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# Changing use and performance of industrial estates from 1965 onward: the case of the Parkstad conurbation, the Netherlands

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## ABSTRACT

In the wake of deindustrialization and economic shifts, industrial estates in the Western world have faced strong changes in programmatic demands. While strategically situated urban brownfields have held a central position in contemporary urban design practice and discourses in the past, industrial estates, developed since the 1960s in suburban peripheries, have become central to these practices and discourses only recently. Drawing on a case study of the productive landscape of the Dutch Parkstad conurbation, this paper offers a novel research agenda for urban design in relation to industrial estates that developed under conditions of dispersal.

## Introduction

Conurbations where twentieth-century industrialization has propelled urban development have been laboratories for continual planning strategies in response to both emerging and declining economic activities. Over past decades, reprogramming of industrial spaces in Western Europe has been in the foreground of urban design discourse. Today, abandoned waterfronts, docklands, industrial plants and mining sites that have gone through periods of decline are transforming into contemporary cultural hotspots, residential areas or landscape parks in service of a post-industrial society. Since World War II, under the influence of modernist town planning, industrial companies remaining in Europe have resettled in urban peripheries, detached from other urban programmes. These estates differ from their older counterparts rooted in the 'first machine age' and pose a separate challenge with regard to functionality, longevity and reprogramming in the face of changing demands. This paper enquires into the historic continuity of dealing with sites of production in an urban system. It contextualizes contemporary redevelopment challenges to the industrial landscape on the basis of a case study in the Dutch Parkstad conurbation in the province of Limburg, which is an urbanized region with a coal mining history that has been strongly affected by the twentieth-century industrial rise and decline.

Mid-century industries were mainly planned under a Fordist accumulation regime. The basic premises of making affordable products and of paying labourers sufficiently so they can consume the products translate into typical spatial production. Fordist spatial development, in congruence with modernist planning, has tied together the pillars of production and consumption in terms of both space and commodities such as the car. Sites of economic production were scattered across the territory, typically generated by leapfrog planning, and the need for connections to suburban residential zones led to increased importance of road infrastructure (Ryckewaert 2011). From the 1970s onward, the Fordist model arguably has been succeeded by a post-Fordist model (Amin 1994). Production has become more footloose and global, replacing the balanced producer-consumer interrelation with flexible responsiveness to changing market demands. As the post-Fordist economy is more differentiated and encompasses services, recreation and leisure, sites of economic production are no longer unequivocally industrial but include other programmes. Moreover, companies are organized in a global manner and are highly specialized, with higher demands in terms of their locational policy. The service-based urban landscape is more diffuse and, in terms of typology and iconography, its generic architecture lacks any expression of functionality or possible ties to local communities.

Under contemporary post-Fordist conditions, transitions in economic spaces are commonly inscribed in the search for new urban programmes in the face of deindustrialization (Secchi 2007). Cities and regions might seek to benefit from the industrial heritage in defining a 'comeback' strategy that benefits from the spatial heritage of the past, inscribing new programmes in unused but cherished industrial buildings (Van Boom and Mommaas 2009). Loures (2015, 77) argues with regard to this endeavour that redevelopment of underutilized industrial resources is beneficial under the conditions of 'a harmonious relationship among the project and its surroundings' and a connection to the 'social and economic interests of the community'. In the context of an urban system, industrial redevelopment of sites that profit from a central location contributes to the goal of 'rebuilding of the urban core and reducing further encroachment into "greenfield" sites' (Kirkwood 2011, 7-8). Alternatively, cities opt for an 'urban renaissance', which relocates economic focal points and leaves industrial areas derelict and vacant (Vitale 2015, 34).

Increasingly, continuation of industrial production in the European city is on the agenda of urban design professionals, in correspondence with the search for more sustainable, less polluting and more inclusive economic profiles of urban regions. The central argument of the 2016 Rotterdam Architecture Biennale exemplifies this quest; existing working spaces in urban environments hold the potential for evolution towards a 'next economy', influenced by contemporary notions of circular, localized and sharing economies that introduce innovative industries in cities (Hajer 2016). In the context of this biennale, several context-based ateliers explored the notion of the productive metropolis across Europe (IABR 2017). The impending influence of an economy of highly skilled manufacturing in the artisan tradition is inscribed in industrial landscapes, resulting in a search for affordable, small-grained working spaces, well connected to urban residential areas and amenities (Kapp 2017). This attention is providing new impetus to urban design in rethinking the presence of productive economies in the European urban environment.

However, the dispersed and generic post-war industrial estates are not readily brought in line with such economic innovations. This paper therefore draws attention to the performance of post-industrial urban systems and, through an historical investigation of the Dutch Parkstad conurbation, assesses how such industrial estates perform in light of changing demands and programmes. Because the contemporary economic landscape of Parkstad is built on the remains of the coal mining industry, the case study is positioned within a broader timeframe of industrial rise and decline (Figures 1 and 2). In recent planning history, which key approaches have determined an economic landscape composed of industrial estates? How does this history determine the challenges to contemporary design and planning of this economic landscape?. The consecutive inscription of new concepts in the economic landscape is thus the central issue. The questions raised by an intricate case study can provide insight into challenges to maintaining the performance of built-up industrial networks through retrofitting and reprogramming.

