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URBAN PLANNING

# Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production

Edited by Yonn Dierwechter and Mark Pendras

Volume 8

Issue 4

2023

Open Access Journal  
ISSN: 2183-7635



Urban Planning, 2023, Volume 8, Issue 4  
Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through  
Conspicuous Production

Published by Cogitatio Press  
Rua Fialho de Almeida 14, 2º Esq.,  
1070–129 Lisbon  
Portugal

Design by Typografia®  
<http://www.typografia.pt/en/>

Cover image: © metamorworks from iStock

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Editorial

## Planning, Manufacturing, and Sustainability: Three Research Themes

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Submitted: 27 September 2023 | Published: 21 November 2023

### Abstract

This thematic issue explores the role that revived emplacements of manufacturing and “blue-collar” work play in the search for more effective models of urban sustainability, drawing on intriguing developments in different cities of different sizes in different Western societies—the UK, Germany, Switzerland, the USA, and Australia. Rather than see industry as a “problem” for green city strategies, our point of departure considers what role manufacturing and “blue-collar” work can (and do) play in the search for more effective models of urban sustainability. The articles included here deploy a range of research methodologies, albeit with a predominant emphasis on qualitative case studies, to raise key challenges for urban and regional industrial planning. This editorial provides some overarching context and commentary on the topic and specifically discusses three synoptic themes that emerged most prominently from the collection of articles: the difficulty (and importance) of identifying and illustrating the practical sustainability benefits of local manufacturing; the complexity of advancing “conspicuous production” in the urban context; and the need to broaden industrial politics and planning in order to better utilize existing industrial spaces and enhance the role of production in the city. These themes help to capture emerging trends and challenges in the field while providing foundations for future research.

### Keywords

blue-collar work; innovation; manufacturing; planning for industry; sustainability

### Issue

This editorial is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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After decades of deindustrialization and “post-industrial” urbanism, many cities and metropolitan regions around the world are actively rethinking how to plan for a renewed manufacturing economy even as they must also face the immediacy of climate change and the mandatory transition to a more sustainable future.

This thematic issue explores these two challenges in explicit relation to one another. Rather than see industry as a “problem” for green city strategies, our point of departure is the exact opposite. We ask instead: what role can (and do) revived emplacements of manufacturing and “blue-collar” work play in the search for more effective models of urban sustainability? Relatedly, what particular challenges does this generate for the field of urban and regional planning? The select articles that fol-

low here discuss intriguing developments in different cities of different sizes in different Western societies—the UK (Clossick & Brearley; Ferm), Germany (Meyer; Schwappach et al.), Switzerland (Cima & Wasilewska), the USA (Pendras et al.), and Australia (Grodach et al; Hearn et al.). They furthermore deploy a range of research methodologies, albeit with a predominant emphasis on qualitative case studies. In this brief essay we wish to highlight three synoptic themes that emerged most prominently for us as we engaged with this emerging body of research.

The first of these themes is the challenge of capturing and advancing the practical sustainability benefits of local manufacturing. Given the amount of work on green manufacturing, this might strike some readers of this

journal as odd. But the issue, in our view, is that we know far more about how to “green up” blue-collar activities, especially in relationship to energy transitions and pollution mitigation strategies, than we do about how to “blue up” green city strategies. Industrial activity is still treated (mainly) as an environmental problem to fix, not (or not yet) an economic resiliency or social equity opportunity to embrace. Simply put: the challenge has too often been presented in terms of seeking to make blue-collar work *greener*, rather than to make green-city strategies *bluer*.

This is crucial to appreciate. Invocations of an Anthropocene-driven crisis are built on the 200 year-long industrialization of carbonized capitalism and the empirical excesses of modern industrialized society, especially with the advent of neoliberal globalization in the 1990s. Yet green cities, both big and small, are under assault by scholars and citizens alike for their elitist effects, unequal economies, and contradictory territorializations. The explosion of left academic work on “green gentrification” since 2016 is one indication of this anxiety; right-wing populist hostility to urban and national climate action, still another. Unpacking and better supporting the sustainability benefits of re-localized urban manufacturing activities—of interwoven production *in situ* rather than extruded Fordism *ex loco*—is one way to foreground the long-neglected contributions of working-class residents who may not readily identify with rain gardens and bike lanes. Sustainability is less a design issue, at bottom, than a political struggle. Green coalitions that embrace working-class culture are more likely to matter. Urban planning for meaningful industrial inclusion is arguably a key element of that multi-scalar project.

While most articles here acknowledge this first challenge, two take it up directly. Noting that commercial and industrial areas can become “sustainable role models” for urban planning, Schwappach et al. (2023, p. 181) explore the mutual interrelation between commercial and industrial redevelopment requirements and climate adaptation in the Berlin-Brandenburg region. Using a “backcasting” technique on three cases, they offer in detail what they call “hands-on” guidance for regional planners seeking to climate-proof vulnerable areas (Schwappach et al., 2023, p. 166). The practical sustainability benefits of local manufacturing are also evident in metropolitan Australia. Grodach et al. (2023) document how planning regulates and shapes “the sustainability potential” of manufacturing enterprises in Melbourne, particularly in the food and beverage sector. They find “ripe potential” for encouraging sustainable production, including local supplier networks in dense environments, but also highlight “extant challenges,” such as retrofitting buildings and local use conflicts (Grodach et al., 2023, p. 194). These are important insights into better connecting sustainability with industrial planning. But more work is needed. We see the mostly tangential linkages made to this theme in the other articles here as both a reflection of the importance of bringing new attention to this theme and an indication

of the relative difficulty of weaving together sustainability and urban industrial revival.

The second synoptic theme we consider central to this thematic issue is the importance and complexity of the “conspicuous production” argument. Most contributors acknowledge the extent to which the displacement of manufacturing from urban areas and the celebration of alternative economic sectors since the late 20th century have rendered industrial activity increasingly invisible. As Baker (2017) argued, invisibility can breed a lack of interest, understanding, and support for manufacturing in the city. In this context, making production more conspicuous—more visible, more central, more connected—in urban environments is a promising industrial revival strategy. While most contributors here accept the logic of this argument, they also caution, however, against easy solutions for the complex challenges of urban industrial planning. Not all industrial activities are equally suited to the spotlight. Whether due to safety concerns, the difficulties of managing commonly perceived “nuisances” (sounds, smells, vibrations), or simply production processes that are “complex, intangible, and embedded in highly specialised production chains” (Cima & Wasilewska, 2023, p. 205), becoming more conspicuous does not inherently lead to greater appreciation. In fact, the opposite might occur: increased visibility of some firms and activities could undermine public support.

The question of suitability for increased attention links with questions about when or even whether seeking increased industrial “conspicuousness” is desirable. Such an emphasis can bring an unwelcome element of performance to the sector, advancing a kind of “Santa’s workshop” fantasy of happy workers inoffensively tinkering away for an appreciative audience. More substantively, privileging manufacturing processes that are suited to conspicuous production—tech-oriented advanced manufacturing, luxury crafts, food services—can also add to the already growing trend towards industrial gentrification. Concerns that advanced manufacturing “brings to the industrial sector the same patterns of exclusion and inaccessibility that have plagued professional services” (Pendras et al., 2023, p. 228) complicates the role that conspicuous production can play in industrial revival strategies. That said, Clossick and Brearley (2023) demonstrate the importance of “revealing” existing industrial activity in order to facilitate understanding and build support, while Cima and Wasilewska (2023, p. 199) push for new ways to think about “conspicuousness” through “other senses beyond the visible.” They introduce the idea of “sensible production” that aims for “a more open consideration of how manufacturing shapes urban sensescapes” and pushes beyond spatial design to cultivate support for urban industry through broader dimensions of politics, planning, and social learning (Cima & Wasilewska, 2023, p. 201).

Broadening industrial politics and planning to enhance the role of production in the city is our third

synoptic research theme from this thematic issue. As noted previously, a newfound appreciation for manufacturing has taken root in a wide variety of urban and national contexts. On the heels of decades of disinvestment and other structural adjustments and cultural shifts, much of the foundational scholarship on urban industrial revival understandably focused on how (and why) to stop the bleeding: defining and defending industrial zone boundaries, policing land uses, limiting variances and conversions. That work remains important, but scholarship also demonstrates that industrial planning needs to move beyond preservation and the defense of historic boundaries. The challenge is to find ways to better *use* the spaces that already exist, to better integrate those spaces into the city, and to consider whether and how new industrial spaces might be created.

That more nuanced approach to urban industrial planning, focused on gathering specific data to confront challenges that are unique to specific places, is reflected in most of the contributions included here. In the German context, Meyer (2023) uses two written surveys to examine the location requirements of different kinds of small urban manufacturers (SUM)—comparing construction site crafts, workshop crafts, and store crafts for their nuanced differences. While mixed-use structures and sharing spaces that actively include SUM are increasingly crucial to building a wider circular economy, Meyer explores the willingness of future apprentices to work in mixed-use areas of the Ruhr. Before new industrial landscapes are constructed, in other words, we need to know more about worker preferences. In their analysis of the Northgate industrial precinct in Brisbane, Hearn et al. (2023, pp. 258–259) connect with this need for greater local specificity by asking: “What are the elements of a locale that actually contribute to the social capital required to sustain urban manufacturing?” Focusing on “the mix of different kinds of capabilities and capital”—tangible and intangible—their case study highlights new kinds of blue-collar work associated with the co-location of “bespoke public art” and “advanced robotics” in the context of green neighborhood revitalization and transit accessibility (Hearn et al., 2023, p. 252). This is about finding the combinations of assets and support mechanisms that can bring meaningful change and progress to the manufacturing spaces of the city.

Ferm’s (2023) contribution reinforces this push beyond general efforts to protect “manufacturing” by calling additional attention to competition *within* the industrial sector and planning measures that favor some firms and activities over others. Highlighting a theme echoed by others in this thematic issue (see particularly Clossick & Brearley; Grodach et al.; Pendas et al.), Ferm clarifies that in recent years industrial planning has become more complex, raising questions not just about whether manufacturing can compete favorably against other land uses (residential, commercial), but rather *which types* of manufacturing can and should be

supported, through which policies, in which locations, and serving which populations. As she puts it:

The literature on the urban manufacturing renaissance has not, to date, engaged fully with the issue of *how* to practically accommodate this renaissance within the urban built environment, specifically what the role of planning is in either supporting or stifling these ambitions. (Ferm, 2023, p. 266)

That on-the-ground engagement with the complexities of industrial planning is best reflected in Clossick and Brearley’s (2023, p. 214) “Audit, Reveal, and Promote” methodology that identifies and publicizes existing industrial activities and ultimately helps local and national political leaders develop the kind of “fine-grained and nuanced understanding” needed to effectively plan for industrial retention and revival. An important component of this work, echoed across all the contributions to this thematic issue, is incorporating the voices and participation of local community members so that they can educate planners and development officials about sectoral needs and help shape future investments. This emphasis on identifying, cultivating, and empowering the “constituencies” for urban industrial planning is central to shifting from the generalities of boundary policing and land use preservation to the production of new knowledge about how to better utilize, activate, and incorporate existing industrial spaces and activities into contemporary urban life.

Industry, in sum, need not be a “problem” for green city strategies. But the revived emplacement of new kinds of manufacturing and the new kinds of “blue-collar” work they might nurture in (and for) our currently unsustainable cities and metropolitan regions pose major challenges for the urban planning community. We thus hope that the three overall research themes gleaned directly from this excellent collection of articles—(1) better capturing and advancing the practical sustainability benefits of local manufacturing; (2) refining our strategies for how to make production more “conspicuous,” valued, and visible; and (3) broadening and intensifying industrial politics and planning—form useful entry points for innovations in planning practice and future research on planning, manufacturing, and sustainability, including new doctoral dissertations, more thematic issue articles, and, not least, scholarly monographs.

### Acknowledgments

The authors wish to thank the contributors and their informants.

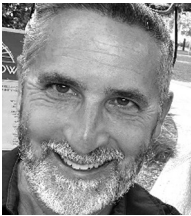
### Conflict of Interests

The authors declare no conflict of interests.

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Article

## Place-Based Climate-Proofing of Commercial and Industrial Areas: Inventory and Guidelines From a Regional Planning Perspective

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Submitted: 29 April 2023 | Accepted: 7 August 2023 | Published: 21 November 2023

### Abstract

In spite of all efforts to reduce greenhouse gases, climate change has become a new reality that requires regional planning to provide effective solutions. This article focuses on commercial and industrial areas (*Gewerbegebiete*), which are important but often overlooked spaces, by means of examples in the Berlin-Brandenburg region. The article investigates whether and how regional planning can help these areas adapt to climate change. Three commercial and industrial areas in different spatial settings are examined, using an inventory of place-based measures, general standards, and regional networking of planning actors. This inventory is based on a backcasting analysis that compares normative future images of climate-adapted commercial and industrial areas with their current local situation. Spatially differentiated guidelines for the adaptation of commercial and industrial areas are then developed from a regional planning perspective by “climate-proofing” regional plans. These guidelines provide both place-based and general solutions for integrating and governing climate adaptation measures and standards into existing frameworks using a hands-on regional planning approach.

### Keywords

backcasting analysis; Berlin; Brandenburg; climate adaptation; climate-proofing; commercial areas; Germany; industrial areas; place-based; regional planning

### Issue

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### 1. Introduction

Adapting to climate change is an urgent mission for regional planning as its consequences are already affecting various regions in the form of heat waves, droughts, storm damages, and flooding events (Beyschlag et al., 2021). Such events, however, vary regionally in their intensity whereby inequalities in living conditions are becoming increasingly common. Regional planning must find answers to how to assure equal living and working conditions (König et al., 2023). Despite their high need and potential for adaptation to climate change, commercial and industrial areas (*Gewerbegebiete*) are often given lower priority in regional planning (Schack et al.,

2023). These areas provide employment, income, welfare, and high living standards, but are also responsible for a significant amount of land consumption, are highly sealed, and are often located in hazardous areas, making them vulnerable to the consequences of climate change (Benden et al., 2012).

While the importance and mutual interrelation of climate adaptation and the (re)development of commercial and industrial areas seems evident, these two fields are often considered separately by urban and regional planners. Despite a few notable exceptions (Birkmann & Fleischhauer, 2009; Breuer et al., 2020; European Commission, 2021a; Roost et al., 2021), little research or practical guidance is available. The theoretical objective



of this study is to bridge this gap and integrate the discourse on climate adaptation and on developing industrial areas by climate-proofing regional plans in a general sense. By identifying this new field of action, the study aims to accelerate climate adaptation processes for commercial and industrial areas and to promote a rethinking of the planning and construction of such spaces. Methodologically, the study rests on the backcasting analysis, which addresses complex problems in exploratory fields, and aims to link a desired future with the near future by asking the question: “What has to happen first?” (Bollien, 2021). In the present case, this methodology integrates findings from the individual case studies into guidelines for shaping the future. The underlying approach is both place-based and regional; it aims for an equally distributed and widespread utilisation of climate adaptation standards and measures. The standards and measures are summarised deductively from literature and expert interviews and proposed inductively through spatial test designs within selected case studies in the German states of Berlin and Brandenburg.

The article is organised as follows: Section 2 deductively outlines current observations and theoretical discourses related to climate adaptation and the (re)development of commercial and industrial areas. In Section 3, a normative vision of a climate-proof industrial area is presented and compared to three case studies from the Berlin-Brandenburg metropolitan area in order to inductively derive viable measures for climate adaptation. Section 4 provides an inventory of standards and measures for climate adaptation. The findings are compiled into a practical regional planning guide for climate-proof commercial and industrial areas in Berlin and Brandenburg, highlighting the regional level as the appropriate scale of action for climate adaptation of industrial areas.

## 2. (Re)Development, Regional Planning, and Climate Adaptation in Commercial and Industrial Areas

### 2.1. Current Strategies in Commercial and Industrial Areas in Germany

Discussions about the renewal of existing commercial and industrial areas and efforts to limit land consumption in commercial construction in Germany have a sobering tone (Freudenau, 2016; Oediger et al., 2020). Many conventional commercial and industrial areas—apart from modern science and technology parks—suffer from urban development deficits and a low-quality built environment (Suwala et al., 2021). Although issues are diverse and location-specific, regional planning research agrees that all areas older than 15 years require redevelopment measures (Roost et al., 2021). Researchers have identified three general needs for action in commercial and industrial areas in Germany (Hüttenhain, 2012; Senatsverwaltung für Stadtentwicklung, Bauen und Wohnen [SenStadt], 2020): *modernisation* and *preserva-*

*tion* (type 1) for brownfield areas in need of modernisation and safeguarding against non-industrial use in prosperous regions and inner-city areas; *new development* (type 2) for greenfield developments with high soil sealing in suburban areas; and *revitalisation* (type 3) for under-utilised brownfields in stagnating, peripheral regions.

### 2.2. Climate Mitigation and Climate Adaptation in Commercial and Industrial Areas

In the 21st century, addressing the general needs for action in commercial and industrial areas must also take into account the consequences of climate change. This involves implementing standards and measures to mitigate and/or adapt to its detrimental effects. Climate adaptation measures describes the adjustment to the effects of climate change, while climate mitigation measures reduce emissions to make impacts of climate change less severe (Greiving et al., 2011; Marx, 2017, p. 9). Regardless of the urgency, climate adaptation measures face greater obstacles than those of climate mitigation, such as a lack of political determination and formal enforcement. Climate mitigation measures are usually juristically embedded in acts, regulations, and rules and are easier to implement through explicit targets such as emission figures (Freimann et al., 2013). Uncertainty about the consequences of climate change for specific areas makes it difficult for municipalities to invest in precautionary measures (Hasse, 2021; Reese, 2018). However, climate adaptation and mitigation are complementary (Marx, 2017), and adaptation efforts can never substitute vigorous climate mitigation action.

A tool for integrating both measures of climate mitigation and adaptation into governance practices is known as climate-proofing (see Section 3.3; European Commission, 2021a). The article elaborates on the concept of climate-proofing governance practices to improve climate adaptation within commercial and industrial areas from a regional planning perspective.

Commercial and industrial areas are referred to as the “black sheep of sustainability transitions” (Heimann, 2018, p. 224). They face enormous sustainability challenges, such as high energy emissions, underutilised plots, and excessive greenfield consumption (Benden et al., 2012). Many industrial areas are also vulnerable to climate change due to their location in floodplains and poor building quality. While some examples of sustainable and climate-proof architecture exist (e.g., Alnatura Campus in Darmstadt or the Lütvogt logistics hub in Wagenfeld; Djahanschah et al., 2020), implementation is lacking due to a reliance on voluntary initiatives and a lack of systematic coordination and funding.

### 2.3. Climate-Proofing of Existing Planning Thought and Concepts

Neither voluntary initiatives nor pilot projects are enough for proper climate adaptation in commercial and

industrial areas. Standards need to be set at higher levels, such as regional or national planning (Roost et al., 2021), to improve implementation and increase the unassailability assessment (*Abwägungsfestigkeit*; Diepes, 2018). Generally applicable standards for climate adaptation in (preparatory) land-use plans must clearly outline targets and limits to become legally binding (Baumüller, 2019; Reese, 2018). However, determining and verifying these standards require sophisticated climate models or monitoring tools that may overburden municipalities in terms of personnel and expertise (Bula et al., 2015). To avoid overburdening municipalities with complex and elaborate climate impact assessments, we propose integrating climate adaptation into existing plans and processes. This approach is inspired by the concept of “climate-proofing” (Birkmann & Fleischhauer, 2009). Climate-proofing can be understood as:

A process that integrates climate change mitigation and adaptation measures into the development of (built) infrastructure projects....It sets out common principles (standards) and practices (measures) for the identification, classification and management of physical climate risks when planning, developing, executing and monitoring infrastructure projects and programmes. (European Commission, 2021a, p. 7)

The concept of climate-proofing was introduced in spatial planning as early as 2009. It was originally derived from development cooperation practice (European Union, 2016; Fröde et al., 2013). Climate-proofing is also increasingly discussed in the context of urban and regional planning as a tool for integrating climate mitigation and adaptation issues into spatial planning (Birkmann & Fleischhauer, 2009; Dosch et al., 2016; Fichter & Hintemann, 2012; Greiving et al., 2011). In contrast to the German strategic and environmental impact assessments (*strategische Umweltverträglichkeitsprüfung*), which primarily focus on climate mitigation and assess the impact of a pending project on the environment, the concept of climate-proofing works in the opposite direction. It examines the effects that climate change may have on the project. While researchers consider the formal environmental assessment a prerequisite, they also acknowledge that it is insufficient to ensure climate adaptation, since the negative impacts of climate change are not explicitly checked within this process (Reese, 2018).

#### 2.4. Capitalist Imperatives and Place-Based Regional Planning of Commercial and Industrial Areas

Reflecting on capitalist imperatives affecting industrial development, this section outlines the theoretical foundations of our approach, explaining why commons strategies and regional planning are particularly effective in ensuring climate adaptation within commercial and industrial areas.

Recent research on global economic networks has emphasised the importance of examining both the regional context of regulatory frameworks and planning governance, as well as the trans-local interrelations between geographically distant industry locations vying for positions within global production networks (Beyer et al., 2020; Hagemann & Beyer, 2020; Suwala, 2021). The critical role played by industrial infrastructure, such as industrial zones that meet the environmental standards of transnational investors and buyers, and the role of multiple stakeholders in providing such infrastructure are particularly noteworthy (Beyer, Elsner, Hagemann, et al., 2021). A comparative view of commercial and industrial areas, taking into account both metropolitan hubs and rural hinterlands, reveals a connection between “left-behind” places and privileged spaces within global economic networks (Pike et al., 2023). For example, a logistics hub on the outskirts of a city is necessary to supply goods to the central consumption areas. This trans-local perspective can provide a systemic understanding of the interrelationships between spatial and economic factors, such as the availability of brownfields and greenfields or vacant and highly demanded areas, which goes beyond the narrow focus on land maximisation for corporate profit (Beyer, Elsner, & Hagemann, 2021). The power distribution among industrial spaces does not prioritise individual prosperity but rather global efficiency through competition, which allows for profits by means of spatial arbitrage (Hüttenhain, 2012). When a location cannot keep up with global competition, this is often attributed to endogenous factors, leaving locations to solve these problems themselves (Ouma et al., 2023; Suwala, 2023). However, the criteria for success and failure are typically determined exogenously by the global economic system, leading to a race to the bottom among municipalities to attract companies at the expense of the environment, without generating any significant spatial qualities (Funk & Leuninger, 2014; Hüttenhain, 2012).

The (neo-)capitalist economic order is not a given but rather a system that can be changed (Harvey, 1989). Regarding commercial areas as part of a network or region reveals place-based idiosyncrasies, power structures, and conflicts that can transform existing conditions beyond capitalist imperatives (Gualini & Bianchi, 2015; Hillier, 2002). Place-based approaches ensure a distinctive and regionally appropriate fit and the integration of climate adaptation principles into regional plans and regulations (König et al., 2023; Tödtling & Trippel, 2005). By recognising the mutual problem of exploitation in the global circuit and working together on a regional scale, intercommunal competition can be transformed into cooperation through approaches such as commercial pooling (*Interkommunale Gewerbegebiete, Gewerbeflächenpools*; Knieling et al., 2017; Ostrom, 1990). Regional regulations and planning are crucial for implementing climate adaptation measures in municipalities facing a two-fold problem of scale (Diekelmann,



of Brandenburg face stagnation (Kulke & Suwala, 2015). The administrative borders of the two federal states are of little relevance to the daily lives of residents, as the region virtually functions as one labour market area.

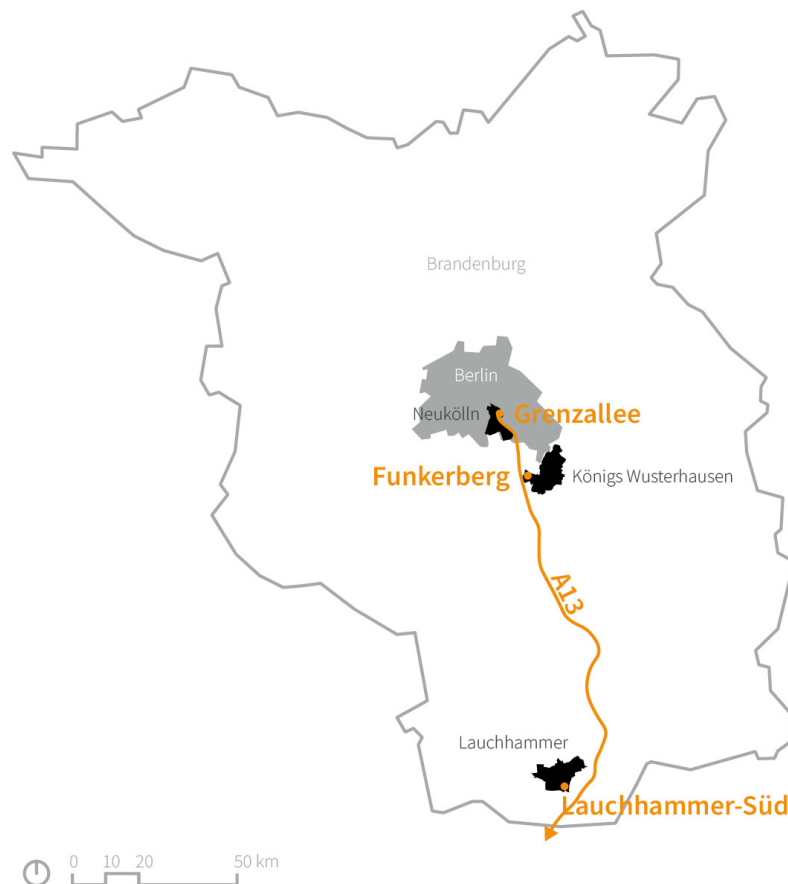
The entire region is considered highly vulnerable to climate impacts (“Klimawandel: Das erwartet Berlin und Brandenburg bis 2100,” 2019). The average annual temperature has risen by approximately 1.3 °C since 1881 (Ministerium für Landwirtschaft, Umwelt und Klimaschutz, 2022; Senatsverwaltung für Mobilität, Verkehr, Klimaschutz und Umwelt, 2022), and extreme annual temperatures have become more frequent since 2000 (Märkische Allgemeine, 2021). Prolonged droughts and an increased risk of forest fires have been observed due to extended periods without rainfall (Senatsverwaltung für Mobilität, Verkehr, Klimaschutz und Umwelt, 2022). Insufficient winter snowfall jeopardises groundwater replenishment, while intensified heavy rainfall events lead to damaging floods (Kixmüller, 2018). These combined factors make the region an ideal location for the purposes of this study.

In principle, three different economic situations can be identified in the federal states of Berlin and Brandenburg: recovery, growth, and structural change. Accordingly, three different forms of land dynamics can be observed in commercial and industrial areas:

land shortage, land consumption, and abundant land. Climate-proof regional planning is tasked with finding solutions for all three of these cases. To grasp the spectrum of these economic and land-use dynamics in Berlin and Brandenburg, we focused on areas located in proximity to the federal motorway A13, an essential lifeline for commercial and industrial areas (Figure 2). The motorway starts in the Berlin district of Neukölln and runs across the south-east of Brandenburg to Lusatia, connecting to Poland via the city of Cottbus and to the Czech Republic via Dresden. Along the A13, three commercial areas were singled out as exemplary case studies. These three areas have roughly the same size and are primarily characterised by manufacturing activities. The three selected examples also correspond to the general spectrum of needs for action in industrial areas defined in Section 2: *modernisation and preservation, new development, and revitalisation*.

### 3.3. Need for Modernisation and Preservation (Type 1): Grenzallee in Inner-City Berlin

The Grenzallee industrial area covers over 70 hectares of land and is located on the northern feeder road to major motorways in the Neukölln district, at the intersection of two waterways and the Berlin inner-city railroad ring

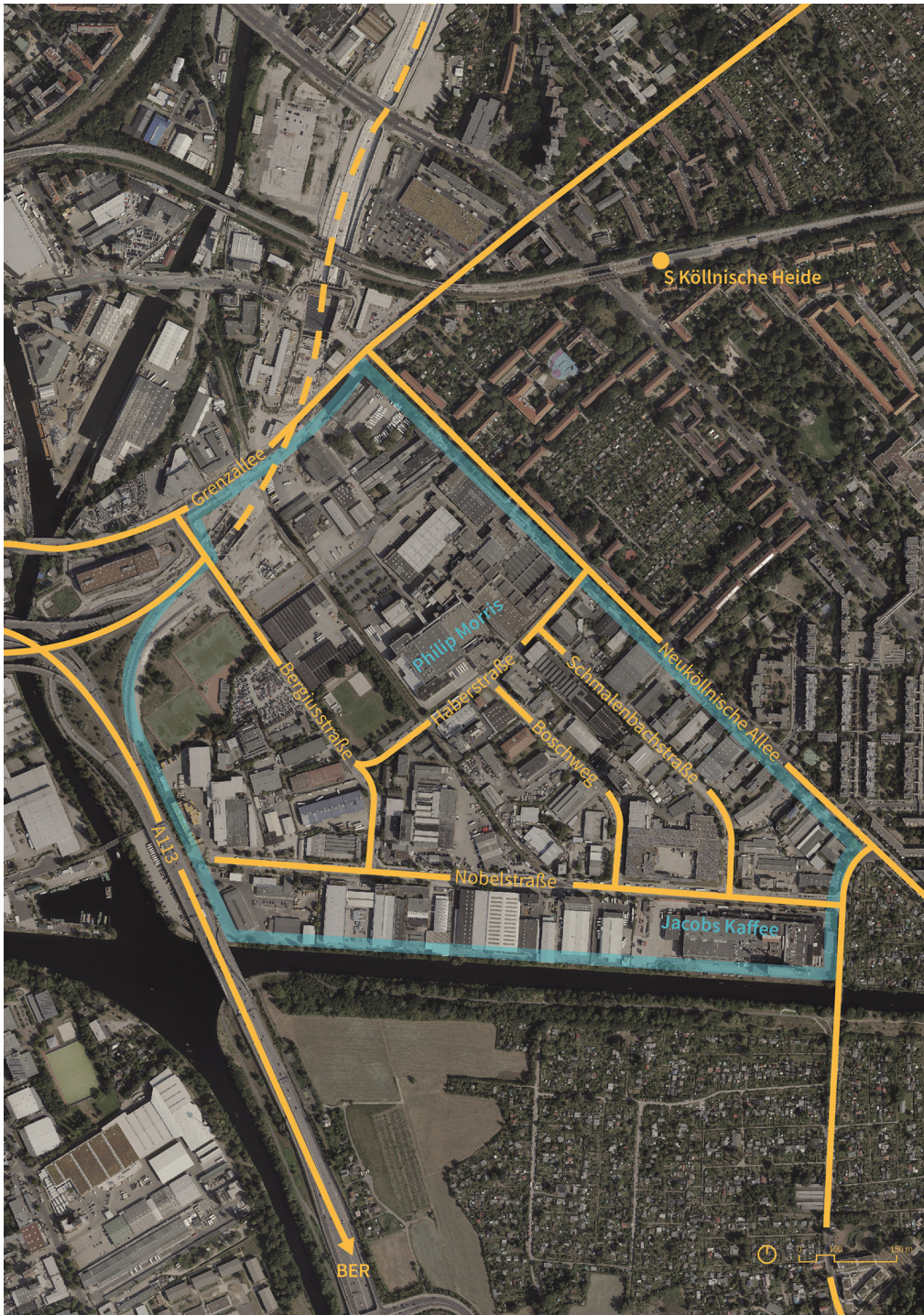


**Figure 2.** Location of the three case study sites (Grenzallee, Funkerberg, and Lauchhammer-Süd) within the Berlin-Brandenburg metropolitan region.

(see Figure 3). The area is situated on the outskirts of Berlin's inner-city and is bordered by tenement house districts and large-scale housing areas from the 1970s. With standard land values ranging between EUR 250 and EUR 350/m<sup>2</sup> (land ready for construction), the area accommodates over 50 manufacturing companies, most of which are individual parcel owners. Originally constructed as a mono-functional commercial site on the periphery of isolated post-war West-Berlin, it now enjoys a central

location in Berlin's metropolitan context and is in high demand. However, the area is confronted by challenges associated with modernising its aged building stock and managing space constraints, while preserving its original function.

The Grenzallee industrial area is far from being adapted to climate change due to its outdated 1970s infrastructure. Both public spaces and existing buildings require renovation measures, including adjustments



**Figure 3.** Aerial view (from 2022) showcasing the major traffic connections and boundaries of the Grenzallee industrial area in Berlin.

to basic infrastructure like pavements and roads and the design of company premises. However, the area benefits from promising sustainability initiatives and supportive institutions on various scales. At the local level, the Südring e.V. business network facilitates stakeholder communication and cooperation. These channels are crucial for effectively managing existing commercial properties while initiating sustainability projects such as the New Green: Climate-Neutral Businesses in Neukölln (*Neu-Grün: Klimaneutrales Wirtschaften in Neukölln*; Breuer et al., 2020). Furthermore, the Grenzallee area has potential for future adaptation to climate change through initiatives implemented by both the municipality of Neukölln (e.g., by the district level officer for climate issues) and Senate departments of Berlin, including the Berlin Energy and Climate Protection Programme (*Berliner Energie und Klimaschutzprogramm*) at the city level.

### 3.4. New Pending Developments (Type 2): Funkerberg in Suburban Königs Wusterhausen

Funkerberg is a 100-hectare commercial and industrial area in the town of Königs Wusterhausen, located 35 km southeast of Berlin in the state of Brandenburg

(see Figure 4). The area is fully marketed to 20 companies with a standard land value of EUR 120/m<sup>2</sup>. The area is in the Berlin-Lusatia development corridor, 3 km east of the motorway junction (A13 and A10), 1 km from railroad (Berlin-Cottbus) and waterway access (Königs Wusterhausen harbour), and close to both the Berlin-Brandenburg Airport and the new Tesla factory. The Brandenburg part of the metropolitan region attracts many land-intensive businesses on greenfields. This creates the problematic evolution of rapid land consumption within commercial and industrial sites in suburban areas. This is exemplified by the development of the additional 50 hectares of commercial land that could be allocated according to the land-use plan on further agricultural land, and concerns expressed by the Brandenburg Economic Development Board regarding a shortage of commercial land in the future, calling for an intensified search for further expansion.

In newly developed areas, high benchmarks for climate adaptation measures are expected. However, Funkerberg falls short of these standards with no use of sustainable building materials and no land-saving urban design. The lack of efficient public transport connections also hinders the implementation of sustainable low-emission transport. Furthermore, funding guidelines



**Figure 4.** Aerial view (from 2022) showcasing the major traffic connections and boundaries of the Funkerberg industrial area in Brandenburg.

for new commercial and industrial areas do not take into account urban design or climate criteria (J. Glase, personal communication, 26 January 2022; Oliwkowski & Schmuck, 2018). The municipality prioritises financial surpluses over climate action plans, and exerting influence in the future will become increasingly difficult as parcels are sold to private investors, even if public property has been allocated lately based on the best development concept rather than to the highest bidder (*Konzeptverfahren*). Additionally, two commercial and industrial areas were developed north of the location in the municipality of Wildau (A10 shopping centre and Hoherlehme) before formal regional planning was established in the early 1990s in Brandenburg. Parts of these areas in Wildau are underused and have no spatial or functional relationship with the commercial areas in Funckerberg despite their proximity.

3.5. Need for Revitalisation (Type 3): Lauchhammer-Süd in Peripheral South Brandenburg

Lauchhammer-Süd, a 100-hectare commercial and industrial area, is located in southern Brandenburg, just 5 km west of the A13 motorway at 150 km south of Berlin and 50 km north of Dresden, the state capital of Saxony (see

Figure 5). The area has a standard land value of EUR 8/m<sup>2</sup>. While it is currently home to 25 companies, less than half of its area is being used for commercial purposes after a large company that produced rotors for wind turbines shut down in 2022. With the end of coal mining in the region in sight, Lauchhammer Süd is undergoing a transformation and serves as an example for the revitalisation (type 3) of commercial and industrial areas needed in the region of Lusatia. Despite the area’s potential, the peripheral municipality of Lauchhammer has a surplus of commercial and industrial land, a common challenge in Lusatia.

Only very few measures can be identified in the Lauchhammer-Süd commercial and industrial area that contribute to climate-proofing, except for the water-permeable outdoor premises and tree-lined areas of the now-vacant wind turbine company. Although freight tracks offer a potential for future emission-free transportation, the existing plans fall short in terms of climate adaptation measures. In addition, there is a lack of emission-free mobility options for individual transport. The unregulated 1990s development of commercial and industrial areas like Lauchhammer-Süd opting for investors serves as an example of how such speculative endeavours can “lead to a dead end” (Funk &

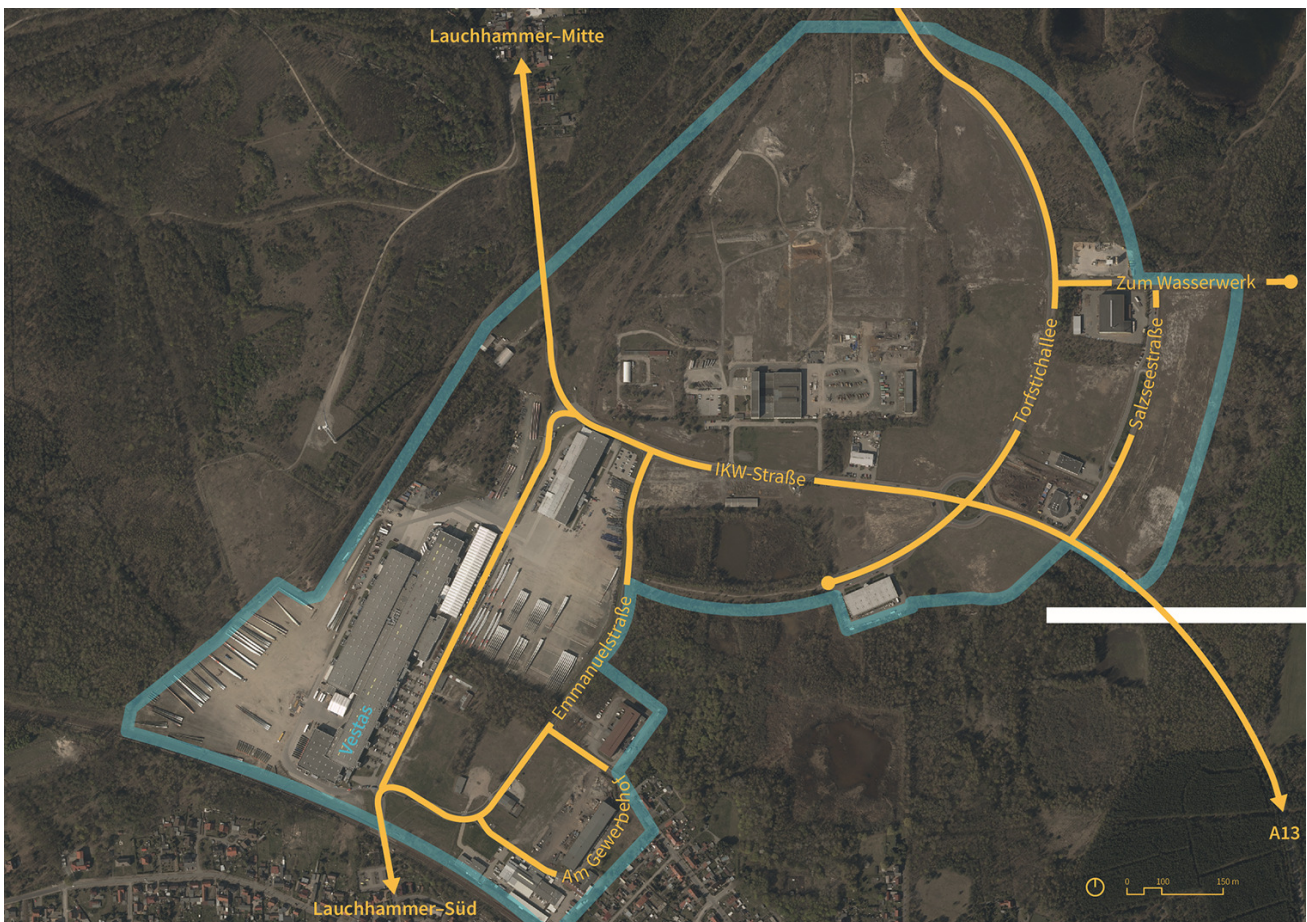


Figure 5. Aerial view (from 2022) showcasing the major traffic connections and boundaries of the Lauchhammer-Süd industrial area in Brandenburg.

Leuning, 2014, p. 155). Another structural deficit is that buffers of around 50 hectares of commercial and industrial spaces in Lauchhammer-Süd are not located in one coherent area. In other words, the industrial area is not an option for large-scale investments and vacancies persist. The peripheral location of the municipality in southern Brandenburg is also challenging. Funding for the transformation of Lusatia is currently focused on other sites in the region, such as a former large-scale lignite-fired power plant in Spremberg or the Science Park in Cottbus. Lauchhammer will also miss out on investments in rail infrastructure (Wüpper, 2021) and a new cathode and battery recycling factory in Schwarzheide (Richter-Zippack, 2023).

### 3.6. Backcasting: Comparison of Normative Image With Test Designs

The description of the case study sites presented typical examples of the challenges encountered by industrial areas. Our analysis was based on a variety of sources, including statistics, documents, SWOT analyses, and expert interviews. In order to explore how these three areas can implement climate adaptation measures as proposed in the normative vision, test designs were developed for each site. These test designs serve as an

integral step in the backcasting method, allowing us to assess the feasibility of implementing different aspects of the normative vision based on each specific type of area.

