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TOWARDS A MULTIDIMENSIONAL UNDERSTANDING OF URBAN INTEGRATION: THE CASE OF THE CITÉ DES SCIENCES IN ESCH/ALZETTE

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Geography is the scientific discipline that aims to understand the functioning of the world we live in, be it the physical system of the earth or the social phenomena in space. I have never understood how something could be more fascinating than that. Hence, geography has always been a part of my life. As a toddler, I received a jigsaw puzzle with a map of the world that I probably did a thousand times during my childhood. Later on, I never really questioned what I would like to study. What I never imagined, though, was that I would be writing a doctoral thesis in order to obtain a PhD in geography.

All those years of effort, doubt, perseverance and delight materialise in the present work, and I would like to dedicate these preliminary lines to the people who have accompanied me along this way.

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ABSTRACT

The present dissertation develops and discusses a multidimensional analytical framework of urban integration in the context of large-scale urban development projects (LSUDPs). By investigating the basic building blocks of the concept of integration, it becomes clear that the initial sociological definitions are currently blurred by political discourses around integration policies. Therefore, I propose to redefine the social and spatial integration between two urban neighbourhoods in order to clarify the various aspects from which this concept can be observed and to analyse the underlying mechanisms or processes. Following this conception, four major dimensions of urban integration can be distinguished: (i) structural dissimilarities, (ii) flows, (iii) governance and planning, and (iv) place attachment and belonging. They are completed by more overarching dimensions, such as the spatial and temporal contexts. The three chapters that compose this dissertation use this analytical framework and apply it on the case of the Cité des Sciences, a 21st-century LSUDP in Esch/Alzette, Luxembourg, and main site of the University of Luxembourg.

The first chapter discusses the current state of the literature on the socio-spatial integration of LSUDPs and uncovers the partially contradictory approaches and vagueness of the analyses that fail to consider urban integration as a holistic and multidimensional concept. The chapter then presents the suggested analytical framework and focuses on a specific dimension – structural dissimilarities – that is analysed by an indicator-based multivariate analysis. Findings reveal strong structural dissimilarities between the Belval neighbourhood and neighbouring areas, but – against preliminary expectations – they were not linked to the economic status of the inhabitants. In fact, it is the young, international and professional profile that mainly causes the emergence of highly significant dissimilarities and thus leads to a socio-spatial fragmentation of the city framework. Due to the inclusion of various indicators, this chapter comes up with a more nuanced conclusion on the structural impacts of knowledge-related LSUDPs, which completes the current academic debate.

In the second chapter, I suggest focusing on the actual users of the Cité des Sciences, and more concretely the student population who form the most important new population group in Esch/Alzette since the move of the university in 2015. This chapter argues that urban integration should not exclusively be apprehended by administrative indicators and puts the dimension of place attachment and belonging to the fore. Indeed, people-place relationships play a crucial role in urban integration as they contribute to the formation of a collective identity that provides a certain coherence to the urban territory

as a whole. After a theoretical discussion on current academic works on place attachment in the field of student geographies, the empirical part analyses the emergence of place attachment among the students of the University of Luxembourg. Using a combination of survey results and qualitative insights from focus groups, I aim to provide evidence on how the students' place attachment to the campus and the city is influenced by their place of residence and by socio-demographic characteristics. A cluster analysis reveals that most of the study participants show only limited attachment to their university location. However, some students seem to develop a certain intangible student identity linked to the city of Esch/Alzette. Older students and non-Europeans are significantly overrepresented among the latter. Consequently, the student population potentially plays an increasingly important role in the urban integration process between the university district and the city of Esch/Alzette through their spatial practices and place attachment.

Chapter 3 proposes a critical analysis of urban integration and mixed-use development as two guiding principles in the planning of LSUDPs. As the theoretical discussion shows, the combination of mixed-use development and urban integration potentially leads to contradictory effects on the urban space and the populations, when the scales of their application are insufficiently coordinated and included in a holistic planning strategy. Discussions from focus groups with students and a qualitative analysis of planning documents reveal these contradictions in the case of the Cité des Sciences. Indeed, a functional mix at the level of the regeneration project tends to counteract the objective of urban integration at the level of the city by reducing incentives to travel from one area to another. Moreover, planning of a social mix that dilutes the student campus into a mixed-use urban neighbourhood negatively affects students' place attachment and prevents them from appropriating their urban environment. A more holistic development strategy that reunites the different scales of intervention (city, neighbourhood, building block) and harmonise the objectives of the various stakeholders would benefit the process of urban integration through increased exchange between territories and an enhanced feeling of belonging of the population.

The aim of this dissertation is less to analyse all potential aspects of the key concept and to embrace its entire complexity, than to challenge current views on the mechanisms of urban integration and how it is conceived both in academics and urban planning. The concluding discussion thus initiates a debate around the political objectives linked to the uncontested planning principle of urban integration and critically asks how we can mitigate the socio-spatial threats caused by the processes of integration and fragmentation. The multidimensional framework on urban integration offers the necessary nuances for this debate that could guide future studies and political decisions.

PREAMBLE

My position as a doctoral candidate at the Luxembourg Institute of Socio-Economic Research (LISER) was linked to a research project entitled *Observatoire social d'Esch-sur-Alzette* (Social Observatory), that is commissioned by the City of Esch/Alzette. In parallel to the preparation of this dissertation, I was actively involved in the data collection, data analysis and writing of reports for the account of this project. To be part of a research team during these years was a fruitful experience that allowed me to get involved in a collective work that balanced the more solitary work of writing a dissertation.

Since the publication of the first report in 2021, the Social Observatory has become an important reference for the municipal administrative services, civic organisations and local politicians. It gathers data from various administrative sources, such as the municipal departments, the National Inspectorate of Social Security (IGSS), the National Institute for Statistics and Economic Studies (STATEC) and produces an important set of indicators that depict the social situation of the city. Most indicators are updated every two years, which will allow a dynamic longitudinal analysis in the long term. In-between the biennial updates, the Social Observatory publishes studies on specific topics, according to the priorities of the commissioner. Over the past years, that were struck by the subsequent crises of the COVID-19 pandemic, the war in Ukraine, and increasing socio-economic threats, the Social Observatory proved its usefulness through a certain flexibility and continuity, that allows a dynamic monitoring of the social and economic situation of the city and the most pressing needs of its inhabitants. The local-level scale of the analysis and the distribution of the reports to the general public constituted a novelty in Luxembourg, where social or economic microdata is generally hard to access.

My working time at LISER was divided equally between my contribution to the Social Observatory and the preparation of this dissertation. The availability of neighbourhood-level datasets allowed me to approach my research topic from a quantitative perspective. The writing of the research articles thus constituted an academic valorisation of the data collected in the framework of the project. But also the comprehension of the overall social dynamics and the socio-political challenges the city faces, as well as the recurrent exchanges with municipal services helped me in the choice of my research topics and fuelled the findings and discussions in the different chapters. In return, my learnings from the academic research work enriched the content of the Social Observatory reports by raising crucial questions, especially what concerns the social and spatial relationship between the newly built Belval neighbourhood and the rest of the city, as well as the presence and practices of students in Esch/Alzette.

In sum, the symbiotic link between the Social Observatory and the present dissertation presented important benefits for all parts, including for my own personal and professional development.

INTRODUCTION

Analysing integration at the intraurban scale

On December 23, 2022, Luxembourg Minister of Mobility and Public Works François Bausch inaugurated a 1.2km-long cycling bridge (Figure 1) between the centre of Esch/Alzette – the country's second largest city – and the Belval regeneration site, that has been developed for the past twenty years and includes the main campus of the University of Luxembourg since 2015. It seemed to be an ordinary pre-electoral inauguration ceremony of a public infrastructure project, including ribbon cutting and press photos. However, for both local and national political actors, this project is a crucial step in urban planning. 'With this project, something has been made up for Esch/Alzette that was missed in the design of Belval at the time: firstly, a proper urbanism and secondly, that the historic Esch is linked to the new Esch', stated the Minister (Feyereisen, 2022, p. 20 [translated[1]]). The mayor of Esch/Alzette Georges Mischo added: 'The most important thing is definitely the connection between Esch and Belval - this is vital for the survival of Esch-centre' (Feyereisen, 2022, p. 20 [translated]).

The stakes seem to be extremely high; the 'survival' of the historic city centre would depend on the construction of this bridge. It represents the connection between the old and new parts of the city, between past and future, between the former *Métropole du Fer* (Iron Metropolis) and the *Cité des Sciences*[2] (Science City) (Figure 2). It is presented as the missing piece of the puzzle, the hyphen that unites the city. Policymakers expect that the bridge will significantly facilitate travelling by foot or by bike between the centre of Esch/Alzette and the knowledge campus. 'This link will enable people who work or study here in Belval to easily reach the historic centre of Esch, to go out in the evening and do some shopping. This will help to improve life in the town.' (François Bausch, cited in Chaty, 2022, p. 8 [translated])

[1] All translations are my own, unless otherwise noted. For the original quotes, please refer to appendix 1.

[2] The area officially called 'Cité des Sciences' forms the Eastern part of the Belval regeneration project and is located on the territory of Esch/Alzette. It has been developed by the Luxembourg state and mainly includes the university and research campus. However, students and university officials commonly refer to their campus as 'Belval', which sometimes leads to confusion. The main focus of the present dissertation lays on the Cité des Sciences, but the general development project obviously plays a major role as well. Figure 2 provides a visual representation of the imbricated areas.

Figure 1 : The cycling bridge with the Belval landmarks in the background (Source: Ville d'Esch-sur-Alzette).

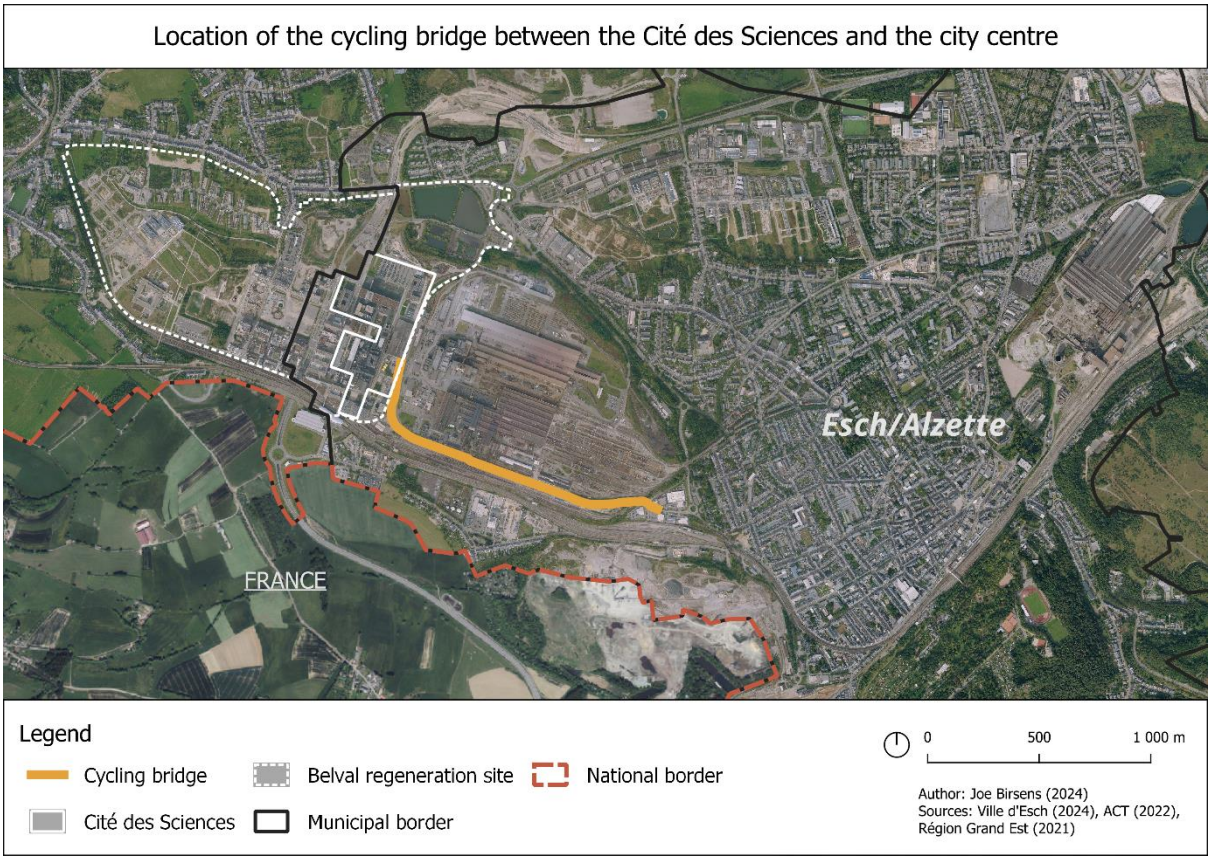


Figure 2 : Satellite image of Esch/Alzette with specific emphasis on the Belval perimeter, the Cité des Sciences and the cycling bridge. The bridge bypasses a vast industrial area and connects the Cité des Sciences with the city centre.

The mayor shares the hope that the students would visit the city centre more often. 'Now, for example, Esch students also have the possibility to get to Esch-centre on foot or by bike' (Feyereisen, 2022, p. 20 [translated]). The knowledge institutions that have been developed in the Cité des Sciences play a fundamental role in the regeneration strategy of the City of Esch/Alzette, and of the southwest region of Luxembourg, that was marked by the steel industry for over a hundred years. The attraction and retention of international students and knowledge workers into the city centre is perceived as essential for the renewal of the local economic and social structures.

Both local and national politicians present the bridge as a necessity for connecting the new developments with the existing urban structures and, in turn, enabling students and knowledge workers from Belval to access the city centre. Opening up the area, triggering exchanges and avoiding the development of a university enclave were central objectives of the regeneration project. Policymakers and urban planners use the notion of integration to depict this process.

> Integrating Belval entirely into the respective urban fabrics of Esch/Alzette and Sanem, in order to achieve a polycentric model rather than the creation of a 'new town', is a common mission of the actors in the Belval project. [...] The integration of the University into the city and the interaction between Belval and the population of the city's other neighbourhoods is essential to ensure social cohesion. (Poos, 2013, p. 30 [translated])

The integration of Belval – and more specifically the Cité des Sciences – into the city of Esch/Alzette is seen as a precondition of the regeneration strategy. Without assuring the links between the developments in the knowledge district and the older structures, the potential beneficial effects on the city as a whole, such as economic growth, a boost for the centre's commercial mile, and increased visibility and attractiveness as a university town, would remain very limited. The opening of the cycling bridge – also called *Studentewee* (student route) (Weyrich, 2022, p. 16) – thus marks a symbolic and functional milestone in the Belval regeneration project, as well as in the socio-economic transformation of Esch/Alzette. A coherent integration between the Cité des Sciences and the city centre of Esch/Alzette now seems to be achieved since both areas are now connected by roads, rails, and a direct route for unmotorised mobility.

Although this understanding of integration is widely shared by planners and political actors, it remains rather simplistic and does not take into account the multiple perspectives from which it can be approached. In public discourse, integration is used to describe various processes depending on the analytical context. Does the integration of a newly built area into its urban environment relate to social exchange between communities? Or to the insertion into the existing mobility network? Do we achieve integration when areas show high similarities, when new neighbourhoods are harmoniously added to the urban realm? Or, on the contrary, do we need spatial complementarity instead of similarity? Despite its frequent use, these questions about the definition of integration remain largely unanswered.

Therefore, this dissertation suggests revisiting the concept of integration, deconstructing its various meanings and developing a coherent analytical framework to analyse urban integration at the neighbourhood scale. Before discussing the theoretical foundations of the concept, I will briefly lay out how it is used in the scientific literature on planning and development of large-scale urban development projects. The following section will reveal that the notion of integration is used to describe various processes, which justifies the elaboration of a holistic analytical framework.

Knowledge-based urban development projects and their links to the city

Contemporary large-scale urban development projects (LSUDPs) are mostly designed for mixed uses (residential, commercial, office and leisure spaces) with a growing focus on activities of the so-called knowledge economy. Such knowledge districts – sometimes called 'knowledge locations' (Van Winden et al., 2010, p. 2) or 'knowledge precincts' (Yigitcanlar et al., 2008, p. 7) – can be defined as clearly delimited, planned, urban or suburban areas with a high density of higher education institutions and knowledge-intensive activities, i.e. activities with a high share of highly qualified employees (Eurostat, 2020). In theory, the agglomeration of these institutions is motivated by several advantages from mutual proximity, such as facility sharing, face-to-face interactions, links between companies and universities and knowledge spillovers, as well as political aspirations of city branding or urban regeneration (Porter, 2000; Van Winden et al., 2010). City officials see knowledge districts as a possibility to enact structural economic changes. The creation and transfer of knowledge are considered as the predominant drivers of economic growth in the post-industrial, capitalist societies, so that national and local policymakers are actively encouraged to invest in the knowledge sector (Wyckoff, 2013). Similar to creative and cultural activities, knowledge-related institutions seem promising in this respect because they attract an international workforce that engages in research or entrepreneurial programmes of strategic importance that are strongly supported by national and international funding. Regenerating industrial brownfields and developing the knowledge economy mostly follow the same objectives: diversifying the economy, attracting new activities after the downturn of the industrial sector, contributing to a beneficial dynamic in terms of employment and social upscaling.

Unlike the monofunctional science parks, or the 'technopoles' (Castells & Hall, 1994, p. 1) of the second half of the 20th century, spatial proximity to a dynamic inner city area is seen as an asset by urban planners (Yigitcanlar et al., 2008). The preference of knowledge institutions to integrate central urban areas and to benefit from a location near the dense city centre also acts as an attractive factor for knowledge workers. This reflects the often cited creative class theory, according to which cities must provide spatial and functional proximity between workplaces in the creative or knowledge-intensive sectors and a diverse urban environment if they aim to become successful in attracting international

talent (Florida, 2002). Despite their critical position on the overly deterministic creative class theory, Bontje et al. (2017) agree that international knowledge workers tend to be 'urban oriented' (p. 146), meaning that they value living close to urban amenities and dynamic city centres. They conclude that urban amenities act as retention factors for knowledge workers, which thus favours their long term stay in the city or region. The connection between the new development and the existing urban structures, interpreted as urban integration between the knowledge location and the city, counts as a precondition to enable economic growth for the entire city or region.

Besides mutual proximity between knowledge spaces and urban amenities, Pancholi et al. (2018) advance the need for a more extended comprehension of societal integration and its benefits:

> While physical integration of KISs [knowledge and innovation spaces] with their surroundings is necessary for providing the quality of life and vibrancy of environment as desired by the knowledge workers as well as shaping creativity and uniqueness, a holistic approach towards societal integration is necessary for reaping the benefits of knowledge produced in these specialised environment[s] for societal development. (p. 20)

By making redevelopment processes transparent and accessible to local communities, urban projects encounter increased acceptance, which allows the initial objectives of LSUDPs to unfold.

In the research field of LSUDPs, the social and spatial relationship with the wider urban framework is approached from two main points of view: their debated impacts on the urban space, and the effective compatibility with local structures. First, many authors focus on the socio-economic impacts of large-scale urban development in general. Empirical evidence from Rotterdam suggests that local communities see their quality of life improved by megaprojects, when they are led by public actors that monitor urban impacts beyond economic growth indicators (Doucet et al., 2011). Such ex-post evaluations, however, remain the exception and most authors agree that LSUDPs do not respond to a local demand. They are 'aimed at an outside audience of tourists, investors and potential (high-income) residents' (Doucet et al., 2011, p. 125) and act as a neoliberal tool to enhance a city's image at the international level (Lehrer & Laidley, 2008). Ponzini & Rossi (2010) state that the socio-spatial implications of creative class policies are widely underestimated at the level of local communities. As they show in the case of Baltimore, such revitalisation strategies benefit the 'entrepreneurial mayor' (p. 1039), political élites and a handful of organisations in the creative sector, while they exclude poorer population groups. The political bet that the added value created by knowledge- or culture-related institutions trickles down – or spills over – to the rest of the city, is highly contested (Loftman & Nevin, 1995; Madureira & Baeten, 2016). Evidence from Lille shows that the socio-spatial reconfiguration of the urban structure enacted by a LSUDP leads to displacement pressures felt by local communities (Moulaert et al., 2001). Therefore, LSUDPs are criticised as 'an embodiment of and vehicles for neoliberal urbanization' (Kim, 2023, p. 177). This echoes findings from Swyngedouw et al. (2002) that

most LSUDPs translate a New Urban Policy and widen socio-economic polarisation. In their seminal comparative study, they present evidence from various European cities in which such projects form ‘a patchwork of discrete spaces with increasingly sharp boundaries’ (p. 571), leading to a fragmented city framework. For example, the *Parque das Nações* in Lisbon or the *Adlershof* in Berlin present such urban discontinuities with only very few links to neighbouring areas. Madureira & Baeten (2016) demonstrate in their analysis of two LSUDPs in Malmö that the most visible effects of knowledge- or culture-based urban projects are enhanced attractiveness and increasing housing prices, which seems to cause further polarisation and fragmentation at city level. Schulze Bäing & Wong (2018) argue that the ‘clear signs of social polarisation’ (p. 530) created through the attraction of an international and qualified population contradicts the initial postulates that LSUDPs would benefit adjacent areas, which acted as a legitimation of massive public investments in the first place. With the example of the Salford Quays in Manchester, they show that only a limited share of the created job opportunities have been occupied by local residents, while the seemingly beneficial effects of the redevelopment project are closely linked to the inflow of middle- and upper-class residents. The constitution of wealthy fragments surrounded by a much poorer urban fabric is diametrically opposed to the idea of urban integration.

Second, many authors question the actual compatibility between LSUDPs and local urban structures, which would critically block the process of integration. It remains unclear whether the simple co-location and physical proximity between knowledge institutions and an urban centrality lead to the expected objectives of increased attractiveness and economic growth. Despite being placed into an existing urban realm, the effective connection with the area and its population is often problematic due to contemporary planning and governance structures (Van Winden et al., 2010). Swyngedouw et al. (2002) report ambiguous impacts of LSUDPs on the city as a whole due to their very limited integration into local urban planning processes. Already at the conception phase, LSUDPs are being detached from the urban environment through the adoption of exceptional administrative measures and the use of project management tools in urban planning (Leick et al., 2020). Given that they are mostly turned to the international scene, and engage in the interurban race for private investment, Lehrer & Laidley (2008) conclude that their link to the local environment is neglected. This is in line with Harvey's (1978) reflections on the investment opportunities provided by the financialisation of real estate development. The multiplication of LSUDPs in nearly all capitalist countries can be seen as an example of capital outlet into a secondary circuit of accumulation, that is detached from a local demand while serving the interests of foreign investors (Kim, 2023).

The lack of local integration is also observed through the relationship between the new developments and the population of surrounding areas. Empirical research suggests that the latter are frequently excluded from processes of conception and decision-making. Atkinson et al. (2019) posit that the overly complex governance structures prevent the wider public to participate in the projects. LSUDPs are often managed by opaque constructs, constituted by public and private actors, making it hard to address

criticism. Tarazona Vento (2017) speaks of a depoliticisation of LSUDPs: while the objectives are presented as beneficial for the whole society, developing agencies find ways to overcome democratic processes. Therefore, LSUDPs often fail to provide a connection with local communities, or even local officials, that are often excluded from decision-making due to the scope of the project (Oakley, 2011).

The previous discussion has shown that the current state of research does not provide clear responses to the underlying processes of integration between LSUDPs and their urban environment. First, there is no univocal definition of integration in the context of urban development. It remains unclear whether integration refers to socio-economic inequalities between areas (Madureira & Baeten, 2016), physical proximity (Bontje et al., 2017), the inclusion in holistic planning schemes (Swyngedouw et al., 2002), or open communication with local communities (Pancholi et al., 2018). This plethora of perspectives on the concept of integration results in a blurred overall picture that is difficult to grasp. Second, a consequence of these definitional problems is the absence of a coherent and shared analytical framework that could be applied on various cases and that would lead to a continuous improvement of our understanding of integration at the level of the city. Urban integration is either analysed from a single perspective, or without a satisfying amount of critical distance towards the meaning of the concept. Third, despite the crucial character of urban integration as a precondition to enable further policy objectives, it is not considered a central element in the research field of LSUDPs as of today (Kim, 2023). The previous discussion has shown that many scholars use it to discuss further research topics, such as neighbourhood change (Moulaert et al., 2001; Schulze Bäing & Wong, 2018), urban planning policies (Ponzini & Rossi, 2010; Swyngedouw et al., 2002), or urban competitiveness (Yigitcanlar et al., 2008), but it is only rarely highlighted as primary concern. While a few notable exceptions exist (Madureira & Baeten, 2016; Van Winden et al., 2010; Pancholi et al., 2018), the importance of urban integration in the development of urban projects and in their impact on local social structures is not accurately represented in the scientific literature.

This dissertation aims to address these research gaps and to contribute to the literature on knowledge-based LSUDPs by redirecting the focus on urban integration. Furthermore, this work is also relevant beyond the academic sphere, and most notably in the field of urban planning. Understanding the notion of urban integration, acknowledging its various dimensions, definitions, and implications at different levels – the region, the city, the neighbourhood, the individual – are fundamental in the planning and implementation of LSUDPs. As we have seen, such large-scale urban interventions often bear the risk to function as isolated enclaves and limit their beneficial impacts on the development perimeter when they are insufficiently integrated into local urban structures. At the same time, they seem to threaten local communities through the well-known mechanisms of increased attractiveness and investment in capitalist societies. In order to face these threats, it is crucial to know what urban integration means as a political objective and what are the concrete implications that urban planners need to take into account.

Consequently, the main objectives of the thesis are:

i. to develop a coherent analytical framework to analyse urban integration at the intraurban scale, which means between urban or suburban neighbourhoods;
ii. to apply this framework on the specific case of the Cité des Sciences in Esch/Alzette, so as to investigate the urban integration of this newly built knowledge district;
iii. to initiate a broader discussion on the factors that influence urban integration, as well as the consequences of the integration process for the urban structure and its population.

The general research question that accompanies this dissertation is 'How can the Cité des Sciences and the city of Esch/Alzette form an integrated urban area?'. The three chapters of the dissertation will focus on particular aspects of urban integration following an analytical framework that will be discussed in the following section.

Integration as a multidimensional concept

A sociological concept blurred by political discourses

Prior to the development of the analytical framework, I propose a brief excursus on the concept of integration, its various meanings and definitions, as well as related academic advances. Parts of this section have been published within the Proceedings of the 57th ISOCARP World Planning Congress held in Doha, Qatar, in November 2021 (Birsens, 2021).

Integration is a concept used in various fields, ranging from the social sciences to economics, from politics to engineering. In Western European policy discourses of the 2000s and 2010s, integration has become a central concept (Uitermark, 2014). According to a dictionary, integration is most commonly understood as the 'process by which an individual or group incorporates a community or environment' (Rey, 2001, p. 255 [translated]). It is applied in the framework of integration policies, that aim to conciliate the social and cultural practices of immigrant communities with the values of the dominant group in a certain area. It thus describes a political objective. This conception always involves two or more groups that are subjected to adaptations in order to guarantee the overall stability and to regain a certain homogeneity. It also includes power relations between the implicated groups: integration can be understood as the desire of the dominant group to extend its control over the newly formed group, that needs to invest greater efforts of adaptation.

Due to the various approaches that compose the concept of integration and tend to obstruct a clear understanding of the underlying processes, it becomes necessary to revisit some fundamental definitions. According to the French philosopher André Lalande, integration is the 'establishment of closer interdependence between parts of a living being, or between the members of a society' (Lalande,

2010 [1926], p. 521 [translated]). The idea of two or more actors setting up mutual links and increasingly depending on each other already existed in the initial sociological meaning of integration (Ruiz-Tagle, 2016; Schnapper, 2007), that was used by Emile Durkheim (1978 [1893], 1986 [1897]) in the nineteenth century. He understood the concept of social integration in the social sciences, as a voluntary act between individuals to live together (Rhein, 2002). According to Durkheim, an integrated society has an integrating effect on its members, which pressures them to conform to social norms and thus prevents anomic behaviour. Based on this definition, many different interpretations and operationalisations have been developed in various fields. The diversity of the integration concept surfaces when we take a look at the whole range of notions that are frequently opposed to integration, such as segregation, fragmentation, anomie, alienation, marginalisation, and so on.

In the public debate of the late twentieth century, the political dimension of the concept became predominant due to integration policies that mainly emerged in the United States through functionalist and positivist theories. Integration policies were mainly implemented by state-led housing and relocation programmes to disperse highly segregated population groups, namely immigrants and ethnic minorities (Ruiz-Tagle, 2013). Today, this conception of integration blurs its initial sociological meaning (Schnapper, 2007; Ruiz-Tagle, 2016). The technocratic assumption that spatial relocation enhances social integration is heavily contested because it reduces the concept to the unique dimension of physical proximity and ignores the role played by social networks, sense of belonging or public services (Ruiz-Tagle, 2013).

A frequently used derivate of integration is the concept of (social) inclusion that appears ever more frequently in the public discourse. In certain domains, such as education, inclusion has become a guiding principle to allow an equal participation of all individuals in the society, while accepting their respective differences. At the European level, ensuring social inclusion is a major policy priority (European Commission, n.d.). For social cohesion policies, inclusion seems to be better suited than the notion of integration because it is more respectful towards diversity; people are accepted and have equal rights without adaptation to a given norm (Grosche, 2015). In contrast, the process of integration always implies a certain assimilation to a dominant group in order to fit in (Jaeger, 2015).

This discussion shows that integration is above all a normative concept; it is seen by policymakers as a general objective, something desirable to achieve. This dissertation tries to reframe the dominant views on the integration concept, to redefine integration in the field of urban planning, and to provide a critical assessment of its various dimensions, as well as its consequences for the society.

From social to spatial integration

In order to fully grasp the meaning of integration, it is necessary to investigate its basic conceptual building blocks. A very general definition is provided by Galtung (1968) who suggested that 'integration is the process whereby two or more actors form a new actor' (p. 377). This simple definition contains two major components. First, it highlights that integration is a process that takes place in a temporal context (cf. Reitel, 2013). Translated to urban planning, a neighbourhood can become more integrated to the rest of the city over time or can engage in a process of disintegration or fragmentation. Second, the definition addresses the coexistence of two or more actors and the links connecting them. These actors depend on each other, there are exchanges between them, which will eventually lead to a convergence of their systems.

When it comes to the integration of inhabited territories, or delimited spaces with inherent sociodemographic and economic characteristics, integration has both a temporal and a spatial dimension. It is defined as 'the creation and maintenance of intense and diverse patterns of interaction and control between formerly more or less separate social spaces' (Lee, 2009, p. 387). In order to clarify the reference to defined areas and their populations, scholars sometimes suggest the terms socio-spatial integration or urban integration in the specific context of the city. Madureira & Baeten (2016) treat socio-economic and spatial integration separately in their analysis of the uses and users in two urban development projects in Malmö. However, Rhein (2002) argues that spatial integration cannot exist without social integration and it always implies particular power relations between the actors engaging in the integration process. This view echoes Lefebvre's (1974) interpretation of a dialectic connection between social relationships and space that mutually reproduce each other. We can interpret integration between territories as a social product with concrete social and spatial implications. It is most visibly enacted by policymakers and urban planners, but, as this dissertation argues, the production of integrated (or fragmented) urban space is the result of a dialectical process between different social groups and their urban environment. Integration between territories is thus characterised as 'an inherently uneven process' (Lee, 2009, p. 387), that can be observed from different perspectives. Ruiz-Tagle (2013) proposes a theoretical framework of socio-spatial integration that includes these multiple perspectives in the context of highly segregated US cities. It breaks down integration into four dimensions: a physical (proximity between social groups), functional (access to opportunities and services), relational (interaction between social groups) and a symbolic dimension (identification with a common ground) (Figure 3). This framework offers an inspiring, multi-perspectival approach that aims to define integration as much more than the opposite of segregation. It suggests going beyond mere physical proximity between social groups and to include interpersonal interactions, exchange, and mutual identification.

MACRO DIMENSIONS	SOCIO-SPATIAL DIMENSIONS	CHARACTERIZATION
Systemic	Physical	Physical proximity between different social groups (defined by power and status)
	Functional	Effective access to opportunities and services in the territory
Social	Relational	Non-hierarchical interaction between different social groups
	Symbolic	Identification with a common ground

Figure 3: The dimensions of socio-spatial integration proposed by Ruiz-Tagle (2013).

In the European context, the notion of integration is widely used in the context of the political and economic integration process of the European Union. For Brunet (1997), to integrate means 'to connect, to ensure interrelationships, to eliminate ruptures and distances between elements, which, nevertheless, will preserve their being' (p. 11, [translated by Reitel, 2013]). He describes a territory or system as integrated when the different places are interconnected, when all parts are well provided with services, goods, information, and work resources, and when their products are efficiently distributed. The integration process is fuelled by two major objectives: reducing internal obstacles, by allowing the free flow of goods and people, and joining forces in order to resist external pressions (Brunet, 1997). Cross-border integration and territorial cohesion have emerged as political ideals of the European Union, which pushed researchers to elaborate rich and stimulating theoretical frameworks around the concept of integration that go beyond conceptual advances in urban studies. Therefore, I decided to explore the existing frameworks in this specific field with the aim to elaborate a more general conception of socio-spatial integration that could be applied at the intraurban scale.

Integration in border studies

The analytical definition of cross-border integration varies according to the factors taken into account. Some authors stress out the role of political institutions at different levels as a driving force behind the integration process (Hansen & Serin, 2007). Others consider a single, quantitatively measured dimension, such as cross-border commuting flows, as a proxy to measure integration between two contiguous territories (Matthiessen, 2004). When politicians inaugurate a new bridge and expect 'enhanced integration' between two areas, they actually expect increasing flows of people.

A major point of this dissertation is that the analysis of socio-spatial integration should not be limited to a single factor, as this would not do justice to the complexity of the urban space (Reitel, 2013). Today, there is a significant consensus in the academic field of border studies that socio-spatial integration is a

complex, multidimensional process and that we need to consider different indicators in order to evaluate it (De Boe et al., 1999; Van Houtum, 2000; Reitel, 2013; Hinfray, 2010; Jimmy et al., 2019; Lundquist & Trippl, 2009; Durand, 2015). De Boe et al. (1999) define it as 'a system of links (flux, similarities, proximity, territoriality, connexity,...) between territories which is the emerging result of concrete social, economic, and cultural relationships, but this system is also a structure which influences and sometimes determines the further development of social, economic and cultural links.' (p. 30). Socio-spatial integration is thus not only determined by flows between territories, but also by complex elements, such as social or cultural proximity, as well as a 'willingness to co-operate' (De Boe et al., 1999, p. 13). For example, the breaking down of a mental barrier between the populations of two territories seems to be a crucial factor to integration in certain cases (Hardi & Uszkai, 2017).

Based on these elements, various authors developed analytical frameworks that evaluate the process of cross-border integration. Considering the case of the German-French-Swiss borderland, Reitel (2013) distinguishes four types of urban integration that can be evaluated at different stages: the morphological integration (continuity of the built fabric), the functional integration (interactions through commuting flows), the intentional integration (common interests and a shared vision of the future), and the institutional integration (links between public authorities and mutual trust) (Figure 4). The originality of this model is the subdivision of the dimensions into different stages or temporalities that are assessed independently and can be more or less developed at a certain point in time. Durand (2015) proposes another deconstruction into four dimensions, namely structural (spatial characteristics), functional (flows), institutional (cooperation) and ideational (individual and collective representations) integration (Figure 5). He redefines cross-border integration as a multi-dimensional process of bringing territories closer together and strengthening social bonds. Durand's article highlights the complexity of the cross-border integration process as it 'results as much from the symmetries and similarities between territories that make up a cross-border region as from the asymmetries and existing differentials on either side of a border' (p. 314). Indeed, a low structural integration (for example, high economic differences between an urban centrality and a peripheral region) may trigger high functional integration (frequent commuting flows from the periphery to the employment centrality), which sustains or even amplifies a contradictory system of integration and disintegration. This relationship has been formalised by Decoville et al. (2013) who state that increasing integration through cross-border commuting does not automatically lead to a convergence of the territories' socio-economic structures. In fact, three integration processes can be distinguished: (i) integration by specialisation (commuting flows to the metropolitan centre and residential flows to the periphery, translating a process of cross-border suburbanisation); (ii) integration by polarisation (commuting flows and residential flows to the metropolitan centre leading to a highly dominant urban centre); and (iii) integration by osmosis (bi-directional flows of commuting and residential flows) (Figure 6). The first two models show the existing hierarchy between two areas

depending on the socio-economic contexts and the potentially contradictory effects of the various dimensions of integration.