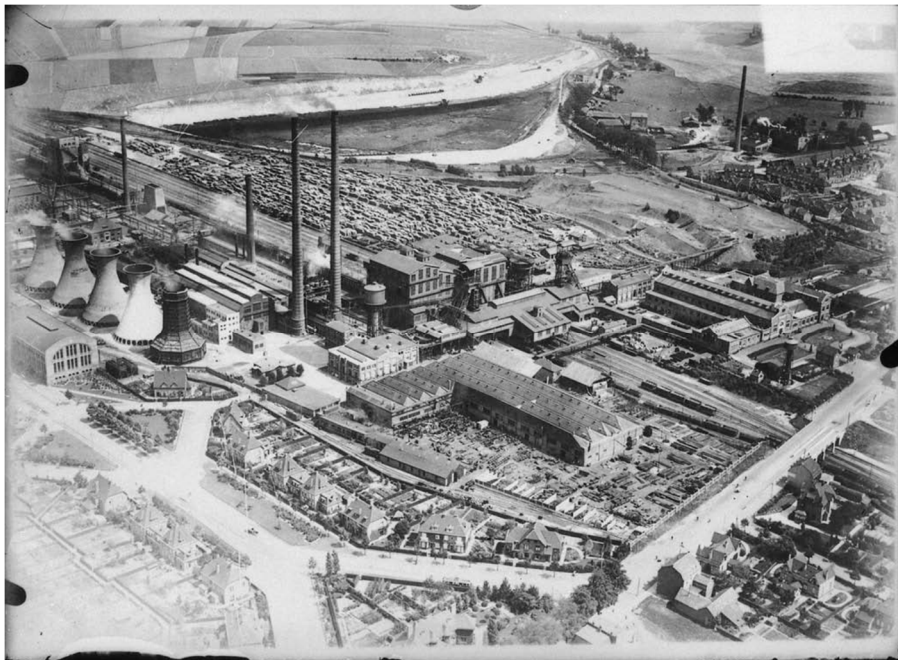


Figure 1. Aerial photo of State Mine Emma in Heerlen and Brunssum. Source: RHCL, photo collection Staatsmijnen/DSM, HI 745.



Figure 2. Contemporary warehouses on the terrain of the former coal mine Julia. Source: author.

Parkstad is in the foreground of the contemporary urban landscape facing continual changing demands. It is discussed in this paper with respect to planning interventions made throughout the lifetime of such estates to improve performance. This paper primarily examines the approach to urban redevelopment chosen for Parkstad by comparing that approach to significant trajectories to implement new spatial-economic configurations that replace obsolete industrial land uses across Europe. Drawing on the urban design literature, the paper also describes challenges to industrial estates regarding the urban periphery and waste spaces that are relevant for Parkstad. The case study draws on multiple sources, rendering a thick description of urban development processes. Key to the analysis are the continuity and persistence of underlying decision making in design, planning and policy, which testify to ‘the perspectives of regulators, producers and users of the urban space’ (Madanipour 2006, 174).

Grey literature such as planning documents, drawings, memoranda and brochures provides the foundation of this study. In addition, archives of the regional statutory industrial board and several municipalities were consulted, with a focus on reports, drawings and photographs. These documentary data were complemented with additional interviews with local stakeholders, along with observations of the conurbation made during explorations on foot and by bicycle. The historic trajectory is presented in sections corresponding to the perceived stages of this developmental process, with each stage being defined by explicit spatial challenges and strategies. A concluding discussion, which relates the case study to the elaborated theoretical section, presents a novel research agenda in the face of the challenges to contemporary urban design.

#### Changing economic perspectives: Parkstad in its European context

The industrialized regions most prominently discussed in terms of transition to urban design are those where traditional industries have been replaced by alternative economic activities. Across European mining regions, a major shift has occurred towards a service economy (Reicher et al. 2011) and towards socio-cultural development, especially in continental Europe – exemplified in the establishment of museums and cultural centres celebrating the heritage of local industrial cultures (Murzyn-Kupisz and Gwosdz 2010; Rautenberg 2012). Those formerly industrial regions that have not succeeded in making such a comeback have moved to the economic peripheries because of cultural and spatial inflexibility to develop in new economic directions (Hudson 2005).

The Parkstad region, a conurbation in the province of Limburg in the Netherlands, has a long history of attempts to make a comeback after the closure of its coal mining industry (Figure 3). The conurbation encompasses the cities of Heerlen, Kerkrade and Landgraaf and the villages of Brunssum, Nuth, Onderbanken, Simpelveld and Voerendaal in the outermost southeastern tip of the Netherlands. The area is in proximity to many national and regional borders, but is a great distance from the country’s central urbanized region (the Randstad) to the west. Formerly known as the Dutch Eastern Mining Region, Parkstad hosted 11 of the 12 operational industrial Dutch coal mines. This industrial monoculture permeated all layers and segments of society. Its decline started in the 1950s, when profitability came under pressure, especially during the 1958 coal crisis (Kasper et al. 2013). By December 1974, all mines were closed and the infrastructure faced all but complete demolition. This economic foundation was gradually replaced with new industrial estates and state-led relocation of government bodies to offer new white-collar jobs. As a result of the mining closure, the conurbation has experienced declining social coherence and cultural institutions, limited economic opportunities, and gradual decrease of population growth that has turned into demographic shrinkage (Verwest, Sorel, and Buitelaar 2008; Kasper et al. 2013; Elzerman and Bontje 2015; Hermans 2016). In response to the diminishing need for buildings, re-use and demolition are increasingly being introduced into design vocabularies (Oswalt 2006; Cairns and Jacobs 2014).