#### 3.6.1. Backcasting Analysis of the Grenzallee Inner-City Area

Future developments in Grenzallee should support the area's redevelopment process, meet current commercial and industrial demands, and integrate measures to increase climate adaptation. Figure 6 illustrates a test design for incorporating measures, including the redensification and development of building stock, increased permeability and connection to surrounding neighbourhoods, changes in modes of transportation, unsealing, and creating qualified public spaces to enhance the climate-proofing of the area. However, "[i]n most parts...built on, it is much less dense than the development plan allows" (SenStadt, 2020, p. 63). Thus, new building projects should use the height potential for multi-storey buildings with small-scale areas for artisan or medium-sized production companies, while sustainable materials and green roofs or façades should be prioritised. Conversion and densification measures at the margins and entrances can contribute to the profiling and development of the entire area, with certain areas

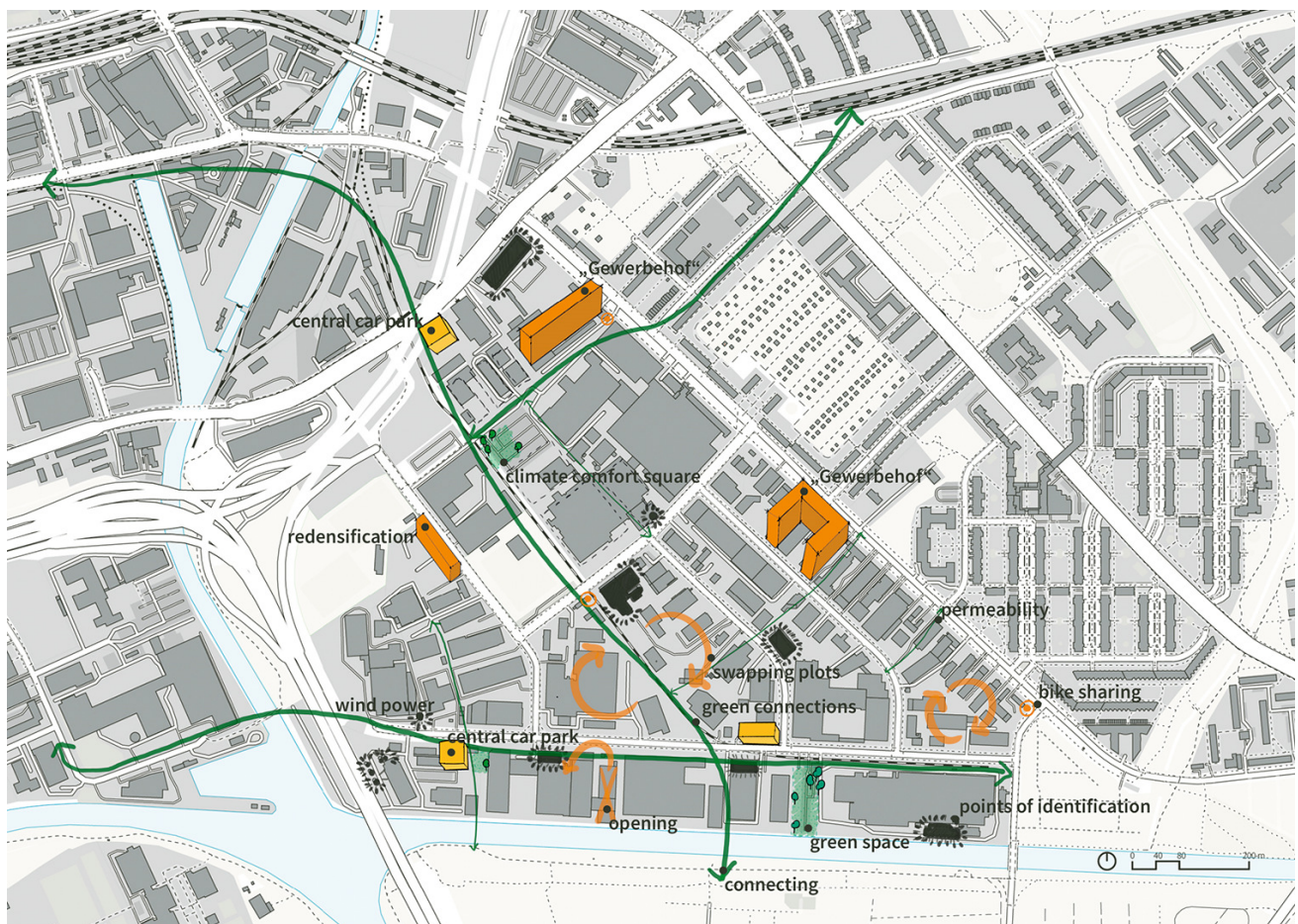


Figure 6. Test design for the Grenzallee industrial area.



preserved for less flexible businesses. Public spaces and access roads should be qualified, with attractive bicycle and pedestrian connections established. Central car parks (*Quartiersgaragen*) and car-sharing facilities can be promoted, while underutilised areas can be repurposed. Train tracks and waterways can be (re)activated for delivery logistics. Planting trees combined with infiltration trenches or roadside infiltration swales can improve water management and cooling. There should also be an upper limit on surface sealing for company properties or green spaces (*Klimakomfortplatz*; SenStadt, 2018).

The Grenzallee commercial and industrial area requires intensive renewal due to a large renovation backlog and the preservation of existing buildings. However, these circumstances also present opportunities for climate-proofing, including climate adaptation measures such as greening, unsealing, and traffic flow changes. Collaboration among businesses and the municipality can facilitate the implementation of small-scale climate adaptation interventions. Mixed-use developments and industrial diversity can prevent commercial gentrification and the displacement of existing businesses. Preserving a mix of industries and production areas is essential for the area's future (C. Mehner, personal communication, 9 September 2021), while balancing modernisation between exploiting trends of upgrading to improve climate adaptation and maintaining artisan and manufacturing industries.

### 3.6.2. Backcasting Analysis of the Funkerberg Suburban Area

If additional land consumption is justifiable at all, it must meet demands for climate adaptation, soil preservation, and emission-free transport. To this end, enforceable climate-proofing should be incorporated into (preparatory) land-use plans and funding incentives when awarding land. Large-scale businesses migrating from Berlin to suburban hinterlands contribute to high land consumption along Berlin's commuter belt even though there is still untapped potential in existing areas. This contradictory situation is known as the building land paradox (Davy, 1996), where suburban municipalities are pitted against each other. The test design highlights the importance of anchoring measures that promote space-saving density and profiling within the area. Only with this profiling and the spatial concentration of uses within a central spot in the area can a potential new business park serve as a flagship for climate-proof urban development and sustainable architecture. However, it must be ensured that climate-proofing one area is not used as a justification for further greenfield developments.

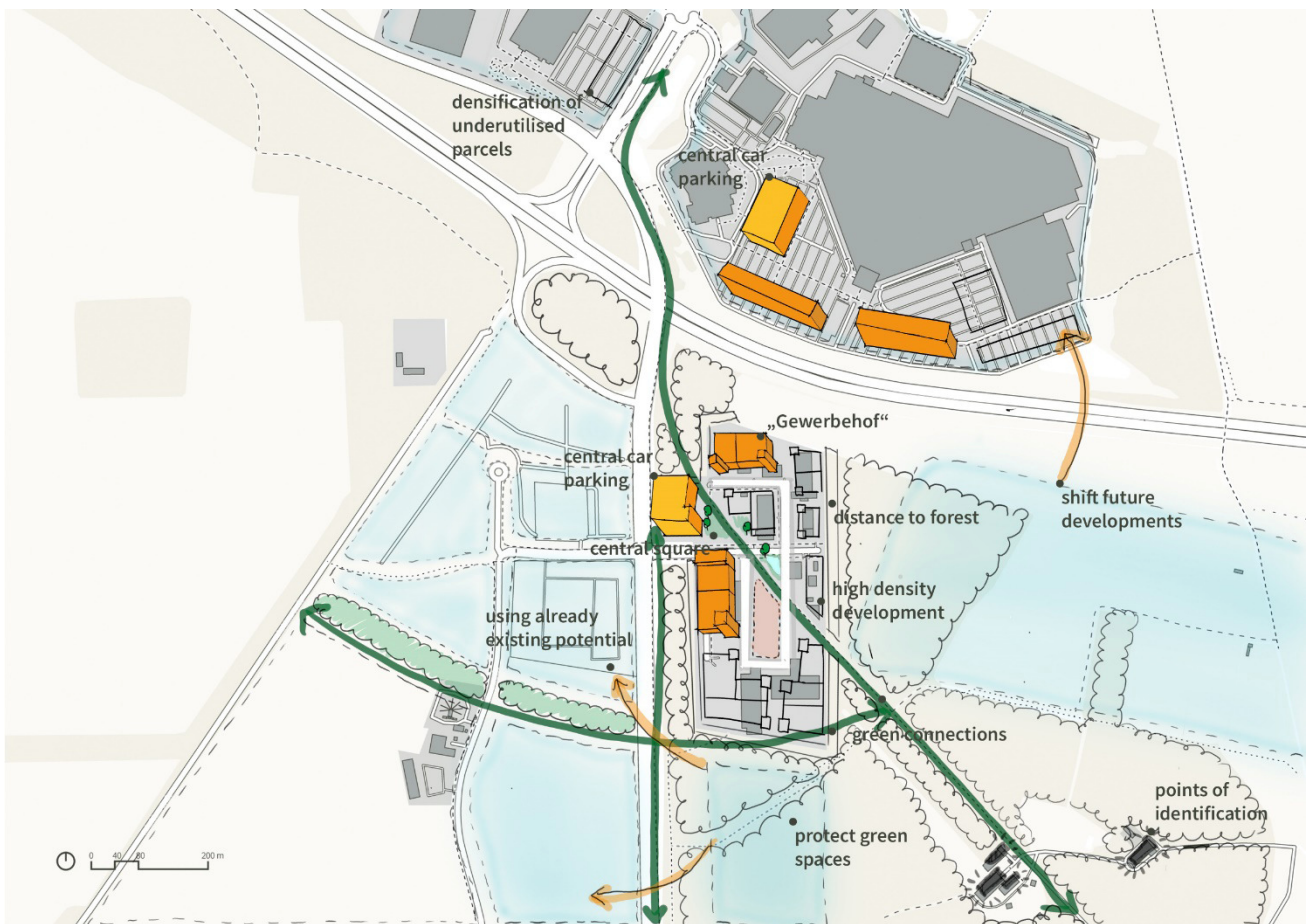
The backcasting analysis revealed that Funkerberg was the only viable location for commercial development in Königs Wusterhausen (J. Glase, personal communication, 26 January 2022), making it crucial to provide cornerstones for optimising the trade-off between land consumption and climate adaptation measures. To prevent

further land consumption, an inter-municipal or regional land pool could be established. Enhancing the footprint of the area involves various architectural and land-use solutions to save open spaces as portrayed in Figure 7, such as concatenated industrial halls or multi-storey commercial buildings (*Gewerbehof*) with separate storage or shunting areas.

To support climate-proofing, an array of climate adaptation measures (e.g., emission-free traffic or a hydrogen filling station) should be installed, and a strategy for cycling infrastructure and stationary traffic is necessary. A central car park (*Quartiersgaragen*) with charging points for electric cars can be established, and parking spaces on company property can be reduced in size to promote effective use of the facility. The development should prioritise sustainable building materials, such as wood with PV systems on green roofs. The forest should be preserved by creating an appropriate protective strip between the new development sites and insect-friendly greenery with native and climate-adapted species should be planted throughout the area. To foster social cohesion and community building, a central site for social interaction with several services (e.g., cafeteria, event rooms, day care) could be established. Finally, properties should be transferred into a diverse ownership structure to ensure future municipal intervention capabilities.

### 3.6.3. Backcasting of the Peripheral Lauchhammer-Süd Area

To attract future-oriented industries, Lauchhammer needs an integrated vision with regard to climate-proofing and cost-benefit ratio. Its location between Berlin and Dresden, with a decent motorway connection and affordable land, could attract large-scale and automated production facilities, such as those in renewable energy and biotech sectors (Figure 5). Those facilities allow for economies of scale when implementing climate adaptation measures. To better manage the transition between industrial and residential areas in Lauchhammer-Süd, the allocation of land for small and medium-sized enterprises in the south and east of the area should be considered in order to prevent further encroachment of residential development (Roost et al., 2021). The existing railway lines in the south of the area could serve as transfer and access points for public and freight transport with potential to create a genuine commercial centre with a multi-storey utilisation. Lauchhammer-Süd currently relies heavily on car usage, but providing new infrastructure for electric vehicles, such as charging stations, could contribute to a shift in modes of mobility. Lauchhammer's economy is hindered by a lack of skilled workers and young people, which is partly due to a need for improvement in the quality of life in the municipality (Liepelt et al., 2021; Stadt Lauchhammer, 2015). To address this, green spaces in the land-use plan should be made accessible for recreation and used as a stepping stone for a bicycle and



**Figure 7.** Test design for the Funkerberg industrial area.

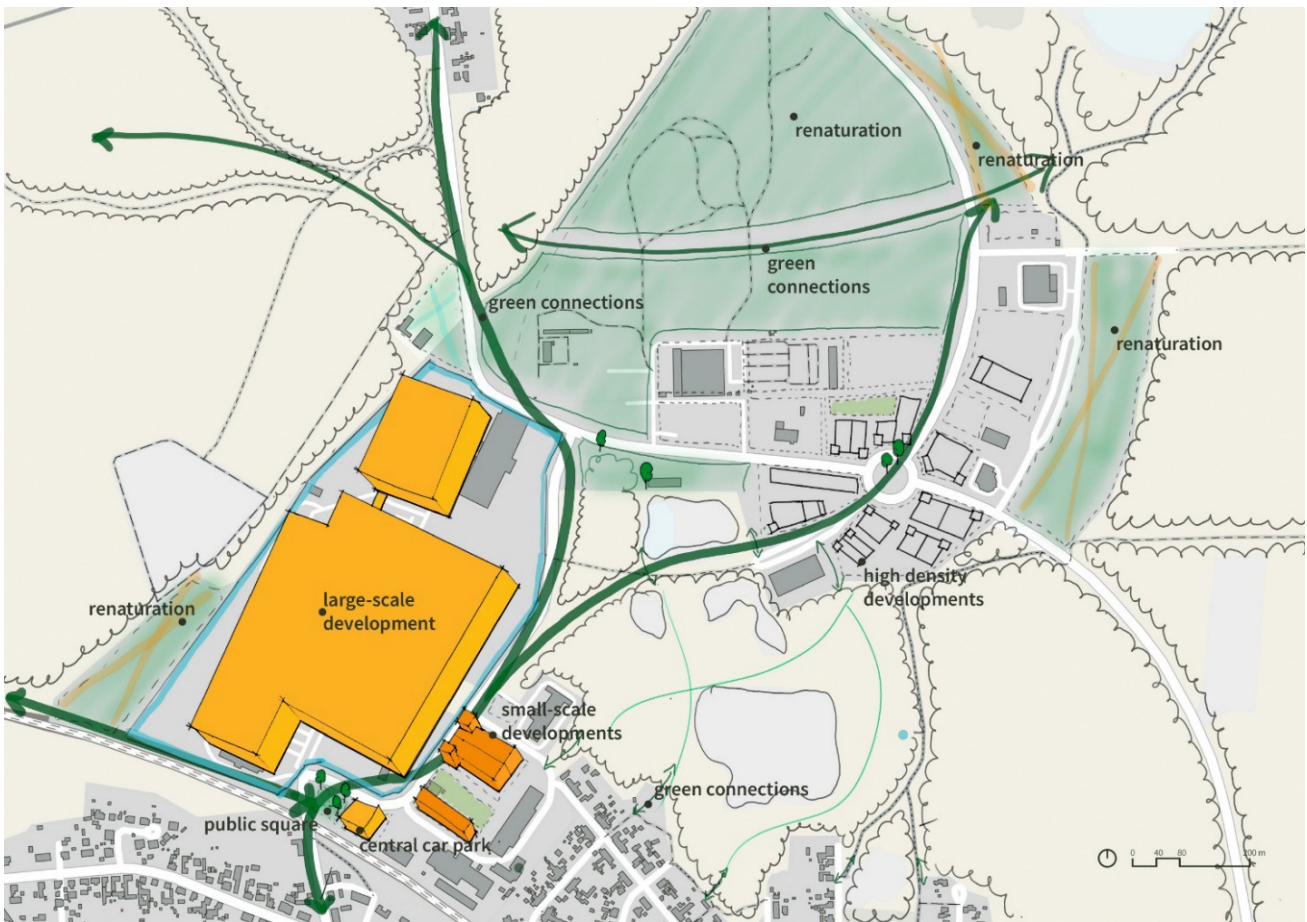
foot connection between the different areas. Land in the north-eastern part of the area should be saved to address challenges in finding compensatory areas for new developments (A. Fischer, personal communication, 7 December 2021). A regional land pool or transregional partnership with another municipality along a transport life line with complementary needs (e.g., the Grenzallee area) could be set up to distribute commercial and compensatory land (Hardraht & Uhlig, 2019). In this model, vacant industrial areas could be offered as compensatory sites, either by receiving compensation payments or by allowing sites to be redeveloped in other suitable locations.

Lauchhammer-Süd’s built-up area is scattered throughout the municipality due to past lignite mining as building on post-mining areas is generally not recommended (Liepelt et al., 2021; Stadt Lauchhammer, 2015). Notwithstanding, parts of the new commercial and industrial areas have been designated on adjacent greenfields, resulting in additional land consumption. In order to attract urgently needed skilled workers, the municipality’s dispersed spatial structure should be upgraded and enhanced to improve quality of life, education, and leisure (Funk & Leuninger, 2014). Lauchhammer’s leeway to enforce climate-proof governance is limited due to its economic situation. Currently, the success of future climate adaptation measures will largely depend on the

willingness of prospective investors and businesses, as well as brave novel building laws (Roost et al., 2021). However, the municipality must not become a marginal site for commercial enterprises unwilling to transition to a climate-friendly economy, as conventional processes do not guarantee economic success. Potential solutions include attracting future-oriented companies to complement the value-chain with neighbouring sites such as Schwarzheide or regional partnerships with distant sites in agglomerations such as Grenzallee. The test design for Lauchhammer (Figure 8) shows that climate-proofing areas in need of revitalisation should focus on two domains: creating novel focal points in central areas and renaturing temporary vacant land during periods of low economic activity on the outskirts. Once new businesses are attracted, construction and climate adaptation measures should be established in a central location. This approach could promote sustainable development and improve the image of Lauchhammer-Süd.

#### **4. Climate-Proofing Regional Plans to Adapt Industrial Areas to Climate Change**

The objective of our next analysis step is to create a practical guide for place-based climate-proofing from a regional planning perspective by combining the climate adaptation measures developed inductively from case



**Figure 8.** Spatial concept proposal for the Lauchhammer-Süd industrial area.

studies in Section 3 with general standards obtained deductively. The substantial integration of the two topics of climate adaptation and industrial land development is rarely addressed in regional planning practice (Birkmann & Fleischhauer, 2009; Breuer et al., 2020; Roost et al., 2021), despite being a guiding principle in German spatial planning law (*Raumordnungsgesetz*) since 2008. Climate adaptation should be included as a cornerstone in commercial development concepts rather than as a separate topic or plan (Osenberg et al., 2013).

To address the deficiency in implementing climate adaptation in commercial areas, better integration of the two topics is necessary. The concept of “climate-proofing” offers a solution by examining and adjusting plans and instruments to enhance resilience against current and future climate impacts (Birkmann & Fleischhauer, 2009). Unlike traditional environmental assessments, climate-proofing considers the project’s vulnerability to the effects of climate change. This approach has already been successfully applied in infrastructure sectors like water and power supply (European Commission, 2021b). Originally intended for development cooperation, climate-proofing is now being discussed as a tool to integrate climate adaptation into urban and regional planning (Ahlhelm et al., 2020; Birkmann & Fleischhauer, 2009; Dosch et al., 2016; Fichter & Hintemann, 2012; Greiving et al., 2011).

Although possible in German planning law, controlling the spatial distribution of commercial and industrial areas through formal regional plans is rarely practiced (Schmitt, 2016; Wagner, 2021; Zaspel, 2012). Integrating climate adaptation measures into informal commercial development plans would provide a cost-effective approach that impacts other instruments such as formal regional plans (Veres-Homm et al., 2019). Hence, the objective in the last step of the backcasting method is to create a practical guide for climate-proofing existing regional plans with regard to industrial areas. The goal is to combine the standards obtained deductively from the literature with the inductive climate adaptation measures from the case studies. Below we outline an inventory of guidelines with differentiated place-based measures and general standards for climate adaptations in industrial areas to be integrated into regional planning.

The Berlin Climate Adaptation Concept of 2016 called for “making existing planning instruments climate-proof” (Reußwig et al., 2016, p. 5), but the instructions remain vague. At the same time, guidelines with differentiated place-based measures and general minimum standards for climate adaptation are necessary for effective climate-proof regional planning, reflecting the diversity and idiosyncrasy of regions.

To attract new investors, the Office for Economic Development in Lusatia currently observes that “central

to all investment enquiries are sustainability, climate neutrality [and] resource efficiency, in addition to the endorsing locational factors for settlements” (Niederlausitz Aktuell, 2022, para. 3). The objective of future regional commercial and industrial concepts for Berlin and Brandenburg must, therefore, include the climate adaptability of such areas as a reason for attracting new investors in addition to location-specific factors related to renewable energies. As a first step toward improving the deficit of climate adaptation in industrial areas in Berlin and Brandenburg, we propose identifying starting points within existing planning instruments into which climate adaptation measures can be integrated. In Berlin, commercial and industrial development and climate adaptation have been addressed in separate urban development plans to date (*Stadtentwicklungsplan Wirtschaft* and *Stadtentwicklungsplan Klima*) but are not fully developed yet, while there are currently no spatial plans for either topic in Brandenburg. The regional development concepts of the municipalities in Brandenburg (*Regionale Entwicklungskonzepte*) are compatible with Berlin’s plans, but they would likely be overburdened if climate adaptation were to be included as a separate thematic field, as seen in the confusing diversity of climate mitigation concepts at this level in Brandenburg (Ministerium für Infrastruktur und Landesplanung des Landes, 2022).

#### 4.1. Step 1: Defining Types of Commercial and Industrial Areas and Their Individual Development Goals

A solid database and the use of standardised and reliable GIS data are indispensable for making strategic decisions about commercial and industrial development. Both Berlin and Brandenburg are in the process of implementing such GIS systems (Berger et al., 2020; SenStadt, 2020). This should be used as an opportunity to accomplish two things: ensuring reciprocal compatibility and comparability of information in and between the states, and integrating climate adaptation and mitigation standards under the framework of climate-proofing.

#### 4.2. Step 2: Place-Based Climate Adaptation Measures for the Three Types of Commercial and Industrial Areas

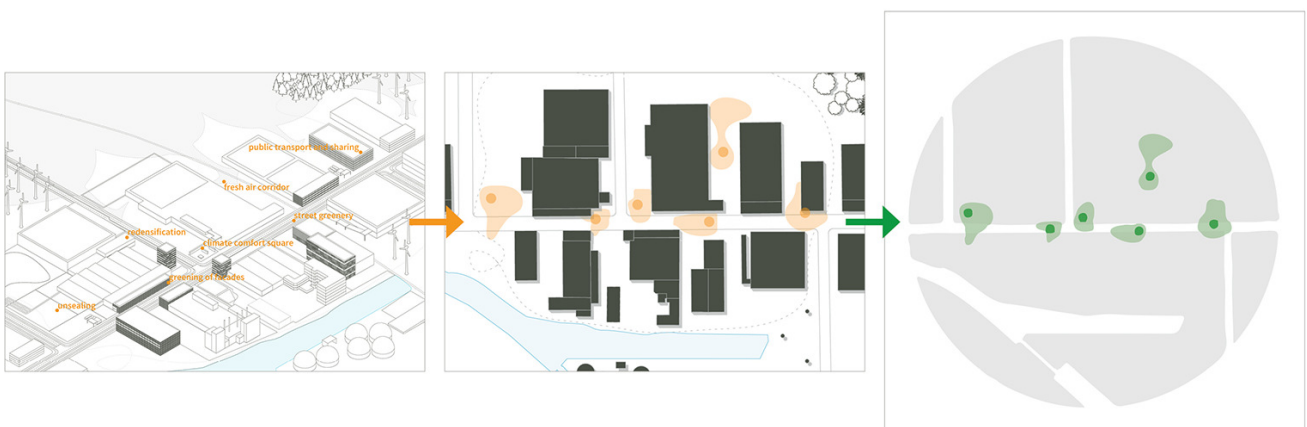
Climate adaptation must also be individually tailored to the different needs of the commercial and industrial areas in the respective region. Place-based measures have been brought to the fore by the inductive findings in our case studies, where specific links between climate adaptation and types of commercial and industrial areas (types 1–3) are found. However, this article shows that commercial and industrial areas benefit more from place-based climate adaptation measures according to their specific type and differentiated needs.

For *modernisation* and *preservation* (type 1) areas, small-scale and customised measures are favourable to increase climate adaptation, such as green roofs, unsealing of parking spaces, and redesigning overly wide streets (Figure 9):

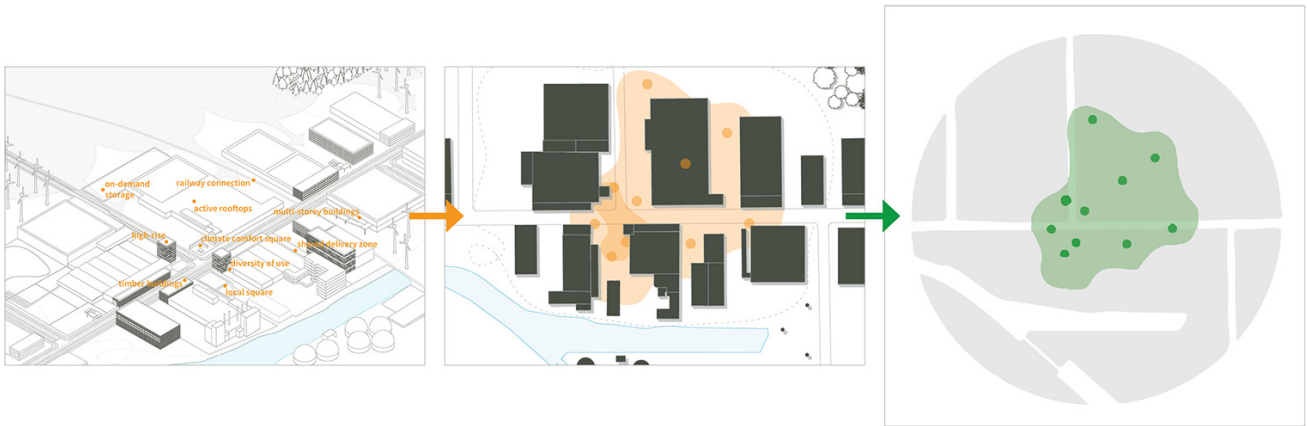
- Full utilisation of existing planning legislation
- Densification through stacking of commercial areas
- Restructuring and better utilisation of land areas
- Exclusion of mixed use, multiple use, and multi-functionality to prevent displacement
- Many small greening measures for a cumulative effect
- Obligation to unseal surfaces on company premises
- Re-opening of fresh air corridors and integration to surrounding neighbourhoods
- Rental bicycles or car-sharing options

For the *new development* (type 2) area type, it has been shown that compact, dense facilities should be strengthened by climate-adaptation measures (cf. Figure 10). These areas should be designed around a nucleus in a land-saving manner:

- Space saving urban design (e.g., shared delivery and storage areas)



**Figure 9.** Spatial strategy for adapting *modernisation* and *preservation* (type 1) in commercial and industrial areas.



**Figure 10.** Spatial strategy for adapting *new development* (type 2) in commercial and industrial areas.

- Commitment to multi-storey construction (e.g., vertical logistic flows)
- Required multiple use and multifunctionality
- Funding guidelines should also incentivise climate adaptation
- Tailor-made planning regulations with a focus on climate adaptation
- Establishment of a sustainable ownership structure (mix of municipal ownership, leasehold, and private land)
- New developments only in connection with the establishment of inter-municipal industrial areas or pools
- Required train connections for new developments

- Mix of huge spaces and smaller structures
- Restructuring and better utilisation of land areas
- Multiple use and multifunctionality in a central location (an invigorating mix and critical mass is especially important for this type)
- Connected to the surroundings by landscape and urban design
- Measures for permanent and temporary greening and unsealing
- Prevention of forest fires by establishing green corridors
- Interregional cooperation with complementary urban commercial and industrial areas
- Profiling of future investors is crucial for the climate resilience of the site
- Restructuring towards a sustainable ownership structure (mixture of municipal ownership, heritable building rights, and private land)
- Modification of existing planning law to integrate more climate adaptation measures
- Establishment of (virtual) inter-municipal land pools to improve marketing and allocation of spaces

For the *revitalisation* (type 3) area type, the spatial anchoring of climate adaptation measures is two-fold. On the one hand, at the margins of the area by means of renaturation or green connections with the surroundings (Figure 11); on the other hand, climate adaptation measures need to be conflated within a central point to attract desirable new economic activities. This promotes both the revitalisation and the improvement of climate adaptability in the areas:



**Figure 11.** Spatial strategy for adapting *revitalisation* (type 3) in commercial and industrial areas.

### 4.3. Step 3: Climate Adaptation Standards for Commercial and Industrial Spaces in Berlin and Brandenburg

Although the above-mentioned measures are tailored to the individual needs of the three exemplary types of commercial and industrial areas in this study, the following requirements should apply universally to all industrial areas in Berlin and Brandenburg. The reason for implementing general standards for such areas stems from the results of the case studies, interviews, and test designs above. It was shown that although the three stylised types require place-based approaches, several overarching climate adaptation measures can be translated into standards. On this basis and in accordance with planning literature (see Section 2.4), the present study developed general standards for climate adaptation related to minimum requirements for four aspects: building quality, heat prevention in outdoor spaces, precautions against urban flooding, and transformation of transport.

#### Building quality:

- Obligation to use sustainable building materials (e.g., wood, clay, or recycled products)
- Application of building materials with high albedo value
- Specification of a percentage of green roofs or façades
- Percentage of self-produced energy from renewable sources
- Insurance of excellent building insulation and ban on air conditioning in social and office spaces

#### Heat prevention and promotion of biodiversity:

- Minimum size of evaporation or infiltration areas in relation to the total area
- Planting of continuous roadside greenery with trees on the main axes of the industrial areas
- Application of material in sealed open spaces with high albedo value
- Integration of small-scale neighbourhood greenery and creation of high-quality open space per sqm of industrial space or employee
- Selection of climate-resistant and native plant species

#### Prevention of urban flooding:

- Establishment of a maximum percentage of sealed surface area allowed on properties
- Continuous creation of infiltration swales along the greenery accompanying the main roads
- Use of porous surfaces or turf stones on manoeuvring and storage areas

#### Traffic:

- Obligation to install cycling lanes on the main roads/retrofitting of bike paths
- Obligation to install quality bicycle parking facilities on company property
- Creation/provision of high-quality footpaths
- Prohibition of ground-level parking spaces on company property as well as alongside roads
- Obligation to build and operate a neighbourhood car park
- Promotion of sector coupling in electromobility and hydrogen technology for commercial transport

## 5. Conclusion and Outlook

This article raises awareness, offers practical guides, and contributes to the advancement of existing regional planning instruments by integrating place-based climate adaptation measures and standards within commercial and industrial areas by utilising the concept of “climate-proofing.” The process of climate-proofing results in the integration of (general) climate adaptation standards into planning governance at the regional level. The standards were derived from place-based climate adaptation measures at the local level. This multi-scalar and place-based perspective allows for relevant points of reference and widens operational ranges even for disadvantaged industrial areas. Integrating climate adaptation into strategic regional planning has the potential to define an entirely new guiding principle in practical planning and conforms with recently published political frameworks and practical guidelines (European Commission, 2021a; Schramm et al., 2023). New, robust structures and convincing images could entrench climate mitigation and adaptation as self-evident standards for planning under the roof of climate-proofing—just as fire safety guidelines were enshrined in German planning regulations a century ago.

Theoretically, the article connects and integrates the topics of climate adaptation, commercial and industrial areas, and regional planning by means of climate-proofing regional plans. In this regard, the concept of climate-proofing acts as an umbrella and unites both standards and measures for climate adaptation (and even mitigation; Birkmann & Fleischhauer, 2009; European Commission, 2021a; Schmitt, 2016). The practical guide for climate-proof regional plans developed in Section 4 incorporates the empirical findings from our backcasting analysis, thus taking into account local considerations and generalising them into a comprehensive inventory of standards (Ministerium für Infrastruktur und Landesplanung des Landes, 2022). However, it also maintains the necessary flexibility to incorporate locally specific measures. Moreover, it takes into account the economic reality and fierce competition of such areas in global production networks (Beyer et al., 2020;

Hagemann & Beyer, 2020) and opts for inter-municipal and regional cooperation (Veres-Homm et al., 2019) in order to avoid a municipal race-to-the-bottom and left-behind places (Dierwechter, 2021; Pike et al., 2023).

The suggestion to systematically anchor climate adaptation as a basic principle in existing strategic planning instruments at the regional level not only enhances intra-regional cooperation but also allows for the more efficient utilisation of existing areas. This also creates the necessary unassailability assessment (*Abwägungsfestigkeit*) to successfully impact future projects in Germany (Diepes, 2018). With the increasing political significance of climate change, as well as the funds, measures, and regulations earmarked for it, it is crucial for spatial planning to define suitable standards, particularly for commercial and industrial areas. This is essential in terms of responding appropriately to the challenges and opportunities of climate adaptation. Regional planning is uniquely positioned to overcome sectoral thinking and implement the cross-cutting issue of climate adaptation.

Commercial and industrial areas can become sustainable role models for urban planning with renewable materials, green spaces, and innovative traffic solutions. Climate-proofing must be anchored in regional planning to achieve this vision. The days of voluntary action are gone, and the building and planning culture of tomorrow will emerge from creative design and governance responses to the main challenge of the future: climate change.

### Conflict of Interests

The authors declare no conflict of interests.

### Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

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Article

## Regulating Sustainable Production

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Submitted: 19 April 2023 | Accepted: 21 August 2023 | Published: 21 November 2023

### Abstract

Zoning that supports urban manufacturing may offer new opportunities to promote sustainability benefits ranging from improved job accessibility to reduced waste and resource use. However, industrial uses in urban areas face displacement from competing and conflicting uses. While the process of industrial gentrification is well documented, little work has examined how planning strategies and regulations affect urban manufacturing and its potential contribution to sustainable economic development. Drawing on a review of planning documents and interviews with food and beverage manufacturers, we examine how planning regulates the sustainability potential of manufacturing enterprises in Melbourne, Australia. In doing so, we contribute a deeper understanding of the ways that zoning affects urban manufacturing and the obstacles, tensions, and trade-offs urban planners face in creating a more sustainable local manufacturing base.

### Keywords

Australia; beverage manufacturing; economic development; food manufacturing; industrial districts; land use; Melbourne; sustainability; urban manufacturing; zoning

### Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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### 1. Introduction

Principles of sustainability and sustainable development have been increasingly centralised in urban planning strategy and policy since the 1990s, coupling economic development with environmental and social benefits (Gunder & Hillier, 2009; John et al., 2015). However, despite decades of sustainability efforts, urban planning has largely ignored the role of urban industry and industrial land in achieving sustainable development outcomes (Leigh & Hoelzel, 2012). Instead, cities have rezoned industrial land for mixed-use areas that exclude industry to meet their sustainability goals, allowing market processes to drive redevelopment (Chapple, 2015; Leigh & Hoelzel, 2012). This is problematic because while compact, mixed-use places may offer a more sustainable approach to urban development than single-use suburban sprawl, they likewise catalyze speculative invest-

ment, can amplify social inequalities, and potentially create larger carbon footprints (Grodach & Limb, 2020; Quastel et al., 2012; Rice et al., 2020).

Rezoning industrial land and relaxing zoning standards may also price out or regulate out the potential sustainability benefits of productive activity. This includes an economic role through contributions to a diverse economic base and quality jobs, supporting social equity through job accessibility and support for underemployed groups, and environmental contributions such as reliance on and retrofit of existing industrial building stock over new greenfield supply and the promotion of sustainable resource use in production (e.g., recycling and reuse, energy conservation, shared resource, and energy sources).

While the market processes behind rezoning and industrial gentrification are well-articulated in the literature, little work has examined the potential sustainability

contributions of urban manufacturing and industrial land or how planning strategies and regulations may affect productive activity. This article investigates these issues through a case study of food and beverage manufacturers in Melbourne, Australia. We begin by examining key planning and regulatory documents to establish the policy context and intent. We document how the pervasive language of sustainability in strategic planning overlooks the potential of urban manufacturing and industrial land and highlight how use separation and other industrial zoning standards may inadvertently hinder sustainable production. We then present the results of interviews with 31 food and beverage manufacturers to better understand their experience with policy implementation on the ground, concentrating on sustainability practices related to location choices, supply networks, and energy and waste management. We find producers offer potentially overlooked sustainability benefits, yet some are also dependent on gentrifying markets. Further, start-up and hybridised businesses that do not easily fit industrial zoning categories can trigger complex approval processes where more conventional and often unsustainable industry is allowed. These findings contribute to a deeper understanding of the ways that zoning affects urban manufacturing and the obstacles, tensions, and trade-offs urban planners face in supporting a more sustainable local manufacturing base.

## 2. Literature Review: Zoning and Urban Industry

Urban planning scholarship is pushing back against the long-held assumption that productive activity is incompatible with other land uses and the largely absent consideration of industrial activity in urban sustainability discourse. In many cities, a significant share of manufacturing now consists of small firms that require little space, employ clean production processes, and have a low impact on neighbours. As a result, some argue that manufacturing may co-exist in mixed-use, transit-oriented places and thereby contribute to more sustainable urban outcomes by “keeping blue collars in green cities” (Dierwechter & Pendras, 2020, p. 1). Further, localised manufacturing clusters have the potential to strengthen circular economies through shared skills, reduced transport emissions, and industrial symbiosis processes that localise resource flows and reduce waste (Hatuka & Ben-Joseph, 2022; Hill, 2020; Prendeville et al., 2016; Tsui et al., 2020). Manufacturing also contributes to more sustainable and equitable development because it supports a high share of middle-wage jobs (Chapple, 2015). It includes a diverse set of industries and occupations, which provide economic resilience compared to the high- and low-wage services employment characteristic of mixed-use places (Grodach & Guerra-Tao, 2022).

This reality is rarely considered in contemporary urban policy, which predominately plans for industrial activity in low-density outer suburban areas even as it aims to support innovation-led advanced manufacturing (Grodach &

Gibson, 2019). It also contradicts the notion of the “post-industrial” city. Literature documents that spaces of production endure even in finance and tech centres like New York, London, and San Francisco (Curran, 2010; Ferm & Jones, 2017). This is partly because the knowledge economy still requires localised manufacture and distribution of key supplies and services. It is also because cities will always require certain industrial activities to function such as food production and waste processing.

This combination of factors has led to emergent work, which seeks to reimagine spaces of production and weave industry back into the city. Attention has focused on advanced manufacturing firms and processes, small-scale maker enterprises, and those that link to cultural product industries (Grodach et al., 2017; Hatuka & Ben-Joseph, 2022; Hill, 2020; Wolf-Powers et al., 2017). This encompasses a diverse set of manufacturers that employ varied production techniques from rapidly advancing digital fabrication to handmade craft production that has changed little over decades. Producers often engage in small-batch production for high-end and local consumer markets. Some rely on other local manufacturers for components and supplies or support waste reduction through the use of recycled and recovered materials (Gibson-Graham et al., 2019; Prendeville et al., 2016). These characteristics mean many manufacturers are highly dependent on the urban environment. This reflects the benefits of physical proximity long documented in economic geography (cf. Piore & Sabel, 1984), but also highlights the overlooked sustainability potential of small-scale manufacturers.

Proponents call for more flexible regulatory environments that go beyond conventional industrial use separation to support the reintegration of manufacturing into the city (Hatuka & Ben-Joseph, 2022; Hill, 2020; Lane & Rappaport, 2020; Roost & Jeckel, 2021). They argue that proximity is important for redistributed forms of manufacturing that can minimise environmental impact and engender circular economies through localised supply chains and digitised production (Prendeville et al., 2016; Tsui et al., 2020). However, attempts to allow production, consumption, and residential spaces to co-exist also face the realities of real estate speculation and conflicting uses. This may price out or regulate out the productive activity and their potential sustainability benefits. Research has documented industrial gentrification where the introduction of higher-value commercial and residential uses results in a loss of productive space and the displacement of industry (Curran, 2010; De Boeck & Ryckewaert, 2020; Ferm & Jones, 2017). Additionally, intra-industrial gentrification is on the rise in which specialised manufacturers and those that blend production and consumption on-site like breweries may displace other production and repair activities on ever-dwindling industrial land (Grodach, 2022; Mathews, 2022; Walker & Fox Miller, 2019).

Planning approaches must navigate tensions between protecting industrial areas and alternative

zoning that risks gentrification and displacement. Industry advocates have long argued for the preservation of industrial land to shield industry from rising rents and conflicting uses (De Boeck & Ryckewaert, 2020; Lester et al., 2013). This typically takes the form of strict codes prohibiting virtually all nonindustrial uses in an area. However, recent work finds that while industrial preservation zones slow industrial displacement, they may not help grow manufacturing (Davis & Renski, 2020). In part, this may be due to comparatively large floor spaces and tight restrictions on use, which create challenges for small urban manufacturers.

Other work considers alternative zoning and space arrangements that aim to integrate productive activity with commercial, residential, and institutional uses. This includes design explorations of flexible or vertical mixed-use buildings that support production (Lane & Rappaport, 2020; Love, 2017). However, these projects frequently face conflicts with noise, smell, access, and proximity to residential uses (Ryckewaert et al., 2021). Theoretically, these issues may be addressed in project design, but zoning and building codes often do not permit them or require special amendments. In response, some cities have revised zoning codes or implemented “micro-zoning” strategies that allow high flexibility around lot size, building heights, and permitted ratios of office and retail to production uses to encourage a mix of industry with other land uses (Grodach, 2022; Hatuka & Ben-Joseph, 2022; Hill, 2020). Finally, cities may adapt industrial symbiosis strategies to establish more sustainable, closed production systems through shared infrastructure, utilities, and waste recycling (Chertow, 2000).

However, mixed-use industrial zones may fail to support the diversity of urban manufacturing sectors—partly due to ambiguous zone language (Bonello et al., 2022). Additionally, the economic viability of mixed-use zones means developers often defer to higher-paying residential and office uses and not manufacturer needs (Ferm, 2016). As such, mixed-use industrial areas are more likely to benefit advanced manufacturing and makers, which may contribute to ongoing gentrification processes by bidding up rents (Grodach, 2022). For example, the growth of breweries that blend production and consumption has caused cities to revise zoning codes hoping to encourage denser mixed-use development yet this results in expanding residential redevelopment rather than supporting urban industry (Mathews, 2022; Nilsson et al., 2018; Walker & Fox Miller, 2019). While breweries often engage in sustainable practices such as adaptive reuse of existing buildings (Mathews & Picton, 2023), their presence may also reduce industrial mix and other potential sustainability advantages.