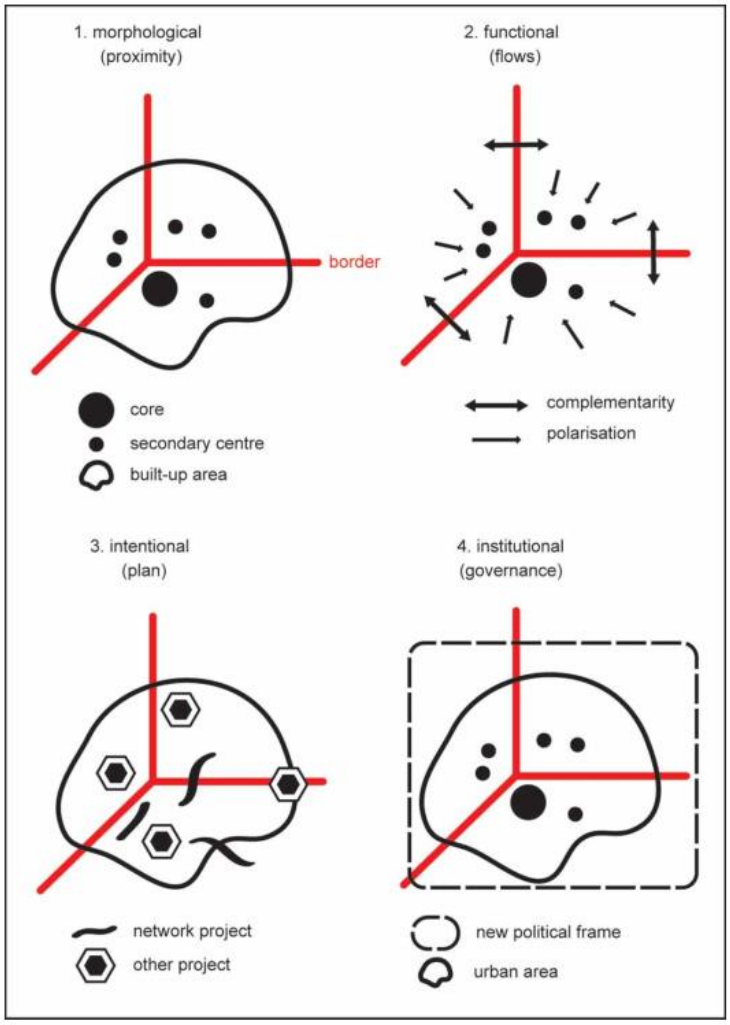


Figure 4: The four types of transborder urban integration proposed by Reitel (2013).

Dimensions	Actions	Explanations
Structural	To converge	• Spatial and social composition • Dynamics of convergence or divergence of spatial development of territories
Functional	To exchange	• Cross-border economic flows • Individual and collective spatial and social practices • Communication networks
Institutional	To organise	• Networking of actors (political, economic, civil society, cultural milieux) and setting up of cross-border collaborations • Willingness of actors to cooperate and define strategies and common projects • Cross-border planning and policies
Ideational	To represent	• Sharing of same cultural, social and political references • Adjustments of identities and sense of belonging to cross-border living area • Perceptions of actors/people

Note: The term interaction, so often used in academic work on cross-border integration, has not been applied here to the description of the four dimensions, as it regroups actions or phenomena which are transversal to these dimensions. There is no hierarchy between the four dimensions.

Figure 5: The dimensions of cross-border integration proposed by Durand (2015).

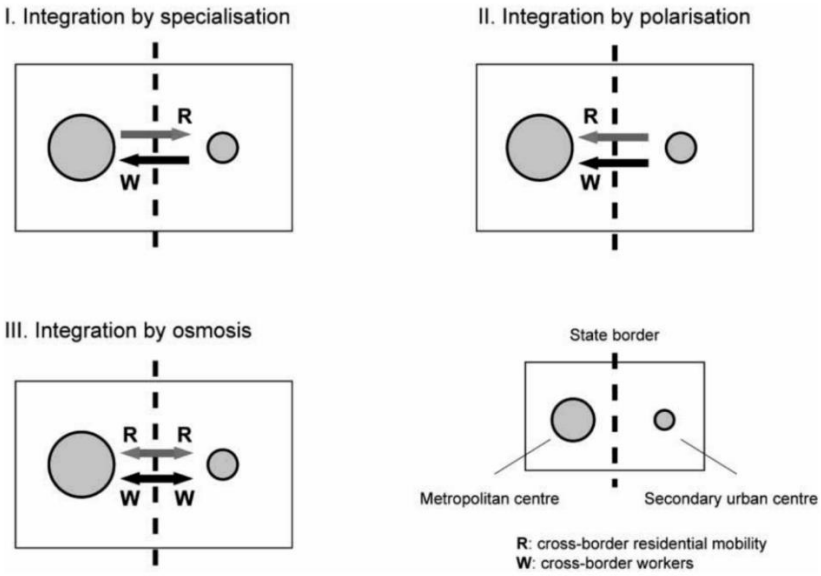


Figure 6: Three models of cross-border metropolitan integration proposed by Decoville et al. (2013).

This dissertation proposes that the promising theoretical advances in cross-border research be employed to develop an analytical framework for the analysis of urban integration at the intraurban scale, that is, between neighbourhoods of a city. The main similarity is that I consider urban integration as a multidimensional process. However, some fundamental differences compared to the neighbourhood scale need to be discussed.

Applying the multidimensional conception of integration to the neighbourhood scale

A fundamental difference of urban integration – compared to cross-border integration – is the absence of a national and cultural border determined by the power relations and the geopolitical interests of two territories that potentially share a long history of recurrent conflicts and wars. In the case of LSUDPs, the 'border' between newly developed and formerly existing areas is defined by political actors based on the availability of land and the cooperation of stakeholders. Cultural differences and identities do not fundamentally differ from one neighbourhood to another, as it may be the case between two states. Consequently, institutional cooperation and the development of a shared vision of the future seem less appropriate to assess at neighbourhood level. In contrast, the ideational dimension continues to play a major role in the integration process, despite the absence of identity-forming nation states. It can be reinterpreted as the population's sense of belonging and attachment to a common territory. The inhabitants of newly developed LSUDPs thus contribute to the process of integration at the intraurban

scale when they develop an attachment to their urban environment and feel themselves as citizens, or as a part of a shared territory.

On a similar note, social and demographic borders potentially become more important at the neighbourhood scale. A newly built neighbourhood attracts a certain type of population, especially when it is specialised in knowledge-intensive activities. The social structure of this district can therefore remarkably diverge from the existing social structure of the city, which influences the integration process.

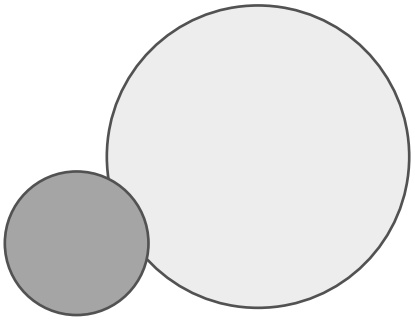
A further element of discussion are the changing power relations between the territories and the implicated stakeholders. The different processes of cross-border integration presented earlier (specialisation, polarisation, osmosis) (Decoville et al., 2013) are not directly applicable to the intraurban scale. While the analysis of commuting flows remains of high interest in order to characterise the integration level between neighbourhoods, the overall relationships are mostly an integral part of a development plan that covers the entire city or region. A newly built LSUDP adopts a clearly defined position in the urban hierarchy and the commuting and/or residential flows constitute major planning objectives. When they are insufficiently balanced or coordinated, the new activities and the increased attractiveness of the new developments may create an intraurban competition with traditional urban centralities. In the case of knowledge districts, new developments can play a major role in the urban and regional economy, and generate benefits for the city as a whole (Luo et al., 2020). However, there is also the risk of the reverse development, especially in small cities with struggling economies. When the new neighbourhood becomes the dominant centrality, the polarisation process changes direction, with harmful side-effects for the existing structures. In the process of urban integration, it is greatly important to understand the converging or diverging views of public or private actors at local, regional or national levels.

While it appears that the setting between cross-border integration and urban integration slightly differs, the most important features can be translated into a generalised definition of socio-spatial integration. It refers to a process by which the differences, cleavages and fragmentations between two socio-spatial entities are reduced and tend towards the formation of a single new coherent and more homogeneous socio-spatial entity, whose constituent parts are largely interdependent. I consider two areas as being socially and spatially integrated when (i) their structural dissimilarities are minimised, (ii) flows and links between both areas are maximised, (iii) they are included in a holistic governance and planning strategy, and (iv) their populations share one common territory through their spatial practices and perceptions.

In this dissertation, I use both the terms ‘socio-spatial integration’ and ‘urban integration’ to describe the same process. I avoid to simply use ‘integration’ due to its ambiguous character in other domains. The adjectives ‘socio-spatial’ or ‘urban’ indicate the dialectical relationship between the urban space and its

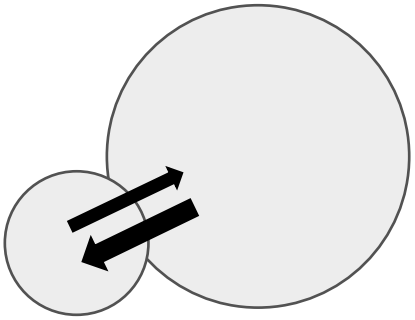
populations that are at the centre of the integration process. In the following part, I will briefly lay out the constituent dimensions of socio-spatial integration, that are applied at the intraurban scale.

i. *Structural (dis)similarities*



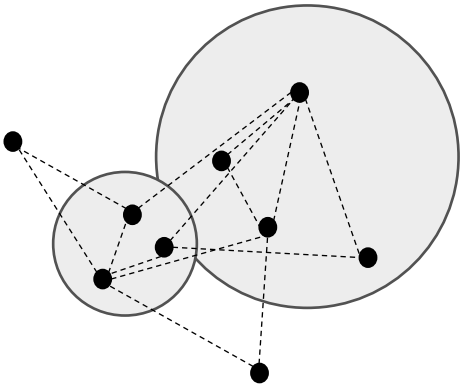
Structural dissimilarities refer to the differences of social structures between two areas. When the population of a certain neighbourhood has a significantly different profile than the communities living nearby, structural dissimilarities are high, which translates a low level of integration. This dimension is often used to describe fragmented spaces in the scientific literature (MacLeod & Ward, 2002a). Similarly, when LSUDPs form 'islands of wealth' (Swyngedouw et al., 2002, p. 567), we can conclude that high structural dissimilarities hamper this area's integration into the local social environment. In theory, knowledge-related LSUDPs in post-industrial cities bear the risk of presenting strong structural dissimilarities towards neighbouring areas (Madureira & Baeten, 2016).

ii. *Flows*



The establishment of flows is a common illustration of integration between two entities. The main actors involved in the process are the users of the urban space. When people move from one area to the other for daily activities, such as going to work or for leisure activities, they contribute to the formation of a web of interactions between territories and populations. People's mobility patterns depend on multiple factors, such as the localisation of urban amenities. The constant moving between areas is time-consuming and sometimes considerably hindered through lacking infrastructure. In addition, contemporary planning policies increasingly aim to limit motorised individual transportation distances to reduce carbon emissions, enhance individual well-being and quality of life at neighbourhood level (Hoppenbrouwer & Louw, 2005; Moreno et al., 2021). The neighbourhood scale thus becomes increasingly relevant for daily activities.

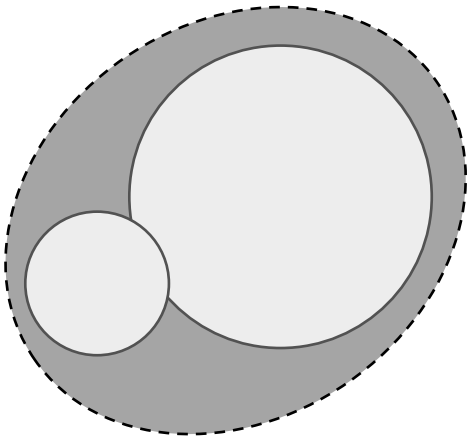
iii. *Governance & planning*



The governance and planning dimension relates to the actors and institutions involved in the development of urban areas. At the intraurban scale, it is less the emergence of common institutions that is concerned (Hansen & Serin, 2007), than the active role of existing actors at various scales that shape the relationships between the territories and their populations. Governance and planning activities have a major influence on

urban integration because of their powerful role in the production of the urban space (Lefebvre, 1974). By considering the local and regional contexts, as well as the expectations and perceptions of the existing and future communities, planners act in favour of an urban integration process. However, due to an increased use of project management practices in urban planning, LSUDPs are sometimes disconnected from their urban environment. The use of masterplans with fixed perimeters increases the probability of overlooking surrounding areas and top-down planning mechanisms often neglect the role of community networks. In the case of a missing holistic planning strategy or when the planning objectives of the various actors are insufficiently coordinated, the political objective of urban integration is severely threatened.

iv. *Place attachment & belonging*



The notion of place attachment refers to Durand's (2015) ideational dimension and describes the more intangible, affective relationship between the population and their urban environment. When residents or users of a new neighbourhood feel that they belong to the wider urban community, there is a high probability that they visit various places and thus contribute to the atmosphere and urban life of the city. The establishment of place attachment is intimately connected to the dimension of flows because through daily travels and exchanges, people get to know other spaces and establish a connection to them. Place attachment and belonging also translate an immersion into the civic life of local communities, which fosters the creation of social links and rootedness. These elements are often underrepresented in the analysis of urban integration because they act on a longer timeframe and are sometimes difficult to assess. This dimension underlines the fact that not all aspects of urban integration are measurable by quantitative indicators, such as structural dissimilarities or the intensity of flows.

v. *Temporal context*

A temporal dimension overlaps all other dimensions and reminds us that integration is a dynamic process. There is no doubt that the deconstruction of dissimilarities, the establishment of flows or the formation of place attachment are processes that require time. Many people do not become attached to place until they have lived there for several months or years. Changing habits is a slow process and people do not instantly visit a new neighbourhood when they are satisfied with their activity patterns in the areas that they know. Planning strategies and the formation of dissimilarities are also time dependent. While the former respond to upcoming and changing needs, the latter reflect the social inequalities between two areas at a certain point in time. Due to data limitations, I was not able to take into account the temporal dimension in the present study. My analyses are limited to a certain moment, roughly

twenty years after the start of the redevelopment of Belval. Therefore, it needs to be reminded that the process of urban integration as it is considered here is bound to a temporal context that will necessarily evolve in the following years.

vi. *Spatial context*

The physical or spatial context is a further aspect that influences all other dimensions. For example, long distances or physical obstacles between two areas affect the establishment of mobility flows. In the case of the Cité des Sciences, an active industrial area separates the urban development perimeter and the city centre, as the next section will detail. The planning of the knowledge district and its physical connections with the urban environment thus always need to be assessed in this specific context. Travelling from one area to another is definitely facilitated when the distances between them are short, even though this is not a sufficient factor that enables flows of people. Besides mere distance, the existence of infrastructure and the integration into rail and road networks also play a role. For what concerns the Cité des Sciences, a straightforward connection to the city centre for soft mobility has only recently been achieved through the cycling bridge mentioned above. It shows that even the spatial context has a temporal dimension and may have a different impact on social processes at different points in time.

This dissertation uses the presented aspects as an analytical framework that proposes a multidimensional understanding of urban integration. It does not aim to function as the only coherent template to analyse the processes of urban integration because it undoubtedly remains incomplete. My objective is to initiate a discussion on the various factors and dimensions that influence urban integration at the neighbourhood scale and to apply some aspects of this framework to the case of the Cité des Sciences in Esch/Alzette. In the following section, I intend to provide an extended presentation of the study location, the context of the redevelopment project, and the motivation behind the choice to put this specific case at the centre of my research interest.

Introducing the Belval regeneration project, the Cité des Sciences, and the urban context of Esch/Alzette

Esch/Alzette is located in the southwest of Luxembourg (Figure 7). It is the second most populated city of the country (37,000 inhabitants in 2023) and owes its status to the exploitation of iron ore and the industrial steel production. At the end of the nineteenth and beginning of the twentieth centuries, three steel mills were built on its territory, leading to a massive increase of the population due to the attraction

of a foreign workforce. In 26 years, between 1890 and 1916, the number of inhabitants tripled (going from 6,900 to 20,700) (STATEC, 1990).

Figure 7: Location of Esch/Alzette in Luxembourg.

The *Adolf-Emil-Hütte,* as the Belval steel mill was initially called, was built in 1909 on the western fringe of Esch/Alzette. After World War I, it was taken over by the *Aciéries Réunies de Burbach-Eich-Dudelange* (ARBED) and emerged as largest steel production site of the region (Knebeler & Scuto, 2010). For over eight decades, the *ARBED Esch-Belval* contributed to Luxembourg's economic growth and deeply marked the landscapes and social structures of the *Minett* region (Figure 8). After the steel

crisis of the 1970s, a long phase of deindustrialisation led to a progressive abandonment of the industrial sites, rising unemployment throughout the region and a re-centralisation of the national economy to Luxembourg City that emerged as international financial centre and one of the three capitals of the European Union. In 1997, the last high furnace was shut down and the western part of the Belval site turned into an industrial wasteland, while the electric steel production took over on the eastern part.

Figure 8: ARBED Esch-Belval around 1990 and the city of Esch/Alzette in the background (Source: Service des Sites et Monuments nationaux; Le Fonds Belval, 2013)

As a consequence of this past, the municipal territory of Esch/Alzette is profoundly marked by industrial areas and abandoned brownfields (Figure 9). Due to its strategic location and development potential, the Belval site was defined by national policymakers as priority for regeneration (Knebeler & Scuto, 2010). In 2001, the development agency Agora – formed by a partnership between the Luxembourg State and the landowner ArcelorMittal (former ARBED) – presented the masterplan for the area. The project is located on the territory of the municipalities Esch/Alzette and Sanem. The creation of a modern, mixed-use urban neighbourhood was one of the main guiding principles of the project and the initial constructions included a concert hall, a shopping centre, residential and office buildings, and the Cité des Sciences – composed by the University of Luxembourg, research centres, labs, and an incubator for startups (Figure 10).

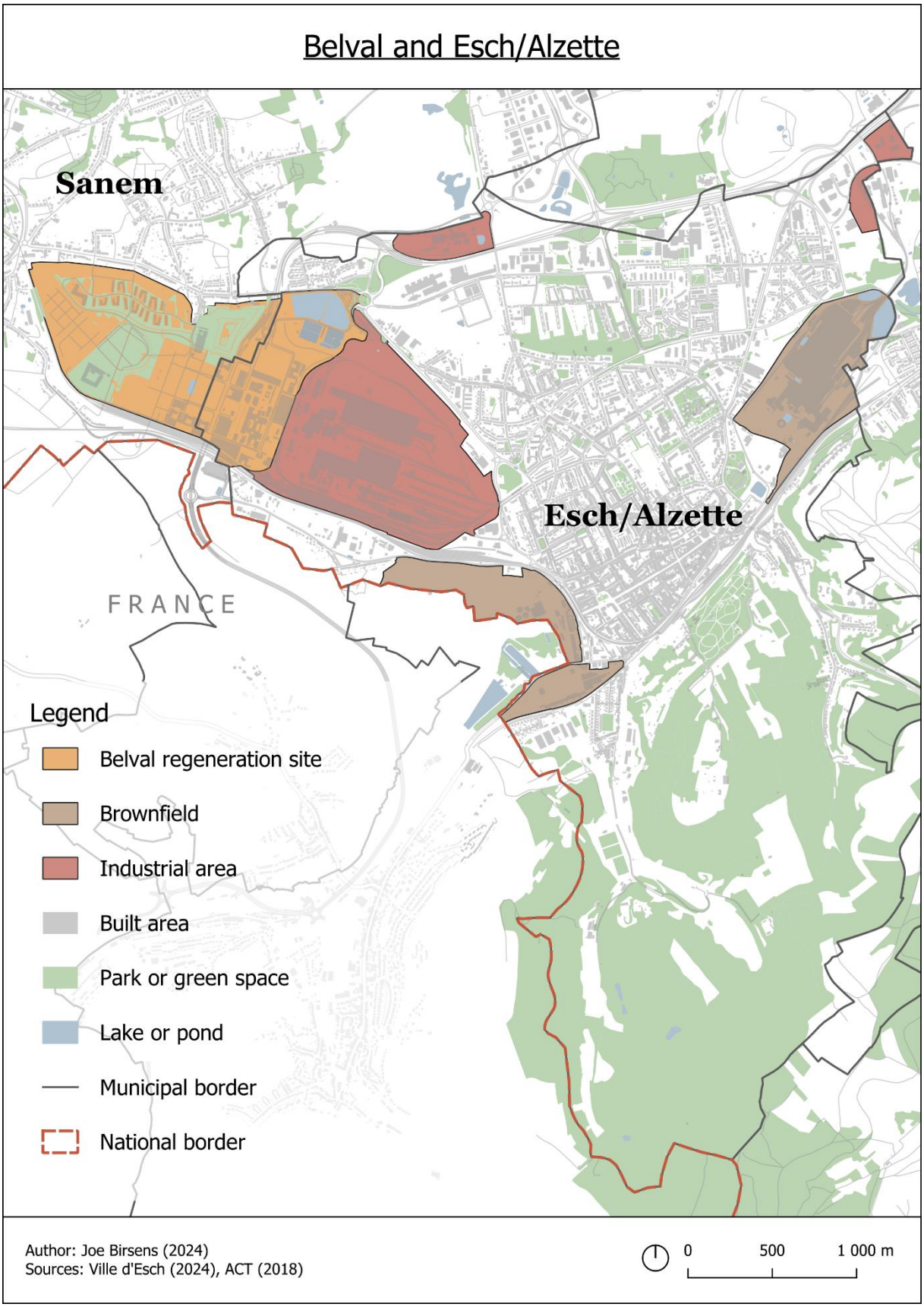


Figure 9: The municipality of Esch/Alzette with the Belval regeneration site on the western fringe.

Figure 10: View of the Belval skyline from the west. From left to right: a residential building, student accommodation, the main university building, an office and administrative complex, and one of the two high furnaces, as remnant of the past. The area in the foreground is under construction and will be urbanised in the coming years (own capture, 2021).

Belval is a national flagship project with ambitious local, national and international objectives. First, the massive public investments in the establishment of the Cité des Sciences are justified by regeneration efforts for the southern region, that faces a structural socio-economic downturn since the deindustrialisation period. Following the rapid development of the financial sector, socio-spatial inequalities increased between Luxembourg City and the post-industrial Minett region and the regeneration of industrial brownfields was perceived as an opportunity to enact a structural social and economic change (a so-called *'Strukturwandel'* (Le Fonds Belval, 2004, p.9) (Becker & Hesse, 2013; König, 2013). Second, Luxembourg is confronted with chronical housing and mobility problems due to a disproportionate growth of the capital city during the past decades (Becker & Hesse, 2013). The creation of a knowledge district close to the French border is thus in line with the national strategy to decentralise economic activities and distribute them from Luxembourg City to regional-level development poles (Ministère de l'Intérieur et de l'Aménagement du Territoire, 2005). Third, Belval has become the main campus of the University of Luxembourg in 2015 after the premises gradually moved there from the capital. While it undoubtedly presents an opportunity for local students, state officials use it also for purposes of nation branding with the aim to attract and retain high quality researchers and students and develop the knowledge economy sector (Amis de l'Université du Luxembourg, 2016). Today, Belval serves as exemplary model for further regeneration projects of derelict industrial land. Their role in the national territorial development strategy is of paramount importance because they are often located in proximity to dense urban areas and can be redeveloped without additional land take (Département de l'aménagement du territoire, 2023).

The developments around the Cité des Sciences initiated a considerable growth of the tertiary sector in Esch/Alzette, even though the city still has a comparatively high share of industrial activities and manufacturing. An important part of the population is affected by structural socio-economic difficulties: the unemployment rate is the highest among the 100 municipalities in Luxembourg (9.0%) (STATEC, 2023) and the share of people receiving the cost-of-living benefit is double the national average (18.8%, compared to 9.4%) (Birsens et al., 2023). But unlike many other deindustrialising cities in Europe, Esch/Alzette is not a so-called shrinking city (Martinez-Fernandez et al., 2012). It is still a gateway for international workers – both manual and knowledge workers – seeking a foothold in Luxembourg. In addition, public and private investment in the regeneration of the remaining abandoned brownfields that surround the city will lead to a massive growth of the population (Figure 11). The city is thus facing considerable social and economic upheaval over the next 25 years and the establishment of the Cité des Sciences can be seen as the starting point in this process.

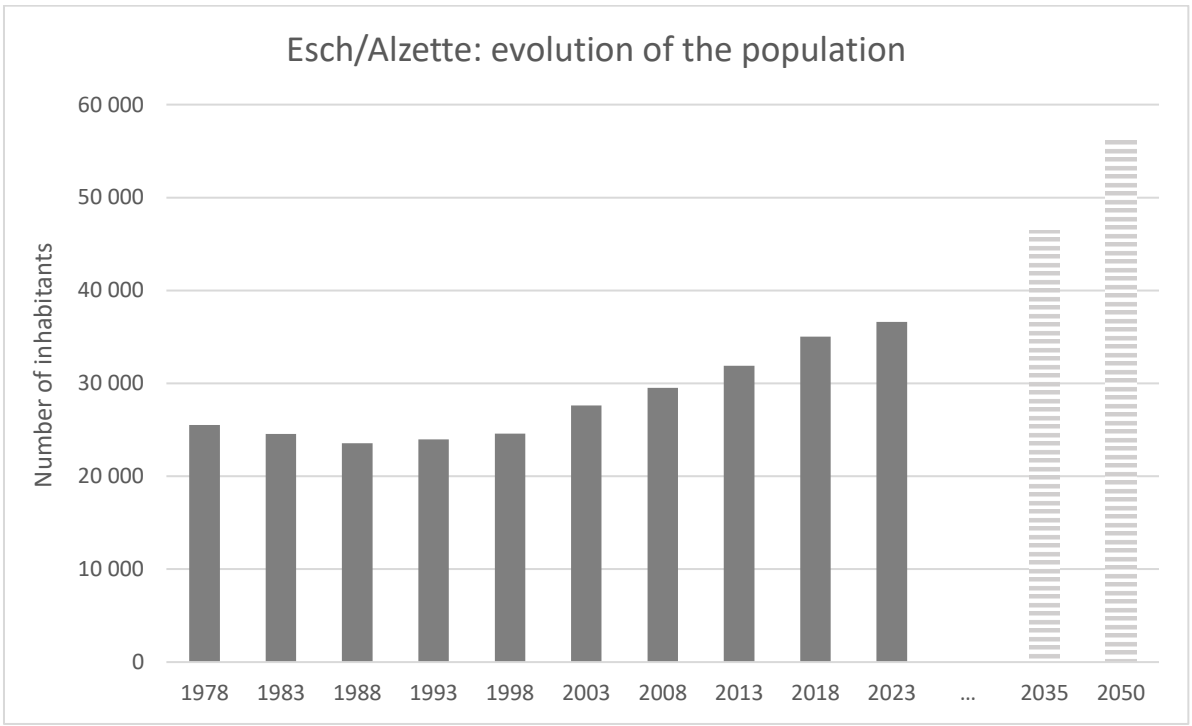


Figure 11: Evolution of the population of Esch/Alzette from 1978 to 2023 (STATEC, 2024) and estimations of future development (Ville d'Esch-sur-Alzette, 2023).

From a more academic point of view, the regeneration of Belval has sparked the interest of researchers due to its neoliberal planning and management processes, that neglect the local social context (Leick et al., 2020). The project has been criticised for its top-down governance practices and lacking public participation (Becker et al., 2018) and for benefiting from extraordinary measures to overcome administrative obstacles in an accelerated manner (Leick et al., 2020). Urban integration is a major

concern in the academic and public debate around the Cité des Sciences and the Belval regeneration project. Multiple social and economic benefits are expected from a successful integration of the knowledge district into the local and regional urban framework.

First, national policymakers see the integration process as a necessary condition for enabling the establishment of connections with the urban environment, and thus achieving the objective of regional socio-economic development. The attraction of an international and specialised population into the former industrial region and their integration into local structures is believed to boost the structural change towards a post-industrial, knowledge-based society. Second, an anchoring to the local territory and exchanges with local communities are also necessary elements of a sustainable twenty-first century university (König, 2013; Newman, 2013; Becker & Hesse, 2013). The development of universities on isolated campuses is definitely at odds with the new standards of Western contemporary urban planning. In the past decades, universities have experienced a growing interest of their local urban environments and their integration into the local realm is thought to create sustainable benefits for both sides. Third, the urban integration of the Cité des Sciences is also actively supported by the city officials of Esch/Alzette (Figure 12). The redevelopment of the formerly abandoned brownfield appeared as a huge opportunity, both in terms of economic development and international visibility and place-branding, when urban integration is achieved (Poos, 2013). Therefore, the local embedding of the university through the construction of student residences in the city centre has been defined as top priority for the city (Goedert, 2013; Poos, 2013).

While there is a broad political consensus on the objective of urban integration between the Cité des Sciences and its urban environment, academic works have highlighted some contextual factors that potentially threaten this strategic aim. In administrative terms, the Cité des Sciences is located on the territory of Esch/Alzette, but there is a clear physical and morphological disconnection from the existing urban realm through an active industrial site that is closed to the public. Even though the infrastructural connection by train, bus and bike has gradually improved in the last years, the distance of about 3km between the University of Luxembourg and the city centre remains. In addition, from a more psychological point of view, the landmarks of the Belval site – the high-rise buildings and the high furnaces – are not directly visible from the city centre of Esch/Alzette, which seems to provide an isolated character to the area (Birsens, 2019). Moreover, according to Hesse (2013, 2016), megaprojects in Luxembourg are chronically detached from their urban contexts due to their vast dimensions and ‘exceptional urbanism’ (2013, p. 12). From an urban planning perspective, an integration process thus appears to be rather complicated. But also from the point of view of the social structures, it remains unclear if and how the newly attracted population linked to the Cité des Sciences actually connects with

the existing local structures or if their life exclusively evolves around the newly developed area, which would threaten the initial political objectives.

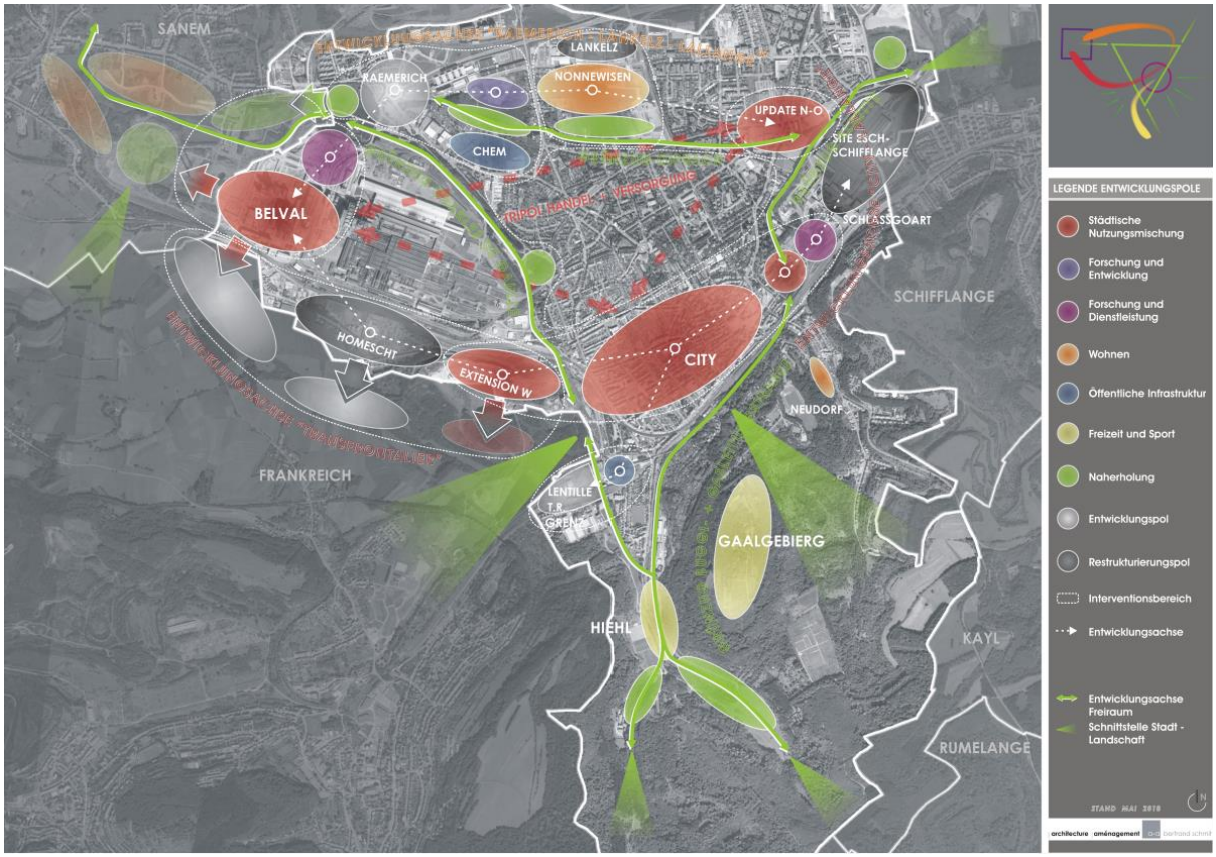


Figure 12: Belval is depicted as a first-level development pole and an urban centrality of Esch/Alzette by the municipal urban planning officials (Source: Ville d'Esch-sur-Alzette – Division du Développement Urbain).

Current academic works on Belval focus on specific aspects that influence urban integration, but they miss a broader, more holistic approach that is able to embrace the complexity of the concept. Observations mostly rely on single elements, such as physical distance or governance structures, which are important, but not sufficient factors to formulate conclusions on urban integration. Scientific analyses of the integration process between Esch/Alzette and Belval are limited to analyses of planning documents and interviews with key stakeholders (Becker et al., 2018; Leick et al., 2020). While these preliminary works constitute an influential starting point, we should be careful to draw conclusions before an in-depth analysis of the spatial practices and perceptions of the people that actually live in the area. It seems rather reductive to proclaim a lack of integration without considering the residents and users. According to the analytical grid developed above, the population plays a crucial role in the process of urban integration, and it is therefore necessary to include them in the analysis. Chapters 2 and 3 of

this dissertation will discuss these points by providing empirical evidence from the users of the Cité des Sciences, and more specifically from the student population.

The case of the Cité des Sciences is particularly insightful for an empirical study on urban integration. Integration has been a central topic all along the redevelopment process because of the specific physical and social context discussed above. In addition, Esch/Alzette was the industrial centre of Luxembourg and had no links to higher education when the national government decided to move the country's only university there. This decision can be seen as a fundamental disruption in the city's development path and city officials expect a boost in the transformation process from a post-industrial to a knowledge-based society. Lastly, Belval is a unique opportunity to analyse a specific population group – university students – arriving on a newly built campus and contributing to its urban integration. As will be detailed in the next section, my research lays a specific focus on the student population. Given that they cannot rely on preexisting student spaces as is the case in other university towns, the present case will provide original evidence on how this new population group contributes to urban integration by appropriating the newly created campus area and the traditional city centre.