### Industrial estates: peripheries and waste spaces

The issue of dispersal forms a primary challenge to urban renewal common to postindustrial conurbations. Urban growth in the twentieth century destabilized the notion of the city as a clear nucleus in the landscape, certainly in regions that developed out of rural areas into fully-fledged industrialized urban landscapes before declining in the wake of deindustrialization. With a current population of approximately 255,000 inhabitants, Parkstad materialized out of a sparsely populated rural area when the industrial coal mines induced rapid urbanization in a piecemeal manner.

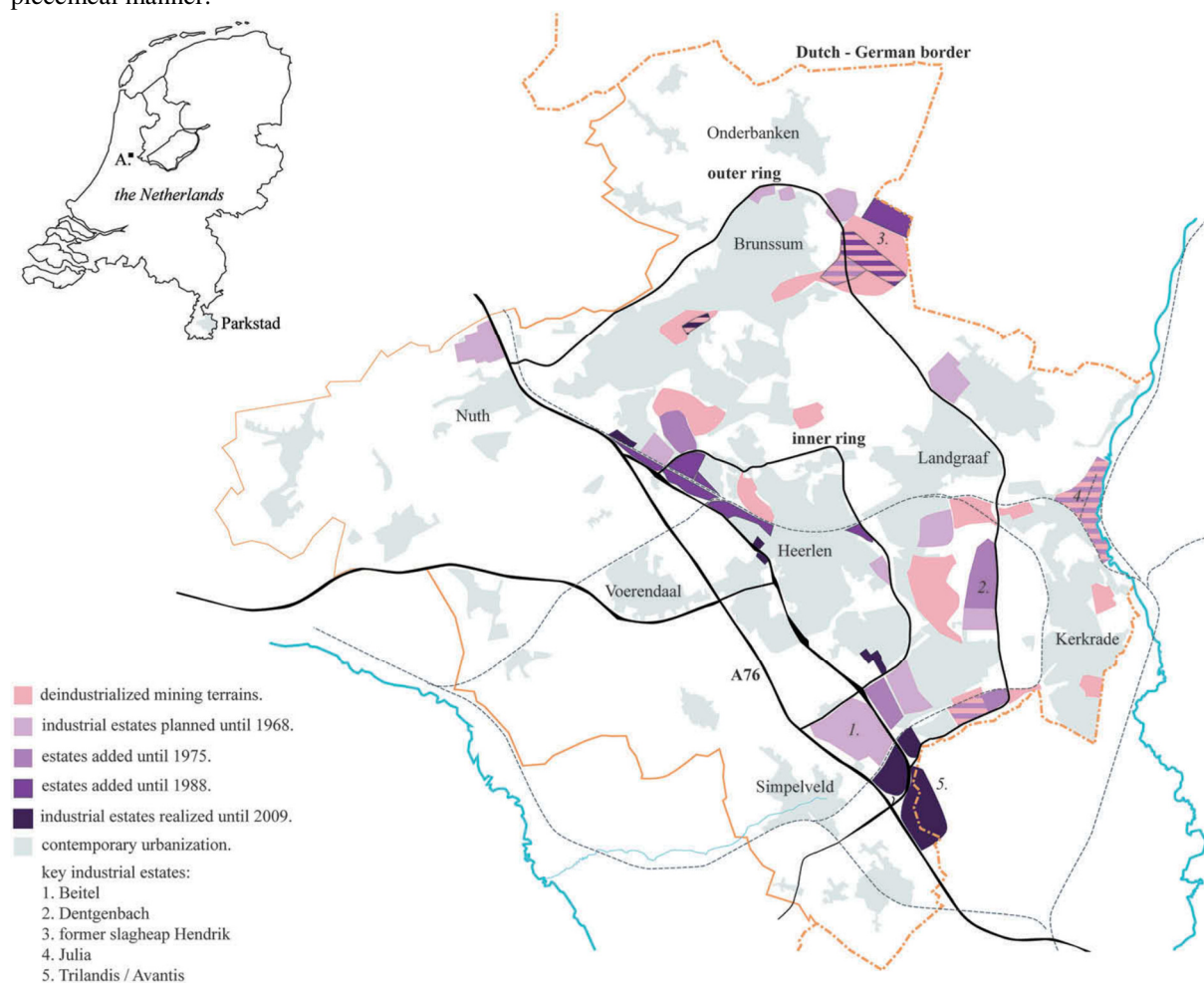


Figure 3. Development of the industrial landscape. Sources: Archive Statutory Industrial Board, Rijkshet, inventory nr. G106 25; Ingenieurs- en Architectenbureau van Hasselt en de Koning (1975); Streekgewest Oostelijk Zuid-Limburg (1988); Parkstad Limburg (2009).

Importantly, Parkstad fits into a European context of ‘archipelago cities’, defined by urbanized shards in a landscape (Viganò 2012), ‘diffuse cities’ blurring traditional gradations from core to periphery (Indovina 2016), and ‘urbanized countryside’ that mix urban and rural lifestyles (Sieverts 2003), in which people live in close proximity to both the city centre and rural landscapes with recreational, ecological and cultural value. The development of settlements for the booming mining population according to garden city ideals has engendered this condition. Industrial estates have contributed to this urban dispersal, but because such designs prioritize economic and business optimization over arguments of urban form and morphology, they have not been emphasized in recent urban design discourse (Ryckewaert 2011).

