	Sponge Blasting	20.20%	\$65,760	0.40%	-
	Preconstruction and Exploratory Work		\$43,840		\$43,840
	General Conditions		\$734,320		-
	Demolition		\$931,600		-
03	Polished Concrete	5.80%	\$65,760		\$65,760
	Concrete Work		\$569,920		
	<i>New Construction - Concrete Work</i>		-	17.44%	\$569,920
	<i>New Construction - Foundation</i>		-		\$1,260,000
04	Masonry, Interior Brick	4.70%	\$515,120	6.54%	-

¹⁵ GetASitePlan. (2023). *Building permit cost - complete list of average prices* [online]. Available at: <https://getasiteplan.com/building-permit-cost/> [Accessed 29 Nov. 2023]

¹⁶ Potter, B. (2021). *Construction Cost Breakdown and Partial Industrialization* [online]. Available from: <https://www.construction-physics.com/p/construction-cost-breakdown-and-partial> [Accessed Nov. 29 2023]

¹⁷ Biro, A. (2023). *A complete guide to adaptive reuse in 2023* [online]. Available at: <https://www.mbharch.com/post/a-complete-guide-to-adaptive-reuse-in-2023> [Accessed 29 Nov. 2023]

¹⁸ Historic Preservation Tax Credit (HPTC). (2023). *Pennsylvania Department of Community and Economic Development* [online]. Available at: <https://dced.pa.gov/programs/historic-preservation-tax-credit-hptc/> [Accessed 29 Nov. 2023]

	Repointing, Brick Cleaning, and Lead Paint Removal on CMU				
	<i>New Construction - Masonry (External)</i>		-		<i>\$710,643</i>
05	Steel and Miscellaneous Metals	5.50%	\$482,240	9.91%	\$482,240
	Metal Panels		\$120,560		\$120,560
	<i>New Construction - Steel Columns, Beams</i>		-		<i>\$103,437</i>
	<i>New Construction - Steel Trusses, Purlins</i>		-		<i>\$371,175</i>
06	Millwork	0.90%	\$98,640	0.91%	\$98,640
07	Roofing	5.30%	\$438,400	5.69%	\$438,400
	Fire Protection		\$142,480		\$142,480
	<i>New Construction - Wood Roof Underline</i>		-		<i>\$37,229</i>
08	Glazing	3.10%	\$328,800	3.13%	\$328,800
	Overhead Doors		\$10,960		\$10,960
09	Drywall/General Trades	11.40%	\$1,063,120	11.50%	\$1,063,120
	Tiling		\$43,840		\$43,840
	Flooring		\$76,720		\$76,720
	Painting		\$65,760		\$65,760
14	Elevators	0.60%	\$65,760	0.61%	\$65,760
22	Plumbing	3.40%	\$372,640	3.43%	\$372,640
23	HVAC	11.20%	\$1,227,520	11.30%	\$1,227,520
26	Electrical	12.90%	\$1,413,840	13.01%	\$1,413,840
31	Site Concrete and Earthwork	5.10%	\$558,960	5.14%	\$558,960
32	Asphalt	2.00%	\$54,800	2.02%	\$54,800
	Landscaping		\$164,400		\$164,400
	Total	100.00%	\$10,960,000	100.00%	\$10,866,614
	Tax Incentives/Credits	12.5%	(\$1,370,000)	0%	-
	Margin of Error	0%	-	5%	\$543,331
	Grand Total		\$9,590,000		\$11,409,945

The comparison between adaptive reuse and the new construction approach shows a similar result for the total hard construction cost. However, by applying a 12.5% tax credit to the adaptive reuse project and incorporating a 5% margin of error for the new construction project (due to some limitations and uncertainties in our estimation), we could achieve savings of nearly \$2 million with an adaptive reuse approach. Our savings could further increase if we secure a higher tax credit percentage that can go as high as 20%, which varies from one project to another.

The bar graph below, illustrated in Figure 9, represents the percentage of total construction cost associated with the Masterspec division in a comparative analysis between an adaptive reuse structure and new ground-up construction, sorted in descending order to demonstrate specific components that consumed the highest and lowest consumption. From this graph, it is evident that the highest hard construction cost for the adaptive reuse project is associated with existing conditions, followed by electrical, finishes, and HVAC, respectively. In contrast to the adaptive reuse project,

new ground-up construction incurs the highest cost in concrete works, with existing conditions having the lowest cost among all elements.

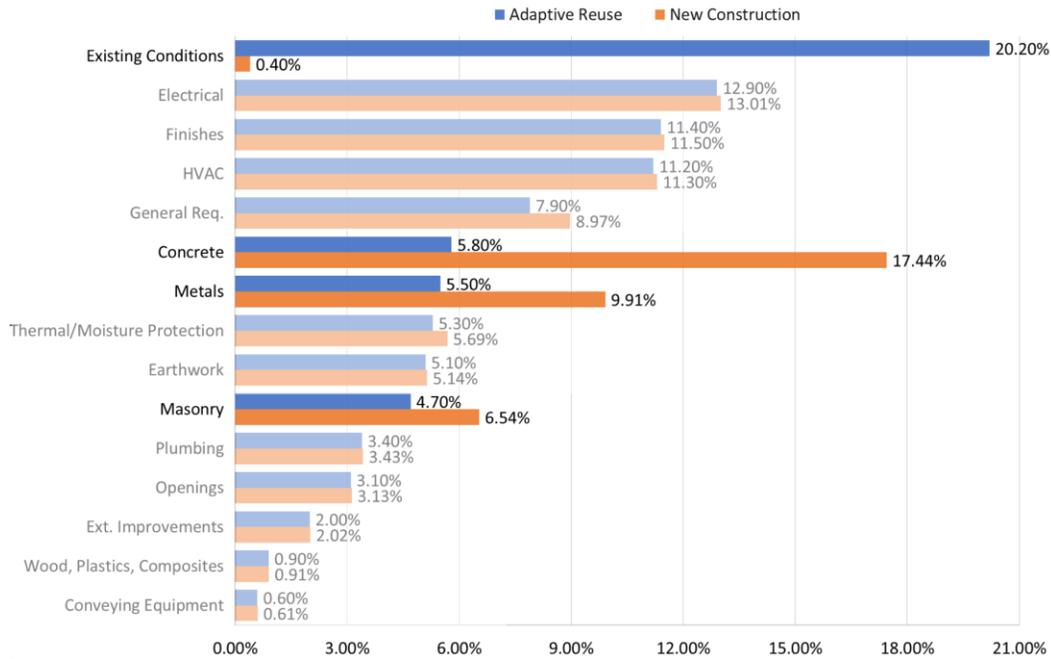


Figure 9. Comparison of total construction cost percentage between adaptive reuse and new construction

DISCUSSION

We have emphasized four elements that exhibit the most significant difference between adaptive reuse and new construction approaches in Figure 9. As mentioned earlier, a substantial portion of construction costs in an adaptive reuse approach is allocated to existing conditions. Existing conditions are inevitable in adaptive reuse projects, given the building's age, particularly considering that most roundhouses were constructed in the late 1800s. In new construction, concrete significantly influences construction costs. Utilizing existing concrete can result in substantial cost savings in construction. The same applies to the steel structure, assuming that most roundhouses are equipped with steel structures. Reusing these two elements not only yields significant cost savings but also aligns with sustainability considerations. It is noteworthy that just two materials, concrete and steel, contribute up to 13.5% of global CO₂ emissions.¹⁹

Recommendations

Our research has the potential to significantly influence and inform future practices in adaptive reuse projects involving railroad roundhouses across the United States. Drawing lessons and recommendations from the Hazelwood Green Roundhouse case, our findings provide valuable insights for stakeholders and professionals engaged

¹⁹ Fennell, P., Driver, J., Bataille, C., & Davis, S. J. (2022, March 23). Cement and steel - nine steps to net zero [online]. Available at: <https://www.nature.com/articles/d41586-022-00758-4#ref-CR1> [Accessed 29 Nov. 2023]

in similar initiatives addressing a current dearth of information in the field. Regarding construction challenges, our research offers an understanding of potential hurdles during construction, empowering project teams with the foresight needed to tackle uncertainties and manage risks proactively. The cost analysis we present offers guidance for owners and designers to implement effective cost-saving strategies. This enables stakeholders to make well-informed financial decisions, optimize resource allocation, and improve the overall viability and success of adaptive reuse projects. Our objective is to encourage other stakeholders to consider adaptive reuse for roundhouses, preserving their historical and cultural significance. Instead of abandoning, we hope that the existing 17 partially intact roundhouses in Pennsylvania could be preserved, emphasizing the importance of safeguarding what remains of this architectural heritage. Through this proactive approach, we also aim to encourage stakeholders to view them as valuable opportunities to ensure the continued relevance and significance of roundhouses. Thus, below are a few recommendations from our study for the stakeholders involved.

Economic Considerations

Owners and Designers:

- Conduct a comprehensive cost-benefit analysis to evaluate the economic feasibility of repurposing existing structures with constructing new ones from the beginning. Prioritize the retention and refurbishment of existing materials, particularly concrete and metals, to minimize construction costs.
- Apply value-engineering techniques to maximize resources and save costs, particularly concerning materials, by incorporating local or cost-effective alternatives.
- Examine financial incentives, like government grants and tax incentives, to improve the economic viability of adaptive reuse initiatives. Explore the possibility of establishing public-private partnerships to get supplementary money and assistance for the effective execution of the project.

Broader Applicability

Owners and Designers:

- Leverage the circular form of roundhouse constructions for practical versatility. Examine various utilization typologies, such as cultural and event venues, commercial establishments, offices, fitness and recreation centers, exhibition spaces, and give priority to projects focused on preserving historical significance.
- Retain distinctive historical elements such as turntables and cranes to uphold the authentic nature of the roundhouse architecture. Integrate these historical aspects strategically into the design, boosting the overall appearance of the adaptive reuse project.

Contractors and Construction Managers:

- Conduct thorough site visits before construction to identify and mitigate potential unforeseen issues. The purpose of this is to detect any pre-existing issues that may provide difficulties during the adaptive reuse process, such as

structural defects, environmental factors, encased structural components, or unforeseen challenges associated with the incorporation of both old and new elements.

- Given that roundhouses, like many older structures, may potentially contain hazardous materials such as lead paint or contaminated soil, it is crucial to carefully consider these materials from the project's inception. Furthermore, the objective is to formulate methods that mitigate or tackle these problems at the initial phases of planning, and assess the associated risks, hence diminishing the probability of expensive unforeseen events throughout the construction process.
- It is imperative to pay careful attention to accessibility considerations, specifically to ensure compliance with the Americans with Disabilities Act (ADA). Existing conditions and potential barriers should be assessed to understand how to incorporate the necessary accessibility standards into an existing building.

Limitations

This research has several limitations. To begin with, the study primarily concentrates on the lessons learned from Roundhouse at Hazelwood Green related to economics and constructability. Although important, this does not extensively consider the historical and environmental aspects of these structures. Second, concerns arise from data source bias as the division of hard construction costs relies heavily on input from the project's contractors, architects, and stakeholders, while the total project costs are sourced from online references. There is a lack of confirmation from project stakeholders regarding the accuracy of the total project costs and the allocation of costs to hard construction expenses. In addition, the accuracy of the 3D model used for quantity take-off is compromised by discrepancies between online drawings, 3D scans, and on-site photographs, leading to limitations in accurately representing smaller and more intricate components. Finally, while our research aims to offer guidance for other adaptive reuse projects involving railroad roundhouses, it's important to acknowledge that the findings from the Hazelwood Green case study may be site-specific and some cases are not universally applicable to other locations.

Future Work

In future work, it is crucial to expand the scope of the research beyond the single instance at Hazelwood Green. While the insights gained from this case serve as a valuable basis, a more comprehensive foundation can be developed through the examination of additional roundhouse projects. By conducting studies on a broader range of such projects, we can accumulate more data, enabling a deeper understanding of the various factors influencing roundhouse initiatives. This expanded research effort will contribute to a more nuanced and applicable set of insights for the planning and execution of diverse roundhouse projects.

CHAPTER 2: STRATEGIC ADAPTIVE REUSE FOR THE WILKINSBURG BANK BUILDING FOR COMMUNITY AND ECONOMIC REGENERATION

SNEHAL AVHAD, SHASHWATI KHAWALE & ALEXANDRA TERAN-RUBIO

CHAPTER SUMMARY

In response to the escalating global challenge of vacant buildings, adaptive reuse emerges as a sustainable solution, surpassing the conventional approach of new construction. Wilkesburg, a Western Pennsylvania borough near Pittsburgh faces property vacancy issues tied to poverty and population loss. The community, which was once a thriving industrial hub, started seeing an economic downturn followed by population decline and blight with the fall of the steel industry. The vacancy rate for Wilkesburg, as of January 2023, is approximately 15% (around 1,066 vacant properties).²⁰

Our literature review explores the dimensions of adaptive reuse, emphasizing its cost-effectiveness and role as a catalyst for urban revitalization. In addressing vacant properties in Wilkesburg, the review identifies a gap in the applicability of this research to the situation in Wilkesburg, emphasizing the need for a holistic market study and funding exploration specific to Wilkesburg.

This study offers a magnified view of the market attributes in Wilkesburg by focusing on finding strategic adaptive reuse for the Wilkesburg Bank Building, located at 901 Wood Street, located in the central business district of Wilkesburg. Our market analysis using GIS and economic feasibility analysis using pro forma modeling informs the approach to repurposing the project. The inferences drawn from this study aim to support the community revitalization movement at large.

Wilkesburg faces economic challenges due to population decline, vacant properties, high taxes, and a high crime rate. Based on records, Wilkesburg has 1,066 empty properties, accounting for 15% of the borough's total property inventory.²¹ Old buildings decay amid funding constraints, leading to a business exodus. A phased adaptive reuse plan recommends a shared kitchen, escape room, and rooftop BBQ rental facility, educational and office spaces addressing community needs. The projected investment strategy for the recommended use prioritizes community development along with profit generation. Findings indicate a sustainable approach, with the investor

²⁰ Dufalla, L. (2023) Wilkesburg's vacant property problems on Precipice of Change, PublicSource. Available at: <https://www.publicsource.org/wilkesburg-pittsburgh-housing-vacant-property-sheriff-sale/> [Accessed: 13 Nov. 1 2023.]

²¹ Dufalla, *Wilkesburg's vacant property problems*.

projected to break even in the fifth year, initiating revenue accumulation for transformative community and economic regeneration.

This project stands as a model for revitalizing the historic building, fostering community pride, and creating sustainable cultural and economic impact. Embracing this innovative approach will contribute significantly to Wilkinsburg's social fabric and promote a vibrant, inclusive future for the community.

INTRODUCTION

Situated a mere seven miles from Downtown Pittsburgh, Wilkinsburg stands as a resilient community embracing its past while forging a sustainable future. Originating in the 1850s along the Great Road to Fort Pitt, Wilkinsburg thrived with the advent of the railroad, gaining independence in 1876 after a brief annexation to Pittsburgh. Officially designated a borough in 1887, its prosperity waned in the mid-20th century with the decline of the steel industry.

The closure of steel mills, notably the Homestead Works of U.S. Steel, resonated in neighboring areas like Wilkinsburg, intensifying the challenges of blight. The demise of tens of thousands of steel and manufacturing jobs triggered an economic downturn, impacting the Monongahela Valley. The subsequent loss of industrial identity led to economic distress and physical deterioration. The struggle to find alternative employment and revitalize the region compounded blight challenges in Wilkinsburg. Despite a pro-development history in the 1990s, the borough contends with blight, crime stigma, high tax rates, and a widespread low-income population. Despite these challenges, Wilkinsburg, rooted in its history, showcases strength and potential, exemplifying perseverance.

In recent years, community efforts have sparked revitalization, addressing economic challenges and instilling optimism. Key players in this development are Wilkinsburg Borough and the Wilkinsburg Community Development Corporation (WCDC). The borough serves as the local municipal governing entity, focusing on public objectives beyond county and municipal capacities.

Founded in 2008, WCDC, a 501(c)(3) nonprofit, aims to revitalize Wilkinsburg through business and residential development, civic leadership, and cultural diversity. Seeking to change negative perceptions of Wilkinsburg, WCDC tackles intricate challenges, charting a course for a sustainable future. Both organizations collaborate to address economic and social challenges, emphasizing residential and commercial development in the central business district to combat the pervasive issue of vacant properties.

The adaptive reuse concept aligns with ongoing efforts to address vacant properties and enhance the overall health of the community. This research case study advocates for the adaptive reuse of the Wilkinsburg Bank Building, a vacant property in the central business district that has remained unoccupied since 2019. This transformative vision aims to rejuvenate the building and spur economic redevelopment in the surrounding neighborhood and the borough as a whole.

LITERATURE REVIEW

The literature studied delves into the diverse dimensions shaping the discourse on adaptive reuse and its benefits. Scholars highlight the cost-effectiveness of repurposing existing structures compared. Further, the review explores how adaptive reuse acts as a catalyst for urban revitalization, fostering healthier and more livable communities. Recognizing a pervasive gap for the specific case and application of adaptive reuse strategies, this review aims to provide a comprehensive reference point for developers, addressing challenges and offering insights into the transformative potential of such projects.

The Rhetoric of Adaptive Reuse

Bullen and Love (2010) touched on the central question of choosing between adaptive reuse or demolition for new construction. They have discussed the facets of this issue such as economic, social, environmental, and the corresponding dynamics. The authors have proposed an adaptive reuse decision-making process model following the discussion about the benefits of adaptive reuse.²² Scholars such as Hall (1998), Douglas (2006), and Kohler and Yang (2007)²³ showed that reusing buildings tends to incur lower costs compared to the expenses associated with demolition. The rationale behind this perspective is that adapting existing structures can be potentially more economical than tearing them down and rebuilding them. This is attributed to the presence of pre-existing structural components, leading to reduced costs of borrowing, particularly as contract periods tend to be shorter, as highlighted by Shipley et al. (2006).²⁴ The owners and practitioners are the key decision-makers in these processes and their perspective of utilizing the available resources to maximize the gains takes center stage.¹ Bullen and Love (2010) have focused on this aspect of redevelopment and proposed a building viability process model, that owners, occupiers, and planners can use to determine the strategy needed to meet changing commercial and regulatory demands required of buildings to address the barriers to adaptive reuse.²⁵

Adaptive Reuse as a Tool for Revitalization for Healthier and Livable Cities

Cherchi (2015) discussed various factors that the adaptive reuse of monumental buildings offers to healthier and livable communities. These factors include proximity, connectivity, awareness of community identity, and permeability. This study discusses how recovering a historic abandoned building and the beginning of a new regenerative program contributes to the improvement of the sense of belonging and identity of a

²² Bullen, P.A. and Love, P.E.D. (2010). The rhetoric of adaptive reuse or reality of demolition: Views from the field. *Cities*, 27(4), pp.215-224. And Hall, P.G., 1998. *Cities in Civilization* (Vol. 21). New York: Pantheon Books. And Douglas, J., 2006. Building adaptation. Routledge.

²³ Kohler, N. and Yang, W., 2007. Long-term management of building stocks. *Building Research & Information*, 35(4), pp.351-362.

²⁴ Shipley, R., Utz, S. and Parsons, M. (2006). Does Adaptive Reuse Pay? A Study of the Business of Building Renovation in Ontario, Canada. *International Journal of Heritage Studies*, 12(6), pp.505-520. doi:<https://doi.org/10.1080/13527250600940181>.

²⁵ Bullen and Love, *The rhetoric of adaptive reuse*.

community.²⁶ Hassan, Khalifa, and Hamhaber (2020), have shed light on how employing a framework for reuse purposes acted as a revitalization tool for Cairo when the administrative center was moved to a new satellite town from Cairo. This research investigated the potential effects of adaptive reuse of abandoned buildings in downtown resulting from the relocation to the New Administrative Capital (NAC), on their neighborhoods and, collectively, the city. By examining the existing framework for relocation and reuse processes, the research established a clear connection between adaptive reuse and the revitalization of abandoned structures and contributed insights to the broader discourse on urban renewal. Minding the difference of scale between the two cases in the picture, the research has clearly shown that a planned and well-researched approach is vital in revitalizing communities hit.²⁷

The persistent challenge of vacant properties and blight in Wilkinsburg, despite its proximity to a thriving urban center, suggests a critical gap in the understanding and application of adaptive reuse strategies by property owners and practitioners. While the benefits of adaptive reuse have been widely acknowledged, there seems to be a lack of a comprehensive reference point for justifying and evaluating decisions related to repurposing existing assets. This paper seeks to address this gap by providing valuable insights to developers engaged in adaptive reuse projects, focusing on the pivotal elements of a holistic market study and an exploration of funding opportunities.

PROBLEM STATEMENT & RESEARCH QUESTIONS

The primary objective of the research study is to guide decision-making by delving into the intricate composition of the community and neighborhood. By considering these aspects, the aim is to identify a viable reuse for buildings that can serve as catalysts for revitalization. The paper recognizes that the successful execution of adaptive reuse projects requires not only a well-conceived plan for repurposing but also a strategic approach to securing funding. Consequently, it proposes a hypothesis for reuse and conducts a preliminary evaluation to gauge potential returns over time.

Crucially, the study emphasizes the significance of aligning carefully selected reuse strategies with the most suitable funding options available. This synergy can substantially enhance the chances of success while mitigating the risk of failure. To illustrate these principles in action, the paper presents the example of the adaptive reuse of the Wilkinsburg Bank Building as a practical roadmap for revitalizing the community.

To conclude, the gaps in existing research point to a need for a more nuanced understanding of the intersection between adaptive reuse, community dynamics, and funding mechanisms in Wilkinsburg. By addressing these gaps through a comprehensive market analysis and practical evaluation, this paper aims to contribute to a more

²⁶ Cherchi, P.F. (2015). Adaptive Reuse of Abandoned Monumental Buildings as a Strategy for Urban Liveability. *Athens journal of architecture*, 1(4), pp.253-270.

²⁷ Hassan, N., Khalifa, M.A. and Hamhaber, J. (2020b). Adaptive Reuse as a Revitalization Tool: The Case of Downtown Cairo Post Relocation of Governmental Buildings to the New Administrative Capital. In: *Architecture and Urbanism: A Smart Outlook Proceedings of the 3rd International Conference on Architecture and Urban Planning, Cairo, Egypt*. Cham: Springer International Publishing : Imprint: Springer, pp.289-302.

informed and strategic approach to adaptive reuse projects, ultimately fostering the revitalization of Wilkinsburg.

Research Question

How can the adaptive reuse of the Wilkinsburg Bank Building be strategically planned and executed to maximize community impact and economic revitalization?

METHODOLOGY

To tackle Wilkinsburg's vacant properties and blight challenges, our strategy adopts a dual methodology centered on the adaptive reuse of the Wilkinsburg Bank Building.

Method 1: Market Analysis

The initial step involves a market analysis employing GIS mapping and charts to comprehend the Wilkinsburg community and the broader real estate market. Focused primarily on adaptive reuse, we examine factors such as building characteristics, site location, historical property records, demographics, connectivity, and community conditions. This targeted approach allows us to unravel crucial market dynamics, facilitating informed decisions for the success of the adaptive reuse initiative.

Method 2: Economic Feasibility Analysis

The second facet of our methodology involves an economic feasibility check evaluating the financial viability of repurposing the Wilkinsburg Bank Building, intertwining market analysis insights with economic considerations. We explore various funding sources to gauge the feasibility of the proposed construction, ensuring a nuanced understanding of potential profitability or loss. The report delves into funding feasibility by exploring grants, loans, equity, and tax support. The research considers eligibility and various factors. Upon securing funding, the revenues and expenses based on local market prices are estimated, deriving net operating income (NOI). Development costs, encompassing hard, soft, and site acquisition expenses, are thoroughly evaluated. Employing an optimal cap rate, the property's current value is determined, streamlining the calculation of the project's breakeven point for potential investors.

Crafted to align adaptive reuse strategies with community dynamics, this dual methodology combines market insights and economic analysis, forming a robust foundation for informed decision-making and successful revitalization initiatives in Wilkinsburg.

FINDINGS

Method 1 - Market Analysis

Background Information and Zoning

Wilkinsburg is governed by Wilkinsburg Borough, which aims to transform the central business district through a comprehensive plan. The Wilkinsburg Community Development Corporation (WCDC), established in 2008, focuses on driving economic development and enhancing the Central Business District's strength. In December 2022, Citizens Bank donated its former branch building to WCDC for redevelopment, a historic structure of over 14,074 square feet excluding the rooftop. Collaborating with a skilled project team, WCDC focuses on adaptive reuse, emphasizing critical stabilization, building system upgrades, and tailored improvements for the building. The strategically located Wilkinsburg Bank Building, at the intersection of Wood Street and Ross Street, holds economic development potential due to its historical significance, accessibility, and community dynamics.



Figure 1. Wilkinsburg Bank Building Project Location- Aerial View Zoning.

Zoning

Situated strategically in Wilkinsburg's prime area, the site is surrounded by commercial development along Penn Avenue. Moving away from the urban center reveals a transition to more residential development. The site has dual zoning of Transit-oriented development (TOD) and Central Business District (CBD).²⁸ This allows for flexibility in the zoning for building use. The existing use is commercial. Proposed use categories may be

²⁸ Borough of Wilkinsburg (2017) - Zoning Map 2013. Available at: <https://www.wilkinsburgpa.gov/departments/boards-committees-and-authorities/zoning-hearing-board/zoning-map-2013-2/>. [Accessed 13 Nov. 2023]

commercial, residential, small-scale public assembly, and institutional or community facility.

Demographics

According to the US Census Bureau Wilkinsburg, currently has a population of 14,140, which has declined by 24.2% since 2000 with a population growth rate of about -1.22% annually, See Figure 2. In 2021, there were 1.53 times more Black or African American (non-Hispanic) residents (7,730 people) than any other race. White (Non-Hispanic) and Two or more (Non-Hispanic) residents constituted the second and third most common ethnic groups. This demographic shift, where 97% of comparable cities grow faster, significantly shapes our market analysis.

Notably, a majority of Wilkinsburg's population is concentrated in young adults aged 22 to 39 presents a compelling opportunity as it is also the working population. The study suggests these demographic commutes to Pittsburgh, particularly in the food sector, making the site's proximity strategically advantageous for an industry where people would be comfortable working. Furthermore, the site benefits from the majority's use of public transportation due to its location and connectivity.

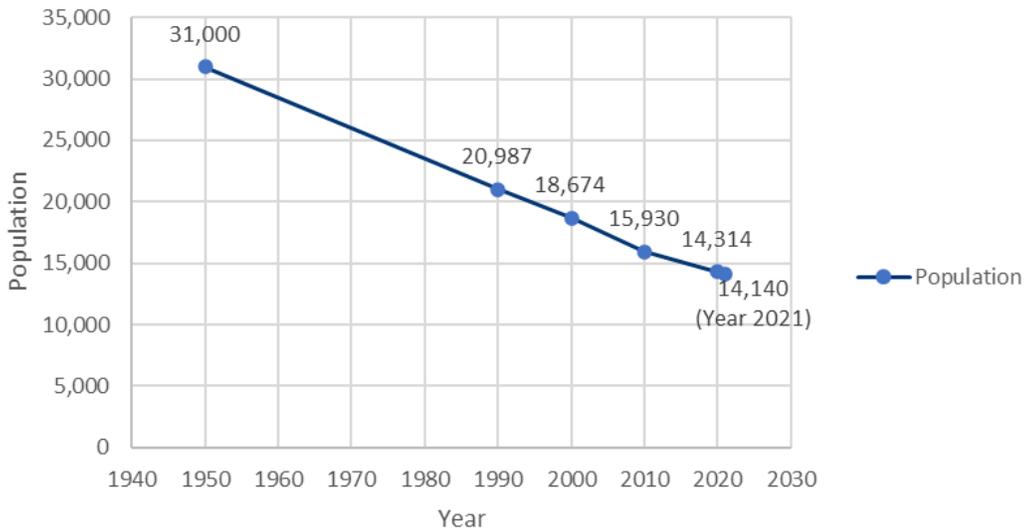


Figure 2. Wilkinsburg Population Trend.²⁹

²⁹ United States Census Bureau QuickFacts (2023) *U.S. Census Bureau QuickFacts: Wilkinsburg borough, Pennsylvania*. Available at: <https://www.census.gov/quickfacts/fact/table/wilkinsburgboroughpennsylvania/PST045222>. [Accessed 29 Nov. 2023]

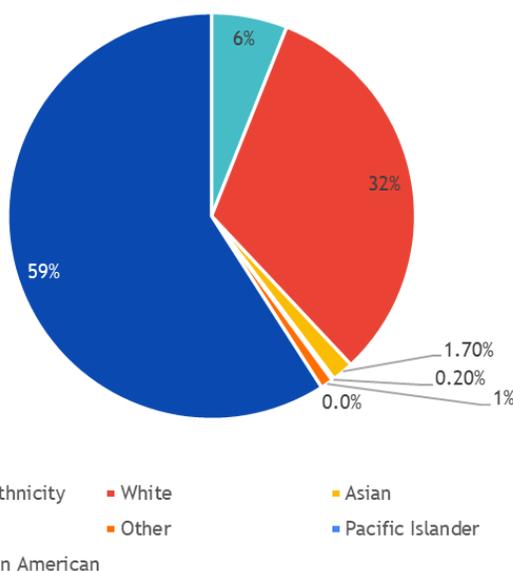
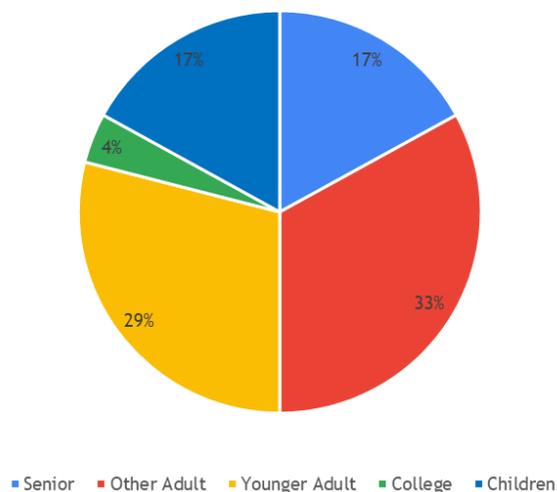


Figure 3. Population composition - Age (up) & Race & Ethnicity (down).

Tax Structure

High tax rates, notably a total millage rate of 43.23, a prominent cause of population decline in Wilksburg, create a significant financial burden compared to neighboring municipalities like Pittsburgh. For a \$100,000 property, Wilksburg owners pay \$1,974 more than their Pittsburgh counterparts, discouraging property ownership. Tax-delinquent properties further compound financial challenges, with approximately one-fourth of owners struggling to meet taxes, causing significant revenue loss for the borough.³⁰ These taxation challenges act as formidable barriers, hindering investment

³⁰ Allegheny County (2023). *Community Profile*. Available at: <https://apps.alleghenycounty.us/website/MuniProfile.asp?muni=129>. [Accessed 29 Nov. 2023]

and intensifying Wilkinsburg's economic challenges, particularly considering the substantial demand for smaller living or communal spaces.

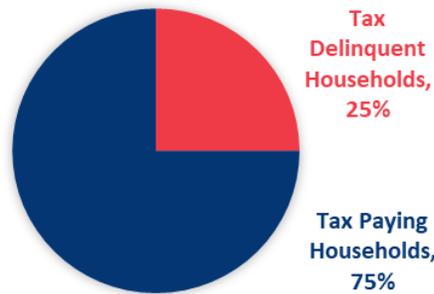
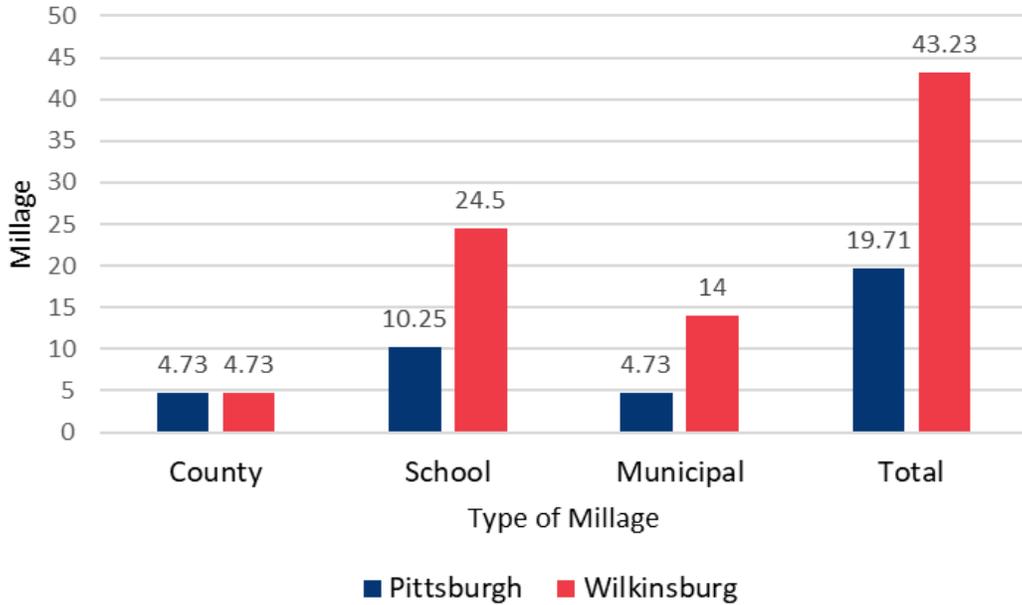


Figure 4. Taxation comparisons in Wilkinsburg and Pittsburgh(up) & Tax paying population (down).³¹

Average Income

In 2021, the median household income for the 8,100 households in Wilkinsburg, PA increased to \$39,793, up from the previous year's figure of \$37,649. The majority of households fall within the income range of less than \$10,000.

³¹ Allegheny County, *Community Profile*.

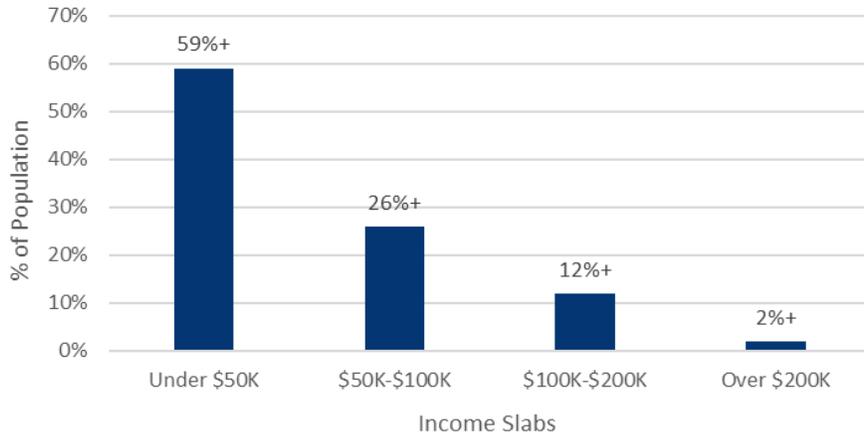


Figure 5. Household Incomes in Wilkesburg compared to Pennsylvania.³²

The borough’s median household income is \$39,793, just under two-thirds of the county’s annual median income of \$66,659. This insight informs adaptive reuse project feasibility, target audience identification, and purchasing power assessment. Notably, 23.4% of the population, exceeding the national average, lives below the poverty line, with males aged 6-11, females 25-34, and females 65-74 most affected. Analyzing Census Bureau income thresholds, this demographic understanding shapes a nuanced market approach, considering Wilkesburg’s economic landscape and potential challenges.