While the literature has documented the dynamics behind industrial gentrification, little research has analysed how zoning and planning impact urban manufacturing or studied how manufacturers negotiate regulatory environments. Approaches to industrial land including tools like zoning do not seem to be framed

by sustainability, nor integral to how sustainability is embodied in planning practice. Understanding how different types of manufacturers are affected by and respond to planning is important in a context where many cities seek to adapt planning regimes to support sustainable economies. Even under strategic planning visions that aim for a sustainable and circular industry, manufacturers may face outdated codes that do not account for contemporary needs or face an undersupply of appropriate land under new zoning regimes (Grodach, 2022). Planners’ knowledge of urban industry may be patchy or non-existent. Conversely, manufacturers could exploit code loopholes or develop other survival strategies that enable them to conduct their business (Martin & Grodach, 2023).

### 3. Data and Methods

Our study examines the potential sustainability contributions of urban manufacturers and how planning policies and zoning regulations impact their practices. We focus on food and beverage manufacturing in Melbourne, Australia, concentrating on location decisions, supply chain linkages, and consumer relations. Food and beverage manufacturing is a comparatively large and growing industrial sector with strong ties to local consumption. Between 2011 and 2021, metropolitan Melbourne’s food and beverage manufacturing workforce grew by over 20% (Australian Bureau of Statistics, 2021). Food and beverage producers are also subject to more stringent planning regulations due to food handling and liquor licensing.

We conducted a document analysis to understand how planning policy positions and regulates urban manufacturing in relation to sustainability objectives. First, we reviewed Melbourne’s two primary strategic industrial plans, Plan Melbourne 2017–2050 (Victoria State Government, 2017) and the Melbourne Commercial and Industrial Land Use Plan (MICLUP; Victoria State Government, 2020). Building on sustainable urban industry literature (e.g., Leigh & Hoelzel, 2012), we looked for references to urban manufacturing’s potential economic (e.g., economic diversity, essential service provision), social (e.g., job accessibility and quality), and environmental (e.g., greenhouse gas emissions, resource flows, and waste management) impacts.

Second, we reviewed the Victoria Victoria Planning Provisions (VPPs) to investigate relationships between strategic objectives and the statutory planning tools available to implement them (Victoria State Government, 2023). The VPPs comprise state-defined statutory planning tools including zones, overlays, and provisions. This provided crucial insight into how planning legislation defines industry and how this translates to land use provisions and permitting processes.

This informed the 31 interviews with owners or senior managers of food and beverage manufacturing firms. We identified food and beverage manufacturers

across metropolitan Melbourne through Google Maps and local business directories. Our interview sample included a majority of firms in industrial zones (65%), reflecting the fact that most food and beverage operations are required to be located in these areas (Table 1). We selected firms from inner (<10 km from the central business district), middle (10–20 km), and outer (>20 km) locations to observe how planning and zoning regulations impacted firm operations and their sustainability potential in high- and low-density urban settings. However, the study concentrated more on inner and middle areas where land use conflicts are most evident. We also included firms in mixed-use zones (35%) to study regulatory impacts in areas that allow commercial, residential, and institutional uses. Food and beverage manufacturers in mixed-use zones are disproportionately located in central areas, which is reflected in our sample. Six of the 15 manufacturers that combined production with onsite sales were located in inner mixed-use zones. This included beverage manufacturers with tasting rooms and bakeries and coffee roasteries with cafés or retail outlets.

In addition to location and zone type, we also considered operational characteristics when selecting inter-

view participants. Characteristic of the diversity within food and beverage industries, our interviewees included producers of 13 product types (Table 2). They also represented firms of varying ages, sizes, and market reach. On average firms were relatively young (average establishment year 2011) and ranged in age from a confectionary manufacturer founded in 1989 to a pastry business started in 2020. Employment size ranged from a sole trader coffee roaster to a long-life milk manufacturer with 90 employees and a brewery with 166. The majority (55%) serve the metropolitan market, while a third supplied nationally and a 10th exported internationally.

We asked interview participants about their supply chains, workforce, market geography, location decisions, and built environment needs to understand their potential sustainability impacts. We then asked about experiences with planning processes and how this influenced locational and operational decisions.

#### 4. Melbourne’s Industrial Planning Policy

The Victoria State Government provides strategic direction on industrial land use planning through the metropolitan strategic plan Plan Melbourne (Victoria

**Table 1.** Firms by location and zone type.

	Inner	Middle	Outer	Total
<b>Industrial zones</b>	7	9	4	20
Industrial 1	4	7	3	14
Industrial 2	—	—	1	1
Industrial 3	3	2	—	5
<b>Mixed-use zones</b>	9	1	1	11
Capital City 1	1	—	—	1
Commercial 1	1	—	—	1
Commercial 2	4	—	1	5
Mixed-Use	3	1	—	4
<b>Total</b>	16	10	5	31

**Table 2.** Main product.

Main product	Number of firms	%
Beer	6	19.4
Coffee	6	19.4
Prepared meals	4	12.9
Bakery products	3	9.7
Spirits	3	9.7
Smallgoods	2	6.5
Chocolate	1	3.2
Commercial kitchen hire	1	3.2
Confectionary	1	3.2
Lifelong milk	1	3.2
Non-alcoholic beverages	1	3.2
Pasta	1	3.2
Spice blends	1	3.2
<b>Total</b>	31	100

State Government, 2017) and the MICLUP (Victoria State Government, 2020). This is implemented through state-defined statutory planning tools (e.g., zones) via the VPPs and applied to local planning schemes. We evaluate how these plans and provisions frame the role, location, and regulation of manufacturing and industrial activity.

#### 4.1. Planning for Sustainable Industry?

Plan Melbourne is structured around seven outcomes intended “to drive Melbourne as a competitive, liveable and sustainable city” through higher-density neighbourhoods and employment clusters within integrated transport networks to capture “the social, economic and environmental benefits of creating a more compact, sustainable city” (Victoria State Government, 2017, p. 3). Manufacturing and industry are not part of this sustainability framing. However, the plan identifies the role of new manufacturing industries and processes in transitioning to a low-carbon economy, noting that industry is the largest source of greenhouse gas emissions in Victoria.

The plan’s primary economic development objective is for Melbourne to be a “productive city that attracts investment, supports innovation and creates jobs” (Victoria State Government, 2017, p. iii). It identifies priority sectors ranging from medical technologies and pharmaceuticals to “food and fibre” (p. 20) and concentrates on “knowledge-based” service industries as growth drivers. It establishes “places of state significance” designed to “create a series of interconnected learning, working and living precincts across the city” (Victoria State Government, 2017, p. 20). These include the central business district, major urban renewal precincts (many formed through rezoning industrial land), and national employment and innovation clusters (NEICs), which overlay industrial zones and are intended to promote knowledge-based industries including advanced manufacturing. The high-level sustainability objectives in strategic plans for Melbourne in relation to these areas do not encompass industrial uses, outside of aspirations toward knowledge-based and advanced industries.

Concurrently, Plan Melbourne includes traditional industrial development strategies focused on freight networks and protection of priority industrial areas, including five state-significant industrial precincts (SSIPs) located in Melbourne’s outer suburbs. While Plan Melbourne celebrates the potential of “advanced” forms of production, industrial planning also maintains a traditional focus on monofunctional industrial parks in outer suburbs.

Sustainability is, in turn, largely absent from the planning frameworks for industrial areas. MICLUP’s scope is to ensure an adequate supply of commercial and industrial lands in suitable locations and is primarily concerned with the protection and expansion of large outer suburban SSIPs. Like Plan Melbourne, MICLUP seeks to man-

age Melbourne’s future economy as it “transitions away from one based on manufacturing, to a more service and knowledge-based economy” (Victoria State Government, 2020, p. iii); yet MICLUP also suggests that “demand for industrial land remains high for uses such as logistics and advanced manufacturing” (p. iii). According to MICLUP, manufacturing is expected to “see very little change in job numbers” with future demand for industrial land driven by wholesale trade, transport, postal, and warehousing sectors that “typically gravitate to industrial areas where large and affordable sites are available” (Victoria State Government, 2020, p. 15).

MICLUP establishes a hierarchy of industrial lands and offers zoning guidance. Of primary importance are the SSIPs—monofunctional industrial precincts intended to minimise land use conflicts. In addition to SSIPs, regionally significant industrial precincts offer more local flexibility and “can provide for, or transition to, a broader range of employment opportunities” (Victoria State Government, 2020, p. 34) including for commercial and residential development. Local industrial precincts are designed to “support local communities and other businesses operating in the local area” (Victoria State Government, 2020, p. 35). These two lower tiers allow for local discretion and flexibility but may introduce non-industrial uses and competition.

The VPPs have limited focus on the role of industry in urban sustainability beyond minimizing impacts on neighbours (e.g., Victoria State Government, 2023, Clauses 17.02–17.03) or maximising access to freight and port terminals, mostly “in places of state significance” (including SSIPs and NEICs; Victoria State Government, 2023, Clause 11.01–1R).

#### 4.2. Zoning Mechanisms for Industrial Areas

Victoria’s local planning schemes provide the statutory basis to implement strategic plans. Planners assess proposed land uses or developments against the state-standardised zoning provisions and against MICLUP. Industrial land use and development are subject to planning schemes, incorporating state-defined strategic directions and state-defined statutory planning tools (zones, overlays, provisions, and definitions) based on the standardised VPPs and applied to local contexts. Victoria’s system is characterised as strategy-based discretion, meaning proposed land uses or developments are assessed both against the zoning provisions and against the strategic framework including Plan Melbourne and MICLUP.

The definition of industry is critical: land use definitions determine which zones permit, prohibit, or allow activities under specific conditions. “Industry” in the VPPs includes manufacturing, waste processing, excavation, dismantling, laundering, and repair services (Victoria State Government, 2023, Clause 73.03). It also covers ancillary uses including storage, amenities, and wholesale trade, and specifies “uses with an



adverse amenity potential” that require additional zoning exclusions and buffer requirements (Victoria State Government, 2023, Clause S53.10). This includes some food and beverage.

Zones specify uses that are allowed as of right, subject to permit, or prohibited. The designation of the strategic precincts described above, such as NEICs, is more broadly defined. State government only provides general boundaries for NEICs and they overlay other existing employment areas, particularly industrial zones. Half of the total NEIC land area is currently zoned industrial or within 100 meters of an industrial zone (Grodach & Guerra-Tao, 2022, p. 5).

Victoria has three industrial land use zones, which reflect a hierarchy based on potential amenity impacts (through transport, appearance, noise, or emissions) and avoidance of conflict. Industrial 1 is the standard industrial zone and the primary zone used in SSIPs. The purpose of the Industrial 1 zone (Victoria State Government, 2023, Clause S33.01) is “to provide for manufacturing industry, the storage and distribution of goods and associated uses in a manner which does not affect the safety and amenity of local communities.” Within this zone, “industry” as a land use is section 1—permit not required. This is, however, subject to conditions and exclusions, as a result of which many industrial land uses—and associated developments such as new buildings or changes to car parking—are discretionary uses, subject to a planning permit assessment normally by a local council. Industrial 2 is for heavy industry and prioritises uses with amenity impacts (Victoria State Government, 2023, Clause S33.02). Industrial 3 primarily supports service industries like laundries and auto repair and requires a permit for other industries “to avoid inter-industry conflict” (Victoria State Government, 2023, Clause S33.03).

Industrial uses are prohibited from nearly all other zoning categories. Limited light industry is allowed in Mixed-Use and Commercial 2 and 3 zones. However, it requires a permit and strict assessment around potential neighbourhood amenity impacts (Victoria State Government, 2023, Clause S32.04). Additionally, the range of uses allowed as-of-right in these zones tends to price out most rent-sensitive industrial firms.

New industrial businesses or those with changes to operations will trigger a planning permit process. For example, Industrial 1 zones require industrial uses with an amenity impact to apply for a permit, including large-scale beverage production and food roasting (Victoria State Government, 2023, S53.10). They must also meet threshold (buffer) distances from residential and other uses (Victoria State Government, 2023, S53.10). In Industrial 2 and 3 zones, nearly all new uses of land for industry or warehousing require a permit, along with information on the proposal and its likely emissions (Victoria State Government, 2023, Clauses S33.03–S33.02). Ancillary retail and office uses require assessments and trigger traffic and off-street parking assessments (Victoria State Government, 2023,

Clause S52.06). Uses requiring a liquor license, including breweries and distilleries, also trigger planning permits (Victoria State Government, 2023, Clause S52.27). Zones and other provisions combine in complex ways, with local discretion through which local councils assess planning permit applications against local and state strategy. In practice, a significant portion of businesses trying to establish or change an industrial business will likely trigger a planning permit assessment process.

Critically, while many new industrial uses trigger planning permit assessments, existing use rights protect the ongoing use of land irrespective of impacts. Hence, legacy industries that are potentially noxious and unsustainable are not subject to the same regulatory processes as new uses. Moreover, the process of matching permit assessments to strategic objectives requires a high degree of local discretion. This creates uncertainty for businesses that do not clearly fit existing definitions or established practices, including manufacturers with retail or on-site consumption.

In summary, manufacturers in Melbourne operate in a context where strategic planning seeks to promote a sustainable, compact, and productive city through knowledge-based industries, including advanced manufacturing. However, the approach to zoning upholds conventional separation in dedicated industrial zones and imposes strict limitations on mixed-industrial development. Beyond this, new industries can encounter a complex range of planning permit triggers that require planners to understand and assess specialised industrial operations and their possible impacts. This discretion can create uncertainty that may constrain nascent industrial sectors with sustainable supply chains and operating practices.

## 5. Regulating Food and Beverage Manufacturing

We found that zoning ordinances and other regulatory measures provide important support, but also create challenges for Melbourne’s food and beverage manufacturers. Below, we examine the sustainability attributes of food and beverage manufacturers, concentrating on their location decisions, supplier networks, and energy and waste management initiatives. We then turn to analysing how regulations affect firm operations and their sustainability potential.

### 5.1. Food and Beverage Manufacturing: Sustainability Potential

Food and beverage manufacturers predominately selected their location based on factors tied to affordable rent and various features associated with physical proximity. While sustainability principles do not directly explain location decisions, the tendency for food and beverage manufacturers to cluster in relatively close proximity—often enabled by industrial zones—creates a number of indirect sustainability benefits. These

include reduced transportation costs, building reuse and retrofit, smaller building footprints, and promotion of local consumption, albeit primarily in higher-end consumer markets.

Affordability was a primary location factor for firms in industrial zones, which keep rents lower than surrounding areas by regulating competition from higher-paying uses. Despite this, some firms reported rising rents and increasing competition for industrial space due to building conversions. As a food wholesaler in a central industrial area explains:

[There are] little warehouses that are popping up or being converted....Lots of people buy them and put their cars or their toys and stuff like that in there....There's a building three buildings up from us, that basically, they tore it down and they've built, I think, six little warehouses...and across the road from us, they were building apartments.

Location choices are also determined by an area's reputation and the marketing advantages associated with a concentration of like firms. As a distillery owner describes:

In the street, we've got a bakery, we've got three coffee roasters...within walking distance of us there are three breweries and there's another distillery. There's chocolatiers, there's cheesemakers, there's everything...as you get further out there's less density of those sort of businesses....So it amplifies your marketing.

This type of destination was important for many firms because on-site sales are a key component of the business model. About half of the manufacturers operate hybrid production/consumption businesses and depend on customer foot traffic. As a result, some have opted to trade the protection that comes with an industrial zone for sites in commercial or mixed-use zones. Finally, transport accessibility is a consideration in a firm location both in terms of customer access and proximity to the workforce with over two-thirds of interviewees citing degrees of public and active transport access as either a significant benefit or drawback to their location.

The tendency to locate near the workforce and customers encourages more sustainable adaptive reuse of older industrial spaces. All but four firms opted to move into existing buildings and retrofit the space to suit their production requirements (three of the four firms in new buildings located in a new industrial development marketed by developers as a food manufacturing hub). Adaptive reuse ranged from minor improvements of spaces previously housing similar operations to an A\$45 M retrofit of an old hangar space for long-life milk production. Firms report that older industrial spaces offer more flexibility to accommodate changing production requirements and growth. However, the scarcity of industrial lands means they also struggle with secur-

ing larger floorplate buildings in central locations. Older buildings often require retrofit to accommodate truck access and larger equipment and lack appropriate utilities, as discussed below.

Interestingly, firms did not report that concentration engendered direct collaboration among businesses in the same industrial district. However, it did support untraded relationships. A coffee roaster located in a new food manufacturing precinct chose their location in part because "they're all businesses like us...it's building a nice network of like-minded people...to have conversations with, people who, you obviously all make different things, but [share] the growing pains, etc."

Traded relationships are more common at the metropolitan level where supplier and labour networks have important economic and environmental implications. Food and beverage producers typically adopt a dual-sourcing strategy that blends global and local supply chains. For example, a pasta maker sources lower-cost flours from overseas but works with local packaging and printing firms to enable quick turnarounds on custom orders. Similarly, breweries may import yeast and grain but rely on local packaging manufacturers. Distilleries source malt and botanicals locally including orange peels and other fruit by-products and ferment in recycled Australian wine barrels. However, they import glass bottles because local bottle manufacturers have large minimum orders they cannot meet.

Most interviewees seek out local suppliers. This is driven in part by product branding but also has functional benefits that can reduce environmental footprints. A wholesale bakery aims "to make sure that we're using things like Australian flour and local products where we can. It's not always cost-effective, but it's something we really pride ourselves on doing and it's a great selling point to our customers." Local supply chains also provide more predictability and give producers tighter quality control over material and labour sourcing than those overseas. Firms increasingly look to local sources in the face of ongoing supply chain insecurity following Covid-19 and the war in Ukraine. Tight local networks enable manufacturers to respond quickly to changes in demand. A distillery finds that "you can call people directly and say, 'We need this in two weeks'....What's the chances of getting that turnaround overseas?...Even if they [shipped] it that week [if it] sits on a ship for six months, it's not much help." Close relationships are particularly important for start-up firms: "The only reason we probably got off the ground was because [our suppliers] were supporting us and giving us credit at the beginning...you support local, they generally give back to you as well."

In addition to using local ingredients and working with local suppliers, many firms seek to directly engage in more sustainable production processes through waste processing and energy consumption. Food and beverage manufacturers often have large amounts of organic waste, which they compost or provide to regional

farmers for fertiliser or animal feed. Packaging waste is significant and typically recycled. Breweries cite a move to cans from bottles to reduce breakage waste and shipping costs. In one instance, a prepared meal service takes food scraps to a local packaging company that recycles them into food packaging. However, these initiatives are not universal and often difficult to maintain. One coffee roaster that processes six to 10 tons of coffee beans each week found programs to compost used grounds often fail because the grounds go mouldy quickly. This has prompted them to work with other firms on recycling coffee grounds into road and building materials.

Many firms have significant power requirements, but face difficulties transitioning to more sustainable energy sources. Interviewees ranging from wholesale bakeries to breweries are concerned with sufficient energy supply and rising costs and have installed or intend to install solar panels on their buildings. However, many struggle with outdated utilities and buildings. Older buildings in central areas often need power upgrades for coffee roasting, baking, and brewing. They also have lower roof heights and/or asbestos making expansion or retrofit for solar panels challenging. Conversely, newer spaces in outer industrial zones are often designed for logistics operations and lack suitable utilities for manufacturing.

### *5.2. Planning Systems: Implications for Sustainable Production*

The planning system has a significant effect on manufacturing operations and their sustainability potential. Strategic planning policy supports industry development and food is among the targeted high-value sectors in Plan Melbourne. Sustainability objectives are central to strategic planning policy, however, little connection is made with industrial uses. In the implementation mechanisms of zoning ordinances and other regulatory measures, sustainability is largely absent in relation to industrial activity. The statutory planning system places greater scrutiny on new and changing uses, which is not always proportionate or easily navigated by small and start-up firms. New businesses may require a planning permit for the new industrial use of land, for secondary uses like retail, and for building expansions, parking variations, and liquor licenses. Uses that have specified threshold distances (including food and beverage manufacturing) have additional controls on zoning and location. By contrast, existing use rights protect ongoing use of land, irrespective of most impacts. As a result, the planning system may inadvertently support ongoing and unsustainable industrial land uses while making newer and potentially more sustainable operations difficult to implement.

Food and beverage producers in industrial zones gain important protections that enable the potential for sustainable operations. Industrial zones shelter firms from competing uses that can bid up rents and create use conflicts. However, such mechanisms are not always equipped to support contemporary operations.

The focus of industrial zones is to separate industry and its potentially negative amenity impacts on surrounding uses as well as restrict “incompatible” uses including retail and hospitality. Planning regimes are caught between protectionist industrial zoning, which concentrates on managing amenity impacts, avoiding use conflicts and, by association, constrains land value and more flexible approaches that can nurture a changing and often hybrid manufacturing base. Hybrid business models that blend production and consumption are typically not allowed as-of-right in industrial zones, creating challenges for many contemporary food and beverage manufacturers. As a brewery explains:

Council doesn't seem to really get behind [us] because we're not really in column A or column B. We're not fully industrial. We're not fully commercial—We're somewhere in between. And most of the zoning is not really flexible to share both.

Conversely, mixed-use commercial zones allow such activity but have considerably higher rents and competition for space. Firms near targeted high-density residential areas may benefit from a larger local market base but also may struggle to afford area rent even in industrial zones.

Respondents across the board expressed concerns about the significant risk, uncertainty, and unanticipated costs associated with obtaining planning permit approvals. Firms had to lease their premises for months or even years before opening while they waited for planning approvals. This prefigured into location decisions with some businesses trading off more direct customer access for less planning-related risk. A coffee roaster wanted:

To find a location that gave me the best chance of success quickly....There were no residences within a kilometre of here...all of the cafe density is sort of within that 8 km ring of the city, all of the quality ones, so I wanted to be within that zone....Like all of those sorts of spaces [near residential] I knew would be permit challenging....[But] there's no foot traffic so there's no opportunities to serve coffee in a cafe sort of environment. I can't really make a cafe space here.

Firms particularly face challenges with permit processes for new uses or use changes on site (e.g., adding retail). Delays were significant when planners assessed whether operations would impact neighbourhood amenities. Many change-of-use permits are triggered by businesses seeking to adapt or upgrade their property. For example, firms that seek to install bar or retail operations in an Industrial 1 zone require noise, traffic, and odour assessments. This creates long delays with requirements often more onerous for new uses (and start-ups with limited planning experience) than for as-of-right businesses with potentially greater impacts.

Mixed-use zones, which allow hybrid manufacturing and retail business, do not necessarily make change-of-use processes easier. Some respondents in mixed-use zones experienced delays in adapting their premises for ancillary hospitality. In one instance, a coffee roaster had to rework their business model after eleven months without trading reduced their capacity to hire staff, and permit restrictions limited the number of people allowed on-site due to the available parking.

Parking requirements were an issue affecting all businesses to varying extents. When a pureed food producer in an industrial zone expanded their building, the local council “made us put in even more car parking spaces....We’ve got 90 car parking spots but we only have 20 employees. Now, the maximum this factory can hold will be 50 employees.” At the same time, this respondent pointed to “problems with our trucks...turning into our facility because the road has cars parked on it” from employees at smaller and older factories with over-spill parking.

In industrial zones, three firms faced issues with establishing customer-facing uses despite their manufacturing operations being allowed as-of-right. One distiller reported commissioning nearly A\$80,000 in traffic, acoustic, and odour surveys over a 15-month period to set up their production facility and tasting room. They attributed this to the lack of planning officer knowledge about the distillation process and the lack of precedent in their council area:

Because we’re one of the first [distilleries with a tasting room], they literally went through every single thing that they could possibly think of that could cause an issue. Fortunately for others who’ve now come into the area, it’s a bit more streamlined....They had no precedent.

Firms that worked with knowledgeable planners and/or local councils with experience around specific industry regulations (e.g., dangerous goods storage, noise, and odour restrictions) for specific food and beverage industries reported better experiences.

Consequently, it often falls to local planning departments and individual officers to bend old codes to support new industries. This creates significant variation and means that businesses often work with planners with varying levels of knowledge responsible for their cases. To illustrate, while the distiller above spent nearly two years and significant money on regulatory approvals, another distiller in a different council area leased their premises and began trading later that year:

When [the planner] asked questions about “how are you going to do this or that” we had explanations, which they had no objection to....They didn’t have any understanding of the distillation process. So one of the things they said was, “Oh, you can’t have a plaster roof because of the steam...it will break and fall down.”

I said to them, “Well, if we’re losing steam, we’re throwing our product away.”

Where councils and planners were open to learning about businesses and willing to negotiate, respondents reported a more positive experience with the planning process. A spice wholesaler and manufacturer used parking spaces to store pallets because they had outgrown their facility. Although the planning permit required use for parking only, the council planner “saw the problem and the issue and worked with us, which was great because sometimes [they] can get a bit of a negative rap. But he was very understanding and so it was good, win-win.”

## 6. Conclusions

This study examined the potential sustainable economic development contributions of food and beverage manufacturers in Melbourne, Australia, and how planning policies and zoning regulations may influence sustainable industry. The aim was to identify if and how planning frameworks support the potential for urban manufacturers to develop sustainable practices related to their location, supply networks, and energy and waste management initiatives. The findings contribute new empirical research on the sustainability potential of urban manufacturing and highlight the obstacles, tensions, and trade-offs involved in supporting sustainable production in the planning system.

Based on our interviews with 31 food and beverage manufacturers, we found ripe potential for encouraging sustainable production, but also extant challenges for firms. Those located in denser urban areas contribute indirect sustainable benefits through firm clustering and a focus on local supplier networks and ingredients. At the same time, firms simultaneously face cost pressures and introduce intra-industry gentrification processes with a focus on higher-end markets. Businesses also practice sustainable production processes through waste processing and energy consumption, but face challenges in retrofitting buildings to support this.

However, while the language of sustainability pervades Melbourne’s strategic plans, there is little effort to incorporate manufacturing in a more sustainable city. Moreover, statutory planning tools have significant trade-offs that may run counter to broader sustainable planning goals. Industrial zoning codes maintain a traditional focus on use separation to protect industry from the encroachment of other uses and to protect other uses from industry amenity impacts. This approach helps constrain the land price impacts of mixed-use development and industrial gentrification. However, the complex landscape of planning requirements and permit triggers creates time, cost, and knowledge burdens for applicants. These are compounded for new and hybrid business types and impact disproportionately on smaller firms.

Conversely, mixed-use zoning, which is core to sustainability directives, allows for greater flexibility

important to small, diverse, hybrid, and emerging sector firms. Yet it does not account for the price and use conflicts inherent in higher-density environments. In tension here is the fact that many hybrid uses, especially those with increased focus on direct retail and hospitality may both value and feed an amenity premium in industrial precincts while others are negatively impacted via the increased competition for real estate and attention to amenity impacts.

In general, there is also significant variation in the approvals process depending on the understanding of local planning officers and the existence of local precedent. Businesses diverting from established norms are likely to attract higher scrutiny, resulting in delays and costs. While local planning departments and individual officers have a degree of flexibility in adapting codes to support new industries, the results suggest a more systematic failure in the planning framework to adequately balance scrutiny of industrial business activity with support for industrial innovation and growth as part of a sustainable economy. Future research should extend this work by engaging directly with urban planners to understand their motivations and perceptions of challenges around sustainable production and industrial zoning.

In conclusion, the study points to the need for greater strategic planning recognition of manufacturing diversity and the potential to contribute toward sustainability objectives. It requires regulatory reforms that engage with new and emerging forms of manufacturing, alongside a continued focus on protecting industry and regulating amenity impacts. Our findings also highlight that the implementing environment is as critical as the underlying policy strategy. With coordinated planning officer education and mechanisms for sharing knowledge and experience, planners will be better placed to support sustainable urban industry.

### Acknowledgments

This work was supported by the Australian Research Council Discovery Project *Remaking Post-industrial Plans: Urban Industrial Zoning Past and Future* (Grant No. DP210103690). Thank you to Maria Daels for the invaluable research assistance.

### Conflict of Interests

The authors declare no conflict of interests.

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Article

## Sensing Urban Manufacturing: From Conspicuous to Sensible Production

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Submitted: 2 June 2023 | Accepted: 7 August 2023 | Published: 21 November 2023

### Abstract

Environmental destruction, social inequalities, geopolitical vulnerability—the limits of the long-time praised paradigm of post-industrial cities and globalised value chains are becoming evident, while calls for (re)localising production in cities are getting increasingly vocal. However, the material implications—i.e., where and in which form manufacturing should concretely take place in cities and the consequences on urban space and relations—are rarely addressed in debates on (re)industrialisation. In this article, we engage with the concept of conspicuous production by combining research on mixed-use zones with sensory methodologies. We focus on the multisensory dimension of urban manufacturing to interrogate the spatial possibilities for production in a small town in Switzerland. Together with a group of graduate students, we apply sensory methods to explore how production shapes urban sensescapes and how these sensescapes affect our relation to production. Our exploratory endeavour provides ideas of how sensory methods can be integrated into urban planning research and practice: we suggest that these methods, which necessarily emphasise subjective experience, can constitute powerful tools if they take into attentive consideration the local political and economic context, including the norms and power relations that shape individual perception. Our study sparks critical questions about conspicuous production and mixed-use zoning and tentatively advances the concept of *sensible production*: a production that not only is perceptible and can actively be engaged with, but that also shows good sense, makes sense, and focuses on what we need rather than on appearance.

### Keywords

affect; learning to be affected; mixed-use zones; (re)industrialisation; sensory geography; sensory methodologies; small towns; sustainable cities; urban manufacturing; zoning

### Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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### 1. Introduction

Making production more visible in cities—what Baker (2017) calls “conspicuous production”—has been advanced as a strategy to revalue manufacturing activities against the post-industrial zeitgeist that has segregated them at the urban margins and displaced them to distant countries and continents. Baker’s proposition is part of a broader reflection that questions the inevitability of deindustrialisation in the cities of the minority world

and opposes their framing as “post-material spaces...that privilege and prioritise services, entertainment and other forms of consumption over the production of material goods” (Dierwechter & Pendras, 2020, p. 2). We acknowledge that, despite the post-industrial narrative, “cities remain spaces of production” (Dierwechter & Pendras, 2020, p. 2); yet, manufacturing is increasingly marginalised in cities’ symbolic and material space.

Name it deglobalisation (Livesey, 2018), reshoring (Vecchi, 2018), or reindustrialisation (Nawratek, 2017a),



the idea that communities might be better off if they can retain, expand, or attract back production activities is gaining terrain over the frenzy of the creative city, contributing to the revaluing of manufacturing (Smith, 2023). However, the material implications of this idea for urban space and everyday life must still be assessed, especially the question of *where* exactly production should take place and *in which form*. A lively debate has emerged on the advantages of mixed-used zones where industrial activities cohabit with other land use types, in opposition to the segregation approach of modernist zoning practices (Roost & Jeckel, 2021). Whereas the functional aspects of such cohabitation are central to most studies, its affective and sensory dimensions are rarely addressed. How manufacturing shapes urban sensescapes and how people experience, perceive, and make sense of the city and manufacturing itself remains largely unexplored.

Baker's concept of conspicuous production has the merit of attracting attention to the materiality of urban manufacturing in its visual appearance. Yet, other senses remain—almost literally—out of the picture. This article expands the debate by focusing on other senses beyond the visible, drawing on the rich tradition of urban studies applying sensory methods, which have however rarely addressed questions about manufacturing. By bringing our bodies where things are produced, we look for new connections to manufacturing in contrast to the disconnecting effect/affect of zoned urban experiences. In a process that Roelvink (2020) calls “learning to be affected,” we pay attention to the material dimension of manufacturing through our bodies and, thereby, learn to care for it. Along with Gibson-Graham et al. (2019, p. 2), we aim to shift the way we look at manufacturing from seeing it as part of the problem to framing it as an entry point for the radical transformation of our cities. This approach can then serve as a basis to reflect on what *place* (literal and metaphorical) we wish to reserve for manufacturing within our communities.

We focus on Mendrisio, a small industrial town in Southern Switzerland, where the proximity of manufacturing activities to other urban functions is almost inevitable, given the limited spatial extension of the city. The empirical material we draw upon emerged in the framework of a laboratory course during which the authors and a group of graduate students conducted sensory research in Mendrisio. Our research design was exploratory and intended to inspire reflections around conspicuous production in relation to urban (re)industrialisation and zoning practices. Our observations, even if limited in scale and scope, warn against generalisations that risk stigmatising or romanticising urban manufacturing.

We suggest that making production visible—or, as we prefer, *sensible* in the sense of “perceptible to the senses” (Sensible, n.d.)—should not be seen as an ultimate solution per se. Instead, first, the diverse material and sensory qualities of different types and components of production must be carefully considered when plan-

ning to (re)integrate production in cities. Second, our experience in Mendrisio raises the question of whether spatial urban design alone can be held responsible for transforming our relation to production and, ultimately, unequal and unsustainable production and consumption habits. We believe that *sensible* production—production that, in the first sense of the adjective, shows “good sense [and] reason” (Sensible, n.d.)—must not only be passively perceived but also actively engaged with spatially, sensorially, and politically.

This last observation points to the limits of sensory methods that focus exclusively on individual perception without seriously embedding it into political, social, and cultural context. Our relatively circumscribed experimentations can provide ideas for integrating sensory methodologies in planning for urban manufacturing more extensively and systematically. Sensory methods can represent a powerful starting point for a deeper engagement by urban communities with manufacturing. This engagement should also include questioning, reflecting, discussing, and possibly rethinking the meaning and *sense* of production in our societies.

In the following two sections, we present the conceptual basis of our research. Section 2 contextualises urban manufacturing in the tension between the post-material paradigm of post-industrial cities and the call for urban (re)industrialisation. Section 3 discusses sensory approaches in urban studies, emphasising their potential for reshaping (affective) relations to production. The context and methodology of our study are presented in Section 4. Section 4.1 provides an overview of Mendrisio's industrial transformation, while Section 4.2 specifies our methodological approach, introducing the main observations that emerged from our fieldwork. The last two sections of the article discuss these observations in relation to conspicuous production and their implications for urban planning.

## 2. Production and the City

It is undeniable that the exodus of production from cities of the minority world (and, in different terms, of the majority world; see Pike, 2022) has exacerbated social inequalities in the last half century (Massey & Meegan, 2014; H. McLean, 2014). The fragmentation of production networks across the globe has not only accelerated environmental degradation but also increased their geopolitical vulnerability. Against this backdrop, (re)localising production appears as a necessity for sustainable and resilient economies. In addition, reintegrating (or maintaining) production in cities provides quality jobs and career opportunities for workers with low education and thus counters the social polarisation produced by creative cities (Dierwechter & Pendras, 2020). In this line, Edwards and Taylor (2017) insist that localised production should be an integral part of progressive urbanism, of “an inclusive city, a city for all its residents” (Nawrotek, 2017b, p. 16).

Baker's reflections on conspicuous production highlight the relational dimension of the (re)industrialisation debate. Paralleling the more popular notion of conspicuous consumption, conspicuous *production* invites overcoming the stigma currently attached to manufacturing (see Bryson et al., 2015) and instead seeing it as something to be proud of. In addition to the more obvious environmental, social, and geopolitical rationales for localised production, Baker (2017, p. 120) insists on the necessity to nurture more meaningful "connections between consumers and producers of manufactured goods" through "a built environment that explicitly prioritises public connections to industry." This would increase mutual respect and reciprocal recognition between producers and consumers (Baker, 2017, p. 121).

The connections Baker emphasises are materially embedded in and shaped by the urban space. More localised and more visible production can strengthen these connections. It can also counter the sanitised environment of post-material cities (Dierwechter & Pendras, 2020), add vitality to city life, and improve the legibility of urban space (Baker, 2017, p. 122). By recognising this material embeddedness, Baker (2017, p. 117) takes the often-overlooked "spatial implications of re-industrialisation" seriously. If production should stay in or return to town, how should it *materially* relate to the urban space and other urban functions? Baker (2017, pp. 123–126) suggests two complementary directions: a higher mix of land uses and a more open design of individual buildings.

Exclusionary zoning, where urban functions are separated into designated areas, established itself as a planning principle in the early 20th century in North America (Hall, 2014). This principle found support in functional models like those by Von Thünen and later Burgess, which theorised the spatial distribution of urban activities as a function of land costs and thereby offered a tool to optimise (in economic terms) land use in cities. While zoning promised to protect the health and life quality of residents from the dangers and nuisances of industrial activities, it also provided a powerful tool to control selected population groups (Wilson et al., 2008) as well as to protect the economic interests of investors and higher classes (Fischel, 2004).

Due to the exclusionary and environmental effects of zoning, the opposite idea has gained popularity recently. The principle of integrating different land uses in mixed-use zones has become widely accepted in urban planning today, to the point that it is often presented as a panacea for urban social and environmental challenges and towards more vibrant and safer cities (Hirt, 2016). However, implementing the mixed-use principle in practice is challenging and commonly privileges other uses than industrial ones (Ferm & Jones, 2016; see also Hirt, 2007; Ryckewaert et al., 2021). The stigma on manufacturing, framing it as a nuisance, suits the interests of real estate speculation, which drives manufacturing to the

urban margins or outside the city. In the process of industrial gentrification, mixed-use regeneration often means displacing manufacturing to make space for housing and other more profitable uses (Ferm & Jones, 2016), to the point that Ferm et al. (2021, p. 352) suggest that exclusionary zoning might represent a necessary strategy to preserve industrial activities in cities.

The scarce research on the materiality of (re)industrialisation (for some examples, see the contributions in Million & Bentlin, 2021, and Nawratek, 2017a) emphasises the need to differentiate between types of production and to consider their specific spatial needs and impact in planning and design. Mixing of uses can happen at different scales—from neighbourhood to the building level (Roost & Jeckel, 2021) and even within the home (Bryson et al., 2017)—and can show different degrees of integration—from separation to symbiosis (Ryckewaert et al., 2021). The highest degree of integration might not be adequate, or desirable, for all types of production and urban space. Instead, planning policies and design should be adjusted to the peculiarities of each context, developing "clever solutions for shared spaces" but also, when needed, "careful design of separation between uses" (Ryckewaert et al., 2021, p. 346).

Rare studies examine the relational and affective effects of manufacturing's material presence in cities. Ferm et al. (2021, p. 355) demonstrate that "spatial morphologies of urban manufacturing" shape "the wider relations between manufacturing and the city." Different building configurations result "in tighter or looser urban tissues" (Ferm et al., 2021, p. 355), leading to varying possibilities for engaging with manufacturing. Large industrial estates and inward-facing redevelopment projects produce "a very formal urban environment" and a "clear separation between private and public space," hindering a sense of community (Ferm et al., 2021, pp. 360, 362). In contrast, outward-facing morphologies, with direct access from streets and open spaces, create a permeable and transparent urban environment. Baker (2017, p. 125) proposes that these qualities be achieved through "open windows, large doorways and opportunities for signage."

Production activities in cities inevitably shape not only real estate patterns and the relationship between producers and consumers but also how people perceive, make sense of, and understand both manufacturing and the urban space. While Baker's proposition focuses, as the few other existing studies, on functional and visual elements of industrial buildings, our contribution seeks to include other senses in these reflections and to emphasise their affective dimension more explicitly. Therefore, we turn now to sensory methodologies in urban studies.

### 3. Sensing the City

In the last two decades, there has been a growing interest in the role of senses in shaping human experience (Pink, 2015, p. 3), including in urban studies (Adams &

Guy, 2007). This interest corresponds to increased attention to the materiality of social life in general and of cities in particular. This attention emerges from acknowledging that our experience is necessarily embodied and emplaced; it addresses nonhuman agency and “the idea that the sensory and material context of the city also acts on us” (Pink, 2007, p. 62).

Throughout history, cities have been viewed as places with abundant sensory stimuli (both attractive and repellent) that must be controlled and governed. This control often implies displacing, fencing off, and eliminating sources of repugnant and unpleasant sensory elements. The zoning of industrial activities (often together with working-class housing) in the peripheries of cities can be seen as a strategy to screen off bad smells, noise, and ugly sights from the modern city while simultaneously demarcating class boundaries (Urry, 2011, pp. 353–354). The senses thus constitute a crucial component of spatial exclusion in cities, as Low’s (2015) work on the role of olfactory differentiation in the segregation of racialised groups also shows.

A variety of methodologies, including sensory ethnography (Pink, 2015), walking (Springgay & Truman, 2017), and mapping (K. McLean, 2020), contribute to better grasping the role of senses in shaping urban experience and inequalities and to improving the sensory quality of cities (Maag & Bosshard, 2016). The potential of sensory methods and design is often mobilised concerning place-making, memory, and history (Low, 2010). To mention an industry-related example, Brennan’s (2010) sensory historical walks in Loughborough (UK) follow the route—a sort of pub crawl—of a group of Luddites who attacked industrial machines on a night of 1816 (see also Pink, 2015, pp. 183–184).

The potential of sensory methods still needs to be explored in connection to the present and future of urban manufacturing. Not surprisingly, when attention is paid to the sensory dimension of contemporary industrial activities, it is usually in negative terms. For instance, Ryckewaert et al.’s (2021, p. 341) study mentioned above considers five dimensions of environmental impact within mixed-use projects: “visual relationship, noise reduction strategies, smell avoidance strategies, access routes and loading arrangements.” Manufacturing is framed here as a nuisance to the (sensory) urban experience.

While we do not intend to downplay the nefarious impact of acoustic, olfactory, and visual emissions caused by industry, we propose a more open consideration of how manufacturing shapes urban sensescapes today and how it could shape them in the future. We follow Roelvink’s (2020) take on Latour’s (2004) original concept of *learning to be affected*. We understand affect “as a non-ideological force that works through bodies,” and that confers them the capacity “to move and be moved by the world in some way (to affect and to be affected)” (Roelvink, 2020, pp. 428–429). This capacity depends on other bodies and can be reinforced through

practice, as Latour’s (2004) famous example of the perfume kit enhancing the pupil’s ability to distinguish different smells suggests. Crucially, learning to be affected generates “shifts in the capacity for action centred on caring for others” (Roelvink, 2020, p. 431). In other words, the more we pay attention to bodily sensations (i.e., how our body is affected by the world surrounding us) and the more we care for these sensations, the more possibilities for action will be available.