The modernist productive landscape does have a pronounced role in the seminal discourse relating to waste space. Picon and Bates (2000) propose a continuous process of production and decline of built spaces, exchanging the historical sense of place for a form of place comprising a continuous urban tissue, devoid of

place-specific characteristics and architectural emphasis. They argue that in contemporary spatial production, the notion of the core versus periphery has been replaced by the notion of consumption space versus waste space. Waste space is determined by temporary spatial commodities, mono-functional spaces with disposable architectures or 'drosscapes' (Berger 2006). The development of 'junkspace' is effectively the consequence of modernity, and constitutes an omnipresent condition on which traditional design paradigms have no hold (Koolhaas 2002). This framing in terms of waste, temporality and commodification marks a dividing line between heritage-laden former industrial sites and more contemporary business parks where production economy continues to develop. Industrial buildings that turned to ruin illustrate the rapid sequence of accumulation and decay specific to capitalism (DeSilvey and Edensor 2013). Derelict factories become the decor for criminal, playful or exploratory activities that can occur only outside of the controlled normality of urban society (Edensor 2005). Because its fragmentation developed out of diverse phases of industrialization, deindustrialization and reindustrialization, Parkstad is a rich illustration for a better understanding of fragmentation, waste space and consecutive spatial conceptualization of the industrial productive landscape.

#### Phasing out an old industrial configuration and replacing it with a new one

The gradual ending of coal-mining activities in the Netherlands by 1974 hastened the making of a new economic landscape for the former Eastern Mining Region. The mines were framed as obsolete waste spaces. The heavy air pollution of the mining industry, dereliction of its vacated premises, gradually accumulating pollution in the soil, along with the increasingly cultivated societal mind-set that the coal-mining days were finished, induced a rigorous policy of demolition and redevelopment. This strategy included the search for a new economic spatial structure. What few other industries the region had were interwoven within the urban tissue, impeding ambitions for expansion of such companies. A regional plan issued in 1962 had proposed industrial expansion in a region that is very hilly and has fewer potential sites owing to extensive mining damage, and where already dense and dispersed habitation put a significant claim on the landscape. Between 1970 and 1974, a plan was developed for the conurbation (co-supervised by modernist town planner Cornelis van Eesteren), which formed the spatial basis for phasing out the mining industry (Stadsgewest Oostelijk Mijng gebied 1974). The fundamental concept throughout these years was to provide each municipality with its own portion of these new estates to keep commutes short, but with enough distance between them for heavy industries to develop without interfering with other urban programmes (Figure 4). Clean industries could still be interlaced with the existing urban tissue 'and can form, by means of their architectural composition, appealing elements in built-up areas which for the rest is mainly tailored to residential purposes' (Provincie Limburg 1962, 50). A statutory industrial board, established in 1961, began to develop industrial estates in 1965. Main design arguments for the new industrial estates included diversity, freedom of choice, visibility and prevention of nuisances affecting residential zones (Industrieschap Oostelijk Mijng gebied 1968). Some of the areas were planned adjacent to the mining sites and offered connection to the available railway infrastructure. In expectation of infrastructure to be developed, others were projected in greenfield locations: at the site of a forest and heathland, in an agricultural area and on a plateau in between two stream valleys.

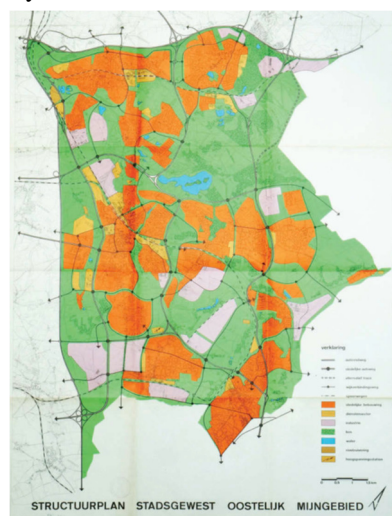


Figure 4. The 1974 structure plan for the Eastern Mining Region. Source: Stadsgewest Oostelijk Mijng gebied (1974). Collection SHCL.



In 1970, the executive of the conurbation estimated that 1000 hectares were needed for the post-mining economy to compensate for the closure of the mines, which encompassed 750 hectares on the surface (Stadsgewest Oostelijk Mijngebied 1970). It was argued that such vast development of virgin terrains was needed to compensate for job opportunities lost in the closing of the mining companies (Figure 5). Furthermore, the conceptual structural plan proposed that most existing mining terrains would not be suitable for continued industrial activities because of their scattered locations, close proximity to residential areas and apparent randomness. This perception was contrary to the mining companies' actual intentions to continue their industrial activities on their own sites, with subsidiary companies. The concept version of the structural plan suggested that such activities would risk conflict with other urban purposes in the densely populated conurbation. After critical evaluation, the mine locations were proposed to be shifted to services or residential estates. Early in the planning process, it was argued that the fragmented insertion of new industrial estates had caused damage to the ecologic system and its recreational performance (Adviesbureau Arnhem n.v. 1971). The recreation annexe to the structural plan proposed interlacing 'green' and 'red' spaces to closely interrelate qualities and to limit distance between urbanized areas and green spaces. This corollary halted the development of corridors composed of interconnected industrial estates (Stadsgewest Oostelijk Mijngebied 1970, 1973).