Homeownership analysis

A high proportion of single-person households (50.1%) suggests a potential demand for smaller living or communal spaces. Out of these households, 65% are renters. One of the reasons why people are hesitant to buy properties in Wilkesburg is its tangled titles and strict property rights laws associated with it.³³

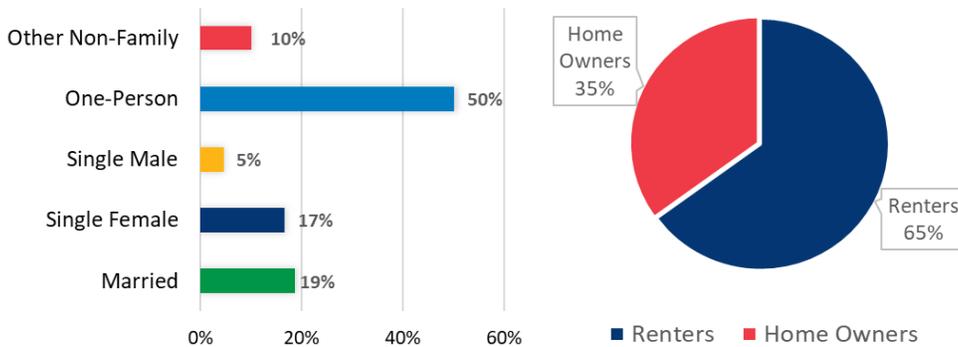


Figure 6. Number of Households (left)^{***} & Home Ownership in Wilkesburg (right).

^{*}Single male/female: Male/female householder, no spouse/partner present with children of the householder under 18 years

^{**}One-person: Householder living alone

³² Allegheny County, *Community Profile*.

³³ Data USA (2023) | Wilkesburg, PA . Available at: <https://datausa.io/profile/geo/wilkesburg-pa/>. [Accessed Nov. 6, 2023].

Urban Services in the Neighborhood

The site enjoys convenient proximity to essential community infrastructures. Health services, churches, police stations, fuel stations, train stations, and community centers are all within walking distance. Furthermore, a bus stop within a one-minute walk enhances accessibility for both residents and those relying on public transportation from outside the immediate vicinity. The yellow line in the map below shows the bus connectivity in the area which is opted by the majority of the population for commuting.

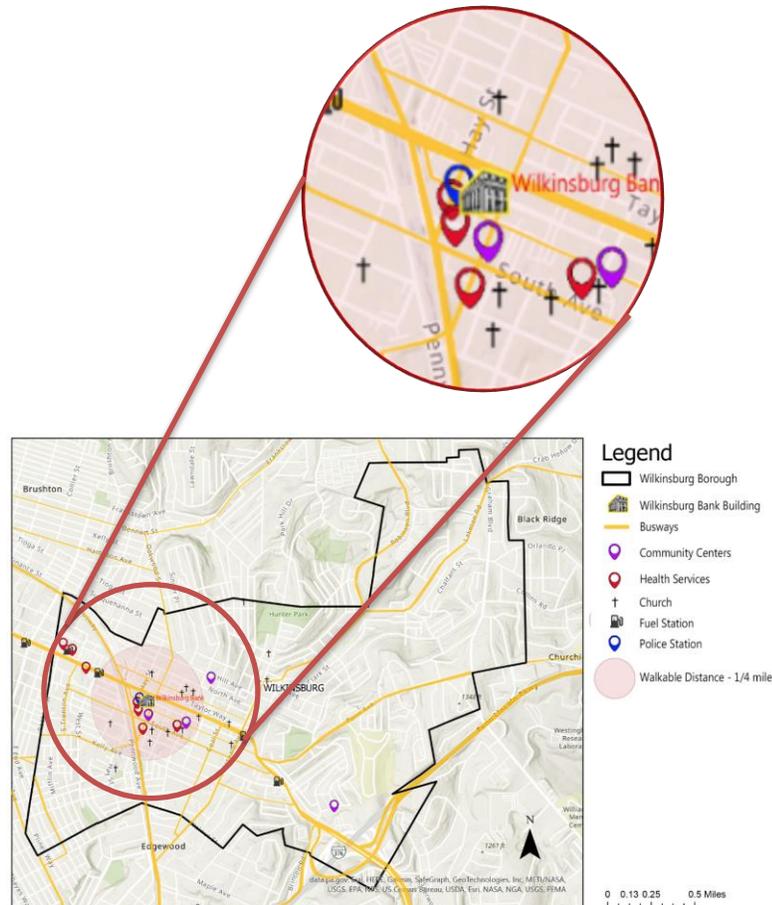


Figure 7. Location Map and Facilities in the Vicinity.

Vacancy and Blight

In Wilkinsburg, several tools, including Allegheny County's Vacant Property Recovery Program, actively listed sheriff sale properties, and the WCDC's Vacant Property Initiative, aim to address vacancy and blight. These programs facilitate residents in acquiring vacant and tax-delinquent properties while providing support to potential investors and homebuyers in terms of acquisition, financing, and restoration.

Despite these efforts, the alarming rise in vacancy persists, compounded by the burden of high property taxes, rendering current resources insufficient.³⁴

Notably, of the vacant properties, 500 are single-family houses, a crucial factor for understanding demand-supply dynamics. This data holds significance for making informed decisions regarding adaptive reuse in the Wilkinsburg real estate market, signaling challenges in the feasibility of repurposing these vacant single-family residential units for housing purposes.³⁵

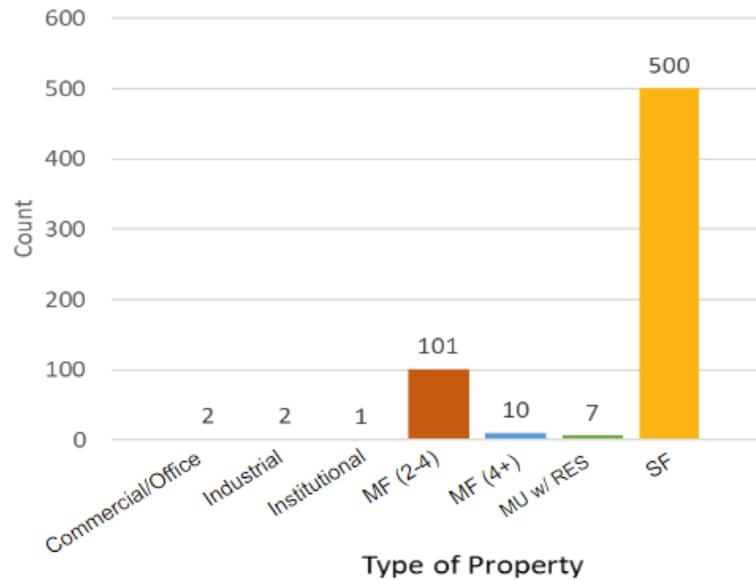


Figure 8. Chart showing vacant property count in Wilkinsburg.

Property Values and Trends

Most households in Wilkinsburg possess property values ranging between \$125,000 and \$150,000, with a median property value of \$98,600. The median sale price per square foot in Wilkinsburg is \$103/Sq.Ft.³⁶ Based on current market conditions, existing tenant occupancy, and ongoing redevelopment efforts, the most promising opportunities for facilitating additional revitalization are identified in the 600 and 700 blocks of Penn Avenue, along with the 700 to 900 blocks of Wood Street where the property is located, as indicated in the WDC report 2016.³⁷

Crime Rate

³⁴ burg2burgh (2023). *Vacancy & Blight*. [online] Wilkinsburg Merger. Available at: <https://wilkinsburgmerger.org/learn/vacancy-blight/> [Accessed 4 Dec. 2023].

³⁵ Western PA Regional Data Center (2023). <https://www.wprdc.org/en>. [Accessed Nov. 16, 2023].

³⁶ www.redfin.com. (n.d.). *Wilkinsburg Housing Market: House Prices & Trends* | Redfin. [online] Available at: <https://www.redfin.com/city/20858/PA/Wilkinsburg/housing-market#demand> [Accessed 4 Dec. 2023].

³⁷ Evans, T. (2022). *Wilkinsburg Business District Market Analysis Update*. [online] Available at: https://wilkinsburgcdc.org/wp-content/uploads/2023/04/DDAs-Wilkinsburg-Market-Analysis-2022_Final.pdf. [Accessed 29 Nov. 2023]

The city's violent crime rate for Wilkinsburg in 2019 was higher than the national violent crime rate average by 105.52% and the city property crime rate in Wilkinsburg was higher than the national property crime rate average by 24.11%.⁷⁶

Figure 10 highlights a higher incidence of criminal activity in the central region of Wilkinsburg, where our project is situated. Moving away from Penn Avenue corresponds to a decrease in the crime rate. Property fraud and larceny are the predominant crimes in Wilkinsburg, measured per 10,000 people. These insights are crucial for aligning building use strategies with the community's safety parameters. WCDC has a community process for restaurants selling alcohol and that can avoid ill effects from the crime rate perspective. One successful precedent of this is Salvatore Pizza house around the block that has a bar and there are no incidents of increased criminal activities.

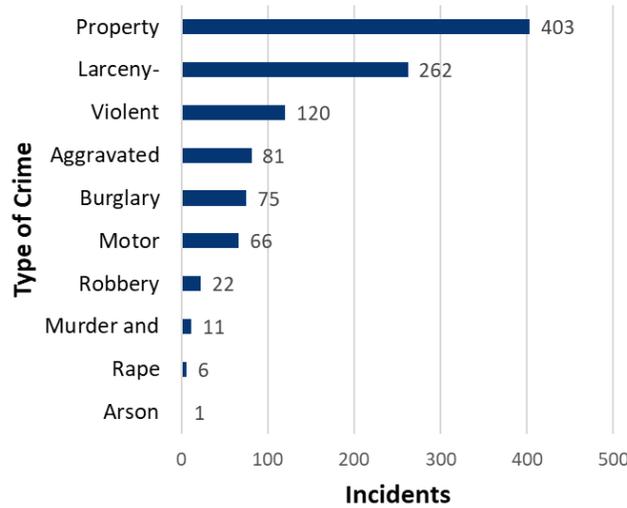


Figure 9. Crime Rate according to the number of incidents per 10K population in Wilkinsburg.³⁸

³⁸ Crime statistics report (U.S. crime rates) (2023) CityRating.com: Find the Best Places to Live in the USA. Available at: <https://www.cityrating.com/crime-statistics/>. [Accessed 09 Jan. 2024].

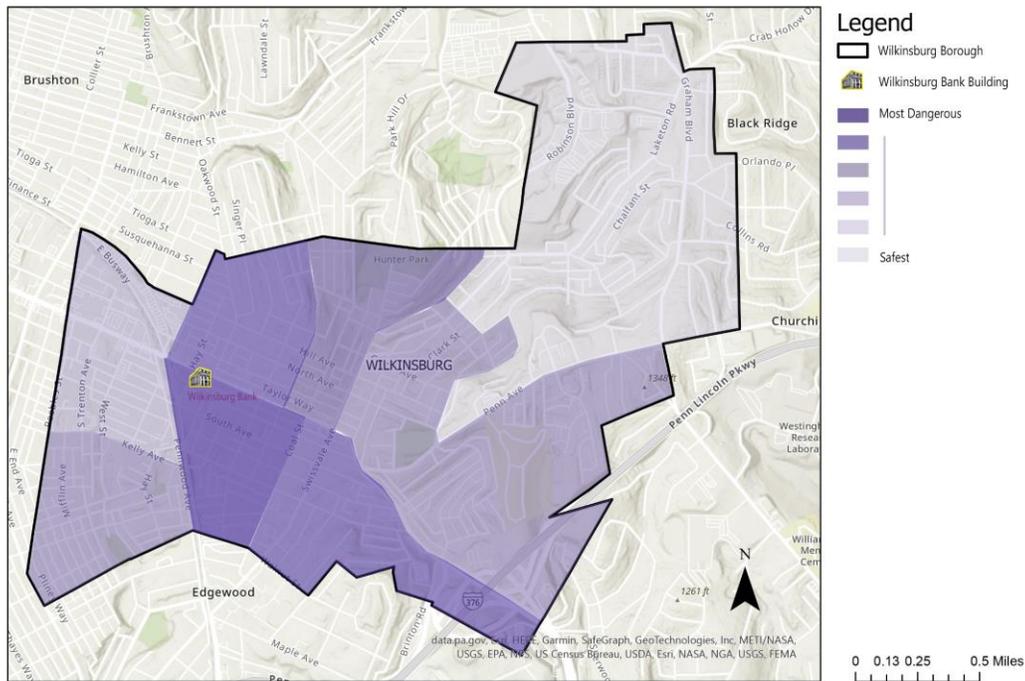


Figure 10. Crime Rate in Wilkinsburg.

Existing Businesses in the Neighborhood

The neighborhood's business analysis in Figure 11 highlights a thriving food industry, particularly in restaurants with approximately \$9,900 in sales annually. While the Gas/Auto and Healthcare sectors dominate retail sales, they are unsuitable for this building's structure, because of the physical constraints of the building. Grocery stores and Markets are significant but mostly vacant in the block. So restaurants are the next feasible option.³⁹

This data highlights the lucrative potential for redevelopment in the food industry. Real estate developers can capitalize by creating restaurant-friendly spaces, collaborating with culinary entrepreneurs, and aligning adaptive reuse with the growing demand for dining experiences. Figure 10 shows the composition of retail businesses in Wilkinsburg. This suggests a scarcity of bakeries, music stores, used merchandise, auto parts, and beverage carry-out shops suggesting a development potential of these businesses in the neighborhood.

³⁹ Evans, T. (2016). *Wilkinsburg Business District Market Analysis*. [online] Available at: <https://wilkinsburgcdc.org/wp-content/uploads/2023/04/DDAs-Wilkinsburg-Market-Analysis-Final.pdf> [Accessed 6 Dec. 2023].

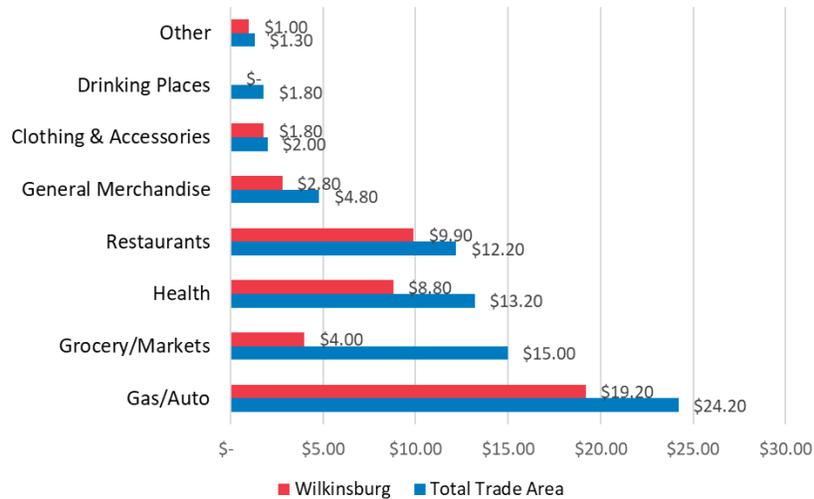


Figure 11. Estimated Annual Retail Sales in Wilkinsburg (in Thousands).⁴⁰

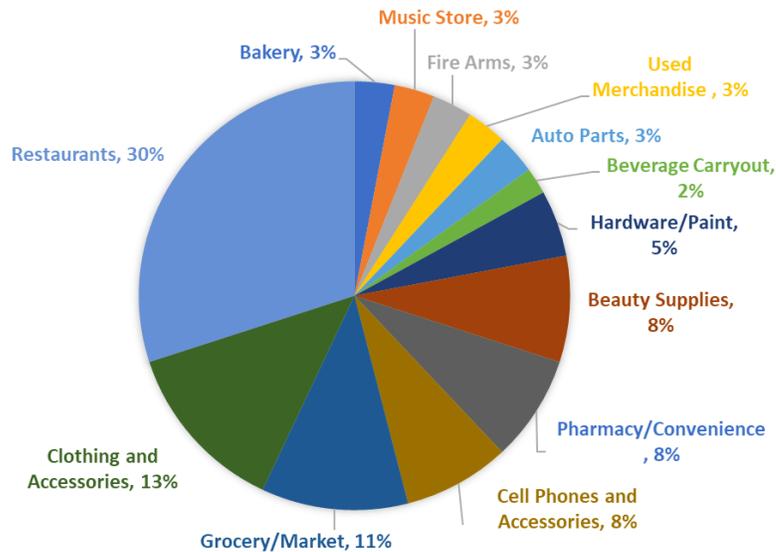


Figure 12. Retail Businesses in Wilkinsburg.⁴¹

Eateries and Beverage Stores

Concentrating on the food sector, Figure 13 illustrates the distribution and quantity of eateries and beverage stores. Notably, the majority of establishments in the area belong to the fast-food category. However, there is a limited presence of fresh food restaurants, with only four bakeries identified. Furthermore, it is observed that these bakeries are not open daily to the public. This observation underscores a potential gap in the market, indicating an unmet demand for businesses and services in the area that provide fresh and regular food offerings. Addressing this gap could present a valuable opportunity for entrepreneurs and investors looking to diversify and enhance the local food service landscape.

⁴⁰ Western PA Regional Data Center.

⁴¹ Western PA Regional Data Center.

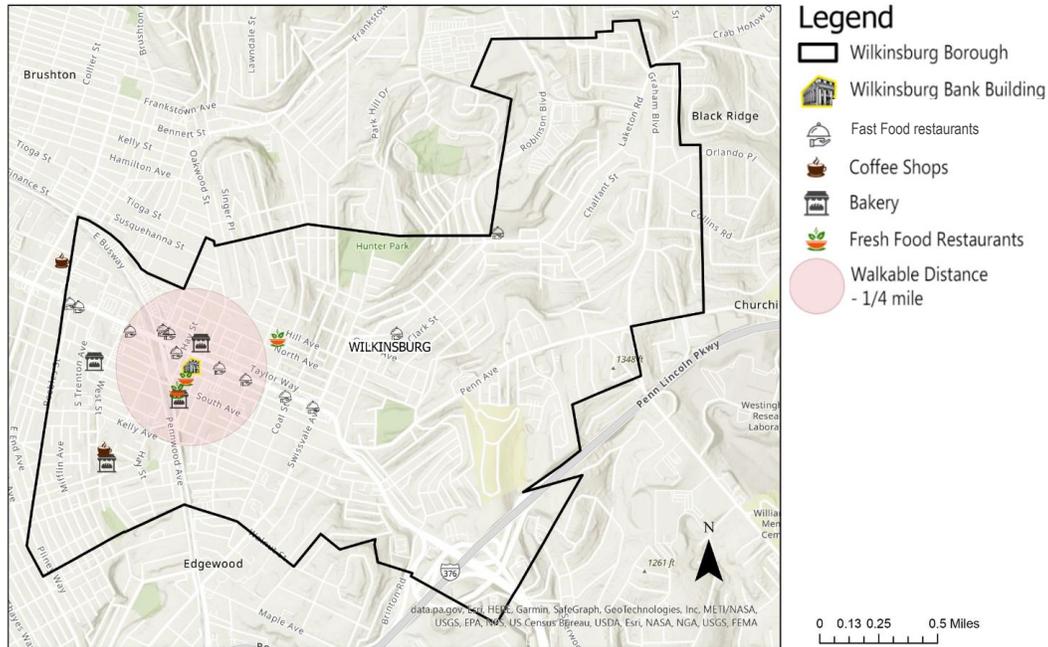


Figure 13. Eateries and Coffee Shops in Wilkinsburg.

Property Details

The facility is a three-story brick structure with a full basement. Ceilings are plaster or ceiling tiles. Walls are plaster, drywall, paneling, marble, and brick. Flooring surfaces include concrete, wood, floor tile, carpet, leveler, mastic, sheet flooring, ceramic, marble, and cork. The existing condition of the Wilkinsburg Bank building reveals varied states across its floors. The basement, unfinished and to be maintained as such, had one room renovated in the past, with plans for additional restroom installations. The 1st floor underwent a previous renovation, removing marble columns for improved layout flow. New concealed beams reinforce the structure, and the HVAC system is fully functional. The mezzanine, formerly the bank manager's office, is intended to become a mechanical room. The 2nd floor, renovated in the 1980s, lacks ventilation adequacy and requires HVAC system upgrading. The 3rd floor shows exterior wall cracks, ongoing structural studies, water infiltration, and necessitates HVAC and roof upgrades. The exterior requires window replacements due to leakage signs, while the walls remain in good condition overall.

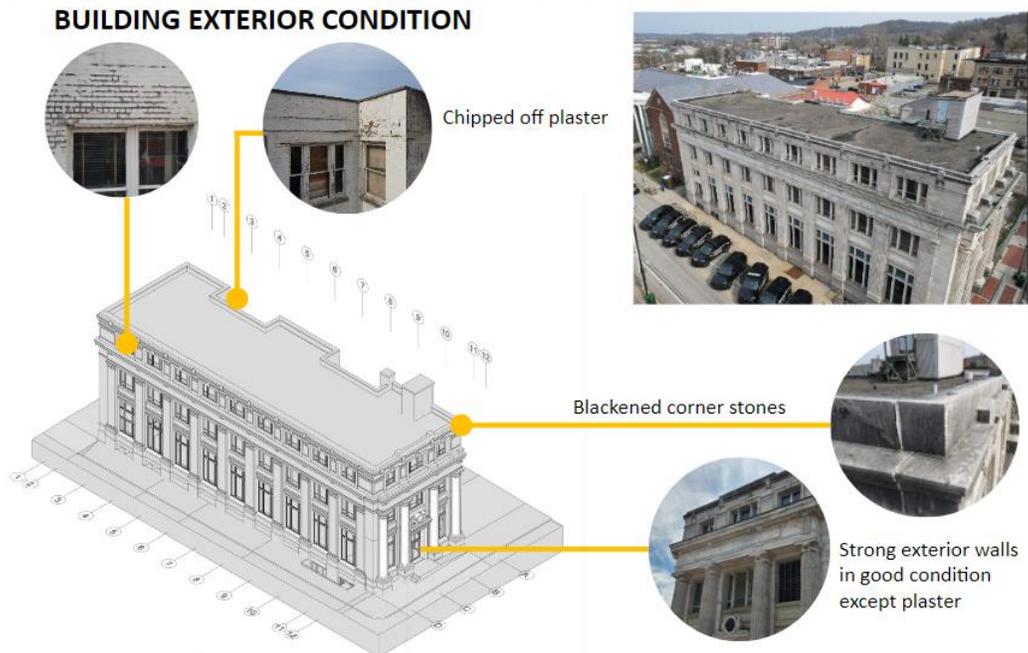


Figure 14. Building exterior condition.⁴²

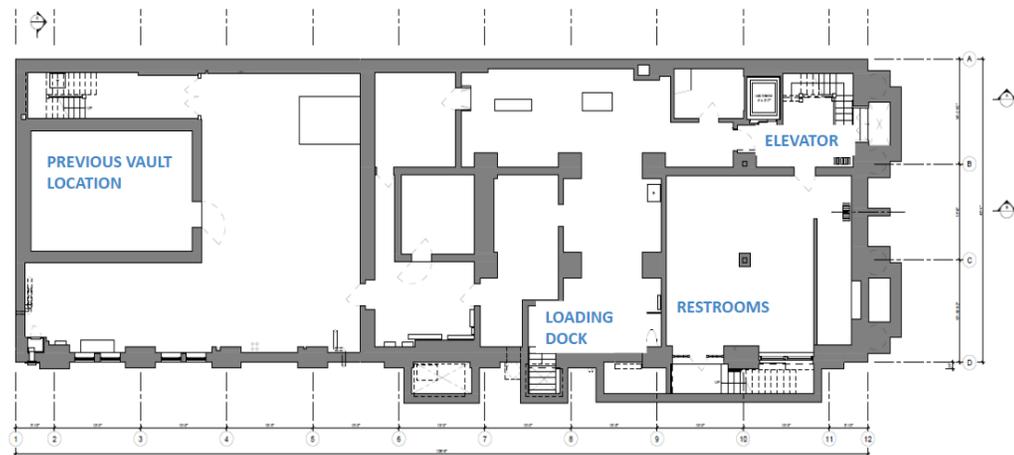


Figure 15. Basement Plan.⁴³

⁴² G Marin 2023, Personal Communication, 13 October 2023

⁴³ Marin, Personal communications.

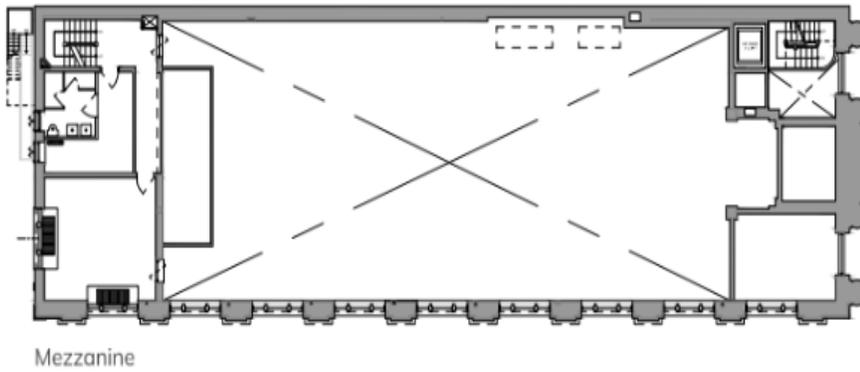


Figure 16. Mezzanine Floor Plan.⁴⁴

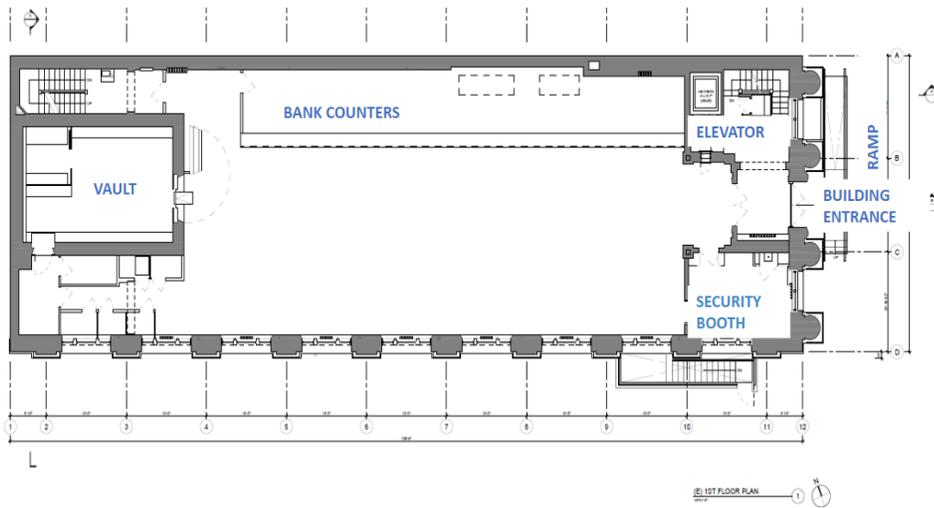


Figure 17. First Floor Plan.⁴⁵

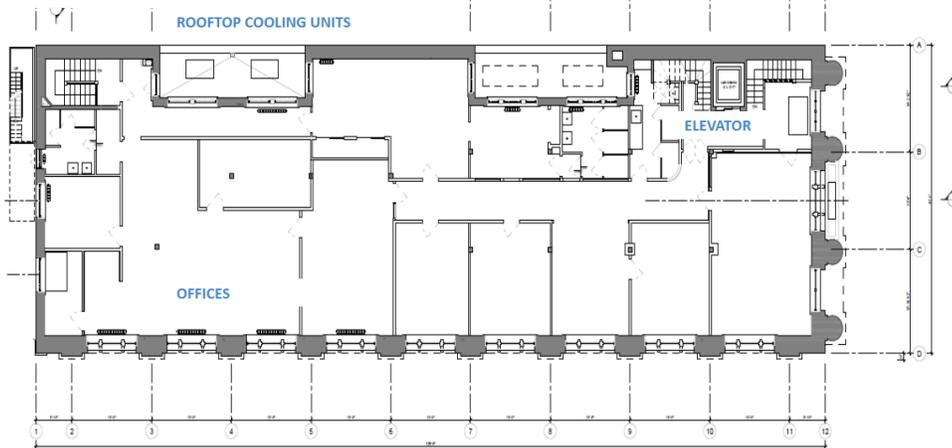


Figure 16. Second Floor Plan.

⁴⁴ Marin, *Personal communications*.

⁴⁵ Marin, *Personal communications*.

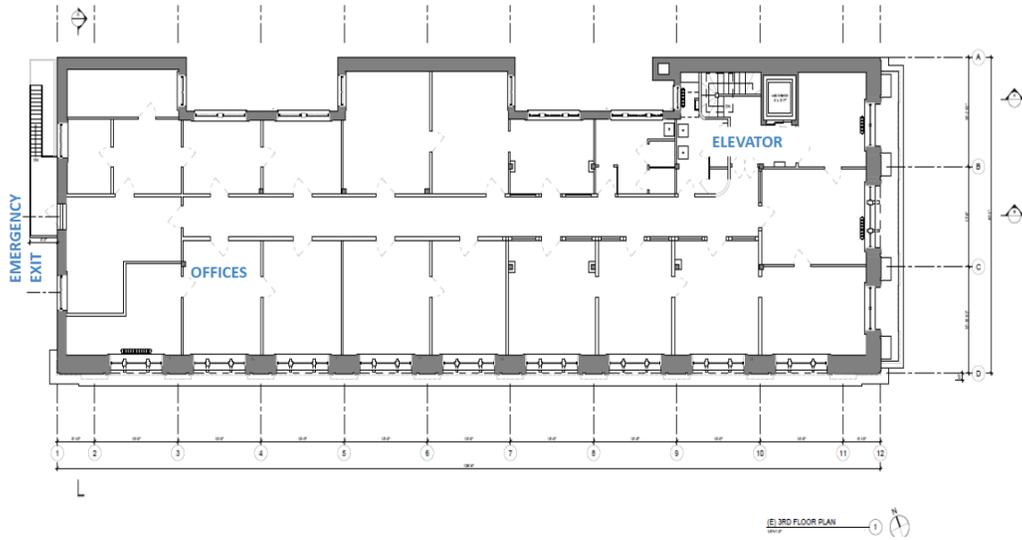


Figure 18. Third Floor Plan.⁴⁶

1st Floor

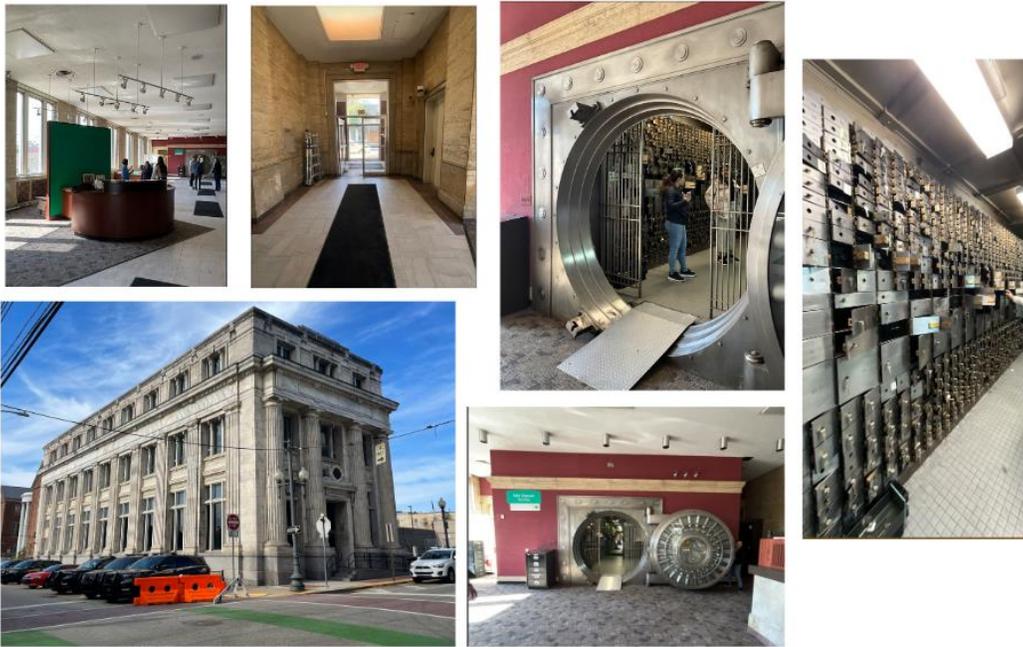


Figure 19. Interior photographs from the 1st floor (photos by Authors).

⁴⁶Marin, *Personal communications*.

2nd Floor



3rd Floor



Figure 20. Interior photographs from the 2nd and 3rd floor (photos by Authors).

Purpose Identification

The primary aim of this project is to formulate a comprehensive plan, focusing on the adaptive reuse of the Wilksburg Bank building. This aligns with our key objectives to revitalize the Wilksburg Business District, emphasizing architectural excellence, and ensuring financial viability despite economic challenges. Supported by WCDC, the historic architecture and strategic location highlight its potential.

A community needs assessment reveals a predominantly young adult population commuting to Pittsburgh, particularly in the restaurant industry. Despite liquor license restrictions, the restaurant sector emerges as a catalyst for local economic rejuvenation, especially in the central business district.

The building, centrally located with proximity to essential amenities, holds historical significance, notably featuring an accessible grand vault. Its unique attributes, including flat rooftops, position it ideally for adaptive reuse. The rental affordability for businesses makes it an attractive location for office use purposes.

Proposed development program

The development program is strategically structured adapting to the building and making the most of its existing features. As shown in Figure 20 below, the program includes stabilizing the building envelope, establishing an immersive escape room experience in the vault, and a shared kitchen facility on the first floor to host a coffee shop, a bakery, and a healthy fresh food restaurant. These businesses will share a communal dine-in space, enhancing the overall visitor experience. Additionally, the rooftop will be transformed with the installation of two barbecue grills, complemented by landscaping and furnishings. Simultaneously, the basement will undergo demolition,

making way for the construction of a storage and refrigeration unit and restrooms to support the operational needs of the facilities on the first floor. The second floor will be developed to be rented out to a training institute that will support community skill building. The third floor will be developed into office spaces.



Figure 21. Proposed Development Plan Section (Photo by Authors)

Method 2 - Economic Feasibility Analysis

Pro Forma Analysis

To start with the proforma the total development costs were calculated (Table 1). The total development costs, account for construction costs or hard costs, soft costs, site acquisition, and building assessment costs.

Table 1. Development Costs

Development Costs			
Hard Costs	SF	\$/SF	Total Cost
Basement (restaurant)	2000	\$120.00	\$240,000
First Floor (restaurant)	4,174	\$185.00	\$772,190
Second Floor (offices)	3,950	\$122.00	\$481,900
Third Floor (offices)	3,950	\$122.00	\$481,900
Rooftop	3,950	\$20.25	\$80,000
Exterior Stabilation			\$1,000,000
Contingencies	20%		\$611,198
Total Hard Cost			\$3,667,188
Soft Costs	20%		\$733,438
Site Acquisition (Legal fees)			\$60,000
Building Assesment			\$100,000
Total Development Costs			\$4,560,626

A percentage of 20% was allocated for contingencies within the hard costs. Additionally, an estimated 20% of the hard costs were attributed to soft costs. The site acquisition cost is recorded as \$1 owing to an arrangement with the current property owner, WCDC, yet it amounts to \$60,000 considering the legal fees associated with the acquisition transaction. Furthermore, the building assessment cost of \$100,000 was factored in to evaluate the building's conditions before construction.

Then, the Net Operating Income (NOI) was calculated, after defining the revenue from the annual rent and the operating expenses (Table 2). Resulting in \$180,023 annually.

Revenue			
Lease	SF	\$/SF	Annual Rent
First Floor (restaurant)	4,174	\$14.00	\$58,436
Second Floor (offices)	3,950	\$19.00	\$75,050
Third Floor (offices)	3,950	\$19.00	\$75,050
Outdoor Rooftop	3,950	\$75.00	\$296,250
Potential Gross Income			\$504,786
First Floor vacancy	5.00%		\$2,922
Second Floor vacancy	5.00%		\$3,753
Third Floor vacancy	5.00%		\$3,753
Outdoor Rooftop vacancy	70.00%		\$207,375
Effective Gross Income			\$286,984
Operating Expenses			
Insurance	16,024	\$0.10	\$1,602
Real Estate Taxes	16,024	\$1.50	\$24,036
Repairs and Maintainance	16,024	\$3.00	\$48,072
Reserves	16,024	\$0.50	\$8,012
Management Fees	5%		\$25,239
Total Expenses			\$106,962
Net Operating Income (NOI)			\$180,023

To fund this project, we used the funding structure shown in Table 3 and Figure 22, reaching a total funding of \$4,560,626.

Table 3. Potential Funding Options.