This dissertation is a monographic case study of the Cité des Sciences in Esch/Alzette. By focusing on a specific context, I hope to achieve a certain analytical depth that uncovers the mechanisms entering the process of urban integration, as well as potential side-effects of urban planning policies. Applying the analytical framework to other cases in order to further refine and extend it would thus be a possibility for further research that would reveal the significance of local conditions in the process of urban integration.

Approach, materials and methods

In order to respond to the research questions and to the multidimensional approach of the key concept, I chose to adopt a combination of both quantitative data from administrative sources and a survey questionnaire and qualitative data from focus group proceedings, analyses of planning documents, and observations. The choice of using mixed methods to collect empirical evidence can be characterised as pragmatic (Morgan, 2007) and resulting from the diversity of the analytical framework, as well as issues of feasibility. The research questions guided the choice of methods, and their diversity is thus reflected by the various methodological tools that I used to approach the issue of urban integration. I believe that neither a purely quantitative nor a purely qualitative approach would allow to fully grasp the concept. Far from labelling my approach as exhaustive, the idea was to propose a multidimensional analytical framework that observes urban integration from different points of view.

Chapter 1 aims to investigate the social and spatial integration between the Belval knowledge district and the city of Esch/Alzette through a dissimilarity-based analysis. I chose to analyse structural dissimilarities by using administrative data at neighbourhood level obtained through the Social Observatory of Esch/Alzette. I used sixteen demographic and socio-economic indicators at neighbourhood level, that have been set up in the framework of this project, and calculated an 'index of territorial fragmentation' by using a principal component analysis. The index constitutes the absolute value of the difference between the PCA scores of two adjacent neighbourhoods and thus synthesises the structural differences of the areas' populations. By using an original mapping method, I could interpret the level of socio-spatial integration between the neighbourhoods of Esch/Alzette from a dissimilarity-based perspective.

This quantitative analysis provides a robust evaluation of the major socio-spatial challenges that the city currently faces in the context of its territorial regeneration process. It uncovers the existing social structure of Esch/Alzette and the existing structural differences between the university district, the city centre, and the other neighbourhoods. However, the reliance on administrative data presents the inconvenience that it only takes into account the resident population. A main message of this dissertation is to extend the analysis of urban integration to the users of the urban space, who do not necessarily reside there, but do contribute as much to the process of integration than the official residents. Therefore, as mentioned above, I decided to put a specific emphasis on the student population in the subsequent chapters. This user-centred approach aims to shift attention to the everyday actors of the site who 'live' it on a daily basis, while being too often underrepresented in the planning process. The idea behind this choice was to narrow down the target population in order to refine the formulation of hypotheses. In addition, the students represent the most important new population group in the study area and are assumed to have specific social and spatial practices in the urban space that provide interesting insights to the relationship between the campus area and the city.

As a consequence, the methodological core of this dissertation relies on a range of focus groups, linked to an online survey. While the former discussed aspects of the students' place attachment and more subjective views on their study location, the latter allowed me to collect background information about the participants (origin, place of residence, study level, etc.) and quantitative data on spatial practices and perceptions.

The survey was entitled 'Student life in Belval and Esch/Alzette' and included four main parts: (i) General information, (ii) Residential situation, (iii) Daily life in Esch and Belval, (iv) Views on Esch

and Belval[3]. It was an active choice not to reveal the entire topic and purpose of the survey (the analysis of spatial practices and place attachment) in the title or the introduction. The survey was structured according to the research question of the second chapter. The section on the residential situation had a major importance since both the spatial practices and place attachment assumingly depend on it. In particular, it was necessary to detail the respondents' places of residence in order to distinguish between campus residents and others. An additional complexity resulted from the fact that the Belval site extends over two municipalities without clearly visible limitations. Given that nearly all the users refer to the entire site as 'Belval' without distinguishing specifically the Cité des Sciences from the other parts of the site, the design of the questions in this section was challenging. In addition, the questions on the place of residence could not be too fine-grained in order to be compliant to the General Data Protection Regulation (GDPR). Invitations to participate in the study were sent out through the mailing list on the university's student portal. In addition, I distributed written and non-nominative invitation letters to the post boxes of the student residences, of which addresses are published by the university and the municipality of Esch/Alzette. This strategy can thus not be considered as random sampling, but it was efficient in reaching out to the highest possible number of students, especially the ones living in the student residences in Belval. The main objective of the survey was not to achieve immaculate statistical representativeness, but to collect as many responses as possible that could be evaluated by qualitative and basic quantitative tools. From the roughly 7,300 students registered at the University of Luxembourg in 2022 (University of Luxembourg, 2023), only an estimated number of 4,700 attend the Belval campus and were thus targeted by the survey. The number of overall responses (309) was thus satisfying, but only two thirds of the responses were fully exploitable, which translates a rather worrisome drop-out rate. The reasons for the dropouts are unknown. The survey was not excessively long (about 15 minutes), but some questions may have been a little tiring to understand, especially in section three in which questions asked about daily activities, place of activities and frequency of activities at the same time. Also, students who only rarely visit Belval or the centre of Esch/Alzette could have been discouraged from finishing the questionnaire.

Among the respondents, 57.8% were women and half were aged 24 or more. There was a remarkable overrepresentation of PhD students (36.4% while they make up for one sixth of the total students[4]) (University of Luxembourg, 2023), which limits the representativeness of the survey sample. Due to the relatively small target population, I decided to proceed with the collected responses and to communicate the potential shortcomings linked to the representativeness of the survey sample. In terms of nationalities and places of residence, the sample presents a promising heterogeneity. 24.8% are Luxembourgers, 25.2% are citizens of a neighbouring country, and 27.7% of a non-European country. The strongly international character of the University of Luxembourg thus seems to be represented in the sample.

[3] The survey questionnaire is attached in appendix 2.
[4] By excluding the students enrolled in vocational and lifelong learning programmes.

Similarly, 26.2% of the respondents reside in Belval and 25.2% in Esch-centre, which translates a rather satisfying share of different residential backgrounds. A complete set of descriptive statistics of the survey participants, their spatial practices and perceptions of Belval and Esch-centre is provided in the appendix 3.

The online survey, as well as the focus groups, were carried out with full compliance to the GDPR[5]. Participation was based on the participants' active consent. Storage and access of the responses was managed by the Data Centre at LISER. In case the respondents wished to participate in the focus groups, their e-mail addresses had to be collected for sending out the invitations. After the data collection phase, the data was stored on secure servers and no personal data was shared outside of the institution.

At the end of the online questionnaire, interested students could sign up to participate in a focus group during which they could express their feelings using their own words and experiences. The choice to conduct focus groups was guided by the wish to collect opinions, perceptions and feelings that a specific population group (students) has in relation to a specific area (their campus and university town), as well as to understand the factors that influence their positions (Krueger & Casey, 2015). Preparing and conducting focus groups was a particularly enriching experience due to the amount and quality of personal insights that have been collected. I realised that the daily life of students in Belval and Esch/Alzette is a topic that raises multiple questions (even regarding issues that go beyond the content of this dissertation) and that the students themselves care about.

The composition of the focus groups was guided by several factors: (i) the students' level of place attachment based on the findings from the survey; (ii) their place of residence (on the campus, in the city centre or elsewhere); (iii) their origin (local students or international students); (iv) their availability on the proposed timeframes. The limited amount of candidates and the partly conflicting agendas made the composition of the focus groups a challenging task. The first group (5 participants) included international students residing on the Belval campus, in immediate proximity to the university. The second group (4) was made up of local students. The third group (4) consisted of international students residing in Esch/Alzette, but not in Belval and the fourth group (5) also included international students, but with mixed residential backgrounds. Then, I tried to have in every group a satisfying mix in terms of place attachment levels, study levels and gender.

There was a clear overrepresentation of doctoral students in the focus groups, which is probably due to their more flexible agenda. The survey findings have also shown that doctoral students have developed a higher level of place attachment to the city of Esch/Alzette than Bachelor or Master students and they

[5] The processing of personal data was based on article 6. 1) a) of the General Data Protection Regulation (EU) 2016/679.

plan to stay in Belval or Esch/Alzette after graduation more often than the average respondent. Therefore, another hypothesis for their overrepresentation in the focus groups is that they demonstrate a higher sense of concern or interest to their university location than younger students.

The first part of the focus groups was carried out as mapping workshops. Mental mapping is a frequent tool in focus groups when spatialised topics are being discussed (Yu et al., 2018). The students were asked to split in groups of two or three and to draw the areas and places they know and visit in Belval and in Esch/Alzette, and the feelings they relate to them. Following Vitman-Schorr & Ayalon (2020), mental maps are effective in depicting people's level of attachment to the urban environment and there is a high correlation between elements represented on the maps and familiarity with these places. Since mental mapping is also useful to represent feelings and emotions (Pearsall et al., 2015), I specifically asked the participants to indicate their subjective feelings by drawing symbols or adding emoji stickers that I provided. For the second part of the focus groups, the group came back together to discuss the places they have drawn. The maps have been extremely useful during this discussion because the participants could make a direct link between their shared experiences and the places on the map[6]. The discussion focused on the students' use and experience of their university environment and how it affected their place attachment and feeling of belonging to the student community and to the city of Esch/Alzette (Fincher & Shaw, 2011). The focus groups were entirely recorded and transcribed. With the support of qualitative data analysis software (MAXQDA), the transcripts and the maps were coded. Thereafter, a thematic analysis was performed in order to compare different views and to uncover certain patterns and themes across the focus groups (Krueger & Casey, 2015).

Survey and focus group results are used in both chapters 2 and 3. Chapter 2 investigates how the students' place attachment contributes to urban integration, by specifically looking at their place of residence (on-campus, in the city centre or elsewhere) and socio-demographic characteristics. First, place attachment was evaluated by a 'place attachment index'. This index – calculated both to the campus and to the city for each participant – is based on the widely shared conception of place attachment being a second-order factor composed of various sub-dimensions (Williams & Roggenbuck, 1989; Ramkissoon et al., 2013). Following slight adaptations of existing frameworks, I decided to operationalise place attachment through the dimensions of place social bonding, place affect and place identity, that are composed by several items[7]. This structure underwent a reliability check and some variables were discarded in order to guarantee a Cronbach's alpha of 0.7. The Likert scales of the survey questions were interpreted as ordinary scales, which was necessary to quantify the place attachment sub-dimensions through simple means. Even though this method is debated in the scientific community, I

[6] The maps created during the focus groups are attached in appendix 4.
[7] A detailed representation of the analytical framework is provided in chapter 2.

assume that the potential risks are very limited since the indices are solely used to compare different subgroups of the same population.

Second, I analysed to what extend the attachment level varies according to the students' place of residence (on the campus, in the city or elsewhere). I used a series of ANOVA for the place attachment dimensions that respected the requirements of parametric tests (homogeneity of variances, normal distribution of residuals, no autocorrelation among residuals, no heteroscedasticity) and Kruskal-Wallis tests for the others.

Third, I conducted a multiple correspondence analysis and hierarchical clustering on the initial survey results to further define various subgroups of students according to their relative place attachment to the campus and the city. This is a widely used method to analyse sociological phenomena through survey data (Bourdieu & de Saint Martin, 1978; Lebaron, 2010) and it proved highly efficient in creating categories of respondents with similar views and place attachment forms.

Fourth, I adopted a much more exploratory and qualitative approach to analyse the survey results. I used descriptive statistics on specific survey questions to interpret previous findings from the quantitative operations. In addition, the focus group results were extremely useful to interpret the findings from the survey.

In chapter 3, the findings from the focus groups have a more central role in the analysis of the students' spatial practices and place attachment. The aim of this chapter is to analyse the extent to which the urban integration process – that is approached here through the daily activities of students and their feelings of belonging towards their urban environment – is influenced by the governance and planning principles of the Cité des Sciences. As this chapter reveals, the initial planning strategy of creating a mixed-use campus seems to work against the more general objective of urban integration, when the scales on which these planning principles act are insufficiently coordinated. These effects directly impact the student population and their relationship with their study location in multiple ways, as the focus groups revealed. On the other hand, the governance and planning process of the Cité des Sciences is evaluated by a qualitative analysis of planning documents and by participating in public discussion rounds, including the one-week conference 'Let's talk about Belval' that was organised by the Master in Architecture of the University of Luxembourg and gathered a wide panel of experts and stakeholders involved in the Belval regeneration project.

Being a doctoral student at the University of Luxembourg and working daily in the Cité des Sciences was of course very helpful in this study. It proved beneficial not only in terms of contacting the students and distributing the survey, but also in enabling frequent observations of the area and informal discussions with other students. However, this direct connection to the studied population also bears the

risk of a biased analysis. It would be dishonest to posit that my research was completely neutral. But it was not my aim to achieve flawless objectivity, which anyhow is not completely achievable in the social sciences. This work primarily aims to create advances in the research field of large-scale urban development projects and their relationship with the urban environment, to inform policymakers and planners about the concrete implications and effects of urban integration policies, and to shed light on the student population that is too often underrepresented in the planning process of campuses and struggles to gain visibility and participation in the concrete case of the Cité des Sciences in Esch/Alzette.

An important limitation of this study is due to the availability of existing data that could be used in the analysis of urban integration. Accessing administrative data at the local level – that is necessary for the analysis of integration at the intraurban scale – is a general challenge that researchers face in Luxembourg. The municipality is the most precise scale on which the National Institute for Statistics and Economic Studies (STATEC) publishes certain indicators. The Social Observatory of Esch/Alzette thus constituted a unique opportunity to access and process neighbourhood scale data that allowed me to analyse urban integration based on statistical indicators (cf. chapter 1). However, as discussed above, the data only depicts the situation at a precise moment, which made it impossible to observe integration as a dynamic process that changes over time. Future studies that repeat the proposed methodology would be useful to cover this important limitation.

Finally, as most dissertations published in the last months and years, this work was partially carried out during the COVID-19 pandemic and the successive lockdowns that heavily impacted all aspects of life. Fortunately, the focus groups could be organised without major issues because the health situation was stable in spring 2022. For me, the biggest impact of the COVID-19 pandemic was the inability to attend face-to-face conferences for almost two years, and the lack of direct contact with colleagues and peers during the months of the lockdown. Formal meetings and seminars were held online, while informal exchanges were completely abandoned for a considerable time. Even after the sanitary measures were eased, online meetings often remained the preferred if not only option. None of the fourteen courses I accomplished during my doctoral studies was completely held at the university premises, which significantly affected direct exchanges with peers. Fortunately, the time of complete lockdown was limited in the end, and LISER offered a quick and safe return to the offices. In November 2021 and in July 2022, I attended two in-person conferences, in Doha (Qatar) and Tartu (Estonia) respectively. In addition, I had my first experience in teaching at the university in March 2023. All in all, I feel extremely privileged that, despite the difficult external conditions, I could continue my work without major limitations, which was not the case for all doctoral candidates, nor for many people in other professional domains.

Structure of the dissertation

The three chapters that follow this introduction constitute the core of the dissertation. They are structured as research articles that are either published or to be published in scientific peer-reviewed journals. The present introduction and the general conclusion wrap up the three chapters and aim to clarify their links and overall coherence. This reflects the clear structure of the suggested cumulative thesis format. While this format has the benefit that the doctoral candidate proves their ability to publish in a scientific review, it also presents the disadvantage that every chapter is rigidly structured as a research paper, which leads to repetitions of the content. For example, every chapter includes a short part introducing the study context, which only slightly changes across the chapters but which is necessary for readers of the isolated research article. Similarly, chapter 1 introduces again the analytical framework of urban integration, that is laid out above in more detail, in order to define and underpin the adopted multidimensional approach. The three chapters are thus stand-alone research works bound together by a common research object.

The initial plan was to present and discuss the entire analytical framework in a single chapter. This idea was however dismissed after extensive reflections in order to allow a more detailed and in-depth discussion of the various dimensions and their different effects on the urban space. Chapter 1 thus focuses on a more theoretical discussion on socio-spatial integration and the analysis of structural dissimilarities between neighbourhoods. This chapter was submitted as a research paper (co-authored by Dr Antoine Decoville) to the journal 'European Urban and Regional Studies' in August 2021. After taking into account the precious comments from two anonymous peer reviewers, it was accepted in October 2022 and published in its current form in Volume 30, Issue 2 in April 2023 (online first in November 2022).

In the second chapter, I wanted to go beyond the analysis of quantitative indicators and put the focus to the actual users of the study area. The main objective was to show the diversity of the urban integration concept by asking to what extend the student population – the most important population group attracted to Esch/Alzette by the Belval redevelopment project – contributes to the integration between the campus and the city. This chapter was finalised in June 2023 and submitted to the journal 'Population, Space and Place'. In October 2023, I received inspiring comments from an anonymous peer reviewer that have been processed and included in an enhanced version that has been published online in April 2024 ('Early View' version: e2783).

The third chapter keeps the focus on the student population and takes the analysis a step further to investigate the relationship between the students' lived experience of their university environment and the planning and governance strategy applied in the Cité des Sciences. Planning documents reveal that the Belval regeneration project was marked by a mixed-use development strategy and the wish to integrate the university district into the urban environment. The different stakeholders involved in the

development project act at different scales, which can have contradictory effects, as this chapter reveals. The analysis focuses on the spatial practices and feelings of belonging of the students – interpreted through the focus group proceedings – and asks to what extent the governance and planning principles affect the students' lived reality on their campus and beyond. Chapter 3 has been submitted to 'European Planning Studies' in January 2024 and is currently being revised following the receipt of highly valuable remarks from two anonymous reviewers.

The concluding chapter summarises the different findings from the three chapters and proposes an extension of the analytical grid that frames the dissertation. The discussion in the final part aims to depict the advances in the scientific literature and in urban planning provided by the present study and opens the floor to further debates and research paths around the concept of urban integration.

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CHAPTER 1

Investigating the local socio-spatial integration of the Belval knowledge district into Esch/Alzette: A dissimilarity-based approach

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Introduction

The integration of knowledge-related urban development projects into their local environments has become one of the main objectives and challenges associated with their planning process. This has not always been the case: specialized technopoles of the second half of the twentieth century were planned as entities that were spatially and functionally detached from the city (Castells & Hall, 1994; Van Winden, 2011). Higher-education institutions and technology firms clustered in remote greenfield campuses in order to emphasize their global scope and their detachment from any specific place (Goddard & Vallance, 2013; Addie et al., 2015), as in the iconic examples of Silicon Valley (US) and Sophia Antipolis (France).

Contemporary knowledge and high-tech clusters seem to have experienced a 'back to the city' movement, since they are considered to offer a great opportunity to trigger the local economy by attracting national and international actors from knowledge-related sectors into the cities. This political strategy relies on the hypothesis that the development of urban knowledge districts and their integration into the local context constitute necessary steps to generate 'knowledge spillovers' (Van Winden et al., 2010). In addition, this rationale responds to the post-industrial planning objective to close the inner-urban gaps of the industrial era and to prevent urban sprawl by regenerating centrally located brownfield sites (Glumac & Decoville, 2020).

This urban turn in knowledge-related, technical and scientific activities was led under the influence of the 'knowledge economy' paradigm and new urban strategies (Gerhard & Hoelscher, 2017). In Europe,

it has been politically supported by the European Commission, with twenty years of economic agendas promoting R&D with the Lisbon strategy and its successor, the Europe 2020 initiative. Institutional actors, such as universities, are now predominantly seen as regional drivers for economic development, thus producing tangible benefits for local communities (Addie et al., 2015). Several examples, such as Arabianranta in Helsinki or Poblenou in Barcelona, follow the model of 'knowledge districts'; that is, clearly delimited, planned, urban or suburban areas with a high density of higher-education institutions and knowledge-intensive activities. Due to its expected beneficial effects, socio-spatial integration into the existing urban environment has become a common policy objective of knowledge districts.

The literature nevertheless remains fairly divided about the definition and the possible assessment of integration in the context of knowledge-related urban development projects. Yet, it is crucial to understand what it clearly means for a neighbourhood to be integrated into its environment, as it is to understand the driving forces behind this process and the social consequences it can have. Many authors illustrate the lack of integration between two spaces by highlighting the contrast between high-income residents in the newly developed district and low-income residents in the neighbouring areas. (Swyngedouw et al., 2002; Madureira & Baeten, 2016). Others emphasize the incompatibility between knowledge-related urban projects and a sound connection to existing urban structures, due to neoliberal project management practices that neglect the surrounding areas (Leick et al., 2020). These approaches address different single aspects of the integration concept without clearly defining and without reflecting on a holistic analytical framework for comparing findings across case studies.

This article has two objectives. First, it proposes to examine the concept of socio-spatial integration when applied to a knowledge district, and to provide an original analytical approach based on structural dissimilarities between neighbourhoods to help measure it. The second objective is to contribute to the debate about the supposed 'spillover effects' that a newly built knowledge district could have on the neighbouring urban environment. For this, the study focuses on the case of Belval in Esch/Alzette, Luxembourg; a publicly driven knowledge district that has been developing since 2005. We rely on a set of sixteen indicators that provide a multi-faceted framework to assess structural dissimilarities at the local level.

This work is based on two hypotheses describing the specific categories of people that knowledge district developments intend to attract. The first hypothesis concerns the socioeconomic profile of the inhabitants. It postulates that knowledge districts attract people who are highly qualified and have high income levels, but are much less open to economically vulnerable inhabitants (Doucet et al., 2011). A related sub-hypothesis is that the development of a knowledge district is also characterized by higher housing prices compared with other districts, and this may exclude poorer population groups (Stefanovics, 2016).

The second hypothesis relates to the demographic profiles of knowledge workers. It posits that inhabitants of knowledge districts are younger (they are at the beginning of their professional career and not yet established elsewhere), they come from wider geographical horizons (since the profiles sought by the knowledge institutions cannot be found locally) and a larger proportion of them work in knowledge-intensive sectors, compared with the populations who live in other neighbourhoods (Bontje et al., 2017).

These potential neighbourhood-level disparities – observed through socioeconomic and demographic indicators – are interpreted in terms of the dissimilarities between adjacent neighbourhoods, allowing us to uncover the existing socio-spatial fragmentations in the urban space.

As the existence of structural dissimilarities is likely to influence the way in which individuals develop a sense of belonging to the city, we introduce two complementary indicators that allow this dimension to be approached, although without capturing it completely: first, the length of residence within the neighbourhoods, and second, the participation of foreigners in elections. The idea behind adding these indicators is to provide material for the debate rather than to actually test any additional hypothesis.

A multivariate analysis and a cluster analysis allow us to observe the structural dissimilarities that accumulate over multiple indicators and to break down these dissimilarities into their constituent components to provide more fine-grained interpretations. With this multi-layered analysis, we aim to provide a more thorough and nuanced discussion about the socio-spatial integration of knowledge districts into the city, and the possible 'spillover effects' this may have on the local urban environment. Such an analysis is important to help public actors respond to the specific needs of these populations, but also to address the challenge of their smooth integration into the urban social structure.

The next section discusses the socio-spatial relationships between knowledge districts and their urban environment, and contributes to the theoretical reflection about the integration concept.

Integrating knowledge districts into the city

Socio-spatial integration: a key for shared growth or a policy objective hiding neoliberal regeneration strategies?

The development of a new large-scale knowledge district and its integration into an urban framework is believed to affect existing parts of the city, for instance through attracting institutional actors and through job creation. Some authors see such initiatives as major drivers of the 'knowledge-based urban development' strategy (Yigitcanlar et al., 2008; Penco et al., 2020); an urban planning paradigm that has been supported at the European level since the beginning of the 2000s (Bontje & Musterd, 2009;

European Parliament, 2000). Knowledge- and culture-related urban strategies have been influenced, among others, by Florida's (2002) 'creative class' theory, which underlines the importance of attracting a dynamic, international and highly-educated population to generate economic growth and success in the global urban competition (Lehrer & Laidley, 2008; Madureira, 2015; Bontje et al., 2017).

In this context, the relationship between knowledge districts and the city as a whole becomes a central element for discussion. The integration of these newly-built areas into their urban environment has become a major policy objective (Duarte & Sabaté, 2013), for at least three reasons. First, the integration of a knowledge district into a dynamic and diverse urban area contributes to the 'quality of place' (cf. Florida, 2002) and to attracting students and knowledge workers to the city (Yigitcanlar et al., 2007). Second, public authorities expect that the integration of a knowledge district into the city enables long-term 'trickle-down effects' or 'knowledge spillovers', with the creation of other businesses and the increase of revenue for the municipality. Third, an enhanced connection between a knowledge district and the local communities is thought to trigger cooperation, with tangible benefits for all areas (Den Heijer & Curvelo Magdaniel, 2012).

Some scholars, however, question the potential effects that knowledge districts can have on the surrounding areas, which have their own specific social reality. They argue that the reproduction of inequalities and the marginalization of local communities are widely underestimated in knowledge-led or culture-led policies (Bontje & Musterd, 2009; Ponzini & Rossi, 2010). This echoes common criticisms of large-scale urban development projects that are managed by a cooperation between entrepreneurial governments and private actors, and that formulate their strategies according to concrete, area-based objectives (Harvey, 1989; Tarazona Vento, 2017). Furthermore, critical voices accuse 'creative class' and 'creative city' discourses of hiding underlying objectives, such as attracting external investors, increasing land value and city branding (Doucet et al., 2011; Sacco et al., 2014; Sechi, 2016). They are seen as a neoliberal tool that legitimates massive investment flows for large-scale projects and responds to the needs of upper and middle classes, and thus entails the risk of growing social polarization (Moulaert et al., 2001; Shaw, 2013; Gerhard & Hoelscher, 2017).

Due to the specific governance and financing processes of large-scale urban projects, Leick et al. (2020) conclude that they are incompatible with successful integration into the local context, and thus result in 'foreign matter in the urban realm' (p.2). Other authors compare newly-built neighbourhoods with 'islands of wealth', (Swyngedouw et al., 2002, p.567) as they predominantly target high-income groups of the population (Madureira & Baeten, 2016). Rugkhapan and Murray (2019) present the extreme example of the 'spatially disjointed, socially disconnected' (p.272) Songdo district in Incheon (South Korea) as an enclave in the urban framework, creating what MacLeod and Ward (2002) call a 'fragmented geography' (p.163). This disconnection can be observed at the level of structural discontinuities (differentials in housing prices or characteristics of the population) or physical obstacles

(Duarte & Sabaté, 2013; Grésillon, 2011). Therefore, critics argue that socio-spatial fragmentation and enclave formation driven by an exogenous growth could work against the expected effects of an endogenous regional development. This tends to contradict the presupposed 'trickle-down' effect resulting from megaproject developments (Tarazona Vento, 2017) that would function more, in reality, as self-sufficient enclaves.

Another important point is that strategies promoting the urban integration of knowledge districts bear the risk of a 'new-build gentrification' (Davidson & Lees, 2005) or even a 'studentification' process (D. P. Smith, 2005), when the project comes with university facilities, causing displacement pressures and feelings of exclusion among the local communities (Stefanovics, 2016). Gerhard and Hoelscher (2017) argue that 'mechanisms of class closure' (p. 136) benefit an already privileged population, while other social groups remain excluded from the creation of knowledge-related jobs and suffer further marginalization. There is a discrepancy between on the one hand, the place and investments attributed to knowledge institutions, considered as key actors in neoliberal regeneration policies, and on the other hand, the mostly low-qualified profile of the local population, who may feel excluded from the project (Chatterton, 2010; Van Winden, 2010).

These elements of discussion reveal a theoretical impasse regarding the urban integration of knowledge districts. Although there seems to be a consensus that these projects must consider the environment in which they are embedded, many authors have doubts regarding the actual possibility of this integration, given the way in which the projects are conceived and that they stem from an elitist vision of society. In face of this paradox, we argue that socio-spatial integration should be considered and apprehended as a multidimensional concept that has to be observed through different (yet complementary) approaches. However, academic literature does not provide a univocal definition of socio-spatial integration, or any holistic assessment approach. The following section aims to help fill this gap.

Deconstructing the socio-spatial integration concept

Integration has become a very popular term in public discourse to describe the deconstruction of barriers and the strengthening of interdependence and cooperation between two entities or groups. In urban and planning studies, the term 'integration' is blurred by the wide range of social and spatial phenomena to which it is applied. The most intuitive understanding of it is probably when it is used to depict physical proximity or connectedness between neighbourhoods. However, when it refers to large-scale urban projects as unintegrated 'islands of wealth', the emphasis is put on the disparities between socio-economic structures. Other works use the concept to focus on the active involvement of local communities in the planning and development processes (Van Winden, 2011), or the integration into local and regional planning programmes (Grésillon, 2011). Border studies literature, which offers various analytical frameworks to measure cross-border integration, adds to the definition the importance

of flows between areas and the population's feeling of belonging to a common territory (Ruiz-Tagle, 2013; Durand, 2015; Decoville & Durand, 2018). The concept of socio-spatial integration is thus mobilized in many different contexts, leading to diverging interpretations.

In their analytical framework, Van Winden et al. (2010) consider 'urban-spatial integration' as an outcome of knowledge location development. However, they do not deconstruct the integration concept into its various dimensions, and they ignore how these dimensions affect the local environment. We argue that socio-spatial integration can be analysed through different prisms, such as the structural dissimilarities between territories, but also the flows that tie them together, the strategic cooperation efforts between stakeholders that allow a common governance to be generated, and the population's identification with a common territory. We consider two areas as being socially and spatially integrated when their structural dissimilarities are minimized, links between actors from both areas are maximized, and their populations share one common territory through their spatial practices and perceptions. Given this last dimension, the introduction of the complementary indicators (the length of residence and the participation of foreigners in elections) appears to be important to approach the multidimensional nature of the integration concept. Spatial proximity also plays an important role in the definition of integration, and it influences the other dimensions: Den Heijer and Curvelo Magdaniel (2012) argue that physical discontinuities and gated areas can lead to feelings of exclusion. These various dimensions mutually interact and affect the socio-spatial outcomes of knowledge district development. For example, large disparities in social status, demographic structures or cultural backgrounds may block social interaction and mutual acceptance. Therefore, it is important to be aware of the polysemy of the integration concept before assessing the level of integration of two neighbourhoods at the local scale. In the remaining part of this article, we present the analysis of structural dissimilarities as an original approach that highlights one specific dimension of socio-spatial integration.

Applying the dissimilarity-based approach to the case of Belval

Belval: creating a neighbourhood 'from scratch'

With 36,000 inhabitants in 2020, Esch/Alzette is the second largest city in Luxembourg. Even though industrial activities remain important for the local economy, the city is surrounded by several abandoned industrial sites that have become precious resources of land. In a national context of high population growth rates and a scarcity of building plots, leading to skyrocketing land and housing prices (Observatoire de l'Habitat, 2020), the redevelopment of these brownfield sites have indeed become economically opportune. Massive public investments enabled the development of a new mixed-use neighbourhood on the territory of the municipalities Esch/Alzette and Sanem. The knowledge district (Cité des Sciences) is built on the eastern part and consists of the University of Luxembourg, several

research centres, a business incubator and student residences. It is completed by private flats, commercial properties and leisure facilities.

The decision to move the university to Esch/Alzette in 2015 was motivated by several factors. First, the national spatial planning policy has for decades favoured a polycentric strategy of institutional deconcentration, that aims to relieve pressure on the property market in Luxembourg-City and to boost development in secondary regional centres (Becker & Hesse, 2013). Second, policymakers expect the agglomeration of higher-education and research institutions in Esch/Alzette to contribute to the socio-economic regeneration of the city and of the whole southern region (Knebeler and Scuto, 2010; König, 2013). This objective is of major importance since Esch/Alzette has undergone a deep deindustrialisation process that affected a large part of the working-class population. Today, the municipality has the highest unemployment rate in the country, at 10.9%, and incomes are much lower than the national average. The choice to set up this knowledge district in Esch/Alzette therefore stems from a political intention to reduce the social and economic differences between it and the capital region by attracting international scholars, but also by increasing the chances of the local and regional population to attend a higher education institution, thereby facilitating their insertion in the local labour market. The socio-spatial integration of Belval into the local urban context, and the connection between the local population and the knowledge institutions, are thus considered as a precondition to enable a virtuous development process.

In recent years, however, multiple side effects of the planning and financing processes, as well as the potential risks of negative outcomes, have become ever more visible. Becker et al. (2018) and Leick et al. (2020) criticize the lack of public participation and the top-down governance practices inspired by neoliberal managerial strategies that do not consider the socio-spatial context of the Belval regeneration site.

The lack of integration of the new Belval district into its urban and regional context is seen as a risk for the entire redevelopment project. For Hesse (2013), this partly results from the national policymakers' inclination towards mega-projects that are not easy to integrate into the existing urban fabric given their sizes and scopes. Becker et al. (2018) recognize that the confrontation of two diverging 'life-worlds' (p.192) — local working-class communities on the one hand and a new 'services class' on the other — tends to hinder the social acceptance of the project. The physical context of the Belval neighbourhood is also considered as unfavourable to integration because it is cut off from the rest of the city by an industrial area (Birsens, 2019) (Figure 13).

In spite of these obstacles, the socio-spatial integration of Belval into its urban environment and the deconstruction of borders towards local communities are seen as necessary conditions for achieving regional development and sustainability objectives (König, 2013; Newman, 2013; Becker & Hesse, 2013). This perception is shared by the municipal authorities of Esch/Alzette that also see the potential

economic and symbolic benefits of enhanced connections between the old and new neighbourhoods (Goedert, 2013).

To date, empirical studies about Belval have been limited to analyses of planning documents and interviews with key stakeholders. We aim to complement these analyses by focusing on the structural dissimilarities between neighbourhoods in order to evaluate the extent to which Belval is socially and spatially integrated into Esch/Alzette. We believe that this analysis is a prerequisite to understand and manage the socio-spatial effects for the city and for the entire region.