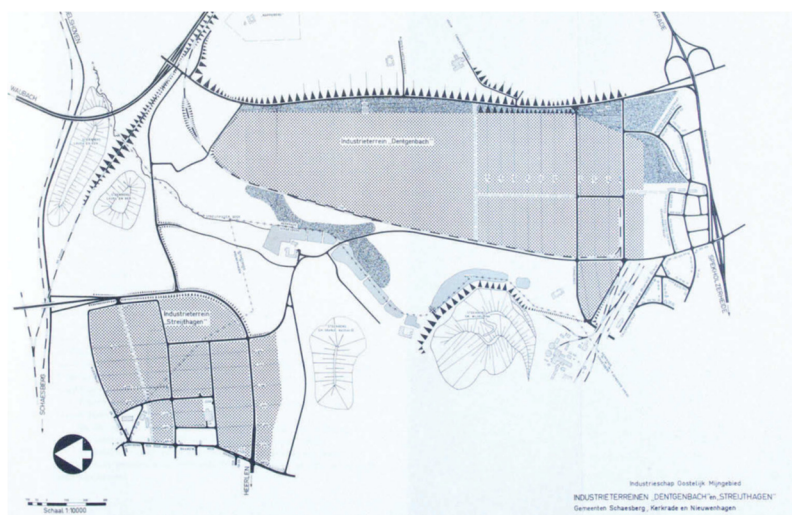


Figure 5. Plan for the implementation of Dentgenbach. Royal HaskoningDHV, reproduced with permission. Source: Industrieschap Oostelijk Mijngebied (1968). Collection SHCL.

### Facing the limits of growth and oversupply

The process of dismantling and retrofitting the older industrial system of the mines picked up speed in 1974. Between 1975 and 1985, an urban redevelopment programme (Hoefnagels 1974) to reprogramme the mines as residential areas, green spaces and leisure areas, urban amenities, and industrial estates was implemented. Large new office complexes were introduced into the urban landscape, characterized by brutalist and structuralist architecture. At industrial estates, warehouses were typically constructed using steel structures, shed roofs and profiled wall cladding and were placed behind representative office buildings mainly covered with brickwork and glass. Where continued industrial activities were allowed at peripheral sites, plans were required to mitigate emerging conflicts with bordering spatial programmes. The province of Limburg felt the economic crises of the 1970s in an exacerbated way, which urged recalibrations to the new industrial landscape as it was being implemented. By 1976, the massive amount of land brought into development for industrial purposes resulted in a surplus, leaving many lots undeveloped (Figure 6). The respective municipalities then experienced financial difficulties because of the interest rates of these unused terrains. Following the national government's acknowledgement that a larger part of the Limburg province was an area of economic restructuring, an official memorandum regarding future prospects for the province was elaborated between 1976 and 1978. The first draft of the memorandum (Coördinatiecommissie Perspectievennota 1976) was subjected to a participatory process involving a plethora of societal organizations in public discussions on the potential perspectives for the province. This procedure resulted in a course change. The Eastern Mining Region was to focus on light industries and services, which required less space and heavy infrastructure (Coördinatiecommissie Perspectievennota 1976, 117).



Figure 6. Aerial photo of industrial estate Beitel, showing the progress of industrial development at a greenfield site in 1975. Source: Collection Rijkheyt, Heerlen, inv. nr. 6647\_1975.

Increasing density became a goal for the management of economic sites (Werkgroep 2000 1977a, 65). However, many industrial estates were developed without a close connection to residential areas and urban centres, which would be beneficial to such service industries. During the participatory process, debates concerned economic interest on the one hand and residential quality – paired with a clean environment, attractive nature and ecological robustness – on the other hand (Werkgroep 2000 1977b). These debates resulted in placement of the actual problems of industrial estates on the agenda (Werkgroep 2000 1977c). These issues included vacancy, poor connections to the road system and exorbitant land prices. Moreover, the estates' diffusion across the territory, which initially was an explicit strategy to spread labour opportunities, was considered to be detrimental. The participatory procedure resulted in the proposal of two scenarios (Werkgroep 2000 1977c). These scenarios conceptualized diverse plausible future conditions that would integrate short-term decision making into a broader timeframe. Dutch spatial planning and urbanism at that time was strongly influenced by such scenario thinking (Salewski 2012). In this local case, one scenario emphasized economic growth and liberalization to attain economic recovery by means of reindustrialization. The other scenario acknowledged the unattainability of a complete economic recovery and reconciled this situation by proposing more government control of industrialization to attain an industrial sector, subservient to housing and nature and centred on a local market. This scenario halted further development of industrial sites and brought into the limelight the possibility of repurposing underused estates only approximately 10 years old.

The duality of these two scenarios presented a challenge to urban planning. The shortage of industrial terrains, determined by the limited access to waterways, resulted in a selective policy for ongoing development of terrains to offer more diversity and alternative transport modalities (Ministry of Economic Affairs 1978). The 1981 revision of the structural plan noted that 'the factual occupation of industrial estates has not at all been up to principal estimates and much terrain has remained undeveloped' (Adviesgroep Partners bv 1981, 29). Of the initial 1000 planned hectares, 809 were actually brought into development, of which 450 hectares were still vacant. This revision proposed to expand the most successful of industrial estates – those in proximity to residential areas and suitable road infrastructure – while converting unattractive estates to other functions. Recreation was emphasized as an important opportunity for the conurbation. However, elaborating this advice into actual plans was prevented by the concern that too many industrial opportunities might be lost to the region.