Potential Funding Options	
RACP	\$1,000,000
RK Mellon	\$651,518
Hillman Foundation	\$250,000
New Market Tax Credit	\$228,031
USDA / DCED grants	\$1,000,000
Building PA Loan	\$715,538
Equity	\$715,538
Total Funding	\$4,560,626

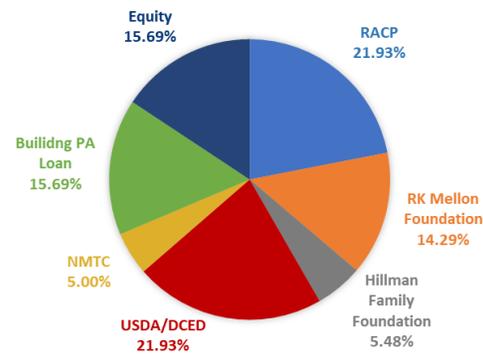


Figure 22. Potential Funding Sources.

- Redevelopment Assistance Capital Program (RACP): This is a Commonwealth grant program that provides financial assistance for the acquisition and construction of regional economic, cultural, civic, and historical improvement projects.⁴⁷
- Richard King Mellon Foundation Grant: Of the 6 programs the foundation offers, the one for our project is “Social Impact Investments”. This enables companies to secure the risk capital, networks, and resources they need to develop products, deploy services, and address societal issues at the individual and community level.⁴⁸
- Hillman Family Foundation: From the 6 strategic priorities, our project falls within the “Community and Economic Development”.
- New Market Tax Credit (NMTC): Has as its goal to disrupt the pattern of divestment by drawing in private investments essential for revitalizing struggling local economies.⁴⁹
- USDA / DCED: We are also proposing to look for other sources of funding like USDA that provide grants to food incubators businesses. Also from other sources like the Department of Community and Economic Development (DCED) with grants like the Community Development Block Grant Programs (CDBG).⁵⁰
- Building PA (BPA): Offers intermediate-level funding to real estate developers for

⁴⁷ Office of the Budget (2023) 'RACP', [Online] Available at: <https://www.budget.pa.gov/Programs/RACP/Pages/Main%20Page.aspx> [Accessed 29 Nov. 2023]

⁴⁸ Richard King Mellon Foundation (2023) 2021-2030 Strategic Plan. Available at: <https://www.rkmf.org/about/2021-2030-strategic-plan/> [Accessed 29 Nov. 2023].

⁴⁹ Community Development Financial Institutions Fund (2024) New Markets Tax Credit Program. Available at: <https://www.cdfifund.gov/programs-training/programs/new-markets-tax-credit> [Accessed 29 Nov. 2023] And Agricultural Marketing Service (2024) Grants, Loans and Other Support. Available at: <https://www.ams.usda.gov/services/local-regional/food-sector/grants> [Accessed 29 Nov. 2023].

⁵⁰ Community Development Block Grant Programs (2024) [Online] Available at: <https://www.hudexchange.info/programs/cdbg/> [Accessed 29 Nov. 2023].

properties located in smaller to medium-sized towns across Pennsylvania.⁵¹

Reaching an equity amount of \$715,538 resulting from the total development costs of the project minus the funding options proposed.

With this information, a cash flow diagram was executed. Where we can see the initial investment done by the developer in year 0, and by year 5.5 the investor would break even (Figure 22).

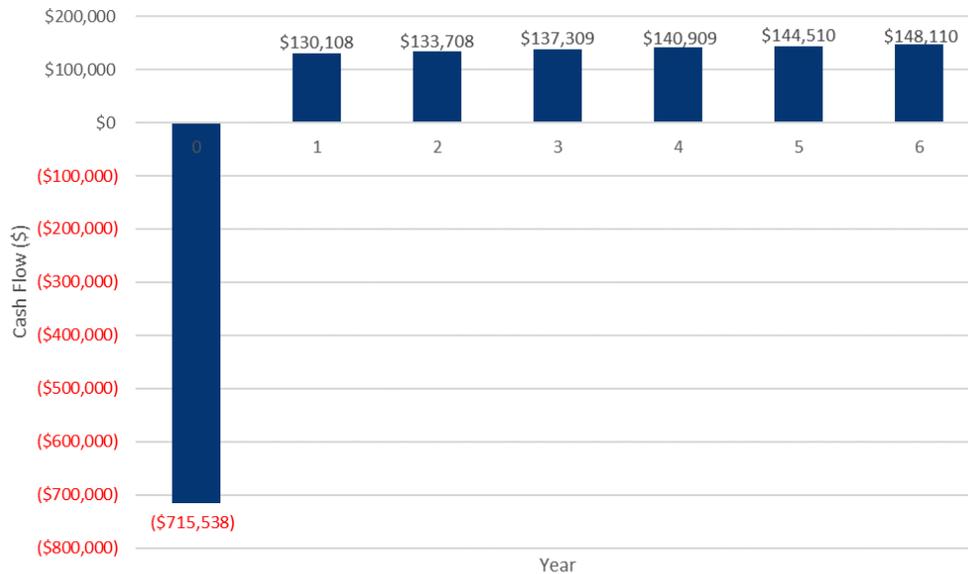


Figure 22. Cash Flow Diagram.

The investor is projected to achieve a cash-on-cash return of 19%. Also, by utilizing a 10% capitalization rate and the calculated NOI, the investor's Return on Investment (ROI) would reach 25.80%. Showing the profitability of this project.

DISCUSSION

The demographic analysis of Wilkinsburg forms a critical backdrop to the proposed adaptive reuse project, as it provides insights into the community's composition and dynamics. With a declining population at a rate of -1.22% annually since 2000, understanding the demographic shift due to higher tax rates and other problems in the area becomes pivotal for market analysis and checking the project feasibility. The majority of the population, concentrated in young adults aged 22 to 39, presents an opportunity for strategic development, particularly in food-related businesses, where

⁵¹ PA Department of Community & Economic Development (2023) Building PA (BPA). Available at: <https://dced.pa.gov/programs/building-pa/> [Accessed 29 Nov. 2023].

commuting to Pittsburgh is common. This is evident from the market analysis report from WCDC indicating the higher potential of the restaurant business in Wilkinsburg.⁵²

Recognizing crime patterns is crucial for both strategic planning and minimizing potential risks linked to the project. This understanding prompts a careful approach in selecting a business to ensure it does not contribute to an increase in the crime rate. Analyzing the map from Figure 11 reveals a concentration of fast-food establishments in the area, with a notable scarcity of fresh food restaurants. The presence of only four bakeries, operating intermittently, highlights an untapped market demand for consistent and fresh food offerings. The community is identified as a healthy food desert and requires the establishment of a bakery and coffee shop. This gap in services not only addresses the community's needs but also offers a lucrative opportunity for entrepreneurs. Skill-building initiatives are imperative for taxpayers, fostering economic revitalization in the region.

The proposed adaptive reuse strategies, encompassing shared kitchen, escape room, and rooftop facilities, not only optimize the building's inherent attributes but also address the community's culinary talent and entrepreneurial aspirations, as a majority of the low-income population commute for work to Pittsburgh to work in the food sector.

This case study provides a market analysis and economic feasibility by delineating a funding pathway, not solely for this project but also for future projects in the Wilkinsburg area. The primary objective is to contribute to the community as part of the redevelopment plan. This study emphasizes the crucial aspect of exploring funding options and criteria that will ultimately determine the success or failure of the project. Despite limitations in data availability, the study provides a robust foundation for decision-making, offering realistic insights into the potential returns and challenges associated with the adaptive reuse plan.

The implications of this project extend beyond the immediate rejuvenation of the Wilkinsburg Bank Building. It serves as a strategic roadmap for the revitalization of Wilkinsburg as a whole, addressing economic challenges, vacant properties, and high tax rates. The proposed plan, with its emphasis on community development, aligns with ongoing efforts by Wilkinsburg Borough and the Wilkinsburg Community Development Corporation. As a model for adaptive reuse, this initiative sets a precedent for future projects in Wilkinsburg and similar neighborhoods grappling with comparable issues.

Limitations

One of the limitations we faced involved the lack of updated market analysis data. Some available information dates back to 2016 and 2018, potentially overlooking shifts in market trends post-COVID-19. Specifically, this outdated information pertained to vacancy rates and data on retail businesses. Additionally, the crime rate information we found did not originate from Wilkinsburg itself, leading us to utilize the nearest available rate.

⁵²Western PA Regional Data Center

Another constraint was the absence of precise information from organizations offering funding in the form of loans, grants, and tax credits. These entities required a formal application before assessing proposals. Consequently, we relied on data from past projects conducted within the Wilkinsburg area over the past seven years that aligned with similar criteria.

Furthermore, accuracy in construction cost estimation presented a challenge. We utilized estimating tools such as RS Means, selecting Pittsburgh as the location due to the unavailability of Wilkinsburg as an option. Therefore, our reliance on RS Means' data accuracy for cost estimation in this project was a necessity.

Future Work

Future research needs to address gaps identified in market and pro forma analysis, considering the dynamic nature of the real estate landscape. Conducting a comprehensive risk assessment is crucial, taking into account factors such as interest rate fluctuations, regulatory changes, and economic downturns. Tailoring risk mitigation strategies is vital to bolster projects against unforeseen challenges.

Subsequent research should focus on evaluating the long-term economic impact on the Wilkinsburg Business District. This involves tracking metrics like job creation, property value appreciation, and tax revenue generation. Securing diverse funding sources is essential for financial stability, while continuous monitoring of community impact ensures sustained success and a positive local contribution.

It is important to note that our findings hinge on specific assumptions made during the analyses. Considering the potential variability in these assumptions, conducting a sensitivity analysis becomes imperative. This practice allows for a more comprehensive exploration of potential outcomes across various scenarios, providing a wider spectrum of results. Integrating sensitivity analysis would enhance the robustness of our projections, offering a better understanding of the potential impacts of different variables on the project's feasibility and success.

CHAPTER 3: CONVERTING ST. CASIMIR CHURCH INTO THE 22ND STREET CONDOS: AN ADAPTIVE REUSE CASE STUDY

SUDHA DWIVEDI, ZAHRAA AATHA, TANISHA YELAKA

CHAPTER SUMMARY

Against a backdrop of widespread demolitions contributing to 90% of construction waste, adaptive reuse emerges as an eco-friendly alternative. With a surge in church closures, we explore the growing trend of adaptive reuse, focusing on the economic nuances and community impacts, exemplified by the case study of the 22nd Street Condos in Pittsburgh's South Side Flats.

The literature we studied explores the transformative concept of adaptive reuse, emphasizing the intricate dynamics of converting abandoned religious buildings, specifically churches, into different types of spaces, specifically residential conversions. The existing literature covers decision-making processes, cultural nuances, and financial considerations. While providing valuable insights, research gaps persist in detailed case studies, pre- and post-construction economic analyses, and the impact of adaptive reuse on neighborhoods. This study aims to address these gaps, offering practical guidance for developers in locations like Pittsburgh, focusing on the process of converting these religious buildings into condominiums, their economic viability, market impacts, and the construction perspective.

Our research employs two methods. Method 1 combines a building case study of the 22nd Street Condos with a market study of South side Flats, exploring conversion details, and analyzing crime-vacancy impacts. Method 2 is a financial analysis of 22nd Street Condos, focusing on funding, unit sales, and developer profits. Key stakeholders, including the developer and architect, provide critical insights through interviews, and market implications are explored through engagements with city council members and GIS technology for mapping crime statistics.

The findings are presented in three key sections: Project Information, Financial Analysis, and Market Study. The successful transformation of St. Casimir Church into luxury condos is detailed, revealing the construction approach from the developer, optimizing space use and integrating premium features for market appeal, the project's financial viability, showcasing strategic decisions, and the potential profit of \$1.13 million for the project. This adaptive reuse promotes a thriving urban environment while also protecting history.

The report promotes sustainable urban development that is focused on the needs of the community and views abandoned buildings as assets.

The 22nd Street Condos case study showcases the developer's strategic choices, which demonstrate both economic feasibility and the importance of neighborhood impact. While assessing the market and community revitalization, understanding crime rates, vacancy rates, and the development of a harmonious land-use mix become critical metrics, indicating how essential it is to understand these aspects to promote community well-being and its revival. The relevance of maintaining cultural value, bringing innovation in these conversions, valuing the building, and interacting with local authorities is emphasized in recommendations for developers and architects.

Introduction

Shifting our focus to abandoned church structures, our research goes beyond the surface-level environmental benefits of reuse versus demolition. It dives deeper into the complex economic variables at play, as well as the broader impact on the local community, preserving meaningful fabric and cultural values when these churches are transformed. A study by Mirza-Avakyan¹ claimed that about one in three churches could become redundant in Pittsburgh and over 130 church properties have been sold prior to 2010. But the story of their adaptive reuse, especially as it relates to factors, financial benefits, and the developer's perspective, is still mostly untold in Pittsburgh, even though adaptive reuse of church buildings is quite common there.

LITERATURE REVIEW

In the realm of architectural evolution and societal responsiveness, the concept of adaptive reuse, as eloquently captured by Stewart Brand in *How Buildings Learn*, signifies a profound transformation that preserves architectural heritage while adapting spaces to contemporary needs. This transformative process unfolds as vacant structures face a crucial decision point—succumb to demolition or undergo a revitalizing metamorphosis through rehabilitation.² In the backdrop of the ever-growing concerns surrounding demolition waste and its environmental repercussions, the decision to demolish vacant buildings becomes a pivotal consideration. According to Garstka (2012) the hierarchy of societal acceptance reveals a nuanced landscape where different varieties of vacant structures, particularly those with historical and religious significance, are treated distinctively. While other buildings with a weaker structure might be deemed expendable, old historic buildings constructed with durable materials carry an inherent attachment to the city, the neighborhood, and the surrounding landscape.³

¹Mirza-Avakyan, G. (1970) Adaptive Reuse of Historic Churches in New York City: The Opportunities and Challenges for Community Development, Academic Commons. Available at: <https://academiccommons.columbia.edu/doi/10.7916/D8057P4G> [Accessed 29 Nov. 2023].

² Brand, Stewart. (1995) *How buildings learn : what happens after they're built*. New York: Penguin Books.

³Garstka, B.J. (2012). Holy renovations: Adaptive re-use and dependent stakeholder opinion of converted church buildings. [online] studenttheses.uu.nl. Available at: <https://studenttheses.uu.nl/handle/20.500.12932/17622>.

Roger Tackeff, Chairman of Renaissance Properties, emphasized the importance of understanding the economic viability of church conversions for informed decisions by developers and assessment by investors. The act of demolishing such vacant churches, laden with cultural and religious sentiments, transcends mere environmental impact, making our literature review a crucial exploration into the transformative journey of these significant structures, encompassing four key aspects from which we try to understand any gaps from the process, challenges, benefits, and various implications of these adaptive reuse conversions.

Topic 1: Abandoned Religious Buildings

According to Thurston and Yezer (1994), church closures have increased in the United States, particularly in Northeastern and Midwestern areas. Redundant religious buildings in the United States face closure due to suburbanization, which has dramatically affected older urban areas.⁴ Additionally, immigration and migration contribute to the underuse of traditional American religious structures in urban areas, as new residents prefer attending churches led by their countries' religious leaders⁵. U.S. Religious Landscape Survey in 2008⁶ shows a decline in religiosity and denominational shifts resulted in the closure of congregations, impacting the number of religious buildings. The net loss in congregations, especially in old-line Protestant denominations, can be attributed to the sale of redundant religious properties.

Congregations are shrinking as a result of urban migration, shifting religious connections, and economic pressures. Churches are being converted into dwellings or cultural spaces as a result of the closing trend. In Pittsburgh's context, the City's population has decreased by nearly 20% since 1952, and the number of adherents has decreased by 22%, implying that religiosity in the city has barely declined at all, the number of congregations has increased by 15%, reflecting a 47% decrease in the adherent per congregation ratio. Leaving everything else unchanged would imply that one of the three churches may become obsolete.⁷

Topic 2: Adaptive Reuse of Religious Spaces

Simons (2010) found that by 2010, there were a total of 210 successfully repurposed religious buildings in the US. Simons categorizes these adaptations into various uses, including 52 buildings transformed into residential condos, 22 into apartments, 43 into retail spaces, 26 into offices, 42 into cultural facilities, 24 into schools, and 1 into an industrial facility.

⁴ Thurston, L., & Yezer, A. M. J. (1994). Causality in the suburbanization of population and employment. *Journal of Urban Economics*, 35, 105-118.

⁵ Simons, R.A. and Choi, E., 2010. Adaptive reuse of religious buildings and schools in the US: Determinants of project outcomes. *International Real Estate Review*, 13, pp.79-108.

⁶ Wormald, Benjamin. 2008. "U.S. Religious Landscape Survey: Religious Beliefs and Practices." Pew Research Center's Religion & Public Life Project. June 1, 2008. <https://www.pewresearch.org/religion/2008/06/01/u-s-religious-landscape-survey-religious-beliefs-and-practices/>.

⁷ Mirza-Avakyan, Adaptive Reuse of Historic Churches in New York City.

Several research papers, delve into the adaptive reuse of sacred spaces, providing comprehensive case studies on church conversions across the United States and the Netherlands. Among these case studies are notable examples such as "The Arches," "The Sanctuary," "St. Elias Church," "Our Lady of Loreto Church," "Church Brew Works," and "Union Project." These case overviews contribute valuable insights into the varied typologies of churches and the diverse transformations they undergo during the adaptive reuse process.

Simons and Choi's national study of 210 adaptive reuse projects reveals that residential apartments result from various building types and market demand, including market-rate rentals, senior housing, and condominiums. Building characteristics such as more stories, younger age, lack of historic features, larger size, brick exterior, and specific locations favor apartment conversions. Interestingly, it also states that schools are more likely than churches to be converted into apartments, as the floor plan favors easier conversion. The adaptive reuse of churches poses unique challenges compared to industrial or commercial spaces, as these spaces hold deep religious and emotional significance.⁸

"Unlike the extensive literature on brownfield sites encouraging reuse or demolition of industrial and commercial spaces, the decision to repurpose vacant churches is complex due to their connection to religious belief and the challenges of preserving sacredness".⁹ As noted by Murtagh (1997) Architect Robert Scarano emphasizes that churches are often demolished due to the difficulty and inherent challenges of adaptive reuse, particularly in terms of construction effort and financial constraints.¹⁰ Scarce resources often limit the conversion of large interior church spaces, making such projects financially unfeasible for owners. Simons and Choi's national study on adaptive reuse projects highlights that churches face greater challenges in conversion compared to schools, with factors such as larger size, lack of historic features, and specific locations influencing the likelihood of successful adaptation.¹¹

Topic 3: Economic Considerations for Adaptive Reuse

Albert Rex of the Boston Preservation Alliance mentions that within the intricate dance of preserving and adapting religious structures, economic considerations take center stage and despite mentions of economic gains, a comprehensive analysis of the financial outcomes for both developers and investors remains elusive. The need for developers to grasp the economic viability of church conversions, as emphasized by Roger Tackeff of Renaissance Properties, is a cornerstone for informed decision-making. While economic gains are often mentioned, the literature mentions the multifaceted nature of financial outcomes for developers and investors.¹²

⁸Simons, R.A. and Choi, E., 2010. Adaptive reuse of religious buildings and schools in the US: Determinants of project outcomes. *International Real Estate Review*, 13, pp.79-108.

⁹Green, R., 1999. "Meaning and Form in Community Perception of Town Character." *Journal of Environmental Psychology*, 19, pp.311-329.

¹⁰Murtagh, W.J., 1997. *Keeping Time: The History and Theory of Preservation in America*. New York: John Wiley and Sons, Inc.

¹¹ Simons, and Choi, Adaptive reuse of religious buildings and schools in the US.

¹²Kiley, C., 2004. *Convert! The Adaptive Reuse of Churches*. Massachusetts Institute Of Technology.

Not all religious adaptive reuse projects are financially viable without public subsidies. Simons and Choi highlight the nonfinancial value communities place on preserving significant landmarks, often leading to nonprofit or public agency development with substantial subsidies and minimal financial expectations. Developers heavily depend on debt financing, requiring positive cash flow to cover expenses and debt service. Ensuring a profit is crucial for justifying the considerable effort involved in moving such projects forward.¹³

Examining these papers on the adaptive reuse of church projects reveals diverse means of financing, highlighting the importance of appropriate financial structures for developers to yield returns. Historic buildings, more cost-effective to convert, provide economic benefits by saving construction time and costs. The complex interplay of economic considerations in adaptive reuse, as recognized by Rypkema (1994), showcases property rehabilitation as a "catalytic activity," emphasizing the interconnectedness and multiplier effects within these endeavors.¹⁴

Topic 4: Neighborhood Relevance

Burchell and Listokin (1981) highlight the significance of property conditions and building features in the decision-making process for selecting reuse outcomes. Their study suggests that residential conversion is optimal for buildings in good condition with attractive architectural features, regardless of market strength. However, it is deemed unsuitable for buildings in poor condition under both weakening and strengthening markets.¹⁵

Market studies reveal spill-over effects within communities, establishing adaptive reuse projects as pivotal for wider regeneration efforts.¹⁶ Adaptive reuse projects not only reduce derelict buildings but also serve as community focal points, attracting positive publicity and dispelling negative connotations associated with impoverished neighborhoods. In the context of church adaptive reuse, Rypkema identifies major measurables of economic impacts, highlighting the unique significance of historic churches in representing neighborhood values and historical identities akin to important municipal buildings. These churches incentivize new construction, enhance property values, and contribute to neighborhood vitality, historic value, and marketability¹⁷.

In conclusion, the review of the literature offers an extensive amount of information about the adaptive reuse process, particularly concerning the conversion of religious buildings and the positives of the church to residential conversions. It explores the complex journey of abandoned religious buildings, going over the decision-making procedure, cultural quirks, and financial factors related to their adaptive reuse. However, significant research gaps remain, necessitating further investigation.

¹³Simons, R.A., and Choi, E., 2010. "Adaptive reuse of religious buildings and schools in the US: Determinants of project outcomes." *International Real Estate Review*, 13, pp.79-108.

¹⁴Rypkema, D.D., 1994. *The Economics of Historic Preservation: A Community Leader's Guide*. Washington, DC: National Trust for Historic Preservation.

¹⁵Burchell, R.W., and Listokin, D., 1981. New Jersey. The Center for Urban Policy Research.

¹⁶Garstka, B.J..Holy renovations.

¹⁷Rypkema, D.D.,*The Economics of Historic Preservation*.

The reviewed literature provides great insights into the process of adaptive reuse, however, there is a scope to build up the information by doing detailed case studies that comprehensively cover the developer's perspective in converting these structures. The challenges, considerations, and lessons learned in the adaptive reuse process remain underexplored. A nuanced understanding of the economic viability of church conversions is emphasized, yet the literature falls short of dissecting pre-construction economic analyses and post-construction profit evaluations. A comprehensive exploration of the economic intricacies involved in the entire project lifecycle is crucial for developers and investors to make informed decisions. Moreover, while market implications are touched upon, the literature lacks a robust examination of the impact on property values, livability, and neighborhood dynamics. The absence of detailed discussions on how adaptive reuse projects contribute to the improvement of neighborhoods, addressing concerns like vacancy, safety, and crime, leaves a significant research gap.

PROBLEM STATEMENT & RESEARCH QUESTIONS

The existing literature on the adaptive reuse of religious buildings lacks comprehensive insights into the developer's viewpoint, particularly regarding challenges, considerations, preconstruction and post-construction financial evaluations, and lessons learned. There is also a need for thorough market implications in terms of neighborhood revitalization, including vacancy rates, safety concerns, and property values. This study, focusing on the 22nd Street Condos in the South Side Flats, aims to fill these gaps, offering practical guidance for developers engaged in transforming religious buildings into residential typologies.

This research aims to contribute practical insights to the field of adaptive reuse for typology: scared to condo, specifically in locations like Pittsburgh. The study offers guidance for developers, focusing on economic considerations, market impacts, and the developer's viewpoint during construction. The goal is to play a crucial role in facilitating the successful adaptive reuse of religious buildings into residential spaces.

Research Questions

- 1. How did the developer navigate the transformation of the church into condos for 22nd St Condos?*
- 2. What is the impact on real-estate values due to the crime rate, vacancy, and market demand of South side Flats?*
- 3. What were the economic gains for both the developer and investors in the 22nd St Condos project*

METHODOLOGY

Method 1

This Combines a thorough building case study of 22nd Street Condos and a market study of South side Flats, the area in which 22nd Street Condos is located. The building case study extensively explores the church's conversion into condominiums, explaining the changes made and the elements retained. It delves into the site's historical context and examines its structural characteristics.

A multidimensional method is used to answer the first research question. Interviews with both the architect and the developer provide critical information. Discussions with the architect shed light on the process of restoring historical features and converting them. In addition, interviews with the developer and site visits provide insights into the developer's decisions and skills in the conversion. Credible online sources enrich the building's historical context.

Method 2

While the second method focuses solely on doing a thorough financial analysis of the 22nd Street Condos. This includes an examination of the project's financial structure, including the methods of funding, unit sales strategies, and an assessment of the developer's economic profits or losses from the venture. Method 2 is dedicated to answering the second research question.

For the second research topic, a direct interview with the developer allows the acquisition of reliable financial estimates of the project's feasibility and post-project gains or losses. Other financial information and market standards, which are not available from direct sources, are obtained from credible online platforms.

Method 3

Additionally, the market analysis explores the relationship between crime and vacancy rates in south side flats, examining their impact on real estate demand and potential interdependencies. Method 3 seeks to provide answers to third research question.

To tackle the third research question comprehensively, engagements with city council members are scheduled. These interactions aim to gather insights into the crime rate, vacancy statistics, and real estate demand. Utilization of GIS technology aids in mapping crime statistics and other factors contributing to crime rates. The correlation between these factors is analyzed through the interview and data collected online. Once the research questions are answered, detailed inferences, limitations, challenges, and future discussions will be formulated.

FINDINGS

The research findings are presented in three distinct sections, offering a comprehensive analysis of the project. The first segment, Project Information, furnishes intricate details about the development of 22nd Street Condos, shedding light on its key aspects. The second part, Financial Analysis, delves into the economic considerations from the developer's standpoint, unraveling the financial intricacies of the project. The third section, Market Study, contributes valuable insights into the broader market dynamics within the South Side Flats neighborhood. This systematic breakdown aims to provide a lucid and well-organized presentation of the study's outcomes.

About the Project:

The conversion of St. Casimir Church into the 22nd Street Condos, orchestrated by developer Ivor Hill, epitomizes the harmonious blend of historical preservation and contemporary living. Initially abandoned in the early 1990s, the church underwent a shift in ownership in 2006, but the new owner struggled to find a purpose for the structure, resulting in annual losses. Recognizing the challenges, the decision was made to sell the church in 2017. Under the visionary leadership of Ivor Hill, the Sacred to Condo transformation unfolded, breathing new life into the architectural gem. This metamorphosis not only salvages Pittsburgh's architectural heritage but also enhances the city's urban living landscape.

Some important details about the project include:

The original built year: 1893, completed in 1902

Project Year: Completed in 2018.

Building's Age: 130 years

Construction Duration: ±13 months

Selling History: The church was sold in 2006 for \$625,000 and resold in 2017 for \$578,000.

Developer and General Contractors: Ivor Hill and HHF LLC

Architects: Indovina Associates Architects.

Project Size: 9600 sq. ft.

Historical Significance: St. Casimir, the first Lithuanian parish in the diocese, was founded in 1893. As the congregation grew, the need for larger, more permanent gathering space resulted in the completion and dedication of St. Casimir church on June 27, 1902. This church served the community for over 80 years. However, due to population loss in the South Side, it was no longer practical to maintain all of the South Side parishes as independent entities. In 1992, the South Side parishes were merged and the new Prince of Peace parish was created. St. Casimir church was closed as part of this merger.¹⁸

¹⁸The History of St. Casimir (n.d.) 22nd Street Condos. Available at: <https://22ndstreetcondos.com/the-building> [Accessed: 26 Nov. 2023].



Figure 1: Old St. Casimir church elements retained in 22nd Street Condos(n.d.)
 (Available at: <https://22ndstreetcondos.com/progress-gallery>. Accessed 26 November 2023)

Location: The project is situated at the intersection of 22nd st and Sarah St, South in Pittsburgh's South Side, nestled along the Monongahela River, boasts a lively business district on East Carson Street, hosting diverse dining options from local pubs to international cuisine. Popular spots include 1889 Cafe, Piper's Pub, and Hofbrauhaus.

Entertainment venues like South side Works Cinema and City Theater, along with the scenic River Front Trail, provide leisure options. The neighborhood offers a mix of shopping, from thrift stores to Urban Outfitters, and is well-connected by public transport, making it a preferred choice for downtown professionals. As a burgeoning tech hub, South Side combines walkability and urban amenities, ensuring a dynamic lifestyle.

Key Features: The 22nd Street Condos showcase a meticulous conversion of a Baroque Revival-style church into twelve individually designed luxury residences. Each condominium, with large windows and soaring 20-foot high ceilings, seamlessly integrates modern amenities, including kitchens, baths, and living spaces. Residents also enjoy access to an onsite furnished guest suite with a bedroom, kitchen, dining room, full bathroom, and common living space.



Figure 2: Present-day 22nd Street Condos (n.d.) available at:
<https://22ndstreetcondos.com/progress-gallery>. Accessed 13 March 2024)

Developer's Approach: Ivor Hill, the visionary behind the 22nd Street Condos, strategically selected the St. Casimir Church for its structural integrity and unique historical value. Ivor Hill, under HHF, LLC, has a track record of successful historic

renovations, including brownstone residences and mansion conversions. Recognizing the financial benefits of repurposing the church, which was partially demolished, desanctified by the previous owners, and had removed HVAC systems, Hill envisioned a multi-story residential complex that not only preserved the structure but also added a distinctive feature to the city skyline.

Hill's market study indicated a demand for condos, aligning with the local real estate trends and attracting pre-construction buyers. His study also revealed a long waiting period for rental permits with over 3000 pending permits. His motivation extended beyond profits to a genuine passion for architectural restoration. The conversion into 22nd Street Condos took place in 2018. Choosing St. Casimir Church it was a smart financial investment. Beyond profits, Hill's motivation was fueled by a love for architectural restoration.

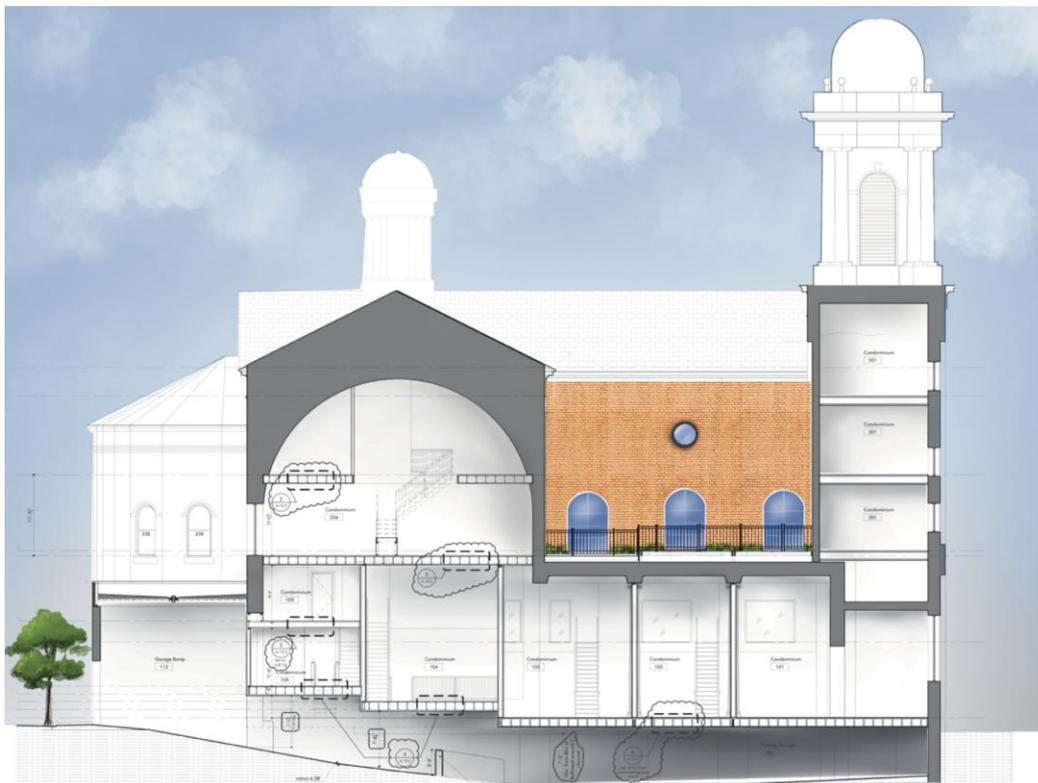


Figure 3 : 22nd Street condos Sectional Elevation (Author's Interpretation)
(Source: Indovnia Architects (n.d.) available at: <https://www.indovina.net/> Accessed 13 March 2024)

The developer utilized the church's 40-foot height effectively, creating two levels of 20 feet each. This design allowed for mezzanine levels in the condos, optimizing space. Figure 3 illustrates the section of St. Casimir Church transformed into 22nd Street Condos, highlighting the level 2 spaces with an additional patio, offering premium features and enhanced views from the elevated height.

Beyond the financial aspects, the project significantly preserves Pittsburgh's urban landscape. The successful conversion of a historic church into modern luxury condos

blends the old with the new, honoring the city's architectural heritage while meeting contemporary living standards.

Financial Analysis

Our financial analysis of the 22nd Street Condos project provides a comprehensive insight into its funding framework, economic considerations, and profit outcomes. Project financing for the condos involved a blend of equity and around \$3 million construction loan from Ameriserv Bank. The developer and two investors collectively contributed \$1 million, with a 40% distribution for the developer, 20% from an investor, and 40% from another.

Although historical tax credits and other financing alternatives were accessible, they were not pursued due to time and design limitations. The sales history of the 12 condo units is depicted in Table 1 below, revealing one unsold unit and providing details on selling prices, sale years, and unit areas. This data provides us with the lowest and highest selling unit prices, which were \$367,000 and \$700,000, respectively, with a median selling price of \$502,760. Based on the data collected, we generated Figure 4 to analyze the sales pattern of the condos. The developer's pricing strategy involved a thorough examination of the price per square foot (price/SF) and the sale year for each unit. The objective was to identify discernible patterns and trends in condo pricing over time.

Table 1: 22nd Street condos Sales

Owner Name	Unit	Year sold	Selling Price	Area (sq.ft)	Price/sqft	Floor
KILLMEYER ANDREW & ELIZABETH (W)	Unit 101	2021	\$ 521,000.00	2,012	\$ 258.95	1
JAMAL KHALID FEISAL	Unit 102	2018	\$ 463,000.00	1,568	\$ 295.28	1
MEHRING SHIRLEY	Unit 103	2023	\$ 420,000.00	1,780	\$ 235.96	1
Unsold	Unit 104	-	\$ -	2,090	\$ -	1
SOKOL THOMAS & PATRICIA (W)	Unit 105	2021	\$ 610,000.00	2,364	\$ 258.04	1
CRANDALL BENJAMIN & KIMBERLY	Unit 201	2019	\$ 479,360.00	1,701	\$ 281.81	2
LASOTA DOUGLAS C	Unit 202	2019	\$ 367,000.00	1,178	\$ 311.54	2
MASTERSON MARC	Unit 203	2018	\$ 633,000.00	2,056	\$ 307.88	2
SALJOUGHI SEPEHR & JIOCONDA (W)	Unit 204	2019	\$ 425,000.00	1,332	\$ 319.07	2
WALLACE KATHY R & MARK J (H)	Unit 205	2019	\$ 545,000.00	1,978	\$ 275.53	2
HARRIS ALAN & ANN (W)	Unit 206	2019	\$ 367,000.00	1,188	\$ 308.92	2
MONKS DENNIS C JR	Unit 207	2019	\$ 700,000.00	2,200	\$ 318.18	2

The graph below illustrates the successful sale of two condominiums before the commencement of construction in 2018, depicting a deliberate strategy targeted at mitigating initial financial risks and creating a cash inflow at the beginning of the project. Notably, Level 2 units exhibited a swifter sales pace, commanding a price of \$300/sf, whereas Level 1 units underwent a later discounting process, settling at an approximate rate of \$250/sf during sales. The figure illustrates this data efficiently, where the left Y-axis shows the price per sf/year and the right Y-axis units sold each year. This observation highlighted a clear trend - Level 2 units consistently outperformed their Level 1 counterparts in terms of both sales speed and pricing. Referencing the sectional elevation in Figure 3 and conversations with the developer illuminated that this discrepancy arose from a valuable lesson learned. Initially, all units were listed at the

same price. However, the data indicated a substantial demand for Level 2 units, which was influenced by the addition of accessible patio spaces at Level 2 of the building as seen in the section, prompting the developer to acknowledge an untapped profit potential. The oversight in differentiating pricing strategies for distinct unit levels resulted in a missed opportunity for enhanced profitability. This revelation could significantly influence future development decisions.