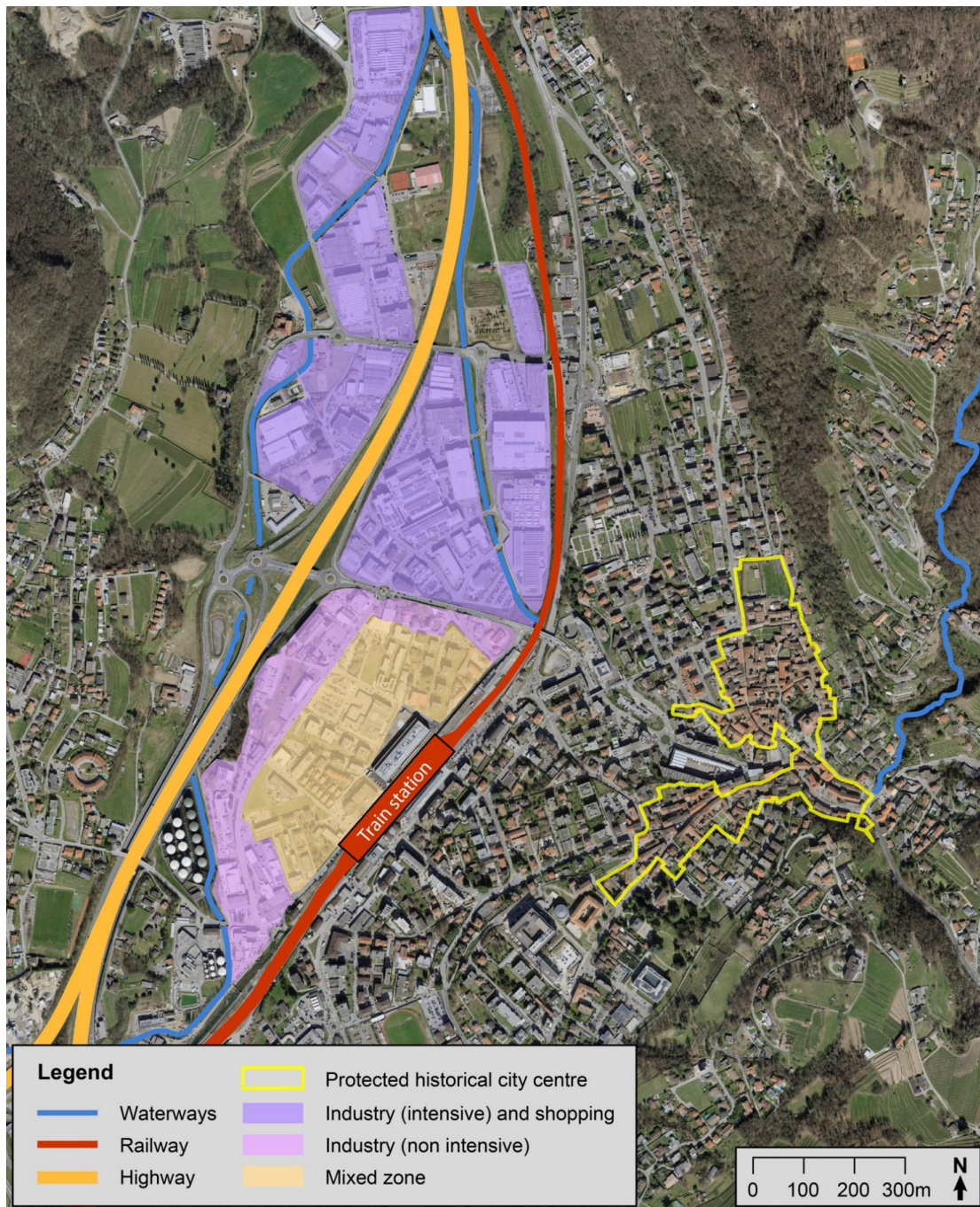
With our laboratory, we wanted to create a space where we could learn to be affected by urban manufacturing in Mendrisio. We intended to discover together how this process would change us and our relation to manufacturing; what new connections, awareness, and sensibilities it would nourish; and what our personal and collective experience could teach us about (re)industrialisation and urban planning.

## 4. Exploring Sensory Manufacturing

### 4.1. Manufacturing in Mendrisio

Mendrisio’s location (population: 16,000 inhabitants), at the Southern edge of the Alps and bordering Milan’s metropolitan area, has proven historically favourable for manufacturing. The first proto-industrial activities comprised small spinning mills, shirt factories, and dyeworks along the stream that once ran through the town centre. The connection to the railway in 1874 drew the town’s expansion, including further textile and light manufacturing industries, from the centre downhill—a process further accentuated by the inauguration of the highway in the 1960s. The valley floor, especially the area between the highway and the railway (called Piana di San Martino), has experienced an impressive acceleration of construction, especially since the 1980s: infrastructures, industrial and commercial buildings, as well as, in the mixed-use zone, residential units (Figure 1). Today, Mendrisio presents a diversified industrial landscape ranging from pharmaceuticals to metal manufacturing, through the textile and chemical sectors (Mayer et al., 2023). Most enterprises are small- to medium-sized and part of international conglomerates; they produce highly specialised intermediate or capital goods for export, such as rubber profiles, refined gold, zippers, or steel cables.

The modalities of this development have fed resentment among the local population, which has only partially benefitted from it (Mayer et al., 2023). Local enterprises (both in the secondary and tertiary sectors) have traditionally employed numerous cross-border workers from Italy, leading to wage dumping. Air pollution frequently reaches alert levels, and traffic congestion is constant during peak hours. Unregulated development of the valley floor has disorderly replaced fields with sheds and roads, leaving little space for leisure areas and green spaces (Figures 2 and 3). The industrial sector faces criticism for environmental issues and working



**Figure 1.** Map of Mendrisio. Orthophoto courtesy of © Swisstopo, modified by M. Kummert after Ufficio Tecnico Comunale, Mendrisio.

conditions, even though commercial activities also contribute to these problems.

Mendrisio’s industrial zone is relatively small and close to the town centre, with many enterprises situated near the train station in the mixed-use zone. Contrary to Baker’s argument, however, the visibility and the proximity of manufacturing to other urban functions—features of conspicuous production—seem to intensify resentment against the industrial sector rather than fostering a positive connection to it. As detailed in the next section, our laboratory aimed to explore this tension from a sensory perspective.

#### 4.2. Sensory Research in Mendrisio

We conducted sensory research with 11 graduate students in the framework of a laboratory course in economic geography at the University of Bern, Switzerland, during the Spring term of 2023. The overall methodological approach of the course, deliberately open and exploratory, was rooted in sensory ethnography and auto-ethnography (Pink, 2015). Drawing on feminist epistemologies, we considered the body not a research object but a research tool that produces knowledge through its presence in space (Landrin, 2022). After



**Figure 2.** A view of Mendrisio's Piana di San Martino. Photo by the authors.

an initial phase in which we established a common conceptual framework, the students developed group projects to explore the multisensory dimension of manufacturing in Mendrisio. Fieldwork took place over three days in April 2023. We started with a collective explo-

ration of the Piana di San Martino; then, students conducted field research for their projects and had informal exchanges with a few local actors. We regularly integrated moments of mindful meditation and soft mobility exercises throughout our stay in Mendrisio to connect



**Figure 3.** Collage of pictures from Mendrisio's industrial zone. Photos by the authors.

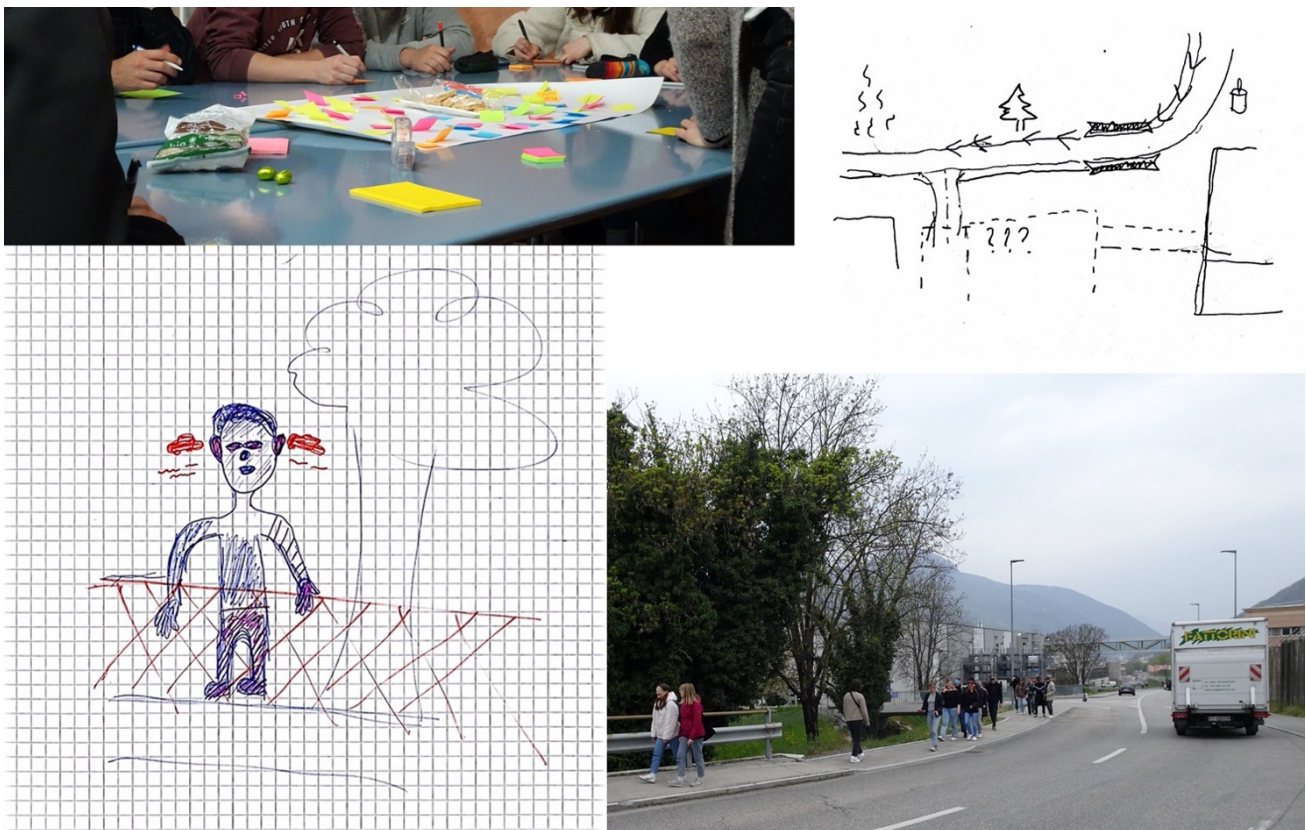
to our body and enhance our attention and sensibility. During the term, students held a personal journal to track the transformation of their relationship to manufacturing and urban space.

For the collective exploration of the industrial zone, we used a combination of embodied methods (Figure 4):

- 1) A blind walk (Waxman, 2017; Zawadzka, 2022). In pairs, students walked with a blindfold guided by their partners and later drew a map to document their experience. The uncommon condition of this first walk in the area intensely affected many participants, as the sound of passing cars challenged their sense of security.
- 2) A body mapping (de Jager et al., 2016; Jokela-Pansini, 2021). We marched through the area in silence, focusing on our bodily sensations. We then drew a downsized contour of our bodies to collect, organise, and communicate our feelings.
- 3) A poetic inquiry (Faulkner, 2017). During an additional walk, students noted down words that came into their minds and shared them with the group afterwards. They then selected five words among those mentioned by their colleagues and wrote a short poem entailing the five words. Writing with the words of others enhanced the interconnectedness of our collective experience.

For their group projects, students applied a variety of methods:

- Group A combined acoustic and visual methods to compare the external appearance and soundscape of selected enterprises with fictional representations of what might be seen and heard within the buildings, integrating these elements into a Story Map. They pointed to the perceived lack of transparency produced through visual elements and the homogeneity of soundscapes dominated by the noise of ventilation systems and motorised traffic.
- Group B used audio recordings and a self-questionnaire to compare the subjective perception of the soundscapes in the mixed-use zone and a purely residential area, visualising the results with colour-coded treemap diagrams. They emphasised the impact of motorised traffic on their perceptions and the variable contextual meaning of sounds.
- Group C explored the relationship between nature and industry by producing a sensory map of a walking path along the river that flows through the area. They, too, noted the predominance of cars (mainly connected to a big shopping mall) in the sensescapes. Yet, they were simultaneously surprised by the quietness and cleanliness of the area



**Figure 4.** Collage of sensory explorations in Mendrisio: poetic inquiry, (body) mapping, blind walk. Photos by the authors, drawings by the participants.

(apart from traffic) and the (positive) impact of natural elements on their sensory experience.

- Group D let themselves be guided by their senses in free sensory walks, recording and analysing all sensory encounters along the way and synthesising them in a visual-acoustic-olfactory installation. Their analysis called attention to the role of prejudices in shaping sensory experiences and reinforcing biases. The students noted that because they had a negative image of the industry from the start, their sensory attention tended to be attracted by negative elements (the sight of garbage, the noise of the ventilation system, or the stink of exhaust gases). Only after actively training their senses could they perceive more pleasant elements, such as the smell of wood from carpentry or birds singing.

The insights generated by the groups mainly confirmed what had emerged during the collective exploration. Methodologically, we noticed that a strong focus on one sense simplifies the analytical work but at the same time contradicts the actual experience, which is necessarily multisensory and charged with emotions that shape the perception of place (Howes, 2004). Concerning the sensescapes of manufacturing, the main observations pointed to their homogeneity and uniformity; the lack of spatial, visual, and sensory transparency; the sensory predominance of motorised mobility; and the incoherence and contradictions within sensescapes, especially concerning natural elements. We realised that all this limited our ability to read the place and affectively engage with manufacturing.

Negative preconceptions further limited this possibility. The whole group had a substantial prejudice against the industry as something inherently loud, polluting, ugly, and smelly, as it had emerged in a creative writing exercise in the first session of the laboratory. The experience in the field did not fulfil these expectations as the industrial site turned out to be calm, clean, and not very impactful on the senses, despite the heavy motorised traffic. Nevertheless, students mostly maintained a rather negative image of manufacturing as they interpreted the lack of sensory transparency as a sign of some guilt. The fences, walls, no trespassing signals, monotonous noises, and interactions with security staff surprised some students, who described the atmosphere in the area as hostile and suspect—as if enterprises had something to hide.

## 5. From Conspicuous Production to Sensible Production

### 5.1. Interrogating Conspicuous Production

Our exploratory work in Mendrisio opens up several questions on conspicuous production and, more generally, on the presence of manufacturing in cities. We join

here Ryckewaert et al.'s (2021) call for differentiating between various degrees of integration of functions. Yet, we broaden their point to consider the diversity of production forms and elements, their impact on sensescapes, and their differing potential for meaningful sensory experiences. The sensory approach of our research accentuates the wholeness of experience in space, rather than just the visual field, as crucial in influencing the perception of industrial activity.

As noted above (e.g., Ferm et al., 2021), it is essential to maintain a nuanced stance and ask *what is visible* (and perceptible in general) and *how*. Mendrisio's industrial area is within walking distance from the city centre and includes a mixed-use zone. While this proximity could contribute to conspicuousness, our experience suggests that more than this is needed to render the industry approachable. The heavy traffic generated by the busy shopping mall negatively affected our sensory experience in the area. Additionally, the few perceptible elements of manufacturing created a sense of opacity rather than conspicuousness. Fences, often designed to prevent interaction with the street or intentionally used by manufacturers to avoid public scrutiny, contradicted the principle of conspicuous production. Students perceived these elements, along with other sensory aspects like monotonous ventilation noises, as fostering a sense of hostility and mutual mistrust.

We should also differentiate *what is produced* and *how*. Indeed, as indicated by Baker, small-scale craft production can be easily integrated into urban centres. However, focusing on these kinds of activities risks romanticising production and making other, more invasive forms invisible, which are still necessary for our well-being, at least to some extent. The type of production performed in Mendrisio, and even more the heavy industry usually segregated outside cities, might not be pleasant to see (or hear or smell). The paradox is that if only selected elements are made perceptible from the outside, there is the risk of sanitising the image of a process that might be better known in its entirety if it is to be valued more realistically.

Furthermore, for production that, like in Mendrisio, is oriented towards intermediate or capital goods rather than consumer goods, the question arises about the possible abstraction level in the conspicuous production concept. Even if a rich sensory encounter with the production process is possible, the manufactured product might be out of the imaginaries of everyday life. It is thus questionable whether it is feasible to raise consumer awareness when the product's linkages to lived experience are rather complex, intangible, and embedded in highly specialised production chains.

More generally, our experience in Mendrisio exhorts us to consider the specificities of each type of production not only within its unique spatial and material context but also its social and cultural one. How different sensory elements of production are perceived and valued depends strongly on local historical trajectories, norms,

and, not lastly, power relations. Our reflections and most of the literature we draw on emerged in the context of de-industrialising or still-industrialised cities of the minority world: in other contexts, integrating production in the urban fabric to make it more perceptible might have very different effects. In the case of Mendrisio, the resentment emerging from the social and environmental problems of the last decades of economic transformation certainly influences the possibilities for openly engaging with, sensing, and caring for the local manufacturing and industrial area (Mayer et al., 2023). Initiatives limited to increasing the visibility of manufacturing and improving the industrial sensescapes through planning tools but not tackling broader structural conditions (for instance, through stricter regulation of working conditions and environmental impact) would constitute, we believe, an ineffective exercise. In the worst case, it could lead to industrial gentrification, as it often happens with redevelopment projects (Ferm & Jones, 2016) and greening interventions (Curran & Hamilton, 2020; McKendry & Janos, 2015).

### 5.2. *The Effects/Affects of Sensing Production*

Our project revealed the potential of combining conspicuous production with sensory methods for reinforcing our sensitivity and mindfulness towards (in other words, our *care for*) production processes. During the term, students realised how disconnected they were from the process of making things. In their reflective assessments, they expressed a newfound awareness about manufactured goods and the manufacturing sites in their towns. A student even stated that:

Often, when I use a zipper now, the fine sounds of the sewing machines from the open window flash in my mind, but also thoughts about the problems related to the industry in Mendrisio, especially the heavy traffic and the harsh working conditions.

Notably, this heightened consciousness emerged despite the absence of intentionally designed conspicuous production and direct insights into the manufacturing processes during our fieldwork. This raises the question of whether Baker's goals on conspicuous production can be reached predominately by social processes rather than urban design. In fact, it was rather the collective effort to think and feel together that transformed our relation to production. This resonates with Anderson's (2014, p. 102) observation that learning to be affected is always a collective process since "affect is transpersonal [and] formed through encounters and relations that exceed any particular person or any particular thing." Group discussions, readings, and on-site meetings with local actors were essential to making affective processes possible.

At the same time, the collective character of these processes resulted in the crystallisation of some perceptions and interpretations—especially negative ones—

partially limiting the full expression of individual experiences. This was true in particular regarding the impact of preconceived images of, and attitudes towards, industry. Some students timidly described changes in their prejudices about manufacturing, acknowledging the pluralism of possible forms of production. However, this differentiation was not a rule for the whole group, and the industrial imaginaries of most students maintained a negative—if transformed—connotation. While their initial image of the industry was about loud noises and bad smells, at the end of the course, it shifted to monotony, hostility, and mutual mistrust—all feelings that strongly influenced our collective reflections.

Our positionality shaped the way the sensory experience in Mendrisio affected us. Students (all from Northern Switzerland) arrived in the town with an idyllic image of Southern Italian-speaking Switzerland as a holiday destination praised for its charming natural landscapes and picturesque architecture. As economic geography students, they were generally concerned and engaged in sustainable regional development and more attuned to the working culture of services than of the industrial sector. This combination probably resulted in participants focusing mainly on the negative components of their experience in Mendrisio.

Without a doubt, the results of our exercises would vary significantly with different groups and in other contexts. In spring 2023, Ottavia conducted two sensory walks in the same area with local teenagers, which included information on local history and development. Participants had similar prejudices about the industry and even stronger ones about the site, where most had never lingered despite passing by regularly. While environmental concerns about production remained, pride emerged as they discovered previously unknown elements of the place's history and materiality. Hatzold (2023) conducted sensory bike tours in a traditionally industrial valley in Central Switzerland with local architects and planners who had already been engaged in the preservation of local industrial heritage. Like our students, Hatzold's participants noted the lack of sensory transparency and readability of industrial spaces on their route. However, this observation raised their curiosity and the desire for more profound encounters with production sites and processes.

Positionality, including prejudices, is pivotal for the perception of space. Degen and Rose (2012, p. 3283) define the difference between the perception of places and the sensory experience of them as a "paradox." They remark that "memories of other places can entail judgements that can be very negative in relation to [another place] and thus disengage an individual from full sensory immersion in the urban environment" (Degen & Rose, 2012, p. 3282). In our case, the judgements and prejudices of students were not necessarily rooted in their embodied memories but in cultural imaginaries of industry strengthened by the pressure of the group. As Gibson-Graham and Miller (2015, p. 9)



observe about hegemonic discourses on the economy, such imaginaries:

Literally [make] sense—transforming our sensual perceptions and experiences, altering the material and conceptual conditions of possibility for our identifications with others, and changing our abilities to see, think and feel certain inter-relationships and the responsibilities that come with such experiences.

Our prejudices and negative cultural narratives about industry reduced the sensory feel of the researched area and the possibilities to be affected by it. As in Hatzold's case, positive biases might also prove problematic if they limit the opportunities to critically scrutinise our inter-relationships and responsibilities by delivering romanticised images of manufacturing. When engaging in such exercises, it is thus crucial to reflect openly on our positionality and background if we want to nurture more meaningful and honest relations to manufacturing, as advanced by Baker.

Furthermore, establishing a connection between localised sensory experiences with a critical place inquiry and broader environmental, political, or cultural discourses on industrial production posed a significant challenge for students. This might be a constraint of sensory methodologies themselves, as they risk focusing instead on “the micro and yet universal level while ignoring the situated realities of historical and spatial sedimentations of power” (Tuck & McKenzie, 2015, p. 36). Despite providing theoretical foundations and pertinent information on the research site, several students struggled to relate these components to their observations. Integrating this information in sensory exercises and actively stimulating reflections that link individual experience to structural analysis seems thus a critical requirement when applying sensory methodologies in urban planning.

We might ask if sensory encounters in urban space are enough to change attitudes towards manufacturing as well as consumption patterns and production processes themselves. Long and branched value chains are at odds with a focus on consumer awareness that places greater value on local products with transparent and traceable origins and assumes that labour practices and environmental impact can be better regulated when production is nearby. Those ethical, social, and environmental concerns must be broadly present in local discourses. Otherwise, planning regulations and building environment changes might appear unrelated and hard to link with social and environmental responsibility.

We thus tentatively advance the notion of *sensible production* to simultaneously make better justice to Baker's original goals and expand them. While we like the sense of pride conveyed by *conspicuous production*, we find it risky, too: what about production elements of which one cannot (and should not) be proud? Should they be hidden behind a shiny façade? In fact, this is what happens with conspicuous *consumption*. Those

who engage in this practice are primarily concerned with appearance and usually ignore the (potentially exploitative) relations that make the production of the displayed good possible. Instead, the polysemy of *sensible* is productive of an approach that not only acknowledges the materiality and multisensoriality of production but also invites us to reflect on what kind of production we want and need—a production that makes sense for people and the planet and shows good sense because it is “designed for practical ends rather than for appearance” (as in another meaning of the adjective; Sensible, n.d.). *Sensible production* cannot brag about a few selected elements but must expose its tensions and contradictions to perception, teaching us to be affected and to care for its complexity. It invites us to engage with production not as detached consumers, but as part of an interconnected collective that bears responsibility for what, where, how, how much, for whom, and why it is produced.

## 6. Conclusions and Outlook

Our study points to the potential of conspicuous production and mixed-use zoning for reinforcing awareness and connection between people and manufacturing. However, it also warns about considering these approaches as simple solutions to complex social and environmental problems. It emphasises the importance, for urban planning research and practice, of differentiating *what type* and *what elements* of production processes are made more visible, perceptible, and accessible, as well as of considering the social, cultural, and political peculiarities that shape relations to manufacturing in each local context and for different social groups. We propose *sensible production* as a concept that invites us to acknowledge the complexity of production and consumption relations and take responsibility for them.

(Sensory) planning risks resulting in ineffective (or even counterproductive) interventions if it remains blind to structural settings (e.g., labour market conditions) and broader spatial arrangements (e.g., mobility patterns). Motorised mobility strongly affected our experience of Mendrisio's sensescapes, while most of our positive encounters related to natural elements, such as green spaces, the river, or birds. An approach that aims at more production visibility without simultaneously actively working to reduce the presence of cars seems thus to be destined for little success. At the same time, increased attention to the design not only of individual industrial buildings but also of the surrounding environment can encourage people to linger more in proximity to manufacturing, multiplying the possibilities for sensory experiences and connections. Greening interventions have proven effective in this regard (Curran & Hamilton, 2020; McKendry & Janos, 2015). Other strategies could include a focus on soft mobility (Valente et al., 2021) or the integration of additional functions in the industrial and mixed-use zones (like sports facilities, shops, or restaurants), paying, however, attention that

this does not result in the displacement of manufacturing activities (Curran, 2007).

Our research applied sensory methodologies to go beyond the analysis of functional and visual elements of industrial production and towards embodied human experiences. In the limited framework of our laboratory, we could only explore the usefulness of a multi-sensory approach in autoethnographic terms by interrogating our own affective transformation and its relation to conspicuous production. Further research could expand the timeframe, number, and profile of people involved to assess and transform existing perceptions of urban manufacturing.

By actively encouraging the process of learning to be affected, we believe that such methodologies can complement visual and functional approaches to fulfil the social and environmental promises of conspicuous production and mixed-use zones. Sensory methods can represent a powerful tool for mobilising local communities and trigger discussions on the space and role people wish to give to manufacturing in their cities. Sensory elements can be combined with participatory activities such as community discussions, sensory walks, and any event that raises curiosity about local manufacturing activities and increases their readability in the public space. Such events could include exchanging ideas and experiences between residential and industrial communities to increase mutual understanding and care. Interventions could also more explicitly aim to transform and contest existing spatial arrangements through targeted performances. In this case, bodies would become not only receptive devices and research tools but also means of active expression (Landrin, 2022, p. 109).

### Acknowledgments

Our acknowledgements go to the students that participated in our laboratory. We are thankful to the editors and anonymous reviewers, as well as to Heike Mayer, for commenting on early versions of the article. We would like to thank Mirko Winkel and the mLab for their precious support. Ewa's stay at mLab was made possible by Constanze Fischbeck's encouragement as well as by a scholarship from Erasmus Mundus+. The research was funded by the University of Bern and the Swiss National Science Foundation (project 10001AL\_192764). The course materials are available upon request.

### Conflict of Interests

The authors declare no conflict of interests.

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Article

## Auditing, Revealing and Promoting Industry in the London Borough of Southwark

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Submitted: 11 April 2023 | Accepted: 13 September 2023 | Published: 21 November 2023

### Abstract

Renewed enthusiasm surrounds the potential for urban industry and its contribution to the socioeconomic diversity of cities, despite concerns about the loss of industrial uses, land, and buildings in high-value, post-industrial cities. Yet, industry is often hidden and undervalued, and methodologies to change the culture around nurturing industry in cities have not been well explored. As a first step in moving this agenda forward, this article proposes effective ways to reveal industrial uses and to advocate for policy protections of the land they occupy. It examines how London Metropolitan University's School of Art, Architecture and Design (AAD) Cities action researchers applied their *Audit, Reveal and Promote* methodology to Southwark, a London borough with a high concentration of urban industry. There are key aspects to revealing industrial economies: collecting accurate data on the ground, showcasing local businesses, building stakeholder networks through mutual trust, and creating a space of possibilities between vertical hierarchical and grassroots power networks to enable stakeholders to participate in urban change. This article presents a methodology for cultural change towards valuing a mix of uses, including industry, to transform land development towards retention and densification of industry.

### Keywords

action research; industrial economy; methodology; New Southwark Plan; participatory research; policy protection; Old Kent Road; stakeholder engagement; sustainable development; urban planning

### Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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### 1. Introduction

After a period marked by the dispersal of large-scale manufacturing in London, a renewed enthusiasm has recently emerged for small-scale urban manufacturing in the context of “post-industrial” cities. Manufacturers leverage cutting-edge digital technologies while also gaining from their urban setting by exploiting proximity to networks of suppliers, services, and workforce (Grodach et al., 2017). City-centre locations facilitate links with consumers and markets, a pivotal attribute for firms emphasising design-driven approaches (Ferm & Jones, 2016), and industry is a core aspect of a city that works (Davis, 2019).

A threat to industry in London, however, is the scarcity of available land to accommodate it. The challenge is evident in the overshooting of industrial land loss targets since 2001. Three times the target loss occurred between 2011 and 2015 across the city, and nearly eight times in central London (Greater London Authority [GLA], 2016). Loss is fuelled by higher land values for other uses, rather than directly by deindustrialisation (Ferm & Jones, 2016). A widespread notion exists that manufacturing has no place in the post-industrial inner city, on account of its association with dirt, noise, and perceived land inefficiency. However, this perspective fails to acknowledge the nuanced industrial geographies and how new urban manufacturing endeavours tend to

cluster within remaining industrial pockets (Grodach & Martin, 2020).

### 1.1. *Audit, Reveal and Promote*

This article discusses a methodology—*Audit, Reveal and Promote*—designed by the London Metropolitan University’s School of Art, Architecture and Design (AAD) Cities (Clossick & Brearley, 2021) to create the conditions for retaining and intensifying London’s valuable urban industrial places. It is guided by a number of research questions: How can a city’s industrial activities be effectively researched through “audits”? How can the findings be made accessible to stakeholders, both governance and grassroots? How can those stakeholders be empowered to utilise their knowledge to participate in urban change? What type of actions could influence decision-making by those in power towards densification of industry?

This article is one output of action research that was carried out from 2014 to the present day by the AAD Cities Research Group (including work by Masters students in the Cities Unit); primarily academic activist Dr. Jane Clossick, and Prof. Mark Brearley, an academic who owns a tray factory in Southwark, where these experiments were undertaken. The aim of the action research is a just and sustainable city, in line with The New Leipzig Charter. The Charter outlines a vision for urban development in promoting the common good, emphasising the need for sustainability in urban planning, addressing climate change, resource management, and the conservation of heritage (European Commission, 2020), all of which are potentially fulfilled by retaining industrial land and accommodation in cities. Methodological explorations in Southwark are documented in the hope that our experience will be of use to future urban activists.

The article draws on three theses which underpin the methodology. The first is that engagement in planning begins by revealing local value and empowering stakeholders. Using the theory of social movements as networks (Diani & McAdam, 2003, p. 78), stakeholders were mobilised to bring their attention to local industry. Southwark is a well-examined place in its industrial and post-industrial history and exemplifies broader spatial and political changes in London and elsewhere. Groups such as Pempeople (a community group aiming to empower local people) and the Southwark Planning Network (an informal network that assesses and acts upon planning policy change) have a long history of activism. They form part of a wider social and scholarly movement which sees industry as an essential component of city life (Chapple, 2014; Davis, 2019; Grodach et al., 2017) and recognises that, in order to keep it in the city, dominant market forces must be challenged.

The second thesis is that urban activism supports the growth of networks both inside and beyond industrial places, where urban learning is operationalised.

The actors in the Southwark network include industrial businesses, as well as activists, developers and policy-makers. Social movements can be understood as complex networks of interactions among individuals and organisations which shape the dynamics of change. Relationships between actors are crucial, affecting the mobilisation of resources. Appadurai (2002) discusses the importance of collaborative networks to achieve change, and uses the term “deep democracy” to describe how through the formation of networks, new ideas for development emerge, as well as modes of implementation. Similarly, according to Manzini (2015), grassroots innovation relies on enabling people to work together in novel ways. Activists and organisations within the network can pool their resources and expertise to achieve common goals. Our work seeks to facilitate network formation, with a view to retaining and intensifying industry.

Thirdly, by highlighting the diversity of existing industrial economies, policymakers can cross the socio-economic divide, leading to decision-making that sufficiently accounts for the range of needs and rights of the people whose lives are affected by the loss of industry. Through action, a deeper democracy is fostered (Appadurai, 2002) by bridging gaps between stakeholders and middle-class “radical activists” (Mayer, 2013). In questioning the notion that industrial localities are expendable in the 21st-century city, action is a challenge to the dominant ideology (Gamson, 1975, p. 142), although the challenge is not confrontational, but participatory (Blundell-Jones et al., 2005). Ours is a mode of “academic activist” research (Chatterton et al., 2007) which acknowledges that to act within urban processes is to understand their social and political dimensions, which enables change.

## 2. Urban Industry in Southwark and Beyond

A wide mix of accommodation types, occupied by a varied mix of uses which includes “industrial,” is valuable in the 21st-century city. “Industrial” includes the type of Industry 4.0 described but also construction, fabrication, logistics, waste handling, repairs, utilities infrastructure, and wholesale.

Industrial uses are significant to the economy in the UK, and the sector is growing. In Southwark, there are 18,320 businesses trading (London Councils, 2019, p. 6), of which “industrial” makes up around 10% (1,684), employing 16,000 people (Clossick & Brearley, n.d.). The UK’s industrial base contributes four times more to gross value added (GVA) than its financial core (Lawlor et al., 2009) and in Lewisham and Southwark, GVA grew steadily in the period 1998–2017 (Office of National Statistics, 2017). Production, manufacturing, construction, distribution, and transport made up 20% of the borough’s GVA in 2015, compared to information and communication at 14%, and public administration, education, and health at 17% (GLA Economics et al., 2015,

p. 58). Production-based and construction enterprises in Southwark both grew by over 150% in the period 2010–2018 (Office of National Statistics, 2019), and in 2019 44% of industrial businesses said they were growing (Clossick & Brearley, n.d.). Similarly, in 2016, 95% of industrial businesses said they would need either the same or more space in the coming year (AAD Cities, 2017, p. 39).

Industrial districts nurture creativity and entrepreneurialism because they host small and medium enterprises (SMEs), which are also a source of prosperity (Garcia-Martinez et al., 2023). Wood and Dovey (2015) revealed that a diverse structure associated with a multitude of functions played a pivotal role in generating the distinctive characteristics of a creative cluster. In Southwark, 88% of industrial organisations have 10 employees or fewer and 98% are SMEs (Clossick & Brearley, n.d.). Making accommodation available that is suitable for the wide range of potential industrial uses also fosters innovation and competitiveness (Curran, 2010), encouraging research and development. In Southwark in 2023, Monty Ravenscroft invented a folding toilet (Ramirez, 2023); such innovation will keep London at the forefront of global markets.

Mixed economic uses, including industry, are ecologically sustainable and economically resilient (Leigh & Hoelzel, 2012). In this diverse borough, across 22 sectors there are 1,684 industrial organisations (Clossick & Brearley, n.d.). Just-in-time activity meets the growing needs of cities without generating excessive trips and associated carbon emissions (Ferm & Jones, 2016) and the existence of local supply chains supports progress towards a circular economy. Eighty-three percent of Southwark's industrial businesses have customers mainly located inside the Greater London area and, when it comes to suppliers, only 14% of businesses rely on suppliers outside of the UK, whereas 60% rely on those in the Greater London area (Clossick & Brearley, n.d.). Clusters of industrial land and uses tend to be robust, and nurturing them in a 21st-century metropolitan UK context allows for a diverse economic ecology that is resilient to economic, technological, and social shocks (Chapple, 2014).

Industrial uses form part of local heritage and ecosystems, and are often considered to be part of local "cultural heritage" (Skoura, 2023); in Southwark, 47% of the industrial organisations were established before the year 2000 (Clossick & Brearley, n.d.) and many are tied to local cultural identity (AAD Cities, 2017). Collaboration and cooperation among firms is fundamental to the success of industrial districts, such as in the classically-studied Emilia Romagna region in Italy (see, e.g., Andreoni, 2018). Southwark's industry is characterised by a dense network of SMEs in related industries within a specific geographical area and has a high level of complementarity, with many contributing a unique product or service that enhances the activities of others in the network. In Emilia Romagna, companies in the same district often form horizontal networks to share knowledge, resources, and best

practices, which fosters innovation and efficiency (Ferri & White, 1999); these networks also constitute heritage.

Industrial land in Southwark is being eroded, however, for a number of reasons. Industrial uses require space, and where overall accommodation is limited, higher-value uses will take over where no policy protection exists. When land values rise, industrial areas are often destroyed in favour of residential or services development (Davies et al., 2017, pp. 7–8; Roger Tym & Partners, 2011, p. 9). Southwark is on the periphery of central London with excellent transport links and a gentrifying local population, full of prime development sites. It also contains the Old Kent Road (OKR) Opportunity Area (OA), since 2016 named in the London Plan as one of London's "major sources of brownfield land" (GLA, 2020), where most of Southwark's industrial uses are concentrated. Urban development is driven by developers who seek profit, and the status quo assumption is that accommodating residential and service uses is more profitable than building industrial space (Ferm & Jones, 2016).

Existing high-level planning policy does not protect industrial land. In the Planning Use Classes system (Planning Portal, 2020) the wide net cast by industrial use classes means that, through permitted development, industrial uses can be lost easily. Policy E4 in the Draft New London Plan (GLA, 2018) protected existing industrial accommodation with an objective for "no net loss" across London, but this condition was removed as a result of central government pressure to prioritise housing delivery (GLA, 2021). The new London Plan (GLA, 2021) acknowledges the necessity of bolstering industrial capacity citywide, and encourages a more concentrated industrial presence.

The protection (or otherwise) of industrial land through policy designation is down to local policymakers, who might have conflicts of interest. The New Southwark Plan (NSP) removed much of the industrial-only land designation policy and replaced it with policy which allows for the development of "mixed use" (Southwark Council, 2022). Currently, 7,362 (48%) of industrial employees are working in locations that are site allocations in the NSP, while only 3,485 (22%) remain working in areas designated as locally significant industrial sites (LSIS) or strategic protected industrial land (SPIL) in the NSP. Regarding floorspace, 77% of the industrial floorspace in Southwark is outside areas designated for planning protection as LSIS or SPIL, and 38% of the floorspace is contained within an allocated site, some of which are owned by the council (Clossick & Brearley, n.d.). Moreover, before the NSP came into force in 2022, planning permissions were being granted which assumed the emerging policy was already in effect, resulting in loss of industrial accommodation in contravention of existing policy.

Once policy is in the pipeline, "planning blight" takes place in which businesses move in anticipation of future policy-led redevelopment (CAG Consultants, 2017), and this is happening in Southwark: the number

of businesses in the OKR area decreased by 4.5% in the period 2015–2019 (We Made That, 2019, p. 28). The term “brownfield” implies an empty or under-occupied industrial site, but industrial areas in Southwark cannot be characterised as such. As leases are reduced and landlords stop maintaining buildings in the hope of high-value land sales, formerly vibrant and busy areas become “brownfield.” In the evolving, complex system of a locality such as Southwark, changes are taking place that need understanding prior to prescribing policy, yet local and national government are not engaging with the task of fine-grained and nuanced understanding. The consequence may be the policy-led destruction of a fragile but important set of industrial ecosystems.

Often the activities inside industrial buildings and land are invisible, because of the particularities of post-war modernist industrial buildings. There are large industrial estates dominating OKR, which emerged in the tradition of “rational” post-war urban planning, which consist of inward-looking block-scale buildings, with few entrances and even fewer outward-facing apertures. The activities within are concealed within “urban depth” (Clossick, 2017) and render OKR industrial activity relatively invisible and therefore easy to dismiss. According to Ferm et al. (2021), who compared OKR to the more resilient development pattern enabled by the mixed land use and small plot size of Hackney’s Mare Street, the land uses of OKR can be better separated, and large plots can be developed, characteristics which have contributed to its large-scale redevelopment of industrial space.

### 3. Audit, Reveal and Promote in Southwark

OKR has historically been considered unremarkable—an ill-favoured route consisting of conventional manufacturing, retail depots, and a dilapidated high street (Cargill Thompson, 2018). This, coupled with its classification as strategic industrial land prior to the development of new policies in the NSP, resulted in OKR being perceived by artists and industrial occupants as one of the few inner London areas untouched by gentrification pressures (Cargill Thompson, 2018). Recently, however, Southwark and particularly the area around OKR have suffered a rapid loss of industrial land and uses, so this was where action research efforts were focussed.

The aims of action research in Southwark were determined by the situation at hand. The *Audit, Reveal and Promote* methodology discussed here developed in response to engagement with these on-the-ground problems, and associated policy, using the practice of architectural research to produce knowledge (Katoppo & Sudrajat, 2015). In Southwark, the objectives were: (a) to reveal the nature of the local industrial economy, its richness and diversity, and its multi-use and multicultural nature (qualities that are often invisible to policy-makers; Ferm & Jones, 2016); (b) to produce evidence about industrial uses in the whole borough of Southwark to present to the Inquiry into the NSP in February 2022;

(c) to empower stakeholders to participate in NSP consultations and other activities related to urban change; (d) to build networks between communities and policy-makers around a common goal; and ultimately (e) to influence urban change in the OKR OA towards retention and densification of industrial land.

Our research combines activism, pedagogy, and old-fashioned doorstep social research. Each set of happenings described below developed through the establishment of strategic partnerships with 14 local stakeholder networks. In contested spaces, power relations are central to creating and occupying urban space (Conn, 2011) so the actions we took were deliberately non-confrontational. The *Audit, Reveal and Promote* methodology draws on ethnographic studies (Hall, 2015), visual ethnography (Pink, 2013), and the production of knowledge through drawing and design (Lucas, 2019; Martire, 2020). Images of a construction of reality were produced, highlighting the value of industrial locations; with these components, an anthropological approach meets a campaigning dimension. Four components were tested: auditing, revealing, capacity-building and promoting. The practical application of these strategies overlaps in an ongoing, reflexive process and the intention is that the methodological findings will be of use to urban action researchers coalescing around places of rapid urban change. For a detailed timeline and locations of all activities in Southwark, see Clossick and Brearley (2021).

#### 3.1. Auditing Southwark

An “audit” involves finding out what exists: uses, jobs, and aspirations of local firms. It explores rich economic and civic life in defined localities, seeking to uncover what occurs in places that are typically overlooked. Audits use quantitative methods, such as counting jobs, people, floorspace, and yard space, as well as qualitative methods such as photographing, filming, sketching, engaging in participant observation, and interviewing people. An audit provides a snapshot of conditions at a single point in time, but multiple audits conducted over time allow changes taking place in the local economy to be recorded. This is useful particularly when these changes in the economy are occurring in response to policy changes.

Four audits were conducted in Southwark. The first two were carried out in collaboration with students in the Cities Unit at London Metropolitan University (AAD Cities, 2016, 2017) who determined the number of jobs and businesses in the OKR OA as well as interviewing and photographing businesses (Figure 1). The third audit, a collaboration with a photographer, brought to life the inside of industrial businesses which otherwise would have remained hidden from public view (AAD Cities, 2018). London Metropolitan University funded the final audit, which is in the analysis phase and is a comprehensive look at every industrial property in the borough as well as a photographic survey, many of which were published in the book *Made in London* (Brearley et al., 2022).





**Figure 1.** AAD Cities’ model of the OKR OA, with different economic sectors in various colours, shown at the Livesey Exchange Exhibition as part of the London Festival of Architecture (LFA), 2017.