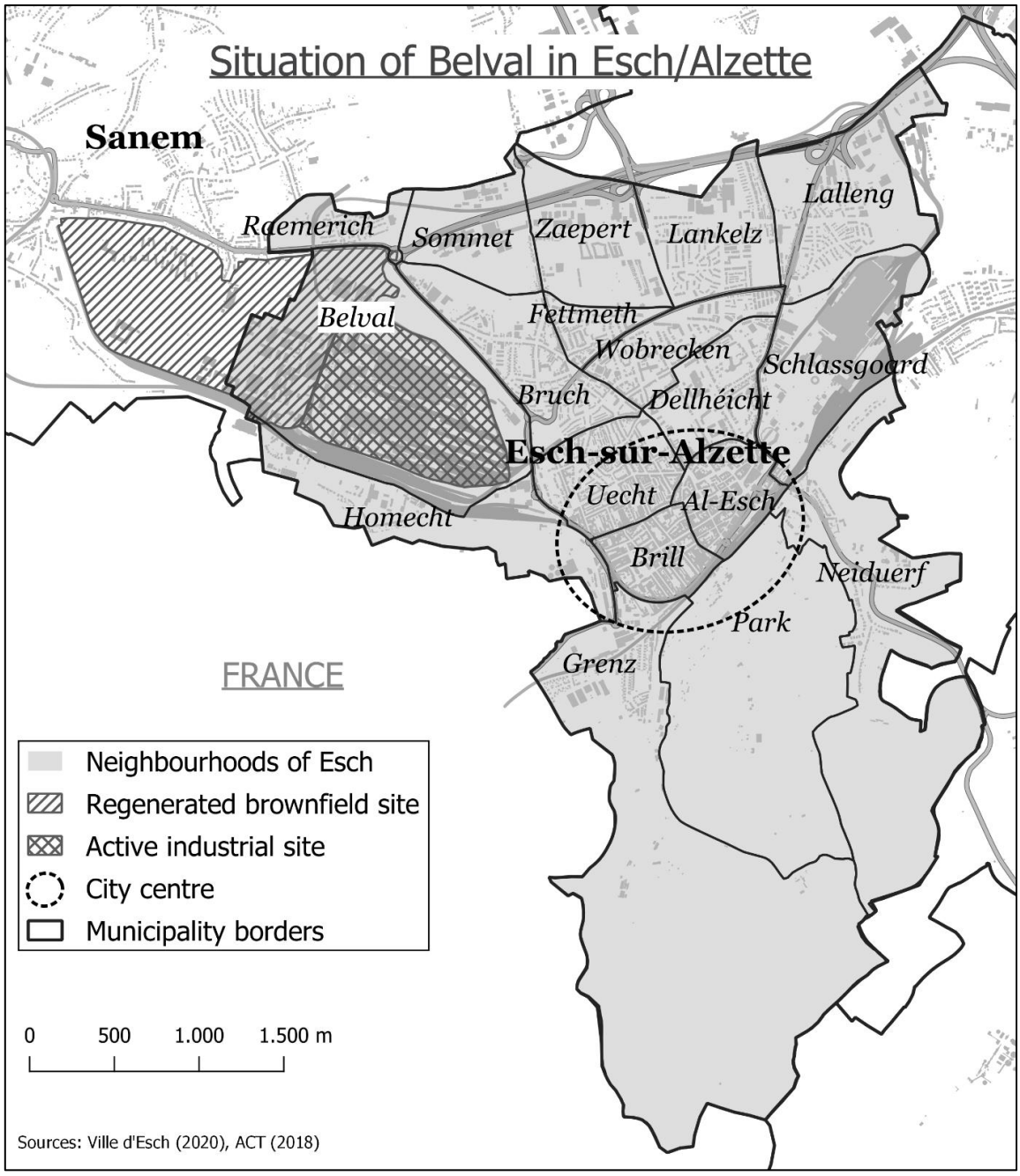

Figure 13: Situation of Belval in the municipality of Esch/Alzette.

Esch/Alzette is divided into 18 neighbourhoods that present important differences in terms of population size and density (Table 1).

Table 1: Descriptive statistics

Neighbourhood	Total population	Active population	Population density per hectare	Share of foreign population
Al-Esch	5064	2038	196.1	68%
Belval	941	485	35.5	77%
Brill	5282	2826	220.4	76%
Bruch	3299	1396	67.7	50%
Dellhéicht	1555	448	45.7	38%
Fettmeth	1073	484	74.8	41%
Grenz	1329	577	51.9	62%
Homecht	315	162	7.1	49%
Lalleng	2350	1099	52.4	50%
Lankelz	2660	1061	55.1	40%
Neiduerf	1883	782	53.7	50%
Park	133	71	22.9	58%
Raemerich	548	283	46.1	42%
Schlassgoard	200	58	16.6	49%
Sommet	140	63	6.0	46%
Uecht	5804	2385	134.3	62%
Wobrecken	2674	997	80.8	48%
Zaepert	999	450	23	50%
Total	36249	15665	27.7	57%

The methodology relies on a set of studies on 'territorial discontinuities' that aim to lay out territorial cleavages separating different socio-spatial systems (see for example François, 1995; Grasland, 1997; Le Goix, 2005).

The availability of fine-scale data from public sources allows an intra-urban analysis at the neighbourhood scale. The data was collected in the framework of a research project entitled 'Social Observatory of Esch/Alzette' to which the authors contributed. 16 indicators were mobilized and processed to reveal the structural dissimilarities between the Belval knowledge district and the other neighbourhoods of Esch/Alzette. Instead of relying on a single characteristic to measure integration, we

aim to identify the existence of contrasting social structures in the urban framework of Esch/Alzette through an indicator-based analysis.

Socioeconomic indicators measuring social and economic wealth, as well as the socio-professional status of the residents:

- median income (INCOME); proportion of the population receiving the social inclusion income (INCLUSION-INCOME)
- housing prices per square metre (selling prices of existing flats only) (FLATS-PRICES);
- proportion of the active population employed in the construction sector (CONST); the finance and insurance sector (FINANCE); and the professional, scientific and technical activities sector (PROF-SCIEN-TECH).

Demographic indicators measuring age, nationality and household structures:

- proportion of children under 15 years of age (15LESS), young adults aged between 15 and 39 (15TO39), and seniors aged 65 and above (65PLUS);
- proportion of the two most represented nationalities; that is, Luxembourgers (LUX) and Portuguese (POR), as well as the grouping of other citizens from outside the EU (NOT-EU);
- proportion of single-parent households (SINGLE-PARENT); household size (HOUSEHOLD-SIZE).

Complementary indicators relating to the population's sense of belonging:

- mean length of residence in the same dwelling (LENGTH-RESID); participation rate of foreigners in municipal elections (ELECTIONS).

These indicators were selected to address a diverse range of the area's social composition. In addition to a limited availability of fine-scale data, our choice was guided by a preliminary correlation analysis that allowed us to discard highly correlated indicators.

A varimax-rotated principal component analysis (PCA) concentrates the information provided by these indicators and summarizes it on a limited set of continuous factors. For every pair of adjacent neighbourhoods, an 'index of territorial fragmentation' — constituted by the absolute value of the difference between the PCA scores — is calculated. It is inspired by the dissimilarity index, which is a

widely-used measurement of spatial integration (Guan, 2019) and was popularized by the works of Duncan and Duncan (1955). In contrast to this traditional measurement, the 'index of territorial fragmentation' compares spatial units (neighbourhoods) instead of population groups, in order to test the existence of a structural discontinuity between the populations that live in the knowledge district, and those living in other neighbourhoods.

The index values are linked to the borders separating two adjacent spatial units, and allow to represent the dissimilarities between neighbourhoods on a map (cf. Le Goix, 2005). The interpretation of these results is guided by the following statement: if the dissimilarity observed between Belval and the other neighbourhoods is significantly higher than the dissimilarities usually observed between the neighbourhoods of Esch/Alzette, then the knowledge district can be considered as poorly integrated regarding territorial homogeneity. In a second step, a hierarchical cluster analysis is performed on the PCA scores to show the extent to which Belval can be grouped (or not) with other neighbourhoods.

It is important to emphasize that this indicator-based analysis is limited in time and space since data is only available for one single year (2019) and is limited to the municipality of Esch/Alzette. Therefore, it does not allow an assessment of the evolution of the integration level, or the situation in the part of the Belval regeneration area that is located in the neighbouring municipality of Sanem. Similarly, and for the purposes of data protection, the analysis is limited to aggregated data at the neighbourhood level, although the use of individual data would have been more robust and would have avoided potential ecological errors. It should also be added that the use of indicators in territorial analyses comes with inevitable limits, given that they generally hide part of the social realities and reduce complex phenomena to incomplete observations (Decoville, 2018). Data is only available for permanent residents, while non-resident employees or visitors may spend a great deal of time in the neighbourhood and contribute to its integration.

Despite these data-related limitations, the combination of multiple indicators from various institutional sources allows a fine-grained analysis that relies on official data and provides a quantified evaluation of the socio-spatial integration of the Belval knowledge district into its urban environment.

Results & Discussion

A divided socio-spatial structure, reorganized by the development of Belval

The varimax-rotated PCA summarizes the 16 indicators on three factors, representing 77.6 per cent of the total variance. Table 2 shows the three components and their correlation to the input variables. Based on this preliminary analysis, we can interpret the first factor as a *socioeconomic status* indicator. It synthesizes the contrast between high and low socioeconomic status, through income indicators

(INCOME, INCLUSION-INCOME), housing prices (FLATS-PRICES), as well as strongly negatively correlated activity sectors (CONST, FIN-INS) and nationality groups (POR, LUX). Portuguese citizens indeed represent by far the largest foreign community in Esch-sur-Alzette (30%) and are characterised by a working-class profile. The second factor acts as an indicator of *international and young professionals* and describes the contrast between on the one hand, the young, working-age population group (15TO39) and international communities (NOT-EU), and on the other hand, an older (65PLUS), well settled (LENGTH-RESID) population group. The third factor is an indicator of the household composition (highly correlated to large family households and children).

Table 2: Correlation of rotated factors and input variables

Variable	Factor 1	Factor 2	Factor 3
15LESS			0.926*
15TO39		0.930*	
65PLUS		-0.867*	
LUX	0.735*	-0.656*	
POR	-0.918*		
NOT-EU		0.770*	
SINGLE-PARENT			
HOUSEHOLD-SIZE			0.882*
FLATS-PRICES	0.950*		
INCOME	0.895*		
INCLUSION-INCOME	-0.842*		
CONST	-0.913*		
FIN-INS	0.848*		
PROF-SCIEN-TECH	0.471		-0.495
LENGTH-RESID		-0.820*	
ELECTIONS		-0.631*	0.575*
eigenvalue	5.44	4.98	2.00
% of total variance	33.98	31.14	12.51

N.B. only significant values for α = 5%
* significant for α = 1%

The mapping of the territorial fragmentation index (Figure 14) shows the accumulated dissimilarities of the three main factors between the neighbourhoods of Esch/Alzette. Four main points can be highlighted from these findings.

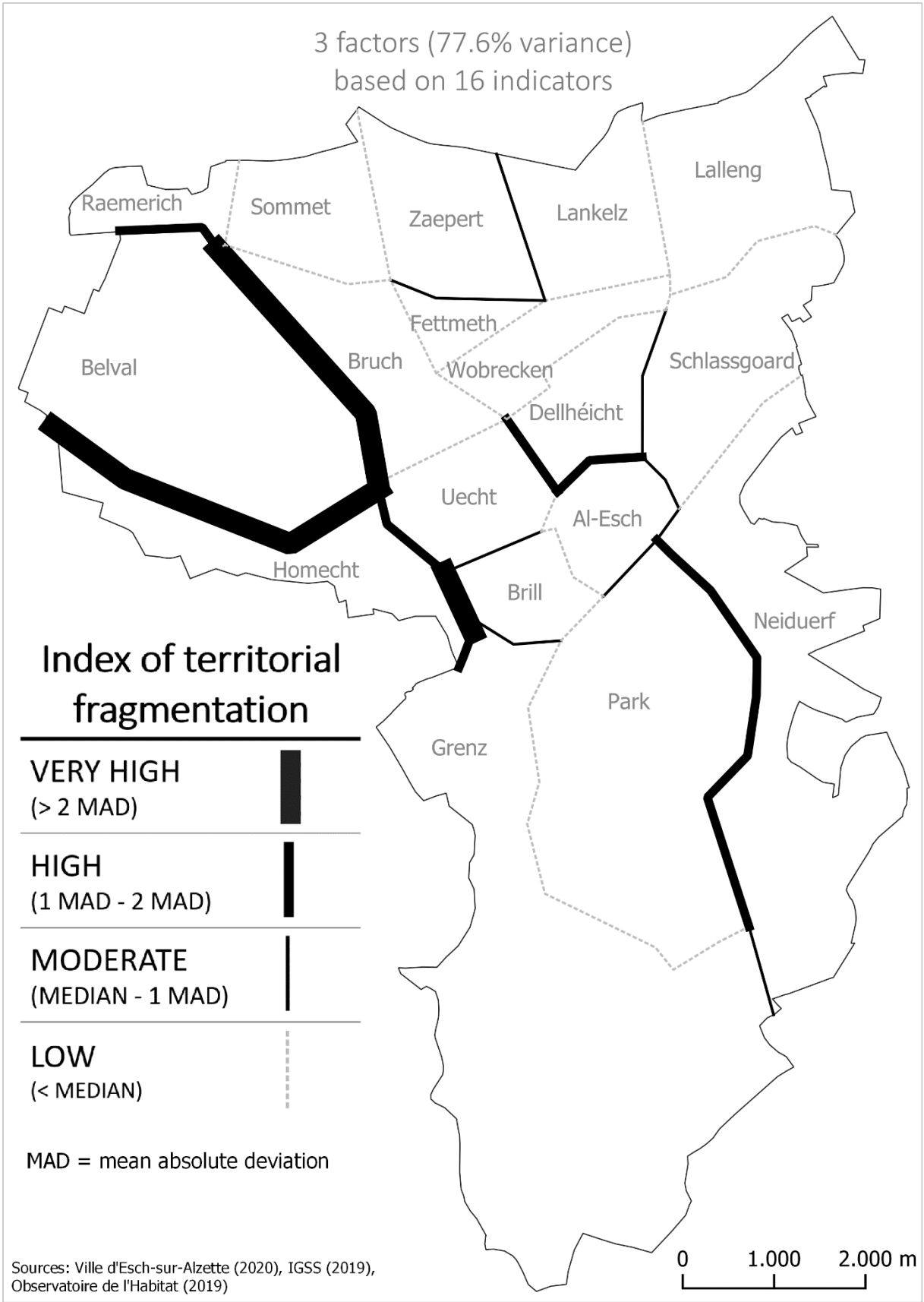

Figure 14: Structural dissimilarities between the neighbourhoods of Esch/Alzette.

First, very large dissimilarities exist at the borders of the Belval and Homecht neighbourhoods in the western part of the city, indicating a clear contrast with every adjacent neighbourhood, as well as *between* these two neighbourhoods. Second, the city centre (composed of the Al-Esch and Brill neighbourhoods) presents high disparities with the areas to the west (Homecht) and north (Dellhéicht), and to a lesser extent, the areas to the east (Schlassgoard, Neiduerf). Third, the northern neighbourhood Zaepert, that also has a newly built district on its territory, presents moderate dissimilarities towards Fettmeth and Lankelz. Fourth, the dissimilarities are mostly insignificant between the central neighbourhoods of Al-Esch, Brill, Uecht and Park, and between most of the pericentral neighbourhoods in the north of the city (except Zaepert). These areas seem to be relatively homogeneous.

With regard to the Belval knowledge district, the results indicate the existence of a significant structural discontinuity between this new neighbourhood and the other parts of the city. However, it is not the only discontinuity that can be observed in Esch/Alzette; the city centre in particular shows important contrasts with neighbouring areas.

The hierarchical cluster analysis — performed on the four (de-standardized) rotated factors — underlines the uniqueness of the Belval neighbourhood and its population since it constitutes an entire cluster on its own. The other clusters are formed through the distinction between the central neighbourhoods and pericentral ones. This shows that the socio-spatial structure of Esch/Alzette is dominated by a differentiation between central and peripheral neighbourhoods and that Belval forms a novel type in the urban framework that completely differs from the existing clusters.

Belval: a new type of neighbourhood generating a new type of fragmentation

In order to understand the existing discontinuities in Esch/Alzette, the rotated factors are evaluated separately (Figure 15). The maps show the level of dissimilarities between neighbourhoods (thickness of borders), as well as the orientation of the gradient (the ‘teeth’ are oriented towards areas with a lower index).

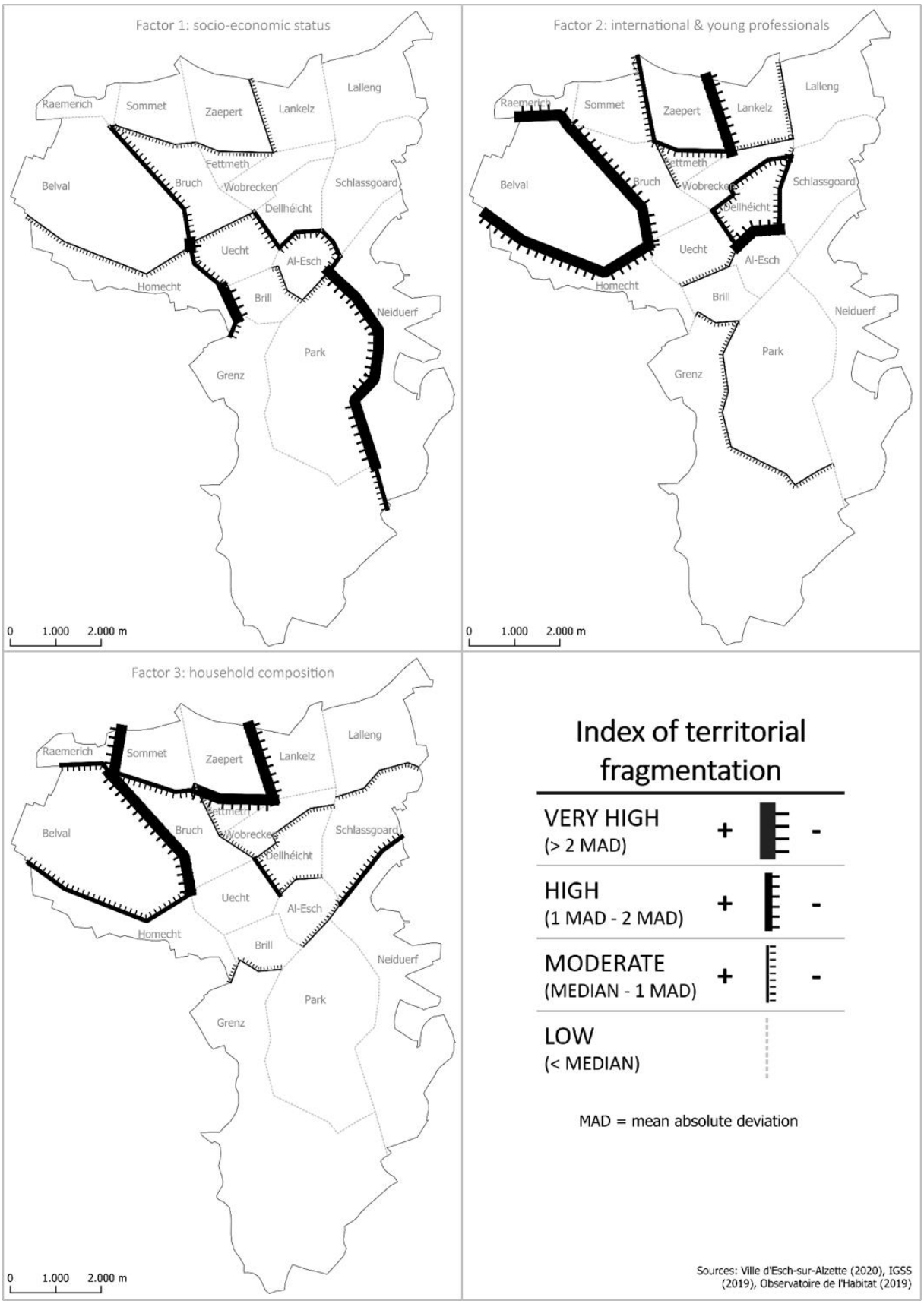

Figure 15: Dissimilarities for factors 1, 2 and 3. N.B.: Thickness of the border indicates the level of dissimilarities. The 'teeth' are oriented towards areas of lower values for the different factors.

First of all, it appears that, while Belval shows significant dissimilarities across all factors, the territorial configuration as well as the intensity of the dissimilarity varies. On factor 1, for example, we observe a high index of territorial fragmentation surrounding the western neighbourhoods (including Belval), but also around the city centre. In the latter case, a mostly working-class city centre of immigrants with a relatively young demographic structure is opposed to far wealthier, bourgeois neighbourhoods dominated by an older, native population of Luxembourgers. Since the end of the nineteenth century, the central areas have been important gateways for immigrant workers, while important parts of the Luxembourgish population, as well as foreign or naturalized retired workers, prefer the less dense environment of the northern fringes of the city. Today, Belval is associated with the better-off parts of the city, but it does not stand out with particularly high income levels; the dissimilarities on factor 1 mostly stem from high housing prices that can be partially explained by the recent character of the district. These insights tend to nuance the observations made elsewhere (Swyngedouw et al., 2002; Madureira and Baeten, 2016) of socioeconomic enclaves created by knowledge district developments.

On the other two factors, the dissimilarities involving Belval are much more visible. The highest disparities between Belval and the adjacent neighbourhoods can be observed through the second factor (‘international and young professionals’). The knowledge district’s specificity relies on the demographic and ethno-cultural characteristics of the population. Some 48 per cent of the Belval population are between 25 and 35 years old, and both children and elderly people are almost absent. The proportion of foreigners reaches 77 per cent (much higher than the city average of 57%) with both the categories of other EU (34%) and non-EU citizens (29%) comprising the top proportions in the whole city. Belval seems to reunite many aspects that actively attract young knowledge workers and students from many different countries (Bontje et al., 2017). The dynamic and highly mobile character of the population is also shown by the reduced length of residence in a dwelling: at 2.5 years compared with the city average of 9.5. This reinforces the aspect of Belval as a neighbourhood built for a population of students and young professionals (whether or not related to the knowledge institutions) who stay in Belval for a short period.

Similar findings are presented for factor 3 (‘household composition’). The significant disparities are explained by small student residences and an underrepresentation of children. The map also shows that Belval is strongly opposed to Zaepert and Sommet that are characterized by a high share of large family households. Recent developments in this area specifically attract young adults with children (single-family houses in a calm environment).

To summarize, Belval does not seem to fit into any of the two categories of neighbourhoods forming the traditional centre-periphery contrast, but constitutes an entirely new type of neighbourhood. The dissimilarities observed between the knowledge district and the other neighbourhoods of the city are significant on all factors, making Belval appear as a foreign element in the urban framework.

Belval, an 'island of wealth'? The need for a more nuanced view on socio-spatial integration

The present case study is an example of a knowledge district forming a new cleavage in an existing urban structure that had already shown important dissimilarities beforehand. Indeed, the socio-spatial fragmentations in Esch/Alzette are far from being exclusively attributable to the knowledge district, as revealed by factor 1, which contrasts the traditional working-class and bourgeois neighbourhoods. The analysis of the different factors reveals that the dissimilarities involving Belval are much lower for the socioeconomic factor than for the other factors. Therefore, in the specific case of Belval, we cannot confirm the claim of knowledge districts forming 'islands of wealth', as stated by some authors (Swyngedouw et al., 2002; Madureira & Baeten, 2016; Leick et al., 2020) who rely for their analyses on social and economic status.

The development of the Belval knowledge district has, however, created a new urban discontinuity regarding nationalities, age groups, households' structures and employment sectors due to the specific international, young and professionalized profile of its population (factor 2). These dissimilarities could act against the development of a feeling of identification with the city on the part of the population, as partially shown by the complementary indicators of belonging. With regard to the local elections in Luxembourg, foreigners can only participate after they have lived in the country for five years. During the communal elections in 2017, the eligible foreign residents of the Belval neighbourhood showed by far the lowest participation rate (10% of the potential voters, compared with a city average of 21%). Thus, although most residents of Belval are unable to participate in elections due to their short period of residence, even those who would be allowed to vote, tend not to do so. Although it is important not to over-interpret this indicator, it tends to show a low level of investment in local political life, thereby raising questions about the identification of Belval's inhabitants with the city of Esch/Alzette. All these elements suggest that the integration of the Belval knowledge district, and of its population, into the city is far from having been achieved. The differentials in housing prices between Belval and the other parts of the city are an additional barrier to greater integration, as they prevent lower-income groups from settling in the knowledge district.

Nevertheless, this article does not allow us to fully assess the overall level of integration of Belval within the city of Esch. As discussed earlier, such a phenomenon is based as much on quantifiable socio-demographic data as on more subjective identification processes, influenced by practices and representations. Moreover, integration is a process that requires time, and the absence of a dynamic assessment of the situation prevents us from observing whether there is a tendency towards a greater homogenization of socio-economic characteristics between Belval and the city of Esch.

At this stage of the redevelopment process, we still cannot confirm for the current case study the hypothesis that is often brought to the fore to justify large-scale urban development projects and

according to which these developments trigger endogenous growth dynamics. However, we observe that the necessary precondition — that is, successful integration in the urban environment — seems far from being met. The quantifiable social fragmentation of the urban space is a rather worrisome sign of current developments that could rule out future 'spillover effects' at the aggregate level of the municipality, regarding the average level of Esch residents' qualifications. However, only a longitudinal analysis based on microdata could help us to understand the social impact of urban change related to the implementation of a knowledge district, which is complex and difficult to grasp (Moos et al., 2018).

Conclusion: are knowledge districts really efficient in stimulating endogenous redevelopment dynamics?

Beyond the input brought by the analysis of the specific case of Belval, this article raises questions that are important for all knowledge-related urban projects that are developed next to older parts of a city and that raise challenges in terms of urban and social integration. First, this article highlights the importance of providing a multi-perspective approach to the concept of urban integration, which is complex and multi-dimensional and needs to be studied with an appropriate set of tools and indicators. More importantly, however, it brings some nuances to the debate on urban integration.

When dissimilarities appear on many different levels between a new knowledge district and an older city, we can assume that populations from the different neighbourhoods do not visit the same places in the city and do not have the same values or beliefs, and that the likelihood of their mutual interactions is thus extremely low. This can be largely reinforced by the existence of a physical separation and the presence, in the knowledge district, of a wide range of urban amenities (shops, cinema, restaurants, etc.) and services that could make it 'self-sufficient'. The concentration of international students, researchers and other temporary residents living in the same area creates a 'campus atmosphere' or an environment that puts the knowledge district at the centre of their interest (as a place of residence, work and even leisure), and thus limits social contacts with other well-rooted population groups. This can lead to the formation of two detached 'life-worlds' (Becker et al., 2018).

Moreover, the presence of structural dissimilarities may influence other dimensions of integration, such as flows between territories or cooperation between different actors. Residents from other neighbourhoods are likely to have difficulties in finding a job in the new neighbourhood since they rarely match the desired profile. The other way round, knowledge-related institutions will find hardly any collaborators from the local communities if the sector they represent was previously completely absent. The jobs are taken by an external workforce and businesses search for cooperation at an international scale, thus further blocking sustainable integration into the local environment. New graduates from the university contribute only to a limited extent to meeting the demands of the labour

market since ‘students are generally temporary urban residents and, despite impacts on the local economy, do not necessarily contribute to the local skilled labour pool’ (Revington et al., 2018, p. 190).

Last but not least, the fragmentation between the old city and the new knowledge district can be reflected by the low level of civic engagement of the population living in the knowledge district, indicating that the population does not feel very involved in decisions that concern the city as a whole. This means that the urban integration of knowledge districts, and thus their added value for the society as a whole, is potentially more challenging to achieve than expected when multiple, interrelated aspects are taken into consideration. In other words, simply moving a university to a region that has to deal with structural socioeconomic difficulties is not sufficient to foster economic growth.

The implementation of a social development strategy that considers the different constitutive elements of what urban integration really means is necessary to anticipate the various potential impacts of a large-scale urban development project on its environment, as well as to unlock the endogenous development potential instead of replacing the local population by another one, more fitting to a globalized competitive agenda.

Other prisms of analysis, such as the interdependence between neighbourhoods, their connectedness in terms of flows and cooperation networks, and the population’s sense of belonging to a common territory are still underrepresented research areas as of today and constitute a possible path for further research.

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CHAPTER 2

Analysing urban integration through place attachment: How do university students contribute to the formation of an integrated urban space?

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Introduction

Planners can no longer ignore the issue of integration between large-scale urban development projects (LSUDPs) and their urban environment. It has become common practice to ensure a smooth connection between old and new neighbourhoods through road and rail infrastructures, although many examples in the past have failed to do so. Urban integration is often discussed through the analysis of structural dissimilarities between urban areas (Birsens & Decoville, 2023; Madureira & Baeten, 2016; Rugkhapan & Murray, 2019), that are typically observed when knowledge-led or culture-led regeneration projects emerge in former industrial cities.

Today, many scholars agree that the concept of urban integration goes beyond ensuring functional connectedness and avoiding structural discontinuities (De Boe et al., 1999; Van Winden et al., 2010; Ruiz-Tagle, 2013; Durand & Decoville, 2020). Integration has multiple dimensions, some of which are barely measurable with descriptive statistical indicators (Durand, 2015). Its interpretation is based at least as much on what is seen, perceived and experienced, as on what is calculated. By focusing on people, rather than just on socio-economic indicators, we can better capture the complexity of urban integration. In that sense, this paper adopts a user-centred approach; that is, an analysis of urban integration through the spatial practices and the perceptions of the population, to discuss whether two areas form an integrated urban space. These components of the integration concept are underestimated

in the scientific literature as of today, but they have the potential to provide complementary insights to the discussions around the urban integration of knowledge districts.

The concept of place attachment offers an original approach to analyse urban integration from a user-centred perspective. It refers to an intimate relationship between individuals and their environment, built over time through accumulated knowledge and experiences (Altman & Low, 1992; Lewicka, 2011; Scannell & Gifford, 2010). The development of place attachment among new users is a major policy objective in the context of LSUDPs, as it acts positively on the quality of life of the attracted population and contributes to their long-term retention in the area (Laczko, 2005). When new users form an attachment to the newly developed area and to the wider urban environment, they contribute to developing ties between different parts of the city. The current article posits that these links contribute to the strengthening of urban integration. It is important to emphasise that place attachment does not exclusively determines whether two areas are integrated, but it constitutes an original approach to diversify the discussion that is mainly centred around structural inequalities.

The present study investigates the case of Belval, a knowledge district in Esch/Alzette, Luxembourg, and main site of the University of Luxembourg. It focuses on the university students' place attachment and discusses their role in the process of urban integration. More precisely, it analyses the multidimensional relationship between the students and the city, and how it is influenced by their place of residence (in the newly developed area, in the city centre or elsewhere) and by socio-demographic characteristics.

In the following part, the multifaceted relationships between students and the city are discussed, in particular by examining students' place attachment to their study location and by specifying the study context in Belval. Then, the article provides further details about the operationalisation of place attachment in the present study and the methodology. The remaining part presents and discusses the findings.

Students and the city

The relationship between students and the city they live and study in is at the centre of a growing research field that originated in the 1990s. Revolutionary reforms in higher education (D. P. Smith, 2009) have led to a process of massification and diversification of the student population, with the result that students have not only become greater in number, but their profiles have also become more heterogeneous (Holton & Riley, 2013). As universities increasingly engage with their local environment and emphasise their 'civic' role, the traditional representation of students as an international population

residing in student halls without contact to local communities is brought into question (Chatterton, 1999; Holton & Riley, 2013; Holton & Finn, 2018).

The general popularisation of higher education has had far-reaching consequences for the socio-spatial, economic and cultural development of cities, such as neighbourhood and community disruption (Munro et al., 2009), the formation of segregated student spaces or 'studentscapes' (Fincher & Shaw, 2009; Zasina et al., 2021) and the adaptation of commercial or cultural actors to the students' consumption practices (Chatterton, 1999). Smith (2005) interprets these phenomena as a process of 'studentification', by comparing students with 'apprentice gentrifiers' in cities (D. P. Smith & Holt, 2007). On the other hand, these changes have affected the students themselves, their mobility patterns in and outside of the city, and their place attachment. For example, the increasing number of 'local' students who continue to live at their parents' home means an increase in the number of commuting students, who form a completely different activity space and attachment to their university town – which is also their 'hometown' – compared with their non-local peers.

Increasing academic interest in the students' place attachment

The concept of place attachment originates from John Bowlby's (1969) attachment theory and has become fundamental in environmental psychology studies. According to Lewicka (2011), 'place attachment means emotional bonds which people develop with various places [but] there are a multitude of operationalisations of this construct, each giving it a slightly different theoretical meaning' (p. 219). However, it proves useful to explain the attitudes and feelings of people towards the urban space they live in. For example, a person's strong attachment to their neighbourhood is related to an increased feeling of safety (Brown et al., 2003) and to the willingness to protect the local environment (Ramkissoon et al., 2013). Furthermore, place attachment is closely linked to people's residential mobility and their individual well-being (Theodori, 2001). In the context of urban regeneration policies, a major objective is the attraction, as well as the retention, of new population groups (for example students after their graduation) (Darchen & Tremblay, 2010). From this point of view, the development of place attachment – in addition to 'hard' factors, such as the existence of career opportunities – appears to be essential.

Previous research suggests that the population's attachment to the urban environment contributes to the process of urban integration besides other aspects, such as the reduction of structural dissimilarities, increasing flows and a coherent urban governance (Birsens & Decoville, 2023). In other words, when residents and users of one area explore neighbouring spaces and develop an attachment to them, they add to the emergence of a collective identity of the territory as a whole, that becomes more integrated. This people-centred perspective on integration stems from earlier works on cross-border regions, in

which the subjective sense of belonging through shared representations and symbols are considered as a dimension of cross-border integration (Durand, 2015). Similarly, Ruiz-Tagle (2013) includes the identification with shared symbols in his multidimensional conception of social integration. In the context of a newly developed university campus, we thus consider the students' development of place attachment to their university town as one important, yet underestimated factor in the urban integration process between the campus and the city.

Students' place attachment emerges through familiarity, and the development of local knowledge and connections with people and place (Hinton, 2011; Pearsall et al., 2015; Relph, 1976). Mobility plays a determinant role in the formation of place attachment (Gustafson, 2001; Holdsworth, 2009; Holton, 2015a; Prazeres, 2018), in that everyday mobilities, experiences of walking and sitting in the city, and the engagement with local practices, places and people are important elements that contribute to constructing a sense of place and attachment to the city (Wilkinson & Badwan, 2021). Place attachment is an inherently subjective relationship and it is commonly accepted that local and non-local or international students experience sense of place and place attachment differently (Christie, 2007; Holdsworth, 2006; Holton, 2015b; Yu et al., 2018). Pearsall et al. (2015) analyse the transition between being a local resident and becoming a student, and how this affects identity formation and the relationship with their hometown. Holton (2015b) finds that local students remain attached to their non-student locations, and thus maintain a certain distance to traditional student communities, while international students often arrive in a city without any preconceptions and develop only marginal attachment to the place (Sokołowicz, 2019). There seems to be a certain tension between local and non-local students in terms of their identity and relationship with the city, which creates spatially separate student areas. Local students feel 'between two worlds' (Holdsworth, 2009, p. 225) and international students prefer interacting with other internationals (Fincher & Shaw, 2011). Yu et al. (2018) find that a high level of engagement in the city (for example civic or professional activities) contributes to a more expansive knowledge of certain neighbourhoods, but these forms of engagement seem to be relatively limited among international students. This is particularly true when physical, social or cultural boundaries dominate the urban space, forming a divide between being on and off campus (Wilkinson & Badwan, 2021; Yu et al., 2018).

The relationship between students and the city is also influenced by the residence type and place: students living in halls on or close to a campus tend to remain in a 'student bubble', while those living in rented houses get to know the city earlier in their career and thus develop a closer link to it (Holton, 2015a). Some authors highlight the importance of the year of study (Chatterton, 1999). Initially, first-year non-local students arrive in the city and are channelled to student halls, and thus socialise mainly with other international students – they 'learn the rules of the student game' (Chatterton, 1999, p. 120). In the subsequent years, they 're-sense place' (Holton, 2015b, p. 26), choose other forms of residence and develop a closer relationship with the city and local communities. In general, we can state that the

place of residence determines mobility patterns and students' living spaces (Choplin & Delage, 2011). Therefore, this article argues that residing on campus, in the city centre or elsewhere plays an important role in the establishment of an attachment to the city and, in turn, in the process of urban integration.

It should be emphasised that the political, social and urban context, and the type of campus, play a crucial role in the interpretation of the relationship between students, the campus and the city. In many Anglo-Saxon cases, we observe a relatively strong link between students and physically detached, 'greenfield' universities. In Western Europe, many universities are physically embedded in an urban environment that has developed over a long period, and students thus establish a longer-lasting attachment to the city, rather than to the university campus itself. The case of Belval does not fit into either of these two categories, as the following section will reveal.

Integrating a knowledge district into its urban environment

The foundation of the University of Luxembourg in 2003 constituted a strategic turning point for the country: whereas native Luxembourg students had previously been encouraged to leave the country, study abroad and bring back foreign expertise and knowledge after graduation, they now have the opportunity to study locally. In addition, students from all over the world are now attracted to Luxembourg. The university facilities gradually moved to the regenerated Belval site, a former industrial area on the western fringe of the city of Esch/Alzette, forming a national knowledge district (Figure 16). This relocation, officially completed in 2015, has led students, academics and university employees to settle in Esch/Alzette and the neighbouring municipalities.