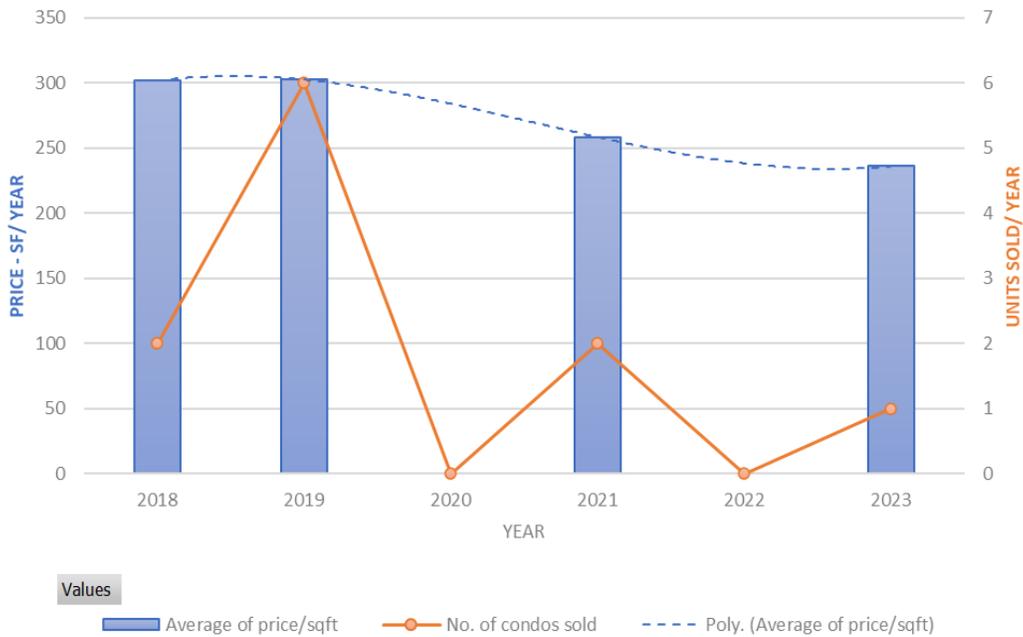


Figure 4: Selling Price/SF and Unit sales per year for 22nd St Condos

For a more in-depth insight into the project's profitability, we constructed a proforma to comprehensively assess the developer's total expenses, income, and eventual profit. This financial forecast serves as a guide for project stakeholders, offering insights into anticipated costs, funding origins, and potential profits or losses at various stages. It plays a crucial role in informed decision-making, enabling a thorough evaluation of the project's financial viability and providing a roadmap for effective resource and investment management. The intricate analysis presented in the proforma can assist fellow developers, investors, and other stakeholders in evaluating the financial feasibility of similar sacred-to-condo construction projects.

Construction Costs Estimation: Estimating the construction costs for the 22nd Street Condos relied on the developer's provided range of \$2.5 million to \$3.5 million provided by the developer for the construction hard costs typical for projects of this typology, scale, and similarities. Based on this, we assumed a value of \$3 million for our estimation. This projection incorporates industry standards and assumptions to establish a realistic financial foundation, aligning with the developer's input. The breakdown encompasses hard costs, including rehabilitation and basement parking creation. Financial data from the developer indicates a \$578,517 land acquisition cost and \$1 million in equity. The

proforma was prepared with assumptions of 5% acquisition fees,¹⁹ 20% soft costs,²⁰ \$115/sf condo rehab hard costs,²¹ \$39.50/sf basement hard costs,²² and a 4% interest rate for the construction loan.²³ The proforma is structured into three phases: Acquisition, Construction, and Selling. The detailed considerations for each phase are outlined below. Table 2 displays the proforma for Phase 1 and Phase 2.

Phase 1: Acquisition/Predevelopment: This phase's total projected cost for acquisition and pre-development activities is \$977,403.60. Funding sources include equity from the developer (\$400,000) and investors (\$600,000), covering acquisition costs, fees, and soft costs like architecture and marketing.

Phase 2: Construction: This phase involves both hard costs (construction-related expenses) and soft costs (additional expenses). Hard costs amount to \$2,887,302.38, covering the rehabilitation of the structure and the construction of a basement parking facility. An anticipated construction loan of \$3,010,622.63 carries a 4% annual interest rate, with the interest payments integrated into the overall construction loan amount.

Table 2: Proforma for Phase 1 and Phase 2

Phase 1: Acquisition/Predevelopment			
Uses:			
Acquisition		\$	578,517.00
Acquisition Fees	5%	\$	28,925.85
Soft Costs (includes architecture and marketing/sales)	15%	\$	369,960.75
TOTAL USES		\$	977,403.60
Sources:			
Equity: Developer	40%	\$	400,000.00
Equity: Investors	60%	\$	600,000.00
TOTAL SOURCES		\$	1,000,000.00
Phase 2: Construction			
Uses:			
Equity Return			
Hard Costs (cost psf x gross sf) - rehab	\$	115.00	\$ 2,466,405.00
Basement parking const			\$ 420,897.38
Total Hard costs			\$ 2,887,302.38
Soft Costs	5%	\$	123,320.25
Construction Loan		\$	3,010,622.63
Interest (annual)	4%		-\$120,425
Total Construction loan 2 year period			\$3,251,472.44

¹⁹Debt Free Dr. n.d. "What Is An Acquisition Fee in Real Estate?" [online] Available at: <https://www.dentaltown.com/blog/post/19439/what-is-an-acquisition-fee-in-real-estate#:~:text=An%20acquisition%20fee%20is%20a,from%201%25%20to%205%25>. [Accessed: 03 Nov. 2023]

²⁰Marsh Partners. n.d. "Hard Costs vs. Soft Costs In Construction & Real Estate Development." [online] Available at: <https://marsh-partners.com/blog/hard-costs-vs.-soft-costs-in-construction-real-estate-development#:~:text=soft%20costs%20may%20vary%20between,80%25%20allocated%20towards%20hard%20costs>. [Accessed: 03 Nov. 2023].

²¹Noel, S. 2023. "How Much Does It Cost to Remodel or Renovate a House?" HomeGuide, September 6. [https://homeguide.com/costs/house-remodeling-cost]. [Accessed: 10 Nov. 2023]

²²RSMeans. n.d. "Underground Parking Garage - Commercial Construction Costs Per Square Foot." Available at: <https://www.rsmeans.com/model-pages/underground-parking-garage>. [Accessed: 01 Nov. 2023]

²³NEDCO Nebraska's Small Business Loans: Lincoln, NE (2024) NEDCO Nebraska's Small Business Loans | Lincoln, NE. Available at: <https://nedcolans.org/> [Accessed: 03 November 2023].

Phase 3: Sell the Project: At the end of 2019, the projected profit is \$3,979,360.00 as seen in Table 3 below. This estimated profit is derived by subtracting the total expenses, including paying back the construction loan and equity investments from all phases, from the total revenue. The proforma indicates a potential loss of \$(249,516.04) by the end of 2019, but future profits are anticipated, reaching \$1,551,000.00 after 2023.

Table 3: Proforma for Phase 3

Phase 3: Sell the Project	
Profit end of 2019	\$ 3,979,360.00
Total costs	
Uses:	
Pay Back Construction Loan	\$ 3,251,472.44
Pay Back Equity Investments From All Phases	Developer + Investors \$ 977,403.60
Land acquisition	
TOTAL EXPENSE	\$ 4,228,876.04
PROFIT/LOSS AT THE END OF 2019	\$ (249,516.04)
Future profit (TILL 2023)	\$ 1,551,000.00
	\$ 1,301,483.97

Following the proforma preparation, a detailed cash flow analysis was conducted to precisely delineate the developers' financial inflows and outflows, highlighting when loan repayments, equity returns, and profitability commenced. This cash flow analysis was further incorporated into a Net Present Value (NPV) calculation, considering both data and assumptions. The results, depicted in Figure 5, suggest a break-even point around mid-2020. Utilizing a 6% discount rate, an industry-standard in 2023, the NPV was computed, revealing a profit of \$865,000 over the last six years. Additionally, factoring in the potential profit from the last unsold unit, listed at \$530,000, the final profit could reach \$1.13 million. It is crucial to acknowledge that these figures represent a speculative projection of the project's economic performance.

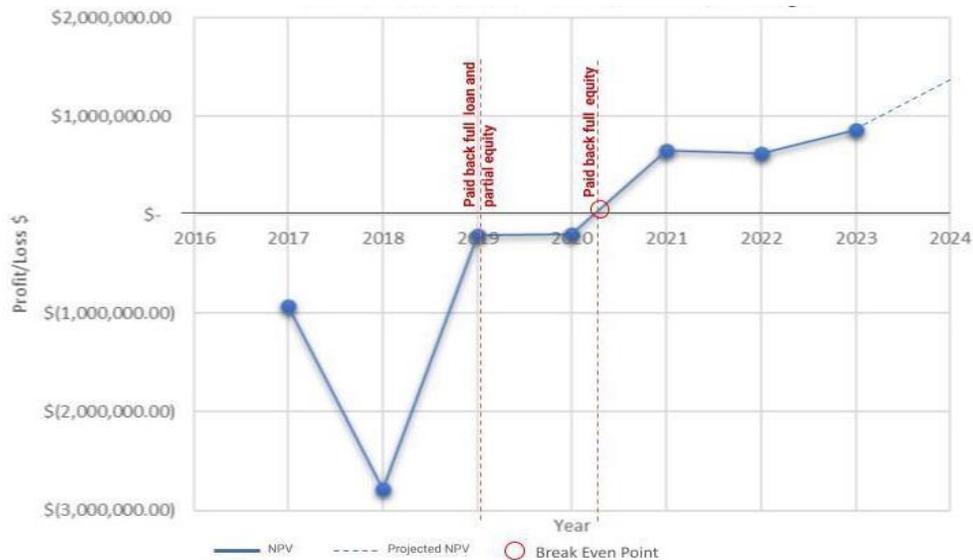


Figure 5: Cumulative Cash flow with discounting for 22nd Street condos over the years

Based on the case study and the developer's perspective, further data was collected on listing prices and sales in South Side Flats. The data indicated that only five months in the last five years did not have condo sales in the South Side, demonstrating a 92% demand for condos. This highlighted the importance of considering market demand and structural integrity before deciding on the typology reuse for old churches.²⁴

Market Study

History of Southside's fabric

Originally known as Birmingham Village, the South Side was annexed into the city in 1872. Initially settled by German immigrants, it gradually welcomed Eastern Europeans looking for work in the thriving heavy industry. For decades, this Pittsburgh neighborhood was known for its supremacy in heavy manufacturing and allied businesses. Notably, until its collapse in the 1980s, the renowned Jones and Laughlin Steel Company was located here. The loss of heavy industry, on the other hand, constituted a watershed moment, fostering an urban resurgence fueled by the preservation and adaptive reuse of historical structures. Since then, the South Side has evolved into a desirable city enclave, attracting a diverse population, including students from surrounding schools such as Duquesne University, the University of Pittsburgh, and Carnegie Mellon University. The South Side, known for its bustling selection of pubs and eateries, has evolved as a sought-after nightlife center for Pittsburgh's younger demographic.²⁵

Crime and Vacancy in South Side Flats

The South Side Flats was known to have one of the largest numbers of crimes in Pittsburgh around 2014.²⁶ Given its reputation, we were curious to understand how luxury condominiums were in demand and how the residents did not feel uncomfortable living in the area. To understand this better we approached the City Council President, Bruce Kraus, to learn about the history, developments, and crime pattern in South Side and how it plays a role in the neighborhood. We were informed that the City Council had recognized a link between growing crime and the expansion of clubs and pubs on E. Carson Street. As this research is an attempt to guide prospective developers and city planners interested in investing in the South Side, we looked into the bars that currently exist on E. Carson Street. As seen below, E. Carson Street is populated with 18 bars.

²⁴Movoto Real Estate. (2023). Southside Flats Pittsburgh Market Trends - Movoto. [online] Available at: <https://www.movoto.com/pittsburgh-pa/southside-flats/market-trends/>. [Accessed: 03 Nov. 2023]

²⁵Pittsburghbeautiful. (2016) Pittsburgh neighborhoods: South Side, Pittsburgh Beautiful. Available at: <https://www.pittsburghbeautiful.com/2016/12/06/pittsburgh-neighborhoods-the-south-side/>. [Accessed: 03 Nov. 2023]

²⁶Jbenzing (2017) Pittsburgh's south side has had largest number of violent crimes for four years running, PublicSource. Available at: <https://www.publicsource.org/pittsburghs-south-side-has-had-largest-number-of-violent-crimes-for-four-years-running/> [Accessed: 03 Nov. 2023].

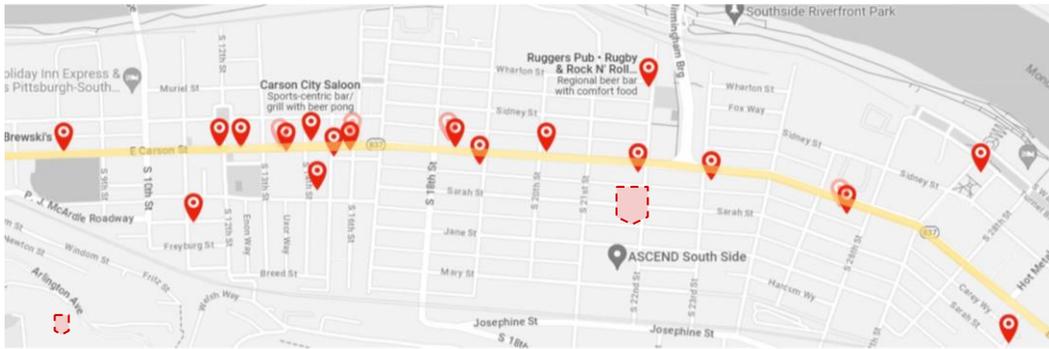


Figure 6: Bars located on or near E. Carson Street

To gain a comprehensive understanding of the influence of the numerous pubs concentrated along East Carson Street, adjacent to our case study, we created GIS maps to analyze crime rates and vacancy levels in the vicinity and their potential repercussions on the South Side. Crime data for 2022 was sourced from the Pittsburgh Bureau of Police Crime Dashboard,²⁷ providing insights into the safety scenario. Simultaneously, information on vacant properties was obtained from Pittsburgh's Vacant Parcel Map,²⁸ aiding in assessing the neighborhood's economic and structural vitality. This multifaceted approach allowed us to scrutinize the interplay between social dynamics, safety concerns, and urban development in the specific context of East Carson Street and its implications for the broader South Side community.

We created a GIS map based on insights from our discussion with the city council, addressing concerns about crime rates and the concentration of pubs in the neighborhood. Figure 7 illustrates that E. Carson Street, particularly streets 13th st. to 18th st., experiences a significant concentration of criminal activities like assault, theft, and non-fatal shootings.²⁹ In response, the council aims to transform these areas by diversifying businesses, reducing pub density, and fostering a more balanced environment with a mix of residences and businesses to attract families. Simultaneously, increased police presence is part of their strategy to enhance security and manage illicit activities. The positive response seen in South Side Flats' decreasing crime rates over the last few years reflects the success of the council's efforts.³⁰ Our case study, is located a few blocks from high-crime areas but near vacant spaces, highlights the vital role of site selection for developers, emphasizing the need to consider crime statistics to positively impact community safety and vitality.

²⁷ArcGIS Dashboards. 2023. [Online] Available at: <https://www.arcgis.com/apps/dashboards/b05e1550c99e42b091cab33e458c1f73>. [Accessed: 20 Oct. 2023].

²⁸Interactive Legend. n.d. Pittsburgh, PA. Available at: <https://pittsburghpa.maps.arcgis.com/apps/instant/interactivelegend/index.html?appid=5f52d455926f4052b361ab695afa1a9a>. [Accessed: 26 Nov. 2023].

²⁹ ArcGIS Dashboards. 2023. [Online] Available at: <https://www.arcgis.com/apps/dashboards/b05e1550c99e42b091cab33e458c1f73>. [Accessed: 20 Oct. 2023].

³⁰Ingram, S. (2022) Violence reduction seen on south side along with dwindling visitors, WTAE. Available at: <https://www.wtae.com/article/pittsburgh-south-side-violence-reduction-dwindling-visitors/41033225#> [Accessed: 03 Nov. 2023].

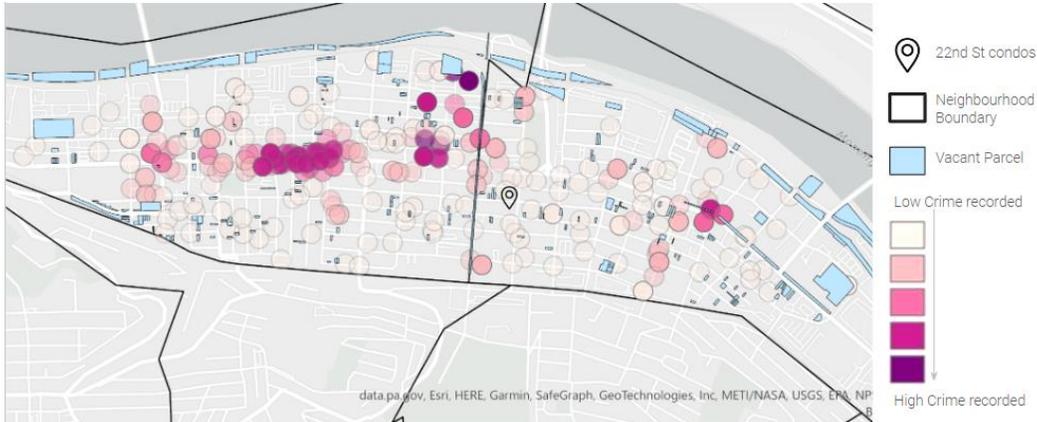


Figure 7: GIS mapping for vacant parcels and crime density in 2022

Analyzing data from Figures 6 and 7, we synthesized the information to create Figure 8, illustrating correlations between vacancies, crime density, and pub locations. The figure indicates a notable concentration of crime around pub-dense areas, aligning with the city council's assertion about the impact of pubs on crime and the resulting reluctance of families to settle in the region. This reinforces the notion that addressing vacancies requires a comprehensive approach beyond residential development. Improving crime rates and achieving a balanced land-use mix in the area are crucial factors in making the neighborhood more attractive to families. Consequently, simply developing vacant land into residences might not resolve the vacancy issue without considering and mitigating the broader influences of crime and the distribution of businesses, particularly pubs, in the vicinity to attract families.

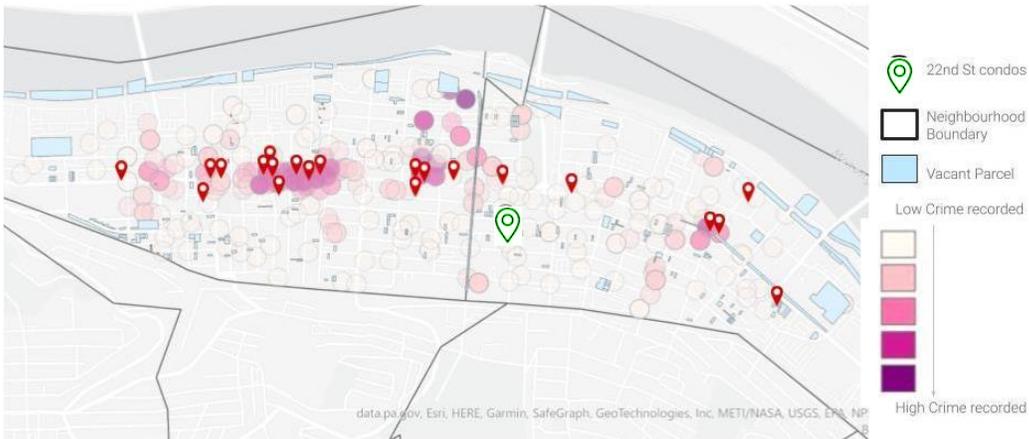


Figure 8: GIS map for vacancies, crime density, and pub locations.

This market study highlights the essential importance of strategic site selection for developers, emphasizing how factors such as crime statistics and neighboring vacancies can not only limit risks but also improve community safety and vitality. Finally, our research acts as a lighthouse for future investments, emphasizing the importance of educated decision-making and its role in constructing thriving, secure, and vibrant urban places. It also gives insights for city officials to refer to and incorporate a planned approach to revitalize these zones.

DISCUSSION

This research challenges the conventional approach of demolishing old buildings and proposes the transformation of historic churches into functional spaces, specifically condos. By looking out for the conversion of churches into condos, the study offers positive feedback on this adaptive reuse strategy. Instead of tearing down these structures, the research suggests that preserving the legacy of historic churches can unlock economic opportunities for developers.

The developer demonstrated a strategic approach to repurposing St. Casimir Church, leveraging its height for efficient space use. Dividing the structure into two levels of 20 feet each allowed for the creation of mezzanine levels in the condominiums, maximizing the usable space. The inclusion of premium features like Level 2 units with added patio spaces showcased his understanding of market demand. This helps developers make educated judgments and maximize profit by providing an understanding of the process of estimating property values before selling. The financial analysis, including the pro forma and cash flow analysis, provides a comprehensive overview of the project's economic aspects. The projection of profitability over the following years indicates the long-term viability of the project, reinforcing the developer's strategic and financially sound decisions.

Along with the financial considerations, the study highlights the broader impact of adaptive reuse on the community and urban environment. The successful conversion of a historic church into modern luxury condos represents a positive transformation. This approach not only preserves architectural heritage but also contributes to a culturally vibrant urban environment. The findings guide developers to view abandoned structures as assets, encouraging a more sustainable and community-oriented approach to urban development.

The neighborhood impact discussion delves into the multifaceted factors influencing the success of such projects. The importance of engaging with local authorities to understand crime patterns, revitalization efforts, and the overall dynamics of the urban environment is emphasized. This insight reinforces the notion that the success of such projects can be measured with appropriate financial considerations to encompass the well-being and livability of the neighborhood.

In conclusion, the developer's approach to the St. Casimir Church conversion exemplifies a holistic and strategic perspective. The lessons learned from this case study provide an overview of the financial realm to encompass profitability, market dynamics, neighborhood impact, and the broader benefits of adaptive reuse. The findings contribute to the body of knowledge guiding developers in transforming abandoned structures into assets, fostering positive changes within communities, and creating economically sustainable urban environments.

Potential impact

This research confirms that it is feasible for developers to turn holy places in South Side Flats into condominiums depending on factors and conditions similar to 22nd Street Condos, thereby, improving the neighborhood's liveability and drawing in more families. The neighborhood's revival is sparked by the conversion of these abandoned buildings. However, similar endeavors should be preceded by a thorough market analysis. The results dispel stereotypes and show that there is a strong demand for upscale condominiums in South Side Flats. The neighborhood is receptive to creative housing solutions, especially those that include converting churches into living spaces. The study also emphasizes how crucially the types of businesses in the area affect South Side Flats' crime density, underscoring the necessity of having a thorough grasp of the local business environment when evaluating adaptive reuse projects, especially those that transform churches into opulent condominiums.

The idea of converting holy sites into condominiums in South Side Flats not only represents an economic boost and communal revitalization, but it also bears tremendous environmental promise. Embracing adaptive reuse reduces demolition waste, greatly lowering the environmental impact of standard demolition. This strategy reduces the influx of demolition waste into landfills by rescuing and repairing old structures, hence limiting the depletion of resources required for new development. Furthermore, converting abandoned buildings into livable spaces helps to create a more sustainable urban landscape by encouraging efficient land use and reducing the need for new land development, ultimately promoting environmental conservation and aligning with responsible, eco-conscious urban development practices.

Recommendations

Our findings give vital insight for developers and industry professionals working on similar projects in Pittsburgh or similar cities. Our goal is to encourage other developers to embrace adaptive reuse for churches, emphasizing the preservation of historical and cultural significance above demolition.

For Developers:

- Historic structures like churches have religious attachments and should be tried to be preserved instead of being demolished.
- Before investing, it is critical to determine whether old structures, such as churches, are structurally sound. This helps to avoid further costs for structural difficulties.
- Before starting the project, it is critical to understand the market demand in the area. Knowing what people require allows for more informed judgments and ensures that the project meets the demands of the community.
- Developers should actively engage with local authorities to understand the dynamics of the urban environment, including crime patterns and revitalization efforts.

For Architects:

- Architects can offer innovative solutions for the redevelopment of challenging structures like church buildings by employing creative design strategies. For instance, the utilization of the roof on level 2 as an expanded patio space in the 22nd Street Condos not only enhanced the quality of the condos but also created a premium area, potentially contributing to increased profitability for the developer.
- Strategies such as integrating existing architectural elements and maintaining the original character can enhance the adaptive reuse project.

Limitations

Our primary focus was on the conversion of sacred spaces into condominiums, which may have limited our representation of the complications inherent in other sorts of conversions, such as rental apartments. Furthermore, our analysis was limited to the South side Flats neighborhood, providing in-depth insights particular to this location but posing difficulties in applying these findings to other socioeconomic contexts. The dependence on a small number of sources, such as developers, architects, city council members, and published materials, may impose biases and neglect alternate perspectives within the community. Notably, our study focused primarily on economic and socio-cultural aspects, neglecting an examination of sustainability implications in this setting.

Future Work

Researchers could explore the diversification of sacred space conversions into various residential types, such as rental apartments, affordable housing, or mixed-use developments, to better grasp adaptive reuse potential across diverse housing needs. In-depth studies are recommended to understand sustainability and socio-economic impacts, tracking changes in property values, community dynamics, and the urban environment over time. Delving deeper into sustainability metrics, including energy efficiency, materials used, and ecological impact, could enrich our understanding of the environmental implications of adaptive reuse. Additionally, public perceptions and involving local communities in decision-making processes, alongside investigating policy implications such as zoning regulations, financial incentives, and government support to facilitate successful adaptive reuse initiatives can be explored.

CHAPTER 4: SOCIAL IMPACTS OF ADAPTIVE REUSE IN THE CONVERSION OF VACANT OFFICE BUILDINGS TO RESIDENTIAL IN DOWNTOWN PITTSBURGH

DEEPANSHI JAISWAL, ODETTE JIN, WEI-NI TING, JUNQI WANG

CHAPTER SUMMARY

The current urban landscape reflects a nationwide trend of increased office vacancies and a shortage of affordable rental housing, prompting cities to explore office-to-residential conversions. As of the first quarter of 2023, the nation has witnessed a noteworthy increase in office vacancy rates, standing at 20.2% across 54 office markets.¹ On the other hand, 7.3 million rental homes nationally as of 2021, are lacking for individuals with extremely low incomes—defined as at or below the federal poverty guideline or 30% of their area's median income, whichever is higher.² The city of Pittsburgh mirrors this national trend of office vacancies and affordable housing shortage. To address this issue, the City and Urban Redevelopment Authority of Pittsburgh (URA), in partnership with the State and Allegheny County, launched the Pittsburgh Downtown Conversion Program (PDCP) in 2023. The program aimed to revitalize Downtown Pittsburgh by converting vacant office space into mixed-income residential, including affordable and workforce housing.³ However, while extensive studies have been conducted to quantify the environmental and economic impacts of adaptive reuse, there is limited research on examining the social impacts of such conversions.

The purpose of this study was to identify the social benefits and challenges associated with living in downtown Pittsburgh and address how the city or office-to-residential conversion, hereby known as conversion projects, could better support social sustainability. Geographic Information Systems, case studies, and interviews were used as the research methods, in order to analyze social impacts at both the city scale and

¹ Allegheny Institute. (2023). Office vacancy rates continue to climb. [online] Allegheny Institute for Public Policy. Available at: <https://www.alleghenyinstitute.org/office-vacancy-rates-continue-to-climb/> [Accessed 1 Dec. 2023].

² Affordable Housing Finance. (2023). Shortage of affordable and available rental homes hit 7.3 million. [online] Affordable Housing Finance. Available at: [https://www.housingfinance.com/news/shortage-of-affordable-and-available-rental-homes-hits-7-3-million_o#:~:text=There%20is%20a%20massive%20shortage,Income%20Housing%20Coalition%20\(NLIHC\)](https://www.housingfinance.com/news/shortage-of-affordable-and-available-rental-homes-hits-7-3-million_o#:~:text=There%20is%20a%20massive%20shortage,Income%20Housing%20Coalition%20(NLIHC).). [Accessed 1 Dec.2023]

³ City of Pittsburgh. (n.d.). City of Pittsburgh Announces Legislation to Launch Pilot Program on Downtown Conversion. [online] Available at: <https://pittsburghpa.gov/press-releases/press-releases/5778>. [Accessed 24 Nov. 2023]

project scale. The research focused on key variables that contribute to social equity, such as accessibility to resources, housing affordability, and safety.

Our findings showed that while the downtown Pittsburgh fabric created some opportunities for living downtown, some amenities and infrastructure could be improved to better support social equity. While public perception suggests that bringing more people into the neighborhoods creates more safety, there was no particular correlation found between the increase in population and crime rates. With the expectation that more residents would be moving to downtown Pittsburgh through PDCP, this research aimed to raise awareness of the potential social values and risks associated with conversion projects and close a research gap by emphasizing the social aspects of the building industry.

INTRODUCTION

Over the past 7-decade period, the population of Pittsburgh decreased by more than half. In the 1950s, Pittsburgh reached its population peak with approximately 676,806 residents, but it has since seen a continuous outflow of people.⁴ By 2023, the city's population had decreased to 295,739.⁵ Although the city of Pittsburgh's population has remained stable since the start of the pandemic, in the fourth quarter of 2019, Pittsburgh boasted a considerably lower office vacancy rate of 7.60%.⁶ This scenario has transformed drastically, as the city was facing an office vacancy rate of 21.8% in early 2023.⁷ Alongside changing office trends, there is also a critical shortage of affordable rental housing in Pittsburgh. The number of extremely low-income renter households stands at 85,802, while the available rental homes that meet the affordability criteria amount to 41,048.⁸ This disparity underscores the urgent need to address housing affordability challenges at the local level.

To address the lack of quality affordable housing options while reducing underutilized office space, Pittsburgh Downtown Conversion Program (PDCP) was launched in January 2023, offering funding to developers for the conversion of vacant office buildings to affordable housing in Downtown Pittsburgh. The four main goals⁹ of the City are:

1. Stimulate economic recovery of Downtown Pittsburgh through reduction of underutilized commercial office inventory and support for retailers and restaurants.
2. Provide equitable access to housing through the creation of a diverse and affordable supply of housing opportunities.
3. Activate historic buildings.

⁴ World Population Review. (n.d.). Pittsburgh, Pennsylvania Population 2020 (Demographics, Maps, Graphs). [online] Available at: <https://worldpopulationreview.com/us-cities/pittsburgh-pa-population>. [Accessed 24 Nov. 2023]

⁵ World Population Review. Pittsburgh, Pennsylvania Population

⁶ Leighton, K. (2023). Office Vacancy Rates Up 3% Since 2019. [online] Pennsylvania Association of Realtors®. Available at: <https://www.parealtors.org/blog/office-vacancy-rates-up-3-since-2019/>. [Accessed 1 Dec. 2023].

⁷ Leighton. Office Vacancy Rates Up 3% Since 2019.

⁸ National Low Income Housing Coalition (2023). The GAP. [online] National Low Income Housing Coalition. Available at: <https://nlihc.org/gap>. [Accessed 24 Nov. 2023]

⁹ City of Pittsburgh. Pilot Program on Downtown

4. Create a more vibrant and resilient neighborhood.

As of October 2023, it is recorded that one project, the Triangle Building, has moved forward with this program, receiving funding from the Urban Redevelopment Authority. However, if the program becomes successful in the coming years and more affordable housing is expected to be brought into the city center, it is important to study the downtown district and how these adaptive reuse projects have an impact on the society. These studies could help to address some opportunities or challenges the downtown community still holds in order to accommodate a large population of residents. This research delves into the social impacts of office-to-housing conversion, their effect on population stability and social sustainability, as a microcosm of a broader national trend. By examining these interrelated factors, we aim to gain a comprehensive understanding of the opportunities and risks of office conversions and raise awareness on social equity in the building industry.

LITERATURE REVIEW

A study of several papers gave insight into drivers for conversion from office buildings to residential in the central business district, the benefits and risks of such conversion, and the importance of social sustainability in adaptive reuse projects.

Drivers for Office Conversion in Central Business District (CBD)

Building vacancy is perceived as a problem because economically it poses inefficiency in an owner's business model. In evaluating the financial viability of office conversion, government incentives posed an important driver for the developers, as it would "narrow the gap between suburban and core area development conditions,"¹⁰ such as land costs, hazardous materials removal costs, preservation costs...etc.¹¹ Socially, vacancy can lead to "insecurity, social uncertainty and may bring about criminality ranging from vandalism and graffiti to break-ins, illegal occupancy and fires."¹² In order to revitalize the central business district, policymakers have begun to investigate the idea of bringing more residents in downtown.¹³ This housing-based strategy not only addresses the growing shortage of housing but also centers on the idea that by introducing more residents into the downtown area, it would "translate into increased demand for retail goods, entertainment facilities and all kinds of personal and household services."¹⁴ Revitalization of the city downtown would also improve the image of the city; thus, "further facilitate the attraction of other people-oriented facilities such as arts and crafts centers and recreational facilities."¹⁵ Buildings with historical significance

¹⁰ Bunting, T. *et al.* (2020). Housing Strategies for Downtown Revitalization in Mid-Size Cities: A City of Kitchener Feasibility Study. *Canadian Journal of Urban Research*, 9(2), pp. 145-175.

¹¹ Anderson, B. (2020). Apartment Developers Scout Adaptive Reuse Possibilities. *Wealth Management*. [online] Available at: <https://www.wealthmanagement.com/development/apartment-developers-scout-adaptive-reuse-possibilities>. [Accessed 12 Oct. 2023].

¹² Remøy, H.T. and van der Voordt, T.J.M. (2007). A new life: conversion of vacant office buildings into housing. *Facilities*, 25(3/4), pp.88-103. doi:<https://doi.org/10.1108/02632770710729683>.

¹³ Shipley, R., Utz, S. and Parsons, M. (2006). Does Adaptive Reuse Pay? A Study of the Business of Building Renovation in Ontario, Canada. *International Journal of Heritage Studies*, 12(6), pp.505-520. doi:<https://doi.org/10.1080/13527250600940181>.

¹⁴ Bunting. *et al.* Housing Strategies for Downtown Revitalization.

¹⁵ Bunting . *et al.* Housing Strategies for Downtown Revitalization.

also place a need for preservation, regardless of “whether they are functionally efficient or not.”¹⁶ These economic, environmental, and social drivers for office conversion showcase the different interests of various stakeholders.