The findings of all the audits are reported elsewhere (AAD Cities, 2016, 2017, 2018; Clossick & Brearley, n.d.).

### 3.2. Revealing the Audit Findings

The “Reveal” phase involves bringing to light the audit findings through the production and dissemination of easy-to-understand documents such as maps, models, and photographs, and exploring the opportunities they expose with stakeholders and policymakers.

Audit findings were shown at three exhibitions as part of the LFA (shown in Figures 1 and 2), in community spaces, and published in the “OKR Manufactures”

broadsheet (AAD Cities, 2018), a photographic catalogue. Design research was shown, with examples of co-location of industry and other activities, convincing photographs, and curated guided walks through localities. The aim was to demonstrate the value of industry to the local economy, as well as to argue against displacing industry in favour of other development. The exhibitions communicated the needs and qualities of industrial uses, so they could be accommodated appropriately in local urban strategies. All stakeholders were invited to these events, and they were held in convenient, accessible locations in which networks could form and grow.



**Figure 2.** AAD Cities’ exhibitions of OKR Audit findings at Asylum Chapel, Southwark, 2016 (left) and at Central House, Tower Hamlets, 2017 (right).

### 3.3. Capacity-Building

Community “capacity-building” aims to empower all the stakeholders involved in urban change. Dissemination activities are held in collaboration with grassroots groups, public agencies, developers, and policymakers. The targets of capacity-building are local communities, civic groups, industrial business owners, and workers. The aim is to create links between public agencies, community groups, and developers; build networks among stakeholders at all levels; and garner knowledge and enthusiasm amongst them, so that all involved come to share common goals. Capacity-building activities are designed to pique people’s interest and to offer them the tools to engage in urban transformation.

In a few examples of capacity-building events (shown in Figure 3), two participatory design workshops were held as part of the LFA in 2018 and 2019, working with local stakeholders to demonstrate the potential impact of planning policy changes and to familiarise people with the documentation through interactive model-building, sketching, and discussions; making and exploring design propositions collaboratively; and helping people to engage in consultations. Collaboration took place with local groups on the Urban Room OKR (231 OKR) campaign to establish a “room” in a shop on the OKR as a place for local people to gather urban knowledge, and the second LFA workshop took place there. It involved building a large-scale model of the locality with granted planning permissions. Continuing the theme of empowerment, in 2018 the team collaborated with the Southwark Planning Network on the Shaping Southwark Community Hustings, where local people could ask candidates about the built environment.

A key achievement was the establishment of the Vital OKR business association in 2017, to give voice to the OKR industrial economy. During the audits of OKR, student surveyors handed out Vital OKR flyers to build a network of local businesses, as shown in Figure 9. Around 75% of the businesses in the OKR OA have joined Vital

OKR (Vital OKR, n.d.), and as a group have submitted responses to consultations on the NSP.

### 3.4. Promoting

“Promoting” makes use of audit materials and design propositions, as well as personal contacts which come into being because of network formation. It seeks to share these materials and to foster a commitment at all levels—from residents to Government—to retain and densify industry. Promoting aims to influence stakeholder networks, especially those with power in urban space, planning, policy, and governance, both locally and city-wide. Such activities include individual and small group meetings, policy advice, and engagement with policymakers via written communication. Like the other stages of the methodology, promoting is collaborative and emerges from participatory action, steering away from confrontational activism and instead working to build robust relationships of mutual trust.

In this action research, promoting took many forms, shown in Figure 4. One such form was meetings between action researchers and policymakers: meetings were held with Southwark Council Cabinet Members, and, at London-wide governance level, with GLA officers and London Assembly politicians. Mark Brearley also appeared on a panel at the NSP launch event and on the panel of the London Assembly Planning Committee on Industrial Land in London. Another form of promoting involved participation in academic and NGO events, such as the Southwark Planning Network Workshop on industrial land, workspace, high streets and employment. In addition to formal meetings and events, “walking and talking” guided tours were held around industrial zones in Southwark, for the public, policymakers, grassroots groups, urban design professionals and NGOs including New London Architecture.

Promoting also came in the submission of consultation responses. Representations were made on behalf of the AAD Cities Research Group from London



**Figure 3.** Planning Action OKR workshop at the Treasure House OKR, 2018 (left, photo by Alexander Christie, used with permission); poster for LFA workshop at 231 OKR, 2019 (centre); and Shaping Southwark Hustings, 2018 (right).



**Figure 4.** Mark Brearley on the panel of the London Assembly Planning committee on Industrial Land in London, 2017 (left); walking and talking as part of the LFA OKR workshop 2018 (centre); and Open House weekend tours of Kaymet, Mark Brearley's factory on the OKR (right).

Metropolitan University and the business community in planning policy consultations on the NSP, including Vital OKR community representations at Southwark Council Assembly and on the draft OKR Area Action Plan (Vital OKR, 2019). In 2019, evidence was presented to Burgess Business Park Planning Appeal Inquiry and, in February 2021, initial findings from the Southwark Industrial Audit were used to give representations on the Examination in Public of the NSP.

#### 4. Methodological Insights About Auditing, Revealing and Promoting

The testing of the *Audit, Reveal and Promote* methodology in Southwark led to several methodological insights. These concern how London's local industrial economies may best be revealed so stakeholders can appreciate their social and economic value; how best to persuade stakeholders at all levels of power to engage with urban change; what actions contribute to the emergence of new networks that represent the interests of all; and what actions influence decision-making by those in power.

##### 4.1. Auditing: How Can a City's Industrial Activities and Economies Be Researched Through "Audits"?

Planning policy in Southwark and elsewhere cannot be underpinned by desktop studies because the data is not fine-grained enough. Uses are often interdependent and support major central London activities (e.g., AECOM et al., 2015; Cities of Making, 2020; Ferm & Jones, 2016; Gort Scott, 2013). Although studies can begin with available datasets, surveyors must visit the locations and speak to the people involved to ascertain the details of the interconnected metabolism of London's industrial places. In an example of how existing data underpinning desktop studies can be wrong, Ordnance Survey maps are often missing the spaces beneath railway lines. In Southwark that is a significant proportion of the available industrial floorspace: 5.2% (Clossick & Brearley, n.d.). Consequently, that space was missed from figures in GLA documents (AECOM et al., 2015; CAG Consultants,

2017), which affects projections. The inaccuracy is shown in a sample area in Figure 5.

As Southwark experiences urban development, one argument against retaining industrial land is that conflicts could occur between industrial zones and residential areas due to noise, pollution, and safety concerns. Only through detailed on-the-ground auditing is it possible to ascertain whether this is the case for specific industries. According to our research, 77% of industrial businesses in Southwark are undertaking activities that would not disturb residents (Clossick & Brearley, n.d.). However, where businesses produce noise made by the movement of vehicles and goods, it may cause conflict with residents, and these would be best situated amongst other industrial businesses rather than embedded in a mixed-use development.

Auditing is an effective method for reaching non-residential occupants in complex places like Southwark: The door-to-door survey allows a rapid depiction of a local economy, its organisations, and the nature of their accommodation. Our flexible auditing method grew from other work including Hall's (2015) ethnographic approach, as well as methods derived from Mark Brearley's GLA work (Cities of Making, 2020; Gort Scott, 2013). An audit has two stages. First, the research team must identify the area to be audited, prepare a survey, and collect data and photographs at every non-residential property. Afterwards, qualitative accounts are collected through follow-up interviews. The door-to-door survey identifies businesses that are not known or those that will not respond to written communications, reveals where multiple firms share a property, or identifies who is occupying in situations where property changes hands frequently.

Door-to-door collection of information leads to the building of trusted contact networks. During the audits in Southwark, student researchers met firms, gathered information about planning, and distributed information about them while collecting information from people they met, and this led to the formation of business group Vital OKR. Their status as students meant they were non-threatening, and they clarified that their intentions were benign. Similarly, photographing a business



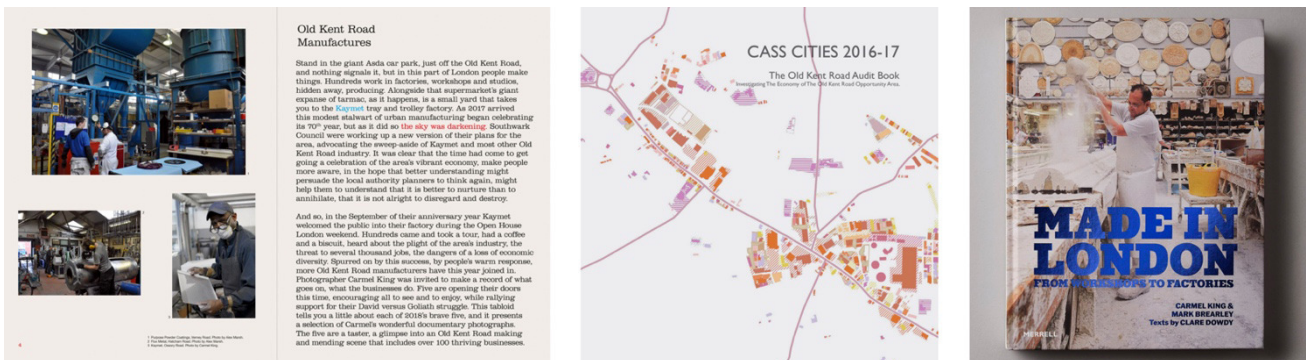
**Figure 5.** Sample area analysis from the Southwark Industrial Audit, correcting the baseline used for the projections by AECOM et al. (2015) and CAG Consultants (2017).

is an intimate act which can lead to the development of deeper social connection and trust. Local communities may be more likely to engage in capacity-building when they build trust among one another and with the research team during auditing.

Auditing reveals social and cultural value which is not immediately apparent. Quantitative methods used by others included calculating collective business rates of Rye Lane (Hall, 2015) and measuring employment, the number and range of independent businesses, and the range and cost of goods produced or sold in the area (New Economics Foundation, 2006). However, value may also mean non-monetary things, such as social

contributions to local economies. As Ferm et al. (2017, p. 27) argue, “particular activities might be cherished by communities, firms might contribute to local economic diversity, and more broadly underpin the human vitality that characterises local economies.” The action research reveals this non-monetary value effectively by producing interview books, stories, and narratives, which capture the human element (AAD Cities, 2016, 2017, 2018), shown in Figure 6.

There are, however, inherent challenges auditing in a culturally- and socially-diverse place like Southwark: people may not be honest in their responses, and the findings may be skewed by the interpretations of the



**Figure 6.** Audit publications from AAD Cities: OKR Manufacturers broadsheet, 2018 (left); Cities Unit Audit, 2017 (centre); and *Made in London* by Mark Brearley and Carmel King (right).

researchers undertaking the audit, based on their own biases. So, reflexive engagement with the questions of researcher positionality is essential.

4.2. Revealing: How Can the Findings Be Made Accessible to Stakeholders?

During the “revealing” events, the map with key sectors boldly marked was an effective tool. People could see the extent of the land coverage for a single industry, such as construction-related activities which might include logistics, builders’ merchants, and scaffolders. Mapping is a political and activist endeavour (Monmonier, 2018), and the division of categories impacts how a diverse economy is represented. The standard industrial classification (SIC) codes divide businesses by their primary product, but many produce multiple products, so SIC codes are not fit for purpose for understanding the nuances of local industrial economies (Ferm & Jones, 2016). Since the framing of diversity within industrial economies could influence decision-making, there are risks of essentialising certain industries and “revealing” must take place without oversimplifying key nuances.

Based on logical groupings of ecosystems of industrial businesses, we proposed our own categories for mapping. They indicate which nuanced sectors are present: printing, construction, and arts-related logistics. In 2016, 13 businesses related to stage and set production were in the OKR OA, including scenery fabrication in various materials; scenery painting, storage and logistics; event production; and lighting. Many of these are mapped in Figure 7 in an extract from the

Southwark Industrial Audit (Clossick & Brearley, n.d.) as “creative industrial” units in the context of allocated sites in the NSP, showing that much creative industrial is located where it is likely to experience extensive redevelopment. These businesses are involved in shows in central London, where they must install and uninstall sets quickly and carefully so proximity to town is important. If these diverse activities were mapped with SIC codes, the relationships would become invisible. The visual representation of the multiplicity of economic uses allows stakeholders to understand the value of retaining specific sectors locally.

Another useful tool is photography, showing people in their businesses along with short interviews, key quotes, and their ambitions and imaginaries. The OKR Manufactures broadsheet (AAD Cities, 2018) put an individual face and story to the local economy, humanising it. Similarly, *Made in London* (Brearley et al., 2022) was a collection of intimate photographs and interviews. At present, a catalogue of photographs by Carmel King is being developed to accompany the Southwark Industrial Audit (2024). An example of some of the photographs from the photographic audit of industrial businesses is in Figure 8.

Revealing counteracts the typological problem of “inward-looking” industrial urban form, which hides what is within. Local industrial economies tend to be undervalued, as they are situated in “urban depth” (Clossick, 2017), and in the OKR in particular there are often inward-looking industrial estates that are not integrated with their surrounding urban fabric (Ferm et al., 2021). Physically concealed from view, ways must be



Figure 7. Creative industrial units around OKR in the context of allocated sites in The Southwark Plan (2022) and the outlines of the OAs.



**Figure 8.** Car Repairs, Bolina Road (upper left); Petriiski Fashion, Tanner Place (upper right); Mons Cheesemonger, Lordship Lane (lower left); and McCollin Bryan, Urlwin Street (lower right). Photos by Carmel King, used with permission.

sought to make them visible. Displaying audit findings in a persuasive manner could help stakeholders to appreciate industry’s civic and social value, even when it does not form part of their everyday city experience.

*4.3. Capacity-Building: How Can Stakeholders Be Empowered to Participate in Urban Change?*

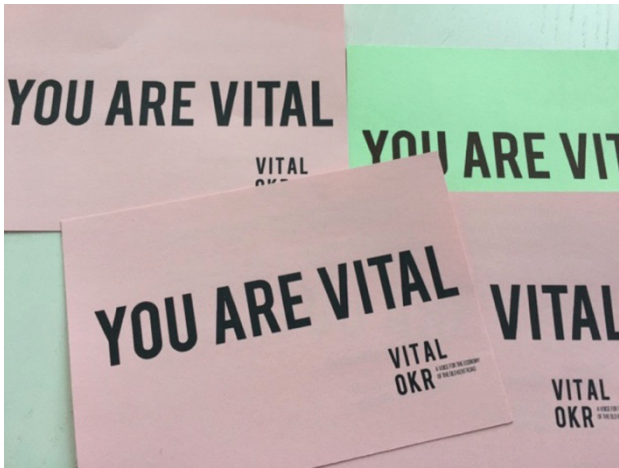
Bringing people together to form effective networks is at the core of the methodology. Providing accessible information and expertise at events, and facilitating discussion between stakeholders, is likely to be fundamental to creating and assisting the development of those networks. Centre for Local Economic Strategies (the national organisation for local economies) and New Economics Foundation identified that co-produced local economic development is a core feature of a good city economy (Friends Provident Foundation, 2016, p. 36). When community stakeholders and governmental bodies tasked with urban space development collaborate, it can give rise to intricate webs of interactions among individuals, groups, and organisations. These interactions, in turn, play a pivotal role in moulding the configuration, dynamics, and efficacy of urban transformation.

Placement in the city and visibility of capacity-building events matters. Local stakeholders play a signifi-

cant role in activism (Taylor, 2020) and for events to succeed they must involve the right people, so they need to be accessible to those people. Yet local stakeholders are often busy and need a short cut to participation in planning. The events we hosted with what if: projects for Planning Action OKR were placed in highly visible locations such as in shops on the OKR, and held over several days to maximise the possibility of participation (Clossick, 2021).

Trust must be built before the events through face-to-face interactions. Audits and interviews function as both data collection and resource distribution tools, which build trust. Vital OKR came into being thanks to auditing, which allowed researchers to meet stakeholders and assist in network formation amongst local people (the first meeting of Vital OKR is shown in Figure 9); the Southwark Planning Network was consolidated by others in the same manner.

Consideration should be extended to meaningful and sustained engagement of the networks formed beyond the initial phases, especially when the priorities of network members may shift over time. Power imbalances amongst stakeholders could impact the effectiveness of engagement efforts, and there are instances where activism might be seen as confrontational or disruptive by policymakers.



**Figure 9.** Flyers handed out by student researchers during audits (left) and first meeting of Vital OKR (right).

#### 4.4. Promoting: What Types of Actions Could Influence Decision-Making by Those in Power?

The same events which engage grassroots stakeholders can also serve to persuade policymakers. Conn (2011) describes the “vertical hierarchical” world of planning policy, the “horizontal grassroots” system of networked local stakeholders, and the “space of possibilities” where the two types of network intersect. As with horizontal grassroots systems, stakeholder networks where people know one another are of great significance in the vertical hierarchical world of planning policy. A particularly effective technique was “walking and talking,” a guided walk around a locality with a high proportion of industrial occupation so that powerful stakeholders could encounter for themselves the reality of the people and places they make policy decisions about. Many myths about industrial occupation are busted in this way, e.g., that industry is noisy or dirty. Much as showing the photographs and interviews puts a human face to a situation, seeing industrial areas in person, led by a knowledgeable professional, can change hearts and minds about the social and civic value of industry.

Mark Brearley’s simultaneous position as both a factory owner on OKR and a planning professional and architect with a long history of urban activism meant he was in an ideal position to create and maintain a space of possibilities between these two types of networks. The space of possibilities was a literal space, where we held events that brought together disparate groups, such as the Planning Action OKR workshops, the Shaping Southwark Hustings, and exhibitions in the Upper Lea Valley and Southwark. Establishing a position of influence and power ourselves, we represented the interests of community groups at meetings, on walks, and during political participation opportunities, speaking at NGO events and undertaking policy advice, often in places where we were granted access because of our privileged position. These were significant activities for maximising the impact of our work on policy but raises the question of the abuse of power by academic activists. Action

researchers must be mindful to ensure that networks represent a diverse range of voices and interests, rather than becoming echo chambers or reinforcing existing power structures.

#### 5. Conclusions

Despite the demands on industrial land and its rapid loss due to economic and cultural pressures, a movement is growing to reintegrate industry and production into the urban fabric of 21st-century cities (Davis, 2019). It is increasingly recognised that cities such as London need a variety of accommodation types, including industrial. Yet, if industrial policy protection is lacking, higher-value uses will move in where space is limited. In Southwark, where land is at a premium and there is political pressure to build housing, high-level policy is insufficient to prevent the repurposing of industrial land and it is local policymakers who decide whether industrial land should be protected or not, depending on their interests.

This article discusses a methodology for revealing the multi-faceted value of industrial localities; empowering and building the capacity of stakeholders through the formation of networks in both the grassroots and vertical-hierarchical systems of power; and delivering urban change around densification and development of industry which is inclusive, just, and representative of the needs of all. It draws on Diani and McAdam’s (2003) theory of social movements as networks and is based on the idea that “deep democracy” (Appadurai, 2002) can be achieved through deliberate intervention and “academic activism” (Chatterton et al., 2007) using the *Audit, Reveal and Promote* methodology. The contribution is methodological, exploring how to audit industrial activities, how to make the findings accessible, ways to empower stakeholders to participate in urban planning, and actions that may influence those in power.

In Southwark, the lack of available fine-grained data meant on-the-ground, door-to-door audits could reveal the makeup of industrial areas that desktop studies could not. As Southwark develops, conflicts may arise between

industrial uses and residential areas, but only auditing can determine whether this is the case for specific places and industries. Through the audit, firms and their accommodation were quickly identified and could then be mapped with key sectors clearly categorised. Alongside photography, short interviews, and key quotes, mapping is an effective tool during the “revealing” phase, to show the interconnected nature of local industrial ecosystems. Exposing industrial places in these ways counteracts the morphological and typological problem of modernist, inward-looking, industrial urban form. The face-to-face nature of auditing leads to the development of both contact networks and mutual trust, and co-locating stakeholders at events and providing them with information and expertise makes it easier for them to discuss and collaborate.

There may be no reconciliation between the different priorities and objectives of policymakers and industrial stakeholders when considering industrial land use. Cultural change towards valuing a mix of uses, including industry, at both grassroots and governance levels, is essential for transforming the way land is developed, to serve the interests of a wide range of stakeholders. There is a research agenda emerging in this area, in which a variety of methodologies are tested to work out how best to shift perception. Even though this methodology is intended for industrial localities, it can also be applied to a variety of urban situations requiring knowledge-based activism. *Audit, Reveal and Promote* and similar activist endeavours could potentially act as catalysts for building social equity through new community-based networks and, in turn, institutions, to produce a deeper, more ethical, democratic process around planning.

### Acknowledgments

Thanks to London Metropolitan University who funded some of this work. Thanks to photographer Carmel King and all the stakeholders we worked with in Southwark over the past decade, particularly Peckham Weeklies, Southwark Planning Network, Southwark Law Centre, what if: projects, Action OKR, Vital OKR, and Southwark Council. Thanks to the business owners of Southwark who generously gave their time to contribute to audits and events. Finally, thanks to all the students and collaborators in the MArch Cities Unit and AAD Cities Research Group who worked hard over the years to impact Southwark for the better.

### Conflict of Interests

The authors declare no conflict of interests.

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Article

## Departures From the Norm: Innovative Planning for Inclusive Manufacturing

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Submitted: 30 May 2023 | Accepted: 2 August 2023 | Published: 21 November 2023

### Abstract

For decades, urban development strategies that privilege narrowly defined “creative” sectors, and anachronistic zoning policies have been the norm in US cities, bringing persistent displacement pressures to manufacturing businesses. However, as cities have faced mounting concerns over inequality, affordability, and diversity, recent scholarship has begun to revisit the importance of urban industry, identifying key contributions that industrial enterprises make to cities. The challenge is finding the right strategies that can preserve, enhance, and potentially expand existing urban industrial space. This article takes up that challenge in three ways: (a) by calling attention to long-standing industrial planning norms that have simultaneously disadvantaged communities of color and undermined awareness of and support for urban manufacturing, (b) by exploring “innovations” that depart from those norms by prioritizing “inclusion” and “visibility” in their planning efforts, and (c) by taking an expansive approach to “planning” that seeks lessons from beyond the formal planning establishment. Drawing from emerging scholarship, research and policy reports, program documents, and interviews with key participants, this article gathers lessons from two industrial planning examples—in San Francisco, CA and Buffalo, NY—that help reveal existing barriers to industrial retention, help reimagine the role and place of manufacturing in the city, and ultimately help to foster more inclusive urban development in the US.

### Keywords

advanced manufacturing; inclusion; industrial planning; urban manufacturing

### Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendas (University of Washington Tacoma).

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### 1. Introduction

Urban manufacturing has long faced ambivalence from the urban planning community. It is an ambivalence rooted in the tension between desire for the money, jobs, and vitality that industry brings to cities and concerns over the consequences that industrial activity might have for urban environments and conditions. That ambivalence gained strength after the 1970s, as deindustrialization seemed to imply that cities no longer needed—or wanted—urban manufacturing and that cities were better suited to *post*-industrial activity (Bluestone & Harrison, 1982; Sugrue, 1996). Yet, as cities have faced mounting concerns over inequality, affordability, and

diversity, recent scholarship has begun to revisit the importance of urban industry, identifying key contributions that industrial enterprises make to cities, including good jobs that provide workers with relatively high salaries and benefits, low entry barriers to employment, opportunities for career advancement, and broadly balanced and inclusive urban economies. The challenge is finding the right strategies and approaches to create industrial jobs to fit contemporary urban contexts.

This article takes up that challenge by examining how emerging planning innovations can maintain, and possibly expand, space for manufacturing businesses in urban areas. Emphasis is placed here specifically on “innovative” planning in order to call attention to the need to

depart from long-standing industrial planning norms that have both contributed to existing problems and failed to generate inclusive new developments. In particular, we emphasize the role that industrial zoning and land uses have played in the production of racial exclusion and segregation in the US and we consider why recognizing that history is important to improving industrial futures and the lives of marginalized urban residents. Despite the problematic history that created them, existing industrial zones and land uses remain important to current and future social and economic diversity in cities and thus cannot simply be abandoned. Instead, strategies are needed to help activate those spaces in ways that bring new benefits to new populations. While it may be possible to pursue such strategies through traditional planning mechanisms—updated zoning categories or new land use designations—here we take a more expansive approach to “planning” to gather lessons from industrial advocates, community groups, and others outside of the formal planning system about how to better engage the industrial spaces that currently exist in US cities. After a brief engagement with zoning history, this expansive understanding of planning is used to explore new ways to support and advance urban industry and economic inclusion, drawing from emerging literature and interviews with key participants from promising examples in San Francisco, CA and Buffalo, NY. The argument developed here is that these examples provide lessons that can extend beyond their immediate contexts, demonstrating how intentional programming that actively prioritizes *inclusion* and *visibility* can help planners (broadly conceived) work within their inherited industrial landscapes to improve and expand industrial retention efforts. We conclude by reflecting on the importance of industrial planning innovations that confront historical practices in order to reimagine the place of manufacturing in the city.

## 2. Reflections on Industrial Planning Norms

Land-use control and zoning play an important role in the everyday lives of urban residents. Municipalities use land use ordinances and zoning designations to govern how land is to be used and to determine which activities will be permissible in different corners of the city. The 1926 Supreme Court Euclid case (*Euclid v. Ambler*, 1926) and the Standard Zoning Enabling Act that the Euclid case set into motion, established powerful regulatory norms and standards, legalizing land use separation through single-use zoning, especially in protecting residential landowners’ investments from undesirable uses (Wolf, 2008). With the acceleration of industrialization and the waves of large-scale urbanization that accompanied that industrial surge, came pressures that cities were not prepared to manage. From building conditions and housing standards to sanitation and air quality, through political corruption and administrative incompetence, concerns over lives and living conditions in the

industrial city inspired a panoply of reforms at the dawn of the 20th century that characterized the Progressive Era (Warner, 1972). Approached from this perspective, the zoning and land use controls that emerged over the subsequent decades take on the deserved shine of progress as we recognize that “the division of uses in early zoning regulations was a direct response to the desire to remove noxious uses, noise, and fumes from residential areas” (Rappaport, 2017, p. 74). In other words, the use of zoning to separate manufacturing from commercial and residential life was conceptualized as a just solution to mounting urban problems. We do not care to dispute that claim here. Instead, we want to call attention to two undesirable and overlapping patterns that have evolved in connection with normative approaches to zoning over the past century: “expulsive” zoning and “creative” displacement.

### 2.1. Protections and Expulsions

It is clear that the industrialization that brought jobs and investment to cities also brought environmental conditions and quality of life concerns that were then confronted, in part, through zoning and land use planning, insulating many residents from the accompanying industrial hazards. However, it is also clear that this type of land use separation was not simply a benevolent tool for protecting urban residents. While zoning may have spared “many” (mostly white) residents from direct exposure to these industrial nuisances, under the racist housing policies of the 20th century those same actions commonly left—and placed—neighborhoods of color in harm’s way. Separating manufacturing activity from other aspects of urban life also served to make factories and workers less visible and symbolically less important in the city, enabling hazardous industrial practices to proliferate with minimal oversight (Rappaport, 2017, p. 74).

The instrumental use of industrial zoning deserves more attention. As Rothstein (2018) illustrates through his extensive interrogation of racial segregation in the US, another use for industrial zoning has been to reinforce and extend racial segregation and discrimination by placing industrial activities in or near designated Black neighborhoods. Once explicit racial zoning was ruled unconstitutional in 1917 (*Buchanan v. Warley*, 1917), some cities began using industrial zoning—among other strategies—to achieve the same end:

[Local planners] designated land for future industrial development if it was in or adjacent to neighborhoods with substantial African American populations...or [they] changed an area’s zoning from residential to industrial if African American families had begun to move into it. (Rothstein, 2018, pp. 49–50)

Dubin (1993, p. 762) reinforces this connection, noting that:

[I]ncompatible zoning was employed as a “subtler” device in pursuit of segregation as compared to the invalidated devices of racial zoning and restrictive covenants. City planners deliberately displaced black residences with industrial and commercial zoning or used incompatible zoning to confine black residents to particular portions of a city.

It is this active use of industrial zoning to create and enforce racial separation that brought Rabin (1989) to the concept of “expulsive zoning.” In contrast to the more familiar concept of “exclusionary zoning,” which utilizes local zoning powers to maintain and/or enhance existing property values and exclude “undesirable” residents (Schragger, 2021), expulsive zoning uses the threat of compromised health and safety conditions to expel and repel residents with alternative housing options and to trap in place those without such options. That has historically caused Black communities to bear the brunt not only of industrial hazards but also the consequences of restricted housing markets:

Because whites who may have been similarly displaced were not subject to racially determined limitations in seeking alternative housing, the adverse impacts of expulsive zoning on blacks [sic] were far more severe and included, in addition to accelerated blight, increases in overcrowding and racial segregation. (Rabin, 1989, p. 102)

This type of expulsive zoning not only placed Black residents in harm’s way but also failed to uphold the health and safety protections that had been used to justify the constitutionality of zoning in *Euclid* and subsequent cases (Dubin, 1993).

Viewed in this way, it becomes difficult to divorce industrial zoning and urban industrial planning from racial politics and the history of racial exclusion in the US. These patterns have been covered extensively for decades in the broad environmental justice literature, noting how the concentration of industrial hazards and other toxins have undermined the health, safety, and physical integrity of Black and brown neighborhoods in cities across the US (Agyeman, 2006; Boone & Modarres, 1999; Bullard, 1990; DiChiro, 1996; Pulido, 2000). But here we want to bring these aspects of racial discrimination more prominently into the *industrial planning* discussion for two primary reasons. First, reconnecting with Rothstein’s (2018) work, the active participation of the US government, at multiple scales, in creating and enforcing this type of racial discrimination implies a degree of responsibility to remedy the negative consequences. The difficulty is that easy or obvious remedies are elusive. Existing industrial zones are linked with a problematic history of exclusion and damage, but it is neither possible nor desirable to “fix” the problem by simply rezoning those spaces out of existence. Thus, contemporary planners face real challenges as they pursue equity in the

context of inherited industrial landscapes. Other innovations are needed in order to reimagine how industrial spaces can better fit within the city. Our emphasis on an expansive approach to industrial planning recognizes the importance of reaching beyond land use planning and zoning as carried out by formal planners to gather lessons from the broad array of projects, services, and partners that create and support the industrial ecosystem. Second, as the long arc of deindustrialization-to-urban redevelopment continues to unfold, it is often these historically marginalized and disadvantaged neighborhoods of color that hang in balance between abandonment and displacement. New approaches to industrial planning are needed to ensure that urban redevelopment politics depart from destructive historical norms and avoid reproducing patterns of exclusion.

## 2.2. Urban Redevelopment and “Creative” Displacements

Linking industrial land use history with contemporary redevelopment politics is not difficult. The same expulsive zoning that placed industrial hazards in or near Black neighborhoods in the service of perpetuating segregation positioned those same neighborhoods for significant losses from the deindustrialization that unfolded during the second half of the 20th century. Sugrue (1996, pp. 176–177) makes these connections explicit: “[A]s jobs left, the city’s black population remained behind. Black workers remained to a great extent confined to decaying center-city neighborhoods, trapped by invisible barriers of race.” This is not to suggest that Black communities were the only ones impacted by deindustrialization; indeed, the suffering and challenges these processes brought to the white working class have been extensively documented and lamented (Bluestone & Harrison, 1982; Cowie, 2010; Linkon & Russo, 2002). But under the prevailing conditions of systemic racism, and the expulsive zoning practices discussed above, the residents of Black neighborhoods were often tied directly to the spaces of abandonment associated with urban crisis (Sugrue, 1996).

These linkages take on added significance when we recognize that many of those abandoned spaces subsequently became the focus of efforts that emerged in the 1990s to “regenerate” cities. Much has been written about the narrow and exclusionary qualities of neoliberal urban redevelopment in US cities since the 1990s (Hackworth, 2007; Harvey, 1989). From FIRE sector investments to urban entertainment landscapes, through upscale residential developments, the vision that emerged and began to take hold of the collective imagination in the early 1990s presented the city as a post-industrial wonderland, packed with young urban professionals, corporate offices, funscapes, and consumption opportunities (Florida, 2002; Jonas & Wilson, 1999; Logan & Moloch, 1987; Peck, 2005). Whether cities sought “global city” status (Sassen, 1991) or rebranded

themselves to fit the new “creative city” model (Florida, 2002), traditional industrial spaces came to be seen as obstructions to the best (most profitable) use of urban land—literally, by occupying desirable real estate, and figuratively, by symbolizing economic priorities that had fallen out of fashion (Ferm & Jones, 2017). Consequently, property values for spaces that could reasonably be repurposed and/or redeveloped to feed the growing demand for offices, housing, entertainment, and other forms of consumption climbed precipitously (Curran, 2007; Ferm & Jones, 2017), while neighborhoods not as well-located or not as endowed with easily repurposed infrastructure faced additional struggles against neglect and abandonment.

In the context of rising inequalities from these feast/famine development dynamics, industrial revival and the prospect of “the productive city” (Novy, 2022) has attracted new attention as a potentially stabilizing force. Successful urban industrial revival, however, faces some significant challenges. Beyond the obvious struggles over competing priorities and land uses, new investments in industrial sectors are not immune to the same concerns about exclusion, gentrification, and displacement that plague other (neoliberal) urban development efforts. Competing expressions of industrial revival have thus generated new debates among advocates about how the future of the urban industry can/should look and whose interests are served by which visions. Some see the future of manufacturing in urban areas as inextricably tied to the rapid adoption of technological innovations connected with the “fourth industrial revolution” (Industry 4.0) and other smart-cities innovations—3D printing, CNC machines, additive manufacturing, and IoT (Hatuka & Ben-Joseph, 2017; Hatuka et al., 2017; Rappaport, 2020). From this perspective, embracing these technologies will make modern manufacturing firms more compatible with other urban land uses (commercial, residential) and more efficient and competitive, allowing them to take advantage of the proximity benefits in cities “where highly skilled talent and synergies among creative fields facilitate rapid prototyping and the creation of customized high-value products” (Rappaport, 2020, p. 161). Whether expressed through the entrepreneurial “maker movement” (Doussard et al., 2018; Wolf-Powers et al., 2016) or more traditionally organized advanced manufacturing firms (Reynolds, 2017), this perspective envisions the use of “innovation districts,” “vertical factories,” and other design advancements to close the perception gap between the “creative” knowledge economy and “traditional” manufacturing (Lane & Rappaport, 2020; Rappaport, 2017). With its energetic embrace of new technologies that offer a corrective to decades worth of post-industrial thinking and anti-industrial sentiment, this perspective offers a pragmatic vision for taking advantage of the opportunities that are newly available.

Not everyone is so optimistic, however, that new design and production technologies provide the appro-

priate response to the long arc of industrial decline. Others approach this technology-centered vision with more skepticism, concerned that the reliance on complex technologies brings to the industrial sector the same patterns of exclusion and inaccessibility that have plagued professional services. For example, Checker (2017, p. 114), discussing the New York City Economic Development Corporation’s Manufacturing 2.0 initiative to support a broadly defined maker movement, notes how the representation of “manufacturing” has changed:

[T]he program targeted local crafters, artisans, food/drink manufacturers, technology startups, film studios, visual artists, and fashion designers....Clearly, these manufacturers were not the low-income or working-class New Yorkers who once populated the city’s industrial labor force. Rather, they were exactly the highly educated, upper-middle-class creatives for whom Bloomberg built the “luxury city.” In this way, Manufacturing 2.0 signaled the gentrification of industry itself.

That idea of “the gentrification of industry itself” resonates with recent critiques of the emergence of “innovation” and “creative” districts, and the implementation of “artisan zoning” that have carried the maker movement in new directions. The concern is that innovation zones and the like can become tools for *anti*-industrial interests to creatively convert existing industrial lands to new purposes without explicitly appearing to do so (Chapple, 2015). Critics thus argue that “absent a long-term commitment to manufacturing or control of real estate by a mission-driven organization, the innovation district ‘brand’ may simply be the harbinger of industrial displacement through market-driven mixed-use redevelopment” (Lane, 2020, p. 37).

Similar to the discussion of expulsive zoning, above, the message from the debates over Industry 4.0 is that new approaches are needed. The wave of interest in urban manufacturing is exciting, but great care is needed to ensure that investments and developments in the manufacturing sector do not reproduce the same exclusionary patterns of the tech-focused, “creative,” and/or consumption-oriented projects that have dominated urban development in recent decades. Whether the activities take place in an “innovation zone,” “creative district,” or a more traditional industrial space, the challenge is to bring greater access to and inclusion in emerging opportunities. This can happen from within the formal planning infrastructure, through the exploration of new zoning categories and new ways to label and regulate the industrial practices allowed in the variously zoned urban spaces. However, those processes are famously time-consuming and politically contentious, opening room for complementary approaches from outside the formal planning establishment that can work with existing industrial spaces to improve how they fit

within the city and how benefits from those spaces can be extended to a wider share of the population. In the next section, we explore two such examples that offer innovations from the broader planning community.

### 3. Prioritizing Visibility and Inclusion

As the evolving and overlapping histories of expulsive zoning and creative displacement have directly contributed to the unequal landscapes that characterize contemporary US cities, we focus here on approaches that depart from those planning norms by prioritizing racial and spatial inclusion. As noted above, we connect with examples from outside the formal planning infrastructure in order to consider how inherited industrial landscapes might be approached in new ways that enhance and expand industrial retention. The two examples explored here—SFMade, in San Francisco, CA, and the Northland Workforce Training Center (NWTC), in Buffalo, NY—were selected after a review of extant urban and industrial planning literature, research and policy reports, news media, and web content, for their apparent prioritization of “inclusion” and “visibility” in their industrial development efforts. The selection of examples from markedly distinct contexts (tech-sector boomtown in Bay Area California vs. rustbelt city in Upstate New York), is also intended to provide some indication of the common challenges facing industrial advocates in the US and to suggest the possibility of shared remedies. The review of published materials was supplemented by eight semi-structured interviews intended to ground insights from published literature and to provide additional details about programmatic goals and motivations. The selection of interview subjects was guided by an initial targeting of key participants and subsequent snowball sampling. A site visit to San Francisco was included for additional contextualization. Interviews were transcribed and analyzed for important themes and patterns that can reveal lessons potentially applicable to other contexts and locations. We recognize that the small sample size limits the generalizability of the insights gained here and seek instead to reveal promising practices that demonstrate emerging possibilities and provide a foundation for additional exploration.

#### 3.1. SFMade: San Francisco, CA

San Francisco and the non-profit manufacturing advocacy organization SFMade have attracted attention for some of the innovative and collaborative approaches they have developed to retain and expand upon the limited industrial land and manufacturing opportunities available in the city. The historical arc of policy, spatial conversion, and recent industrial retention efforts that have centered SFMade as an influential and effective intermediary have been extensively covered by others (Chapple, 2017; Grodach, 2022; Grodach & Martin, 2018; Martin & Grodach, 2023). Aspects of their work that have

received less attention, and which we want to highlight here, are those that aim to provide inclusive opportunities for the structurally disadvantaged and systematically marginalized groups discussed above.

SFMade, located between two San Francisco neighborhoods (Mission and Potrero Hill) that have experienced extreme gentrification pressures, was established in 2010 with the intention of improving local economic resiliency and expanding economic opportunities by providing support for local manufacturing businesses and by working to “cultivate a vibrant workforce ecosystem” (SFMade, n.d.-a, para. 3). Working as an industrial advocate and workforce intermediary, SFMade has steadily grown its membership of manufacturers (over 600 members to date) and expanded their services in ways that have made them instrumental to bolstering the manufacturing ecosystem on a local and regional level (SFMade, n.d.-a). In viewing manufacturing as “an engine for equity,” the organization provides a range of services to link low-income job seekers with targeted training and employment opportunities and informs policymakers on the conditions needed to create and expand manufacturing opportunities. Their broad suite of services—business development and real estate assistance, membership networking, branding, and general workforce development—is executed through the intentional development of collaborative partnerships across governments, and advocacy organizations, and in working with many community organizations to further carry out their mission (Interview 1, 2022; SFMade, n.d.-b). In this regard, SFMade is an excellent example of a successful workforce intermediary and industrial advocate that facilitates and supports new and existing industrial practices (Clark, 2014; Giloth, 2004; Grodach & Martin, 2018).

Despite their many successes, however, SFMade and their partners have faced challenges as they work against established norms to ensure that the emerging manufacturing ecosystem (and any accompanying industrial revival) is inclusive and equitable. In addition to the more obvious difficulties of operating in San Francisco’s famously hot real estate market (Chapple, 2017), other institutional and knowledge gaps stymie progress, including limited manufacturing-focused career and technical education programs in the area, a lack of short-term, flexible training for working adults, and a K-12 education system that lacks attention to manufacturing occupations as viable career pathways (Interview 2, 2022; SFMade & Bay Area Council Economic Institute, 2021). More specific to the task of improving the racial diversity of the manufacturing workforce and ensuring the industrial sector as a whole is more inclusive, SFMade has found that many employers want to diversify their workforce but lack the knowledge and skills to do so (Interview 1, 2022):

We hear it all the time that [manufacturers] want to diversify their workforce, they want to improve their DEI [Diversity, Equity, and Inclusion]. You start

doing that by having systems in place to recognize that when you are bringing a more diverse workforce in, you need to be ready to support a more diverse workforce....It's fine to put a more diverse workforce in front of employers, but if employers aren't ready to meet people where they are at, support people through to success despite whatever challenges they may have as an individual, and use local resources to have that as a safety net, the job seeker and the employer are going to have a bad experience, and they are not going to work together anymore. The employer is going to say we can't do this; the reality is that they could, they just don't have the systems in place to do it in a meaningful way. So we are helping them do that....It's not only going to help you reach a more diverse workforce and hire them and retain them, it's also going to help you retain the people you currently have, and have them feel more enveloped in what you are doing.

From SFMade's perspective, it is not just that some individuals have barriers to employment; employers also put up barriers that make it difficult for those individuals to get connected to the jobs that are available (Interview 1, 2022). Put another way, while many manufacturing employers perceive a "skills gap" that keeps them from meeting their workforce needs, the SFMade team sees more of an "opportunity gap" that excludes some workers and keeps firms from achieving their inclusion goals. In the face of these challenges, SFMade has adapted to focus more intentionally on building clear pathways to inclusion by connecting employers with underrepresented populations and by helping firms develop support systems to improve how they recruit new workers and retain existing workers. One exemplary program in this regard is called Hiring With Purpose. Through this initiative, SFMade helps manufacturers build and implement more inclusive hiring processes and job opportunities, from assistance with developing job descriptions that focus more on skills and eliminating credentials when they are not necessary, to connecting employers with workforce organizations that serve more diverse communities that encounter various barriers to employment, including the reentry population and veterans (Interview 1, 2022). Establishing connections between employers and workforce organizations is especially important, as these organizations can provide valuable support services for job seekers after they are hired, and they can help employers develop deeper workforce partnerships and talent pipelines.