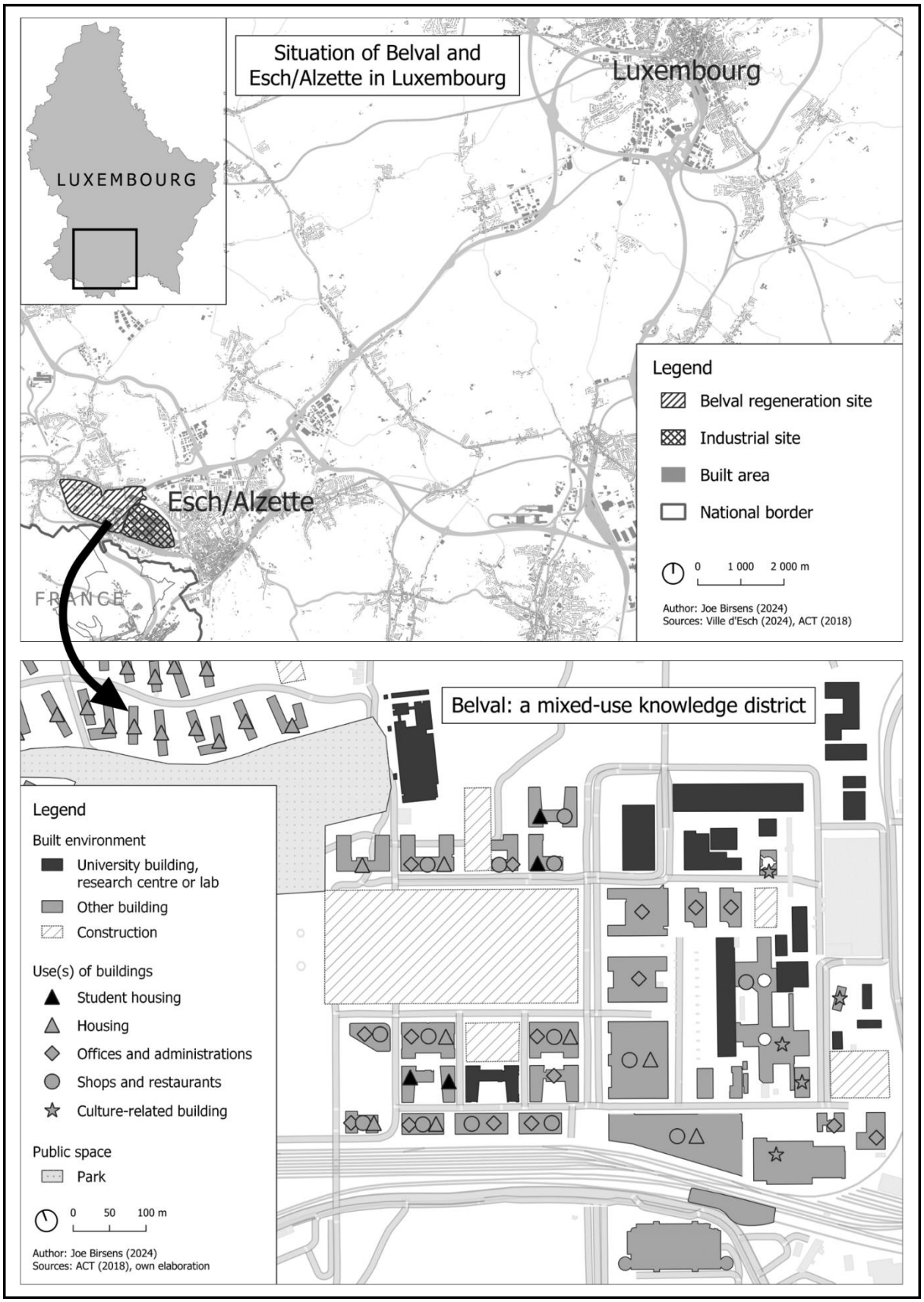

Figure 16: Situation of Belval in the south of Luxembourg, and the current uses of the newly constructed buildings.

The integration of the redeveloped brownfield into the surrounding urban structures was part of the initial planning objectives. Conservative leaders believed that the attraction of students and knowledge workers, and their integration into the post-industrial urban environment would contribute to economic growth at a regional scale (Knebeler & Scuto, 2010; König, 2013). However, preliminary evaluations have shown that the urban integration between the knowledge district and the city of Esch/Alzette is far from being achieved, which jeopardises the social and economic objectives of the entire project (Becker et al., 2018; Leick et al., 2020). To date, most analyses focus on the physical and structural aspects of urban integration. The physical disconnection between the university facilities and the city centre of Esch/Alzette – separated by a 100-hectare industrial area – is perceived as one of the main factors hindering a coherent integration, both on the ground and in the people's minds. Further research has shown the extent to which the creation of a knowledge district in a post-industrial city generates an urban discontinuity that is believed to have potentially harmful effects on the local social stability (Birsens & Decoville, 2023). The population residing in the Belval neighbourhood has a profile that is very young (a mean age of 33.1, while the city average is 39.3), international (78.7 per cent of foreigners, while the city average is 56.6 per cent) and qualified (one out of five residents work in education and one out of eight in the specialised, scientific and technical activities sector) (Birsens et al., 2023). Becker et al. (2018) observe a separation of different life-worlds between Belval residents and local communities, that are characterised by an international, working-class population in the city centre, and a much wealthier, older and mostly native Luxembourg population in the northern areas.

All in all, the context does not seem favourable for exchanges and appropriation. Esch/Alzette did not have any ties to higher education before the arrival of the university facilities in the 2010s. This is not to mention the complete absence of traditional student spaces in the city centre, as such spaces usually play an important role in forging and transmitting a student identity. Given this contextual setting, and the abovementioned spatial discontinuity, it remains deeply questionable whether the students effectively develop an attachment to their university town, which would go against the initial political objectives of integrating the university into its urban environment (Le Fonds Belval, 2006).

In order to analyse the students' place attachment in the context of Belval and Esch/Alzette, this article refers to three major points that remain underexplored in the scientific literature presented above. First, the role of students' place of residence seems underestimated. Whether students reside on campus, in the city centre or outside of the city presumably has a major impact on their place attachment. Second, research has not put sufficient emphasis on the differential development of place attachment according to students' socio-demographic characteristics (Yu et al., 2018), leading to a lack of understanding of what student profiles contribute most to urban integration. Third, there is only limited knowledge about how students connect with a city that does not offer traditional student spaces formed by previous

generations. More specifically, the case of a newly built campus in a post-industrial city has only rarely been considered (Zasina et al., 2021). Evidence about *how* students establish links between the campus and the city is crucial for the planning and development of an integrated and attractive urban space.

Accordingly, the following research hypotheses can be formulated:

(i) Place attachment is mainly influenced by the students' place of residence, in that attachment to the campus is greatest for campus residents, and attachment to the city is greatest for city centre residents.

(ii) As place attachment is also conditioned by perceptions and behaviour, different place attachment patterns can be identified among the student population.

(iii) Since Esch/Alzette is a post-industrial town without traditional student spaces, students' place attachment to the newly built university campus is much greater than to the city centre.

In the following section, the analytical framework of the study and the methodology are presented.

Approach and methods

In the relevant scientific literature, scholars have discussed multiple factors influencing place attachment (Lewicka, 2011). Social relations, neighbourhood ties and local social capital appear to play a crucial role in this regard (Mesch & Manor, 1998). Another factor is the quality of physical and environmental features, such as urban amenities, green spaces and aesthetic or user-friendly architecture. It is easier to become attached to a place where people feel comfortable. Some factors are comparatively intangible, such as a sense of security, feeling of pride and self-projection (Lewicka, 2010; Mesch & Manor, 1998). The frequency of everyday activities, through which people get to know their environment, may also lead to increased familiarity and attachment (Hammitt et al., 2006).

Place attachment is a process that builds over time, in the same way as urban integration. Findings diverge with regard to how many years it takes to develop an attachment to place. Nielsen-Pincus et al. (2010) show that place attachment is strongly influenced by the overall time spent in an area, while other authors state that people develop most of their attachment in the first year of residence (Lalli, 1992; Gustafson, 2009). A feeling of home is often shared among long-established residents who sometimes define their relationship with place by differentiating it from that of newly arrived foreigners (Kühne & Spellerberg, 2010). According to Relph (1976) and Hay (1998), an authentic and complete sense of place can only be experienced by people who have grown in a certain place and lived there for a long time, while temporary residents or visitors develop a more superficial relationship with place.

In order to analyse place attachment, many authors have elaborated consistent frameworks, based on the general consensus of it being a multidimensional concept that can be approached using quantitative

indicators (Williams & Vaske, 2003; Jorgensen & Stedman, 2006; Lewicka, 2010; Halpenny, 2010; Scannell & Gifford, 2010) and/or qualitative research methods (Devine-Wright, 2011; Buffel et al., 2014; Madgin et al., 2016).

According to Ramkissoon et al. (2013), place attachment can be conceptualised as a second-order factor and described by various sub-dimensions. Other authors use similar approaches that operationalise place attachment as a composite concept that is apprehended by two to four more concrete aspects (Williams & Roggenbuck, 1989; Vaske & Kobrin, 2001; Halpenny, 2010). Based on this existing set of literature, the current article proposes to define place attachment through three main sub-dimensions:

i. Place social bonding develops through everyday activities involving social relations;
ii. Place affect describes the affective connection that builds up between people and place (Halpenny, 2010), and develops through the appreciation of physical-environmental features;
iii. Place identity consists of various cognitive and emotional elements that shape people's personal identity in relation to the physical environment (Proshansky, 1978), including the feeling of home or pride linked to a place.

Each dimension comprises a set of indicators that describe factors of place attachment (Figure 17). This analytical framework is, of course, a simplified representation of the overall concept and a few important limitations need to be discussed before results can be convincingly presented. First, the development of place attachment always includes a temporal component that is not represented here. It can be assumed that place social bonding to the residential environment develops in a few days, due to necessary activities in everyday life, while the formation of place identity can take several months or years. Second, the causality between place social bonding and place attachment is ambiguous because the empiric material presented below does not allow to depict the motivations of visiting some places rather than others. Unfortunately, we cannot tell whether people visit one place because they are attached to it or whether they become attached to a place through social relations in that place. Third, the conceptualisation of place attachment resulting from a combination of place social bonding, place affect and place identity is frequently debated in the scientific literature (cf. Jorgensen & Stedman (2006) who understand place attachment and place identity as dimensions of the even broader concept of sense of place). Despite these limitations that are important to keep in mind, the proposed operationalisation in various sub-dimensions is a widely used tool to analyse survey data about people-place relationships.

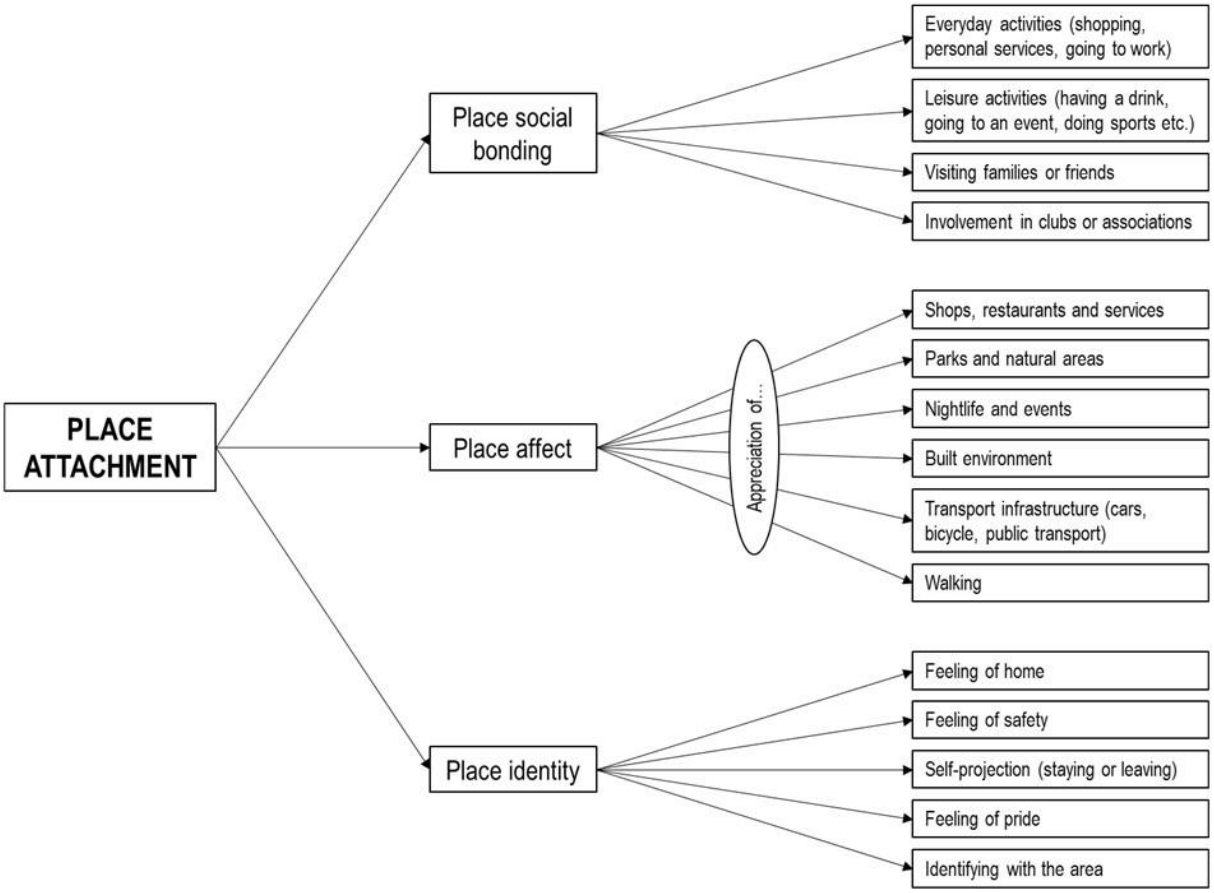

Figure 17: Analytical framework of place attachment used in this study.

The aim of this study is to analyse the students' place attachment – both to the campus (Belval) and to the city (the centre of Esch/Alzette) – and to evaluate the role played by the place of residence (on campus, in the city centre or elsewhere) and socio-demographic characteristics, such as the students' origins (local or international students), their gender and their age. In order to do this, a mixed-methods approach is used, combining an online survey and focus groups. Lewicka (2011) states that 'quantitative measures […] grasp the differentiation among people with regard to subjective importance and strength of emotional bonds with places, but they are little-suited for measuring what the places mean' (pp. 220-221). Accordingly, the combination of quantitative survey results and qualitative insights from both the survey and focus groups enables an in-depth analysis of (i) the profiles of the students who develop (or do not develop) an attachment to their urban environment, and (ii) the meanings they give to the areas and places they encounter in their everyday life.

The survey, titled 'Student life in Belval and Esch/Alzette', was designed according to the analytical framework presented in Figure 2. Some 309 responses were collected in April 2022, out of which 206 were fully exploitable. The participants responded to questions linked to the three dimensions, for both the campus and the city centre, allowing the construction of a 'place attachment index' (PAI) measuring

the level of attachment of every participant to the campus and to the city. Quantitative analysis tools included various ANOVA, a multiple correspondence analysis and hierarchical clustering. In addition, the results were also analysed using a more qualitative, exploratory approach. In a second phase, students were invited to participate in a focus group session. Four sessions with 18 students in total were organised in May and June 2022. They provide relevant qualitative insights and thereby contribute to the interpretation and the discussion of the findings.

The total number of students registered at the University of Luxembourg is around 7,300 (University of Luxembourg, 2023), but it is estimated that only around 4,700 frequent the Belval campus. All of them received an invitation by email to participate in the study. However, the main objective of this survey was not to produce results with absolute statistical representativeness, but to obtain a suitable number of responses in order to conduct quantitative and exploratory analyses. Given the simplified conceptualisation of place attachment, the calculation of the PAI cannot be considered as an absolute measurement of place attachment, and is solely used to compare the level of attachment between subgroups of the population. The interpretation of the quantitative results using qualitative data from the focus groups is thus a necessary and complementary part of this study.

Results and discussion

Place of residence influences place attachment differently according to the observed dimensions

Based on the analytical framework and the survey responses, the PAI shows attachment levels to both the campus and the city. The higher the index, the stronger the students' attachment. Multiple ANOVA compare three sub-groups: (1) students residing on the campus, (2) students residing in another neighbourhood of the city, and (3) students residing elsewhere. The use of the analytical framework enables a distinction to be made between the three constituent dimensions of place attachment, thus offering an insight into the factors influencing the differences in place attachment across the three groups. For the place social bonding dimension, a non-parametric Kruskal-Wallis test was used, due to a non-normal distribution of the residuals.

Table 3 summarises the results.

Table 3: Testing the significance of different place attachment levels according to the students' place of residence

Dimensions of place attachment	**Mean index value**			***Significance tests***			
	Campus residents (1)	City residents (2)	Other (3)	*sig. (1-2-3)*	*sig. (1-2)*	*sig. (1-3)*	*sig. (2-3)*
Campus	0.47	0.35	0.36	*	*	*	
- Place social bonding	0.27	0.18	0.08	*	*	*	*
- Place affect	0.55	0.49	0.52				
- Place identity	0.58	0.39	0.47	*	*	*	
City	0.33	0.37	0.26	*		*	*
- Place social bonding	0.02	0.16	0.02	*	*	*	*
- Place affect	0.55	0.53	0.48	*		*	
- Place identity	0.41	0.43	0.28	*		*	*

* significant for α = 5%

The overall PAI of the three groups is significantly different for both the campus and the city. However, post-hoc tests, comparing the three groups with each other in pairs, show diverging results. Place attachment to the campus varies significantly between campus residents and the two other groups (1-2 and 1-3), but it does not significantly vary *between* the two other groups (2-3). On the other hand, place attachment to the city does not vary significantly between campus and city residents (1-2), while it does for the two other combinations (1-3 and 2-3). This means that the average campus resident's attachment to the city of Esch/Alzette is comparable to that of the city residents.

The analysis of the different dimensions adds some interesting nuances. First, the comparison of the three groups always shows a significant difference, except for the dimension of place affect for the campus. The appreciation of the various urban features of the campus does not depend on the place of residence. The significance of place affect for the city only stems from the difference between campus and other residents. Campus and city residents have similar levels of appreciation of the city's urban features.

Second, we observe that all combinations *between* the three groups have significant differences regarding place social bonding. Social activities are in fact mostly influenced by place of residence – students carry out most of their activities in proximity to their home, and campus residents seem to

socialise in the city very rarely. The PAI is only slightly higher than that for other residents who mostly live much further away. Findings for activities in Luxembourg City show that physical distance is not the main factor, especially for leisure activities such as 'having a drink'. Out of 54 campus residents, 39 indicated that they stay on the campus to have a drink (at least sometimes), only 10 go to Esch/Alzette, but 27 go to Luxembourg City, which is located 30 minutes away from Belval by train. The activity 'going out to have dinner' shows similar results: 37 stay in Belval and/or go to Luxembourg City, but only 17 to Esch/Alzette. Thus, compared with the capital city, Esch/Alzette clearly lacks attraction for these types of activities.

Third, the dimension of place identity shows similar findings to the overall indices. Campus residents share a significantly higher place identity to the campus than other students living in the city or elsewhere. On the other hand, campus and city residents have comparable place identity levels regarding the city of Esch/Alzette. It seems surprising that some students residing on campus identify with the city without experiencing it very often in their everyday life (cf. place social bonding). This finding relates to the temporal dimension of the formation of place attachment. It suggests that place identity is not always built up based on frequent activities in a location. Place social bonding does not necessarily come in advance of place identity, especially for areas that are not in immediate proximity to the place of residence. In the specific context of mixed-use LSUDPs, residents may not feel the need to go to the city centre, but may still perceive themselves as city residents, thus developing stronger place identity than place social bonding. This underlines the space-time complexity related to the concept of place attachment (Gustafson, 2001).

To summarise, these findings indicate that the students' place of residence does play a role in the constitution of attachment to their term-time location, especially through everyday activities and socialising. The creation of additional student residences in the city centre would thus presumably promote the development of student activities there and contribute to the urban integration of the Cité des Sciences and its users. However, the results are less clear for the place identity dimension. City centre residents do not identify more to Esch/Alzette than campus residents. This finding can partly be explained by the students' restricted choice of their place of residence. The survey results show that students who choose to live in Esch-centre in a shared or a privately rented accommodation are significantly more attached to the city than students who are allotted a student residence there by the university or the municipality. Indeed, the allotment system of the university does not include locational preferences and students must accept the first offer, which presumably affects the development of place identity.

Thus, the relationship between students, 'their' campus and 'their' city is more complex than it first appears, and the tendency of place attachment being mainly influenced by the place of residence may conceal a large variety of student profiles and forms of attachment. In the following part, this hypothesis

is further examined by performing a cluster analysis and through qualitative insights from the focus groups.

A wide variety of forms of place attachment

Various multiple correspondence analyses (MCA) (one for each area and place attachment dimension) and a hierarchical cluster analysis (HCA) help us to understand which students develop an attachment to the campus and the city, and thus contribute to the urban integration between the two areas.

Four clusters[8] of students can be distinguished and interpreted accordingly (Table 4).

Table 4: Over- and underrepresentation of place attachment dimensions across the four clusters.

		Place social bonding				**Place affect**		**Place identity**	
	Clusters	Belval	Esch-centre	Lux City	elsewhere	Belval	Esch-centre	Belval	Esch-centre
1	Indifferent locals (n=103)	-	--	o	+	o	o	o	-
2	Locally integrated city dwellers (n=42)	+	++	-	-	o	+	o	++
3	Campus sympathiser (n=33)	++	+	o	o	++	+	++	+
4	Internationals attracted by Luxembourg City (n=28)	--	-	++	o	--	--	--	--

++ strongly overrepresented
\+ slightly overrepresented
o close to average
\- slightly underrepresented
-- strongly underrepresented

Cluster 1 is by far the largest and comprises students who rarely socialise on the campus or the city and who express mixed or indifferent feelings towards these spaces. For example, students in cluster 1 often answered ‘Neither agree nor disagree’ to the questions about whether they find the campus/the city an attractive area, and they often had less strongly positive or negative opinions than the average respondent. This is different to the students in cluster 4, who have much more negative opinions about

[8] Detailed results of the cluster analysis are provided in appendix 5.

the campus, as well as the city, and clearly do not identify with these spaces. In cluster 1, young and local students who do not live in Esch/Alzette are overrepresented. Students from cluster 4 have a more international profile and their activities are centred on the capital city, which offers more in terms of shopping opportunities, services and leisure activities compared with Esch/Alzette or Belval. Interestingly, students who had lived in Belval and/or Esch/Alzette on at least one occasion are overrepresented in cluster 4, thereby suggesting that many of them actively chose to leave this area and move to the capital. A change of residence can be for various reasons, but the negative perceptions of Belval and Esch/Alzette indicate that many students made this choice actively, preferring to live in Luxembourg City.

Cluster 2 encompasses students that seem to have developed a stronger attachment to the city of Esch/Alzette through frequent social activities. They identify with the city and appreciate its urban features more than the average student does. Views about the campus area are somewhat mixed. Residents of Esch/Alzette and Belval and international students (especially non-European nationalities) are overrepresented in this cluster. The population of this cluster is also slightly older than average. Members of cluster 3 seem more than the average to appreciate the urban features of the campus and they seem to identify with these areas to a certain extent. Some of them also share a positive relationship with Esch/Alzette, but they differ from cluster 2 in that their activity field is more centred to the campus and their purpose for going there is more often related to leisure activities and events, whereas students from cluster 2 indicated more work-related activities and social involvement. Residents of the campus are overrepresented in cluster 3, as are internationals (one-third have a non-European nationality), men and older students. The two clusters of people that foster the integration between the campus and the city through place attachment (2 and 3) are thus characterised by an older, international population.

Missing greenness, eating places and urban life: how a sense of lack contributes to establishing links between the campus and the city

By looking at some survey questions individually (Figure 18), the overall level of attachment to the city or the campus reported above for clusters 2 and 3 needs to be relativised. The majority of students disagree with the statements made for Esch/Alzette regarding their feeling of home, their feeling of pride (showing it to others) and their identification with the city. Only one out of five claims to feel at home in Esch/Alzette, and only one out of seven to identify with Esch/Alzette. Responses regarding Belval are slightly more positive, but half of the respondents nevertheless indicate that they do not identify with their campus area. The largest cluster (1) shows only mixed feelings about the areas and is mainly composed of native Luxembourg students living at their parents' home. They mostly commute to the campus for their lectures and return home afterwards. Due to the physical disconnection from the city, they are unlikely to leave the campus during breaks or to go for a drink in the evening, thus hindering

them from establishing any relationship with the city. This finding echoes the claim made by Holton (2015b) that local students keep a certain distance from student places. Similarly, most of the students (46.6%) indicated that they would definitely not live in Esch/Alzette after their graduation. Even if the probability of staying in a place does not exclusively depend on place attachment, it shows that many students would not consider residing in Esch/Alzette in the near future as a realistic and desirable option.

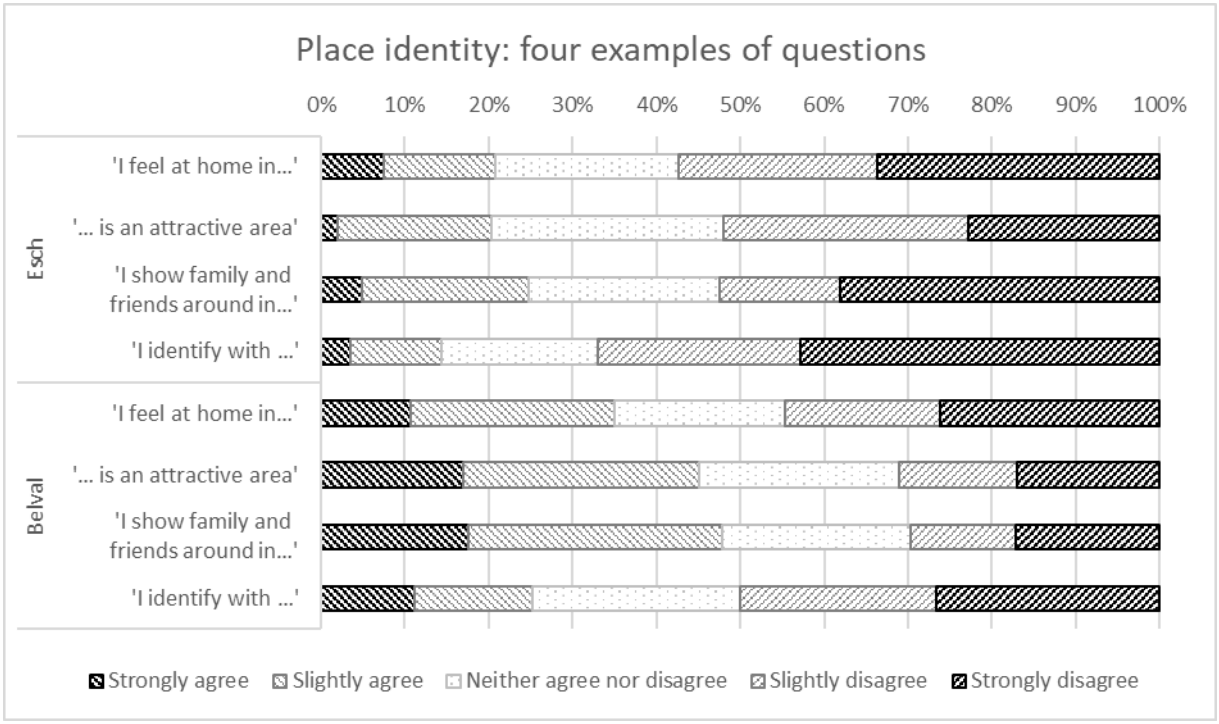

Figure 18: Breakdown of four sample questions (in % of the total respondents).

On the other hand, one third of the respondents can be considered as 'potential future residents', in that they responded 'Definitely', 'Possibly' or 'I don't know' to at least one of the questions about their intention to live in Belval or in Esch/Alzette after their studies. In this group, men and older students (27+, PhD and Master), as well as non-Europeans are overrepresented. The profiles of the potential future residents thus overlap with those in clusters 2 and 3. Unsurprisingly, Luxembourg natives are also overrepresented since many locals want to stay in their country of origin after graduation.

The students who identify with their student location and consider staying after graduation need further investigation as they are a crucial group in the process of urban integration between the Cité des Sciences and Esch/Alzette through their daily activities in the city and their establishment of a local citizen identity. Interestingly, those students often have an international cultural background. Non-European students are overrepresented among the 20.4% who indicated feeling at home in Esch/Alzette. From this point of view, the cultural diversity of Esch/Alzette seems to be a huge asset, since it offers a feeling of

openness towards, and acceptance of, various cultures and lifestyles. Over 70% of the city centre's total population (Al-Esch and Brill neighbourhoods, where over 200 student residences are located) are foreigners and 13.5% are non-Europeans (Birsens et al., 2023) – proportions that are extremely high compared with the national levels (STATEC, 2022). The central neighbourhoods are also characterised by a frequent rotation of the population. One third of the arriving population comes from outside of Luxembourg to the city centre. It can be assumed that many students appreciate this diverse, multicultural and dynamic urban environment. Especially for students from a non-European background, it may be easier to feel 'at home' when other population groups also seem to be 'foreigners' in a certain place.

Consequently, the city centre offers a greater diversity of shops and restaurants than the campus. During the focus groups, some international students expressed their pleasure about the ability to buy cheap snacks and fast food in the city centre:

> I think Esch was really nice because I was right at the youth hostel, so it was the area where there's like a lot of activity. […] I found a lot of places in Esch and especially, I mean on a budget, […] there are not too many, right? […] but in Esch, there are many options, even the sushi right opposite the hostel, kebab places, shawarma places. Otherwise, it's just so hard, like in [Belval], you can either get... you can basically get a sandwich. (PhD student from India)

In fact, the restaurants on the campus are less diverse and mostly relatively expensive for a student's budget, except for the university canteen (which is closed during weekends, evenings and holidays). Other students from West Asian countries were happy to find Arab shops in the city centre offering products from their home country. These elements may seem mundane, but their importance for international students is underestimated and they definitely contribute to urban integration through the creation of links between students and the city. This finding nuances previous claims on a strict separation of life-worlds (Becker et al., 2018) between students and local communities. While high social dissimilarities still constitute a certain barrier for integration, this does not do justice to the whole diversity of student profiles.

The missing elements of the campus are often the main reason for students to go and explore other parts of Esch/Alzette. One example is the lack of greenness and natural areas near the university facilities that led many students to explore and use green spaces in other parts of the city, such as the *Gaalgebierg*, a regionally known recreation zone located within walking distance of the city centre that participants mentioned in all focus group sessions. In addition, many campus users missed more intangible elements, such as an urban atmosphere, or urban life:

A: It's under construction […] and I try to justify it with the thing that it's under construction […] I think it will be like nice and for now it is because everything is new, like the university, the buildings are very pretty, but like…

B: Some things are missing.

A: Yeah, I think life, it's missing here, so… yeah that's what I feel. (interaction between a Master student from Italy (A) and a PhD student from Russia (B))

The absence of some essential elements related to student life in Belval seems to foster the connection between students and the city of Esch/Alzette. Some mature PhD students even decided to move out of the student residence on the campus to a privately rented flat in the city centre:

A: I was living in Uni-Val II [a student residence on the campus]. I didn't really like it.

Interviewer: Why not?

A: I don't know, it feels weird, like, in my experience, people don't talk to each other, like you don't really know your neighbours. Like all the walls are white, it feels a bit like a hospital. […] Some parts of the campus feel completely artificial, like completely new and without any experience, so it's not... it doesn't really feel authentic. […] Also the fact that you live just next to the office, it feels like you never have a distinction between like your personal life and the work […]. So I want to, like, free the mind when the work is done. And when I'm somewhere else I do something else. (PhD student from France)

The relationship between place of residence and place attachment is multifaceted. Especially for PhD students, the separation between the place of residence and the workplace is an important element of their quality of life. But also, the quality of the rooms, the high rent per square meter and multiple administrative issues were mentioned by more experienced students who compared the situation to other universities they had been to. Moving out of a student residence thus led to a significant rise of their quality of life. PhD students also want to distinguish themselves from the lifestyle of undergraduate students living in student halls, illustrating what Holton (2015b) terms 're-sensing of place' (p. 26). Some engage much more in home-making practices (Prazeres, 2018) and could imagine their stay for a longer term: 'My choice of moving to Esch was because I realised that I did not want to spend four years of my PhD living in one room. I wanted a bigger space. And I wanted to make it my home' (PhD student from India). These elements indicate that finding a home and developing place attachment is socially valued among older and international students. They often prefer the denser and more vivid atmosphere of the city that allows them to have a life outside of, and further away from, the university facilities. By moving to the city centre and immersing into the urban life, they start to establish local roots and feel as part of their urban environment. Through their daily travels between the university and the city, they strengthen the functional links between these areas despite physical distance and social dissimilarities.

In turn, these ‘pioneer’ students play a major role in the urban integration of the university district and the new public image of Esch/Alzette as a university town.

Conclusion

This study provides empirical evidence about the relationship between university students and their urban environment, and about the potential of this relationship to sustain the process of urban integration between the university district and the city. Findings indicate that the place of residence seems to play an important role in the development of place attachment, although it comes with some nuances. While place social bonding is strongly related to the students’ place of residence, the dimension of place affect does not seem to vary significantly between the subgroups. Place identity is related to the place of residence for what concerns the campus, but not for the city. The activities of campus residents are mostly restricted to the regenerated perimeter. Despite these results, the hypothesis of a ‘student bubble’ limited to the campus (Holton, 2015b) cannot be confirmed, because (i) many students go to Luxembourg City or elsewhere for activities, and (ii) some of them seem to acknowledge and to interiorise a certain connection to their university town, Esch/Alzette. Student activities in the city centre remain rare at present, but student residences – or shared accommodation – could become a vector to increase them. While a greater diversity of housing locations would increase the potential for students connecting with the city, place attachment depends on personal preferences, which are not considered in the university’s allotment system.

Against preliminary expectations, based on the absence of traditional student spaces, the physical and social disconnection between the campus and the city, and the relatively small number of students, a considerable proportion of them have established a certain form of attachment to their student town. The attachment is less characterised by spatial practices in the city than by the creation of a somewhat intangible student identity linked to the city of Esch/Alzette. From this point of view, students contribute to a connection between the campus and the city – a form of subjective integration that is not measurable by quantitative indicators.

It appears that older, non-European students feel most attached to Esch/Alzette and may potentially settle there after graduation. Of course, this would have important consequences for the city and its population. First, the internationalisation of the population would be accelerated, with the administrative services having to deal with ever-greater diversity in terms of cultures and languages. Second, postgraduates constitute a population group that, by definition, is highly qualified and thus more likely to have a higher income than the average inhabitant. There is a risk of this leading to a gentrification process with important side effects, such as increasing housing prices and housing scarcity, and displacement pressures felt by the most vulnerable (D. P. Smith & Holt, 2007). In this regard it can be

noted that enhancing the students' place attachment is a critical balancing act between the objectives of urban integration and of limiting the potentially harmful social impacts it can entail.

Finally, we observe that students are pushed to leave the campus mainly to carry out activities that are not possible on the campus. From this perspective, functional complementarity between the campus and the city influences the students' place attachment to both areas and thus strengthens urban integration. Mixed-use campuses that provide all daily activities locally thus bear the risk of forming student bubbles and seem counterproductive to urban integration.