Opportunities and Risks

Adaptive reuse projects represent opportunities for reuse, recycling, and redevelopment of existing buildings. This aligns with circular economy approaches aimed at reducing environmental impacts through extending the life cycle of materials and reducing the consumption and waste of materials and energy.¹⁷ By reusing large parts of existing buildings, especially facades, floor slabs, and foundations, this also allows for easier adaptation of the new residential use and reduces construction costs. The typical short timeline of office conversion projects also improves their financial feasibility.¹⁸ Researchers also argue that conversion of outdated office buildings can increase the office rental rates, “as supply and demand will correspond better.”¹⁹

The location within the metropolitan area provides opportunities for convenience, accessibility, and diversity, which are the main attractors for downtown living.²⁰ By providing adequate housing to vulnerable groups such as seniors, immigrants, single parents, refugees, and indigenous people, office-to-affordable housing conversion also fosters social diversity and promotes the inclusion of these groups, addressing social equity.²¹ A study on the adaptive reuse of downtown office buildings into affordable housing in Los Angeles focuses on government incentive actions such as tax credits and reduced regulatory requirements to attract developers' investments, and how such incentives can provide opportunities for affordable housing and illustrate the importance of social justice in housing.²² Other social benefits of adaptive reuse include preserving cultural heritage, creating social diversity, and fostering community involvement, despite the higher social risks associated with it, including bad working conditions for laborers working on old buildings causing health and safety issues, and ultimately infringing on the human rights of workers.²³

Some significant barriers include parking, security, amenities, and quality housing options mainly due to unaffordability of land and construction in the central business district.²⁴ The functional adaptability of office buildings is also a critical factor in determining the feasibility of conversion and whether the project is financially viable. In older buildings especially, the risk of exposure to hazardous materials is higher and

¹⁶ Remøy and van der Voordt. A new life.

¹⁷ Tsenkova, S. (2023). Perspective Chapter: Reimagining Affordable Housing through Adaptive Reuse of Built Heritage. IntechOpen eBooks. doi:<https://doi.org/10.5772/intechopen.110072>.

¹⁸ Remøy, H. and van der Voordt, T. (2014). Adaptive reuse of office buildings into housing: opportunities and risks. *Building Research & Information*, 42(3), pp.381-390. doi:<https://doi.org/10.1080/09613218.2014.865922>.

¹⁹ Remøy and van der Voordt. A New life..

²⁰ Bunting. et al. *Housing Strategies for Downtown Revitalization*.

²¹ Tsenkova. *Reimagining Affordable Housing*.

²² Bullen, P.A. and Love, P.E.D. (2009). Residential regeneration and adaptive reuse: Learning from the experiences of Los Angeles. *Structural Survey*, 27(5), pp. 351-360. doi:10.1108/02630800911002611.

²³ Lundgren, R. (2023). Social lifecycle assessment of adaptive reuse . 4(1). doi:<https://doi.org/10.5334/bc.314>.

²⁴ Bunting. et al. *Housing Strategies for Downtown Revitalization*.

can lead to unforeseen conditions that greatly impact the project's monetary status. The restrictive nature of adaptive reuse building, such as floor height, access to daylight...etc., compared to a new development also poses challenges to creating quality housing and attracting residents. A few studies from the Netherlands identify the types of office buildings and characteristics, such as prestressed concrete and older buildings with poor acoustic insulation, that are harder to translate to residential.²⁵

These studies showed that adaptive reuse projects have both positive and negative impacts. While such conversion projects foster sustainability, economic viability, social diversity, and inclusion for different groups and enhance the sense of belonging for urban dwellers, they can also cause displacement and gentrification in the area leading to public acceptance issues. In addition, the physical conditions of the existing buildings also play a major role in determining the success of office conversion.

Social Sustainability

Social sustainability has gained awareness in recent years, as the “pandemic exacerbated existing social inequalities and social exclusion and demonstrated the importance of affordable housing.”²⁶ Social sustainability, which includes aspects like human rights, social justice, social inclusion, social cohesion, social capital, social innovation, social responsibility, and social development, is also influenced by such conversion projects. Campbell (1996) and Mohamed (2016) both describe the importance of achieving a balance between the three points of triangle, environment, economic, and equity.²⁷ However, compared to economic and environmental sustainability, social impacts are difficult to quantify, and are rarely taken into consideration as the first priority when investing in a project. Arfa (2022) explores the criteria that help determine if adaptive reuse projects are successful, in which social value creation is one of the key criteria for judging the success of adaptive reuse projects in the Netherlands.²⁸

Nevertheless, researchers have different views on the impact of adaptive reuse has on social sustainability. Lundgren (2023) points out the risk that adaptive reuse may lead to a demographic shift where the population settlement structure changes as a consequence of urban development including factors such as aging, migration, urbanization, fertility, mortality, etc;²⁹ Bullen (2009) concludes on the risk of excluding low-cost housing for lower income groups as a result of the adaptive reuse program in Los Angeles³⁰, while Tsenkova (2023) describes that adaptive use of heritage buildings has the opportunity to “address displacement in low-income inner-city communities, and contributes to larger community well-being and sense of place.”³¹ As such, it is apparent that the extent of social impacts office conversions have on the communities depends

²⁵ Remøy and van der Voordt. Adaptive reuse of office buildings into housing.

²⁶ Tsenkova. Reimaging Affordable Housing.

²⁷ Campbell, S. (1996). Green Cities, Growing Cities, Just Cities. Urban Planning and the Contradictions of Sustainable Development. *APA Journal*, pp. 296-312;

Mohamed, R., et al. (2017). Adaptive reuse: a review and analysis of its relationship to the 3 Es of sustainability. *Facilities*, 35(3/4), pp.138-154. doi:<https://doi.org/10.1108/f-12-2014-0108>.

²⁸ Arfa, F.H., et al. (2022). Criteria of 'Effectiveness' and Related Aspects in Adaptive Reuse Projects of Heritage Buildings. *Sustainability*, 14(3), p.1251. doi:<https://doi.org/10.3390/su14031251>.

²⁹ Lundgren. Social lifecycle assessment of adaptive reuse.

³⁰ Bullen and Love. Residential regeneration and adaptive reuse.

³¹ Tsenkova. Reimaging Affordable Housing.

greatly on the context and the policies. It is possible to generalize on how affordable housing brings benefits to the city but more in-depth analysis of the context, the population, and the culture is needed, in order to determine the actual social impacts of office conversion projects.

Research Gap

Shiple (2006) agrees with the feasibility of vacant office building conversion, and it has the potential to contribute to the communities, supported by the analysis of limitations such as construction costs, policy incentives, and construction schedules.³² Bunting (2020) also emphasized the importance of understanding the demographic preferences and housing needs of different kinds of residents.³³ Furthermore, studies from Remoy & Van der Voordt (2007) have explored the risks associated with office-to-housing conversions, including social problems like crime, insecurity, and transportation challenges.³⁴ The economic viability of adaptive reuse projects compared to new construction has been a subject of investigation, particularly in terms of cost-effectiveness based on different building scales.³⁵ Additionally, social life cycle assessments have been conducted to evaluate how these projects affect end-users, local communities, and project stakeholders.³⁶

However, the common gap in these studies is the lack of post-pandemic quantitative data on the social impacts of the conversion of vacant buildings in downtown Pittsburgh. The COVID-19 pandemic has fundamentally altered the dynamics of work and urban living, which created new challenges and opportunities for adaptive reuse projects. This research aims to explore the social implications of office-to-affordable housing conversions in downtown Pittsburgh in the post-pandemic era and provide valuable insights for urban planners, policymakers, and stakeholders involved in the transformation of downtown Pittsburgh and similar mid-sized American cities.

PROBLEM STATEMENT & RESEARCH QUESTIONS

Pittsburgh is facing one of its own problems with buildings that have been vacant for decades. Adaptive reuse of these properties raised different issues for various stakeholders. While property owners almost always evaluate the profitability of such conversion before taking on such projects, government officials may study the expected land value increase leading to additional tax revenue, and professionals working in the AEC industry may care more about the aesthetic quality, physical feasibility, and the sustainability aspects of adaptive reuse projects. There are very few studies specifically tailored to the social impacts of such conversion within the specific context of a city.

This research aims to identify the social impacts resulting from office conversions to residential in downtown Pittsburgh and understand how specific conversion projects have an impact on social sustainability. The goal of this study is to emphasize the social

³² Shiple, Utz ,and Parsons. Does Adaptive Reuse Pay?.

³³ Bunting. et al. Housing Strategies for Downtown Revitalization.

³⁴ Remøy and van der Voordt. A New life..

³⁵ Shiple, Utz ,and Parsons. Does Adaptive Reuse Pay?.

³⁶ Lundgren. Social lifecycle assessment of adaptive reuse.

aspects of the building industry and to bring awareness to the social values or risks that may result from office conversion projects in the downtown district.

Research Questions

1. What are the social impacts of office conversions to residential in Pittsburgh?
2. How do office conversion projects in downtown Pittsburgh contribute to social sustainability?

METHODOLOGY

This research study employed both a quantitative and qualitative approach in studying the potential social impacts. Using tools such as ArcGIS Online and ArcGIS Pro allows us to complete quantitative research between variables on a larger city scale, as well as draw attention to smaller building-scale projects. Case studies of a downtown Pittsburgh conversion project are conducted to gather qualitative information at a smaller scale. Interviews with the project owner also helped us further understand the strategies and considerations during project development.

Method 1 - Spatial Analysis Methodology (ArcGIS Online & ArcGIS Pro)

The first methodology used in this research report uses ArcGIS Online and ArcGIS Pro to conduct different quantitative analyses about different variables of the social impact of conversion projects in downtown Pittsburgh. By using ArcGIS Online to create maps, the study analyzed the factors of social sustainability including housing typology, rental trend, walkability, bike-ability, and other supporting amenities like public transport, parking, grocery, etc. All these factors will have a direct bearing on the quality of life and social dynamics of low-income people. Additionally, by using the spatial analysis tool in ArcGIS Online, 0.5-mile radius buffers were created based on the location of different projects to analyze the walking proximity to public amenities. This spatial technique will provide valuable insights into the accessibility and convenience of these housing units for residents.

In addition, the ArcGIS Pro was used to investigate the crime rate data. It also combined spatial analysis and correlation analysis to evaluate the relationship between different variables. For example, the geographic relationship between the project location and the potential impact on crime rates shows whether the project's existing time affects the crime rates or not. Overall, depending on the nature of our variables, we could use different mapping tools to conduct our research, taking full advantage of each's strengths.

Method 2 - Case Study & Interview

The second methodology used was an in-depth case study, conducted on one of the downtown conversion projects, including an interview with the owner. This method gives us qualitative data of a real-life project for the changes it makes in the urban fabric and our society. The Triangle Building, which is currently the first and only conversion project funded by the Pittsburgh Downtown Conversion Program, was selected as the case study.

After conducting our analysis of the Triangle Building, encompassing a thorough examination of the case study and interviews, the considerations articulated by the various parties involved were systematically organized into 14 overarching categories. These broader categories were established based on insights gleaned from prior research and serve as a framework for understanding the diverse social impacts, as shown in Table1.

Table 1: Categories of Social Impact³⁷

NO.	SOCIAL IMPACT CATEGORIES	EXAMPLES
1	Aesthetic Impacts	physical landscape
2	Archaeological & Cultural Heritage Impacts	housing, poverty
3	Health & Mental Health Impacts	supportive amenities
4	Economic & Fiscal Impacts	Financial Considerations
5	Workforce Impacts	Inclusive for all demographics
6	Gender Impacts	Inclusive for all gender
7	Environmental Impacts	air and water quality, sanitation
8	Psychological Impacts	fears and aspirations
9	Leisure And Tourism Impacts	Supportive amenities
10	Natural Resource & Land Use Impacts	ownership and access
11	Community Service Impacts	police, fire, sanitation, health
12	Cultural Impacts	shared beliefs, customs, values, language
13	Political Impacts	distribution of power, democratization
14	Demographic Impacts	population numbers, diversity

FINDINGS

The golden triangle of Pittsburgh is the context of the Pittsburgh Downtown Conversion Program (PDCP) and the focus of our research. There are currently a total of 15 projects that have been identified as office-to-residential conversions.³⁸ The housing units each project currently provides or intends to provide range from 4 to 300 units. The location of these projects is scattered throughout the Central Business District (CBD), but there is a concentration, particularly in an area known as the Cultural District of

³⁷ SureImpact. (2022). The Ultimate How-To Guide to Social Impact Assessment. [online] Available at: <https://www.sureimpact.com/post/social-impact-assessment> [Accessed 12 Nov. 2023].

³⁸ Pittsburgh Downtown Partnership. (n.d.). Downtown Pittsburgh Investment Map. [online] Available at <https://arcg.is/04vTvp>. [Accessed Oct. 10, 2023].

Pittsburgh, where the art galleries and theaters are located. The concentration of these conversion projects in this region is correlated to the business vacancies result, as shown in Figure 1, which has the second highest vacancy rate.

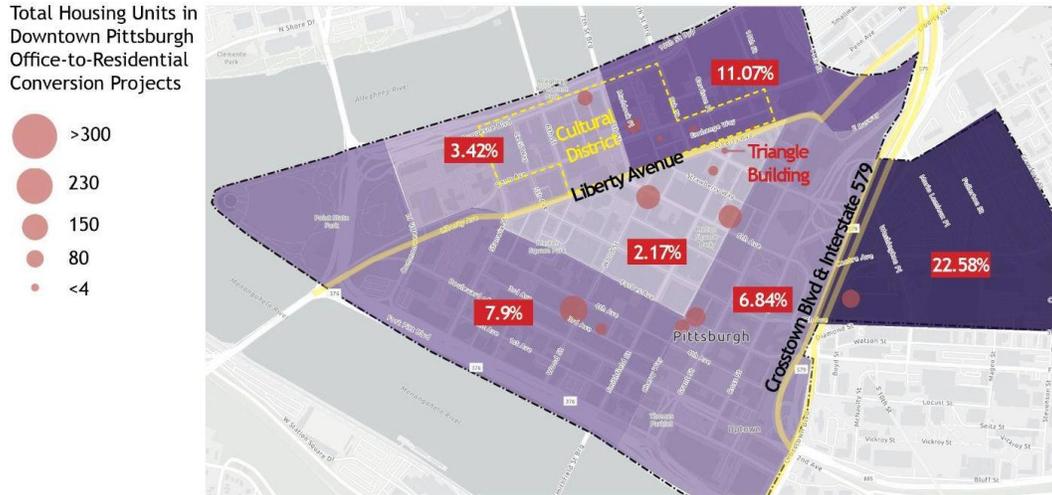


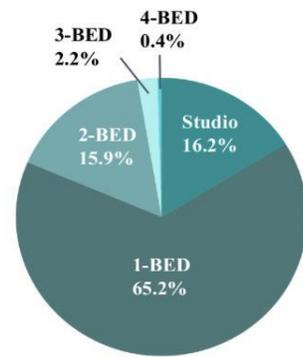
Figure 1: Percent of all vacant business addresses in the third quarter of 2023³⁹

In order to find out what social impacts office conversion to residential projects have on the Central Business District of Pittsburgh, we explored the following topics:

1. **Housing Typologies:** What housing typologies are created through office conversions? Do downtown residential projects target a certain household size or demographic?
2. **Affordability:** Are office conversions to residential projects in downtown Pittsburgh affordable to the average median-income residents in Pittsburgh?
3. **Accessibility:** Are residents accessible to food, a variety of transit choices, and parking spaces?
4. **Safety:** How does the crime rate respond to population changes in downtown Pittsburgh?

Housing Typologies

One of the City’s goals is to provide a more diversified market of housing opportunities, and equitable access to housing for different income groups; however, in terms of equitable access, among the 673 new housing units we calculated, 1-bedroom units constitute 65% of the current rental housing stocks of the conversion projects, which indicates the target household for the downtown market. This deviates from



Data Input: 673 total units

Figure 2: Housing Units Percentage for Conversion Projects⁴⁰

³⁹ Data obtained from Pittsburgh Downtown Partnership. (n.d.). Downtown Pittsburgh Investment Map.[online] Available at: <https://arcg.is/04vTvp>. [Accessed Oct. 10, 2023]; PolicyMap. (n.d.). Percent of all business addresses that were vacant in the third quarter of 2023. Available at: <http://www.policymap.com.cmu.idm.oclc.org/>. [Accessed Nov. 20, 2023].

⁴⁰ Pittsburgh Downtown Partnership, *Pittsburgh Investment Map*.

the city’s plan to create a diversified neighborhood for all types of households.

Affordability

According to the U.S. Department of Housing and Urban Development (HUD), “affordable housing is generally defined as housing on which the occupant is paying no more than 30 percent of gross income for housing costs, including utilities”.⁴¹ Extracting the income limits data from HUD, and calculating the monthly income for the median household in Pittsburgh, we found 30% of income for each household size, and treated these numbers as the baseline for evaluating the affordability of downtown housing.

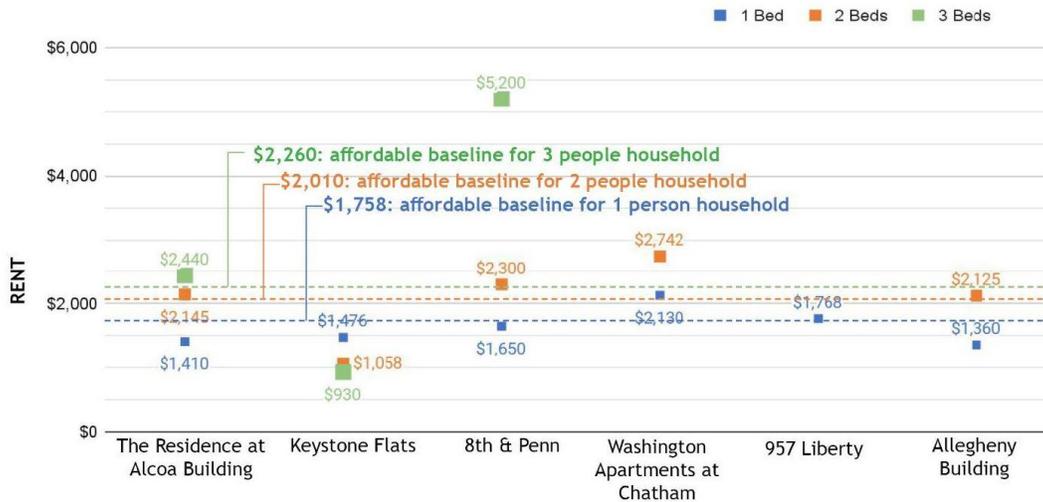


Figure 3: 2023 Pittsburgh Conversion Projects Rental Rate in Comparison with Median Family Income Affordability Baseline.⁴²

The rental rates for each unit type are obtained. From the data, we found that of the 13 projects that provide rental apartments, six of them have rental rates for one-bedroom apartments that fall under the 30% income limit (\$1,758/month). Two out of the 13 projects, which are the Triangle Building and City Club Apartments, are currently under planning, stated that they would provide a percentage of units as affordable units.⁴³ Five out of the 13 projects were still under planning phase, and there was insufficient data. Six out of the 13 projects, which we have gathered sufficient data, are shown in Figure 3. Results show that four out of the six projects have one-bedroom apartments rental rates that are below the affordable baseline for one-person/median

⁴¹ U.S. Department of Housing and Urban Development (2011). HUD Archives: Glossary of Terms to Affordable Housing - HUD. [online] archives.hud.gov. Available at: <https://archives.hud.gov/local/nv/goodstories/2006-04-06glos.cfm>. [Accessed 24 Oct. 2023].

⁴² Data obtained from: The Residence at Alcoa Building, <https://www.pmcpropertygroup.com/corporate/case-study/residences-historic-alcoa-building>; Keystone Flats, <https://www.keystoneflats.com/Floor-Plans.aspx>; Eighth & Penn, <https://www.eighthandpenn.com/about>, <https://nextpittsburgh.com/city-design/eighth-penn-apartments/>; Washington Apartments at Chatham, <https://www.apartments.com/the-washington-at-chatham-pittsburgh-pa/k7mqmg9/>, <https://www.zillow.com/apartments/pittsburgh-pa/the-washington-at-chatham/5XrcXw/>, [Link]; 957 Liberty, <https://www.compass.com/listing/957-liberty-avenue-unit-403-pittsburgh-pa-15222/1304437757608526833/>; Allegheny Building: <https://www.loopnet.com/Listing/429-Forbes-Ave-Pittsburgh-PA/3937833/>, <https://www.keystoneedge.com/2015/01/29/renovating-historic-buildings-and-boosting-residential-development-in-downtown-pittsburgh/>. [Accessed 24 Nov. 2023].

⁴³ Data obtained from: Triangle Building, interview with Hullett Properties; City Club Apartments, <https://www.cityclubapartments.com/>.

income households. The rental rates for apartments with two bedrooms and more; however, are much less affordable to the median household. Only one project (Keystone Flats) offers rental rates for two-bedroom and three-bedroom apartments that fall under the 30% income limit (\$2,010/month; \$2,260/month), but the building targets primarily students as their tenants.

Accessibility

The City also seeks to create a more vibrant and resilient neighborhood; therefore, we studied the accessibility of the downtown district in terms of different transit choices, including walking, biking, public transportation, and cars. It is argued that “cities with more transit choice demonstrate less income inequality and less overspending on rent.”⁴⁴ Thus, there are powerful equity reasons to invest in different commuting systems, including walkability and bike-ability in cities, in order to address social sustainability.

In terms of walking and public transport, the downtown district provides a good opportunity for these two options based on the walk score and transit score. Downtown district is considered a “walker’s paradise”, and earns a walk score of 95 out of 100.⁴⁵ Public transportation is also very convenient in this location, earning a transit score of 98 out of 100.⁴⁶

Accessibility to Food and Amenities

While examining the accessibility to food by walking, there is currently only one grocery store, Target, located in the center of downtown. Grocery stores are a key amenity for residential neighborhoods. According to the Food Access Research Atlas, accessibility to “supermarkets, supercenters, grocery stores, or other sources of healthy and affordable food” is considered low “with at least 500 people, or 33 percent of the population, living more than one-half mile to one mile away”.⁴⁷ Barriers such as building blocks and highways are considered in calculating the walkable region and distance, and a walking proximity study is generated from GIS. It is shown that all of the conversion projects are within 0.5 mile of walking proximity to grocery stores. However, in the coming years upon execution of all the conversion projects, considering the limited selection of food choices, the CBD is expected to become a bigger food desert, unless more grocery options are provided.

Walking proximity to convenience stores and pharmacies was also mapped out, as shown in Fig. 5. All of the conversion projects are within 0.5 mile walking proximity; however, the south-east corner of the CBD is less accessible to these amenities, and could pose social equity issues for some residents.

⁴⁴ Jeff Speck (2018). *Walkable City Rules: 101 Steps to Making Better Places*, 8 DOI 10.5822/ 978-1-61091-899-2_4.

⁴⁵ Walk Score. (n.d.). *Downtown neighborhood in Pittsburgh*. [online] Available at: <https://www.walkscore.com/PA/Pittsburgh/Downtown>. [Accessed November 26 2023].

⁴⁶ Walk Score, *Downtown neighborhood*.

⁴⁷ Rhone, A. (2018). *USDA ERS - Documentation*. [online] Usda.gov. Available at: <https://www.ers.usda.gov/data-products/food-access-research-atlas/documentation/#definitions>. [Accessed 10 October 2023].



Figure 4: Walking Proximity (0.5mi) to Grocery Store⁴⁸

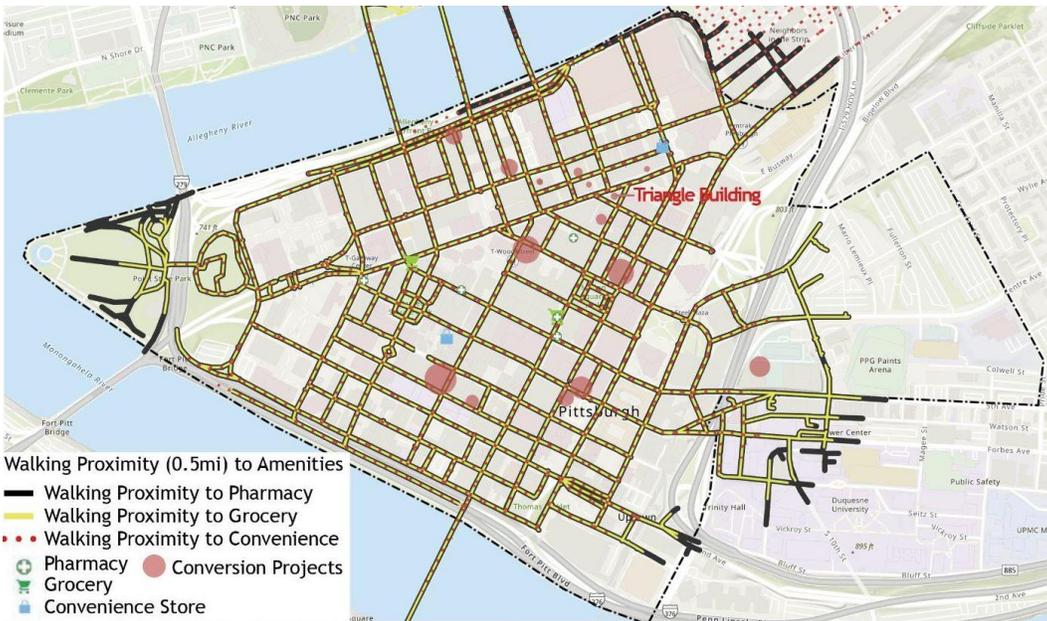


Figure 5: Walking Proximity (0.5mi) to Groceries, Pharmacies, & Convenience⁴⁹

⁴⁸ Location of grocery store generated by Google Map.

⁴⁹ Locations of grocery stores, convenience stores and pharmacies generated by Google Map.

Accessibility for Bikers

In order to maximize the opportunities of various transit choices for residents living downtown, bike sharing could be a robust and sustainable transit option that can be further improved. Although the streetscape in the downtown district is mostly flat and accessible to bikers. There are still some routes that are not particularly safe for bikers, as shown in the red lines. These cautionary routes typically experience high levels of traffic and topographic challenges.

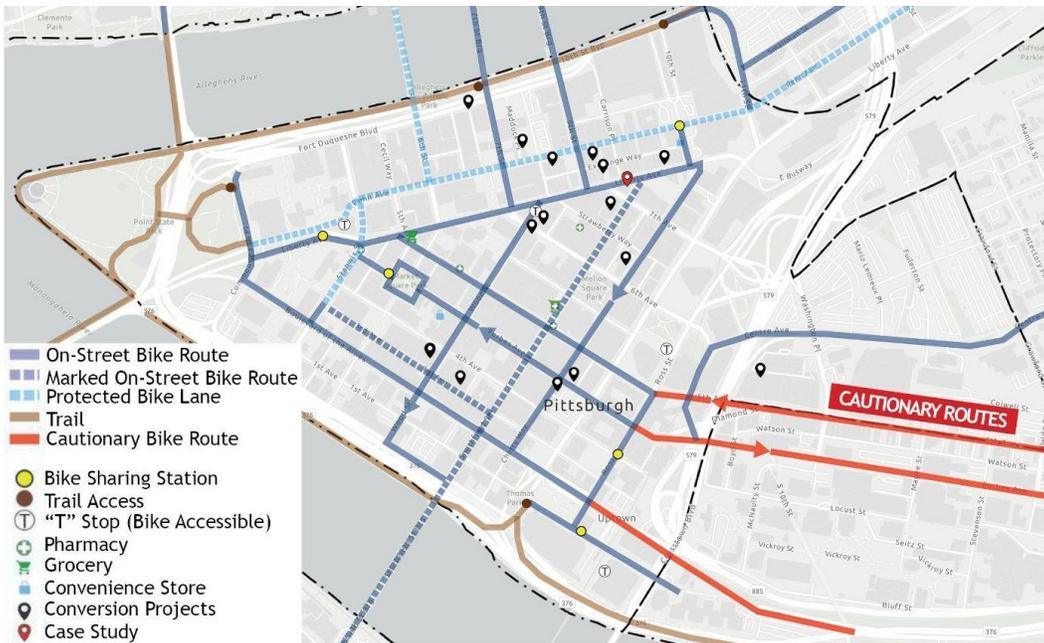


Figure 6: Bike Routes⁵⁰

In addition, there is a major lack of bike-sharing stations available in many parts of the downtown region. “Good bike share systems have lots of stations within a short walking distance in all neighborhoods, including low-income areas. Users tend to be willing to walk around 5 minutes to use a bike. Successful bike share systems in Paris, New York, and Mexico City all have stations no more than 1000 feet apart (approximately 5 minutes’ walk).”⁵¹ As shown in Figure 7, some conversion projects are not accessible to the bike-sharing systems. These stations can be added to support the bike system downtown.

⁵⁰ Data obtained from BikePGH. (n.d.). [online] Available at: [\[Link\]](#) [Accessed 24 Nov. 2023].

⁵¹ National Association of City Transportation Officials (NACTO). (2015). Walkable station spacing is key to successful, equitable bike share. [online] Available at: [\[Link\]](#). [Accessed 24 Nov. 2023].

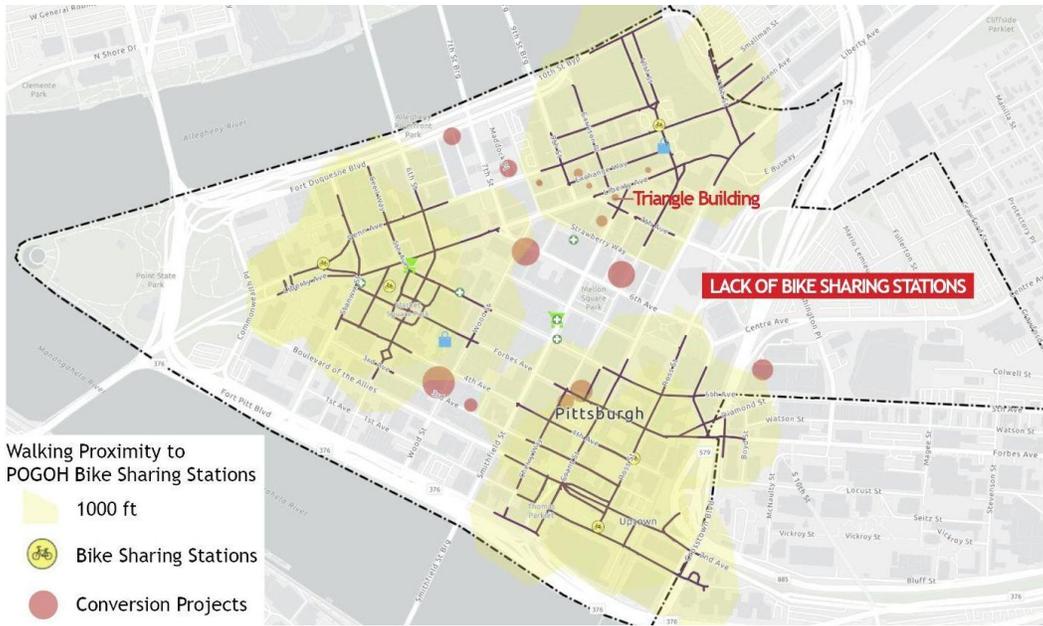


Figure 7: Accessibility to Bike Sharing Stations⁵²

Accessibility to Parking Spaces

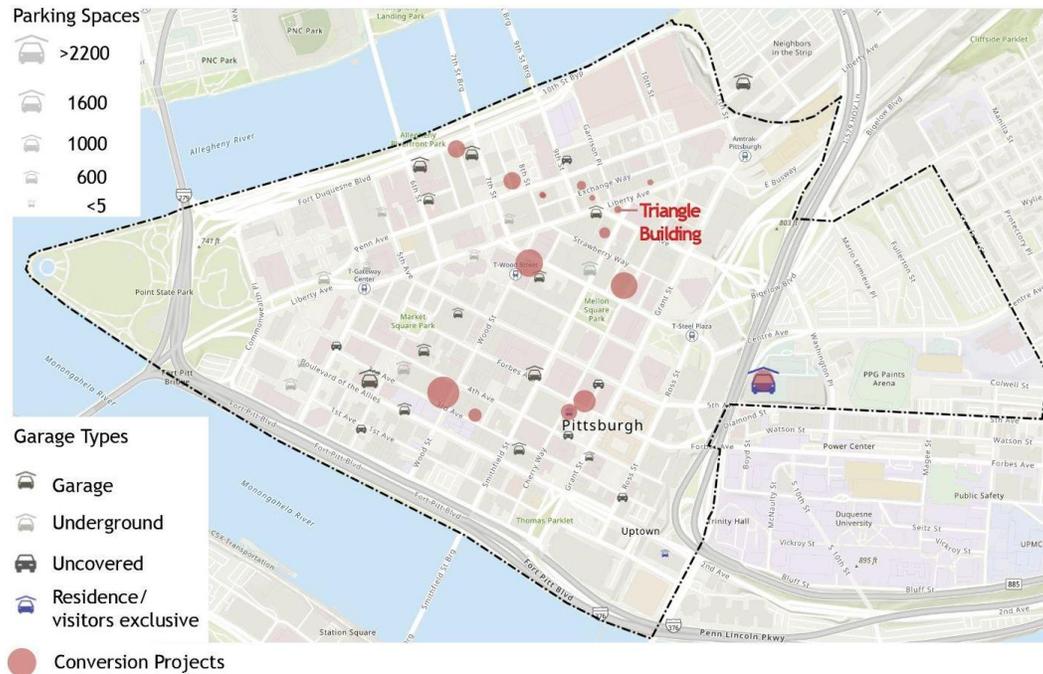


Figure 8: Availability of Parking Spaces (for Monthly Lease)⁵³

⁵² Data obtained from BikePGH.

⁵³ Data obtained from Pittsburgh Parking Authority. (n.d.). Facilities. [online] Available at: [\[Link\]](#) [Accessed 15 Oct. 2023].

Parkopedia. (n.d.). Pittsburgh parking - Car Parks, Street Parking, Private Garages. [online] Available at: [\[Link\]](#) [Accessed 15 Oct. 2023].

The availability of parking spaces is one of the biggest challenges in office conversions. Since most of these buildings are old historic buildings, which may not have a parking garage within the building to start with, it is almost impossible to reconfigure the layout to accommodate more parking spaces in the building due to structural and functional reasons. Therefore, in most cases, residents who own cars would need to find parking spaces in nearby garages. Therefore, the locations of the existing parking spaces based on the different types (garage, underground parking, uncovered parking lot, residence, or visitor exclusive parking) were mapped out to show if certain regions are more accessible to parking than others. Considering these parking garages would also need to serve office employees and visitors, it is recommended for the city or developers to further investigate the availability of the parking spaces when determining the feasibility of such a conversion.

Safety

Another City's goal in downtown office conversions is to create a vibrant and resilient neighborhood. Based on our literature review, criminality resulting from building vacancies is one of the drivers of conversions. To revitalize the central business district, policymakers have begun to investigate the idea of bringing more residents downtown. Therefore, we used ArcGIS Pro to conduct a spatial analysis of crime rates in the CBD to study the impact of conversion projects on crime rates and address safety concerns, which is also a key issue of social impact. Upon completion of conversion projects, it is critical to understand the relationship between crime rates at various time points.

Firstly, we proposed the following hypothesis: there will be less crime in the area where conversion projects are located, as more residents move in. To validate this theory, we collected data on annual crime rates in the central business district for the years 2016, 2019, 2020, 2021, 2022, and the current year, 2023.⁵⁴ However, it is important to note that the data for 2023 is incomplete since the time of this report's compilation is ongoing in 2023. We used ArcGIS Pro to generate maps in different years. Table and point tools were used to show the feature of crime rate location and generate a statistical chart of the table to show the maximum count of offense types. Below are crime rate maps for two years.

⁵⁴ Western Pennsylvania Regional Data Center. (n.d.). Police Incident Blotter (Archive) - CKAN. [online] Available at: [\[Link\]](#). Accessed: [Accessed: 13 Nov. 1 2023].