#### Accessibility and interconnection draw in new users

By the end of the 1980s, revitalization of ageing business estates was put on the agenda nationwide following gradual economic recovery. At this time, ongoing urbanization had affected the functionality of industrial



estates. Car mobility had assumed a nationally predominant role, while transport via rail and water had become less important (Raad Van Advies voor de Ruimtelijke Ordening 1987). As a consequence, a number of terrains had lost their attractiveness to investors. Hence, assumptions on the performance of estates took another turn. In the former Eastern Mining Region, estates acknowledged as having the most potential were those close to the double road system of the main motorway between the Belgian and German border (A76 connecting Brussels to Cologne) and its parallel subsidiary motorway N281, distributing traffic to the hamlets and urban cores of the conurbation (Streekgewest Oostelijk Zuid-Limburg 1988).

Areas that were conceived as industrial estates along this road network were diversified in outlook, as non-industrial programmes such as home-decoration stores and a football stadium settled here in 1994 and 2000, respectively. The industrial landscape henceforth included large warehouses clad in commercial iconography and made accessible via extensive parking terrains. Generic rentable office buildings were also added to the building stock. The existing industrial estates became more strongly interrelated with other functions that have gathered along this corridor, such as the regional hospital (built in the 1960s) and the University of Applied Sciences campus (built in the 1990s). Selected estates drew investment, but informal economies and crime-related activities also found their way to business estates. Street prostitution related to the region's significant drug scene was resettled to the industrial estates by 1999, following societal activism demanding it should be removed from residential areas (Hermans 2016). Subsequently, local business owners protested the coming of prostitution zones and formed a pressure group, an initiative that eventually developed into the establishment of a regional industrial estate management executive.

In parallel, after decades of austerity, the development of new business estates in greenfield sites was again considered. At this point, in 1992 the municipalities of Heerlen and the neighbouring city of Aachen joined forces to develop a cross-border business park called Avantis. Increasing European unification paved the way for this transnational endeavour, which manifested in an urban design taking the shape of a key (Jacobs and Kooij 2013). A smaller business park, Trilandis, forms a keystone in an interconnected configuration between Avantis and the older estates. Both business parks house big-box architecture, composed of large and abstract volumes clad with mirrored glass and sandwich panels and set in a parklike landscape of lawns and asphalt roads shaped as cul-de-sacs. Owing to environmental issues, changing economic conditions, construction difficulties, the complexity of dealing with international regulation (Anonymous civil servant 2017) and optimism about EU integration that led to overambitious planning (Jacobs and Kooij 2013), these newer estates are only gradually being occupied. At present they house only a few companies, which are still separated by agricultural fields. Planning endeavours in the first decade of the twenty-first century built further upon the central economic and infrastructural spine enveloped by the double system of the A76 and N281 motorways as an urban configuration. The Parkstad executive advocates a strategic economic policy centred on renewable energy, healthcare, leisure and tourism, and the structural plan for the Parkstad conurbation explicitly proposes the configuration as a backbone for economic development (Parkstad Limburg 2009; Figure 7). The corridor is directly connected to the centre of Heerlen and together these sites offer the largest concentration of jobs in the province. Recent tentative schemes for the 2014–2020 iba Parkstad project (Coenen 2015) elaborate on this objective, as the corridor is defined as one of the strategic areas for interweaving key programmes in the context of this ongoing urban revitalization project. Further development complements this corridor, notably an inner ring road completed in 2009 with the outer ring road to be completed in 2018. The realization of this outer ring fulfils the promise of a better accessibility for municipalities in the Parkstad hinterland (Creemers 2016). The completion of this infrastructure therefore entails priorities with regard to redevelopment of existing estates at a greater distance from the main corridor (Parkstad 2009), moving these estates from backstage to frontstage. As a consequence, policies for retrofitting and reconceptualizing ageing industrial estates are diversified in accordance with accessibility and programmatic requirements. In particular, backstage terrains have to come a long way; for example, estates that developed in connection with the slagheap of the former mine Hendrik in the municipality of Brunssum are currently part of the periphery, where activities of waste treatment, recycling and earth-moving are located. They are equipped with aged warehouses in metal sheet cladding that have limited or no glazed surfaces. Such estates have been sparsely allotted and granted, and the fenced terrains are used for open-air storage of raw and waste materials. This inefficient spatial configuration (Creemers 2016) lacks any unity owing to the closure of settled businesses (BTM 2011).