Beyond their own initiatives, SFMade has also developed partnerships with complementary agencies and organizations, locally and regionally, to reach additional underserved populations. For example, for the Next Generation Manufacturing Training program, SFMade partnered with the non-profit organization Humanmade, and the City of San Francisco, to provide a three-month manufacturing workforce development training pro-

gram that prepares low-income Bay Area residents with no prior manufacturing experience for entry level, living-wage manufacturing jobs (Humanmade, 2023). In another partnership, SFMade has worked with organizations in the neighboring city of San Jose (MFG: SJ, Goodwill of Silicon Valley, and MetroEd) on a similar training program for machine operators. On a third project, in Oakland, SFMade has partnered with the organization Crucible to launch the Open for Business program that provides BIPOC individuals with support and services to build, launch, and scale artisanal goods manufacturing businesses (Interview 3, 2022; Crucible, 2021). Finally, SFMade has been a central force behind the Bay Area Manufacturing Initiative, started in 2016 to "galvanize city governments, economic development intermediaries, higher education partners, and private sector sponsors" around regional manufacturing investments (SFMade, 2016, para. 13). In these partnerships, SFMade typically plays a coordinating role, helping to boost overall industrial activity and link employers and service providers with marginalized populations to foster "a stronger, more resilient, inclusive, and interconnected local economy" (SFMade, 2016, para. 13).

A key challenge that runs through their various efforts is raising the level of awareness and understanding of contemporary manufacturing. After a long generation of anti-industrial imagery, cultural celebration of non-industrial sectors, and the displacement of manufacturing from urban areas, most urban residents have very little exposure to current manufacturing facilities or practices (Interview 7, 2023). Formal planning efforts in the City of San Francisco have attempted to improve the image of manufacturing through a shift in language from "industrial" to "Production, Distribution, and Repair" (PDR) and have prioritized the protection of existing land use boundaries, but as Grodach and Martin (2018) discuss, the work of connecting with and advocating for these spaces has been taken up by SFMade. By focusing efforts on improving visibility and broadening access, SFMade raises awareness of manufacturing as a desirable career pathway. In other words, though the boundaries of industrial/PDR zones and land uses are relatively fixed, especially in a hot-market city like San Francisco, various other efforts can connect with and "activate" those spaces in new ways. Through a variety of programming—educational outreach, internship and apprenticeship programs, career fairs, and demonstration events like Manufacturing Week, classroom-to-career pipeline development with community colleges—SFMade and its partners combat outdated perceptions and generate a sense of energy and excitement about future manufacturing possibilities (Interview 1):

We're helping these young people understand this is a much safer, more efficient industry. We introduce people to local manufacturing and how it looks. We try to bring in local manufacturers to speak to them about their experience, what their trajectory



was, how they developed their ideas, how they operate here in SF....[We] take all sorts of people on tours of all the manufacturers to see how it's made, where it's made, who is making it. That piece is critical because there is a massive disconnect between the communities, jobseekers, business owners, neighbors, and the manufacturers that are making what we rely on and what the future is.

Importantly, much of this educational outreach also involves making manufacturing more visible to urban planners, developers, and public officials who are unfamiliar with how to think about and plan for industrial inclusion. This is a sentiment echoed across the interviews conducted for this research: Significant effort is needed to teach planners not just how to protect existing industrial zone boundaries but how to make those spaces and their important industrial activities more accessible, more visible, and more inclusive.

The central component of SFMade's work that we want to emphasize here is intentionality. SFMade has attracted attention for its efforts to revive the manufacturing ecosystem of a city famous for tech investments and creative class cultivations. But ensuring that the revived manufacturing ecosystem reaches populations marginalized by historic planning and development practices has required programming innovations that intentionally prioritize inclusion and make manufacturing more visible in the lives of urban residents. In essence, SFMade has engaged in the task of reimagining and "rebranding" how manufacturing fits in the city. The gains are nascent and partial, but they signal growing recognition that breaking patterns of exclusion requires new priorities and new strategies.

### 3.2. Northland Workforce Training Center: Buffalo, NY

SFMade built a foundation of success by reviving aspects of the city's industrial ecosystem; it then innovated to reach new populations by developing programming that prioritizes racial inclusion. For the NWTC, in Buffalo, NY, racial inclusion has occupied the center of its programming from the beginning. Created in 2018 with the mission "to advance the economic well-being of Western New York by developing and maintaining a skilled and diverse workforce to meet the needs of the advanced manufacturing and energy sectors," the NWTC seeks to "increase the number and quality of local candidates prepared for energy and advanced manufacturing careers" (NWTC, 2023, para. 3). The emphasis on "advanced manufacturing" is important in the context of the present discussion as it directly confronts the debate among industrial advocates over the role of technology in industrial futures. The NWTC example is unique in the way that it embraces the pragmatic tech-centered vision for manufacturing that advocates represent as necessary (and critics view as threatening) but does so in a way that centers and prioritizes the inclusion of historically marginalized

populations. Kelmenson et al. (2022, p. 7) characterize this approach in Buffalo as one of "inclusive innovation" for its simultaneous commitment to manufacturing innovations and "an explicit goal of promoting racial and economic inclusion."

Understanding how and why the NWTC pursues the inclusive innovation strategy requires additional context. In Buffalo, the industrialization/deindustrialization/redevelopment dynamic discussed above produced pockets of abandonment around the city from the decline of the historically vibrant manufacturing sector. That abandonment, part of a pattern of racial division throughout the city (University at Buffalo Regional Institute, 2016), was especially pronounced in the city's East Side, the manufacturing district where the Northland neighborhood and the NWTC are located. As various industrial properties lay fallow well into the 2010s, the area came to be "characterized by vacant lots, underutilized commercial and industrial parcels, insufficient housing and outdated infrastructure" (The Buffalo Billion II, 2019, p. 18). Meanwhile, a large-scale state-level initiative called the Buffalo Billion, launched in 2012 by then-Governor Andrew Cuomo, for the purpose of investing more than a billion dollars in economic revitalization throughout the city of Buffalo, was gathering attention through high-profile development projects. But, as one of our respondents notes, these investments were not reaching the East Side neighborhoods (Interview 5, 2023):

So, to make a long story short, because of the significant investment in the Buffalo Billion, the community felt like they were not being a part of the renaissance in Buffalo. Most of those investments went to a place called the Medical campus, which is in an area in Buffalo that's now revitalized. Another place was Canal Side, which is the waterfront....[In contrast] I mentioned early on the Northland Beltline area: low income, high crime, high poverty, no investment industrial areas that are basically dormant sections of the community right next to residential neighborhoods primarily occupied by people of color and low-income residents. It was determined at that time to revitalize this area.

For the industrially zoned East Side, revitalizing the area meant reviving the manufacturing sector that could provide jobs for local residents. According to the Western New York Regional Economic Development Council, reviving the manufacturing sector meant investing in advanced manufacturing. Despite decades of industrial decline, in the early 2000s, the manufacturing sector in the greater Buffalo region remained relatively strong in comparison with other urban areas. However, maintaining that strength and pursuing new growth opportunities required new investment strategies to "help these firms and assets to innovate, update their business models, redeploy assets toward newer products and

emerging markets, and develop advanced manufacturing capabilities” (Western New York Regional Economic Development Council, 2013, p. 11). In other words, the political winds were blowing in the direction of “knowledge based sectors and innovation” (Western New York Regional Economic Development Council, 2013, p. 6), and investment dollars were lining up to apply that vision to the manufacturing sector. In that context, there was not much uncertainty about NWTC’s purpose: to help realize the advanced manufacturing development strategy in Buffalo. As with the example of SFMade, the question was how to activate existing industrial spaces in ways that could reach and serve the desired population.

The two components of the inclusive innovation strategy pursued in Buffalo that we want to emphasize here are the siting of the NWTC building, and the programming that prioritized workforce pipelines, upskilling, and collaboration to broaden access to advanced manufacturing opportunities. In terms of location, the NWTC is housed in the former Niagara Machine and Tool Works building, a 100,000-square-foot facility that serves as the centerpiece of the Northland Beltline Corridor Redevelopment Project. As Kelmenson et al. (2022, p. 16), note, the location choice is intentionally symbolic of the project’s priorities: “This decision reflects the desire to strategically re-use former industrial land and infrastructure, and to include the East Side of Buffalo residents in a vision for shared prosperity.” That type of inclusion makes important resources more accessible to local residents, while the high-profile investment in a state-of-the-art facility in the manufacturing sector combats decades of negative imagery associated with isolation, neglect, abandonment, and loss. Tangible, street-level visibility thus weaves manufacturing into the daily lives of residents and infuses the sector with a new degree of vitality and positivity.

The NWTC’s workforce development programming builds on this physical accessibility to improve awareness of and readiness for emerging opportunities in the manufacturing sector by rebuilding workforce pipelines. Those pipelines serve two pressing tasks: (a) Educating potential employees about the realities of the sector (breaking outdated stereotypes of manufacturing as “dark, dirty, and dangerous”; Interview 7, 2023); and (b) making sure those pipelines reach marginalized groups, including “recent high school graduates, unemployed residents, single parents, and historically underrepresented populations such as women, people of color, veterans, refugees, immigrants, and those involved in the justice system” (Kelmenson et al., 2022, p. 12). The “inclusion” aspect of inclusive innovation thus targets specific populations, many of whom are residents of East Side neighborhoods, in an attempt to ensure that whatever investments are brought to the sector break from past patterns of exclusion.

The centrality of inclusion to their workforce pipeline development work is also reflected in NWTC’s commitment to cooperation and collaboration with comple-

mentary manufacturing service providers. By including organizations such as the Buffalo Manufacturing Works (an advanced manufacturing research, consulting, and fee-based service provider located in the same building as NWTC), Insyte Consulting (a non-profit manufacturing business and process consulting organization and the Western New York region’s Manufacturing Extension Partnership Center), the Buffalo Niagara Manufacturing Alliance (a non-profit industrial intermediary and advocacy organization for Western New York), local colleges and community colleges, and other service providers, NWTC helps coordinate a manufacturing ecosystem that offers comprehensive services to employers, employees, and those looking to enter the sector. Training focuses on building new skills for advanced manufacturing to bring new workers into the field, as well as ongoing training for existing workers to ensure professional mobility within the sector. That emphasis on up-skilling was a consistent theme across interviews, as respondents recognized the importance of pipelines that run not just to entry-level, but through various tiers of a manufacturing career (Interview 7, 2023):

What we want to be doing is more intentional inclusion and upskilling of those machinists that are coming out of Northland [NWTC] to then be up-skilled into automation a few years down the road. So we can continue that career upward mobility of folks so that they cannot just become people that are making a living wage, but the ones that are becoming the innovators.

There is much more to learn about NWTC’s approach to inclusive innovation that falls outside the scope of the present discussion (see Kelmenson et al., 2022, for more details specific to Buffalo; Lowe et al., 2021 and Lowe & Wolf-Powers, 2018, for examples in North Carolina and Illinois, respectively; and the Urban Manufacturing Alliance, 2023, for additional examples). What we have covered here is intended to capture the intentionality needed to break from a history of exclusion and highlight the role organizations like NWTC can play to broaden access to emerging opportunities in existing industrial spaces. Investments in raising the visibility of manufacturing help build awareness of and support for the sector’s viability, while innovative and collaborative programming helps ensure that manufacturing investments prioritize inclusion of populations that were excluded in the past and are too often forgotten or displaced by new initiatives.

#### 4. Conclusion

Our intention here has been to make connections between emerging interest in industrial revival and historic patterns of industrial planning in order to make the case for departures from traditional planning norms. The convention of separating industrial activities from other land uses in urban areas has protected many urban

residents from the worst of industrial pollution over the past century, but the history of expulsive zoning reminds us that those protections were extended inequitably, contributing to the segregation and marginalization of Black communities. More recently, the hard lines of zoning have provided defense against industrial displacement and some hope for industrial retention and revival, but competitive urban real estate markets have also weakened those defenses and ongoing urban redevelopment politics have complicated industrial revival strategies. The examples of industrial planning, broadly defined, explored here offer some promise of improved industrial futures by departing from those traditional norms and working to achieve more equitable gains within the boundaries of inherited industrial landscapes.

The two examples we explore here prioritize “visibility” and “inclusion” to enhance and extend manufacturing opportunities that are already emerging in response to evolving urban social and economic conditions. In terms of visibility, industrial advocates recognize that generations of anti-industrial attitudes and development practices have contributed to a general loss of industrial awareness. As Baker (2017, p. 120) has argued, confronting that invisibility can help strengthen urban industrial revival efforts:

Against this invisibility, a built environment that explicitly prioritizes public connections to industry can bring benefits in raising awareness of production processes, enabling social engagement between producers and the public and enriching everyday experiences of being in the public spaces of the city....This visual presence of production can prompt understanding of the human labor, mechanical processes and energy required to produce the often taken-for-granted material goods of our industrial society.

As discussed above, while the intentionally “conspicuous” siting of new production and support facilities in urban areas is important, raising the visibility of manufacturing also involves outreach to bring awareness of already existing manufacturing activities to new groups. Both SFMade and NWTC have actively sought to attract attention to developments and opportunities in the field and to activate existing spaces through a variety of efforts: hosting demonstration events, building internship and apprenticeship programs, developing new skills training programs, and collaborating with a wide variety of complementary service providers.

When paired with a commitment to racial inclusion, those efforts can help ensure that new investments in the manufacturing sector reach historically marginalized groups and that the expected benefits are more equitably shared. That intentionality is essential; as Checker (2017) has demonstrated, urban development approaches that fail to center new priorities can reproduce patterns of exclusion and reinforce displacement pressures.

There is clearly much more to say about these and other examples of manufacturing retention and revival, particularly with regard to the specific actions taken, the organizing involved, and the coalitions needed to achieve the gains discussed here (see Doussard & Schrock, 2022, on the evolving struggle for work-related justice). And we make no grand claims about these examples overcoming the many barriers faced by the manufacturing sector more generally, or ultimately “fixing” the historic problems of exclusion linked with the industrial sector. In many ways, these examples reveal the many challenges that manufacturing support-oriented organizations face in trying to create more inclusive manufacturing systems. But these departures from destructive industrial planning norms offer a kind of “proof of concept” to demonstrate that prioritizing improved visibility and inclusion in the manufacturing sector can make important contributions to more positive industrial futures.

### Acknowledgments

Special thanks to the reviewers and Editor for helpful feedback and suggested revisions.

### Conflict of Interests

The authors declare no conflict of interests.

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Article

# Next Generation Small Urban Manufacturing: Apprentices' Perspective on Location Factors, Mixed-Use, and Shared Spaces

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Submitted: 29 April 2023 | Accepted: 18 July 2023 | Published: 21 November 2023

## Abstract

Advancements in technology and architecture enable mixed-use development while normative settings like the European Commission's New Leipzig Charter support the concept of a productive city. Nonetheless, small urban manufacturers (SUMs) including crafts still face displacement due to property prices, conflicts with housing, planning laws, and building regulations. Urban planning and economic development emphasise the importance of identifying and redeveloping suitable sites for urban manufacturing companies. Largely unanswered, however, is whether the next generation of manufacturers (apprentices) want mixed-use locations within the city or space sharing, and if so, under which conditions. Based on two written surveys, this article examines the location requirements of SUMs in Germany and the willingness of apprentices in the Ruhr area to embrace mixed-use buildings and shared spaces. The study focuses on three craft groups: store crafts, workshop crafts, and construction site crafts. The results show that SUMs in Germany and manufacturing apprentices in the Ruhr prioritise car- and security-related infrastructure, as well as low real-estate costs. Store crafts specifically seek affordable and well-connected ground-floor locations. Construction site crafts prioritise (un)loading facilities for trucks on industrial land over sustainable transport infrastructure, and they differ significantly from the other craft groups in terms of mixed-use preferences. However, all craft groups express openness to mixed-use locations with offices and additional workshops and shared spaces like garages, canteens, and showrooms. The article suggests that commercial courtyards could effectively meet the requirements and desires of apprentices and urban planners alike.

## Keywords

built environment; company sites; mixed-use; productive city; shared spaces; urban manufacturing; urban planning and design; vocational students

## Issue

This article is part of the issue "Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production" edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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## 1. Introduction and Context

Urban manufacturing, or urban production, is defined as "making and converting tangible goods in mixed-used and often densely populated areas by preferably using local resources and local value chains" (Brandt et al., 2017, p. 27; see also Brixey et al., 2023; Hill, 2020). In this article, we focus on small urban manufacturing (SUM) companies (Mistry & Byron, 2011) including crafts and distinguish between them using the Chamber of Crafts Düsseldorf classification (Handwerkskammer Düsseldorf,

2022) of craft groups: construction site crafts, workshop crafts, and store crafts.

Small urban manufacturers (SUMs) are experiencing a decline in number of employees, companies, and production sites (Bonny, 2021; Brixey et al., 2023; Ferm, 2016; Ferm et al., 2021; Greenhalgh et al., 2021). This is due to international competition with economies of scale, low transport costs, or not-priced-in CO<sub>2</sub> emissions, as well as high wages and high rents, which threaten the profitability of products produced or repaired locally (Gärtner & Schepelmann, 2020). SUMs also compete locally with

other real-estate sectors, such as office buildings and hotels in commercial areas and housing in mixed-use areas, which can result in high property prices and industrial gentrification (Ferm, 2016; Graham & Spence, 1997). Furthermore, challenges in mixed-use areas include conflicts with housing, planning laws, building regulations, or material transportation, which can lead to SUMs relocating into commercial or industrial areas or even company shutdowns. The overall result is that for manufacturing companies and their employees, everyday commutes are getting longer as mixed-use city planning, including manufacturing, has become a rarity (Steinborn, 2020).

In response to these challenges, urban planners and politicians outlined guiding principles, such as the New Leipzig Charter, to reintegrate production and manufacturing into mixed-use neighbourhoods and secure manufacturing spaces. The document sets the normative goal of transformative urban development, including the cornerstones of the productive city with short distances and space for small and medium-sized manufacturing companies, urban agriculture and the green city, including the circular economy (European Commission, 2020). In addition, due to the Sustainable Development Goals, the Paris Agreement, and the European Commission's Green Deal (Angstmann et al., 2022; Hörnschemeyer et al., 2022) there is an increasing focus on the circular economy including industrial symbiosis, area or resource sharing and exchange, and environmental innovation and its diffusion (Clausen & Fichter, 2021; Domenech et al., 2019). SUMs can promote the circular economy primarily through maintenance and repair and also the reprocessing and refurbishing of existing properties to reduce raw material consumption (Hausleitner et al., 2022; Tsui et al., 2021).

From an urban planning and economic development perspective, it is necessary to identify, keep, and redevelop sites to suit small-scale manufacturing companies as part of the circular economy, including production and repair shops or waste treatment in the urban area (Brandt et al., 2017; Fedeli et al., 2020). Several cities, including Berlin, Bremen, Brussels, Düsseldorf, and Vienna have recently developed strategies to promote and maintain mixed-use structures including SUMs (Meyer, 2023).

The research project *UrbaneProduktion.Ruhr*, funded by the Federal Ministry for Education and Research from 2016 to 2022, focused on structurally weak districts in the Ruhr area as opportunity areas for SUMs. The project aimed to develop recommendations for action and living labs to attract manufacturers to vacant stores to enhance district attractiveness and create diverse employment opportunities (Läpple, 2016). The Ruhr in northwest Germany with its approximately 5.1 million inhabitants was chosen because of its ongoing transformation and its character as a metropolitan region with little space for manufacturing and industry. Once a leading industrial region in Europe, heavily reliant on steel, coal mining, and chemical industries, the Ruhr has been undergoing structural change towards a

more service-oriented economy since the late 1950s (Zakrzewski, 2019). However, unemployment remains relatively high, and not all former employees from the mining sector and defunct industries have found employment in services (Dahlbeck et al., 2022). Furthermore, the redevelopment of industrial areas is costly due to contamination, and there is a lack of new commercial and industrial space. While cities like Düsseldorf, Munich, and Vienna have developed mixed-use spaces for SUMs (with a certain degree of subsidisation) the Ruhr has not.

Despite these developments, there is limited prior knowledge regarding the specific location requirements and willingness to use mixed-use buildings or share spaces of SUMs in general, and no information at all about the next generation (Handwerkskammer Düsseldorf, 2022; Meyer, 2019; Mistry & Byron, 2011; Steinborn, 2020; Zentralverband des deutschen Handwerks [ZDH], 2019). Planning and participation processes have failed to give attention to the next generation, particularly apprentices and students who will follow in the footsteps of current urban manufacturers (Bathen et al., 2022; Meyer, 2023). Nevertheless, planning and changes made in the built environment today will directly affect this group.

Therefore, this article addresses the following questions: (a) What are the location requirements of SUMs and manufacturing apprentices, and do they differ? (b) Are there differences among the craft groups? (c) Can manufacturing apprentices envision using mixed-use buildings and shared spaces, and if so, in what way? (d) What should be considered when planning buildings or sites for future SUMs?

To address these research questions, the article provides a comparative study of two surveys regarding required location factors: one of SUM companies in Germany, based on a secondary source analysis (Malec et al., 2019; Meyer, 2019) and another of apprentices (next generation of manufacturers) in the Ruhr area. Further, the surveys were compared in order to cross-check the validity of the results. In addition, the apprentices' survey considers their willingness to use mixed-use and shared spaces to achieve a productive and circular city. The study differentiates between the samples according to the three craft groups to uncover the special requirements of each. The hypothesis is that there are differences between the crafts groups that influence their location and mixed-use requirements in the cities.

The next section considers the theoretical background of the investigation. Section 3 turns to the methodology, which is followed by the presentation and discussion of the results. The article concludes with recommendations for action and further research questions.

## 2. Small Urban Manufacturing: Location, Mixed-Use, and Shared Spaces

Urban manufacturing bridges theories of location (Christaller, 1933; Weber, 1909), clusters (Porter, 2000),

and regional innovation systems (Asheim & Isaksen, 1997; De Propris & Hamdouch, 2013) on the one hand and approaches of a foundational (De Boeck et al., 2017), circular (Hausleitner et al., 2022; Tsui et al., 2021) and local economy (Brandt et al., 2017; Henn & Behling, 2020; Krenz et al., 2022; Lowe & Vinodrai, 2020) on the other. While the theories play a more important role in mainstream economic development, they also are usable for SUM (Sassen, 2009). Work on the foundational economy looks “at the local and regional consumption and the (potential) production of daily life goods” (De Boeck et al., 2017, p. 1880) as well as creating local jobs. The circular economy aims for a climate-neutral future and advocates mixed-use and shorter distances between manufacturer and consumer, more repair options within cities, and circular economy services (Hausleitner et al., 2022; Paech, 2016; Tsui et al., 2021). SUM companies play a particular role in sustainable urban development, e.g., in the sectors of energy transition, resource conservation, demographic change, mobility, nutrition, and resilience (Handwerkskammer Düsseldorf, 2022). Moreover, as part of the local economy SUMs play a role as crafts with particular spatial relevance as they frequently carry out a direct supply function for the local population and are committed to the local development of the location (Henn & Behling, 2020).

Despite the potential benefits, as Brandt et al. (2017, p. 27) point out, “the proximity to living spaces requires...low-emission modes of production to avoid conflicts with residents.” Consequently, it is essential to create an environment for urban manufacturing that benefits manufacturers and residents alike (Rudolf et al., 2023).

Following a classification of the Chamber of Crafts Düsseldorf (Handwerkskammer Düsseldorf, 2022, p. 2), this article categorises SUMs into three groups of crafts, which are also used to analyse the empirical data:

1. Construction site crafts are predominantly found on construction sites. The specific location requirements are less pronounced and essentially focus on the required area and traffic access. They include: (a) construction, e.g., masons, building mechanics, construction fitters, and civil engineers; and (b) interior construction, e.g., carpenters, heating, ventilation and air conditioning (HVAC) plant mechanics, and electrical engineers.
2. Workshop crafts often have very specific location requirements which can conflict with neighbouring uses, especially housing. They include: (a) crafts for commercial use, e.g., metalworkers, plant mechanics, galvanisers, electromechanical engineers (excluding information technicians, cleaners); (b) automotive sector, e.g., automotive mechatronics technicians or service mechanics; and (c) construction components, e.g., furniture producers, glaziers, and joiners.
3. Store crafts rely on attractive city and district centres. Space requirements are generally lower, but the quality of the surroundings is more important. They include: (a) food (technology), e.g., bakers, butchers, brewers, and confectioners; (b) health craft, e.g., orthopaedic technicians, hearing aid manufacturers, and dental technicians (often heavily digitalised); and (c) service providers, e.g., tailors, musical instrument makers, and cobblers (excluding hairdressers, barbers, and beauticians).

In the following sections, we look at the location factors for SUM companies and existing shared spaces, infrastructure, and facilities as an architectural and technological solution to achieve mixed-use.

### 2.1. Location Factors for Small Urban Manufacturing

Classical location theory emphasises transportation accessibility as a crucial determinant, while labour availability is less significant. Weber (1909) later introduced agglomeration economies as a third factor (Sassen, 1991). Recent empirical studies on location factors for urban manufacturing companies tend to focus on global factors to shed light on reshoring and industry 4.0 activities (Bhatnagar & Sohal, 2005; Burggräf et al., 2019; Busch et al., 2021; Ellram et al., 2013; Johansson & Olhager, 2018). In contrast, this study looks primarily at small-scale, local factors that are significant for small and medium-sized enterprises and local crafts.

Nowadays it is more difficult for SUMs to find desirable locations. Historically, small businesses clustered along industrial streets and railway arches, fostering vibrant local manufacturing communities. Unlike railway viaducts, industrial streets with small-scale buildings have experienced residential and commercial gentrification with mixed-use buildings often integrated into them (Ferm et al., 2021). A global political shift towards neoliberalism has “led to the privatization of government-owned land, reducing municipalities’ abilities to protect industrial land” (Tsui et al., 2021, p. 13) and municipalities have converted much industrial land for higher tax revenues. In addition, SUMs have a limited search radius for location. In comparison to large companies, small businesses often choose city sites based on proximity to the founder’s residence rather than rational decision-making (Hahne & Stackelberg, 1994).

In light of this, we take a comparative look at location factors in the crafts sector drawing on various applied empirical studies (see Table 1 in the Supplementary File). The studies clearly illustrate that good transport connections, especially to the motorway, are by far the most relevant factor for craft companies (Domenech, 2020; Handwerkskammer Düsseldorf, 2022; Hausleitner et al., 2022; Landes-Gewerbeförderungsstelle des nordrhein-westfälischen Handwerks, 2005; StadtGUUT, 2022; ZDH, 2019). Furthermore, proximity to customers, good public



transport, availability of parking and expansion spaces, and skilled workers are also important. In addition, low costs for the property are essential (Handwerkskammer Düsseldorf, 2022; StadtGUUT, 2022). Domenech (2020) shows that storage space is crucial for 25% of the surveyed companies, although companies often refrain from storing materials due to spatial constraints and prefer to optimise their processes. One problem is the lack of storage space for waste management and recycling, which “leads to cross-contamination and reduces the ability to introduce high-quality recovery and recycling of industrial and commercial waste” (Hausleitner et al., 2022, p. 95). Storage space is therefore essential to contribute to the circular economy.

According to Sevcik et al. (2022), the most significant potential for urban commercial real estate can be found in city districts, particularly for properties that are more difficult to market due to the age of the building and the high demand for high-quality amenities. As space requirements differ according to craft groups (ZDH, 2019), the question arises as to whether and which of the craft groups would want to use mixed-use spaces.

## 2.2. Mixed-Use Buildings, Shared Spaces, and Services as Environmental Innovation

The original European city was characterised by mixed land-use and mixed-use buildings. Medieval townhouses consisted of business and production rooms on the ground floor, apartments on the upper floors, and storage under the roof. The Wilhelminian buildings constructed in dense blocks were also mixed-use (Söfker-Rieniets & Schmidt, 2023). Due to industrialisation and its emissions, the rapid growth of cities and new transportation options, mono-functional residential areas increasingly emerged based on concepts like Howard’s “garden city” and Le Corbusier’s “functional city” and fences came to represent company sites (Hüttenhain & Kübler, 2021). With the New Leipzig Charter and concepts like the 15-minute city, short distances and mixed-use buildings are experiencing a renaissance (European Commission, 2020; Roost & Jeckel, 2021; Ryckewaert et al., 2021). With the amendment of the Building Use Ordinance in 2017, Germany introduced the *Urbanes Gebiet* (“urban area”; according to the German Building Use Ordinance §6a BauNVO) intended to facilitate the planning of mixed-use cities combining living, services, and manufacturing (Brandt et al., 2017; Schoppengerd, 2023). So far, however, planning for such areas often just mixes services (gastronomy, office, retail stores, social or cultural institutions) and residential functions. New builds of mixed-use structures that include manufacturing remain scarce (Bathen et al., 2022; Haselsteiner et al., 2023; Rudolf et al., 2023).

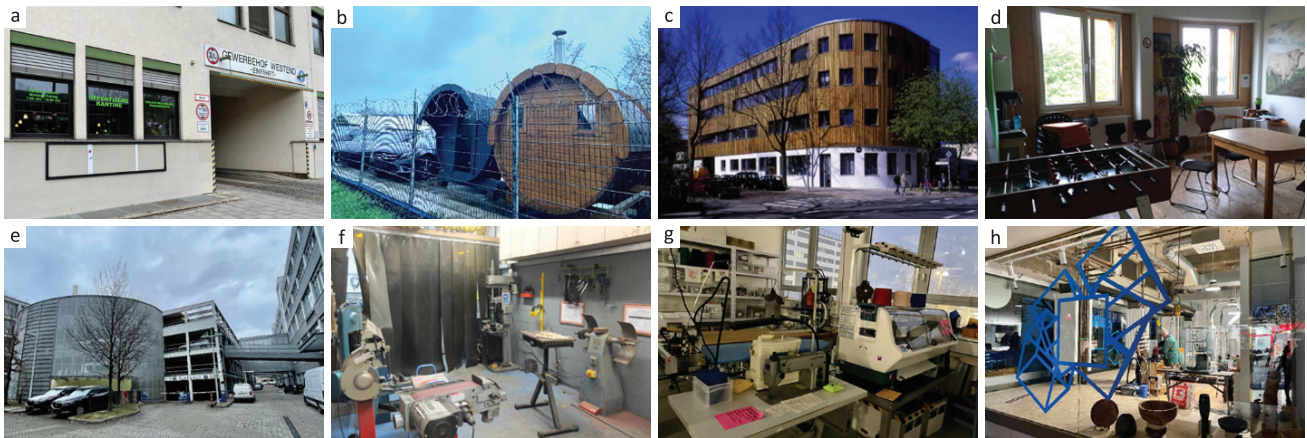
Nonetheless, individual manufacturers are increasingly having contact with the public and the urban fabric and, in some cases, creating visibility and permeability on company sites (Sgobba, 2012). Concepts

like industrial symbiosis (Chertow, 2007), the sharing economy (Lessig, 2008), and sharing spaces (Hahne, 2018; Hausleitner et al., 2020) or machines (Handwerkskammer Düsseldorf, 2022) have evolved in an attempt to achieve higher utilisation of facilities, conserve resources, save costs, and promote cooperation in the context of the circular economy (Handwerkskammer Düsseldorf, 2022; Hausleitner et al., 2022; Lange, 2017). Hüttenhain and Kübler (2021) show that some transforming multi-national companies are highly interconnected on-site (e.g., use waste heat for other processes or develop material cycles). The context and size of the site determine the contact points with the public. These may include ground-floor public areas, attractive public spaces, (social) infrastructures like an open canteen (Figure 1a), and space for external operators like shared storage space. This may involve trivialities, such as offering a storage area for another company (e.g., for the rental of sauna barrels; Figure 1b). “In this way...the necessary critical mass can be reached for some facilities through the joint use of staff and neighbourhood. Offers become more profitable...They serve as intermediaries between the company and the city” (Hüttenhain & Kübler, 2021, p. 373).

By organising small and medium-sized craft companies in commercial courtyards, especially in multi-storey commercial locations (Figures 1c and 1e), costs can be lowered, facilities (e.g., shared kitchenettes, Figure 1d; or shared car-parking, Figure 1e) and resources can be bundled, and synergies can be created. They can trigger ideas of by-product reuse, infrastructure sharing, and the joint provision of services for crafts (Haselsteiner et al., 2023). Within an urban context, sharing resources has become an increasingly attractive option. For start-ups in particular, the possibility of sharing expensive machines can be a good alternative to investing in their own equipment (Handwerkskammer Düsseldorf, 2022; Figures 1f and 1g). For example, in Solingen, knife sharpeners and manufacturers are currently using a previously vacant store as a showroom, event space, and sharpening workshop (Figure 1h).

However, there are obstacles regarding data security, liability in the event of damage, restriction of flexibility, and entrepreneurial responsibility with a high degree of trust required between cooperation partners. According to the Chamber of Crafts, shared-use sites thus offer innovation impetus, but will only be considered for a minority of businesses (Handwerkskammer Düsseldorf, 2022). There is motivation for sharing if “resource sharing can reduce costs and/or increase revenues or industrial symbiosis can enhance long-term resource security by increasing the availability of critical resources” (Chertow, 2007, p. 13).

In existing industrial areas, it is often difficult to know the requirements and perspectives of all the local companies, which usually differ, and individual companies lack the resources or ideas to transform an area. Through the development of a complex manufacturing network by



**Figure 1.** Overview of examples of existing shared spaces eligible for SUMs: (a) Canteen in commercial courtyard Munich-West; (b) storage area used for sauna barrels and cars, Bochum; (c) commercial courtyard Hamburg-Ottensen (Yvonne Rokita); (d) kitchenette in commercial courtyard Hamburg-Ottensen (Marcel Schonlau); (e) parking spaces in commercial courtyard Munich-East; (f) individual machines in the RUB Makerspace, Bochum; (g) production room Black Horse Workshop, London; (h) showroom “Gläserne Werkstatt,” Solingen.

actively linking complementary businesses and services, facilitating exchanges of technology, creating synergies, and collaborating on complex projects, opportunities for industrial symbiosis and the circular use of resources may emerge (Bathen et al., 2022; Hausleitner et al., 2020). However, will SUMs be willing to share facilities?

### 3. Methodology

To address the challenges of displacement of SUMs, the limited industrial land available for them, and the scarcity of models of mixed-use that include SUM, this article aims to discuss how the next generation of potential urban manufacturers envision their locations.

We hence conducted an online survey of manufacturing apprentices in the Ruhr in 2020 and 2021 and compared the results with a “SUMs Survey” in Germany carried out in 2019 (Malec et al., 2019; Meyer, 2019). Both surveys investigated the perceived importance of location factors, allowing us to compare the perceptions of present SUMs with the next generation of manufacturers. For the “Apprentices Survey,” we designed and pretested a questionnaire targeting the next generation of workers and entrepreneurs in manufacturing disciplines (Williams, 2003). The aim was to determine their requirements concerning desired locations, including mixed-use and shared spaces (according to existing shared spaces in Figure 1). In the German dual-training system, apprentices already work in companies and thus have gained initial experience with location requirements. The questionnaire (Supplementary File) includes questions with four-point Likert scales and dichotomous, ranking, and a few open questions; it was adapted and structured into five sections: general information, (training-)company characteristics, value chains and sales markets, images for future location factors and site characteristics, and socioeconomic data.

Table 1 displays the methodological procedure, responses, and sample characteristics including company size, craft group, and gender of the participants. There is a misrepresentation of the three characteristics. Construction site and workshop crafts are barely represented in the survey of SUMs and companies from the store craft sector are overrepresented compared to the apprentices’ survey (for more information about the samples see Table 2 in the Supplementary File). It is assumed that this explains the differences in terms of gender and company size. The average age of the apprentices was 23 and more than half (56%) of them plan to be self-employed, 20% do not, and the rest is uncertain (see Table 3 in the Supplementary File). We considered all responding apprentices in the analysis, as their wishes about their future workplace are of concern, be it as managing owners or employees.

Due to the Covid-19 pandemic, the apprentices’ survey was conducted exclusively online. It was distributed to 138 teachers from 25 vocational colleges and 68 professors and lecturers from three universities of applied sciences and one technical university covering about 60 disciplines. Initially, teachers, professors, and lecturers in the central Ruhr area were asked to forward the link to their students in the final year of training in 2020. Due to the low response rate, we extended the period and contacted student councils at various universities and three Chambers of Crafts. Despite this, the response rate hardly increased and the initial teachers and lecturers were contacted once more in 2021, which finally resulted in 13% of the teachers forwarding the questionnaire. The response rate of the students who received the questionnaire was about 24%. This included 79% apprentices, 9% students from universities of applied sciences, and 12% university students—all referred to as apprentices in the following. Since not all participants answered all questions equally in the surveys, the

**Table 1.** Methodological background and sample characteristics.

	SUMs	Apprentices
Research method	Secondary analysis of a SUM company owner survey (Malec et al., 2019; Meyer, 2019)	Survey of manufacturing students and apprentices conducted in 2020–2021
Research area	Germany	Ruhr area
Research interest	Location factors	Location factors Conceivability of mixed-use buildings and shared spaces
Number of responses	114 (80 fully completed) Response rate: 6.6%	357 (181 fully completed) Response rate: ~24%
Number of employees at company		
1–2	55%	3%
3–10	31%	17%
11–50	12%	40%
51–250	2%	40%
Craft group		
Construction site crafts	14%	36%
Workshop crafts	10%	39%
Store crafts	76%	25%
Gender of participant		
Male	50%	74%
Female	50%	26%

numbers (*n*) differ in the tables (Bartlett et al., 2001). Further, we must note that in the case of apprentices, all crafts were surveyed and no distinction was made according to location, as we generally wanted to know which future locations they would be interested in if they were planning to become self-employed. In contrast, in the SUMs survey, only urban locations were addressed. Data collection problems were mainly due to limited access to vocational and university students due to the pandemic and the lack of technical infrastructure in the vocational colleges.

In the following, we compare the apprentices and SUMs survey using descriptive statistics and mean value comparison for independent samples. To identify the differences between the surveys and the craft groups, a Mann-Whitney-U (for two groups) respectively a Kruskal-Wallis-test (for the three crafts groups) was performed on independent samples since there is no normal distribution. To summarise the location factor items, a factor analysis (maximum likelihood) was performed (see Table 4 in the Supplementary File), resulting in seven factors explaining 42% of the variance of the data.

#### 4. Results and Findings

First, we look at differences in location factors between the two samples, followed by differences in craft groups within each sample. Then, for the apprentices, we present

the results of whether and what kind of mixed-use buildings and shared spaces they can imagine.

##### 4.1. Location Factors by Sample

Starting with the results of the location factors (Table 2), the most important location factors according to the mean for the SUMs are the low real-estate costs (3.67), which are also very important for the apprentices (3.13). Most important for the apprentices (3.39) and also important for the SUMs (3.33) is the car- and security-related infrastructure, which includes security against burglaries as well as the availability of parking spaces, good internet, mobile phone, road connections, and availability of space. The results confirm previous studies on SUMs.

The factors of central ground-floor location, close to home and low real-estate costs differ significantly between the two surveys. In the SUMs survey, store crafts and small companies predominate, which might explain the higher relevance of a central ground-floor location and being close to home. These findings underline that it is worth considering ground-floor locations for SUMs, as well as car and security-related infrastructure and low real-estate costs, both in the reactivation of vacancies in city centres and in the redevelopment of districts. The SUMs show greater importance of location factors that are more attributable to urban mixed-use

**Table 2.** Relevance of location factors for SUMs and apprentices.

Factor	Relevance for SUMs			Relevance for apprentices			Mann-Whitney-U-test
	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>	Significance (two-sided <i>p</i> )
Sustainable transport infrastructure	76	2.83	0.87	184	2.82	0.73	0.705
Car and security-related infrastructure	76	3.33	0.60	184	3.39	0.39	0.695
Proximity to other facilities	75	2.54	0.79	184	2.48	0.57	0.517
Close to home	74	2.47	1.04	184	2.10	0.64	0.012*
Low real-estate costs	75	3.67	0.68	183	3.13	0.68	< 0.001*
Central ground-floor location	76	3.29	0.79	185	2.55	0.67	< 0.001*
(Un)loading facilities for trucks on industrial land	73	2.42	0.89	185	2.60	0.77	0.147

Notes: Values of 1 “unimportant” to 4 “very important”; \* significant difference.

locations than manufacturing apprentices. Therefore, to gain a deeper understanding of the apprentices, we make further differentiations following the craft groups.

#### 4.2. Location Factors by Craft Groups

The Mann-Whitney-U-test showed hardly any significant differences between the craft groups for the SUMs. The similarities of the surveyed SUMs may explain the few differences. The only significant difference between the two craft groups is sustainable transport infrastructure that is more important for store crafts (Table 3). In the apprentices survey we compare three craft groups because of the larger population. The Kurskal-Wallis-test shows that workshop crafts differ significantly from construction site crafts with regard to sustainable transport infrastructure. In addition, workshop crafts differ from store crafts in terms of car and security-related infrastructure. There are further significant differences between store crafts and the others concerning the central ground-floor location and (un)loading facilities for trucks on industrial land. In the case of apprentices, there is a clearer distinction. As expected, store crafts prefer central ground-floor locations, whereas truck-loading areas and good car and security-related infrastructure are less important.

#### 4.3. Conceivability of Mixed-Use Buildings and Shared Spaces by Apprentices

The location factors show that central ground-floor locations play a role in the store crafts, but they do not shed light on whether and what kind of mixed-use structures are envisioned by the apprentices. Table 4 gives an overview based on craft groups of the conceivability for apprentices of having further uses in their building and of sharing spaces. It becomes apparent that most of the crafts can imagine sharing the building with a service

use (0.80) or an additional workshop (0.73). However, there is a significant difference between the construction site’s crafts and the others—with construction site crafts being less open to sharing with an additional workshop, retail, and gastronomy. Further, it is interesting that the store crafts cannot imagine having a residential use in the same building, which is a significant difference from the construction site crafts.

When asked whether the apprentices could imagine sharing their company site, building, individual rooms, or machines with other businesses, there was the most approval from all apprentice groups regarding shared parking spaces (0.80), while 22% of the store crafts already share parking spaces in their actual company situation (see Tables 5 and 6 in the Supplementary File). Further, a majority of all craft groups could imagine using a shared canteen (0.66) or a showroom (0.53). Shared storage space was conceivable, especially for workshop crafts (0.53) and store crafts could imagine sharing a kitchenette (0.54). However, there are no significant differences according to the Kurskal-Wallis-test between the craft groups. Shared spaces are so far not very common in existing manufacturing companies but in some cases are conceivable.