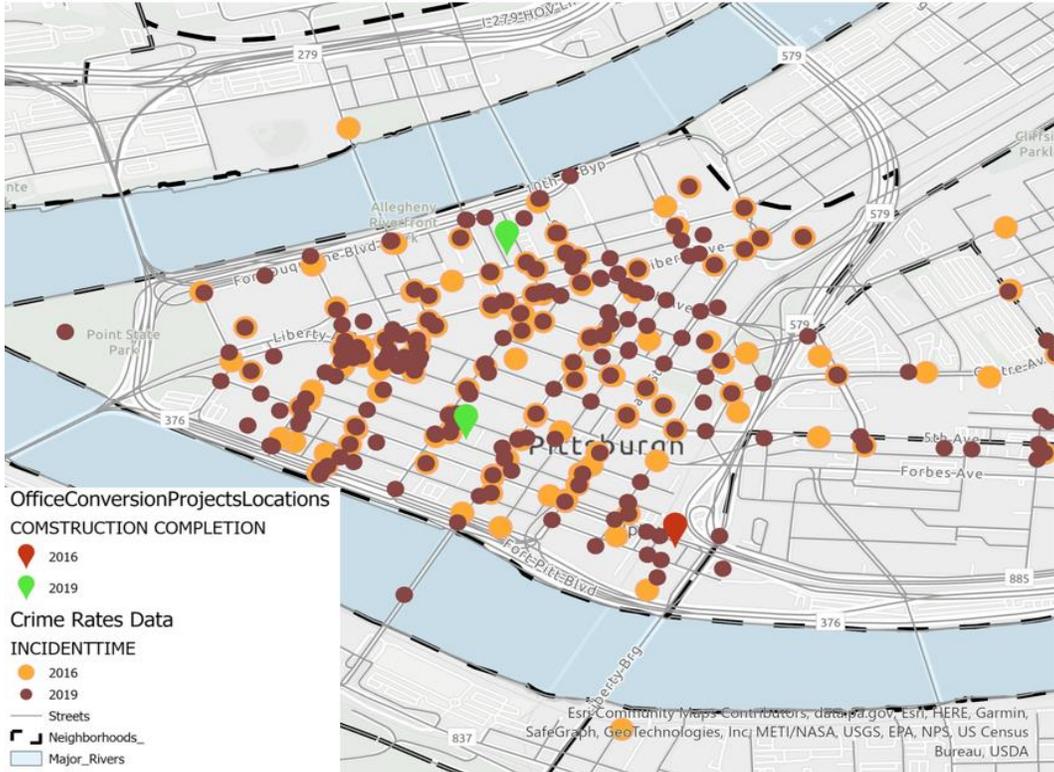


Figure 9: Crime Rates map (2016 & 2019)

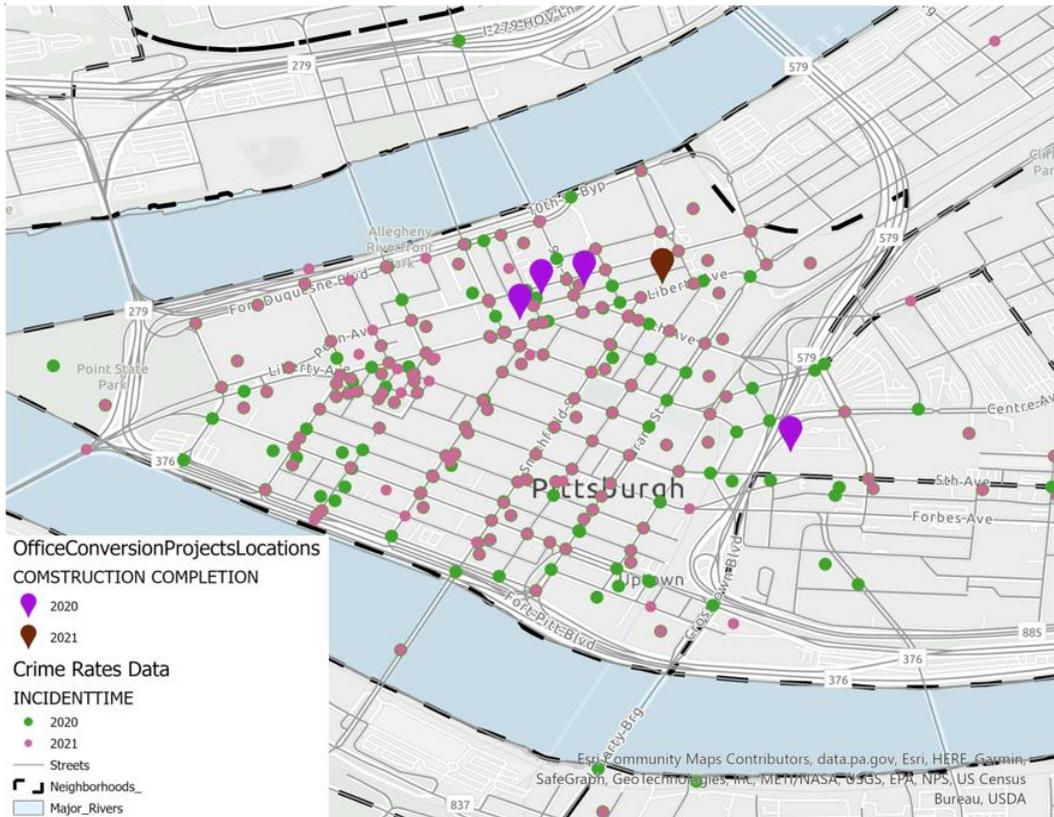


Figure 10: Crime Rates map (2020 & 2021)

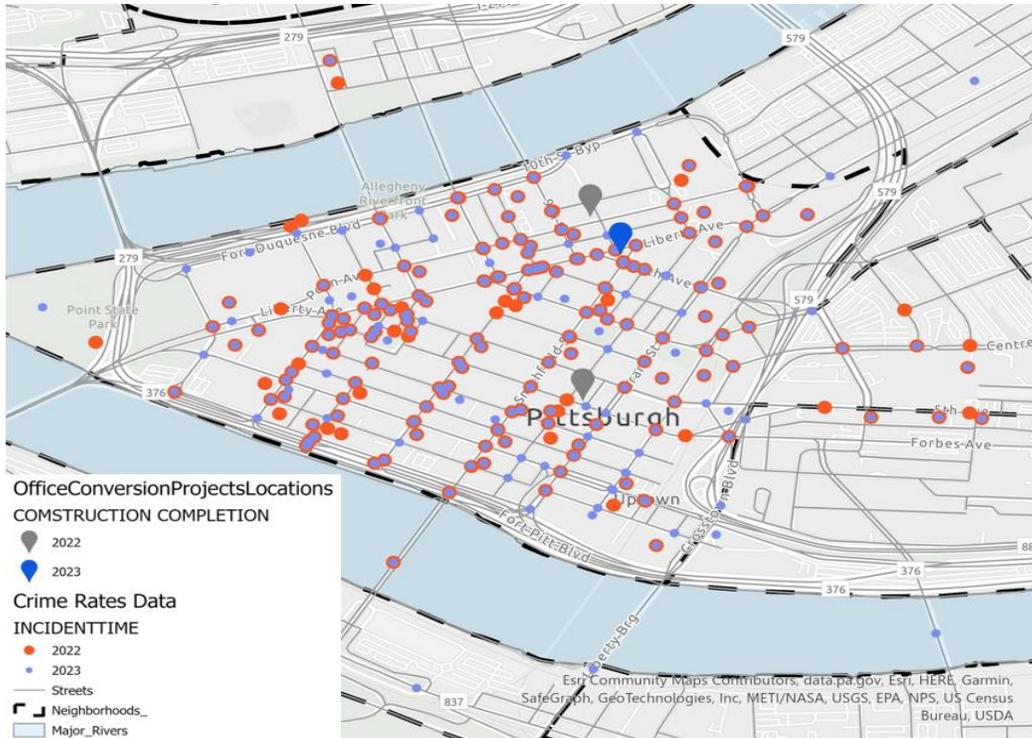


Figure 11: Crime Rates map (2022 & 2023)

These maps clearly show crime incidents in various locations and times, with different color spots representing different years based on project completion. Each map shows the distribution of crimes and their specific locations. For example, in 2016, crime was concentrated on the west and north sides of the CBD. However, there was a noticeable increase in crime incidents and density in the west and north in 2019. Observations in 2020 and 2021 continue to show a decrease in density in those two areas. Surprisingly, despite no ongoing projects, the west side of downtown appears more dangerous in 2022. Based on these maps, it is difficult to draw a conclusive link between project completion and crime rates. In this case, we decided to dig deeper into total crime rates over time and population. The table below summarizes total offenses in different years, based on project completion time points to explore the relationship between crime rates and construction time.

Table 2: CBD Crime Rates Summary

Year	Total Crime	Maximum Offenses Code - Type	Maximum Offenses Count
2016	509	3921- Theft by Unlawful Taking or Disposition	40
2019	1862	3921(a) Theft by Unlawful Taking or Disposition - Movable item	133
2020	2118	9497- Aided Case	113
2021	1308	3921(a) Theft by Unlawful Taking or Disposition - Movable item	87
2022	1642	3929 Retail Theft	127
2023	1833	3921(a) Theft by Unlawful Taking or Disposition - Movable item	90

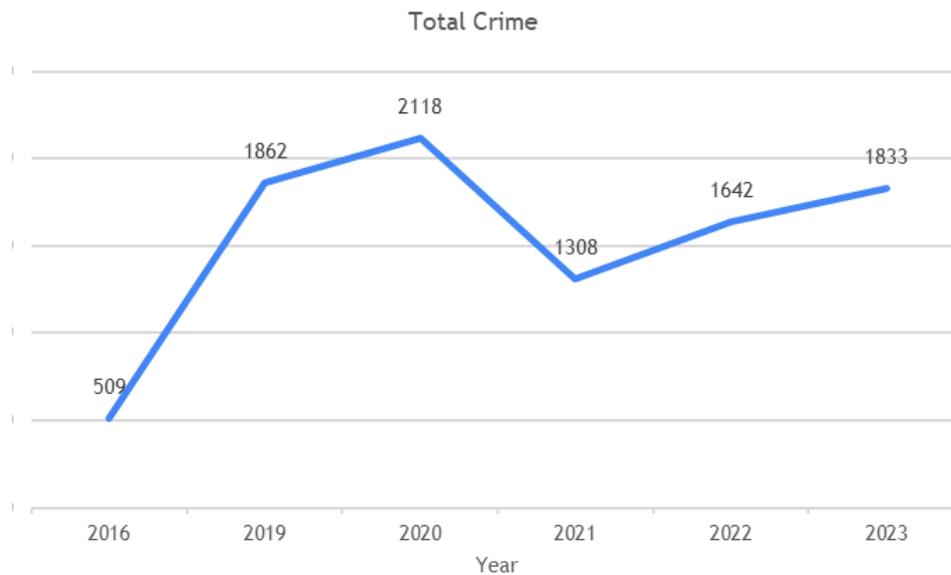


Figure 12: Crime Rates chart

According to the table, in 2016, 2019, 2021, and 2023, the predominant offense type was "Theft by Unlawful Taking or Disposition - Movable item," as indicated in the table. As defined by the Pennsylvania General Assembly, this offense involves unlawfully taking or controlling movable property with the intent to deprive the owner.⁵⁵ Additionally, in 2022, Retail Theft emerged as the primary offense type, encompassing intentional actions like taking merchandise without paying, altering price markings, transferring items to another container, under-ring pricing, or deactivating security

⁵⁵ Pennsylvania General Assembly. (n.d.). Title 18. Available at: [\[Link\]](#). [Accessed 25 Oct. 2023].

measures to deprive the merchant of the full retail value.⁵⁶ In addition, in 2020, the Aided Case is the maximum offense type, although we could not find the definition in an official document in Pennsylvania, this type’s explanation can be found in New York’s NYPD Patrol Guide in 2014, which defines that: “Any occurrence coming to the attention of a uniformed member of the service which requires that a person, OTHER THAN A PRISONER, receive medical aid or assistance.”⁵⁷

From the data presented in the table, we can find trends in the crime rates over the years in the CBD area. Notably, the years spanning from 2016 to 2020 exhibit a consistent increase in crime rates, with the peak occurring in 2020. The widespread economic downturn and people’s job losses could cause this alarming increase. In addition, theft is the most prevalent offense type in these years. After 2020, there was a decline in the total number of reported crimes, decreasing from 2118 to 1642. However, the crime rate in 2023 has once again risen.

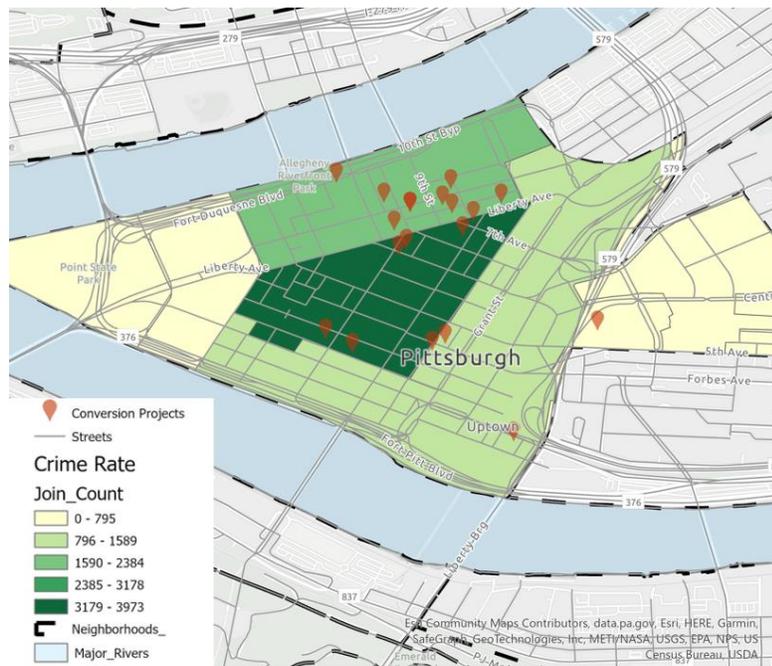


Figure 13: Crime Rates Map (Total Offenses Count)

Furthermore, we used spatial join tools to create another map by combining the total points of crime rates from all years with different zones in the CBD area. This map depicts the total number of offenses counted in various years, as well as the location distribution. Despite being the second-most dangerous area, this map shows a high density of conversion projects in the north. There are significant safety concerns in the central CBD, but there are fewer projects.

⁵⁶ Pennsylvania General Assembly. Title 18.

⁵⁷ P.G. 216-01 Aided Cases General Procedure. (n.d.). Available at: [\[Link\]](#). [Accessed 25 Oct. 2023].

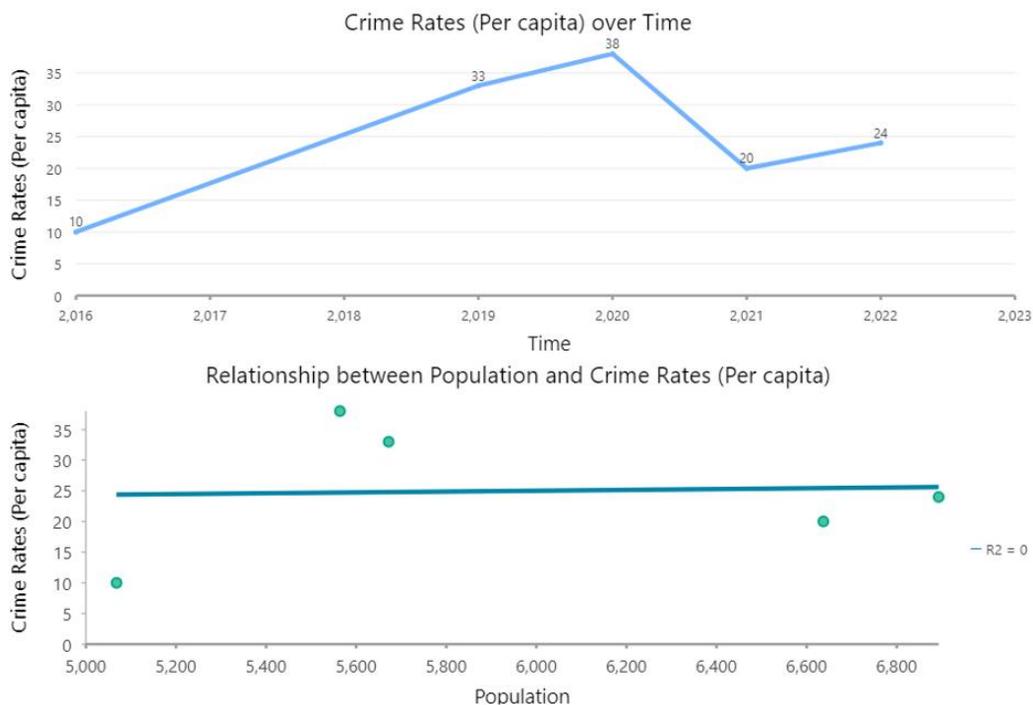


Figure 14: Crime Rates (Per Capita) Over Time; Relationship between Crime Rates (Per Capita) and Population

We collected population data⁵⁸ for the CBD area during the previously mentioned time points to examine the relationship between crime rates and population in more detail. By calculating crime rates per capita for each year, we aimed to research temporal changes and establish the connection between population dynamics and crime rates.

The chart shows a consistent rise in crime rates per capita since 2016, a slight drop during the pandemic, followed by another rise. This pattern corresponds to the overall crime rate over time. A correlation analysis was performed to investigate the potential relationship between population and crime rates per capita. However, there is no obvious positive or negative correlation between population changes and crime rates per capita in the bottom chart.

As a result, the relationship between crime rates and population size remains inconclusive, posing a challenge in conclusively linking crime to population size. Further research is needed because a variety of factors, other than population changes, influence crime rates.

⁵⁸ Downtown Pittsburgh. (2023). State of Downtown Pittsburgh Snapshot Reports. [online] Available at: [\[Link\]](#) [Accessed 29 Nov. 2023].

Case Study & Interview Analysis

An extensive case study for the Triangle Building built in 1868 was conducted to study the possible social outcomes of a real-life office-to-housing conversion project located in downtown Pittsburgh. The case selected is also the first project to be funded by the Pittsburgh Downtown Conversion Program (PDCP) and Urban Redevelopment Authority (URA).⁵⁹ The building is marked as a historic structure which makes it eligible to get historic tax credit benefits.



Triangle Building, Hullett Properties
 Location: 926 Liberty Avenue
 Built: 1868
 Owner: Hullett Properties
 Architect: TKA Architects
 Contractor: Franjo Construction
 Total Number of Residential Units: 15 Units
 Size: 16,583 SF total; -5,000 SF Retail
 Start Date: 2022, Completion Date: 2023
Status: Under Construction

Figure 15: Triangle Building. Photo by Tannaz Afshar

The case was studied in depth based on information available and through open-ended interviews conducted with Hullett Properties to derive several considerations made by the stakeholders. These considerations were categorized into the 14 broad categories of social impact mentioned above. The table below classifies these considerations and their possible impacts on our society.

Table 3: Major Project Considerations categorized under Social Impact Categories

NO.	SOCIAL IMPACT CATEGORIES	CONSIDERATIONS MADE BY PROJECT STAKEHOLDERS	TOTAL CONSIDERATIONS
1	Economic & Fiscal Impacts	economic revitalization through retail smaller apartments available for affordable units to balance NOI Short-Term Flexible Renting Options to make profit Market considerations made for profit	5

⁵⁹ Urban Redevelopment Authority of Pittsburgh. (2023). URA Board Agenda. [Online] Available at: [\[Link\]](#) [Accessed 10 Oct. 2023].
 Pittsburgh Post-Gazette. (2023). URA board awards first loan in bid to convert some Downtown...'. [Online] Available at: [\[Link\]](#) [Accessed: 10 Oct. 2023].

		Consideration to make larger apartment sizes as per market demand	
2	Environmental Impacts	Energy-efficient HVAC system	4
		double insulated roof	
		central water distribution system	
		since there were huge numbers of windows, they were utilized for natural daylight efficiency	
3	Aesthetic Impacts	Optimized residential conversion aesthetics with numerous 8'-11' high windows	3
		High ceiling heights offer excellent aesthetic potential	
		Low window sill levels at 36" height, contrasting with the common 42" in offices, elevated residential aesthetic value	
4	Demographic Impacts	Inclusive for people with disabilities with ADA compliance unit	2
		inclusive for minority groups for affordable units	
5	Community Service Impacts	40 years of commitment to affordable units	2
		streetscape activation through retail	
6	Psychological Impacts	crime reduction in CBD through street activation	2
		boutique aesthetic finish for apartments uplifting living standard	
7	Archaeological & Cultural Heritage Impacts	Historic value Preservation	1
8	Gender Impacts	inclusive for women entrepreneurs	1
9	Leisure And Tourism Impacts	development of retail on the ground floor supports tourism	1
10	Health & Mental Health Impacts	-	0
11	Workforce Impacts	-	0
12	Natural Resource & Land Use Impacts	-	0
13	Cultural Impacts	-	0
14	Political Impacts	-	0

The analysis revealed that major project decisions were made related to three top categories including Economic & Fiscal, Environmental, and Aesthetic impacts. As seen in the graph, 23.8% of decisions were made for Economic & Fiscal Impacts, 19.0% were made leading to Environmental Impacts and 14.3% were made leading to Aesthetic Impacts. This analysis reveals driving factors for making major project decisions made by the stakeholders.

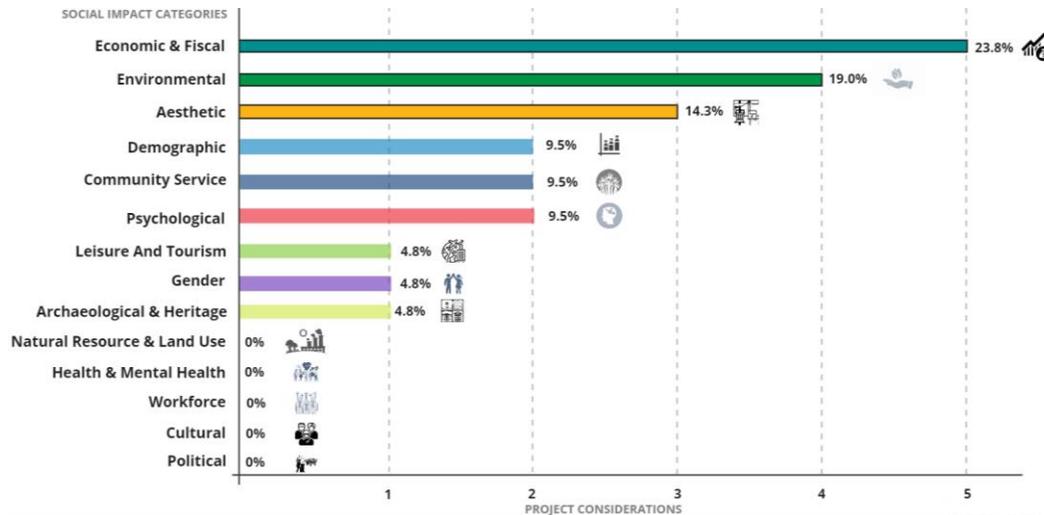


Figure 16: Graph showing Major Project Considerations as per Social Impact Categories

DISCUSSION

Our research contributes to our knowledge of the social impacts of converting offices to residences in Pittsburgh’s Central Business District. As the City of Pittsburgh and other cities around the nation experiment with solutions to mitigate downtown vacancy and shortage of affordable housing through adaptive reuse, it is important to examine the economic benefits associated with reusing existing spaces, but also to study the short and long-term social impact that the urban fabric has on the population. We created various GIS maps to visualize our findings in regard to social parameters such as vacancies, accessibility, and safety. These findings could help policymakers in determining the opportunities and challenges that still lie within the downtown region, in order to accommodate the new population. Furthermore, the case study could illustrate some social considerations that could be further improved during development, raising awareness on potential social impacts while making project development decisions. Ultimately our research could also serve as a foundation for future research.

Recommendations

Based on our findings from GIS maps, case study, and interview with the owner, we recommend the following:

Infrastructure Developments

- Provide multiple transit choices, including bike sharing systems that support commuting in CBD.
- Ensure that the public amenities, including but not limited to grocery stores, support the increased demand resulting from the conversion projects.
- Consider offering incentives or support for grocery store development in conversion project locations to meet the demands of the growing residential population. The convenient access to grocery stores is crucial for the daily needs of residents. This not only enhances the quality of life but also contributes to the overall appeal and sustainability of the revitalized neighborhoods.
- Ensure parking spaces meet the demands of increasing residents, office employees, and visitors.

Policy Improvements & Community Engagement

- Optimize policies that address the diversity of different types of households; consider offering incentives or support for larger affordable housing units.
- Implement social sustainability measurements into policies.
- Simplify and expedite the permitting process and offer more flexibility in tax credits criteria for conversion projects to reduce bureaucratic hurdles and encourage swift implementation.
- Implement policies that promote transparency in the development process. This can include mandatory public hearings, information sessions, and feedback mechanisms.
- Bridge the knowledge gap between government and developers on affordable housing policies.
- Foster public-private partnerships to create affordable housing initiatives, leveraging both government resources and private sector expertise.
- Organize regular community workshops and meetings to gather residents' input and feedback. Utilize online platforms and surveys to reach a wider audience and collect opinions to encourage maximum participation.

Project Development

- Making project decisions that have a positive impact on the Workforce, Natural Resource & Land Use, and Mental Health will lead to more socially sustainable conversion projects.
- Conversion project stakeholders can also create amenities for public use leading to positive community impact for the overall society.

Limitations

The Downtown Pittsburgh Conversion Program is a relatively new program, which was only announced in early 2023. Up until October 2023, there was only a record of one project that received funding from this program. Therefore, our GIS mapping on office conversion projects not only focused on affordable housing but also other kinds of residential projects, including luxury housing. In order to gain more knowledge into the impacts of affordable housing situated in the CBD area, more projects would need to be analyzed.

The social impact assessment in our case study relied on limited information from online resources and interviews with the project owner. Some recommendations made regarding the policy were obtained from the subjective opinion of one project owner. More insights could be gathered in the future if there are more participants in the interview.

When conducting a correlation study between social crime rates and vacancy rates, there is insufficient data. Most of the projects have been abandoned for decades, and they only applied for adaptive reuse for a short time, so it was difficult to draw a firm conclusion for the time being to demonstrate that the decreasing vacancy rate would also reduce crime rates. Currently, we could only obtain population data from a government report, calculate the crime rate per capita in different years after construction is completed, and propose a hypothesis that the vacancy rate may influence the crime rate, but more research is required in the future to prove this.

Future Work

Several projects recorded are still under development or planning, as we expect to see more conversion projects complete shortly, future researchers should continue to track the social changes of those projects over time, including their surrounding urban fabric, such as public amenities and transportation.

Adaptive reuse has environmental and financial values in preserving existing materials. In this research, we provide a general study of the building trends in conversion projects. For future work, more in-depth research into how this transformation, in terms of their spatial quality, construction method, and material usage, could be further investigated to study the social impacts that have impacts on different groups of stakeholders, including residents, construction workers, neighborhoods, and etc.

The subject of crime is a complex issue that may be affected by the larger economy, social behavior, and more. It is evident from literature reviews that cities around the world see vacancy as equivalent to unsafe neighborhoods. However, to draw clearer correlation studies between crime rates and office vacancy rates, more data about the vacancy rates of individual office buildings and their surrounding urban context should be further studied.

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CHAPTER 5: PLANNING FOR ADAPTIVE REUSE INITIATIVES : A SURVEY-BASED STUDY OF THE OWNER'S PERSPECTIVE OF ADAPTIVE REUSE IN WESTERN PENNSYLVANIA

ADVIKA SHETTY, PURAV KOTHIYA, & NAISHAL GAJJAR

CHAPTER SUMMARY

In recent years, the construction sector has witnessed a steady ascent of adaptive reuse, a phenomenon currently transforming the urban landscape of the Pittsburgh region. With new construction contributing to nearly 40% of global CO₂ emissions, adaptive reuse holds immense potential by revitalizing aging structures while bolstering economic growth and sustainability. Our review of the existing literature on adaptive reuse documents shows the unharnessed potential it has. It is reflective of the technical understanding of this concept that has emerged over time but fails to dive into what makes adaptive reuse the right answer from the owner's perspective. To truly understand and guide future strategies, we must delve into the minds of key stakeholders—the building owners. Old factories, warehouses, and historic buildings have been reimagined as vibrant living spaces, offices, and cultural hubs. This shift reflects a growing recognition of the benefits inherent in repurposing existing structures, from preserving cultural heritage to minimizing urban sprawl and its associated environmental costs. Yet, unanswered questions persist. How do they weigh factors when embarking on these projects, and how do they prioritize cost and environmental sustainability? Despite the crucial role they play, a knowledge gap hampers our understanding of their considerations. To bridge these gaps and pave the way for more informed decision-making and policy formulation, this research study embarks on a comprehensive survey-based investigation of owners in the Pittsburgh region. Over the course of the study, the individual importance of cost and sustainability has been assessed and analyzed from a decision-making perspective for building owners, who themselves come from a multitude of backgrounds. Surprisingly, sustainability ranked as having higher importance than cost among these respondents, especially in the areas of contributing positively to mitigating climate change, without the need for expected returns (ROI) as high as new building projects and payback periods considerably longer than new construction. Within this paper, we provide a robust discussion on why owners invest in adaptive reuse, their motivations, and how this is significant to AEC practitioners in Pittsburgh and beyond.

INTRODUCTION

The transformation of urban landscapes through adaptive reuse has surged in recent years, profoundly impacting the construction sector. Buildings contribute to nearly 40% of CO₂ emissions across the globe, and an existing building stock that can further its potential and fulfill our needs, adaptive reuse is rising as a key solution to mitigating these ill effects. Despite the strides made in comprehending adaptive reuse's technical facets, a critical aspect remains unexplored—the perspective of building owners. This research aims to unravel the decision-making processes of these pivotal stakeholders, illuminating their motivations, priorities, and the factors influencing their choices in embracing adaptive reuse projects. By delving into their minds, we seek to bridge existing knowledge gaps and facilitate more informed strategies and policies.

The burgeoning trend of adaptive reuse goes beyond architectural transformations; it embodies a paradigm shift in urban development. Its significance lies in its multifaceted impact, encompassing cultural preservation, environmental sustainability, and economic revitalization. As old factories and historic buildings metamorphose into modern living spaces and cultural hubs, this shift signals a growing recognition of the inherent benefits of repurposing existing structures.

The implications of this research extend far beyond the construction industry. They touch the core of urban life and sustainability. By comprehending the motives of building owners, we unravel the underlying factors that steer urban transformations. This knowledge is pertinent not only to architects, urban planners, and policymakers but also to the general public. It informs decisions shaping the future of cities, impacting their livability, sustainability, and cultural richness. The outcomes of this study offer actionable insights for a broad spectrum of stakeholders. For Architecture, Engineering, and Construction (AEC) practitioners in Pittsburgh and beyond, understanding owner motivations in adaptive reuse projects serves as a compass, guiding their approaches and designs. Moreover, policymakers gain a nuanced understanding of the needs and preferences of building owners, aiding in the formulation of targeted policies that foster and incentivize sustainable urban development.

In conclusion, this research aims to illuminate the decision-making processes of building owners engaged in adaptive reuse projects, unraveling their motivations and priorities. By doing so, it strives to facilitate more informed decision-making, enrich the practices of AEC professionals, and pave the way for sustainable urban development.

LITERATURE REVIEW

In this literature review, we delve into the extensive body of research surrounding adaptive reuse projects, with a specific focus on the perspective of project owners. Our literature review focuses on the factors that are encountered by owners during key decisions pertaining to investing in adaptive reuse instead of new construction. Our aim is to provide an overview of the key themes, historical development, and research gaps within the literature, shedding light on the rationale for our survey-based study.

Key Factors Affecting Decision-Making for Adaptive Reuse

Our study narrows its lens to examine adaptive reuse projects from the vantage point of project owners. Project owners, be they private individuals, organizations, or government entities, play a pivotal role in shaping the trajectory and outcomes of adaptive reuse initiatives. Their strategic decisions influence project feasibility, financial considerations, and compliance with regulatory frameworks aiding policy-based research, among other factors. The papers we reviewed primarily focused on the current analysis of the effects of cost and sustainability on adaptive reuse. The existing literature on adaptive reuse projects has explored several key themes. Financial considerations, including funding mechanisms and return on investment, have been extensively discussed¹². Cost seems to be a driving factor in the majority of these ventures as there are no new materials or construction operations costs associated with these projects. Additionally, sustainability, specifically environmental sustainability, seems to be a core tenet that leads to the development of such projects³. Moreover, Smallwood⁴ speaks about the LEED certification capabilities of adaptive reuse. The author also breaks down the LEED certification criteria and highlights how adaptive reuse can help achieve those criteria making it a sustainable LEED certified building. There is also a growing drive for sustainability coming from owners and occupiers as observed through the surveys within this paper and can be concluded that what owners prefer is the most effective possible use of the land on which a building sits, its cultural and heritage significance, and the location and market opportunity that truly would push or discourage one from investing in an adaptive reuse project⁵.

The policy aspects of adaptive reuse are also key to encouraging owners to invest in such projects. Pittsburgh's own Downtown Conversion program⁶ is an example of the regulatory changes coming from different governing agencies to persuade development in the adaptive reuse space. Bullen and Love's 2009 paper⁷ LA's adaptive reuse program is also a key piece of information on how bridging policy gaps is relevant to these ventures. Some of the salient features of this program are:

(i) Incentives for Developers: The program provided various financial incentives and streamlined permitting processes to encourage developers to undertake adaptive reuse

¹ Shen, L. and Langston, C. (2010) 'Adaptive reuse potential: An examination of differences between urban and non-urban projects', *Facilities*, 28(1/2), pp. 6-16. Available at: <https://doi.org/10.1108/02632771011011369>.

² Bullen, P.A., 2007. Adaptive reuse and sustainability of commercial buildings. *Facilities*, [online] 25(1/2), pp.20-31. <https://doi.org/10.1108/02632770710716911>.

³ Bullen, P. and Love, P., 2011. A new future for the past: a model for adaptive reuse decision-making. *Built Environment Project and Asset Management*, [online] 1(1), pp.32-44. <https://doi.org/10.1108/20441241111143768>.

⁴ Smallwood, C., 2012. The role of adaptive (re) use. Project Management Institute.

⁵ Bullen, P.A., 2007. Adaptive reuse and sustainability of commercial buildings. *Facilities*, [online] 25(1/2), pp.20-31. <https://doi.org/10.1108/02632770710716911>.

⁶ *Pittsburgh downtown conversion program* (no date). Available at: <https://www.ura.org/pages/pittsburgh-downtown-conversion-program> [Accessed: 3 Dec. 2023].

⁷ Bullen, P.A. and Love, P.E.D., 2009. Residential regeneration and adaptive reuse: learning from the experiences of Los Angeles. *Structural Survey*, [online] 27(5), pp.351-360. <https://doi.org/10.1108/02630800911002611>.

projects. These incentives were designed to reduce development costs and facilitate the conversion of older buildings into new, economically viable uses.

(ii) Residential Conversion: One of the primary focuses of the LA Adaptive Reuse Program⁸ was the conversion of underutilized or vacant commercial buildings into residential units. This helped address the demand for housing in the city while also promoting the revitalization of urban areas.

(iii) Zoning and Land Use Changes: The program often required changes to zoning and land use regulations to accommodate new uses in existing buildings. These changes could include modifications to parking requirements, density limits, and other zoning-related regulations to make adaptive reuse projects more feasible.

(iv) Design Guidelines: The program typically included design guidelines to ensure that adaptive reuse projects were compatible with the surrounding neighborhood and maintained a high level of architectural quality.

The implementation of this policy encouraged regeneration in the area and is applicable to other cities facing high levels of homelessness and unaffordable housing due to rent surges. Such measures are key to encouraging owners to invest in adaptive reuse as a profitable means of new development and should be used to stop barriers to progress and instead push for the revitalization of existing buildings by repurposing them for new uses.

Stakeholders Perspectives in Adaptive Reuse

We also investigated several papers concerning decision-making in the adaptive reuse realm. Haroun and Hasan⁹ emphasize the importance of expert input, recognizing the subjectivity inherent in final decision-making, which can vary based on different perspectives and additional alternatives. Overall, the paper offers a comprehensive framework for decision-making in heritage building adaptive reuse, showcasing the practical applicability of the Analytical Hierarchy Protocol (AHP) tool in real-world conservation scenarios. Along the same lines, Mohamed and Alauddin¹⁰ identified 30 unique criteria of decision-making through a detailed literature review. They then conducted a quantitative questionnaire survey among stakeholders, including architects, valuers, planners, government departments, developers, and building owners. The analysis showed that there are seven key criteria that influence the decision-making of adaptive reuse of existing buildings which are building value, building suitability, structural condition, official plan and zoning regulation, building code, client requirement, and heritage-designated buildings. The authors also found that the environmental, economic, and social tenets of sustainability were also identified as

⁸ *Adaptive reuse projects | ladbs* (no date). Available at: <https://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/adaptive-reuse-projects> [Accessed: 3 Dec. 2023].