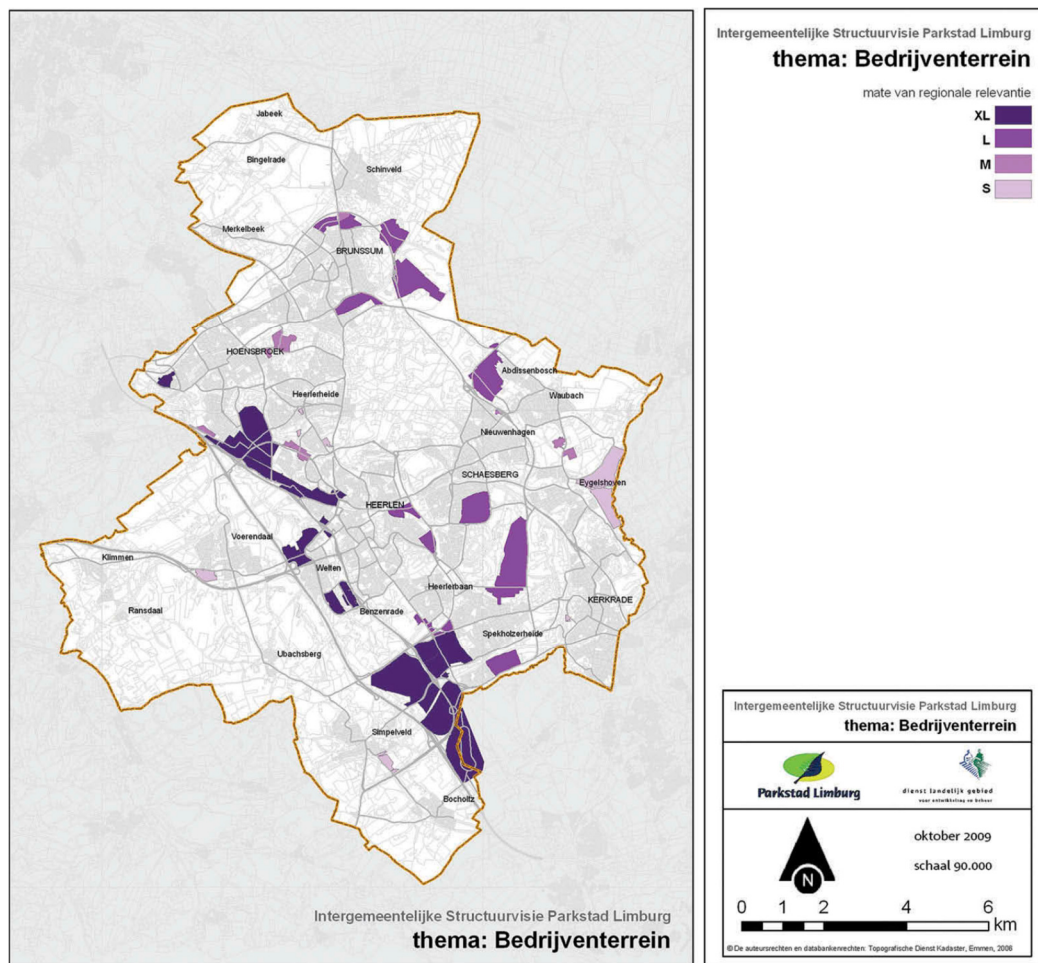


Figure 7. ‘Extent of regional importance’ of industrial estates determined by the executive of the conurbation. Grading from ‘eXtra-Large’ to ‘Small’ importance. Source: Parkstad Limburg (2009, 82), reproduced with permission.

For those areas that are in representative locations and are accessible, a common thread is the improvement of the public domain: road infrastructure, parking facilities and landscaping, with green corridors as buffers (Figure 8). These issues had been on the agenda for some time (Streekgewest Oostelijk Zuid-Limburg 1988). As the road network links the Parkstad region to six European airports, the area is increasingly preferred by large international companies, especially in healthcare technology (Jeuring and Offermans 2017; Bertholet and Delheij 2017; Roland 2017). In contrast, local business increasingly depends on small entrepreneurship in service and manufacturing economies. A former Philips plant with modernist industrial brick buildings dating back to the 1950s is one of the rare sites in Parkstad, where industrial relics are being re-used for such purposes – in this case, as shared office buildings for small businesses such as start-up companies and self-employed persons (Pen et al. 2013; Jeuring and Offermans 2017). This site, branded ‘CMill’, encompasses a network within the manufacturing economy that extends beyond the traditional industrial estates to include cheap and centrally located real estate, such as vacated office buildings, because it has strong links with service-oriented business. A significant contemporary aspect of the economic shift in the conurbation is the emphasis on leisure and tourism, which benefits from ecological values and landscape assets. Spatial plans to valorize and take advantage of these qualities can build on the clean-up operation that left several leisure programmes on the obsolete mining terrains. Some efforts have been successful (a ski centre), others not (a hippodrome and drive-in cinema). Later, the leisure network developed to include a festival terrain and a zoo. In the past decade, aspirations to reinforce this landscape led to proposals for partial deindustrialization of certain terrains that have displayed the potential for conflicts between economy and ecology.

Proposals to disentangle productive, leisure-related and ecological programmes apply to a terrain such as Dentgenbach, which is situated near recreational facilities and ecologically vulnerable stream valleys. Similarly,

the industrial estate Julia, a former coal mine, disturbs the ecologic quality of the bordering valley of the Wurm River, part of a European natural network under the Natura 2000 programme of the European Commission (Houwen, Blokland, and Matti Wirth 2014; Houwen 2016). The estate is an architectural amalgam. It houses former laboratories and warehouses with a brickwork façade and shed roofs that related to the mines; industries of the late 1960s such as a brick factory with a large furnace; a waste treatment plant situated on a large lot for storage of waste materials; and hermetic, rather compact warehouses, built from 2000 onward, which reveal nothing about their use or disuse. Some of the businesses located here are high-grade technological companies, but the estate's poor accessibility and peripheral location have induced significant vacancy and criminal activities, leading to insecurity among entrepreneurs. The site is strongly influenced by a NATO military depot. Furthermore, the area is crossed by an international railway line that is to be programmed more intensively for passenger service.



Figure 8. A future perspective on densification and landscaping of the industrial estate Beitel. Source: Royal HaskoningDHV, published by BTM (2011), reproduced with permission.