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CHAPTER 3

Your urban neighbourhood is my campus: How the mixed-use planning of the Cité des Sciences affects its urban integration

Under revision *(European Planning Studies)*

Introduction

Contemporary large-scale urban development projects (LSUDPs) often include the guiding principles of mixed-use development at neighbourhood level and urban integration at the level of the urban realm. On the one hand, mixed-use development can be understood as the colocation of two or more uses (housing, retail, offices, leisure space, etc.) that are accessible without using major streets or transport infrastructure (Tian et al., 2020). With the growing academic debate on the 15-minute city model (Moreno et al., 2021), it is undergoing a revival because of its many benefits, ranging from short paths for daily activities to increased diversity in urban neighbourhoods (Goetz, 2013; Gao & Lim, 2023). More generally, the increased focus on mixed-use development reflects a reconsideration of the neighbourhood scale in urban planning.

On the other hand, at the city scale, planners and policymakers aim to integrate LSUDPs into their urban environment. A successful connection to existing structures is necessary to enable spillover effects for surrounding areas, which justifies the considerable costs related to their development. While urbanistic programmes often lack clarity on how to achieve urban integration, research suggests defining it as a multidimensional concept with an increased focus on the users of the urban space (Birsens & Decoville, 2023). More concretely, flows of people between two areas and the users' feeling of belonging to a wider territorial entity are important, yet underestimated factors of urban integration. (Ruiz-Tagle, 2013; Durand, 2015).

While there is a broad consensus on the benefits of both mixed-use development and urban integration as urban planning objectives, this paper argues that the promotion of mixed uses at the scale of a LSUDP

can contradict the more general idea of urban integration. Mixed-use planning holds a crucial position in the establishment of exchanges between territories, and the emergence of feelings of belonging among the people. For example, a holistic mixed-use concept guides mobility flows between areas, which directly affects urban integration. Planning decisions to create either monofunctional or mixed areas also potentially influence the establishment of an intangible connection between people and place. However, the scientific literature does not provide answers to the extent to which the expansion of the mixed-use paradigm across LSUDPs affects the process of urban integration, and the concrete implications for the populations.

This paper investigates the existing links, and potential contradictions, between the planning principles of mixed-use urban development and urban integration. The article relies on evidence from the newly developed Cité des Sciences in Esch/Alzette, Luxembourg, that is the main site of the University of Luxembourg (UL) since 2015[9]. The analysis focuses on both planning documents and on the university students' experience of their urban environment to discuss the planning and implementation of mixed-use development and urban integration as major objectives of the Cité des Sciences project. The student population currently forms the most important new population group in Esch/Alzette, both in terms of their numbers (around 7,300 students were registered in 2022 (University of Luxembourg, 2023)) and of their specific profile (young, international and qualified).

Before providing a more complete portrait of the study location, I will discuss the theoretical implications related to contemporary urban planning and the objective of urban integration of LSUDPs.

Mixed-use development and urban integration: two guiding principles of LSUDPs

Mixed-use development and the 15-minute city

There is a growing consensus in urban planning that the concepts of smart growth and mixed-use development are leading principles for LSUDPs (Goetz, 2013; Strauch et al., 2015). Both the public and the private spheres agree on stopping uncontrolled urban sprawl and prioritising dense and compact planning (Goetz, 2013). The multiple benefits of mixed-use development explain this trend: (i) it enhances the attractiveness and liveliness of urban areas (Jacobs, 1961); (ii) it considerably reduces travel distances and travel time, thus reducing carbon emissions and improving quality of life (Hoppenbrouwer & Louw, 2005; Coupland, 1997); and (iii) the prioritisation of active mobility has positive effects on individual health and well-being (Moreno et al., 2021).

[9] The campus is named 'Belval' by the students, following the designation of the entire regeneration project.

In the face of forced travel restrictions during the COVID-19 pandemic, many cities have implemented new urban models promoting mixed-use development, such as the 15-minute city (Moreno et al., 2021; Pozoukidou & Angelidou, 2022). Paris mayor Anne Hidalgo adopted this conception, initially developed by Carlos Moreno in 2016, in order to promote bicycle use, healthy public spaces and proximity-based neighbourhood development (Di Marino et al., 2023). In addition, it aims to improve urban life through the use of new technologies and the re-localisation of workplaces (Pozoukidou & Chatziyiannaki, 2021). The 15-minute city concept is also included as guiding urbanistic principle in Luxembourg's Territorial Development Master Program (Département de l'aménagement du territoire, 2023).

Due to its obvious benefits, mixed-use development is often considered by planners as a 'mantra' for creating sustainable neighbourhoods (Grant, 2002, p. 71). However, some scholars criticise the mixed-use approach in the 15-minute city model for being just another social mixing policy targeting marginalised neighbourhoods while creating further exclusions (Casarin et al., 2023). It should be reminded that mixed-use development serves a neoliberal political agenda and does not put into question traditional growth strategies (Goetz, 2013). More concretely, bringing together different uses – for example by adding housing units into commercial zones – increases the land value through a legal modification, that is in line with private sector interests. Additionally, the 15-minute city seems to fail to represent the multidimensional and diverse character of social life where people have well-established habits and develop an attachment to places that are not necessarily in immediate proximity to their place of residence (Casarin et al., 2023). Referring to Lehrer & Laidley (2008), Strauch et al. (2015) explain that mixed-use LSUDPs are hard to be contested since 'they appear to offer something to everybody and please the various interests of an imagined "everyone"' (p. 178).

Urban integration

Despite a growing academic interest on mixed-use development, it remains unclear how this planning principle interacts with the more general objective of urban integration. This second 'planning mantra' is expected to bring multiple benefits at the level of the city and beyond, such as (i) increased spillover effects emerging from the new developments (Van Winden et al., 2010), (ii) a higher quality of life and attractiveness of the area (Pancholi et al., 2018) and (iii) a more coherent urban continuum. Urban integration has thus also become a major political concern, with strategic importance in the case of knowledge-related LSUDPs (Duarte & Sabaté, 2013).

Given its multidimensional character, there are divergent views on the driving factors behind the process of urban integration. Integration is often understood as the establishment of links between two or more territories (De Boe et al., 1999). These links may form through flows of people, travelling from one area to the other for various purposes (Matthiessen, 2004), as they lead to interactions and exchange that form an integrated network. But in order to draw a more complete picture of urban integration, these

flows need to be accompanied by the establishment of an intangible relationship between the area's users and their urban environment (Durand, 2015). Only when residents become citizens, when they feel themselves to belong to a wider entity, urban integration can be achieved. The emergence of feelings of belonging and place attachment is of strategic importance to policymakers as it helps to retain an international workforce that has the potential to boost the structural social and economic change at a regional scale (Darchen & Tremblay, 2010).

The importance of scale to coordinate mixed-use development and urban integration

A deeper analysis of the previously presented planning principles uncovers a set of inconsistencies depending on the scale on which they are being implemented. The potential contradictions can be declined across the twofold understandings of diversity in mixed-use development: (i) mixed *uses*, the spatial proximity of diverse urban functions; and (ii) mixed *users*, a diversity of housing forms in order to attract a socially mixed population (Moreno et al., 2021; Marchigiani & Bonfantini, 2022; Casarin et al., 2023). First, at neighbourhood level, the mixed-use strategy as it is used in the 15-minute city aims to reduce the incentive to travel long distances for daily activities. However, if people tend to stay in a certain area, because all daily activities can be done locally, neighbourhoods start to function as self-sufficient enclaves (Pozoukidou & Angelidou, 2022). In this case, and by raising the analysis to the city scale, we observe that the urban framework becomes more fragmented, with less exchange, and even growing disengagement or alienation from adjacent areas. Paradoxically, an integration of various urban functions may lead to the fragmentation of the urban space at a wider scale.

Second, mixed-use development also includes the objective to attract a mix of population groups, by offering a wide range of spaces open to everyone and by highlighting diversity as an asset in urban marketing. Moreno et al. (2021) specifically mention the role and potential of place branding and place identity through the implementation of the 15-minute city model in cities. However, discourses on social diversity often hide that LSUDPs mainly attract high-income residents or a highly qualified and specialised workforce (Swyngedouw et al., 2002; Ponzini & Rossi, 2010). For example, the promotion of co-working spaces in order to spatially join housing and workplace typically excludes manual workers (Casarin et al., 2023). The planning and governance of mixed-use LSUDPs seem to target specific population groups more than others, who ultimately feel that the new developments are not for them. According to Ösgård & Spierings (2021), the increase of inter-urban competition leads to a more pronounced disconnection between planning conceptions, its imaginaries and visions on the one hand, and the lived reality by the space users on the other. In their analysis of the new urban developments in Ørestad, Copenhagen they observe what Paddison (1993) termed an 'image-reality gap' (p. 348). This shows that the active promotion of the mixed-use concept and 'the myths of the attractive city […]

without friction or conflict' (Bern, 2023, p. 131) ignore social realities and raise questions on the forms of community that such projects try to create. Harvey (1997) postulates that 'the image of community' is what attracts people, and not community itself. The use of diversity and community as marketing buzzwords at the level of the project thus risks giving only the illusion of mitigating segregation (Marchigiani & Bonfantini, 2022), while parts of the population are unable to appropriate space. Consequently, they do not feel to belong on a more individual level, which jeopardises the establishment of a lasting link with their urban environment and counteracts the process of urban integration.

The previous discussion can be seen as a contemporary interpretation of Henri Lefebvre's (1974) theory of the production of space. The frequently cited spatial triad is particularly useful to approach the different scales on which we observe the interaction between urban planning (conceived space; the 'dominant space in any society' (Lefebvre, 1974, p. 48; cited by Bern, 2023)), the use and appropriation of the area by the attracted population (perceived space), and the people's representation of the area (lived space). The complex interconnections between the components of space production become particularly visible in the context of mixed-use LSUDPs. Planners apply urban models, such as the 15-minute city, at the scale of the project or neighbourhood for purposes of sustainability or urban marketing. However, local communities, as well as newly attracted population groups perceive their urban environment at a human scale and are confronted with the local social realities. Local place attachment may emerge when people feel the right to appropriate space and to reproduce it through practices and representations (King, 2019; Adewale et al., 2020; Oakley, 2014). However, when local needs are misinterpreted, conflictual situations may arise between the planned space and the users' lived space. The reconsideration of space produced through social relations and, in parallel producing social relations, is a central aspect of Lefebvre's theory. It aims to uncover the political and social links between users and planners, who create an abstract space of homogeneity and emptiness (Jones & Popke, 2010).

This article discusses the seemingly contradictory relationship between mixed-use planning and the overall objective of urban integration, through a multiscale lens. To sum up the previous discussion, I formulate the hypothesis that the development and promotion of mixed-use LSUDPs counteract the overall objective of urban integration, when the spatial scales, on which these planning objectives act, are insufficiently coordinated. For analytical purposes, I suggest dividing the hypothesis into two main parts. On the one hand, the mixed-use paradigm reduces mobility flows at neighbourhood level, which is opposed to the objective of urban integration at city level. On the other, the promoted area 'for everyone', combining a functional and a social mix at neighbourhood level, leads to false expectations and an image-reality gap at the individual level of the users. This negatively impacts their feeling of belonging and thus counteracts the process of urban integration from a user-centred perspective.

In the next section, I will briefly outline the methodological approach to analyse these hypotheses. Then, the research context will be presented by focusing on the main actors involved in the development of the Cité des Sciences, that is part of the larger Belval regeneration project.

Approach and methods

This article relies on a study that focused on the student life in Belval and Esch/Alzette. UL students were invited to voluntarily participate in an online survey and focus groups. The first part of the focus groups was a mapping workshop. Students were asked to draw the places they know and visit in Belval and in other parts of Esch/Alzette, as well as the emotions they connect to these places. In the second part, they discussed their creations and used them to express their feelings related to their urban environment. The intimate environment – composed of students interacting and influencing each other – and the use of visual material created a comfortable atmosphere for expressing personal feelings and experiences (Krueger & Casey, 2015).

Four focus groups with a total of 18 participants were carried out in May & June 2022. They were entirely recorded and transcribed. Then, a thematic analysis was performed on the transcripts, which was a particularly helpful method to understand the students' representations across a range of themes. Additional views from students and actors implicated in the Belval regeneration project were collected during a series of public discussions[10] in which the author participated as an observer. In parallel, a qualitative analysis of planning documents of the Cité des Sciences was performed. The material consisted of publications by the Fonds Belval, the developer of the public space and buildings of the Cité des Sciences, as well as additional grey literature.

While the main focus lies on the spatial scales on which the key concepts of mixed-use development and urban integration act, this study does not consider the temporal dimension. In fact, the integration process of LSUDPs into the urban environment are time-dependent. Given that the focus groups were organised at a certain moment in the development process – seven years after the move of the university – it is possible that certain views or feelings of students have changed with the continuing development of the site. While acknowledging that longitudinal studies would be a pertinent way to enhance this research, I believe that the analysis of how the spatial scales of mixed-use development and urban integration are imbricated at a certain point in time, and how this affects the users, provides relevant insights for future planning of LSUDPs.

[10] The one-week public discussions were entitled 'Let's talk about Belval' and organised by the Master in Architecture of the UL in September 2022.

Belval and the Cité des Sciences

Belval is the largest brownfield redevelopment project in Luxembourg and marked a fundamental step in the country's decentralisation and diversification strategy. It is being developed in the municipalities Esch/Alzette and Sanem since the beginning of the 2000s. The Cité des Sciences – that acts today as central pole of the area, and as main campus of the UL – is located on the Eastern part of the site (Figure 19).

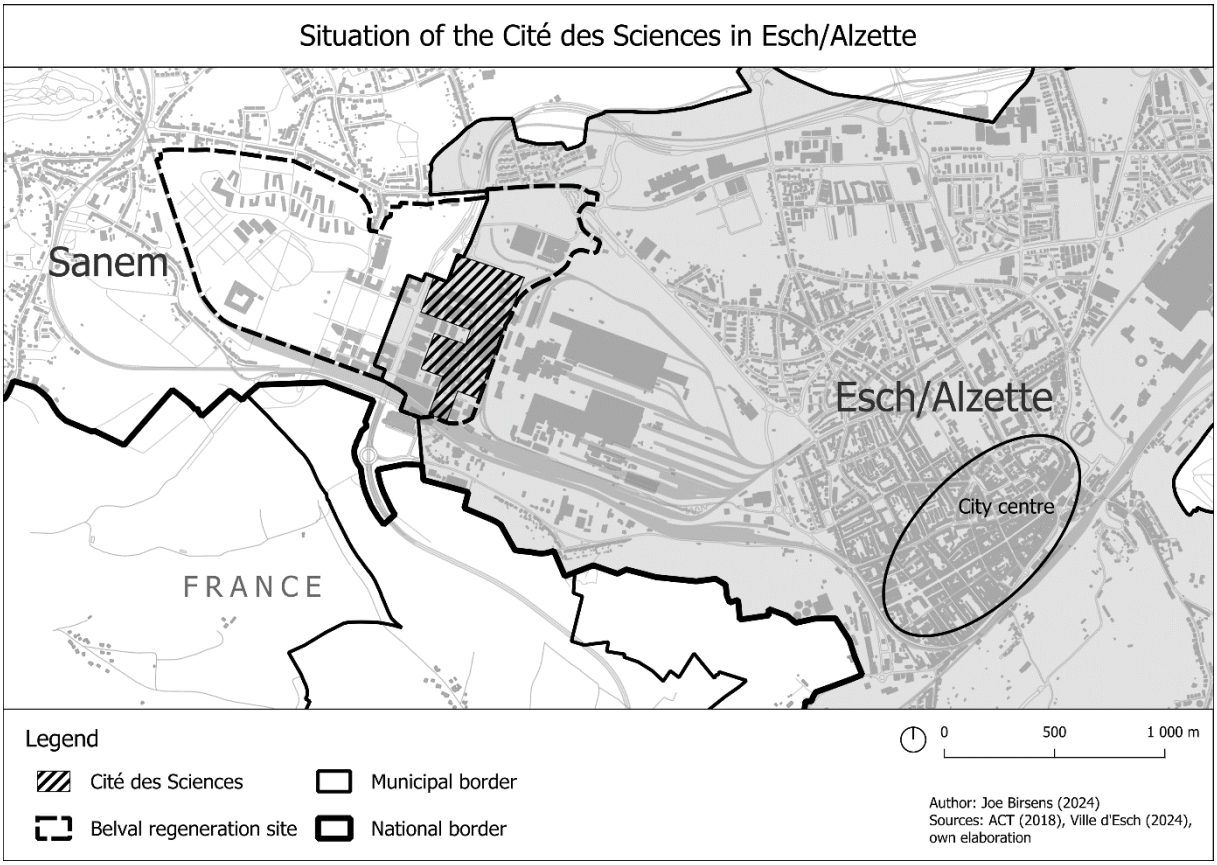

Figure 19: Situation of the Belval site and the Cité des Sciences in Esch/Alzette.

The main developer of the Belval regeneration project is Agora, a public-private partnership between the Luxembourg state and the previous landowner, the multinational steel company ArcelorMittal. The Cité des Sciences is being developed through the state-led development fund for public buildings and infrastructure (Le Fonds Belval). A third actor is the City of Esch/Alzette, since urban planning is a local level competence in Luxembourg. However, due to the scope of the project, planning and decision-making was dominated by Agora, for what concerns the entire Belval project, and the Fonds Belval concerning the Cité des Sciences.

Esch/Alzette has historically grown with the steel industries located on its territory. After the downturn of the industrial productions, national policy defined strategic objectives of socio-economic regeneration and a shift from a post-industrial to a knowledge society. In order to conform to contemporary planning practice, the different actors defined mixed-use development and urban integration as guiding principles (Table 5). However, the interpretations of these principles vary. The Fonds Belval aims to integrate the university and the city (Le Fonds Belval, 2006a) by adopting a mixed land use strategy at the level of the university district. The university should be integrated with other urban functions, as will be detailed below. The City of Esch/Alzette plans mixed uses between the city centre and Belval and lobbies for a successful integration of the Cité des Sciences and its population into the existing neighbourhood structure. City officials expect positive spillover effects on the city centre from urban integration and the presence of students (Le Fonds Belval, 2004a, 2007a; Poos, 2013). The main developer Agora agrees to foster connections between the new area and its urban environment, but focuses on the planning of a mixed-use district at the level of the development perimeter, that is clearly delimited by the masterplan (Figure 20).

The complex interrelationships between the three main actors involved in this regeneration project, and the different scales on which they act, supposedly affect the outcomes of the mixed-use development and urban integration strategies. The following section analyses this phenomenon from the point of view of the student population.

Table 5: The key actors of the Belval regeneration project

		Planning objectives	
Key actor	**Planning scale**	**Mixed-use development**	**Urban integration**
Agora	Belval (masterplan)	Promotion of a neighbourhood to live, study, work, shop and spend free time	Integrate Belval into its local and regional environment
Le Fonds Belval	Cité des Sciences	A mixed-use neighbourhood rather than a monofunctional campus	Integrate the university with other urban functions
City of Esch/Alzette	Municipal territory	Functional complementarity with the city centre in order to avoid competition	Integrate Belval with Esch/Alzette through mobility infrastructure and the students

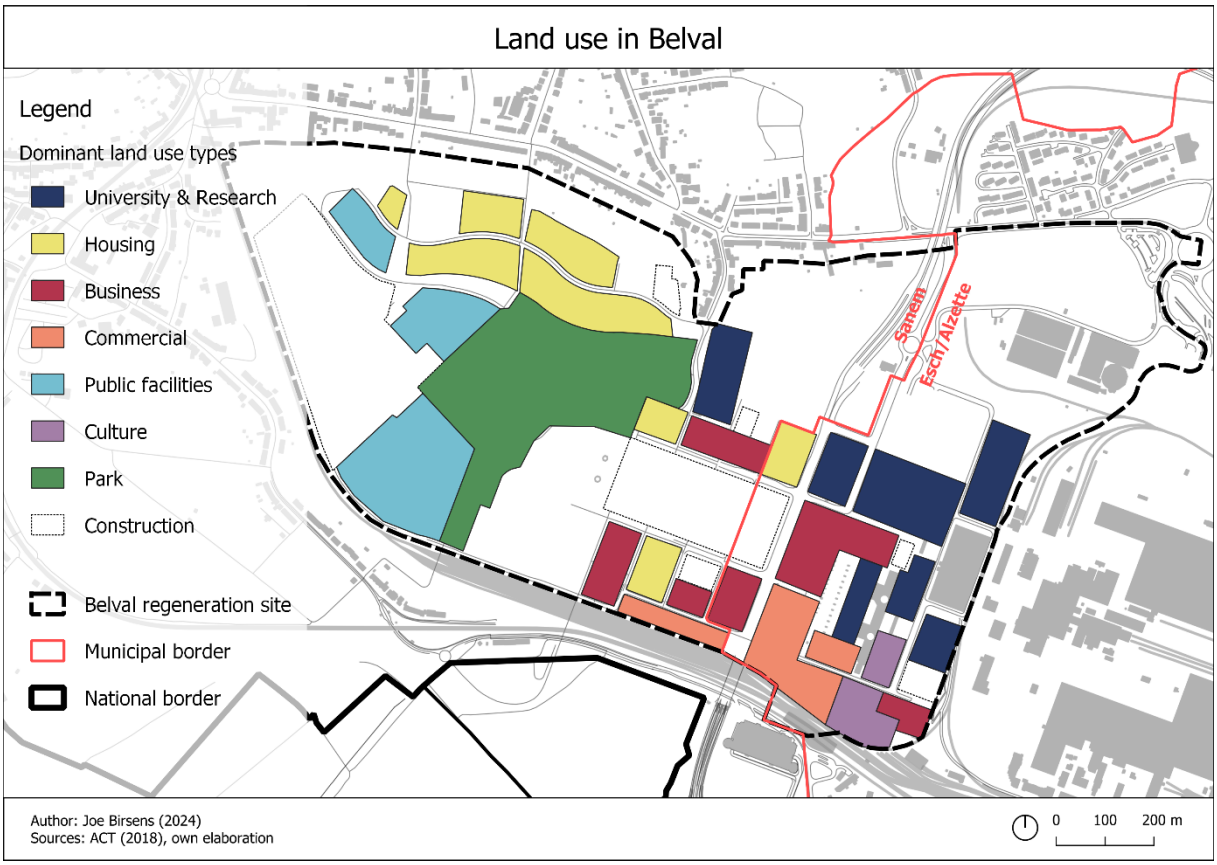

Figure 20: Dominant land uses in Belval.

Mixed-use development and everyday mobility

The Cité des Sciences was largely promoted as an attractive and modern place in which academic and professional functions coexist with cultural, commercial, administrative and recreational activities (Le Fonds Belval, 2007a). Students and researchers share the space with bankers, artists, entrepreneurs, civil servants, or simply visitors. Planning documents reveal that the area should act as a counterexample to the monofunctional zoning developments of the 20th century, that have massively promoted car dependency through the strict separation of workplaces and places of residence.

> The university in the city, not the exclusively university city or district, or the university campus of the 1960s located apart from everything else. The university as urban normality, as part of the city. [...] This makes it possible to invent a new approach, one that creates an intrinsic link between the city and the university, leading to the total integration of the university into the urban fabric and activities. (Le Fonds Belval, 2006a, pp. 14-15 [translated[11]])

[11] All translations are my own. For the original quotes, please refer to the annex.

This claim underlines the planners' wish to integrate the university into a broader urban structure. The formation of a 'socio-professional enclosure' should be avoided at all costs (Le Fonds Belval, 2004b, p. 32 [translated]).

However, the focus groups revealed that the mixed-use character of the Belval site tends to minimise flows of people between neighbourhoods. Many students stay on campus to buy groceries or have a drink after their lectures. Belval offers important services, such as a pharmacy, a post office or a laundromat at walking distance. Some students do not see any reason to go to the city centre of Esch/Alzette for daily activities. As many students do not own a car and alternative connections to the city centre of Esch/Alzette or Luxembourg-City are perceived as unpractical and time-consuming or hindered by construction works, students living in Belval tend to stay around their home area. Additionally, the habit of riding a bike is not as popular as initially believed by the planners (Goedert, 2010) due to a lacking coherent cycling network, connecting the various neighbourhoods, and protecting cyclists from car traffic[12].

According to the initial ambitions of the city officials, the development of Belval should ensure a functional complementarity with the city centre to avoid an intra-urban competition between the two new poles of the city (Goedert, 2004). When all urban functions are provided in Belval, there is no incentive for visiting other parts of the city. Today, we observe that some elements that are not sufficiently provided on the campus area lead the students to explore other places. In the following part, I will explore three of these elements: (i) green and recreational spaces, (ii) the commercial and cultural offer and (iii) student housing.

Green spaces and recreational facilities

A major outcome of the focus groups was the students' regret about the absence of green, natural areas and recreational or leisure facilities at the Cité des Sciences. 'There is no place to have fun', as one student put it during a discussion panel. The entire campus area was sealed due to high decontamination costs, leaving no room for natural soil on the surface.

This example is emblematic to clarify the role of scale in mixed-use development. Considering the entire LSUDP, there is indeed plenty of greenery. On the Western part of the regenerated site is located the Belval Park, that makes roughly 10% of the total surface. However, it is located at a 15-minutes walking distance from the university facilities. According to most students, it is too far away from the campus to just spontaneously go there during lunch break or between lectures. In addition, it is difficult to access

[12] The focus groups were conducted prior to the opening of the cycling bridge between Belval and the centre of Esch/Alzette. In the meantime, the cycling infrastructure has been enhanced, yet it remains questionable whether cycling has become a popular mode of transportation due to the absence of a coherent cycling network in the city centre.

– partly due to ongoing construction works – and it is not visible from the campus. Some students have only discovered it several months after their arrival.

A park at a 15-minute walking distance may be acceptable if you specifically plan to go there, but it cannot replace small-scale green spaces in between the built areas that seem essential for spontaneous interactions and individual well-being. Gao & Lim (2023) have shown that linear parks and small, dispersed parcels are more conducive to interactions, than large land use zones. In Belval, green spaces have not been planned on a human scale, in the same way that the mixed-use strategy of the regeneration project has been developed on the scale of the masterplan, and not at the scale of its users. This confusion of scales becomes apparent through the discourses of the developers themselves:

> Mixed-use development is one of our top priorities, and when we market land we attach as much importance to the price as to the program and architecture of the project that investors want to develop. [...] To create this mix, we have divided the entire site into neighbourhoods, each with its own specific character. (Delwiche, 2010, p. 43 [translated])

A LSUDP composed of areas with specific functions appears to be mixed on the scale of the masterplan, but not at the scale of the users.

Due to the students' perceptions that recreational and green spaces are lacking, they tend to leave their campus and explore alternatives, such as the city park, the forest or the rural land across the French national border. Sports activities organised by university associations mostly happen in the older parts of Esch/Alzette because of the missing infrastructure on the campus. Interestingly, the missing uses of the mixed-use campus create a link between the students and the environing areas.

Alternative stores and culture

The focus groups revealed that students also miss small, cheap and more alternative stores in Belval. The shopping cells of the commercial centre located in the southern part of Belval are mostly occupied by multinational corporations. Alternative commercial or cultural activities take place in the city centre, even if their presence is still quite punctual. Students mentioned the bi-weekly market, small shops selling regional and vegetarian products and a centre for alternative culture. Such initiatives almost never emerge on the Belval site. The cultural and nightlife scene also tends to be more popular in older parts of Esch/Alzette, while many students miss traditional student bars and a diverse urban atmosphere around the Cité des Sciences. The existing urban qualities and the typology of shops and services thus act as important levers to channel student flows and foster the integration between the campus and the city.

However, the city centre of Esch also faces competition from Luxembourg City, that has much more to offer in terms of amenities, nightlife or cultural events. Flows of people depend on the attractiveness of the urban areas, but also on the scale on which mixed uses are planned.

Student housing

Housing has a specific role in mixed-use planning as it determines where people live and where their daily commutes start and arrive. Planning documents reveal that student housing was deliberately planned in different municipalities, following a regional-scale mixed-use strategy that enables flows between the university campus and other cities. The aim was to locate student accommodation in residential areas to encourage social integration of students (Le Fonds Belval, 2005). Student housing and temporary residences for arriving students in the city centre of Esch/Alzette contribute to the connection between the Cité des Sciences and the city. Many study participants had their first experiences of Esch/Alzette through friends who lived there. Mixed-use development and local integration of the student population thus go together when developers coordinate the planning scales.

The previous points have shown that the planning scale is a significant factor in the coordination of mixed-use development and urban integration, as observed through people's everyday mobility. When a holistic mixed-use program at city (or regional) level exists, it may contribute to urban integration with the campus area. The case of Belval also reveals, however, that when mixed-use planning is limited to the project or to a specific neighbourhood, it bears the risk of creating a self-sufficient enclave since daily activities can all be done locally. This is of course in line with dominant planning objectives of reducing travel distances, but it contradicts the former objective of urban integration through flows and exchanges of people. The imbrication of the different key actors involved in the Belval regeneration project, and the scales that their objectives act on, thus leads to a mismatch between the spatial effects of mixed-use planning and urban integration. Finally, it should be reminded that the generation of flows through the distribution of student accommodation and urban amenities is only one dimension of urban integration and does not say anything about the students' feeling of belonging to the region. The following part will address this aspect.

Discrepancies between image and reality

A central finding from the empiric material is that many students have difficulties identifying with their campus. As one student put it: 'we do not feel being part of the infrastructure'. This apparent disconnection between the students and their environment goes against initial objectives of urban

integration and retaining students in place on a longer term. Again, the notion of scale is determinant here: the regenerated space has been conceived and promoted on a macro scale, but it is lived by the users on a more human or micro scale. In the following part, I will discuss how the quality of the public space, the professional atmosphere, and the lack of participation influence the students' micro-scale place attachment, and how this relates to the macro-strategies of mixed-use development and urban integration.

Quality of the public space

Discussions with students revealed that the quality and design of the public space plays an important role in their (lack of) place attachment. Some describe the campus as 'cold' and 'impersonal'. Many students miss places to meet people and to interact with peers, to sit down and read a book or have a conversation in public space.

> I think another thing, what is missing, actually, it's like a green area where you see people and then you join. […] And I just know it from Germany, that there are around the main buildings of the university, there are always people sitting and eating, picnicking, I don't know. And for us, there are like, three benches, and one, tree or four symmetric trees, but not like just really place where you see people enjoying their free time. (Bachelor student from Germany)

This reaction shows that the Cité des Sciences does not correspond to the representations that students have of a university campus. Using the words of Paddison (1993), they experience an image-reality gap. This situation is rather surprising since the illustrations used in the planning documents published by the Fonds Belval to depict a student campus (Le Fonds Belval, 2007b, p. 21)[13] correspond much more to the students' representations than to the effective outcome (Figure 21). Here, we observe a clear discrepancy between the conceived, perceived and lived spaces.

The analysis of planning documents confirms advances formulated by Becker (2010) that the quality of stay or the appropriation by the student population only played a marginal role in the conception phase. It seems that the Fonds Belval prioritised urban design over the needs of the users (Le Fonds Belval, 2010). A neoliberal narrative is used to justify investments in architectural quality: 'The university is one of those institutions that attach great importance to its public identity. This attachment to the quality of its image reflects its commitment to excellence in research and education.' (Le Fonds Belval, 2006b, p. 16 [translated]). Spectacular design translates the University's strive for academic excellence and is thought to attract quality researchers and students (Van Heur, 2013).

[13] The illustration on page 21 depicts a multitude of students sitting on a vast expanse of grass, engaged in conversation and reading.

Figure 21: Photos taken at the Cité des Sciences (left: Ville d'Esch-sur-Alzette, 2021; right: own capture, 2023).

Consequently, the public space around the university buildings was designed by a renowned landscape architect to 'enhance the beauty of the objects' (Le Fonds Belval, 2010, p. 8 [translated]; Le Fonds Belval, 2011). One of the main design elements were artificial water ponds that reflect the buildings, generate a micro-climate on the campus (Le Fonds Belval, 2014a) – whereas this effect is in reality very limited (Jacobs et al., 2020) – and protect the architectural creations from acts of vandalism (Le Fonds Belval, 2015). Initial plans also highlighted their recreational use for people (Le Fonds Belval, 2011), which is totally disconnected from its real use today. They have no qualitative function for the students, who miss to have some pleasant meeting areas. In search for alternatives, students tend to meet most of the time in cafés, restaurants or in the shopping centre. Student areas are either bound to working or consuming areas (Schulz, 2010), which translates the high level of commodification of the Belval project. One local PhD student described this situation: 'There's not really anywhere to go if you're not specifically going somewhere, that's the impression I'm getting.'

The design program of the Fonds Belval resulted in an assemblage of iconic buildings, that is highly appreciated by visitors and photographers, but students regret that not much happens in the public space between them, that one focus group participant called an 'empty space'. Others complained that there is 'a lack of urban space'. On a macro level, there is plenty of public space, but from the micro-level

perspectives of the students, there is no area for spontaneous interactions that would increase the students' connection with each other and with their university environment, which is a fundamental component of an integrated urban space.

'Belval is for work'

A further reason for the students' difficulties to develop a lasting attachment to their university environment is the perceived lack of activity in Belval outside of working hours. The mixed-use character of Belval implies that many users are not related to the university and thus do not participate in student life nor live there.

Due to the previously discussed dispersion strategy of student accommodation, the number of students residing on or around the campus seems to be insufficient[14] to create a large offer of student activities and to attract student-related amenities. The lacking tradition of student life in the south of Luxembourg in general contributes to this situation, which tends to widen the students' image-reality gap. While one PhD student shared that she would regularly have a drink after working hours in Belval, others have a different experience:

> There are like lot of bars and restaurants […] and even if there are a lot of them, I don't know, for me, I feel like this, because it seems like maybe they are too fancy, I can't go there because I'm a student, you know, I mean I can, but still… […] It seems more like, I don't know, for people that are working there. (Master student from Italy)

Perhaps there is also an age factor that plays here: The bars in Belval target mostly older PhD students, that seem to have more similar interests to non-academic employees, than younger Bachelor or Master students.

Participation

From discussions with students also emerges the point that even the few existing student initiatives would be regularly blocked by the Fonds Belval and its regulatory or bureaucratic hurdles. Contrary to claims in the planning documents, according to which urban life should be developed through small and large temporary, mobile and spontaneous activities (Le Fonds Belval, 2014b), it seems extremely hard to organise small happenings in public space. Students complain about the lack of autonomously managed spaces and struggle for a right to the city (or a right to the campus). One campus building has been specifically planned for extra-academic student activities, but it is not self-managed by students. It

[14] Official figures indicate that there are 578 student housing units in Belval (358 located on the territory of Esch/Alzette and 220 in Sanem), but the exact number of students is difficult to assess (Birsens et al., 2021).

is mostly used for formal events and does not seem to play an important role in the students' lives. The procedures and regulations to organise events are fuzzy, communication with the Fonds Belval is complicated and there is lacking support from officials. On the other hand, public discussions revealed that the Fonds Belval cannot imagine alternative models to the current regulations of public space.

The overly controlled space and the lack of participation hinder appropriation by the users, which would be an important precondition for the establishment of place attachment. As micro-level appropriation is not supported by the macro-level actors, we observe a conceptual mismatch between the users' space and the planners' space, which counteracts the process of urban integration.

Student campus or mixed-use neighbourhood?

Analyses of planning documents reveal that the underlying political objective of the Cité des Sciences never was to create a campus for students. The Fonds Belval refuses to call the Cité des Sciences a campus, which fundamentally contrasts with the views of students, professors, and university authorities. This opposition seems to explain the different expectations that planners and users respectively have of the area, and it seems to be the root of the more tangible issues of place attachment and appropriation.