### 5. Next Generation Small Urban Manufacturing? An Outlook

The article gives insights into the location requirements of SUMs in Germany and the willingness of the next generation of manufacturers in the Ruhr to consider mixed-use buildings and shared spaces. Consideration is given to three craft groups. The results show that SUMs in Germany and apprentices in the manufacturing sectors in the Ruhr area generally require car and security-related infrastructure and low real-estate costs. This confirms existing literature and studies on craft location factors. The importance of central ground-floor

**Table 3.** Mean value comparison and non-parametric testing by craft groups for each survey.

Location Factors	SUMs (Germany)						Apprentices in manufacturing disciplines (Ruhr area)								
	Mean value comparison and Mann-Whitney-U-test						Mean value comparison and Kruskal-Wallis-test								
	Construction and Workshop crafts			Store Crafts			Construction site crafts			Workshop crafts			Store crafts		
	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>
Sustainable transport infrastructure	18	2.42*	0.81	55	2.94*	0.86	75	2.63*	0.81	63	3.01*	0.67	46	2.88	0.63
Car and security-related infrastructure	18	3.24	0.50	55	3.39	0.62	75	3.38	0.41	63	3.49*	0.39	46	3.26*	0.35
Proximity to other facilities	18	2.36	0.59	54	2.65	0.83	75	2.41	0.60	63	2.51	0.58	46	2.57	0.48
Close to home	17	2.59	0.96	54	2.46	1.09	75	2.18	0.65	63	2.02	0.63	46	2.07	0.61
Low real-estate costs	18	3.67	0.49	54	3.69	0.72	75	3.21	0.76	62	3.08	0.68	46	3.07	0.53
Central ground-floor location	18	3.16	0.67	55	3.35	0.81	75	2.39	0.61	63	2.47	0.66	47	2.92**	0.66
(Un)loading facilities for trucks on industrial land	18	2.44	0.76	52	2.42	0.96	75	2.74	0.81	63	2.72	0.70	47	2.21**	0.67

Notes: Values 1 “unimportant” to 4 “very important”; \* significantly different to each other; \*\* significantly different to both other groups.

location, proximity to home and low real-estate costs differ between the two surveys, as the SUMs are already in an urban context and the sample characteristics show that smaller companies took part. Regarding the differences between the craft groups, the tested hypothesis, cannot be confirmed for all the location factors. However, a significant difference can be seen in the apprentice’s survey between store crafts, which require central ground-floor locations, and the other crafts. This suggests that store crafts rely on cheap and well-connected ground-floor locations and that they could play a role in both the reactivation of vacancies in city centres and the redevelopment of districts.

For construction site crafts, sustainable transport infrastructure is less important, but (un)loading facilities for trucks on industrial land are more important than for workshop and store crafts. In addition, there were significant differences between the construction site crafts and the others for most of the mixed-use

functions (gastronomy, additional workshop, and retail store), suggesting that these are more inconvenient additional building uses for the construction site crafts. Notably, construction site craft is the only group in which mixed-use with residential functions is conceivable. As within this group the location factor “close to home” is slightly higher than in the other groups, it can be assumed that the ideal location would be in commercial areas, and in some cases including company housing.

Generally, the apprentices of all craft groups are open to mixed-use locations with offices and additional workshops. This may be because offices often need less space, are less disruptive of operations, generate additional revenue, and may create synergies. Shared parking spaces or garages and shared canteens are highly conceivable and shared showrooms are conceivable by all apprentices without a significant difference between the craft groups. A shared kitchenette is also conceivable for store crafts and shared storage spaces for workshop crafts.

**Table 4.** Conceivability of having additional uses in company building or of sharing spaces in the future for apprentices by craft group.

	Construction site crafts			Workshop crafts			Store crafts			Total		
	Mean value comparison and Kruskal-Wallis-test									<i>n</i>	mean	<i>SD</i>
	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>	<i>n</i>	mean	<i>SD</i>			
<b>Conceivable additional use in company building</b>												
Residential	69	0.26*	0.44	58	0.17	0.38	40	0.05*	0.22	167	0.18	0.39
Gastronomy	68	0.26**	0.44	55	0.49	0.5	32	0.56	0.5	155	0.41	0.49
Service (e.g., office use)	53	0.75	0.43	43	0.91	0.29	27	0.7	0.47	123	0.8	0.4
Additional workshop/production facility	65	0.58**	0.5	48	0.83	0.38	37	0.86	0.35	150	0.73	0.44
Retail (store)	66	0.26**	0.44	54	0.31	0.47	21	0.62	0.5	141	0.33	0.47
Social/cultural institution	68	0.19	0.40	58	0.28	0.45	38	0.23	0.43	163	0.23	0.42
<b>Conceivable location in a commercial courtyard</b>												
	46	0.48	0.51	43	0.56	0.50	30	0.73	0.45	119	0.57	0.50
<b>Conceivable shared space</b>												
Storage space	71	0.49	0.5	70	0.53	0.5	47	0.47	0.5	188	0.5	0.5
Canteen	76	0.63	0.49	75	0.72	0.45	47	0.6	0.5	198	0.66	0.48
Kitchenette	76	0.43	0.5	72	0.5	0.5	48	0.54	0.5	196	0.48	0.5
Showroom/presentation room	75	0.55	0.5	70	0.51	0.5	50	0.52	0.5	195	0.53	0.5
Office and administration	74	0.36	0.48	70	0.43	0.5	50	0.34	0.48	194	0.38	0.49
Parking spaces/parking garage	73	0.75	0.43	74	0.82	0.38	42	0.86	0.35	189	0.8	0.4
Production rooms	71	0.34	0.48	67	0.37	0.49	50	0.26	0.44	188	0.33	0.47
Individual machines	73	0.4	0.49	61	0.34	0.48	49	0.31	0.47	183	0.36	0.48

Notes: Values of 0 “not conceivable” and 1 “conceivable”; \* significantly different to each other; \*\* significantly different to both other groups.

Commercial courtyards and “pure commercial buildings” could combine many of the desired location requirements (e.g., low rents, good internet and public transport connections, and shared parking spaces). Since there are hardly any shared properties that include SUMs in the Ruhr so far, e.g., compared to the commercial craft yards in Munich, they could represent a space-saving solution, especially for store and workshop crafts. Subsidies, organised commercial courtyards, commercial area management (Hüttenhain & Kübler, 2021), or a curator (Bathen et al., 2022; Hill, 2020) might be helpful to encourage companies to make vacant space on their sites available to other companies, use a vacant store as shared showroom, or to relocate. Finding new or shared spaces for SUMs and protecting industrial and commercial spaces from gentrification requires a clear vision and political will (De Boeck et al., 2017).

For further research, it may be fruitful to consider apprentices in other regions as well as in service industries or nearby residents as comparison groups, considering the extent to which they could imagine mixed-use properties including manufacturing. Exploring why individual apprentices can or cannot imagine certain additional uses or sharing offers would also fruitfully extend this research.

#### Acknowledgments

Special thanks go to Dr Stefan Gärtner, Maria Rabadjieva, Dr Franz Flögel, and the reviewers for helpful comments on an earlier version of this article and the lecturers of the vocational colleges who distributed the questionnaires. Additionally, the author thanks Joseph Ottolino and Katharine Thomas for linguistic assistance.

The author acknowledges financial support by Deutsche Forschungsgemeinschaft and Technische Universität Dortmund/TU Dortmund University within the funding programme Open Access Costs. This work was supported by the German Federal Ministry of Education and Research (BMBF) under Grant No. 01UR2009A-B.

### Conflict of Interests

The author declares no conflict of interests.

### Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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Article

# Urban Revitalisation Between Artisanal Craft and Green Manufacturing: The Case of Brisbane’s Northgate Industrial Precinct

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Submitted: 1 May 2023 | Accepted: 7 August 2023 | Published: 21 November 2023

## Abstract

As Brisbane prepares for the 2032 climate-positive Olympics, traditional industrial precincts in the city are rapidly transforming. With a population of 2.5 M Brisbane has grown by 20% every decade since 1950, and sustainability-driven urbanism is an imperative. Here we document the history and future of Holland Street in Northgate, an inner-city industrial suburb, in the context of local, state, and national urban revitalisation and policymaking. Two globally distinctive tenants, (a) the Advanced Robotics for Manufacturing Hub and (b) bespoke public art manufacturer and foundry Urban Art Projects, face the twin challenges of embracing green manufacturing and the re-invention of blue-collar work. Digital transformations such as an energy-efficient automated foundry and the integration of cobots in custom manufacturing are advancing the goals of green manufacturing, blue-collar upskilling, and reshoring. An open innovation network creates knowledge spillovers to other industrial precincts in the city. The article discusses local urban planning innovation that is informed by publicly and privately funded R&D, underwritten by state-level government, and a consortium of universities and industry partners. The overall goal is to sketch the nascent planning elements for a locale that is tailored to accommodate the reinvention of urban manufacturing.

## Keywords

advanced manufacturing; blue-collar work; Brisbane; brownfield sites; Industry 4.0; intangible capital; public art; social capital; urban revitalisation

## Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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## 1. Introduction

Australia’s manufacturing sector contributes close to AU\$100 B (6% of GDP) and employs around 900,000 workers (Australian Department of Industry, Science and Resources, 2020). It has regained some policy relevance since Covid-19 exposed both gaps in and the fragility of Australia’s manufacturing supply chains (Free & Hecimovic, 2021). However, it remains a potent example of deindustrialisation which has been occurring over the past 25 years (Worrall et al., 2021). Share of GDP, export/import ratios for manufactured goods, manufacturing self-sufficiency, and economic complexity (in terms

of diverse high-value exports) are among the lowest in OECD countries (Worrall et al., 2021). Indeed, Australia no longer has “manufacturing cities.” However, many of the 99.5% of Australian manufacturing businesses classified as small and medium-sized businesses are based in or near urban agglomerations. In addition to supply chain resilience, advocates for the re-industrialisation of Australia point to national resource advantages in green energy, critical minerals required for net-zero carbon technologies, and niche advantages in high-value, high-complexity goods and services (Australian Industrial Transformation Institute, 2021). This is consonant with Dierwechter and Pendras (2020, p. 3), who suggest that:

As we challenge outdated assumptions and stereotypes about how manufacturing looks (big and dirty), operates (slow and conservative), and fits with the modern economy (at odds with visions for urban sustainability), the task is to find ways to weave spaces of production into the visions that already animate planning imaginaries.

Australia's story of deindustrialisation is similar to that seen around the world. Globally, urban manufacturing today is more an exception than a widespread practice. Urban industrial areas have been declining since the 1980s (Douglas, 2013). Productive areas in city centres predate modern urban planning zoning logics. They aimed to take advantage of the proximity to transportation nodes, and resources, and have easy transport access to markets. The logic of premodern productive areas was characterised by a strong image of the factory, which was an integral part of the brand of a company. The factory, as a building type, embedded the values of a company and displayed wealth, reliability, and a sense of stability through architecture. Architecture was intended to display the status of a company (Iglesias & Bernardo, 2022). As an example of conspicuous production, these buildings were meant to achieve a symbolic purpose rather than just house manufacturing operations (Goffman, 1999). Changes in the economic systems, the need of expanding or renovating premises, and especially the need for accessible and fast transportation of goods and raw materials, have in time pushed manufacturing outside city centres. This relocation was contextual to the adoption of Euclidean zoning principles in urban planning, which dictate the isolation of manufacturing activities so as to reduce the impact of noxious activities on the urban fabric. Factories, hence, moved to areas close to main railway lines, motorways, or airports, where land was affordable and larger premises could be established. The proximity to transport was also fundamental to provide access to the new premises to workers; in some instances, workers' suburbs were also established.

The premises abandoned within the city context, in time, were rediscovered but not just for their central location (Westbury, 2015). Building on their architectural value and their heritage flavour, since the 1980s many urban productive areas have been converted into residential and mixed-use precincts (Klaebe et al., 2009), often unlocking access to amenities, such as waterways, previously reserved as transportation routes for goods (Zukin, 2009). The result of urban renewal in industrial areas, over the past 40 years, had mixed results. In Europe generally, this has provided an opportunity for ambitious urban projects to equip cities with new facilities, a broader range of dwelling options, welcome social housing within central areas, the creation of new parks and public gardens, and the establishment of walkable affordable suburbs. In Australia, this process was mainly characterised by a focus on high-end residential development

with minimal attention to the benefit to the broader community, starting from the established residents of the surrounding areas. First, the redevelopment of urban industrial areas has generally facilitated gentrification, increasing problems in housing affordability and challenging the communities that were deeply rooted in these areas. Second, it accelerated the loss of artisanal values and amplified the segregation of manufacturing to specific compounds in peri-urban and suburban areas. This resulted also in making production invisible and detached from the rest of the urban social and physical fabric. The new manufacturing precincts, developed following modernist paradigms, generated anonymous precincts characterised by big anonymous boxes, where production is concealed. The value of architecture as a key signifier for manufacturing surrendered to functionalism and efficiency. Third, the rise of the creative industries emphasised digital means of production in a knowledge economy. While there is growing evidence of this trend not being limited to just inner-city areas—as first proclaimed by Florida's (2003) "creative class" argument—catering for creative/digital economic activities within urban schemes has seen variegated approaches. In some cases, precincts have been created; in others, the range of activities admitted in residential or mixed-use areas expanded. What is clear is that these types of economic activities do not have the same level of visibility and raise the same level of awareness on the urban scene, often not relying on the same signifiers that traditional hard industry adopt, such as the factory as a recognisable building type (Adkins et al., 2007; Collis et al., 2013; R. Florida, 2017). Finally, the neoliberal post-industrial paradigm depends on the continuing growth of consumption and mass manufacturing, which both undergird the long-term destruction of the ecological environment of the planet (Monbiot, 2007; Moore, 2017).

For many, the building fabric of inner cities is a key point of departure in the reimagining of urban manufacturing. This comprises not only zonings of different precincts but also the actual built form and what kind of activities its features allow. Advocates of urban manufacturing have at times emphasised the possibility of small-scale local manufacturing where labour, consumers, and suppliers are all close by (Grodach & Martin, 2021; Manzini, 2009). Ferm et al. (2021) point out that small-scale manufacturers, startups, or incubation-dependent companies are often connected to other local businesses in their supply chains, and more dependent on local labour than capital compared to larger manufacturers. This disconnection from global supply chains arguably has benefits for the planet. Moreover, the emphasis on low-tech artisanal craft instead of high-tech Industry 4.0 is also a vote against the dominant paradigm. Hence there is an emphasis on saving industrial land in inner cities as a way of exemplifying a countervailing set of possibilities to the global post-industrial paradigm with its spiralling inequality and environmental degradation.

However, there are a number of tensions in this debate, none the least of which is the tension between environmental sustainability and employment as evidenced by the political tensions between the Green parties and Labour parties around the world. The development of conspicuous urban manufacturing streets and redevelopments have often focused on traditional industrial districts in relatively central areas, but these have often also been caught up in processes of gentrification. Consumers of artisan products and artefacts tend to be wealthy enough to afford them compared to “cheap” mass-produced goods. Furthermore, it can be argued that localisation of supply chains is a limited ecological strategy because transportation costs are only a small element of the total environmental impact of manufacturing. Tsui et al. (2020) suggest that small urban manufacturers can reduce transport emissions but these are far less than production emissions as a whole. As well, the size of urban manufacturers may be too small to make an impact on the carbon footprint of the whole city. Grodach and Guerra-Tao (2022) show that in Melbourne the *diversity* of employment in industrial areas and equality between categories of occupation is better in industrial districts than in Central Business Districts (CBDs) or professional services precincts. However, small-scale manufacturers do not make a big impact on total city employment outcomes and, as a result, on income inequality. This focus on inner urban manufacturing at the smaller scale still leaves the issue of larger scale manufacturing on the urban fringe, with its large employment footprint but sometimes questionable ecological credentials, as a problem yet to be solved.

In response to these tensions discussed above, our approach in this article is to ask what is the mix of different kinds of capabilities and capital that are needed in order to reinstate manufacturing in cities. Traditionally, formal considerations of productivity have focused on human capital and tangible assets, namely equipment, factories, and land. The culmination of decades of the “post-industrial society” is that for the first time in history, since around 2000, the amount of investment in *intangible capital* in some countries has exceeded investment in these traditional forms of capital (Haskel & Westlake, 2018). The primary forms of intangible capital are patents and other forms of intellectual property including brands and marketing collateral such as customer data, R&D knowledge, business or other methodologies, and creative and cultural material protected by copyright or other means (Haskel & Westlake, 2018). These forms of capital investments can be owned by either companies, governments, or other entities. In some sectors (e.g., film, knowledge intensive business services), these forms of intangible capital are the principal factors of production; in others, they are a significant factor (e.g., pharmaceuticals). In manufacturing, companies that utilise intangible capital to add value to their products have the opportunity to compete on terms besides the unit cost of labour per output unit. Examples

of high-value manufacturing include superior functionality through advanced R&D, superior aesthetic appeal, add-on services, and brand features such as artisanal or green attributes.

The rise of intangible capital cannot be denied but comes with a significant risk of income inequalities (Hearn & McCutcheon, 2020). Another key aspect therefore is the distinction made by Bowman and Swart (2007) between *separable* intangible capital and *embodied* intangible capital. This refers to whether the use of that capital can be separated from the human—their body or mind—who has this capital. High-level artisanal skills are a good example of embodied, tacit human capital, as is the detailed understanding of a particular factory’s engineering systems, or an artist’s unique aesthetic sensibilities (Foth et al., 2007; Francisco, 2007). Much general trade work is embodied, requiring high cognitive as well as psychomotor capabilities, gained through long practice in order to produce valuable outcomes. This tacit knowledge (Polanyi, 1966) is also key to understanding how manufacturers pass down ways of working that are not codified in any explicit form but are essential to the operation of a manufacturing business.

The constraints on manufacturing that can take place in an urban setting are highly dependent on the kinds of capital that forms the basis of production and the form of manufacturing itself (e.g., bespoke artisanal vs. large-scale replicative via automation). Investment models, public funding, access to skills, energy costs, and political will are all important to the future of urban manufacturing. Simply changing land use or urban planning zoning does not necessarily change the complex mix of capital that is required for an urban manufacturing precinct to be successful and provide employment to blue-collar workers. In light of all these factors, the case study that we present is an illustrative experiment that tries to speak to one path of the viability of manufacturing in urban environments. It illustrates a model that (a) involves artists and artisanal values, (b) is not antithetical to advanced manufacturing, (c) features job growth in a range of both trades and professional workers, and (d) demonstrates the importance of public and private investment and partnerships (Foth & Adkins, 2006). Northgate is a brownfield industrial area in the city of Brisbane, Australia, where public-private collaboration between a publicly funded innovation hub (the Advanced Robotics for Manufacturing [ARM] Hub) and a private large-scale public art manufacturing company (Urban Art Projects [UAP]) is demonstrating new visions for manufacturing in urban centres. Our account is not Panglossian, but replete with challenges and shortcomings not yet addressed. Nevertheless, something innovative is happening that not only can animate new urban imaginaries (Estrada-Grajales et al., 2018) but also offers insight into some of the tensions in the urban manufacturing debates discussed above.

## 2. The Case of Northgate

The case study presented here is centred on Holland Street, Northgate, a brownfield industrial area located 14 km north of the Brisbane city centre. The case focuses on the collaboration between the ARM Hub and UAP. The case approach is “theory oriented” for the purpose of “theory extension or refinement” (Ebneyamini & Sadeghi Moghadam, 2018, p. 8), offering a focus on the *mix* of different kinds of capital as determinants of different kinds of sustainable urban manufacturing. Three of the authors have a long engagement as researchers (2017–2023) with the ARM Hub and UAP; Queensland University of Technology (QUT) is a founding partner of the ARM Hub. The case primarily uses secondary data sources including historical documents of the area, local government planning reports, company reports, published research papers that describe the operation of the companies, and information provided by the companies for this article. A key informant interview with the CEO of UAP was conducted and both UAP and ARM Hub verified the information pertaining to them in this article.

Although the collaboration between ARM Hub and UAP is central here, it is relevant to the urban planning aims of the article to provide some context of the whole of Northgate and surrounding suburbs. The history of the Northgate Industrial District (Brisbane City Council, 2008; Fisher, 2016) can be traced back to the late 1800s when a north-bound railway line was built from central Brisbane diagonally through the Northgate locale sepa-

rating the western higher land suitable for housing, from the flood-prone eastern side of the line. The industrial district began life as a railway workshop when McKenzie and Holland, an Australian offshoot of the British rail equipment manufacturer, opened the first factory on the eastern side of the Northgate railway station (and siding), which is in the same place as it was in the late 1800s (Figure 1). Employment in the district grew with the development of a pineapple cannery in the nearby suburb of Banyo, in close proximity to pineapple plantations in Nundah. In the 1960s the current sites of the ARM Hub and UAP housed National Nails Pty Ltd, a manufacturer of fencing and galvanised products (Agribusiness, 2015). These buildings are adjacent to the rail station on Holland Street in the same vicinity as the very first factory (Figure 2). This transport link to the CBD remains a potent conduit for labour and knowledge workers coming from centrally located universities.

On the western side of the railway line, significantly more residential activity can still be found today, including the transit adjacent development of Nundah (Figure 3). Together, Northgate and Nundah currently have a combined population of around 20,000 people. The industrial district spanning Northgate, Virginia, and Banyo, is currently promoted by the local government as a valuable asset for the city. Brisbane City Council, in its 2019 Banyo-Northgate Neighbourhood Plan, aims to create two employment districts catering for more than 5,000 jobs (Brisbane City Council, 2019). At the same time, the plan aims to protect pre-1911 buildings



**Figure 1.** Site of Northgate station and current Holland Street, 1916. Source: State Library of Queensland (2011).



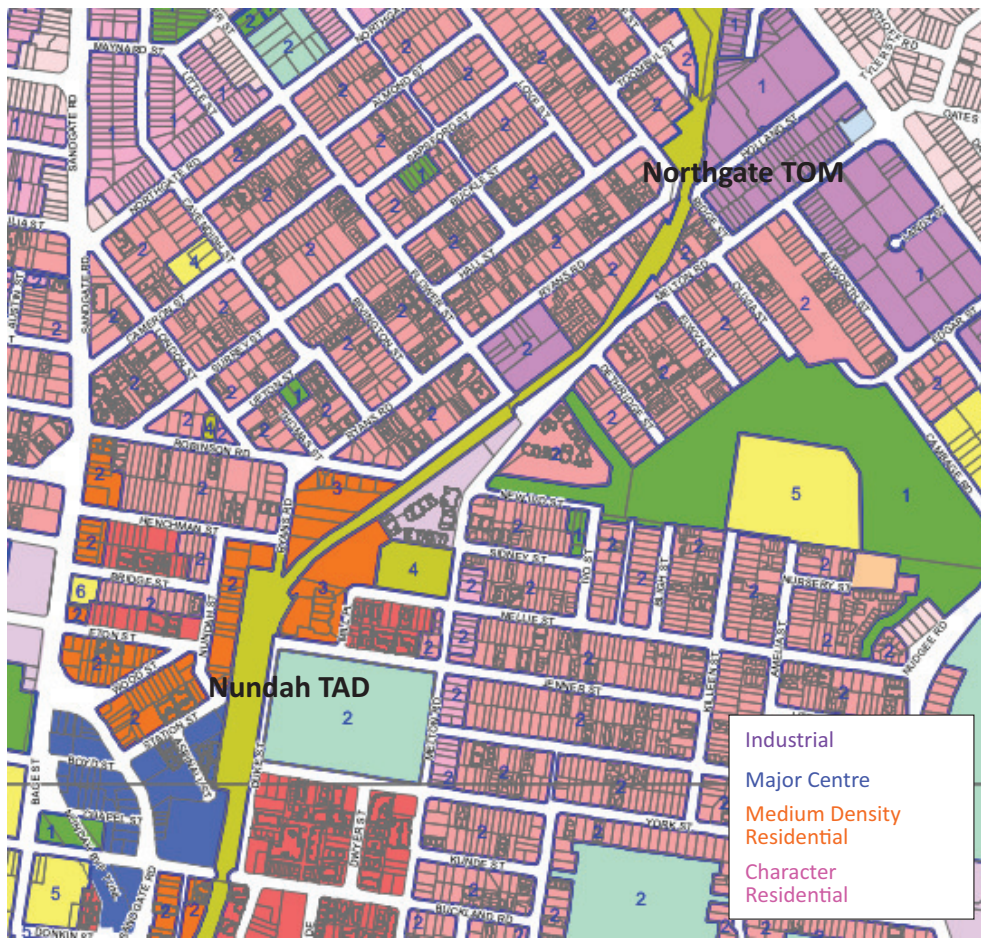
**Figure 2.** ARM Hub and UAP in Holland Street. Source: Google Imagery date: 12/11/2020.

to enhance the traditional character of the area and also allow redevelopment to cater for a broader range of dwelling solutions. Industrial tenants of Northgate in the present day are a wide variety of manufacturing, warehousing, industrial services, some boutique brewers, a salvage yard, mechanical services, and industrial cleaners. Virginia also has a variety of different activities, ranging from large retailers, workshops, food processing and production, and services to the construction industry. The Northgate Industrial Estate is located within several hundred metres of a motorway with connections to Brisbane Airport and the major tourist destinations of the Gold Coast and Sunshine Coast. The greater area is in fact served by four railway stations and two different lines.

The urban structure of the area is characterised by a manufacturing axis, centred on Toombul Road and connecting the productive area of Virginia to the motorway through Northgate, and a residential neighbourhood developed following an “urban village” approach (Garcia et al., 2010), with services and retails clustered around a main street, often directly connected to the railway. This clustering affects the urban form as well as the way people navigate and use the different precincts, with a polarising focus on each suburb village centre more than cross-suburb connections. This situation is also heightened by

the presence of the railway and major roads stressing further the boundary of the contemporary neighbourhood, which follows the boundary of the older villages. This means that the connections in population terms between the more densely populated accommodation area of Nundah compared to the industrial Northgate are hard to navigate for most people. In fact, the only reason that the young urban professionals living in Nundah would visit the east side of the railway line is to visit the two popular craft brewing businesses: Aether Brewing and Fick Brewing. In addition, those renovating older housing stock could be attracted to the popular salvage yard called Grand Ideas and a popular local coffee shop built in a container.

Northgate station is a 15-minute train journey into the densely populated entertainment district of Fortitude Valley. Nundah experienced a planning-driven accommodation boom in the early 2000s creating dense, medium-rise accommodation options and leading to a revival of the high street including a number of popular hotels and eateries. Nundah is today a self-sufficient suburb, which provides a range of services and amenities to its residents. Recent redevelopments have also created new commercial precincts that provide a mix of white- and blue-collar jobs. Nundah is rapidly gentrifying;



**Figure 3.** Contrasting transit adjacent development and transit oriented manufacturing. Source: Adapted from Brisbane City Planning Scheme Zoning Map (Brisbane City Council, 2016).

housing affordability, which traditionally was better than other inner-city suburbs, has more recently been challenged by the heightened demand for dwellings in this area (Brisbane City Council, 2020). Many residents still prefer to commute rather than work in the local area. Nundah is a high residential development area that has a privileged direct access to the CBD through a tunnel. The possibility of driving into the city in less than 15 minutes makes the use of cars the most popular option for locals. Nundah has a disjointed bus network, and permeability with the east, as described, is difficult. As a result, cycling is not easy.

The industrial estate, on the other hand, is an example of a “transit-oriented manufacturing” hub (Dierwechter & Pendras, 2020) where most of the people who work in the ARM Hub or UAP often use the rail network (Figure 3). The connections between the ARM Hub and UAP with the rest of the local industrial district are relatively weak compared with the network ties and relationships with other R&D partners, clients, or in the case of UAP, upstream and downstream fabricators. UAP does use a range of subcontractors, however, most of them are not part of the local industrial estate.

Brisbane City Council has developed a new neighbourhood plan for the Northgate-Banyo area; the pro-

cess, started in 2016 and informed by several community consultations, promotes the idea of railway stations as hubs for the local communities (Brisbane City Council, 2019). Northgate station, in particular, is proposed as an ideal location for a new mixed industry and business zone precinct tailored to advanced manufacturing, creative industries, low-impact manufacturing, commercial uses, retail, and hospitality. This location is meant to become the new centre of the neighbourhood guided by an “urban village” structure (Winger, 1999). The proximity to the Australia Trade Coast, a complex of freight businesses and transport facilities that includes the international airport, major roads, and logistics, as well as a network of manufacturing precincts, makes this site particularly strategic for advanced manufacturing. The plan also stresses the need to preserve heritage and character housing around Northgate station, improving the permeability of the railway station with public space design, supporting existing industrial activities, and also, promoting a diverse offering of dwelling solutions (Collis et al., 2013; Houghton et al., 2015). Holland Street is planned to be redeveloped through active frontage and the creation of new arcades to connect it with surrounding character areas.



### 3. Engineering Science Meets Artisan Crafts

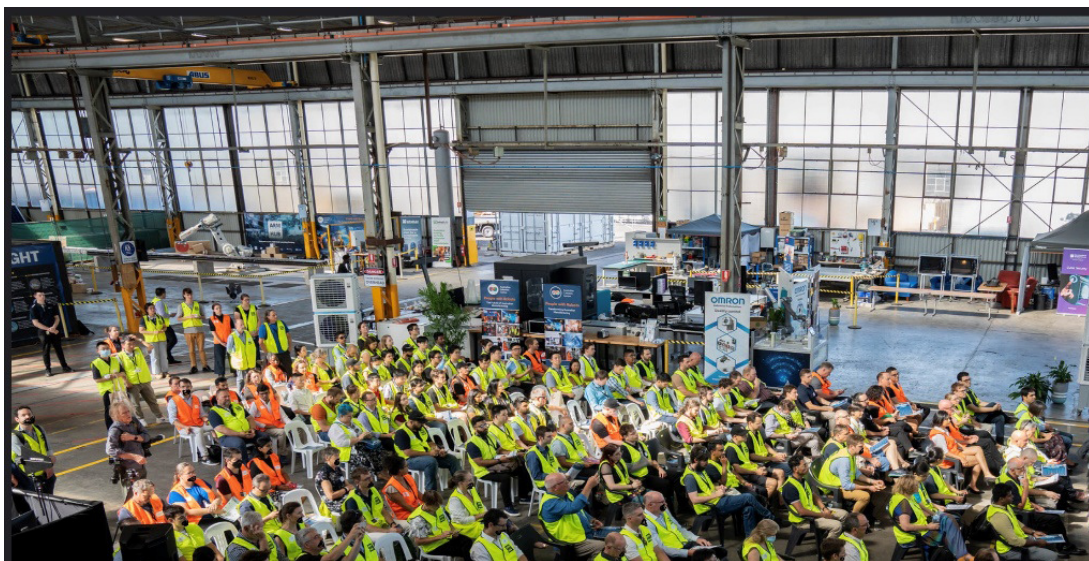
The development of the ARM Hub began in 2017 as a collaboration between UAP and the QUT (Brophy et al., 2020). UAP facilitates, co-designs, and fabricates major public artworks and architectural elements (Caldwell et al., 2019). Inside UAP, a wide variety of art projects have been imagined and designed. The company has developed innovative projects and installed major artistic works in countries such as Australia, USA, Canada, China, and Saudi Arabia. Most relevant to this article, UAP have formally specified digital, environmental, and workforce goals and partnered with QUT to address their need for incorporating robotics and other technology enhancements into their traditional foundry and craft-based processes. This was driven by a business need and a desire to reshore work from their manufacturing operation in Shanghai. Labour costs and supply chain reliability were also key issues. Specialising in facilitating large-scale bespoke public art and architectural features, they wished to retain their strong artisanal and artistic values, whilst at the same time integrating advancements in digital capabilities that enable them to stay commercially viable and maintain exceptional levels of quality.

Following a series of grant-funded research partnerships between UAP and QUT, the ARM Hub was established in January 2020 via an investment by the Queensland State Government, along with substantial investments by QUT and UAP. Despite the difficult impacts of Covid-19, the ARM Hub has since expanded to operate as an innovation hub not just for local manufacturing small and medium-sized businesses but also those in other cities, including regional Queensland. The ARM Hub functions as a demonstrator space, outreach and education hub, provides commercial R&D and design services, supports the development of industry and uni-

versity grants, and co-develops original R&D initiatives consistent with Industry 5.0 (Figure 4). The ARM Hub is collocated with UAP in a 2,000-square-metre 1960s industrial building. In addition to the ARM Hub, the factory space is occupied by tenants who range from startups to established robotic manufacturers and other tenants with an interest in industry verticals such as energy, digital, autonomous systems, and steel processing. The ARM Hub and UAP both seek to champion circular green manufacturing and the upskilling of blue-collar workers. Central to both the ARM Hub and UAP is the role of embodied knowledge in R&D. The importance of knowledge access in new forms of conspicuous manufacturing is a factor well-known in the literature of economic geography with regards to precinct development, knowledge spillovers, and social networks (Adkins et al., 2007; Hearn, 2020).

In terms of workforce matters, UAP is distinctive in its combined artisanal and high-tech manufacturing approach (National Gallery of Australia, 2023). Their blue-collar workforce is a key aspect of their success, underpinning their approach to artisanal traditions and craft practices (e.g., pattern makers and foundry trades) that are essential to the fabrication of artworks. The constraints on manufacturing that can take place in an urban setting are highly dependent on the kinds of capital that form the basis of production. Simply changing land use or planning zones does not necessarily change the complex mix of capital that is required for an urban manufacturing precinct to be successful and provide employment to blue-collar workers.

Both UAP and the ARM Hub are committed to manufacturing trade work as well as attracting talent in the field of robotics, new digital occupations, and other manufacturing-related industries (Tables 1 and 2). Attraction of knowledge workers is a significant issue in conspicuous manufacturing. Key issues for both UAP



**Figure 4.** ARM Hub outreach event. Photo courtesy of the ARM Hub.

**Table 1.** ARM Hub tenant company exemplars (2020–2023).

Company	Innovation	Sectors
Australian Cobotics Centre	Cobotics R&D	Research and education
Verton	Remote controlled load management systems	Mining Construction Offshore turbines
Clean and Recover	Electrochemical wastewater recycling	Mining
Omron	Collaborative robots	Industrial automation
Valiant Space	Bipropellant thruster	Small satellites
Macrobotix	Robotics	Manufacturing
Blue Lens Group	Innovation management	Multi sector
Southern Green Gas	Solar powered CO <sub>2</sub> capture	Multi sector
Bondi Labs	Augmented Intelligence through AR	Multi sector
Wisk Aero	Autonomous air taxis	Transport
Lyro Robotics	Robotic packing	Robotics/food

Note: Information courtesy of the ARM Hub.

and the ARM Hub are access to advanced levels of Industry 5.0 expertise, for example in AI, mechatronics, design, AR/VR, and digital twins. It is this knowledge that is the primary attractor for increasing interest in Northgate (Figure 5). Most visitors to the area are there to learn and observe cutting-edge manufacturing practices (Bilandzic & Foth, 2016). This exemplifies the role of knowledge in conspicuous manufacturing and access to talent in the creative class incorporating scientific, engineering, artistic, and design capabilities at a very high-level (Figure 6). In parallel, because of the significant trade workforce of UAP and the manufacturing workforce mission of the ARM Hub, both entities are committed to upskilling trade workers, particularly patent makers, metal workers, fitters, spray painters, and foundry workers. One of the rationales for the ARM Hub was uplifting smaller metal fabrication and other subcontracting manufacturers into global export markets. Seen through the lens of knowledge flows, an average day

at the ARM Hub and in UAP is an example of global knowledge transfers. UAP's contracts may often require detailed knowledge of a particular geometric algorithm for robotic polishing, and workers from UAP frequently visit the ARM Hub to seek specific technical advice. Some of this knowledge is internationally known, yet UAP staff cannot easily locate it. Due to the tacit nature of current and new industry practices, it is difficult to codify and document them (Rust, 2004).

The ARM Hub–UAP nexus is also noteworthy for the international character of the quotidian day-to-day networks of knowledge. For example, UAP operates not only in Brisbane but in New York and Shanghai, with the principals of the company visiting each site reasonably regularly. The ARM Hub also hosts the Australian Centre for Cobotics bringing together researchers from Australia, Denmark, Germany, and Pakistan. While these knowledge exchanges have become common, they represent a new process that rapidly links university R&D

**Table 2.** Occupational breakdown in 2023 for UAP Brisbane Operations.

Occupation	Approximate % of workforce in 2023	Status
Trades	26	Increasing
Design or art	12	Stable
Technology professional	19	Increasing
Other professions	16	Stable
Admin and management	12	Stable
Other	15	n/a
Total employment in Brisbane	93	—

Note: Information courtesy of UAP.



**Figure 5.** Using AR to sculpt forms for casting. Photo courtesy of the ARM Hub.

to a “glocal” arts-led manufacturing industry (Robertson, 1995). The need to maintain both digital and physical global access raises the question of whether the traditional focus on local urban manufacturing has underestimated this “glocal” nature of viability and visibility. As Ferm et al. (2021, p. 353) suggest: “Despite this growing knowledge about the importance of locale for small urban manufacturers, and place specific social economic ties, there is little understanding of how the urban fabric can be shaped to accommodate such an ecology.”

We argue the daily knowledge exchange processes, though taken for granted in Holland Street, are of rare quality, mixing research scientists, artists, and trade

workers to achieve artistic, academic, and commercial objectives. These knowledge exchanges are also essential for green manufacturing.

Green manufacturing was not an immediate driver of the development of the ARM Hub nor UAP in 2017. However, in 2023, the circular economy and green manufacturing combined is now one of the four pillars of the ARM Hub, and UAP has embarked on an in-house, well-resourced green manufacturing strategy in the last two years. This reflects the turning of the tide in political, community, and consumer discourse. Green manufacturing has become important to many of the clients of the ARM Hub/UAP simply because it is now considered to



**Figure 6.** Stephanie Hutchison performs Cobotic Improvisations dance work “Fling it”, part of an Australian Network of Art and Technology’s Synapse Residency at Australian Cobotics Centre and ARM Hub. Photo courtesy of the ARM Hub.

be non-negotiable. And with the coming of the climate-positive Olympic Games to Brisbane in 2032 (Foth et al., 2022), interest is likely to increase further.

Significant impetus, expertise, and capital investment by UAP have been evident in the last two years, driven primarily by UAP's corporate values but also by recognition of consumer sentiment. For example, UAP is developing a carbon calculator to measure and improve carbon reduction in the supply chain of new projects. UAP is seeking to calculate the carbon footprint of each project as well as for the whole manufacturing operation. The installation of an induction furnace will be more energy-efficient than the current gas system. Another UAP priority is to follow circular lifecycle parameters by using sustainable raw materials. This concern is moving UAP to create artworks that will last a long time and that are created by using green and recycled materials such as recycled aluminium that is available locally. Besides using sustainable raw material alternatives in artworks, UAP is working on reducing other environmental impacts such as water, waste, and the transport packaging's carbon footprint. For example, UAP has decommissioned the use of water jet cutting. As the majority of production waste is produced in casting (e.g., sand-resin blocks or polystyrene), UAP is trying to replace the conventional scale of the blocks by using blocks supplemented with green materials such as potato starch. UAP are now also using additive manufacturing processes when it suits a project, such as PMMA prints for patterns, as an alternative to polystyrene milling. The prints use much less material overall as they are hollow and have a relatively thin wall thickness, which is a big deviation from solid polystyrene patterns. In addition, they are investigating longer-term solutions to the use and recycling of sand resin.

#### 4. Conclusions

As Baker (2017, p. 125) suggests: "In imagining contemporary re-industrialization based on high-tech manufacturing, distributed digital fabrication and the revival of craft, there are various ways in which these activities might be made publicly visible."

Since then, research has identified various models of attempting greater connection between consumers and the costs of that consumption in the pursuit of green, just, and productive cities, as per the New Leipzig Charter (Godson, 2020). Grodach and Martin (2021) juxtapose Industry 4.0 manufacturing with low-tech, high-touch manufacturing in an examination of cultural and food and beverage manufacturing in Melbourne. Such manufacturers as exemplified in inner city Melbourne are often ignored in government policy but offer a diversity of labour and relationships with other kinds of retail consumption activities, which provide for greater visibility of manufacturing as a craft-based activity where consumers and manufacturers interact on a daily basis. Symbolically, this case is relevant to Northgate because it is one potential example of an amelioration of inequal-

ities evident in typical post-industrial cities. In a contrasting example, Suwala et al. (2021) analysed case studies in Berlin that were premised on scientific knowledge as primary factors of production. They consider Adlershof as a successful example, eventually achieving the quadruple helix of academic, business, government and civil society, which were brought together to formulate its planning strategy. Similar to Foth (2003), they also argue that spatial proximity is necessary but not sufficient to stimulate the required successful execution of the strategy, but rather mobilisation of social capital through things such as technology transfer, brokering of relationships between industry and research, and formulation of various combined research and development projects have been key features of the success of Adlershof.

Part of what makes Holland Street notable is that the ARM Hub/UAP collaboration could be considered to be a high-tech, high-touch model that relies heavily not only on access to local labour markets but also on local advanced scientific knowledge resources. In addition, because of a strong emphasis on export, there is a possibility that this model can develop at a greater scale, and is therefore important for Australian manufacturing nationally. UAP's customer base is largely not local, but rather global. ARM Hub serves manufacturers of different scales with markets ranging from national to export. This is not to say that local relationships, trust, and local knowledge are not important because subcontracting firms and connections between labourers, artists, and researchers are important to Holland Street's operation. Put another way, UAP and the ARM Hub are a good example of different kinds of capital and capital flow because the mix of knowledge include blue-collar, arts and design, and scientific knowledge coming together to produce value. This is a good example of embodied intangible capital (Bowman & Swart, 2007) at work to produce high-value manufacturing.

Much of the knowledge of artists is tacit and cannot easily be replicated by other artists. Similarly, very specific artisanal practices of trade workers are equally hard to replicate when these are combined with cutting-edge engineering, and digital or robotic knowledge (Burden et al., 2022). Thus, in addition to labour and buildings, this combination requires a particular kind of social capital to be considered in the future of urban manufacturing. The reliance on tacit knowledge requires experienced intermediaries to build and maintain trusted relationships not only in the operation of a manufacturing business but throughout its supply chain suppliers and through to the ultimate customers (Teli et al., 2022). This accords with Hüttenhain and Kübler (2021), who emphasise soft site factors in urban manufacturing including a range of affordances to encourage collaboration, sharing of resources, exchange of tacit knowledge, and access to knowledge partners such as universities and research hubs.