Several proposals have been raised to reprogramme such sites and to have less interference with nature and leisure, but these ambitions have had to yield to the priority of industrial employment for which spatial reserves are kept. In response, the 2009 structure plan proposed that Dentgenbach should be reconceived as a site for 'pavilions in the inner garden' of the conurbation (Parkstad Limburg 2009, 131), involving a reprogramming of the estate with more weight on landscaping in the service of touristic and recreational purposes. However, the site remains industrially important because of the large lots available (the 'pavilions' are actually large-scale production plants of international companies on lots of up to 24 hectares) and it will fit better in the infrastructural network of the new outer ring, which passes it to the East. Moreover, the site is an important asset to the municipality of Kerkrade with respect to remaining competitive with the other Parkstad municipalities. These considerations make reprogramming the site to attain more coherence within its green context 'wishful thinking' (Bertholet and Delheij 2017). Plans to improve the landscape quality along the Wurm River were abandoned.

### Discussion and conclusion

The development of a novel industrial landscape on the ruins of obsolete coal mines has left the conurbation a network of sites that has faced periods of underperformance, and over time various strategies have been implemented to respond to this condition. Most explicitly, at the end of their lifetime the mines were framed as waste space in need of urban retrofitting. The ensuing planning history shows clear marks of the transition from a Fordist to a post-Fordist context.

The concept of industrial estates, equally divided across all separate municipalities, was driven by quantitative considerations rather than by qualitative demands. The initial project of developing terrains was devised top-down on a regional planning level and sought to establish a new urban configuration by means of structural planning. The gradual but incomplete development of these terrains by diverse users introduced another type of waste space, characterized by a chequered pattern of occupancy and disuse. Over time, these scattered estates became differentiated in accordance with infrastructural requirements, economic opportunities and societal demands. Emerging from this analysis are the consecutive shifts between the decline and prosperity of industrial estates and the way urban design responds to local developments. Despite periods of underperformance, the

studied industrial estates demonstrate a high level of persistence vis-à-vis programmatic changes and interrelations. The nature of such persistence in the case of the Parkstad conurbation makes apparent the contemporary challenges to urban design.

Primarily, this case explains a timeframe wherein alterations to the economic landscape are implemented at intervals and each intervention is determined by its proper timeframe. The manner in which industrial estates, the result of historical planning decisions since the 1960s, undergo consecutive stages of status quo and increased flexibility illustrates this process. While planning occurs at intervals, use of industrial estates and infrastructural systems changes continuously. Planning endeavours give rise to novel organizational configurations based on older configurations of dispersed urban shards. At sites where connections can be made between economic activities and infrastructures, estates diversify and gain potential. Simultaneously, a high level of fragmentation influences the contemporary nature of such estates. Developing a novel urban configuration requires 'a new idea of continuity and relations that is different from the past' (Viganó 2012, 668–669) in order to attain sustainability. The search for new patterns of use in the scattered urban organization passed on from the past hence coincides with the search for remedies for underperforming industrial developments. As a result of this long-term process, notions of dispersal and waste space become flexible and temporary, subject to reinterpretation.

Urban designers and planners face the task of differentiating estates that were generated with similar infrastructural amenities, plot layouts and architectures. Urban design and planning equally face the challenge of how to respond to programmatic changes and societal concerns at shorter intervals. Post-occupancy evaluation and site management should open a window of opportunity to have urban design thinking and practice increase the flexibility of persistent concerns such as programmatic conflicts, under-use, vacancy or negative effects of waste space. Urban design has the potential to envision, diversify and disseminate potential scenarios responding to those persistent concerns.

Second, designing space for industry increasingly needs to take into account more diverse demands and interconnections with other urban programmes. New types of programmes form a challenge for industrial estates that lack diversity in building typology and proximity to residential and business districts. The historically determined generous dimensioning of industrial estates offers a single spatial layout, whereas business models have greatly diversified to include many smaller companies. As a consequence, manufacturing activities increasingly occupy hybrid spaces within the urban matrix. The economic landscape becomes more diverse and requires interaction with other programmes. Third, estates making a limited contribution to sustainable economic growth are particularly subject to investigations regarding their interference with other programmes in the conurbation. Industrial interests do not reinforce these other functionalities but compete with them. These terrains offer the potential for conflicting interests, for example between ecology and economy. This case study reveals the limited impact of design and planning arguments in the face of industrial and financial interests that are defended on underperforming locations. Such areas appear as the frontier of a manufacturing economy where industrial stakes are not compromised with other interests. It is here that challenges arise regarding interrelating spatial uses. The interrelation between spaces of economic and ecologic value stands out, especially when accompanied by the persistent idea that the two are mutually exclusive. The nature of the dispersed urban pattern determines the close proximity between ecologic and economic networks and the increasing challenge of integration.

These case-based corollaries raise awareness of the challenges to urban design that require further exploration with a more generic scope. With its focus on the underexposed spatial typology of the industrial estate, this paper has noted the spatial dynamics in a region determined by dispersal and demographic shrinkage. A key objective for a new research agenda that expands on insight into the economic landscape of the post-Fordist city is to question the longevity and resilience of industrial estates in other regions and conurbations. The analysis presented here raises the question of whether common approaches and challenges across regions with a comparable socio-spatial profile can be pinpointed, documented and evaluated. Follow-up investigation is needed to define a more generic understanding across diverse urbanized regions of interaction between functions within an urban matrix – on the one hand, of the increasingly important connection between manufacturing, services and other urban functions, and on the other hand, of the effects on residential and ecological uses of space, which are programmes that traditionally suffer certain disturbances from industries. Finally, a significant challenge lies in understanding how changing patterns of use and new expectations of sustainability are inscribed in industrial estates that have a determined morphology and allotment pattern. Future studies should question the manner in which building typologies present in industrial estates may answer to new

expectations in terms of programmes and diversity.

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