Multiple planning elements underline the planners' wish to avoid the constitution of a student campus. For example, the university restaurant is not exclusively for students or academic staff, but open to the general public, in accordance with the mixed-use concept of the project (Le Fonds Belval, 2013a). Another example is the welcoming space in the MSA, 'a place for interactions, exchange and informal meetings, a flexible space available to students and anyone else who might like to spend some time there.' (Le Fonds Belval, 2013b, p. 16 [translated]). One student shared her experience of a group of tourists passing through this space while she was studying there. They were following a tour guide who showed them the premises and the intimate spaces of the students, leaving the students feel as a tourist attraction. It appears that the mixed-use development strategy also applies to the interior of the university buildings. Even the spaces that are specifically designed as 'safe spaces for students', are open to the general public.

The planning documents clearly indicate that the Cité des Sciences should not be for students only. The model of traditional universities forming a student bubble, without establishing connections with the broader environment, should be avoided at all costs.

> An eminently intellectual place reserved for a circle of scholars, an intellectual elite living in isolation. This is the image that the university […] has carried for far too long. The concept of the Cité des Sciences breaks away from this vision. It is intended to become an exceptional

> place, welcoming both occasional and permanent visitors, thanks to its friendly atmosphere, the breadth of its offerings and the quality of its infrastructure. Its offer will cover a wide range of interests and will attract a broad public. (Le Fonds Belval, 2004b, p. 31 [translated])

The planners thus label the student population and other regular users of the Belval area as 'permanent visitors'. It shows that Belval is not specifically created for anyone to feel at home or to appropriate space as everyone somehow remains visitor. Furthermore, the documents reveal the planners' disregard and prejudice of public universities and the student population.

> Outdated auditoriums, rundown classrooms and dilapidated laboratories, the sometimes derelict buildings that we have seen and still see in some universities, mainly because of the lack of resources but also because of the carelessness of too many students, reflect a certain decay of a too levelled university mentality. (Le Fonds Belval, 2006b, p. 17 [translated])

Planners use their position of power, over-regulation, and hostile architecture to create an environment that contains the undesirable side-effects of student life. Architectural quality is the main guiding principle that outplays student needs. In return, many students feel that the Cité des Sciences was not made for them.

These points need to be linked to the previous discussion on mixed-use development. In accordance with Moreno et al. (2021), the understanding of diversity is not only about the uses, but also about the users. Planners intended to create a functional and social mix in Belval, a diverse population that is believed to contribute to sociocultural exchange (Casarin et al., 2023).

The outcome shows today that these expectations were disconnected from social realities. Exchanges between the student community and other professional or social groups are indeed very limited. Social mix has little sense when it is transposed to the students' lived reality in Belval. The area has been designed for *everyone*, and thus for *no-one* in particular (Le Fonds Belval, 2004b). The intention to create an inclusive space, where everyone should feel welcome, is in line with contemporary planning conceptions, but it bears the risk that places lack a clear identity and foster appropriation. Occasional visitors or tourists are perhaps the group that most elements are designed for (Le Fonds Belval, 2014a), as the comment on the inauguration of the high furnaces, the landmarks of the site, shows: 'By observing the many visitors, the high furnaces festival revealed one essential thing: the site is a pleasant place. The audience feels at ease despite the gigantic size of the site' (Le Fonds Belval, 2014a, p. 10 [translated]).

This is yet another example of the difference of scale that planners and students refer to. On the one hand, planners evaluate the atmosphere of the regenerated site through the opinions and feedback from visitors and participants in large annual events. Tourists and even visiting scholars would always be impressed by the quality of the developments. On the other, the people that actually live there are not included in the evaluation process.

The project to integrate the university into the city can thus be seen more critically as a dilution of the students into the existing social structures. Top-down urban planning, overregulation and the student housing policy to disperse the students over various municipalities and 'to avoid the creation of a ghetto' (Le Fonds Belval, 2006c, p. 20 [translated]) are only a few elements that underline the planners' fear to create an area where the students live together, appropriate their campus, contribute to its development, and live their student life. The underlying objective was to use the student population to trigger a structural social change of the southern region, but without establishing a real student community, including their specific needs, wishes and criticism.

Conclusion

From the previous discussion emerges a complex picture of the mutual interrelationships between mixed-use development, the formation of place attachment, and the process of urban integration. First, the planning of mixed uses at the scale of the redevelopment project seems to contradict the objective to create connections with neighbouring areas. Most students satisfy their daily needs on the campus and see no need to go to the centre of Esch/Alzette. The fact that some key elements are missing on campus and that, in turn, students explore the environing areas shows that a coherent mixed-use plan at the regional scale would have benefited the process of urban integration. However, this further depends on the accessibility and the attraction of other centralities, such as Luxembourg City. Second, the emergence of place attachment is significantly hampered by the conception and design of the Cité des Sciences. This area has been designed as a mixed-use urban neighbourhood for visitors, rather than as a campus for students. A mixed character means that no specific social group should feel at home and appropriate space. Third, the planning of student housing plays a double role in this process. Due to its regional distribution, it triggers exchanges between the university and environing areas and thus contributes to the regional integration of the university. However, the low numbers of students residing on the campus adds to the dilution of student life into a neoliberal interpretation of urbanity, which acts against the emergence of place attachment and belonging. These findings show the inherent contradictions related to the multidimensional character of urban integration. The same process may trigger flows and connections between territories *and* prevent the population from feeling to belong to them.

By extending these reflections, this article questions the coherence of combining mixed-use development and urban integration. In the context of the 15-minute city, Moreno et al. (2021) assume that when neighbourhoods provide 'the six essential social functions' (living, working, commerce, healthcare, education, and entertainment), we assist at 'the urban social fabric becoming even more closely knitted and with residents made to interact and participate more in activities that ultimately

strengthen their social bonds' (pp. 100-1). The present study challenges this assumption in the context of a LSUDP that is governed by a variety of stakeholder interests acting on different scales. A social and functional mix does not seem to contribute to the establishment of a more integrated urban fabric, from a socio-spatial point of view. On the contrary, it tends to minimise mobility between neighbourhoods and may foster alienation, as the case of the Cité des Sciences has shown. This echoes advances from other scholars cautioning the 'utopian idea of "togetherness" that is conceived and sold as the "remedy" for the many problems affecting the city' (Casarin et al., 2023, p. 6).

This study has shown that the planning paradigms of mixed-use development and urban integration are not always in phase and evolve in the same direction, especially when various actors interpret these principles differently and define their objectives on different spatial scales. Therefore, the definition of mixed-use development needs to be further refined and planners should avoid considering it as a universal recipe that fits all urban contexts (Hoppenbrouwer & Louw, 2005). In some cases, such as university campuses, it is essential to allow student life to develop organically, and to provide the area with spaces designed specifically for students, that are not diluted into a broader neighbourhood. When space is better defined and given a certain character, appropriation by the target groups is more easily achieved, which positively influences integration of the urban space. In an ideal case, students would be implicated into the entire planning process. There is no doubt that this would have increased their place attachment and minimised the image-reality gap that results from a profound miscomprehension by the planners of what students need and how they live.

In the end, the question of why the planners chose the combination of mixed-use development and urban integration as leading principles remains. Did they use the rhetoric of the 'university in the city' to conform to dominant urbanistic principles, and thus provide an attractive and positive image to the regeneration project? Answering this question would exceed the scope of this article, but the evidence presented here indicates a lacking holistic concept that would coordinate the involved stakeholders, as well as their respective objectives. It also translates a seemingly common vulnerability in contemporary urban planning: the growing disconnection between project management and the creation of an idealistic imagery by architects on the one hand, and the lived reality framed by specific social contexts, on the other. In order to combine the objectives of mixed-use development and urban integration, planners need to adopt (i) a broader view at the urban and regional contexts, and (ii) a more fine-grained attention to the human-scale of the users' lived space, instead of limiting their planning horizon to the perimeter of the masterplan.

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CONCLUSION

Towards a multidimensional understanding of urban integration

The previous chapters aimed to discuss theoretical and analytical advances of the concept of urban integration by looking at the underlying mechanisms of the social and spatial integration process between a large-scale urban development project (LSUDP) and its urban environment. The study builds on the case of the Cité des Sciences, a newly built knowledge district in the post-industrial southwest of Luxembourg, and main site of the University of Luxembourg since 2015. As presented in the introduction, I consider integration as a multidimensional process that cannot be fully grasped by a single indicator. In order to approach the polysemy of urban integration, I decided to observe the concept from different, yet complementary perspectives. These perspectives include the quantitative measurement of urban integration through indicators of socio-economic dissimilarities, as well as more qualitative approaches focusing on the actual users of the territory who contribute to the process of urban integration through their spatial practices and place attachment. This conception sets the scene of the empirical part of the dissertation. The overarching research question was formulated as follows: 'How can the Cité des Sciences and the city of Esch/Alzette form an integrated urban area?'. The three chapters provide three different aspects to answer this question, as well as relevant findings that go beyond the case study and add to the ongoing debate around the urban integration of LSUDPs. In the following part, I suggest coming back to the key findings across the three chapters, before discussing the answer to the research question.

Chapter 1 proposes a quantitative analysis of socio-spatial integration through a range of indicators from administrative sources. This conception of integration posits that two areas form an integrated urban entity when the structural dissimilarities existing between them are low – i.e. at a similar level than the dissimilarities found in the reference space. This is a rather common understanding of integration, even though it has never been formalised: when Swyngedouw et al. (2002) observe that LSUDPs risk to become 'islands of wealth in an impoverished environment' (p. 567) due to their dependency on high

rent returns through the real-estate sector, they implicitly refer to the dissimilarities in income or wealth between residents (or users) of the newly developed and of the surrounding areas. The novelty of the present chapter is the contextualisation of the integration concept as a multidimensional phenomenon that should not be exclusively analysed from a purely economic angle, as well as the related quantitative methodology elaborated for the purpose of this study. We collected a diverse dataset of social, demographic and economic indicators characterising the population structure at neighbourhood level. We proposed to include data on age groups, nationalities, household composition and the like, which provides a more complete picture of intra-urban socio-economic differences. Using a principal component analysis to calculate an 'index of territorial fragmentation' and an original mapping method helped us to depict and understand the existing dissimilarities between neighbourhoods (Le Goix, 2005). Findings from Belval confirm previous studies that indicated strong dissimilarities between knowledge-related LSUDPs and their urban environment (Madureira & Baeten, 2016; Rugkhapan & Murray, 2019). However, the chapter calls for a more nuanced debate around the structural integration of these territories. First, the variety of data allowed a more differentiated analysis about the population characteristics that differ the most between residents of adjacent neighbourhoods. It showed that the Belval knowledge district mainly distinguishes itself from the other neighbourhoods of Esch/Alzette through the attraction of young and international professionals, which reflects the target population of the University of Luxembourg and the research centres, while dissimilarities of socio-economic status do not particularly stand out. Second, following the multidimensional definition of urban integration, labelling LSUDPs as unintegrated enclaves due to the sole observation of structural dissimilarities between neighbourhoods appears to be an overly hasty and simplistic conclusion. It can be acknowledged from these findings that LSUDPs attract a specific population group compared to the urban context – especially when the project includes knowledge institutions – which contributes to the fragmentation of the urban space. However, it does not say anything about how the population groups interact or how they perceive their urban environment. In sum, this chapter extends our understanding on the inherent structural factors that underpin the territorial fragmentation linked to knowledge-related LSUDPs. When we assume that different population profiles reflect different world views, interests, and expectations of a city, this study opens the debate about the implications of structural dissimilarities regarding the other dimensions of urban integration.

In chapter 2, I focus on the students of the University of Luxembourg – possibly the most important group of users of the Cité des Sciences – and ask how they intervene in the process of urban integration through their attachment to their study location. Indeed, the theoretical discussion on urban integration revealed that the people who live in the newly built area have the potential to contribute to the process of urban integration when they visit other neighbourhoods and start developing an attachment to place (Altman & Low, 1992; Lewicka, 2011), or a sense of belonging to the city as a whole. The formation of a collective identity is understood here as an intangible way to create links between spatial entities,

fuelled by individual mobilities and spatial appropriation (Durand, 2015). The case of the students in Belval is particularly insightful because Esch/Alzette has no preliminary ties to higher education institutions, and thus no traditional student spaces, as many other European cities do. It was therefore highly questionable whether the students successfully connect not only with their newly built university campus, but also with the city in which this campus is located. At this stage, it is important to recall that the integration of the Cité des Sciences and their users into the wider urban framework is a major objective of the redevelopment project and considered as a precondition for enabling regional political objectives of urban regeneration and post-industrial social transformations (Goedert, 2013). The study presented in chapter 2 mainly uses data from an online survey entitled 'Student life in Belval and Esch/Alzette' that I specifically designed for the purpose of this dissertation. With the aim to analyse the students' place attachment and how it is influenced by their place of residence and by socio-demographic characteristics, I relied on a combination of quantitative and qualitative methods. Findings reveal that the students' place of residence largely influences their level of place attachment. They tend to predominantly connect to their local environment, which is mostly the campus. However, I would avoid calling the Cité des Sciences a 'student bubble' (Holton, 2015, p. 25) because a significant number of students socialise outside of the campus area and identify with their university town. Mostly older, non-European students seem to connect to Esch/Alzette and potentially settle down after graduation. The part of the student population that actively contributes to the integration between the campus and the city through the establishment of place attachment cannot be neglected nor ignored. In turn, the presence of the University of Luxembourg potentially affects the social structure of Esch/Alzette in the long term. However, the limited offer of student housing and the restrictions in the students' choice of their place of residence constitutes a threat for the construction of place attachment and a sound integration between the students and the city.

Finally, chapter 3 examined the urban planning principles of the Belval regeneration project, and specifically of the Cité des Sciences that functions as main campus for the student population. The aim was to understand how the planning 'mantra' of mixed-use development (Grant, 2002, p. 71) interferes with the process of urban integration, and to what extent the combination of the two concepts leads to contradictory situations. The role of scale is determinant here. When a neighbourhood is developed according to a mixed-use model, such as the 15-minute city, we can expect reduced individual travel distances, followed by less flows between neighbourhoods, and thus an increasingly fragmented territory at the scale of the city (Pozoukidou & Angelidou, 2022). Similarly, mixed uses are associated with a higher mix of social groups that potentially have diverging expectations and representations of the urban environment they are attracted to (Casarin et al., 2023). When these expectations differ from the lived reality, the development of a lasting place attachment at a more fine-grained or human scale is problematic, which hinders the process of urban integration (Ösgård & Spierings, 2021). The empirical material is formed by a series of focus groups, during which the students discussed the places they know

and visit in Belval and in Esch/Alzette and how they emotionally connect to these spaces. This chapter used the results of a thematic analysis of the focus group transcripts, planning documents and other secondary sources to investigate the link between the conceived space by planners, and the lived and perceived space by the student population echoing Lefebvre's (1974) well-known spatial triad. The aim was to uncover potential contradictions between the objectives of urban integration and mixed-use development by considering the differing scales of action between urban planning and the students' lives. Findings revealed a strong mismatch between the students' representations of the qualities of a student campus and their lived reality. Planning documents showed that the Cité des Sciences has never been planned as a student campus, but as a mixed-use urban neighbourhood, open to various categories of users. While this is in accordance with dominant planning principles, it complicates a coherent appropriation of the space by the students, which negatively impacts their place attachment. In addition, the mixed-use planning strategy laid out at the scale of the regeneration project tends to keep the students on the campus for nearly all daily activities. However, the few elements missing in Belval, such as natural areas or alternative cultural activities, push the students to visit other places in Esch/Alzette, which then contributes to the urban integration process at the city level. In the absence of a holistic planning concept that coordinates mixed-use development on different scales (city, neighbourhood, building block), a mixed-use LSUDP risks remaining a self-sufficient enclave because the users are not incentivised to connect to the wider urban environment (and are sometimes even prevented from doing so).

The three chapters contribute to the construction of a more complete comprehension of the urban integration concept. *Figure 22* synthesises the main factors analysed in this dissertation and how they can be approached by three prisms of analysis. This representation results from the extended discussions of the present work, and I will refer to it in the following paragraphs that lay out the main messages of the dissertation.

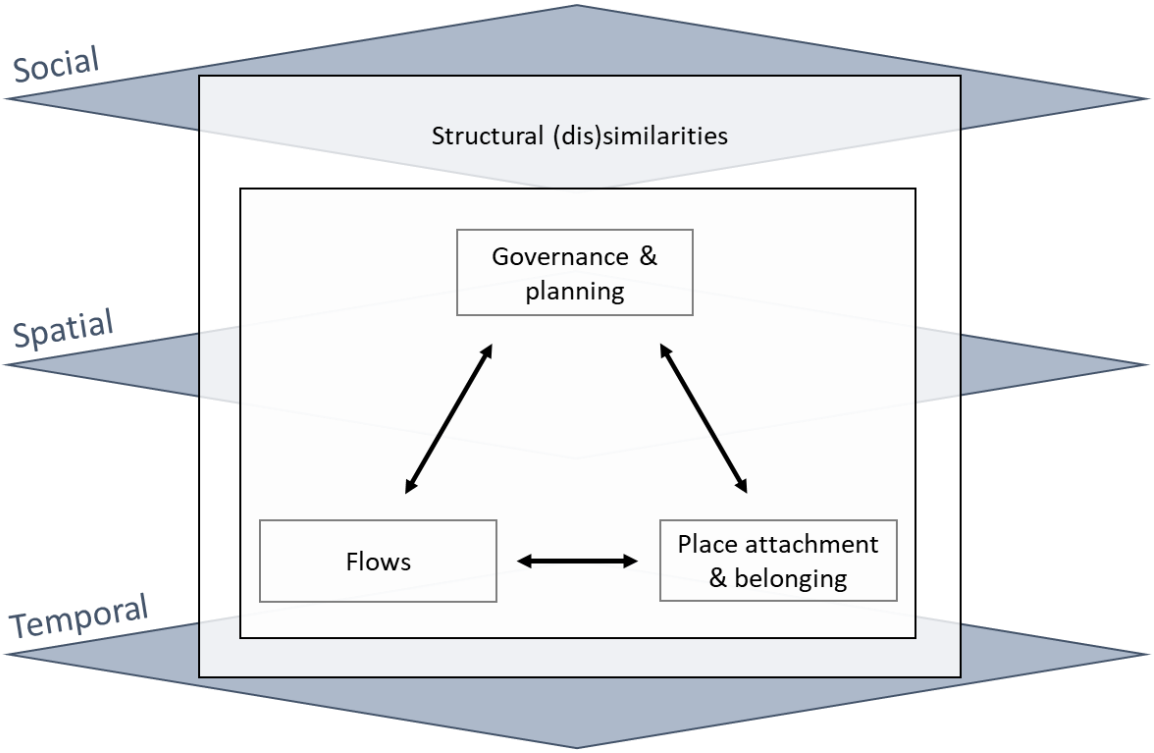

Figure 22: The analytical conception of urban integration resulting from the present dissertation.

First, this dissertation calls for an increased focus on the population that is directly impacted by the process of urban integration and, in parallel, plays an important role in this same process. The two dimensions of flows and place attachment & belonging are intimately linked (Wilkinson & Badwan, 2021) and occupy a central position in the framework. Through regular travels from A to B, people from A become familiar with place B. When these travels involve social relations or other positive impressions, people may develop an attachment that goes beyond their neighbourhood, which eventually increases the chances that they return more regularly (Yu et al., 2018). In the case of students, who often arrive in a completely new country, the exploration of new places is an important part of the 'student game' (Holton, 2015b, p. 2373). The curiosity and open-mindedness of many students, coupled with a few concrete incentives to visit different parts of the city, presents a high potential for connecting Belval to Esch/Alzette. On a longer term, the students would possibly develop a more robust collective identity to their university town.

Analysing flows and place attachment in the context of urban integration requires the elaboration of complex surveys and the organisation of discussion rounds with (future) users. Due to lacking resources, it is often neglected by developers. However, the present results have shown that meticulous scrutiny of the users' spatial practices and expectations uncovers certain elements that cannot be measured by statistical indicators and that are widely underestimated in the formation of an integrated urban space.

Second, as chapter 3 has shown, governance and planning interfere with the flows-attachment couple, forming the triad of the production of an integrated urban space (cf. Lefebvre, 1974). The political and economic strategies of LSUDPs seem to have direct or indirect effects on the mobilities of the daily users, as well as on their relationship with place. For example, ensuring functional complementarity between two areas through urban planning aims to favour exchanges and thus contribute to urban integration. However, when certain neighbourhoods are developed as functional enclaves and when the attracted users have difficulties feeling to belong to their urban environment due to an overly controlled and regulated space, urban governance hampers the process of urban integration. The production of an integrated urban space appears to be a constant negotiation between the actors of governance and the spatial mobilities and identities of the users.

Chapter 3 suggested policymakers and planners to adopt a holistic planning strategy to support urban integration. In the case of LSUDPs, holistic planning means to consider not only the objectives of the project itself, but to include challenges at different scales, such as the existing socio-economic structures of the city and region. The anchoring of the project in local and regional planning strategies and the openness towards the expectations of local communities support the process of urban integration. To understand the outcomes of urban development strategies and their consequences in the urban reality, it is crucial to confront planning documents and policy discourses to the lived experience of the users. Planning objectives have concrete effects on the people's mobilities and their relationship with place, and a critical investigation of urban integration therefore requires putting the abstract creations of planners into the context of the lived spaces.

Third, the existing structural (dis)similarities between two areas set the scene in which the more dynamic relationships of governance, flows and place attachment take place. Socio-economic dissimilarities between newly developed projects and existing neighbourhoods are a prominent method to analyse urban integration from a quantitative perspective. Using statistical indicators to calculate spatial inequalities only requires the availability of small-scale data. However, this dissertation argues that the focus on structural dissimilarities is insufficient when it ignores the underlying processes involving the relationship between the users and their lived urban environment. Therefore, a more holistic approach to urban integration would suggest using the analysis of dissimilarities as a mainly contextual element, that is necessary to understand the overall picture, but from which we should not draw direct conclusions about the people's involvement in the production of an integrated urban space.

The four dimensions presented in the analytical framework – structural (dis)similarities, governance & planning, flows, and place attachment & belonging – can be understood as factors contributing to the formation of an integrated urban space. The roles and implications of these dimensions have been analysed across the three chapters of the present work. While their interrelationships surface on multiple

occasions, it seems that the links that tie them together are far from being straightforward. It is evident that the results from one dimension cannot be extrapolated to inform conclusions about the other dimensions without making vague assumptions. For instance, chapter 1 has shown that there are highly significant dissimilarities between the Belval knowledge district and the city centre on a structural level. This could be interpreted as a barrier in terms of age- or culture-related preferences or socio-professional opportunities, leading to a strict separation of two population groups with different life-worlds. However, the results of chapter 2 indicate that the overall picture is much more nuanced. Certain groups of users are attracted by these dissimilarities and enjoy exploring areas with diverging characteristics. Some even actively choose the city centre as their place of residence over the purpose-built student residences of the Belval campus. This reflects the diversity of profiles within the population group commonly labelled as 'students' and the intra-group differences in terms of taste, habits and lifestyles.

The third chapter has also revealed potential contradictions underlying the various dimensions. When a group of students is attracted to a defined mixed-use area and identifies with the urban environment, we may observe the formation of an integrated urban space at a micro-level. But when we zoom out to the level of the city, a different interpretation emerges. When the students remain within the local area and see no need to venture to other districts of the city, we may interpret this phenomenon as an unintegrated 'student bubble', with no contact to other neighbourhoods. In the case of Belval, it has been observed that the lack of certain elements within the newly built knowledge district prompts students to explore other areas, which in turn fosters a certain connection between the district and the city.

In sum, the empirical findings illustrate the complexity of the urban integration concept and the risk to draw general conclusions from the analysis of single dimensions or aspects. Therefore, as depicted in Figure 22, I suggest incorporating an additional analytical layer into the presented framework, which details three prisms of analysis through which the dimensions can be systematically approached:

- Social prism: the process of urban integration varies according to the characteristics, preferences and perceptions of the social groups considered in the analysis.
- Spatial prism: urban integration depends on the geographical scale of the analysis.
- Temporal prism: as a dynamic process, urban integration is affected by the underlying time dimension, resulting in different effects at different points in time.

In the following section, I attempt to answer the initial research question of the dissertation by suggesting to conceive the process of urban integration through the aforementioned prisms. My aim is to illustrate how the four dimensions of urban integration can have different effects on the urban space, depending on the scale of analysis, the time of analysis, and the social categories taken into consideration. These reflections will lead to a more complete understanding of the urban integration process, which may provide insights for urban planners and pave the way for future research.

The initial research question was as follows: ‘How can the Cité des Sciences and the city of Esch/Alzette form an integrated urban area?’. At this stage, we acknowledge that the four dimensions do not provide any straightforward answer to this question. Given the multiplicity of interrelationships between them and the potential for contradictory outcomes, it is necessary to introduce an additional layer of complexity to the conceptual understanding of urban integration. I propose that we begin with our initial definition of urban integration. In order to form an integrated urban area out of two entities, it is necessary to (i) reduce structural dissimilarities, (ii) increase exchanges, (iii) harmonise the governance and planning strategy with local needs and expectations, and to (iv) foster collective attachment. By considering the various analytical prisms, we can achieve a more nuanced and multifaceted understanding of the overall scheme.

Structural dissimilarities are directly related to the development of knowledge-based LSUDPs and the notion of urban regeneration. The primary objective of such projects is to provide employment or educational opportunities for local populations and to attract a highly qualified external workforce to a region that is struggling with post-industrial disinvestment. It is therefore to be expected that there will be dissimilarities between the attracted population and the local communities. This is an inherent part of the regeneration strategy. It is also the main rationale behind numerous studies that have accused LSUDPs of forming disconnected enclaves or islands within the urban realm. However, as shown in chapter 1, not all indicators describing the socio-demographic or socio-economic situation are equally affected by this phenomenon. There are strong reasons to believe that, in other contexts, findings come out differently depending on development objectives and local structures. As viewed through a social prism, the role of structural dissimilarities in the urban integration process varies according to the social categories and social indicators. Similarly, this dimension is also fundamentally affected by the spatial prism because the measurement of dissimilarities depends on the scale of the analysis. Structural inequalities between cities should be interpreted differently than those between neighbourhoods or housing blocks. As with all geographical indicators, dissimilarities are only applicable to a defined spatial scale and it is often the case that we do not know anything about other potential levels of investigation. Finally, structural dissimilarities also vary with time. In the case of urban regeneration projects, policymakers seek to achieve long-term convergence of structural dissimilarities, which is often synonymous with a slowly emerging gentrification process affecting neighbouring areas. In order to gain a more comprehensive understanding of the spatial and temporal prisms, it is essential to conduct in-depth studies on the different scales of dissimilarities and their long-term evolution in the context of urban integration.

An integrated urban area also requires an internal functional complementarity, resulting in flows of people and exchanges between sub-areas that tie them together. The emergence of enclaves without any links to neighbouring areas is diametrically opposed to the notion of integration. In the case of Belval and Esch/Alzette, it is therefore a crucial task for urban planners to highlight the qualities of the city

centre among the recently arrived population in Belval, in order to attract them and foster interdependence and network building. Alternative spaces that attract certain population groups and that cannot be found in Belval should therefore be supported in the city centre. Examples of such initiatives already in existence include shops selling local products, events destined to a diverse range of cultures and spaces dedicated to alternative forms of cultural expression. To promote the attractiveness and exchanges, planners need to gain an understanding of the diversity of needs and mobility patterns across various social groups. There is no doubt that people flows are to some extent contingent upon policy and planning decisions. For example, the decision not to plan any appealing green areas in the Cité des Sciences has led students to explore other areas in Esch/Alzette, while the development of a commercial centre in Belval has resulted in them remaining locally for daily purchases. However, individual preferences remain a significant factor in the equation. We have seen that not all students respond in the same way to these contextual situations. While some of them appreciate the proximity of a commercial centre, others prefer a denser and more diverse public space for shopping activities and daily strolls. Individual preferences may therefore have a completely different effect on the urban integration process and there is no universal planning-related recipe to guide people flows. In order to analyse urban integration through flows of people, we also need to determine the scale of observation. There is a fundamental difference between intra-neighbourhood flows, that contribute to enhanced coherence at the neighbourhood level in accordance with the 15-minute city model, and inter-neighbourhood or even inter-city flows. The latter foster integration at the level of a region, which has of course completely different implications for urban planning. In order to achieve a better understanding of how regional-scale integration of LSUDPs impact social structures of entire regions, further research is needed. Furthermore, flows of people are linked to individual habits and respond to external changes with a certain delay. Routines and habits evolve over time, and the role of planners is to facilitate the spontaneous development of exchanges between two areas over a certain period. This point is thus directly linked to the governance & planning dimension and requires an in-depth analysis of people's needs and activity patterns.

The call for a more holistic and more democratic governance and planning strategy is key to achieve an integrated urban space. Instead of making technocratic decisions in planning offices following a more or less well-defined economic or functional 'rationality', planners should focus their efforts on understanding the needs of local communities. Involving the public in the planning process and empowering them fosters exchange, acceptance, and attachment, which contributes to the overall process of urban integration. It is too often ignored that territorial governance does not affect all social groups in the same way. The transformation of the Belval brownfield into a mixed-use urban neighbourhood may be perceived positively by employees who work in the area during daytime hours, whereas students who expected a more lively and dense student campus have different views. And even within the student population, individuals may hold diverging interests and lifestyles, as evidenced by

the findings of chapter 2. Ultimately, the outcomes of urban planning decisions favour certain population profiles and risk overlooking others. Future studies could focus on this aspect and explore the consequences of urban planning decisions for different social groups and what this means for the formation of an integrated urban space. Then, urban development projects also play a different role in the integration process according to the scale of investigation. Chapter 3 has shown that the planning of student housing in and around Belval contributes to the overarching objective of urban integration when viewed from the perspective of the city of Esch/Alzette, or the region as a whole. However, at the level of the individuals living and studying in the Cité des Sciences, the overly planned and top-down managed campus area hinders students from freely appropriating the urban space. Lastly, the temporal prism emphasises the necessity of including the urban integration of LSUDPs into a more general development scheme from the outset of the project. Subsequent adaptations seem rather complicated in this regard, particularly in the absence of urban integration as a primary development objective. In turn, the positioning of governance and planning decisions in their temporal contexts is an important element in comprehending the outcomes of urban integration processes.

Finally, an integrated urban area must foster a sense of belonging and inclusion among its users. The emergence of a collective attachment and a senseful relationship between users and their urban environment can facilitate the subjective, psychological integration of an area. In the context of Esch/Alzette, policymakers could foster this evolution by adapting municipal services and communications to the ever-greater diversity of international populations, including students. For instance, the promotion of events in English (the language most commonly spoken on the university premises) would possibly make students feel more welcome, thereby enhancing their identification with the local realm. Furthermore, the focus group meetings revealed that students require more space to allow a sound development of student life. This could be achieved through a more voluntaristic promotion of alternative housing models or a clearer representation of Esch/Alzette as the principal student town in Luxembourg. This could potentially result in students identifying not only as members of the University of Luxembourg, but also as ‘Escher’ citizens. However, the three additional prisms of analysis caution against an overly simplistic and straightforward process of urban integration through place attachment. As revealed in chapter 2, the observed student profiles reflect differing forms of place attachment. Some students demonstrate a certain potential to develop ties with the city centre of Esch/Alzette, whereas others are much more centred on the campus area, their hometown, or Luxembourg City. While acknowledging that not every student identifies with Esch/Alzette and intends to settle there after their studies, planners should support those who do so and limit potential barriers. In the case of the student population, the process of place attachment is a particular challenge due to the limited timeframe. The majority of students reside in the area for two or three years, which underlines the crucial role of the temporal prism in the analysis of place attachment. Future studies could take a closer look at the mid- or long-term evolution of place attachment among other social groups in order

to better understand the role of the time spent in a certain area in the process of urban integration. Last but not least, it is important to clarify the scale of investigation in such analyses. There is a potential for confusion between developing place attachment to the local urban environment and to the city as a whole. While the former is more closely associated with daily practices and routines, the latter often requires a more profound relationship and can be facilitated by tangible actions from planners or developers.

In conclusion, the previous paragraphs have demonstrated the intricate nature of the urban integration process and the intertwined dimensions that comprise it. The three prisms of analysis play an active role in the overall process and must be clearly delineated in the analytical process. This reveals the considerable potential of the present framework for future studies in the field of urban integration.

However, it also shows that any response to our initial research question is necessarily incomplete. What can we say about the urban integration between Belval and Esch/Alzette? Previous works advanced serious doubts on the possibility of the two areas to form a coherent entity because of the specific governance and planning constructs around the regeneration of Belval that have very little in common with local city-level development (Leick et al., 2020) and because of the physical distance that prevents a coherent urbanistic connection. The present dissertation provides the necessary depth to this discussion. By starting with a call for a multidimensional conception of urban integration, it proposes an analytical framework, followed by empiric evidence on structural dissimilarities, the users' place attachment, and the impact of urban planning on the lived reality. On the bottom line, the case of Belval and Esch/Alzette mainly confirms advances from the scientific literature on LSUDPs that their urban integration is rather problematic or – at least – that the observed outcome is not in accordance with the initial objectives of urban integration. On the contrary, the Belval regeneration project created a socio-professional discontinuity on the intraurban scale, due to the attraction of students and other international academics. The specific expectations of this population, the low attractive potential of the city centre of Esch/Alzette (compared to Luxembourg City for example), the mixed-use planning strategy at the scale of the project, and frequent mobility issues reported by the students contribute to relatively rare human exchanges between the users of the Cité des Sciences and the local communities of the older neighbourhoods. In addition, many students experience difficulties to develop an attachment to their university location, partly due to exclusive and top-down urban planning and management processes.

However, it is important to highlight some nuances that my findings reveal. A few signs of an ongoing integration process are visible, such as a certain form of identification with the city of Esch/Alzette that some students described. The localisation of student residences in the city centre, whose number will rise in the future, contributes to off-campus student activities. In addition, the fact that the campus area is overly planned and regulated might push students to explore alternative areas for their activities in

other neighbourhoods. These pioneering elements indicating the establishment of a certain socio-spatial connection should not be underestimated as they might contribute to an acceleration of the integration process in the medium or long term. Many students appreciate their study environment and would like to explore new places. The multiplication of student-friendly events or shops and enhanced public transport connections (especially in the evenings and on weekends) could be possible levers to attract more students to the city centre of Esch/Alzette.

While these findings extend our understanding on the urban integration of LSUDPs and the concrete effects for the users, it should be highlighted that they come with a few caveats. As mentioned before, the temporal prism of urban integration could not be included in the empirical study. The integration process is inherently dynamic, with each dimension exhibiting distinct temporalities. Mobility flows undergo relatively rapid change over time, as they are influenced by infrastructure projects, or the opening of a commercial centre, for example. The emergence of place attachment among the population has a considerably longer temporality, as discussed in chapter 2. It can take several months or years for individuals to become familiar with a place and feel a sense of belonging. Similarly, governance and planning strategies evolve at a relatively slow pace, despite the supposedly dynamic nature of masterplan projects. Political and planning objectives initiated at a certain point in time are rarely subject to fundamental questioning during the development process. Finally, social and economic structures appear to have the longest temporality in the process of urban integration. They are formed by the people and the activities in a certain area and often remain stable across several generations. Contemporary urban development projects and socio-spatial processes (such as gentrification) challenge the rigidity of these social structures, yet changes are only visible in a long-term perspective. While the findings presented in this dissertation always need to be perceived with this important shortcoming in mind, they remain highly relevant as they provide multifaceted empiric material at a certain point in time. In addition, they may guide future research on the relationship between Belval and Esch/Alzette, that will add to our understanding of the ongoing processes and clarify whether we experience increasing integration or fragmentation of the urban space. More generally, the temporal component in the analytical framework suggests developers or urban administrations to install competent monitoring systems able to observe the evolution of integration and fragmentation processes all along the development period. To do this, efficient data collection systems are needed and continuous exchange with different groups of users and stakeholders involved in the area should be promoted.