⁹ Haroun, H.-A.A.F., Bakr, A.F. and Hasan, A.E.-S., 2019. Multi-criteria decision making for adaptive reuse of heritage buildings: Aziza Fahmy Palace, Alexandria, Egypt. *Alexandria Engineering Journal*, [online] 58(2), pp.467-478. <https://doi.org/10.1016/j.aej.2019.04.003>.

¹⁰ Mohamed, N. and Alauddin, K., 2023. Decision making criteria for adaptive reuse strategy in UNESCO world heritage city. *Journal of Facilities Management*, [online] 21(2), pp.169-181. <https://doi.org/10.1108/JFM-06-2021-0068>.

important but were given less weight in matters concerning reuse. Ragheb¹¹ in 2021 similarly asserted the significance of various analysis strategies such as AHP and SWOT in the overall decision-making process of buildings.

Overall, our literature review reiterates why understanding the owner's perspective on strategizing for adaptive reuse projects is not only academically relevant but also highly practical. Our research aims to contribute to both scholarly discussions and practical insights for project owners, policymakers, and urban planners. By shedding light on the strategies employed by project owners, we aspire to inform decision-making processes and ultimately enhance the success and sustainability of adaptive reuse projects.

PROBLEM STATEMENT & RESEARCH QUESTIONS

The Pittsburgh region has found itself embedded in a transformative wave, one that has seen the revival of its urban landscape through a surge in adaptive reuse projects. These ventures hold immense promise, breathing new life into aging structures while fostering economic growth and environmental sustainability. However, beneath this outward success lies an imperative for deeper understanding. To fully harness the potential of adaptive reuse and guide future strategies, we must delve into the minds of the key stakeholders—the building owners. In recent years adaptive reuse has been embraced with fervor. One pressing concern is the nuanced decision-making processes of building owners engaged in adaptive reuse. What factors weigh most heavily on their minds when embarking on these projects, and how do they prioritize such considerations? Despite the pivotal role building owners play in shaping the outcome of these ventures, there is a significant lack of knowledge in understanding the precise importance they assign to these key facets. Furthermore, understanding the driving forces behind building owners' investments in adaptive reuse projects is essential. Are economic factors, such as cost-effectiveness and potential returns, the primary drivers? Or do regulatory incentives and environmental goals weigh more heavily on their choices? Uncovering these motivations is paramount for crafting effective strategies that can optimize the outcomes of adaptive reuse initiatives in the Pittsburgh region. To bridge these knowledge gaps and pave the way for more informed decision-making and policy formulation, this research study embarks on a comprehensive survey-based investigation of building owners in the Pittsburgh region. Through this survey, we aim to capture the intricacies of considerations that shape their decisions regarding adaptive reuse projects.

Research Questions

1. What are the main factors driving the owner's choices?
2. How important are the factors of cost and sustainability and their different aspects to owners?
3. What, if any, policy changes can encourage owners to invest in adaptive reuse?

¹¹ Ragheb, G.A., 2021. Multi-Criteria Decision Making of Sustainable Adaptive Reuse of Heritage Buildings Based on the SWOT Analysis: A Case Study of Cordahi Complex, Alexandria, Egypt. *International Journal of Sustainable Development & Planning*.

METHODOLOGY

The methodology for the research follows two main steps: (1) survey of owners, and (2) inferential analysis of the responses received. Both these steps are explained in detail below:

Method 1 - Survey

Surveys stand as a cornerstone in research, offering a structured method to gather diverse perspectives and quantify insights. Through carefully crafted questions, surveys efficiently capture large-scale data, enabling researchers to explore trends, preferences, and attitudes across populations. Their adaptability—whether online, paper-based, or in-person—makes them versatile in reaching diverse demographics. Surveys wield the power to uncover nuanced details, providing statistically sound conclusions crucial for informed decision-making. However, their effectiveness hinges on question design, respondent engagement, and the careful consideration of biases. When meticulously executed, surveys serve as indispensable tools, unveiling comprehensive insights crucial in shaping policies, strategies, and understanding societal dynamics. We designed our survey to have only ten questions (five based on cost as a decision-making factor, and five based on sustainability) on which we conducted a follow-up analysis. Below is the list of questions posed in our survey:

Respondent Characteristics Questions:

1. How many construction projects have you owned/invested in?
 - a. 1
 - b. 2 - 4
 - c. 5 - 7
 - d. 8 - 10
 - e. More than 10
2. What type of building(s) do you own?
 - a. Residential Buildings
 - b. Commercial Buildings
 - c. Religious Buildings
 - d. Institutional Buildings
 - e. Industrial Buildings
 - f. Recreational & Entertainment Buildings
 - g. Agricultural/Production Buildings
 - h. Temporary/Portable Buildings
 - i. Other (Please Specify) _____
3. Would you consider investing in an adaptive reuse building?
 - a. Yes
 - b. No
 - c. Maybe

Financial Questions:

4. In comparison to a new construction project of a similar size, how much financial investment are you prepared to allocate to an adaptive reuse project?
 - 1) Less than 50% compared to new construction.
 - 2) Between 50% to 90% compared to new construction.
 - 3) Similar to new construction.
 - 4) Up to 1.5 times of new construction.
 - 5) More than 1.5 times of new construction.
5. What are your anticipated return-on-investment (ROI) goals for this project over the next 5 years, considering your initial investment as previously mentioned?
 - 1) Less than 5%
 - 2) 5% to 10%
 - 3) 10% to 15%
 - 4) 15% to 20%
 - 5) More than 20%
6. To what extent are you open to assuming risk in an adaptive reuse project, considering the potential challenges and uncertainties involved?
 - 1) Not open to assuming any significant risk
 - 2) Minimal risk
 - 3) Moderate risk
 - 4) Substantial risk
 - 5) Highest level of risk
7. To what degree do you prioritize the development of a well-defined exit strategy that supports your financial objectives in the context of the adaptive reuse project?
 - 1) Not a priority
 - 2) Low priority
 - 3) Neutral
 - 4) Moderately important
 - 5) High priority
8. What duration are you targeting for the payback period, taking into account your investment level, ROI expectations, and risk tolerance as discussed earlier?
 - 1) 1 - 2 years
 - 2) 2 - 3 years
 - 3) 3 - 4 years
 - 4) 5 years
 - 5) More than 5 years

Sustainability Questions:

9. To what extent does sustainability factor into your decision to undertake adaptive reuse projects?
 - 1) No importance
 - 2) Low importance
 - 3) Neutral
 - 4) Moderately important
 - 5) High importance

10. How interested are you in obtaining sustainability certifications like LEED, WELL, or Green Building for these projects?
 - 1) Not interested
 - 2) Slightly interested
 - 3) Neutral
 - 4) Moderately interested
 - 5) Very interested
11. When evaluating an adaptive reuse of a historic building project, how important is getting historical tax credits?
 - 1) Least important
 - 2) Somewhat important
 - 3) Neutral
 - 4) Moderately important
 - 5) Very important
12. If historical tax credits are not provided, how committed are you to preserving or conserving a historically significant building?
 - 1) Least committed
 - 2) Somewhat committed
 - 3) Neutral
 - 4) Moderately committed
 - 5) Very committed
13. How important is engaging with the local community and stakeholders to align the project with their cultural and historical interests?
 - 1) Least important
 - 2) Somewhat important
 - 3) Neutral
 - 4) Moderately important
 - 5) Very important

Method 2 - Inferential Analysis

Based on the responses received within our survey, we began to identify patterns and trends. Since we used a Likert scale to administer the survey, it allowed us to quantitatively measure and analyze the responses. The structured nature of the Likert scale simplifies data analysis, making it easier to determine statistical significance. All answers were ranked between 1 and 5, with 5 being the most weight attributed to the factor and 1 being the least. The higher the weight, the more positive the attitude of the respondent in investing in adaptive reuse.

FINDINGS

From Figure 1 below, we can see that 57% of respondents expressed a strong interest in adaptive reuse projects, with only one of them expressing a disinterest. This shows us that adaptive reuse is gaining traction within Pittsburgh and administering the survey could prove to be useful for future research.

Additionally, Figure 2 shows us the distribution of the types of buildings for our owners. On average, each respondent owned about 8 or more buildings, accounting for

the perspectives of both small as well as large-scale owners in Pittsburgh. This further bolsters our analysis as we are able to gauge responses from a wide range of sectors within Pittsburgh’s existing building stock. The only interfering factor we anticipate in our results here are the majority of our respondents having architectural or construction engineering backgrounds which is discussed further within the limitations of this study.



Figure 1: Interest in Adaptive Reuse

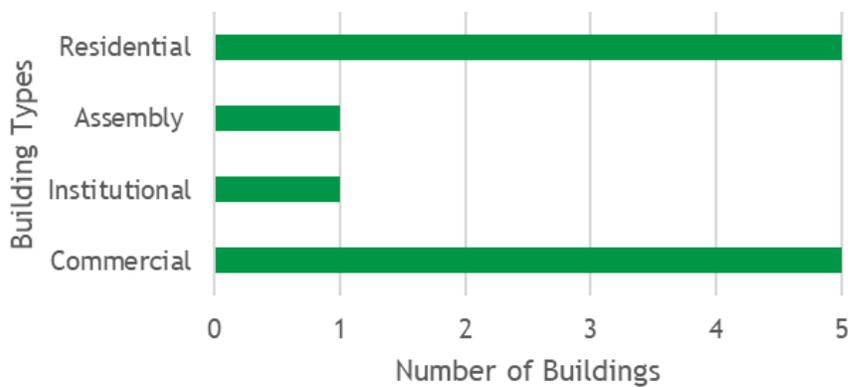


Figure 2: Types of Buildings Owned by Respondents

Further, Figures 3 and 4 depict the mean (average) and mode of the answers received to our survey. Figure 3 details the importance of cost and Figure 4 demonstrates the same aspects for sustainability. The inferences from Figure 3 are illustrated below:

- i. The survey found that, in comparison to a new construction project of identical scale and function, owners were inclined to invest similar amounts. They were prepared to treat adaptive reuse undertakings in the same way as they would a new construction project.
- ii. For the return-on-investment expected of adaptive reuse projects, owners were accepting of an average ROI of 9.17%. This shows us that for adaptive reuse, owners were willing to scale down on ROI as it contributes to other factors.
- iii. Risks/uncertainties did not factor into adaptive reuse projects any more than new construction.

iv. An exit strategy did not seem to be a priority for the owners. In fact, this criterion had the least interest expressed from owners.

v. Finally, owners were willing to accept nearly 1.5 times the payback period of new construction. Since adaptive reuse projects generally take shorter time to construct than new projects, this is a reasonable conclusion of how owners saw their time distributed.

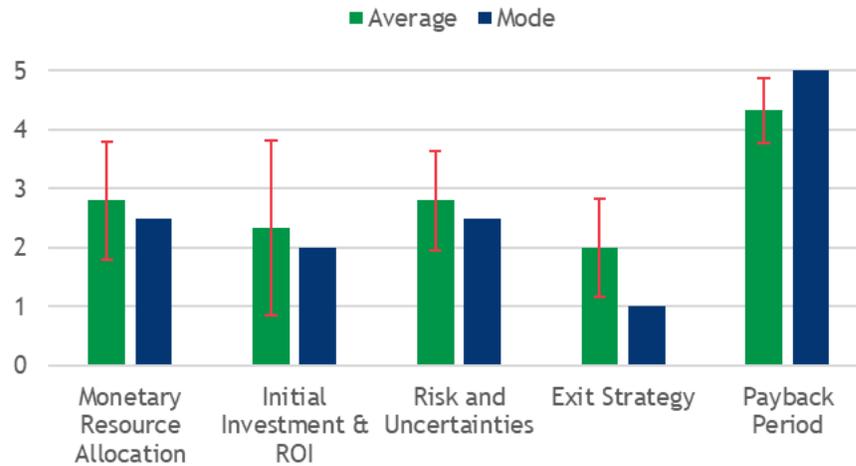


Figure 3: Overall Cost Criteria Breakdown

Inferences from Figure 4 are as follows:

i. Environmental Sustainability ranked as being important to our respondents. With a mode of 5.0, we attributed that this could be due to the architectural backgrounds associated with a majority of the surveyed sample of owners but were pleasantly surprised that this was more important than cost.

ii. Green building certifications such as LEED did not seem to be high on the list of owners' priorities. While it was appreciated in their own adaptive reuse projects, it was not something they actively pursued when compared to new construction projects of similar size as can be observed by the lack of a mode value.

iii. Historical tax credits were important to owners, although it ranked only above green building certifications within the set of sustainability criteria.

iv. Preservation of historical buildings, especially in a city as old as Pittsburgh, seemed nearly as important as environmental sustainability to the owners with the mode being nearly the same as the mean of all responses received.

v. Finally, community input and local stakeholder satisfaction were also a priority when choosing to invest in an adaptive reuse project. Owners agreed to wanting community support and social satisfaction for their adaptive reuse projects and protecting cultural and emotional interests of those who would be affected by such ventures.

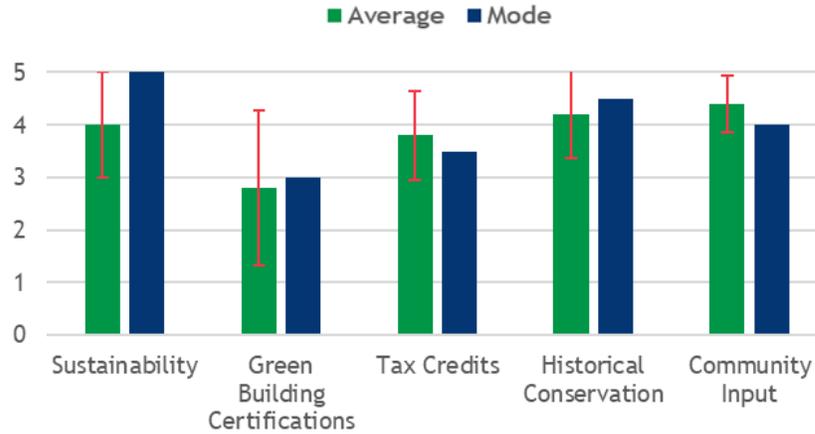


Figure 4: Overall Sustainability Criteria Breakdown

DISCUSSION

Some key highlights from our cost and sustainability criteria are listed below:

- i. Based on Figure 5, we can see that sustainability received a score of 3.84/5.00.
- ii. Similarly, cost received a score of 2.85/5.00.

iii. The primary conclusion we can draw from this is that sustainability plays a more important role when owners decide to invest in adaptive reuse than cost although there is a varying degree of importance of each subfactor under these two main criteria.

iv. We can see that sustainability is 10% more important as compared to cost i.e., sustainability weighs about 38.4% in decision-making for adaptive reuse whereas cost weighs only 28.5%. The remaining 33% weightage can be assigned to factors which were not covered by our survey.

v. Lastly, Table 1 below assigns the percentage weightage for each criteria factored into our survey, not accounting for any factors outside of cost and sustainability when each criteria is given 10% weightage and Table 2 does the same while accounting for the 33% 'unknown' factors i.e., an absolute weighing of the ten criteria, which are discussed further in the Limitations.

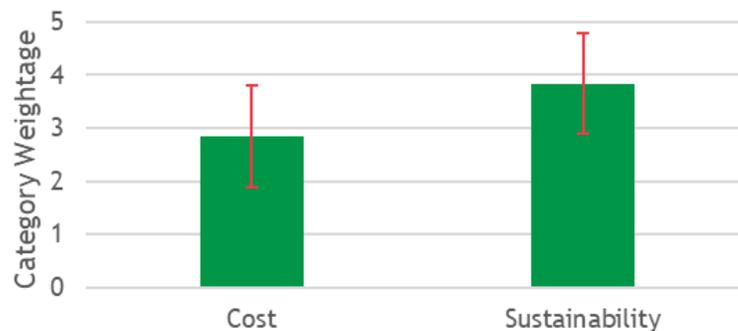


Figure 5: Cost vs. Sustainability Category Weightage

Table 1: Percentage Weightage for Each Criteria Factored into Survey

CRITERIA	CATEGORY	WEIGHT
Financial Investment & Resource Allocation	Cost	8.37%
Initial Investment & Return-On-Investment	Cost	6.96%
Financial Risk & Uncertainties in Adaptive Reuse	Cost	8.37%
Exit Strategy	Cost	5.98%
Payback Period	Cost	12.94%
Environmental Sustainability	Sustainability	11.95%
Green Building Certifications	Sustainability	8.37%
Tax Credits	Sustainability	11.36%
Historical Conservation	Sustainability	12.55%
Local Stakeholders and Cultural Significance	Sustainability	13.15%
TOTAL		100.00%

Table 2: Percentage Weightage for Each Criteria Factored into Survey & Accounting for Unknown Variables

CRITERIA	CATEGORY	WEIGHT
Financial Investment & Resource Allocation	Cost	5.6%
Initial Investment & Return-On-Investment	Cost	4.7%
Financial Risk & Uncertainties in Adaptive Reuse	Cost	5.6%
Exit Strategy	Cost	4.0%
Payback Period	Cost	8.7%
Environmental Sustainability	Sustainability	8.0%
Green Building Certifications	Sustainability	5.6%
Tax Credits	Sustainability	7.6%
Historical Conservation	Sustainability	8.4%
Local Stakeholders and Cultural Significance	Sustainability	8.8%
Unknown Factors	-	33.1%
TOTAL		100%

Implications

The survey results on adaptive reuse in Western PA can have several significant implications for building owners, policymakers, researchers, and the broader community. These implications shed light on the key takeaways and potential actions that can be derived from the findings of the study.

Building owners in the Pittsburgh region may be more inclined to pursue adaptive reuse projects when they perceive them as economically viable. This suggests that promoting economic incentives, such as tax credits or subsidies, could encourage further adaptive reuse efforts, leading to the revitalization of underutilized properties. The survey findings highlight that sustainability considerations are a notable factor in adaptive reuse decision-making. This underscores the importance of promoting green

building practices, energy-efficient technologies, and sustainable materials in the region to align with property owners' interests and environmental goals.

The study also underscores the role of regional factors in influencing adaptive reuse decisions. Policymakers should consider tailoring regulations and incentives to the specific context of Western Pennsylvania to promote adaptive reuse, especially with respect to relaxed zoning laws. This includes streamlining permitting processes, providing tax incentives, and offering educational resources about sustainable practices. The survey results indicate that there may be a knowledge gap among building owners when it comes to sustainable building practices. This suggests a need for educational programs and resources to inform property owners about the benefits of sustainable building and how to implement eco-friendly solutions. These findings emphasize the multifaceted nature of adaptive reuse decision-making. Architects, urban planners, economists, policymakers and environmental experts should collaborate to provide comprehensive support for building owners. This interdisciplinary approach can help integrate sustainability and cost considerations effectively, and aid in promoting more adaptive reuse projects. Additionally, the results indicate that building owners should consider the long-term impact of their adaptive reuse decisions. Strategies that focus on the long-term benefits of sustainable practices, such as energy savings and enhanced property values, may resonate with property owners.

The study also indicates that adaptive reuse is not limited to a specific sector, as the survey includes a variety of building types. Policymakers and stakeholders should recognize that the potential for adaptive reuse exists across a wide range of properties, including residential, commercial, and industrial spaces. The survey results provide a foundation for future research in the field of adaptive reuse.

Finally, building owners' motivations for adaptive reuse may also include a desire to preserve cultural and historic aspects of properties. This highlights the importance of cultural preservation efforts and the potential to market adaptive reuse projects as contributors to the region's cultural heritage. Building owners, local governments, and community organizations can work together to engage the public in adaptive reuse projects. Involving the community in decision-making and planning processes can lead to projects that align with the needs and aspirations of the local population.

In summary, the survey results on adaptive reuse in Western Pennsylvania have implications that span various aspects of decision-making, including economics, sustainability, policy, education, and long-term planning. Recognizing these implications can help shape strategies and initiatives to foster more informed, sustainable, and economically viable adaptive reuse practices in the region.

Limitations

While the study aims to shed light on critical aspects of strategizing for adaptive reuse, it is important to acknowledge the limitations of the research, which may affect the generalizability and comprehensiveness of the findings.

One of the most significant limitations of this study is the number of respondents. With only 8 respondents participating, it may be challenging to draw broad, statistically

significant conclusions that can be applied to the entire Western Pennsylvania region. The limited sample size can result in an underrepresentation of the diverse perspectives and experiences of building owners in the region, potentially leading to a skewed understanding of the factors influencing their adaptive reuse decisions. Those who choose to respond to the survey may not be fully representative of all building owners, as they might have unique motivations or experiences that differ from non-participating building owners. This bias can impact the generalizability of the results and limit their applicability. The research is reliant on self-reported data provided by the respondents which can introduce issues of response bias, as participants may underreport or overreport certain aspects, such as the costs associated with adaptive reuse or their sustainability efforts based on their personal beliefs, experiences and affiliations. The accuracy and completeness of the data depend on the honesty and accuracy of the respondents.

To keep the survey concise and manageable, the study is limited to just 10 questions exclusive of the characteristic questions we chose to ask. While this approach helps ensure higher response rates and survey completion, it also restricts the depth and breadth of information collected. As a result, some crucial aspects of adaptive reuse decision-making may not be adequately explored, potentially overlooking other critical variables that influence building owners' choices. These concerns are further addressed in the 'Future Research' section below. Due to the limitations in time and resources, this research is conducted as a point-in-time study. Adaptive reuse decisions and their influencing factors can change over time. Therefore, the findings may not capture the dynamic nature of this decision-making process, as external factors continue to evolve.

Future Work

The limitations of the current study provide a valuable foundation for further research in the field of adaptive reuse. As we navigate the path toward more sustainable and economically viable building practices, the findings from this study can serve as a springboard for future investigations that offer a broader and more comprehensive perspective. Below, we explore ways in which the current findings can be expanded upon and translated into future work.

To overcome the limitation of a small sample size and potential selection bias, future research can aim to increase the number of respondents and diversify the pool of participants. Engaging a more extensive range of building owners, including those from various sectors (residential, commercial, industrial), different property sizes, and geographic locations, can yield a more representative dataset. Another way to diversify the sample would be to go beyond owners' and understand the attitudes of various stakeholders such as contractors, engineers, and construction managers in decision-making for adaptive reuse. Combining survey data with qualitative interviews or case studies can enhance the depth of understanding. In-depth interviews with a subset of respondents can elucidate the nuances of decision-making processes, uncover unexplored factors, and validate the self-reported data. Qualitative data can also reveal hidden motivations and the complex interplay of personal, economic, and sustainability factors that influence adaptive reuse choices.

Expanding the scope beyond Western Pennsylvania and conducting cross-regional comparative studies can shed light on how regional variations in policies, incentives, and economic conditions impact adaptive reuse. This can provide a broader understanding of how external factors influence building owners' choices and offer insights that can be applied to different regions. Additionally, collaborating with experts from diverse fields, such as architecture, urban planning, environmental science, public policy and economics, can enhance the comprehensiveness of future studies. Interdisciplinary research can uncover connections between construction costs, sustainability, and adaptive reuse decision-making that might not be evident in single-discipline studies. Future research can also delve into the policy landscape and its role in shaping adaptive reuse decisions. Analyzing the impact of local, state, and federal policies on building owners' choices, as well as investigating the effectiveness of sustainability incentives, can be a valuable avenue for understanding the regulatory environment.

Once a more extensive body of research is established, the findings can be translated into practical guidelines such as rating systems or frameworks, and best practices for building owners, policymakers, and the architectural and real estate communities. This knowledge transfer can facilitate more informed, sustainable, and cost-effective decisions in adaptive reuse. In conclusion, while the current study on adaptive reuse in Western Pennsylvania has its limitations, these constraints can be seen as opportunities to guide and inform future research endeavors. Expanding the scope, diversifying the methodology, and embracing an interdisciplinary approach can contribute to a more comprehensive understanding of the intricate web of factors influencing adaptive reuse decision-making. The ultimate goal is to create a body of knowledge that empowers building owners and policymakers to make informed choices that lead to sustainable, economically viable, and culturally significant adaptive reuse projects not only in Western Pennsylvania but across the globe.

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CHAPTER 6: MAXIMIZING ADAPTIVE REUSE POTENTIAL BY DEVELOPING A RATING SYSTEM

KAVIN RAO, FARIS AIJAZ AHMED KHAN

CHAPTER SUMMARY

Adaptive reuse (AR) is gaining prominence in the construction industry as a result of urban areas' inability to satisfy the high demands of their rising population and a desire for sustainable development through reusing abandoned buildings. However, the recognition it receives does not always align with its true potential. Despite the gain in popularity, there are no rating systems that rate Adaptive Reuse projects that are constructed or are under the construction process. The existing Environmental Rating Systems (ERS) do not identify the criteria required for AR projects. Adaptive Reuse Models (ARM) are rating systems for AR, but they can only be used to rate the AR potential of new buildings. They do not rate AR projects that are already built. We used ARM to extract a list of criteria that can be used to maximize the potential of AR. This list could be integrated into ERS to build a rating system with a more holistic approach towards sustainability. Since AR projects have extremely diverse contexts, a single set of criteria is inadequate to rate all of them. As a consequence of this diversity, a new format of rating must be created.

We created a new rating method, where we use the list of criteria to rate AR projects pre-construction and post-construction separately. With this study we define the efficacy of an AR and address the subjective question - "Was the AR project successful in delivering its sustainability potential?"

The findings from case studies performed on Mill 19 and Carina Apartments show that some projects go above and beyond their potential, whereas others, while scoring well overall, do not meet the identified prerequisites and are thus "ineffective" in their adaptation. While projects identified as "ineffective" in their adaptation perform well in Environmental Rating Systems (ERS), they should not be referred to as 'Adaptive Reuse' projects. In our opinion this rating method could be developed further and used for policy making and tax credits towards effective Adaptive Reuse.

Our research reveals that there are benefits to an integrated strategy, by combining ARM (cultural) and ERS (ecological) sustainability goals, that offers a more holistic approach to the design of AR projects. The AR project's "efficacy" is thereby a result of the fulfillment of its identified potential. We propose that this rating system be further developed and utilized in the building codes by giving financial incentives for AR projects to use the full potential in their adaptation.

INTRODUCTION

Adaptive Reuse (AR) refers to the process of repurposing an existing building for a use different from its original, intended purpose. Architect Carl Elefante, former President of the AIA, said, “The greenest building...is the one that is already built.”¹ This statement establishes the significance of retaining embodied carbon and the shift towards sustainability. The building industry is responsible for 11% of the total carbon emissions in the world. It is also estimated that 49% of total carbon emissions from new construction until 2050 will result from material production.² AR is a valid solution that has the potential to solve issues of sustainability along with revitalizing neighborhoods and communities through the reuse of abandoned heritage buildings. Heritage buildings enhance sustainability by preserving history while fostering economic growth and community engagement.³

The city of Pittsburgh had a peak population of 600,000+ in the 1960s and currently has a population of around 300,000. The sharp decline in population resulted in abandoned buildings, which makes the city a prime model for the AR of heritage buildings.⁴ The reuse of these buildings presents financial opportunities for the stakeholders in the AEC market through tax incentives and credits through programs such as the US federal Rehabilitation Investment Tax Credit (RITC).⁵ These grants are beneficial, but they must be disbursed to those AR projects that are performed with a focus on environmental, economic, and equity considerations as a holistic evaluation. The required evaluation for the grants must also guarantee the efficient re-utilization of space and all the materials within. Currently, due to a lack of a system that identifies the potential of a building and its subsequent fulfillment, the “effectiveness” of the adaptation can get ambiguous.

Adaptive Reuse Models such as Adaptive Reuse Potential (ARP) and AdaptSTAR are existing rating systems for adaptive reuse.⁶ However, these models only identify if a building has the potential to be reused, rather than rating adaptive reuse projects under construction for their “effectiveness” in adaptation. On the other hand, the LEED rating system awards limited points towards material reuse, with an inability to impart a holistic AR evaluation. The intersection of environmental, economic and cultural

¹ *Embodied Carbon - World Green Building Council* (2022) World Green Building Council. Available at: <https://worldgbc.org/advancing-net-zero/embodied-carbon/> [Accessed 24 Nov. 2023].

² Bretaña, A. (2021) *The Adaptive Reuse Revolution*, Gensler. Available at: <https://www.gensler.com/climate-action-2021-the-adaptive-reuse-revolution> [Accessed 24 Nov. 2023].

³ Abdulameer, Z.A. and Abbas, S.S. (2020) ‘Adaptive reuse as an approach to sustainability’, *IOP Conference Series: Materials Science and Engineering*, 881(1), p. 012010. doi:10.1088/1757-899x/881/1/012010.

⁴ Daninhirsch, H. (2023) *Go Inside This Historic Pittsburgh Building’s Adaptive Reuse Project, Built | The Bluebeam Blog*. Available at: <https://blog.bluebeam.com/kingfly-spirits-adapt-reuse-construction/> [Accessed 24 Nov. 2023].

⁵ *Keystone Construction Projects* (n.d). *Pennsylvania Historical & Museum Commission*. Available at: <https://www.phmc.pa.gov/Preservation/Grants-Funding/Pages/Construction-Projects.aspx> [Accessed 24 Nov. 2023].

⁶ Farjami, E. and Türker, Ö.O., (2021). The extraction of prerequisite criteria for environmentally certified adaptive reuse of heritage buildings. *Sustainability*, 13(6), p.3536.

sustainability with ecological aspects forms the crux of the paper and highlights the importance of a new rating system.⁷

To summarize, our goal is the establishment of a robust system that eliminates subjectivity and gauges the identified potential of an abandoned heritage building and its fulfillment, resulting in an effective AR. This certification can then be utilized for tax credits and incentives fostering sustainable practices, revitalizing urban areas, and creating vibrant communities and economic opportunities in the realm of adaptive reuse.

LITERATURE REVIEW

Defining Adaptive Reuse

The definition of AR has changed over the years. We adopted the definition by Conejos et al. (2011) who defines AR as: “the act of modifying a building to accommodate uses that are different from those originally intended. These modifications are often accompanied by significant physical changes to the building.”⁸ It is gaining prominence in the construction field, but the recognition it receives does not always align with its true potential. Mohamed et al. (2017) found that a large body of research about the economic and environmental factors of AR exists, but hardly any research about equity factors has been conducted.⁹ Farjami and Turker (2019) further noted that, “A balance between environmental, socio-cultural, and economic sustainability needs to be achieved in the conservation of heritage buildings within tourism-led scenarios.”¹⁰

Heritage Buildings (HB) such as Mill 19, are buildings that hold value to the place or society. AR of HB is a major catalyst in the fields of architectural preservation and urban revitalization. It is an effective sustainable strategy to encourage conservation through renovating old buildings for new uses. It can also provide economically viable alternatives to vacant or underutilized structures. Creative adaptation contributes to pride in heritage, creating a link to the past and an opportunity for architectural innovation and problem solving.¹¹ In the context of heritage conservation, AR means modifying a building, site, or precinct to suit a proposed new use.¹² The buildings thus identified for AR require a toolkit to ensure their potential and viability. “Current rating

⁷Boschmann, E.E. and Gabriel, J.N., (2013). Urban sustainability and the LEED rating system: case studies on the role of regional characteristics and adaptive reuse in green building in Denver and Boulder, Colorado. *The Geographical Journal*, 179(3), pp.221-233.

⁸Conejos, S., Langston, C.A. and Smith, J., (2011). Improving the implementation of adaptive reuse strategies for historic buildings. In *International Forum of Studies titled SAVE Heritage: Safeguard of Architectural, Visual, Environmental Heritage* (pp. 1-10). Institute of Sustainable Development and Architecture.

⁹ Mohamed, R., Boyle, R., Yang, A.Y. and Tangari, J., (2017). Adaptive reuse: a review and analysis of its relationship to the 3 Es of sustainability. *Facilities*, 35(3/4), pp.138-154.

¹⁰Farjami, E. and Turker, Ö.O., (2019). Integrating adaptive reuse of heritage buildings with environmental rating systems. In *Value of Heritage for Tourism: Proceedings of the 6th UNESCO UNITWIN Conference*. Edited by Dominique Vanneste and Wesley Gruijthuijsen. Leuven: University of Leuven (pp. 75-85).

¹¹ Davis, M.P. and Diamonstein, B., (1980). Buildings Reborn: New Uses, Old Places. *Bulletin of the Association for Preservation Technology*, 12(2), p. 130. doi:10.2307/1493752.

¹²Truscott, M. and Young, D., (2000). Revising the Burra Charter: Australia ICOMOS updates its guidelines for conservation practice. *Conservation and management of archaeological sites*, 4(2), pp.101-116.

Langston, C., Yung, E.H.K. and Chan, E.H.W., (2013). The application of ARP modelling to adaptive reuse projects in Hong Kong. *Habitat International*, 40, pp.233-243.

tools are focused only on new construction and recurrent building operations and maintenance.”¹³

Existing Rating Systems

Farjami and Turker (2021) compare all the rating systems around the world through the lens of AR and state which of the systems are “related” or “not related” to AR.¹⁴ There are many papers that speak about the criteria for designing and implementing sustainable AR.¹⁵ Environmental Rating Systems (ERS) rating systems do not manage to identify the criteria required for AR projects. This gap is prominent in AR of Heritage buildings (HB). AR projects have diverse contexts. Therefore, a single set of criteria is inadequate to rate all of them. Consequently, there is no ERS made specifically for AR. For example, the LEED rating system for new construction is a universal rating system that is not specifically designed for AR. It “Includes: LEED BD+C: New Construction LEED BD+C: Core and Shell LEED BD+C: Schools LEED BD+C: Retail LEED BD+C: Data Centers LEED BD+C: Warehouses and Distribution Centers LEED BD+C: Hospitality LEED BD+C: Healthcare.”¹⁶ The system does not explicitly account for equity, but it does encourage AR of historic buildings to conserve material and cultural resources.

Adaptive Reuse Models (ARM) are rating systems specifically for AR but can only be used to rate the AR potential of existing buildings. They do not rate AR projects that are already built except for their AR potential in the future.¹⁶ For example, AdaptSTAR is a rating system specifically for adaptive reuse, but it is mostly used for new buildings to rate their adaptive reuse potential in the future. It could also be used to rate existing heritage buildings for their adaptive reuse potential. The ARP model predicts useful life as a function of (discounted) physical life and obsolescence, so that the right timing for future intervention can be applied. The model has generic application to all countries and all building typologies.¹⁷ ARP is rating the adaptive reuse potential of buildings that are closer to obsolescence.

¹³Schultmann, F., Sunke, N. and Krüger, P., (2009), June. Global performance assessment of buildings: A critical discussion of its meaningfulness. In *Proceedings of the 3rd CIB International conference on Smart and Sustainable Built Environments, Delft, The Netherlands* (pp. 15-19).

Reed, R., Bilos, A., Wilkinson, S. and Schulte, K.W., (2009). International comparison of sustainable rating tools. *Journal of sustainable real estate*, 1(1), pp.1-22.

Tobias, L. and Vavaroutsos, G., (2009). *Retrofitting Office Buildings to Be Green and Energy-Efficient: Optimizing Building Performance, Tenant Satisfaction, and Financial Return*, Washington DC.

Carroon, J., 2011. *Sustainable preservation: Greening existing buildings*. John Wiley & Sons.

“Integrated Sustainable Design of Buildings” (2011) *Structural Survey*, 29(3).

doi:10.1108/ss.2011.11029caa.009.

“Evaluating Sustainable Development in the Built Environment” (2011) *Structural Survey*, 29(2).

doi:10.1108/ss.2011.11029bae.008.

¹⁴Farjami and Turker, *adaptive reuse of heritage buildings*.

¹⁵Djebbour, I. and Biara, R.W., (2020). The challenge of adaptive reuse towards the sustainability of heritage buildings. *International Journal of Conservation Science*, 11(2), pp.519-530.

Conejos, S., Langston, C. and Smith, J., 2015. Enhancing sustainability through designing for adaptive reuse from the outset: A comparison of adaptSTAR and Adaptive Reuse Potential (ARP) models. *Facilities*, 33(9/10), pp.531-552.