A key question for urban planning is therefore what are the elements of a locale that actually contribute to the social capital required to sustain urban

manufacturing? A joined-up ecosystem of makers, applicators, facilitators, intermediaries, and spillover adopters seems key to developing, attracting, and retaining talent for the total ecosystem. In general, the biggest attractor of talent is the availability of jobs and, in the case of families, jobs for both adults. This is made more likely by a joined-up local ecosystem such as that emerging in Northgate. Other factors significant for the future of Northgate are jobs that are secure and at the cutting edge of scientific and practical application, housing affordability, cultural amenity, the global brand of companies, and attractive salary/cost of living ratios. The relationship with local universities is another key factor in the recruitment, development, and retention of talent. Hüttenhain and Kübler (2021) also suggest that industrial districts can have symbolic impacts outside of their immediate footprint. This can be achieved not only through collaborative relationships with the wider city but also through the rise of industrial tourism, which is beginning to become evident in the Holland Street precinct. In terms of the implications for the city of Brisbane, Holland Street could play an important role over the next 10 years leading to the Brisbane Olympic Games in terms of its connection through supply chains within the networks of tenants and the ARM Hub to educate a broader group of manufacturing companies and related industries towards both advanced manufacturing, the importance of design to manufacturing as well as circular economy initiatives.

The Queensland Productivity Commission (2017) points out that approximately 75% of Queensland manufacturing employment is located in the rapidly urbanising greater Brisbane and adjacent municipalities. There is a large diversity of manufacturers providing manufacturing employment with food, machinery and equipment, and metal products dominating in that order. Around 90% of manufacturers are non-employing or employ fewer than 20 people. Around 1% employ more than 200. Fox and Alptekin (2018) propose a taxonomy of types of manufacturers and distribution systems, distinguishing between DIY, artisanal, distributed industrial (e.g., parts, kits, and small products), and large centralised manufacturing (e.g., materials conversion, massive goods). Their taxonomy includes third-wave “glocal” DIY manufacturers, Fab Labs or makerspaces, and mobile factories. Distribution systems include evolving transport and internet-based services providing a wide range of opportunities (e.g., web-based artisanal operations, and component makers for large-scale industrial production). Distributed networks of milling machines and autonomous local air transport options are technically possible now. This could mean that process control work, and parts repair, do not necessarily have to occur in the same place as the primary machinery. Furthermore, in the era of chat GPT-4, knowledge work is easily disaggregated from physical space.

These developments are a good match for the size profile and diversity of manufacturing in greater Brisbane. This suggests that a wide range of capital fac-

tors need to be considered in relation to the viability and sustainability of urban manufacturing in greater Brisbane. We agree with Grodach and Martin (2021, p. 473) that “urban policy needs to broaden its understanding of manufacturing...rethinking the value and uses of remnant inner-city industrial zones [and] experimenting with new forms of mixed-use that permit manufacturing.” It is also important to recognise that different constellations of land, equipment, and knowledge resources are evolving in complex ways to produce diverse opportunities in urban manufacturing. Imaginaries for future urban manufacturing and urban planning should not be restricted to “Industry 4.0” or “high-touch, low-tech” types of manufacturing, but rather encompass a much broader set of possibilities for sustainable operations and local employment. Given the future of manufacturing could evolve in a number of different ways, we suggest that future research in urban planning could develop varied models to account for different constellations of land, buildings, transport, and knowledge suitable for urban manufacturing. The case study presented in this article provides only one novel example which hopefully stimulates future research into a broader conception of different possibilities for urban manufacturing. The planning response to take advantage of the local social capital, and of the local peculiar synergies facilitated by transport, is structured through a precinct approach. More than trying to resolve broad dynamics with complex urban plans, the precinct approach allows one to take advantage in a more timely and fluid manner of local potentials and resources, avoiding the challenges of developing a detailed urban or suburban plan. With the urban planning strategies in place for this locale, the next decade of development will constitute a worthwhile experiment in the rebirth of urban manufacturing that we are keen to study, evaluate, and document further.

### Acknowledgments

The authors thank both the ARM Hub and UAP for their ongoing support. Special thanks to Assoc. Prof. Mirko Guaralda for valuable feedback and input into this article’s earlier drafts, and to Dr. Cori Stewart for providing information, historical sources, and support in her role as the CEO of the ARM Hub.

### Conflict of Interests

Hearn, Caldwell, and Camelo-Herrera have research affiliations with the ARM Hub. QUT and UAP are founding members of the ARM Hub.

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Article

# Hyper-Competitive Industrial Markets: Implications for Urban Planning and the Manufacturing Renaissance

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Submitted: 30 April 2023 | Accepted: 11 September 2023 | Published: 21 November 2023

## Abstract

After several decades of deindustrialisation in the so-called advanced economies, we are seeing a renewed enthusiasm for urban manufacturing in cities, and the integration of production into the city fabric. Yet, small-scale industrial accommodation has long been susceptible to displacement by higher-value land uses—particularly residential and prime office—which directly undermines such aspirations. This article focuses on the case of London and, through a review of planning policy and planning documents, market data, and participant observation in both public and private sector networks, provides evidence for and explores the impacts of a hyper-competitive industrial market that has emerged as an outcome of ongoing limited supply and growing demand in the sector. Although it signals a reversal of displacement dynamics between industrial and residential uses, potentially slowing the loss of industrial land supply, it is also leading to a narrowing of demand and competition within the industrial market that leads to intra-industrial gentrification and threatens smaller manufacturers. The article reveals tensions and limitations in planning approaches that seek to manage industrial land supply and create a diversity of workspace accommodation, as well as a gap between popular policy narratives of industrious cities and manufacturing renaissance, and the coherence of policies to support them. The article concludes with a discussion of future research that could advance policy and other interventions to support manufacturing in cities, to further sustainability and social inclusion agendas.

## Keywords

competition; displacement; gentrification; industry; London; manufacturing; planning

## Issue

This article is part of the issue “Planning, Manufacturing, and Sustainability: Towards Green(er) Cities Through Conspicuous Production” edited by Yonn Dierwechter (University of Washington Tacoma) and Mark Pendras (University of Washington Tacoma).

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## 1. Introduction

In the summer of 2014, Southall—the centre of West London’s South Asian community and home to a vibrant industrial cluster—was officially re-imagined, through the publication of an Opportunity Area Planning Framework. Capitalising on its inclusion on the route of the new east–west rail link through London (the Elizabeth Line), the framework envisaged “new neighbourhoods on former industrial land,” stitching together “the neighbourhoods, town centres and workspaces of Southall” and delivering 6,000 new homes and 3,000 new jobs by 2041 (London Borough of Ealing, 2016). High-density, mixed-use schemes, with attractive pedestrian routes, canalside walks, and new, creative jobs

were to replace former factories, gas works and industrial sheds—a transformation in line with the London Plan’s aspirations for “good growth” and sustainable urban development. The re-imagination of Southall was one of a series of new visions for 48 Opportunity Areas identified in the London Plan 2021, with Southall having originally been identified as an Opportunity Area in 2011. The identification of industrial sites as Opportunity Areas has a history dating back to the first London Plan 2004, part of a planning strategy for managing the decline associated with deindustrialisation. Later iterations included more and more Opportunity Areas, increasingly in outer London and associated with new or planned transport infrastructure (Ferm et al., 2022). Complementing this approach, the latest London Plan 2021 also included

new policies for industrial land, moving away from blanket protection of single-use industrial sites, instead promoting the intensification of industrial uses and their co-location with new housing.

In Southall, a wave of planning applications followed the publication of the Opportunity Area Planning Framework, including one for the redevelopment of the recently vacated Honey Monster (cereal) factory, designated as a locally significant industrial site. In 2019, a planning application was approved for approximately 2,000 residential units and a 22,000 m<sup>2</sup> “creative industrial hub” (London Borough of Ealing, 2019) including a film studio and light industrial units, with nine blocks of buildings of varying heights between seven and 29 storeys. Yet, by the Spring of 2021, the council’s new leader had written to the mayor of London asking to “revoke the outdated Opportunity Area Framework” (Ealing Labour, 2021) and by the summer of 2022 had announced via Twitter (now X) the Southall Reset programme: “Tonight we hit the reset button for Southall, our industrious, resilient, entrepreneurial, diverse, incredible town. Its future is as a place of good, well-paid jobs, of culture and community pride—not a dormitory town” (Mason, 2022).

This statement is reflective of both local opposition to the direction of travel, as well as an emerging optimism about the place of manufacturing and industry in cities, and the role they play in supporting diversity, resilience, and quality jobs (Grodach & Guerra-Tao, 2022; Langdon & Lehrman, 2012; Pike et al., 2010). By 2023, a new application for a wholly industrial redevelopment of the Honey Monster site was received by the council—a joint venture between a logistics firm and a global investor—which was a significant departure from the earlier residential-focussed scheme (“Southall’s Honey Monster site to be transformed,” 2022).

This shift in approach to a key development site in Southall, away from mixed-use, brings our attention to changes within the industrial market across London which have led to rising industrial land values relative to residential, such that residential redevelopment in this location is no longer considered “the highest and best use.” This article seeks to gain a better understanding of the policy and market dynamics that have converged, resulting in a shift in investor confidence and creating a “hyper-competitive” industrial market. It is driven by the following interlinked research questions: What is the likely fate of lower-value industrial occupiers, including smaller manufacturers, in this hyper-competitive industrial market? And how could planning limit the impacts and loss of diverse accommodation?

The next section of the article introduces the literature on the urban manufacturing renaissance and examines how the literature on gentrification and displacement pressures has, to date, focused primarily on the displacement fuelled by pressure for residential redevelopment. Yet, there is a tension between traditional regulatory approaches to industrial land use planning—

designed to protect industrial land and buildings from conversion or redevelopment for higher value uses—and the “softer” planning tools in the form of Opportunity Areas introduced via the London Plan (Ferm et al., 2022), which focus and attract certain kinds of investment to change the character of industrial areas, promoting a mix of uses and accelerating the loss of industrial land. What is currently lacking in the literature is a reflection on the most recent market shifts within the industrial sector as a result of digitisation, the pandemic, and geopolitical change; what this means for smaller industrial occupiers that are less able to compete for limited space; and the planning responses that seek to support them. After an overview of the methods employed, the article sets out a review of the London policy context, followed by a discussion of the changing market dynamics in the industrial sector and explores what this means for both investment and development in the industrial market, and the implications for lower-value industrial businesses, including manufacturing. The findings reveal how the revival of urban manufacturing may be threatened not only by displacement dynamics driven by relatively high residential land values but also by displacement by other industrial users of space, which is more difficult to manage in planning terms. Following Adams and Tiesdell (2010), it is argued that planners, as “market actors,” would benefit from a greater awareness of industrial market information and knowledge, as well as a better understanding of the network of actors influencing and embedded in the industrial development market. In the conclusion, therefore, policy implications are discussed and avenues for future research are explored.

## 2. Manufacturing Renaissance, Industrial Displacement, and Planning

In post-industrial cities, where there has been a pervasive narrative of deindustrialisation and decentralisation of industrial employment since the beginning of the Second Industrial Revolution, there is evidence of a renewed enthusiasm for manufacturing and its positive place in the city. Academic and urban design books and journal articles promoting a form of urbanism where industry is integral to its success have proliferated, with titles that are variations on a theme: *Urban Re-Industrialization* (Nawratek, 2017), *New Industrial Urbanism: Designing Place of Production* (Hatuka & Ben-Joseph, 2022), “Building Better Brussels: Production Urbanism as a Policy” (Borret, 2021), and *The Industrious City: Urban Industry in the Digital Age* (Hosoya et al., 2021).

A wide variety of factors have converged to support this shift in perspective. First is digitalisation and technological change, which is enabling smaller-scale entrepreneurs—so-called *makers*—to manufacture niche products bypassing mass manufacturers, tailored to hyper-local markets (Anderson, 2012). At the same time, advanced high-tech manufacturing is cleaner and quieter than traditional manufacturing and more

practically compatible with other city uses, such as housing. This has meant that “zoning” for single-purpose industrial use started to be seen as an outmoded concept, reflected in changing policy direction in a number of cities, facilitating a mix of uses on industrial sites (the London case will illustrate this later in the article). Second, there are economic and socio-economic drivers. Following the recession of 2007–2008, an emphasis on economic resilience emerged (Pike et al., 2010) which meant that cities, such as London, where there had been a reliance on key leading highly specialised service sectors to drive economic growth, were starting to speak of the importance of diversifying their economies (Greater London Authority [GLA], 2016), acknowledging the importance of manufacturing to a resilient and stable economy that had long been argued by Cohen and Zysman (1987). This was seen as a way to increase economic resilience in the face of future shocks, but also to address growing social inequalities. Manufacturing jobs have been found to have significant wage and benefit premiums compared to non-manufacturing jobs and are attracting increasingly higher-skilled workers (Langdon & Lehrman, 2012). At the same time, industrial zones provide a more diverse employment and income base than other areas of the city (Grodach & Guerra-Tao, 2022). Third, the Covid-19 pandemic and rising geopolitical tensions between China and the US, both placing pressure on global supply chains, have fuelled domestic political agendas to reinvigorate and invest in manufacturing (Gibson et al., 2021; “Globalisation, already slowing,” 2023). Finally, the environmental and sustainability agenda has brought attention to the importance of an urban location for manufacturing—initially with concerns about industrial sprawl and emissions associated with long journey times (Leigh & Hoelzel, 2012) and more recently an interest in the role of urban manufacturing in supporting the circular economy (Tsui et al., 2021).

Yet, in post-industrial cities, for many decades now, urban industrial land has been under intense development pressure, creating a challenging context for the accommodation of an urban manufacturing revival. Planning tools—seeking to protect industrial land or mitigate the impacts of redevelopment—have been adopted with varied success. Recognising that the forces of deindustrialisation would open up real estate speculation on remaining viable industrial land, the City of Chicago was one of the first cities to launch an ambitious industrial strategy towards the end of the 1980s, which devised an industrial land use policy, involving zoning for manufacturing uses and introducing broader “industrial corridors” (Danilo, 2018). Although the Chicago industrial land use experiment was hard won through the actions of a grassroots alliance of neighbourhood groups, workers, and manufacturers (Rast, 2001), in its wake, industrial zoning and industrial land use policies were introduced across a range of post-industrial metropolitan contexts, with some cities such as San Francisco experimenting with policies that specifically seek to pro-

tect production-based manufacturing uses, distinct from other industrial uses (Grodach, 2022).

Despite the introduction of legislation and policy, many of these cities found that industrial land was lost and redeveloped for higher-value uses at a rate far greater than that planned for, with empirical evidence emerging that the displacement of viable businesses was being fuelled by real estate speculation rather than de-industrialisation, expanding the literature on gentrification to consider industrial as well as residential displacement (for an overview of these dynamics in Brooklyn and London, see, respectively Curran, 2007, 2010; Ferm & Jones, 2016). The drivers for real estate speculation on industrial land and property in the last 20 years differ somewhat between cities, with pressures in London and Brooklyn being primarily for residential redevelopment, in Seoul it has been driven by the expansion of the financial and business district into neighbouring manufacturing areas, with associated luxury residential developments (Michael, 2019) and in San Francisco displacement pressures have also arisen from developments associated with accommodation for the tech sector, which expanded rapidly in the early 2000s (Grodach, 2022). In Toronto, manufacturing districts have been displaced by creative and media clusters, and threatened by big box retail complexes (Lehrer & Wieditz, 2009). European cities, such as Brussels, have seen similar dynamics of industrial land loss—primarily to housing—despite the emergence since the financial crisis of 2008 of urban production strategies that seek to grow urban manufacturing (see De Boeck & Ryckewaert, 2020).

Whereas this could be conceptualised as planners “giving in” to market pressure, seeing planning as somehow “in opposition” to the market and failing to protect more vulnerable uses, it is clear in many places the planning system itself has been used to stimulate or facilitate such change in pro-active ways: through either rezoning (Curran, 2007; De Boeck & Ryckewaert, 2020) or creating new policy designations for mixed-use development with industrial in the mix (Ferm & Jones, 2016). Thus, as Adams and Tiesdell (2010, p. 194) claim, “It becomes fallacious to place planning and the market in a dichotomous relationship,” and instead, we need to ask ourselves “how planners have helped construct markets.” In London, the construction of markets through the designation of Opportunity Areas is a clear example, with Robinson and Attuyer (2021) showing how the lines between the state and developer become blurred as the state becomes increasingly reliant on land value capture to achieve broader public benefit. With respect to industrial land, we see how planning is both used as a tool to protect existing (and valued) uses that are under threat, and as a tool for harnessing market potential and being an instigator of change. This is in line with Tiesdell and Allmendinger’s (2005) proposition that regulation is only one of four planning tools, the others being to *shape*, *stimulate*, and *develop the capacity* of market actors. In the case of industrial land use planning, there is potential for

inherent tension in the purposes of these different planning tools. However, as the empirical section of the article will show, in London the tensions are underplayed through an assumption that urban manufacturing can be effectively accommodated within a mixed-use context.

Some recent empirical studies reveal the complexities of accommodating manufacturing within the mixed-use context. In their study of Brussels, which has been at the forefront of the European cities' *production urbanism* drive, Bonello et al. (2022) found that the success of mixed-use zoning designations was limited to accommodating innovative and environmentally friendly manufacturers, aligned with the maker-narrative. Yet in the US, Schrock and Wolf-Powers (2019) found tensions between efforts to support the emergence of a maker economy and what they call the "real-estate driven model of local development" (p. 369). In the Southeast Asian context, Park (2023) provides documented evidence for the re-urbanisation of manufacturing in Seoul since the 2010s, with manufacturers accommodated in mixed-use environments of the city tending to be small-scale, high-tech, and employing skilled workers. This suggests that new mixed-use environments are likely to accommodate a narrow segment of manufacturing activities. And, as Ferm et al. (2021) argue, there needs to be a recognition of the diversity of types of buildings and accommodation required to support a broader manufacturing ecosystem.

The literature on the urban manufacturing renaissance has not, to date, engaged fully with the issue of *how* to practically accommodate this renaissance within the urban built environment, specifically what the role of planning is in either supporting or stifling these ambitions. We know from the literature on industrial displacement in post-industrial cities that industrial uses, in general, have been threatened by displacement and gentrification by *different* higher-value land uses, a process that can, in theory, be managed through land use policies or zoning. However, recent changes affecting both industrial land supply and demand and leading to new competition and displacement dynamics within the industrial sector itself—a form of "intra-industrial gentrification"—have not yet been explored in the literature on industrial displacement. There has also been a lack of engagement with the fundamental tensions inherent in planning approaches that, on the one hand, seek to regulate and protect industrial uses and, on the other, act through market-shaping approaches to facilitate market dynamics which lead to their further loss. Through a London case study, this article brings these diverse strands of literature—on the urban manufacturing renaissance, industrial displacement, and planning—*together in conversation*.

### 3. Research Approach and Methods

The article draws on London as a case study, a global city with historical significance as a centre for a diversity

of manufacturing enterprises (Hall, 2012), but which has undergone major economic change and grappled with heated property markets and gentrification pressures. The mayor of London's approach to managing these pressures through a new approach to industrial land—described in Section 4—has attracted significant international attention and the author's involvement in three professional networks in the sphere of London planning and economy has provided an impetus for the research topic and the methods adopted. The three networks are:

- London Industrial and Logistics Sounding Board (ILSB): An independent body set up in 2017 to ensure "that the crucial role of London's industrial and logistics sector, in underpinning London's continued economic success, is fully understood by policymakers and other stakeholders" (ILSB, 2021, p. 2). Membership of the board includes occupiers, developers, investors, transport and logistics firms, property agents and business representative organisations, local authorities, and GLA officers.
- Industrious London Officer Network (ILON): Set up in May 2022 by a regeneration officer at the London Borough of Ealing, bringing together council officers (planners, as well as regeneration and economic development) across London local authorities to share insights on their work on industrial land and economy matters with a view to "championing the role of London's industrial workspace in creating green, resilient and inclusive local economies" (ILON, 2022, p. 1).
- Just Space Economy and Planning (JSEP): Subgroup of the Just Space Network, set up in 2015 by Myfanwy Taylor as part of her collaborative action-based PhD research on London's diverse local economies (Taylor, 2017). Members include local small business representatives and local community activists engaged in promoting and supporting small workspace provision across a variety of built contexts (high streets, markets, industrial areas, etc.).

The analysis is drawn from participant observation through my ongoing engagement with these networks, which has included attending regular meetings and taking notes, contributing to ILSB and JSEP consultation responses to the London Plan, presenting relevant topics to the networks, holding one-to-one meetings with other members, and—in the case of IILON—running a research focused workshop with the aim of collaboratively identifying new research agendas. In both the ILSB and JSEP networks, I regularly attended meetings and contributed to consultation responses to the London Plan, where my role as a member of the group and advocate for their interests was distinct from my positionality as an academic researcher. As Taylor (2017) discusses in the methodology for her dissertation based on collaborative

action research, there is an opportunity for scholars to mindfully integrate their different roles in these circumstances, rather than struggling to keep them distinct. In doing this, there is potential for the emergence of a “third space” where critical thought is embedded in solidarity with the activities of communities of interest that are oriented towards action. Both networks’ responses to the London Plan consultation were aligned in advocating for resisting further loss of industrial land and securing adequate space for a thriving industrial economy, which was also a line of argumentation in my own research, which protected my academic integrity and avoided intellectual conflict.

The insights gained through the meetings of these networks, as well as discussions with members outside the meetings, have been instrumental in formulating the direction of the argument in this article, as well as identifying further research agendas. The specific research topic emerged through collaborative discussions in meetings and my subsequent review of anecdotal evidence from industrial and logistics occupiers and developers, for example regarding the changing industrial market, alongside published evidence on London’s industrial land supply and demand—which suggested change on the ground that had not yet been captured or documented in official research. This was corroborated by ILON officers and JSEP members who pointed to specific planning applications and developments in London where planned mixed-use schemes were reverting to industrial. My longer involvement—since 2015—in the JSEP network, despite its dormancy over the last few years, allowed reflection on the changing nature of the pressures and policy challenges over time.

The insights gained from the three networks informed the direction for desktop-based research in order to substantiate and further develop the arguments that were emerging. This included: (a) a review of the London Plan (2016 and 2021) and associated evidence-based studies specifically the Industrial Land Supply Studies (2016 and 2023), Strategic Housing Land Availability Assessment (2017), and Economic Evidence Base 2016; (b) a review of borough-level local plans, Opportunity Area Planning Frameworks, and Affordable Workspace Studies; (c) a review of planning applications for key sites in transition, submitted by developers and applicants, along with associated evidence and consultation documents; (d) London market data and reports from leading property companies, such as Savills, Deloitte, and Knight Frank; and (e) local press articles.

#### **4. The London Case: Shifting Perceptions of Industrial Land in Planning Policy**

The way London’s industrial land has been treated in policy over time is reflective of the broader dominant narrative of the moment. As popular perceptions of London transformed in the 1980s and 1990s from a city that had been in demographic and economic decline to a “tri-

umphant city” that was experiencing both population and economic growth (Raco & Brill, 2022), the way it managed its industrial land also changed. The emphasis shifted away from a preoccupation with narratives of decline and how to manage it, and towards a reframing of industrial land as a vessel for accommodating growth.

Whereas London in the 1970s and 1980s had suffered a declining population and inner-city decline, by the time the GLA was established in 1999, London was riding on a wave of success. Whereas there had been an ongoing loss of manufacturing jobs, jobs in other service and professional sectors had grown. It had positioned itself firmly as a leading financial and business centre in the global context, one of the three global cities featured in Sassen’s (2001) seminal book. In the first London Plan, published in 2004, and in subsequent iterations, the focus of London planning policy was to support the agglomeration of firms in leading sectors where London is highly specialised and can demonstrate comparative advantage (Ferm et al., 2018), primarily the financial and business services, real estate, and cultural and creative industries, with more recent emphasis on life sciences, tech and digital, and green economy businesses. London’s population was growing and continues to grow. In the 2021 census, London’s population was estimated at approximately 8.8 million, a growth of 7.7% since 2011 (Office for National Statistics, 2021), and is projected to continue to grow to over 10 million by 2041 (Greater London Authority, 2023).

Accommodating this growth is a cornerstone of the mayor’s London Plan and has been a key driver for the identification of the 48 Opportunity Areas across the city, many of which overlap with areas of Strategic Industrial Land (for an overview of Opportunity Areas and their evolution in purpose over time, see Ferm et al., 2022). Underpinning the transformative approach in Opportunity Areas is an objective in the London Plan (GLA, 2021, p. 17) to “make the best use of land” by creating “successful sustainable mixed-use places,” in order to (a) “enable the development of brownfield land, particularly in Opportunity Areas,” (b) “prioritise sites which are well-connected by existing or planned public transport,” and (c) “proactively explore the potential to intensify the use of land to support additional homes and workspaces, promoting higher density development.”

This planned release of industrial land to other uses was part of a strategy of “managed decline,” justified by employment projections showing an ongoing decline of employment in industry, and an increase in employment in the non-industrial sectors of the global city. However, in the lead-in to the preparation of the latest London Plan, published in 2021, this approach began to be questioned. Reports commissioned by the GLA to inform the London Plan’s evidence base showed that industrial land was being lost at an alarming rate, far above that planned for (AECOM, 2016), but at the same time, there was evidence of a levelling out of the decline in industrial employment, coupled with a projected increased

demand in many industrial sectors (CAG Consultants, 2017). This was of concern to the larger industrial and logistics occupiers and developers represented on the ILSB, who revealed the very real impact of the shortage of industrial space on their businesses and operations, and a need to find additional industrial floorspace to accommodate rising demand. The focus of the group's recommendations was primarily on the quantum and location of industrial land to meet the needs of businesses servicing London's growth. The loss of industrial land was also highlighted as a concern by members of JSEP, whose members included smaller manufacturers, workspace providers, and community groups focused on local economic issues. In their consultation response to the London Plan, building on previous research (JSEP, 2015), the group argued that a loss of diverse workspaces across the city, primarily through residential redevelopment, was creating a more widespread workspace crisis, alongside the much more widely documented housing crisis, and that this was disproportionately affecting small businesses and ethnic minorities.

In response, the new London Plan moved away from a "managed decline" approach to industrial land, with the majority of London's 32 boroughs now required to either retain or provide additional industrial capacity. The plan states that: "Where possible, all boroughs should seek to deliver intensified floorspace capacity in either existing and/or new appropriate locations supported by appropriate evidence" (GLA, 2021, para. 6.4.6), in order to meet the "positive net demand for industrial land in London over the period 2016 to 2041" (para. 6.4.4). However, with the pressure on boroughs to also find additional sites for housing in the context of rising housing targets (Raco et al., 2022), industrial areas are also seen as potential sites for the accommodation of housing targets, particularly given the lack of political will to release land from the Green Belt. According to the GLA's calculations, industrial sites are planned to accommodate over 161,000 homes, approximately 40% of the total large site capacity for housing (GLA, 2017). The solution has therefore been to introduce a new policy promoting industrial intensification and co-location of industrial and residential uses (Policy E7) on all industrial sites, including those with the most strategic protection. This is intended to stimulate denser development, both in the form of multi-storey industrial, and mixed-use industrial and residential development, facilitating the co-location of uses that are competing, but compatible. This approach to industrial land in the new London Plan appears to be influenced by new thinking on industrial urbanism (e.g., Hatuka & Ben-Joseph, 2022), an underlying belief that industry, housing, and other city uses can co-exist side by side, mutually reinforcing principles of good urbanism and lively public spaces. Yet there are also very politically driven and practical considerations, such as the lack of alternative suitable sites for housing and the more recent realisation that additional industrial capacity also needs to be found.

The identification of industrial land for accommodating housing has been a game of numbers, matching housing target numbers with the availability of land. In quantitative terms, co-location and intensification present a potential win-win solution. However, the success of this policy approach relies on whether the market will deliver and the qualitative outcomes required to support the needs of industrial occupiers.

Alongside the lobbying and activism work, there was evidence of growing enthusiasm for a "manufacturing renaissance": London was one of three case studies alongside Rotterdam and Brussels in the European research project Cities of Making (2018), and the wide variety of London's manufacturing businesses have been richly documented in the book *Made in London* (King et al., 2022). However, neither the London Plan's policies on the economy nor the evidence-based studies underpinning them (GLA, 2020, 2016) make reference to growth in niche urban manufacturing, either including manufacturers within the broad category of "light and general industry" or implicitly within the creative industries as a broad growth sector. At the London borough level, on the other hand, it is clear that workspace for manufacturing is increasingly seen as a desired component of emerging mixed-use neighbourhoods. For example, in one local plan (Southwark Council, 2022), it is stated: "In our Opportunity Areas, mixed use neighbourhoods will incorporate new types of flexible business workspace accommodating *manufacturing*, technology, science, creative and cultural industries and the digital economy helping to boost the number of jobs in the borough" (p. 155) and "demand for creative workspace including industrial maker spaces, light manufacturing and artists workspace remains high. Workspace focused and mixed use development is needed to deliver workspace that responds to this demand" (p. 157).

Until recently, the concern in policy and grassroots networks has been that residential would dominate new development and that the market would struggle to deliver suitable industrial accommodation within mixed-use developments. This concern remains, but the narrowing gap between industrial and residential land values is now pointing to an alternative market-driven outcome, whereby planned mixed-use and co-location schemes are replaced with single-use industrial developments. The market dynamics driving this change are considered next.

## 5. Changing Market Dynamics in London's Industrial Sector

As revealed in the most recent London Industrial Land Supply Study (AECOM, 2023) and summarised in Tables 1 and 2, the supply of industrial land in London continues to shrink, whilst demand is increasing, resulting in significant rental value growth in the industrial sector. Specifically, the total stock of land for industrial use in London has declined by 1,500 ha since 2001, a

**Table 1.** London industrial land supply and vacancy rates (2001–2020).

	2001	2006	2010	2015	2020	Change (2001–2020)	Change (2015–2020)
Industrial land supply (ha)	8,281.5	7,841.4	7,504.7	7,153.6	6,798.2	–18%	–5%
Vacancy rate	15.9%	13.7%	11.7%	10.4%	5.8%	–63.5%	–44%

Source: Author’s work based on data from AECOM (2023).

contraction of 18%. Geographically, the majority of industrial land is in the east and western sub-regions, and in outer London, with outer London boroughs accommodating approximately 80% of London’s industrial capacity (AECOM, 2023).

Vacancy rates have also declined steadily over the same period, indicating growing demand. Between 2001 and 2020, vacancy rates dropped by 63.5%—from a rate of 15.9% in 2001 to 5.8% in 2020—with the most rapid decline having taken place in the last five years of the data between 2015 and 2020. Employment in industrial activities has also grown (Table 2). Whereas supply shrinkage in the years between 2001 and 2010 was accompanied by declining industrial employment, the sector is now seeing employment growth, which accelerated to 13.6% in the last five years. Within the industrial sector, there is significant variation. Whereas industrial jobs growth in England over the 10 years between 2010 and 2020 was 4%, jobs in logistics saw a 26% growth—significantly higher than the 14% growth in jobs across the whole economy (Powney et al., 2022).

With falling supply and growing demand, rents for industrial and light industrial properties have risen substantially, a growth of approximately 50% seen between 2015 and 2020 (see Table 2). This has been reflected in an even steeper trend in capital value growth (AECOM, 2023, p. 20). Research by Savills found a particularly strong relationship in London between supply loss and rental growth, plotted by local authority area (Savills Investment Management, 2022). Agents Strettons (2022, p. 2) have referred to a “hyper-competitive industrial market” caused by a “perfect storm between booming online retail sales and falling vacancy rates.”

The growth in online retailing is part of a broader long-term structural change of digitalisation, which has not only changed the way businesses operate but has also affected consumer demand for more efficient and timely deliveries, and the associated growth of e-commerce and logistics, fuelled most recently by the pandemic. This has spatial implications, for example, greater demand for so-called “last mile” distribution centres in urban areas as well as “dark kitchen” premises

for food preparation and space for quick delivery firms such as Getir (Savills Investment Management, 2022). Although a commercial real estate company member of the ILSB more recently reported a slowing of enquiries from dark kitchens and quick delivery firms, there had been a rapid growth during the pandemic.

The second longer-term trend is that of urbanisation. With rising demand for housing in urban centres, this generates a parallel demand for industrial land as the residential population needs to be served adequately—from logistics operations to waste and recycling plants. The British Property Federation found there was approx. 69 ft<sup>2</sup> of warehouse space per home in England in 2019, requirements that could grow as residents’ lifestyles and expectations change (Turley, 2019). This would equate to 36 million ft<sup>2</sup> of new warehouse space alone if the London Plan target of 52,000 homes per year over the next 10 years were to be reached. Shorter-term issues that have affected demand for warehousing are the supply chain issues as a result of Brexit and the war in Ukraine, which has translated into greater demand for warehousing for the purposes of stockpiling (Powney et al., 2022).

Beyond the loss of industrial land—measured in hectares in the GLA’s evidence base—real supply shrinkage is greater due to the age of the industrial building stock. In London, over half of buildings are more than 25 years old with only 10% of accommodation considered “modern” (Savills Investment Management, 2022). Given changing regulations requiring commercial properties to meet new energy efficiency standards in order to be deemed lettable, this effectively means tenant demand will be concentrated into a smaller pool of lettable buildings.

In terms of new supply, most of the new stock coming forward is designed for logistics users rather than other industrial activities. Yet prior to 2020, even logistics businesses were experiencing difficulties finding suitable space in the right location, with good transport links, proximity to consumers and suitable energy infrastructure (Bosetti et al., 2022). In response, the lack of supply to meet rising demand fuelled by Covid-19 led to a

**Table 2.** Change in employment in industrial activities in London and rental values (2001–2020).

	2001–2006	2006–2010	2010–2015	2015–2020
Change in employment in industrial activities	–7.9%	–7.4%	4.4%	13.6%
Change in rental values	19.8%	34.8%	13.2%	50%

Source: Author’s work based on data from AECOM (2016, 2023) and Savills Investment Management (2022, p. 5).

construction boom in the logistics sector—construction starts have increased by approximately 11% since pre-pandemic levels—but this has been tapered by the war in Ukraine affecting build costs slowing new development (Strettons, 2022). Supply of suitable stock therefore remains an issue.

This shortage of supply continues to fuel rental growth, increasing competition, and attracting significant investment into the industrial sector (SEGRO, 2022). In 2022 alone, standard industrial rents in London rose by 13.6%—Taking inflation at an average of 9.1%, this represents a real rental growth of 4.5%. In contrast, there has been a real decline in high street retail rents of 10.6% and a fall of 7% for Central London offices (Savills Investment Management, 2023). Given the relative growth of industrial rents compared to the retail and office sector, together with the longer-term structural trends of digitalisation and urbanisation fuelling demand for industrial, industry networks report that the industrial sector is being regarded as a secure long-term investment by an increasing number of investors.

This is translating into changing decisions made on the ground. In 2022, Savills estimated that 9% of the total residential pipeline coming forward in London could be at risk of becoming industrial, equating to a potential loss of 130,000 residential units (McLaren & Mofid, 2022). The application for a logistics-led development on the Honey Monster site in Southall is one concrete example of this prediction. Yet there are other notable examples. In the South London borough of Southwark, where mixed-use developments on industrial land have also been coming forward in recent years within the Old Kent Road Opportunity Area, there is evidence of sites that had planning permission for residential/mixed-use coming forward as industrial. For example, in Verney Road (numbers 6–12), a site which had planning permission for three mixed-use buildings of up to 22 storeys in height has now been sold to British Land, which is consulting the local community on proposals for a last-mile logistics hub in this location instead. It is one of two similar schemes in the area that are being consulted on concurrently.

As a result, the increasing attractiveness of industrial development to investors has the potential to slow the loss of industrial sites to residential redevelopment. However, at the same time, the hyper-competitive nature of the industrial market has implications for less competitive industrial occupiers. As stated in the London Borough of Southwark’s Affordable Workspace Study

(Monhonval & Boyd, 2019, p. 23): “The impact of an increase in rent of industrial space will have a particularly important impact on manufacturing businesses”

The vulnerability of manufacturing firms is explained in Table 3, which shows the turnover-to-rent ratios for different sectors and use classes in the London Borough of Hammersmith and Fulham. It reveals that manufacturing firms are allocating a higher proportion of their turnover towards rent and that pressures are greater on sites in industrial than light-industrial use, where they would be competing with transport and warehousing and logistics firms, whose “turnover-to-rent ratio” is much lower.

As a result, whereas affordable workspace policies have to date mostly been focussed on securing affordable office space, more recent borough-level affordable workspace studies and policies are targeting manufacturing as a priority area for policy intervention (for example in Ealing, Southwark, and Hammersmith and Fulham). For example, in Hammersmith and Fulham, rental levels of £36 psf (in 2022) achieved in the Townsmead and Imperial industrial area are considered unaffordable for most businesses with turnovers less than £250,000 p.a., which has led to a recommendation that the local authority secure affordable industrial space at 40% discounted rent.

## 6. Conclusions and Implications for Policy

Aspirations for an urban manufacturing renaissance in post-industrial cities are partially dependent on the city being able to accommodate it. Focusing on London, this article has revealed a gap between popular advocacy narratives of such a renaissance and the coherence of planning policies to support it. In considering ways to address this gap, the article has drawn attention to the emergence of a hyper-competitive industrial market showing strong rental growth, which is reversing displacement dynamics between industrial and residential and creating new displacement dynamics *within* the industrial market, negatively impacting manufacturers and revealing a need for more nuanced policy approaches beyond traditional planning tools.

Empirically, the article has documented early evidence of examples in London’s Opportunity Areas, where sites with permission for residential or mixed-use developments are now coming forward as industrial (logistics) developments. Conceptually, this reveals limitations to the influence of planners in *shaping* or *stimulating*

**Table 3.** Turnover-to-rent ratios on industrial sites by selected sectors in the London Borough of Hammersmith and Fulham (2020).

Sector	Turnover per business (£ million)	Light industrial	Industrial
Manufacturing	£1.4	9%	16%
Warehousing and logistics	£15.2	1%	1%
Transport	£15.2	1%	1%

Source: Author’s work based on data from Hatch Regeneris and Turley (n.d., p. 42, Table 4.3).



the market (Tiesdell & Allmendinger, 2005)—in this case through the designation of Opportunity Areas in the London Plan—and tensions between planning’s role to stimulate the market to facilitate transformation on the one hand, and to regulate or protect industrial uses on the other. The findings point to the limitations of both planning strategies in securing space for manufacturing uses. In the case of market-shaping actions, there is a lack of control over both planning applications submitted being in accordance with the aspirations of the Opportunity Area, and over the suitability of the commercial space coming forward within mixed-use developments for manufacturing activity. In the case of regulation, such as zoning and strategic industrial land designations, these are tools that are primarily designed to protect industry from redevelopment for other, non-industrial uses. Fewer tools are available to planners to manage competition *within* the industrial sector itself, in order to promote or retain a diversity of workspace and industrial accommodation. Although in the UK context, there is a system of use classes, whereby different land and buildings are allocated to different categories of use with subdivisions within them, the direction of travel in policy and legislation has been towards deregulation to facilitate flexibility within those use classes. This limits the influence planners have to manage changes that take place within, say, the commercial or industrial sectors. What emerges, therefore, is a mismatch between aspirations for a manufacturing renaissance and the ability of planning to guide the delivery of the diverse accommodation required to facilitate it.

One of the primary problems is the over-reliance on new mixed-use developments to effectively accommodate urban manufacturing through co-location. Its support in policy and political terms is not only driven by the benefits of achieving housing and growth targets but also because it is deemed a more sustainable solution, with high-density, mixed-use development being considered a “better use of land” that is accessible by public transport. Yet this reflects a narrow interpretation of the concept of sustainability that limits the gaze to the location of residential development and the movement patterns of residents to and from (central) places of work. Not only does it ignore the potential positive environmental impacts of retaining industrial land and limiting industrial sprawl (Bronstein, 2009), but focusing attention primarily on the low-carbon economy can also detract from other social equity and justice goals (Schrock et al., 2015), which underpins much of the argument for the inclusion of manufacturing and production into the urban, in terms of the provision of middle-wage jobs that can mitigate income inequalities (Chapple, 2017). It remains important to protect industrial land and ensure an adequate supply of industrial property for a diversity of occupiers including manufacturers; the question is whether regulatory tools are able to effectively achieve the nuanced outcomes required.

In places with statutory zoning systems, land for production can potentially be distinguished from land for logistics or other industrial uses, as in San Francisco (Grodach, 2022). In England, under a more discretionary planning system under deregulatory pressure, this is more challenging.

Following Adams and Tiesdell (2010), we suggest that planners, as “market actors,” would benefit from a greater awareness of industrial market information and knowledge, as well as a better understanding of the network of actors influencing and embedded in the industrial development market. Until recently, in the context of a development market where residential development has out-bid most other land uses, the focus of research in planning and development has disproportionately been on housing and residential developers respectively. However, the emergence of a hyper-competitive industrial market points to a need for further research into the nature of the relationship between industrial land ownership, development and investment, and the other actors (planners, industrial occupiers, third sector) who shape the market. Moving beyond planning, there is a requirement for a better understanding of the tactics smaller manufacturers use in order to compete with larger firms, and the nature of their struggles, building on the work by Martin (2021) in revealing the resilience of urban manufacturers in the face of real estate pressures. To facilitate this, there is an opportunity for the struggles of smaller manufacturers and other less competitive industrial users to be brought into conversation with the larger occupiers and players, an opportunity that has not, as yet, been realised in London, perhaps limited by the current memberships of the three networks mentioned in the research. If we want to support entrepreneurialism in West London’s Southall, or more broadly foster an “industrious city,” we need an industrial strategy that considers what type of industry we would like to nurture, why, and where, developed in collaboration with a range of voices, including perspectives from the grassroots. So far, interventions in London have been limited to planning policy and focused primarily on a consideration of quantum and hectares of land, rather than softer interventions and qualitative outcomes, a strategy that is disadvantaging lower-value industrial occupiers. An internationally focussed research agenda, drawing on the wide experiences of manufacturers, their representative organisations, and the interventions that have been tested, is required to address this gap.

### Acknowledgments

I would like to thank members of the Industrious London Network, London Industrial and Logistics Sounding Board, and Just Space Economy and Planning for conversations that both inspired this article and challenged some of the arguments developed in earlier iterations. Thank you to Jorn Peters at the Greater London Authority, for clarification on some of the most recent London-level

data. I am grateful to the three anonymous reviewers of the article for their very helpful comments and to the academic editors for their overall direction and encouragement to submit to this thematic issue.

### Conflict of Interests

The author declares no conflict of interests.

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URBAN PLANNING  
ISSN: 2183-7635

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