¹⁶US Green Building Council, (2014). *LEED v4 for building design and construction*. USGBC Inc.

¹⁷Langston, C.A., (2008). The sustainability implications of building adaptive reuse. In *The Chinese Research Institute of Construction Management (CRIOCM) International Symposium: Advancement of Construction Management and Real Estate*.

PROBLEM STATEMENT & RESEARCH QUESTIONS

Introduction to Gap

“Heritage buildings provide a remarkable value for both the culture and the region where they are located; hence, there is a necessity for them to be conserved”²⁰ The adaptive reuse of heritage buildings stands as an increasingly vital component for sustainable urban development. They hold the potential to harmonize both cultural and ecological sustainability aspects, thus promoting holistic urban regeneration, while also having a huge environmental impact by conserving and reusing the carbon footprint of an existing building.

Research Gap

There is not a specific rating system dedicated to evaluating the “effectiveness” of AR of HB, especially for equity concerns with their dual objectives of cultural preservation and ecological sustainability. There are useful insights on the cultural aspects of AR in the Adaptive Reuse Models (ARM), which can be used to evaluate the AR potential of existing buildings but is not used to evaluate the AR project during design and construction stages, like other generic Environmental Rating Systems (ERS). The integration of ARM and ERS is crucial for achieving cultural and ecological sustainability in the adaptive reuse of heritage buildings. There is a plethora of ERS that either have a direct or an indirect relation to AR projects. Additionally, there are other ARM systems (AdaptSTAR, ARP, PAAM), however, their independent implementation may ignore crucial architectural aspects as compared to ERSs, which limits the true potential of the adaptive reuse of a heritage building.

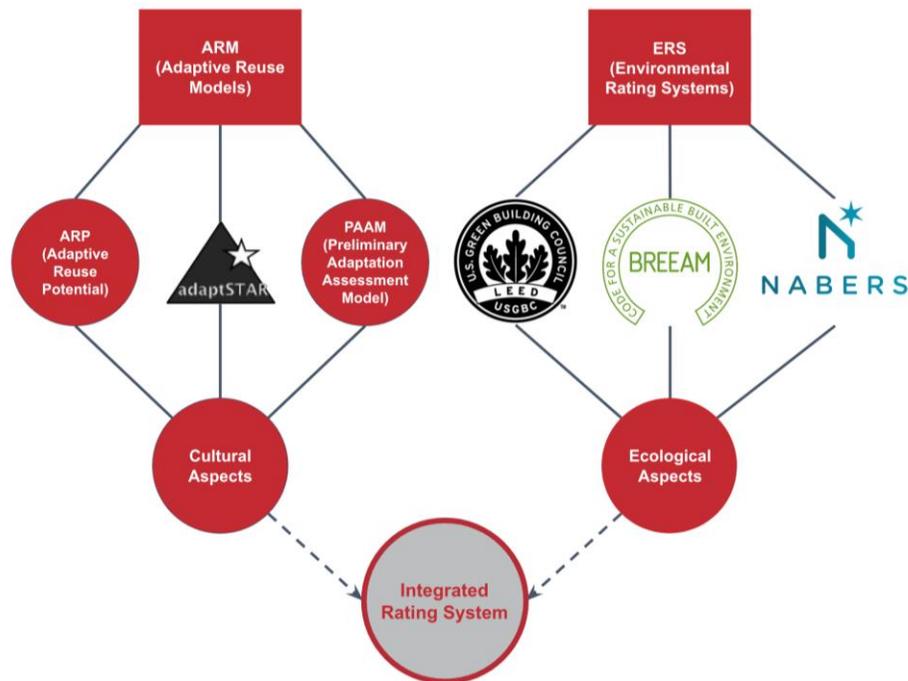


Figure 1. Research gap and recommends the resolutio

Research Questions

Question 1: What are the criteria from existing Adaptive Reuse Models related to heritage buildings?

Question 2: How can these criteria be used to evaluate existing properties before and after reuse?

Question 3: How do Adaptive Reuse projects score with our Pre-Post Analysis compared to Environmental Rating Systems?

Question 4: What is “effectiveness” in Adaptive Reuse and how do we define it?

METHODOLOGY

Our overall strategy is to create and evaluate a new rating method that would work for Adaptive Reuse Projects.

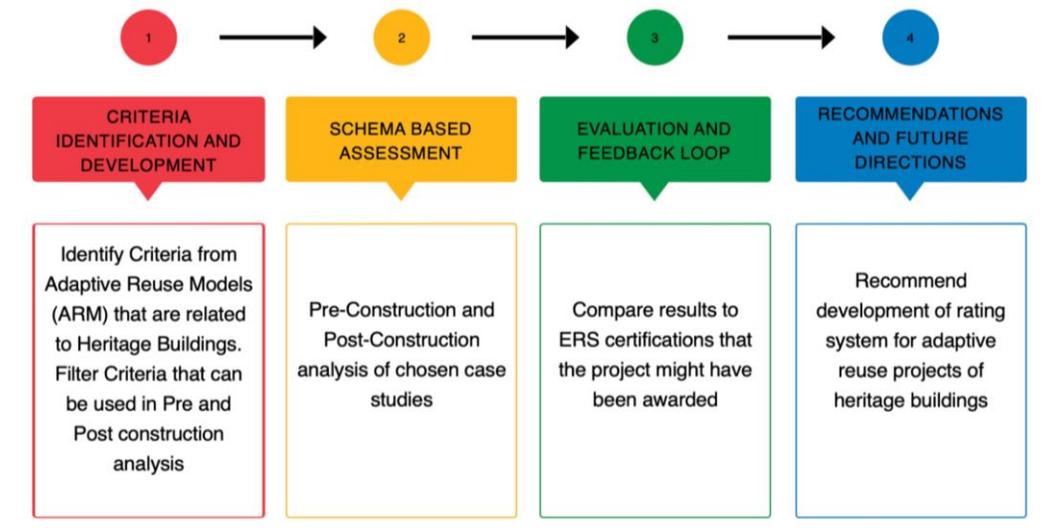


Figure 2. Research Process

Criteria Identification and Development:

We extracted a list of criteria from three Adaptive Reuse Models (AdaptSTAR, PAAM, ARP). This list is then reduced to criteria that relate to the pre-post analyses. Some criteria were removed as they could not be used to compare both pre and post-construction. Table 1, Shows the list of criteria that had been removed with the reason for removing them. This pre-post analysis is created to tackle the diversity of contexts in AR projects. In this rating method, we use the list of criteria to rate AR projects pre-construction and post-construction.

Schema-Based Assessment and Case Studies

We performed the pre-post analysis on two prominent AR cases in Pittsburgh. The list of criteria was evaluated separately for the existing building (pre-AR) and newly adapted building (post-AR). The separate scores are then compared and evaluated.

Evaluation and Feedback Loop

We used the qualitative result through the case study to further justify the relevance of certain criteria in this context. The comparison of pre- and post helped us evaluate whether the complete potential established in the pre-construction analysis has been utilized in the project. We would then compare the project with the LEED credit system to analyze and compare how it would fare with conventional ERS.

Recommendations and Future Directions

Through this evaluation and feedback loop we would make future recommendations and directions for further research and development of a rating system. This rating system should integrate the criteria established in this study with the ecological criteria of Environmental Rating Systems to have a more holistic approach toward AR.

FINDINGS

For the exploration of a comprehensive rating system for adaptive reuse buildings, we address a critical gap by integrating ARM and ERS. Further in our findings, criteria identification is the next step, with the focus on refining it into a pre-post analysis. Our findings then focus on the application of theoretical frameworks to AR projects to draw conclusions and ensure effective evaluation with the dual objectives of cultural preservation and ecological sustainability.

Criteria Identification and Development:

Farjami and Turker (2019) developed a prerequisite schema that not only studied all the ERS but also incorporated a well-balanced Prerequisite Criteria Schema that must be assessed prior to executing an adaptive reuse. This criteria list has been extracted from all the various ARM and ERS criteria pertaining to AR and Heritage value. If it scores the majority of the points, then it can be further developed into an AR project with green certification. If the project does not meet a majority of criteria, then the project can be revised accordingly. This criteria schema is just a list of criteria without any points or weightage. This study's findings are strong; however, its real-world implementation is lacking. Our research takes a step further by bridging the gap between theory and real-world implementation. As we move beyond theoretical frameworks, our research aims to contribute tangibly to the field.⁹

From this criteria schema developed by Farjami and Turker (2019) we reduced the list of criteria to only those criteria that are related to our Pre-Post Analysis. Only those criteria were chosen that can be compared in both Pre-AR and Post-AR. Any criteria that could be used only for one of the two analyses were removed, as seen in Table 1 with a strikethrough. Additionally, any criteria that were inherent values, repeated, or required to be fulfilled anyway were also removed. This left us with a concise list of criteria that when used for our case studies to identify the potential of existing building Pre-AR, and also used to find if these criteria were fulfilled in the adaptation post-AR. The following table shows the process of this extraction.

Table 1: Setting the Criteria

Criteria	ARP	AdaptSTAR	PAAM
Physical (12/19)			
Structure			✓
Structural Integrity & Foundation	✓	✓	
Floor Plate Size	Restrictive		
Reuse Space			
Service Core Location			✓
Elasticity (ability to extend laterally or vertically)			✓
Material Durability & Workmanship	✓	✓	
Degree of Attachment to other Buildings	Inherent		
Access to Building	Restrictive		
Floor Strength			✓
Design Complexity	Inherent		
Workmanship	Repeat		
Prevailing Climate	Inherent		
Deconstruction (Safe efficient and speedily)			
Expandability	Repeat		
Flexibility (Space Planning)			✓
Technological and Convertibility			✓
Maintainability	✓	✓	
Dis-agreeability (Reusability/Recyclability)			✓
Economic (5/9)			
Population Density	Inherent		
Density of Occupation	restrictive		
Yields			✓
Current Value			✓
Transport and Accessibility / Site Access	✓	✓	✓
Plot Size and Site Plan	Inherent		
Increase in Value Post Adaptation	Repeat		
Convertibility (ease of conversion)			
Exposure	✓		
Social (7/13)			
Community Benefits - Historic Listing			✓
Density of Valuable Cultural Resources in Surrounding Area	Inherent		
Image and Identity/ Image and History	✓	✓	
Community Spaces and Engagement			
Transport Noise	Inherent		
Retention of Cultural Past			✓
Aesthetics and Landscape/Townscape	✓	✓	✓
Urban Regeneration			
Neighborhood and Amenity	✓	✓	
Provision of Additional Facilities/Amenities	✓	✓	
Proximity to Hostile Factors	Inherent		
Criteria	ARP	AdaptSTAR	PAAM
Stigma			
Age	Inherent		

Function (5/5)	
Flexibility and Convertibility	✓ ✓
Disassembly	✓ ✓
Spatial Flow and Atria	✓ ✓
Structural Grid	✓ ✓
Service Ducts and Corridors	✓ ✓
Technological (4/6)	
Orientation and Solar Access	Inherent
Glazing and Shading	✓ ✓
Insulation and Acoustics	✓ ✓
Natural Lighting and Ventilation	✓ ✓
Energy Rating	✓
Feedback on building Performance and Usage	Prerequisite
Political (2/5)	
Ecological Footprint and Conservation	✓ ✓
Community Interest/Participation	✓ ✓
Community Support and Ownership	Repeat
Urban Masterplan and Zoning / Urban Regeneration	Prerequisite
Zoning	Prerequisite
Legal (3/6)	
Standard of Finish	✓ ✓
Fire Protection and Disability Access/Fire Codes	Prerequisite
Occupational Health, IEQ, Safety and Security	✓ ✓
Convertibility	✓ ✓ ✓
Energy Rating	Repeat
Acoustic	Prerequisite
Environmental (0/4)	
Internal Air Quality	Req.
Internal Environmental Quality	Req.
Existence of Hazardous Materials	Req.
Sustainability Issues	Req.

Pre-Post Analysis

For the Pre-Post analysis we asked the following questions when scoring the case study. Pre-Analysis: Did the building have the potential for this “criteria” to be reused or adapted? If answered **yes** then the building would gain one point in the pre-analysis. If answered **no**, then it would get a score of zero signifying that the existing building did not have the potential for that criteria to be used in the AR.

Post-Analysis: Was the potential reused? Or does it have the potential for adaptive reuse again? If answered **yes** then the building would gain one point in the post-analysis. If answered **no**, then it would get a score of zero signifying that the potential was not used. If the potential is identified in the pre-analysis then the AR design should use that potential in the adaptation to maximize the potential.

Prerequisite Criteria: Some criteria have been identified as prerequisite criteria as they are more important than the other criteria. If any potential is identified in the pre-analysis for the prerequisite criteria, then those must be fulfilled in the post-

analysis. Failing to do so would label the project as “ineffective” and the project would lose its eligibility as a “Certified Adaptive Reuse Project. In the case where no potential is identified in the pre-analysis, the project loses no points for not fulfilling that criterion in the post-analysis.

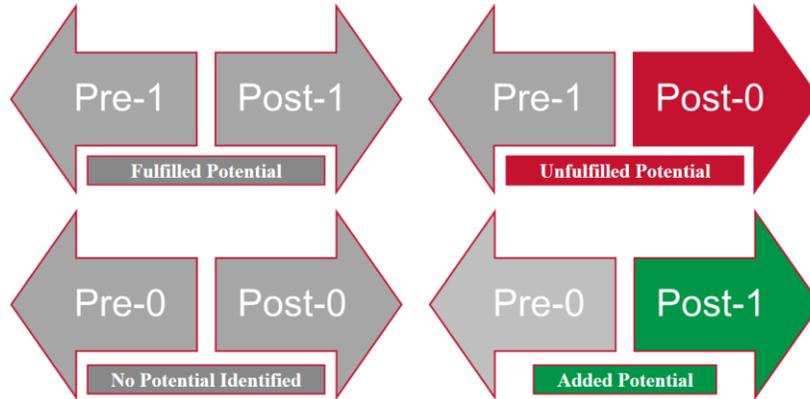


Figure 3. Pre-Post Analysis outcome marking and inference

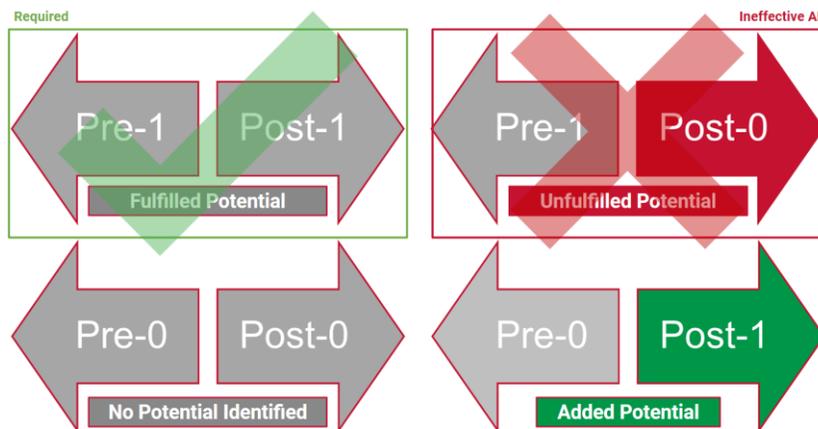


Figure 4. Prerequisite Criteria outcomes marking and inference

Case Study: Mill 19

For our first case study we chose Mill 19 which is a Gold LEED certified and AIA award-winning Adaptive Reuse project. This project was originally built as a steel mill in 1943. The steel mill was then adapted to a state-of-the-art research center by the Regional Industrial Development Corporation (RIDC). This site is part of the 178-acre Hazelwood Green Site. The adaptive reuse of Mill 19 in Pittsburgh signifies the city’s resilience and ability to transform its industrial heritage into a hub for advanced manufacturing and innovation.

At first glance, many would say that Mill 19 is not an effective AR. Many have this opinion because an entirely new building was built inside the old building. We

performed the pre-post analysis on this case study and the result of the analysis shows that Mill 19 scores very well. Additionally, the adaptation gains more points in the post-AR because of the added value. This is an example of a building that had low physical potential as it was a hazardous industrial building with parts that needed replacement. The cultural potential of this building has been fulfilled and scores higher in post-analysis. Table 2 shows the breakdown of the points given for each criterion. The sub-criteria listed in the red text are prerequisites that need to be met in order to proceed. The texts in red are prerequisite criteria and must be fulfilled in the analysis if the potential is identified in the pre-analysis. The points highlighted in red are the criteria that lost points and green are the criteria that gained points.

Table 2: Pre - Post Analysis of Mill 19

Criteria	Pre AR	Post AR
Physical (12)		
Structure	1	1
Structural Integrity & Foundation	0	0
Reuse Space	0	0
Service Core Location	0	0
Elasticity (ability to extend laterally or vertically)	1	1
Material Durability & Workmanship	0	0
Floor Strength	0	0
Deconstruction (Safe efficient and speedily)	1	0
Flexibility (Space Planning)	0	1
Technological and Convertibility	0	0
Maintainability	0	1
Dis-agreeability (Reusability/Recyclability)	1	1
Sub-Total	4	5
Economic (5)		
Yields	0	1
Current Value	1	1
Transport and Accessibility / Site Access	1	1
Convertibility (ease of conversion)	0	0
Exposure - Views / Privacy	0	1
Sub-Total	2	4
Social (7)		
Community Benefits - Historic Listing	1	1
Image and Identity/ Image and History	1	1
Retention of Cultural Past	1	1
Community Spaces and Engagement	0	1
Aesthetics and Landscape/Townscape	0	1
Function (5)		
Flexibility and Convertibility	0	0
Service Ducts and Corridors	0	0
Spatial Flow and Atria	0	1
Structural Grid	1	0
Disassembly	1	0
Sub-Total	2	1
Technological (4)		
Natural Lighting and Ventilation	0	1
Insulation and Acoustics	0	0
Glazing and Shading	0	1
Energy Rating	0	1

Sub-Total	0	3
Political (2)		
Ecological Footprint and Conservation	1	1
Community Interest/Participation	1	1
Sub-Total	2	2
Legal (3)		
Standard of Finish	0	0
Occupational Health, IEQ, Safety and Security	0	1
Convertibility	1	1
Sub-Total	1	2
Total	15	23

Figure 5 shows that the only category where Mill 19 loses points is in Function. This is because it doesn't reuse the structural grid of the existing building. Additionally, it loses another point because the new building cannot be disassembled like the old building. Overall, the project fulfills all the identified potential in the prerequisite criteria. It also gains extra points for adding potential, giving a total post-analysis score (23) higher than the total post-analysis score (15). Mill 19 scored a percentage of 153% which is a high score and therefore it is "effective" in its adaptation.

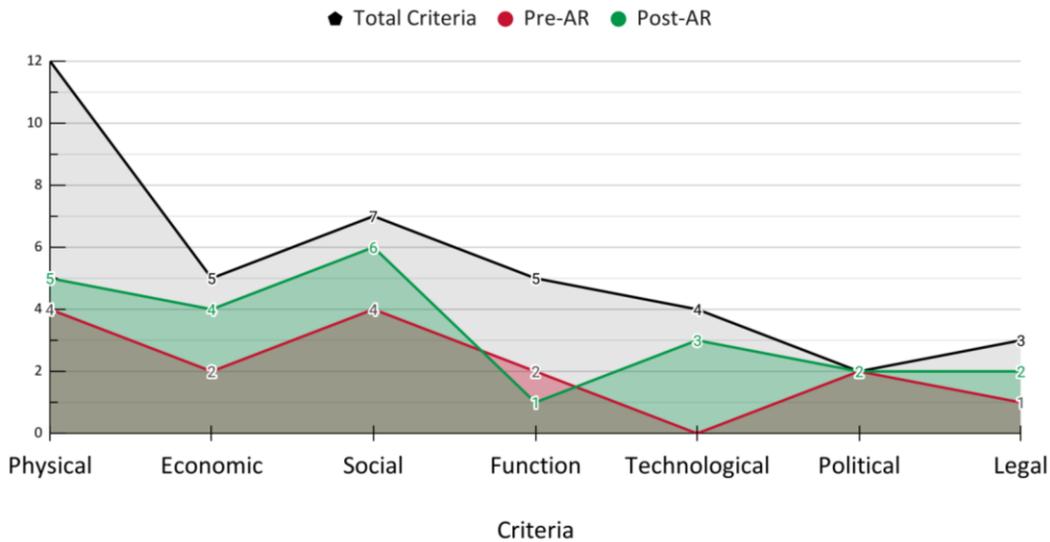


Figure 5. Pre vs post analysis for Mill 19

Evaluation

Mill 19 is a LEED-certified building, achieving a LEED Gold certification as it accrued 66 points as it qualified for LEED ID+C (Commercial Interiors) criteria. We can observe that even though this building is an AR project, the LEED criteria do not explicitly recognize it or any of the 3Es. It is worth noting that 27% of all its points are scored through neighborhood development under 'Location & Transportation', which, although recognizes its community impact, but overshadows important criteria such as physical, social, economic, and functional aspects that have a direct impact on AR. In the

scorecard, we can observe nine sub-criteria related to AR, and even then, it does not score in those categories, highlighting the importance of our dedicated rating system.

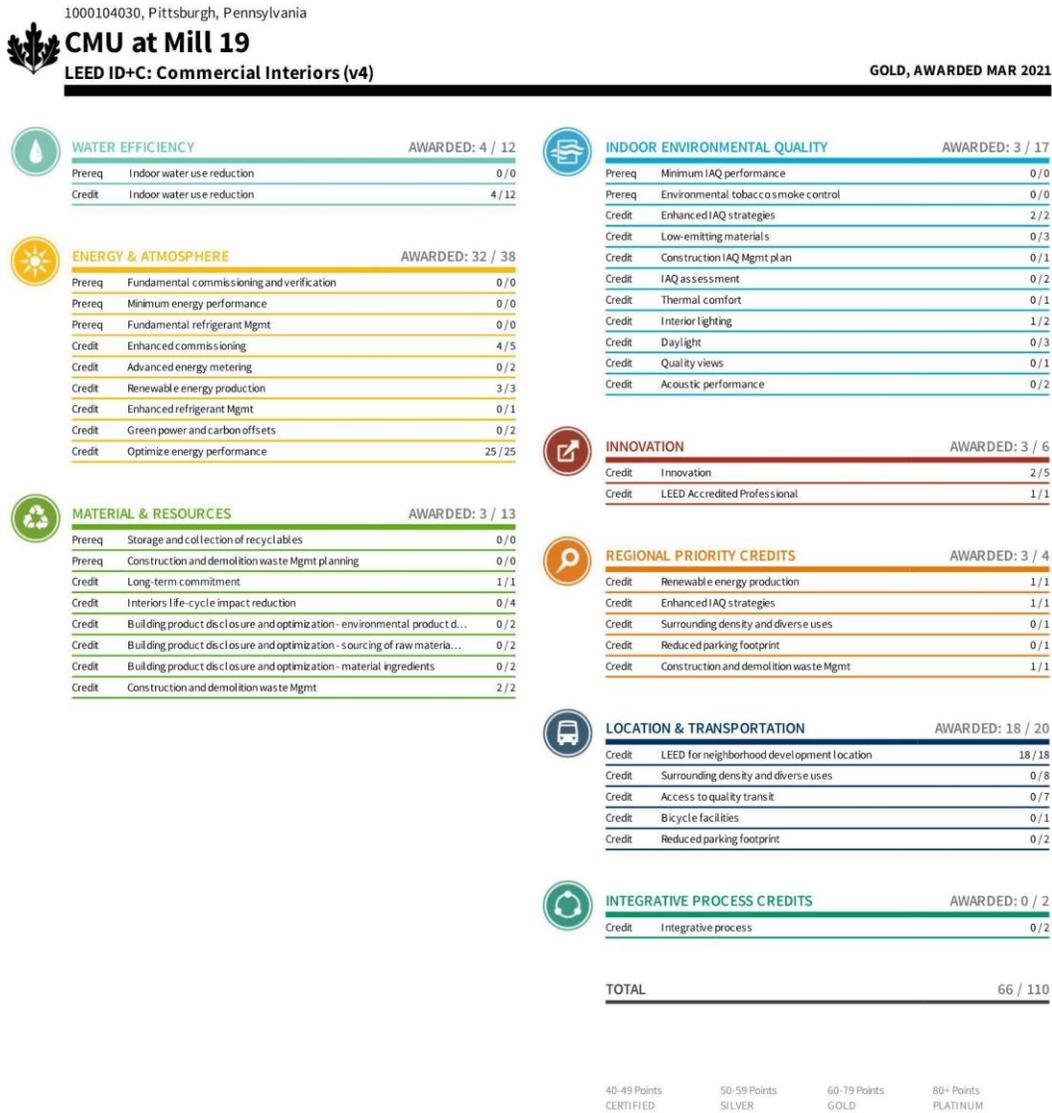


Figure 6. Mill 19 LEEDv4 ID+C scorecard

In Figures 7 and 8, we compare the pre-post analysis to the LEED scorecard. In this comparison it is clear that LEED focuses more on the energy and location aspects of the building whereas the pre-post analysis focuses on the physical and social aspects. It was also noticed that the LEED credits are not as balanced as the pre-post analysis.

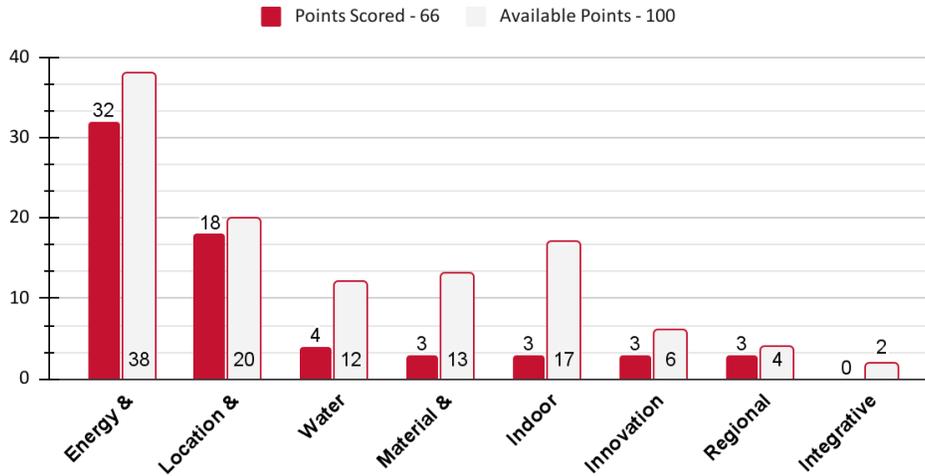


Figure 7. Mill 19 LEEDv4.1 ID+C scoring criteria

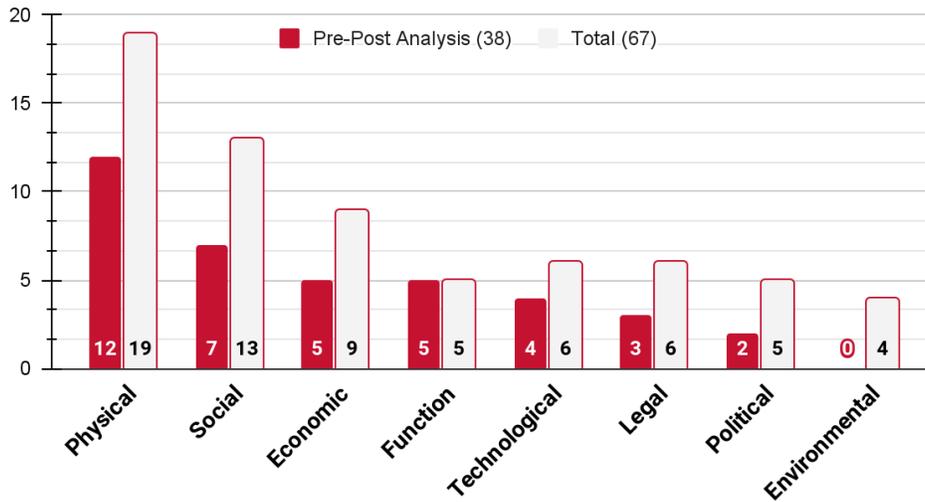


Figure 8. Pre vs post identified criteria for Mill 19

Case Study 2: Carina Apartments

For our second case study we chose Carina Apartments in Pittsburgh, which is an Adaptive Reuse project of a Synagogue and old school building that was turned into a housing complex. This housing complex gained many tax credits for being affordable housing. The first line on their web page says “adaptive reuse” explicitly.¹⁸

¹⁸ “Apartments in East Liberty Pittsburgh, PA | The Carina | Home.” Available at: <https://www.thecarinaapartments.com/>. [Accessed 4 Dec. 2023].

Table 3: Pre - Post Analysis of Carina Apartments

Criteria	Pre AR	Post AR
Physical (12)		
Structure	1	0
Structural Integrity & Foundation	1	0
Reuse Space	1	0
Service Core Location	1	1
Elasticity (ability to extend laterally or vertically)	1	1
Material Durability & Workmanship	1	1
Floor Strength	1	0
Deconstruction (Safe efficient and speedily)	0	0
Flexibility (Space Planning)	1	0
Technological and Convertibility	0	0
Maintainability	0	1
Dis-agreeability (Reusability/Recyclability)	1	0
Sub-Total	9	4
Economic (5)		
Yields	1	1
Current Value	1	1
Transport and Accessibility / Site Access	1	1
Convertibility (ease of conversion)	1	0
Exposure - Views / Privacy	0	1
Sub-Total	4	4
Social (7)		
Community Benefits - Historic Listing Image and Identity/ Image and History Retention of Cultural Past	1	1
Community Spaces and Engagement	1	1
Aesthetics and Landscape/Townscape	0	1
Function (5)		
Flexibility and Convertibility	0	0
Service Ducts and Corridors	1	1
Spatial Flow and Atria	1	1
Structural Grid	1	1
Disassembly	0	0
Sub-Total	3	3
Technological (4)		
Natural Lighting and Ventilation	0	0
Insulation and Acoustics	0	0
Glazing and Shading	0	1
Energy Rating	0	1
Sub-Total	0	2
Political (2)		
Ecological Footprint and Conservation	1	1
Community Interest/Participation	1	1
Sub-Total	2	2
Legal (3)		
Standard of Finish	1	1
Occupational Health, IEQ, Safety and Security	0	1
Convertibility	1	0
Sub-Total	2	2
Total	24	24

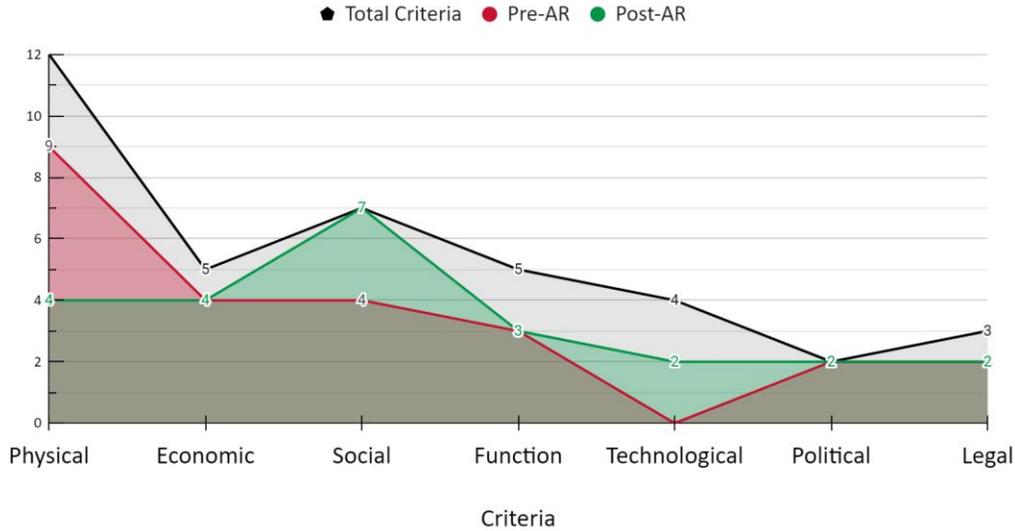


Figure 9. Pre vs post analysis for Carina Apartments

Evaluation

From the Pre-Post analysis as seen in Table 3, we can see that Carina Apartments does not fulfill the prerequisite criteria in the physical category. Therefore, Carina Apartments should not be certified as an AR project. Although Carina Apartments scores higher than Mill 19 in overall score in post analysis, they also score much higher in pre-analysis. This signifies that Carina Apartments had a lot more potential which it did not use. Since it failed to fulfill the prerequisite criteria it would not have been certified through our rating system.

Comparison

Through the findings, it is evident that the rating helps discern effective and ineffective adaptive reuse. It is demonstrated by the case studies, which provide an accurate indicator of a project's capacity to realize its identified potential for AR. Finding common ground through the identification of these distinctions enables the construction industry's stakeholders to recognize this potential and use policymaking to realize it. The subsequent sections will explore the broader implications and applications of these findings, paving the way for a paradigm shift in the evaluation and execution of AR projects.

SIGNIFICANCE AND POTENTIAL IMPACTS

This study aims to revolutionize AR practice by establishing new guidelines and a framework for existing buildings to assess their reuse potential before redesign and after construction. Especially in the context of heritage buildings and their significance in the cultural fabric of the city, it is crucial for AR to not only comply with but also to

ideally surpass its potential. Since every AR scenario is unique and presents distinct obstacles, a pre-AR study is necessary to establish a set of specific, tailored guidelines that guarantee the accurate identification of the potential associated with each case. The same guidelines must be incorporated into the design and construction process. Upon its completion, a post-AR analysis can confirm the effective reuse of the building. This pre-versus-post approach not only enhances effectiveness but can also be used as a toolkit to justify government credits and discourage AR for profit-driven motives that neglect cultural considerations. Effective AR thereby results in a new lease of life for the building that can be reused in the future, reducing the need for new buildings.

This rating system therefore has the potential to establish industry standards and the development of best practices within AR, ensuring a systematic and effective approach. This approach, armored with the capacity to deal with cultural considerations, promotes culturally conscious urban development and provides recommendations for the City of Pittsburgh, local developers, and owners.

Limitations

The only environmental rating system considered in this paper is LEED, as it is widely used. But this is limiting, as there could be a different rating system better suited for adaptive reuse that has not been studied in depth for this paper.

We acknowledge that, upon further study and application of the rating system and through meticulous surveys and interviews with the pioneers in the field, we could potentially identify more sub-criteria to further enhance effectiveness. Currently, the number of criteria that can be used in the pre- and post-analysis are limited, as these criteria should be comparable in the pre-construction to the post-construction of the adaptive reuse projects. They do not mention the criteria and standards that have been identified in the ERS. Therefore, this analysis can only be the first step in a consolidated rating system made specifically for the adaptive reuse of heritage buildings.

Future Work

Future research in this area presents an exciting opportunity, as there are currently no rating systems that gauge the fulfillment of the identified potential of adaptive reuse. Updating the rating systems to their latest iterations is one direction of further research that has the potential to impact both the prerequisite set as well as the pre-vs. post approach. Another aspect that can be worked on is adding weight to these criteria in order of their importance and priority. This can be accomplished through a meticulously conducted survey to measure the preferences of stakeholders. The comparative analysis of the current system with the survey can offer invaluable insights into the refinement of the rating criteria.

Furthermore, the research adopted an iterative approach through the application of an informative case study. This practical implementation facilitates the iterative improvement of the systems, ensuring that they remain effective and adaptable to the changes in the landscape of sustainable development in the domain of adaptive reuse. Our method's application across diverse building typologies yields different

prerequisite criteria, offering valuable insights for policymakers. This approach ensures tax credits are granted to AR projects that fulfill their identified potential.

In conclusion, this research highlights the growing importance of AR in the construction industry and sheds light on the existing gap between ERS that fails to address the diverse requirements for AR projects. Through the development of a comprehensive rating system and a pre-vs. post-approach, we aim to eliminate ambiguity and enhance the effectiveness of AR. This is further enhanced through an integrative approach that combines both the cultural and ecological sustainability goals. This rating system has the potential to set industry standards while incorporating socially conscious urban development while addressing the 3 Es (economic, environmental, and equity considerations). Ultimately, this research lays a strong foundation for a nuanced understanding and evaluation of the effectiveness of AR, offering a valuable contribution to the construction industry through sustainable development practices.

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