Another shortcoming of this dissertation is linked to the analytical framework, that is a simplified representation of the process of urban integration. The aim was not to constitute a universally accepted model that covers all potential aspects of urban integration, but to compose an operational framework

that grasps the main factors and dimensions. While it constitutes a solid basis for the analysis of the Belval case, there is no doubt that it can be further refined or extended.

Future research could also highlight the role of different population groups living in Belval, that tend to be overlooked in my dissertation. For feasibility reasons, I chose to focus on the student population and the conclusions drawn from this analysis do not automatically apply to other groups of users. To give an example, investigating the role of local communities that have lived for a long time in Esch/Alzette in the integration process could provide promising complementary results. Do they connect with the newly built neighbourhood and appropriate it? In what sense is their relationship with place different to the one of the new users? These questions might provide further insights and perspectives to the process of urban integration. The diversity of the Belval users is not entirely represented by the student population. Even though the resident population is comparably homogeneous (at least for what concerns the part located in Esch/Alzette) and characterised by a young, international and professional profile, we know very little about other groups, such as non-academic employees or elderly people. The adjoining commercial centre also attracts various groups of users, such as teenagers from the local high school or families with children. I assume that the student population has among these users the highest potential to create links with the city centre of Esch/Alzette, but we cannot draw definite conclusions on the other users without empirical evidence. The present work should therefore not be conceived as a study of general benefits and shortcomings of the Belval regeneration project as seen by a representative sample of its users, but rather as an attempt to formalise the analysis of urban integration from the point of view of an important, yet underrepresented population group. It suggests planners to adopt a more user-centred approach by actively involving future users into the development process.

Finally, as with all case studies, we should also be careful when translating the present findings to other contexts. While all three chapters provide original insights in specific research fields and nuance previous advances, these conclusions are not necessarily applicable to other cases, especially since the local contexts always play a major role, as mentioned before. Nonetheless, most of the findings are useful to be shared as they can help better identifying potential pitfalls in the design of LSDUPs. In addition, the multidimensional analytical framework, as well as the suggested methodologic tools used in this dissertation are perfectly suitable to be applied elsewhere. The proposed conception of integration can even be further extended and generalised for other situations that do not necessarily involve LSUDPs.

Integration is a widely shared objective supported by nearly all political colours. Whether speaking about urban areas or population groups, integration leads to homogeneity, connectedness, and stability. As a normative concept, integration is presented as a universal goal to achieve and the critical distance to the concept is often missing. Therefore, any analysis involving the integration of social groups or

socio-spatial entities needs to build on a clear understanding of the underlying processes. This means disentangling the political and sociological interpretations of integration and acknowledging the social consequences. Most importantly, the role of power relations between social groups needs to be better apprehended and included in the overall discussions. Indeed, integration is an 'inherently uneven process' (Lee, 2009, p. 387) that targets marginalised groups and pressures them to adapt to a given norm. Already in the 1960s and 70s, post-structuralist philosophers, such as Michel Foucault or Robert Castel, criticised practices of social integration and social control as repressive institutional tools to make people fit in (Rhein, 2002). Uitermark (2014) claims that integration policies are a typical Western European way to deal with marginalised neighbourhoods through social mixing and control. '[I]ntegration refers to the forces that keep [society] together. […] The polyvalence of the concept enables policymakers at different administrative scales and policy domains to use it as a guiding rationality for exercising control over marginalized areas.' (Uitermark, 2014, p. 1423). Instead of further repressing already segregated areas, and thus running the risk of uncontrolled social unrest, governments turn to integration policies in which urban planning plays a major role. For example, urban regeneration initiatives targeting deprived neighbourhoods and the deliberate planning of mixed housing types foster the integration of minorities through dilution and social mixing (Casarin et al., 2023; N. Smith, 2002; Uitermark, 2014). In contemporary urban planning, social mixing has become a widely promoted practice, that is embedded into laws and planning regulations. The recently signed coalition agreement of the Luxembourg Government posits that social mix has to be guaranteed in public housing projects (Le Gouvernement luxembourgeois, 2023). According to Ruiz-Tagle (2016), the planned cohabitation of sociodemographic groups can be understood as 'neoliberal strategies with underlying objectives of gentrification and social control' (p. 36). In addition, it is highly questionable whether the socially diverse population groups actually mix or simply form a social heterogeneity at a defined scale. Social mixing policies only lead to spatial proximity, which is not a satisfying indicator for social exchange and integration, as studies have shown for a long time (Chamboredon & Lemaire, 1970; Rhein, 2002).

While socially and economically balanced neighbourhoods are political priorities, we should avoid seeing integration processes as universally favourable transformations. They often mask social and economic realities at different scales and go hand in hand with harmful social effects. For example, integration and social mixing policies weaken cultural and community attachment when they imply assimilation to the norm (Bolt et al., 2010; Ruiz-Tagle, 2013). Similarly, one way to achieve the integration of segregated neighbourhoods is to attract different population groups with the aim to achieve a higher degree of heterogeneity. In this form, integration echoes a process of state-led gentrification (Uitermark et al., 2007), which gradually increases pressure on the housing market and modifies the neighbourhood's commercial and social structure. This shows that integration does not have exclusively beneficial effects for all layers of the urban society. At the same time, segregation can be beneficial for

certain groups that rely on local social networks, associations and identities (Wacquant, 1997; Ruiz-Tagle, 2013).

This critical reflection on integration can be translated to the case of LSUDPs and their integration into the urban environment. The motivation behind the integration process is less the prevention of social unrest and segregation, than the wish that the growth dynamics initiated by public investments in a specific area have beneficial effects on a wider urban or regional scale. However, the risk to enable a process of gentrification through this objective of urban integration remains high, especially when the surrounding areas are characterised by marginalised population groups. For example, if the integration process between the Cité des Sciences and Esch/Alzette accelerates, with more students and academics visiting and appropriating the city centre, find places to live there and establish themselves as a major population group, we will assist at a deconstruction of dissimilarities, but also at a structural social change that could become problematic for less fortunate groups in the long term. Recently, the local housing market already experienced an extreme increase of rents and selling prices for flats (even compared to the national level) (Birsens et al., 2023), and there are strong arguments to believe that the increased attractiveness of the city is linked to the establishment of the Cité des Sciences. A process of urban integration would thus additionally intensify the pressure on the housing market, with considerable social impacts, such as relegation and displacement pressures felt by the most vulnerable. The commercial structure and the rhythms of urban life would also be affected by increased integration of the Cité des Sciences (D. P. Smith, 2005). It can be questioned whether there would be space left for industrial or manufacturing activities in the former working-class city because of an increased attractiveness for high added-value activities. This situation remains hypothetical as of today, but it shows that the process of integration between LSUDPs and post-industrial urban structures risks to have harmful effects on existing communities. Twenty years after the start of the redevelopment project, urban integration remains fairly limited, but a certain real estate pressure is already visible in the areas between the Cité des Sciences and the city centre. The fact that a new health cluster composed of health tech startups, living labs and a hospital is currently being developed in the north-west of the city is not a coincidence, but a clear influence of the proximity of the university district. Other private development projects focusing on housing and offices are currently being planned in Esch/Alzette, which marks the future orientation and growth of the city.

Following this, we should avoid conceiving urban integration as a universal goal in urban politics and always critically investigate its formalities and concrete socio-spatial consequences. The analyses presented in this work show that the emerging discussions open a much broader debate that goes beyond the initial research question. Instead of asking how the Cité des Sciences and Esch/Alzette can form an integrated urban space, we can ask at present how urban planning and policy could mitigate the negative side-effects caused by a process of fragmentation on the one hand, and by a process of integration on

the other. As we have seen, both excessive fragmentation and excessive integration come with certain threats for the urban structure that need to be included in the assessment.

LSUDPs are often rightly accused of causing urban fragmentation by attracting an international and qualified population, by lacking a holistic approach that implicates surrounding spaces and communities, and by blocking appropriation and identity formation. However, both researchers and urban planners should not conclude from these observations that a complete integration of LSUDPs into the city is the ultimate urban planning goal. Especially when they involve knowledge- or culture-related activities in the context of small-scale post-industrial cities, the increased attractiveness for highly qualified segments of the population risk to cause community disruption and displacement. Urban planners need to ask themselves to what extent the urban integration of a LSUDPs is viable for the local context, and how they can counteract threatening side-effects. This dissertation contributes to a better understanding of the underlying mechanisms of urban integration and the factors that need to be considered. By monitoring the needs and expectations of both existing and newly attracted populations, by acknowledging urban planning as a holistic endeavour that includes socio-spatial transformations at different scales, and by considering the specificities of the local context, planners of LSUDPs could better meet the objective of creating an integrated urban space that is more just and respectful to existing structures.

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APPENDICES

Appendix 1: Original quotes

Page number	Reference	Original quote
p. 1	Feyereisen, 2022, p.20	„Mit diesem Projekt wurde für Esch etwas nachgeholt, das bei der Gestaltung von Belval damals verpasst wurde : erstens einen ordentlichen Urbanismus und zweitens, dass das historische Esch mit dem neuen Esch verbunden wird“
p. 1	Feyereisen, 2022, p.20	„Das Allerwichtigste ist definitiv die Verbindung zwischen Esch und Belval – das ist für Esch-Zentrum überlebenswichtig“
p. 1	Chaty, 2022, p.8	« Cette liaison permet aux gens qui travaillent, qui font leurs études ici à Belval de rejoindre le centre historique d'Esch facilement, pour sortir le soir, faire du shopping. Cela va contribuer à améliorer la vie à l'intérieur de cette ville »
p. 3	Feyereisen, 2022, p.20	„Jetzt hätten beispielsweise die Escher Studenten auch die Möglichkeit, zu Fuß oder mit dem Fahrrad ins Escher Zentrum zu kommen“
p. 3	Poos, 2013, p.30	« Intégrer Belval entièrement dans les tissus urbains respectifs d'Esch-sur-Alzette et de Sanem, afin d'arriver à un modèle polycentrique plutôt qu'à la création d'une « nouvelle ville », est une mission commune des acteurs du projet Belval. […] L'intégration de l'Université dans la Ville et l'interaction entre Esch/Belval et la population des autres quartiers de la ville est primordiale pour assurer la cohésion sociale. »
p. 8	Rey, 2001, p.255	« Opération par laquelle un individu ou un groupe s'incorpore à une collectivité, à un milieu »
p. 9	Lalande, 2010 [1926], p.521	« l'établissement d'une interdépendance plus étroite entre les parties d'un être vivant, ou entre les membres d'une société. »
p. 11	Brunet, 1997, p.11	« mettre en connexion, assurer les interrelations, effacer les ruptures et les distances entre éléments qui, néanmoins, conservent leur être. »

p. 97	Le Fonds Belval, 2006a, pp. 14-15	« L'université dans la ville et non la ville ou encore le quartier exclusivement universitaire, ni le campus universitaire des années soixante à l'écart de tout. L'université comme normalité urbaine, comme faisant partie de la ville. […] Ceci permet d'inventer une nouvelle approche, une approche qui crée une liaison intrinsèque entre la ville et l'université conduisant à l'intégration totale de l'université dans le tissu et les activités urbaines. La ville est conçue et se construit avec l'université, les deux se confondent. »
p. 98	Le Fonds Belval, 2004b, p. 32	« cloisonnement socio-professionnel »
p. 99	Delwiche, 2010, p. 43	« La mixité des fonctions est une de nos premières priorités et lorsque nous commercialisons des terrains, nous attachons autant d'importance au prix qu'au programme et à l'architecture du projet que les investisseurs veulent y développer. […] Pour créer cette mixité, nous avons découpé l'ensemble du site en quartiers ayant chacun leur propre spécificité. »
p. 101	Le Fonds Belval, 2006b, p. 16	« L'université fait partie de ces institutions qui attachent une grande importance à leur identité publique. Cet attachement à la qualité de l'image traduit son souci d'excellence dans le domaine de la recherche et de l'enseignement. »
p. 102	Le Fonds Belval, 2010, p. 8	« renforce la beauté des objets »
p. 104	Le Fonds Belval, 2013b, p. 16	« un lieu d'interaction, d'échange, de rencontres informelles, un espace flexible à disposition des étudiants mais aussi de toute autre personne susceptible d'y passer un peu de temps »
p. 105	Le Fonds Belval, 2004b, p. 31	« Un lieu éminemment savant réservé à un cercle d'érudits, une élite d'intellectuels qui vivent en vase clos. Telle est l'image que l'université […] a par trop longtemps transportée. Le concept de la Cité des Sciences se détache de cette vision. Elle se destine à devenir un lieu exceptionnel, accueillant pour les visiteurs occasionnels et permanents, par son atmosphère conviviale et par l'importance de l'offre qu'elle propose ainsi que par la qualité de ses infrastructures. Son offre couvrira une large palette d'intérêts et va attirer un large public. »
p. 105	Le Fonds Belval, 2006b, p. 17	« Les auditoires désuets, les salles de cours dégradées et les laboratoires vétustes, les immeubles délabrés parfois que l'on a connus et que l'on connaît encore dans certaines universités, principalement en raison du manque de moyens mais également à cause de la désinvolture de trop d'étudiants qui traduisent une décadence certaine d'une mentalité universitaire par trop nivelée »

p. 105	Le Fonds Belval, 2014a, p. 10		« A observer les nombreux visiteurs, la fête des hauts fourneaux a révélé une chose essentielle : le site est un endroit agréable. Le public se sent à l'aise malgré le gigantisme du lieu. »
p. 106	Le Fonds Belval, 2006c, p. 20		« pour éviter la création d'un ghetto »

Appendix 2: Questionnaire of the online survey

Student life on the Belval site and in Esch-sur-Alzette

Understanding the relationship between University of Luxembourg students and their study location.

Hello and welcome dear participant!

This survey is part of a study about the **students' lives** in Belval and Esch-sur-Alzette, and their relationship with their university location. This research is based on **YOUR experiences and views**, which makes your **participation** extremely valuable.

The survey has been elaborated by Joe Birsens, PhD candidate at the Luxembourg Institute of Socio-Economic Research (LISER) and the University of Luxembourg.

Most of the questions in this survey are about your **daily activities** and your **perceptions** of the Belval site, and the city of Esch-sur-Alzette. In addition, you will be asked about your current and past **residential situations**. In the final section you can optionally register for the second part of the study and participate in a discussion group.

With your help, we can develop a better understanding of how students use the spaces around their study location, which might lead to an improvement of the student experience in Belval and its surroundings.

The only condition to participate in this study is that you are a student (BA, MA or PhD) at the University of Luxembourg.

Thank you for your participation and support!

Declaration on data protection

The participation to this survey is not mandatory and based on your consent.

What is the purpose of the survey?

In the framework of his doctoral thesis, the researcher studies the daily spatial practices and perceptions of students, as well as the relationship they develop with the place they live and study in. In the case of the University of Luxembourg in Belval, this is a highly relevant issue for the urban development of the city of Esch-sur-Alzette.

What categories of personal data will be processed?

The questionnaire consists of four parts that aim to collect different categories of data:

- General information, such as gender, age group and level of study;
- Current residential situation and past residences;
- Daily activities in Belval, Esch-sur-Alzette or elsewhere;
- Personal views on Belval and Esch-sur-Alzette.

If you choose to participate in the second part of the study, your email address is necessary for sending out the invitations to the group discussions.

Your answers to this survey will be collected and analysed for research purposes only.

If you are not a suitable candidate for the second part of the study, your collected data will be anonymized, and your email address will be deleted.

Who has the control over my data?

The processing of your responses is managed by the Luxembourg Institute of Socio-Economic Research (LISER). For further information, you can contact the researcher by email: joe.birsens@liser.lu.

Lawfulness

The processing of your personal data is based on your consent according to the article 6. 1) a) of the General Data Protection Regulation (EU) 2016/679.

Who can access my responses?

The database that contains your responses and contact information is hosted by LimeSurvey and stored on servers located in Germany. The researcher is the only person accessing the responses. However, he does not have direct access to the email addresses

At the end of the collection phase, the data is transferred to servers at LISER and deleted from LimeSurvey.

Will the data be shared outside of the European Union?

Personal data will not be shared outside of LISER. LISER is a public institution under strict confidentiality conditions.

How long do you keep my data?

The results of the analysis of your responses, in aggregated form, may be disseminated in scientific publications. For replicability issues, the collected and pseudonymized data has to be archived for five years following the end of the study. The study is planned to last until the end of 2022.

What are possible risks of taking part?

The protection of your data is a top priority at LISER. The potential risks in taking part in the study are very low. Should you have any questions or concerns, please contact us (see contact details below).

What are the possible benefits of taking part?

The participation in this study can be an opportunity for you to reflect on your experiences in, and views about, your university location.

If you register for the second part, it can be an asset to discuss your and other people's experiences in small groups. The experience of participating in a discussion group and the direct contact with researchers may also be beneficial for your own student career.

What are my rights?

LISER engages itself to facilitate the exercise of your following data protection rights: Access right; Modification right; Erasure right; Opposition right or Limitation of the processing.

- To inform yourself about your rights, you can click here.
- To exercise those rights, please contact LISER (see contact details below).

Furthermore, if you are not satisfied with the response, you are allowed to lodge a complaint to the Luxembourg supervisory authority, la Commission Nationale pour la Protection des Données (CNPD) – www.cnpd.lu

Who should I contact for further information?

If you have any questions or require more information about this project, please contact Joe Birsens who is responsible for the study setup and data processing: joe.birsens@liser.lu.

If you have any questions about data protection, please contact the LISER DPO:

- Email: dpo@liser.lu
- Mail: LISER – DPO, 11 Porte des Sciences, L-4366 Esch-sur-Alzette

□ By ticking this box, you consent to the processing of your data for research purposes under the conditions specified above.

1. General information

In a first step, you are asked to answer some general questions about yourself.

Q01: To which gender do you identify?

- Female
- Male
- Other

Q02: Please indicate what age group you currently belong to.

- 20 years or less
- 21 – 23 years
- 24 – 26 years
- 27 years or more

Q03: What is your nationality?

! *When you have more than one nationalities, please choose one of them.*

! *If your nationality is not listed, please choose 'Other'.*

- Luxembourgish
- French
- Belgian
- German
- Portuguese
- Italian
- Spanish
- Romanian
- Greek
- Chinese
- Indian
- Other

Q04: [if Q03 == Other] What is your nationality? Please choose the continent corresponding to your nationality.

- Africa
- Asia
- Australia
- Europe
- Northern America
- Southern America

Q05: [if Q04 == Europe] What is your nationality? Please choose whether your nationality is from the European Union or not.

- EU
- Not EU

Q06: What is your current level of study?

- ○ Bachelor
- ○ Master
- ○ PhD
- ○ Other

Q07: For how long have you been registered at the University of Luxembourg?

- ○ Less than 1 year
- ○ 1 to 3 years
- ○ 3 years or more
- ○ Currently, I am not registered at the University of Luxembourg

Q08: What university campus(es) do you attend?

! *Check **all** that apply.*

- ☐ Belval
- ☐ Kirchberg
- ☐ Limpertsberg

2. My current residential situation

In the second part, you are asked about your place of residence during your studies at the University of Luxembourg, as well as your past residences.

Q09: Where is your current place of residence? Please choose your country of residence.

! *When you currently have more than one place of residence, please choose the one you usually live when you go to the university campus in Belval.*

- Luxembourg
- France
- Belgium
- Germany
- Other

Q09a: [if Q09 == “Luxembourg”] Where is your current place of residence? Please choose the name of the municipality.

! *Please refer to the place you usually live in while going to the university campus in Belval.*

- Drop-down list of all municipalities

Q09b: [if Q09 == “France”] Where is your current place of residence? Please choose the name of the municipality.

! *Please refer to the place you usually live in while going to the university campus in Belval.*

- Drop-down list of selected municipalities

Q09c: [if Q09 == “Belgium”] Where is your current place of residence? Please choose the name of the municipality.

! *Please refer to the place you usually live in while going to the university campus in Belval.*

- Drop-down list of selected municipalities

Q09d: [if Q09 == “Germany”] Where is your current place of residence? Please choose the name of the municipality.

! *Please refer to the place you usually live in while going to the university campus in Belval.*

- Drop-down list of selected municipalities

Q10: [if Q09a == “Esch-sur-Alzette” OR “Belvaux”] Is your current place of residence located on the Belval site?

! *Please refer to the place you usually live in while going to the university campus in Belval.*

- Yes (*zip codes of the Belval site: 4360, 4361, 4362, 4363, 4364, 4365, 4366, 4367, 4368, 4369, 4370, 4371, 4372, 4373, 4374, 4375, 4408, 4409, 4457*)
- No

Q11a: [if Q10 == “Yes”] For how long have you been living on the Belval site?

! *If you have lived in different places on the Belval site, please consider the total number of years.*

- Less than 1 year
- 1 to 3 years
- 3 to 6 years
- 6 to 10 years
- 10 years or more

Q11b: [if Q09a == “Esch-sur-Alzette” AND Q10 != “Yes”] For how long have you been living in Esch-sur-Alzette?

! *If you have lived in different places in Esch-sur-Alzette, please consider the total number of years.*

- Less than 1 year
- 1 to 3 years
- 3 to 6 years
- 6 to 10 years
- 10 years or more

Q11c: [if Q09a != “Esch-sur-Alzette” AND Q10 != “Yes”] For how long have you been living in this municipality?

! *If you have lived in different places in this municipality, please consider the total number of years.*

- Less than 1 year
- 1 to 3 years
- 3 to 6 years
- 6 to 10 years
- 10 years or more

Q12: In what type of residence do you currently live?

- Student residence
- Shared flat or house
- Privately rented flat or house
- My parents’ home
- My own home (property)
- Other

Q13: How many people live in your household?

_____

Q14: [if Q09a != “Esch-sur-Alzette”] Before moving to your current place of residence, have you previously lived in Esch-sur-Alzette?

- Yes
- No

Q15: [if Q14 == “Yes”] For how long have you been living in the municipality of Esch-sur-Alzette?

! *If you have lived in different places in Esch-sur-Alzette, please consider the total number of years.*

- Less than 1 year
- 1 to 3 years
- 3 to 6 years
- 6 to 10 years
- 10 years or more

Q16: [if Q10 != “Yes”] Before moving to your current place of residence, have you previously lived on the Belval site?

- Yes (*zip codes of the Belval site: 4360, 4361, 4362, 4363, 4364, 4365, 4366, 4367, 4368, 4369, 4370, 4371, 4372, 4373, 4374, 4375, 4408, 4409, 4457*)
- No

Q17: [if Q16 == “Yes”] For how long have you been living on the Belval site?

! *If you have lived in different places on the Belval site, please consider the total number of years.*

- Less than 1 year
- 1 to 3 years
- 3 to 6 years
- 6 to 10 years
- 10 years or more

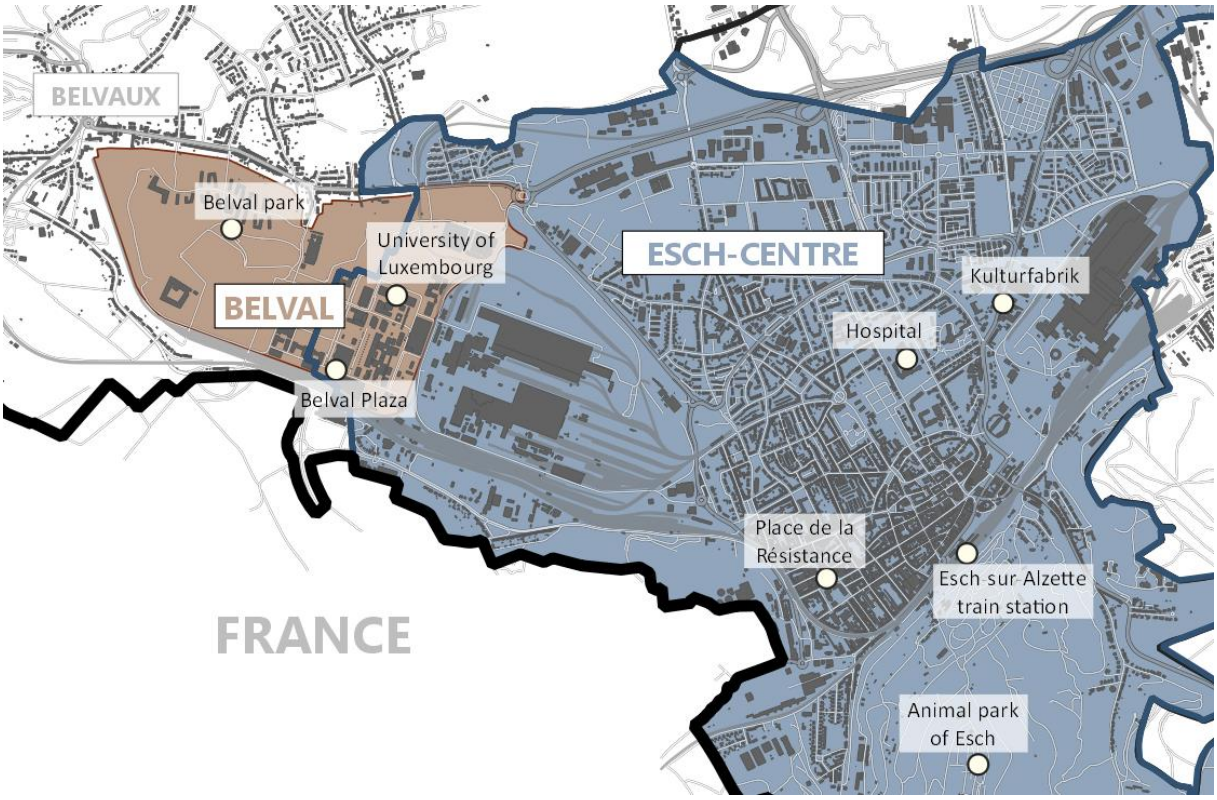
Q18: In what country have you spent the most time of your life so far?

- Drop-down list with all countries.

3. My daily life in Esch and Belval

In this section, you are asked about your daily activities and your involvement in different places. The Belval site stretches over two towns (Esch-sur-Alzette and Belvaux). In the questions, it is sometimes distinguished between "Belval" and "Esch-centre" (see map below):

- "Belval" refers to the entire Belval regeneration site, including Esch-Belval and Belvaux-Belval.
- "Esch-centre" refers to any location in Esch-sur-Alzette, except the part on the Belval site.



Q19: When you have to study for a class, you go to…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence[15]	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

[15] Remove for those who live in Belval, Esch-centre, Luxembourg City

Q20: You go shopping in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q21: For your personal services (hairdresser, bank, doctor, …) you go to…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q22: You go out to have dinner in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q23: You go out to have a drink in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q24: You go out to a party or a nightclub in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q25: You go for a walk in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q26: You go to the cinema or theatre in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q27: You go to a public event in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q28: You visit a family member in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q29: You visit a friend in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q30: Do you currently have a professional occupation in parallel to your studies?

! *Paid or voluntary occupation. In case of multiple occupations, please refer to the one you spend the most time with.*

- Yes (including employed PhD candidates, student workers and volunteers)
- No, I do not have any professional occupation.

Q31: [if Q30 == "Yes"] Where is your main workplace for this occupation located?

- Belval
- Esch-centre
- Your town of residence
- Luxembourg (city)
- Elsewhere

Q32: How often do you work there?

- A few times per week
- One or a few times per month
- A few times per year
- Rarely

Q33: Are you a member in any association / club?

- Yes
- No

Q34: [if Q33 == "Yes"] Please specify the type of the association / club you are member in.

! *Check **all** that apply.*

- □ Student association
- □ Sports club
- □ Music group or cultural association
- □ Civic association (local community association, political organization, NGO, etc.)
- □ Other (please specify)

Q35: [if Q34 == “Student association”] You meet with your student association in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q36: [if Q34 == “Sports club”] You meet with your sports club in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○
Elsewhere	○	○	○	○	○

Q37: [if Q34 == “Music group or cultural association”] You meet with your music group or cultural association in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	O	O	O	O	O
Esch-centre	O	O	O	O	O
Your town of residence	O	O	O	O	O
Luxembourg (city)	O	O	O	O	O
Elsewhere	O	O	O	O	O

Q38: [if Q34 == “Civic association”] You meet with your civic association in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	O	O	O	O	O
Esch-centre	O	O	O	O	O
Your town of residence	O	O	O	O	O
Luxembourg (city)	O	O	O	O	O
Elsewhere	O	O	O	O	O

Q39: Do you do sports (outside of a club)?

- o Yes
- o No

Q40: [if Q39 == “Yes”] You do sports in…

	A few times per week	One or a few times per month	A few times per year	Rarely	Never
Belval	O	O	O	O	O
Esch-centre	O	O	O	O	O
Your town of residence	O	O	O	O	O
Luxembourg (city)	O	O	O	O	O
Elsewhere	O	O	O	O	O

Q41: You are informed about what events are coming up in…

	Almost always	Often	Sometimes	Rarely	Never
Belval	○	○	○	○	○
Esch-centre	○	○	○	○	○
Your town of residence	○	○	○	○	○
Luxembourg (city)	○	○	○	○	○

Q42: You support and follow a sports club in…

	Yes	No
Esch-sur-Alzette	○	○
Your town of residence	○	○
Luxembourg (city)	○	○
Elsewhere in Luxembourg	○	○

4. My views on Esch and Belval

In this final section of the survey, you are asked about your views on Esch-centre and Belval.

Q43: Generally speaking, what aspects of a city are important to you?

! *This question does not specifically refer to Esch-centre or Belval, but to your preferences in general.*

	Very important	Rather important	Undecided	Rather not important	Not important at all
Shopping opportunities	O	O	O	O	O
Restaurants and bars	O	O	O	O	O
Nightlife	O	O	O	O	O
Parks and green spaces	O	O	O	O	O
Access to nature					
Organisation of cultural and popular events	O	O	O	O	O
Attractiveness and accessibility of public spaces	O	O	O	O	O
Architecture and landmarks	O	O	O	O	O
Accessibility of amenities and services	O	O	O	O	O
Bicycle infrastructures	O	O	O	O	O
Accessibility for cars	O	O	O	O	O
Connection to public transportation networks	O	O	O	O	O

Q44: Now, speaking specifically about Esch-centre (not the Belval part!), to what extent do you agree with the following statements?

	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
Esch-centre offers great and diverse possibilities to do shopping.	○	○	○	○	○
There are some very nice restaurants and bars in Esch-centre.	○	○	○	○	○
If you want to go out and party, Esch-centre is a good place to go.	○	○	○	○	○
Esch-centre has beautiful parks and green spaces.	○	○	○	○	○
From Esch-centre, one can easily access natural spaces.	○	○	○	○	○
There are many appealing events organized in Esch-centre.	○	○	○	○	○
Esch-centre has attractive and accessible public spaces.	○	○	○	○	○
I like the architectural quality in Esch-centre.	○	○	○	○	○
In Esch-centre, I find everything I need in terms of amenities and services.	○	○	○	○	○
The infrastructure in Esch-centre is well adapted for bicycle users.	○	○	○	○	○
Esch-centre is easily accessible by car.	○	○	○	○	○
Esch-centre is well-connected by public transportation.	○	○	○	○	○
There are many students in Esch-centre.	○	○	○	○	○

Q45: To what extent do you agree with the following statements related to your personal feelings about Esch-centre?

	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
I like this city.	○	○	○	○	○
I feel at home in Esch-centre.[16]	○	○	○	○	○
I feel safe in Esch-centre.	○	○	○	○	○
Esch-centre is an attractive area.	○	○	○	○	○
I feel proud to tell people about Esch-centre. [17]	○	○	○	○	○
When family or friends from abroad come to visit me, I show them around in Esch-centre.[18]	○	○	○	○	○
It would be hard for me to move away from Esch-centre. [19]	○	○	○	○	○
I am always pleased to go back to Esch-centre.	○	○	○	○	○
I would like to move to Esch-centre.[20]	○	○	○	○	○
I like to take a walk through Esch-centre.	○	○	○	○	○
As a university town, I could not imagine any better place than Esch-centre.	○	○	○	○	○
I strongly identify with Esch-centre.	○	○	○	○	○

[16] This subquestion is only for people who live in Esch-centre.
[17] This subquestion is only for people who live in Esch-centre.
[18] This subquestion is not for people who don't live or work in Esch-centre and who (almost) never go there.
[19] This subquestion is only for people who live in Esch-centre.
[20] This subquestion is only for people who do not live in Esch-centre.

Q46: Specifically regarding Belval, to what extent do you agree with the following statements?

	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
Belval offers great and diverse possibilities to do shopping.	○	○	○	○	○
There are some very nice restaurants and bars in Belval.	○	○	○	○	○
If you want to go out and party, Belval is a good place to go.	○	○	○	○	○
Belval has beautiful parks and green spaces.	○	○	○	○	○
From Belval, one can easily access natural spaces.	○	○	○	○	○
There are many appealing events organized in Belval.	○	○	○	○	○
Belval has attractive and accessible public spaces.	○	○	○	○	○
I like the architectural quality in Belval.	○	○	○	○	○
In Belval, I find everything I need in terms of amenities and services.	○	○	○	○	○
The infrastructure in Belval is well adapted for bicycle users.	○	○	○	○	○
Belval is easily accessible by car.	○	○	○	○	○
Belval is a student campus.	○	○	○	○	○
Belval is well connected by public transportation.	○	○	○	○	○
Belval is well connected to Esch-centre.	○	○	○	○	○

Q47: To what extent do you agree with the following statements related to your personal feelings about Belval?

	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
I like the Belval area.	○	○	○	○	○
I feel at home in Belval.[21]	○	○	○	○	○
I feel safe in Belval.	○	○	○	○	○
Belval is an attractive area.	○	○	○	○	○
I feel proud to tell people about Belval. [22]	○	○	○	○	○
When family or friends from abroad come to visit me, I show them around in Belval.[23]	○	○	○	○	○
It would be hard for me to move away from Belval. [24]	○	○	○	○	○
I am always pleased to go back to Belval.	○	○	○	○	○
I would like to move to Belval.[25]	○	○	○	○	○
I like to take a walk through Belval.	○	○	○	○	○
As a university campus, I could not imagine any better place than Belval.	○	○	○	○	○
I strongly identify with Belval.	○	○	○	○	○

[21] This subquestion is only for people who live in Belval.
[22] This subquestion is only for people who live in Belval.
[23] This subquestion is not for people who don't live or work in Belval and who (almost) never go there.
[24] This subquestion is only for people who live in Belval.
[25] This subquestion is only for people who do not live in Esch-centre.

Q48: Please indicate the level of probability of the following scenarios.

	Definitely	Possibly	I don't know	Probably not	Definitely not
After my studies, I will be living in Belval.	○	○	○	○	○
After my studies, I will be living in Esch-centre.	○	○	○	○	○
After my studies, I will be living in Luxembourg, but neither in Esch-centre nor in Belval.	○	○	○	○	○
After my studies, I would like to work in Luxembourg, but live in a neighbouring country (France, Belgium, Germany).	○	○	○	○	○
After my studies, I will leave Luxembourg and go live somewhere else.	○	○	○	○	○

5. What comes next…

This study will be followed by discussion sessions in small groups of up to six people. The aim is to have a more personal and in-depth exchange about how you perceive the Belval site and its surroundings. If you are willing to participate in one of these groups, please leave your email address so that we can contact you to fix a date.

The session will last up to two hours and will be held in a comfortable environment. Your participation in this study would be extremely helpful. As a small recognition, every chosen participant receives a 20€ shopping voucher from Lëtzshop. Please note that the number of places in the discussion groups are limited.

By giving my email address, I consent to be contacted for the second part of the study.

My email address is: _____

Important notice:

- Your email address will be stored separately from the survey responses.
- The researcher will only have access to your email address for the purpose of organizing the discussion groups.

Thank you so much for your participation!

If you registered for the second part of the study, you will be contacted in the coming weeks to schedule a date for the discussion session.

Appendix 3: Descriptive statistics of the survey results

Profiles of the respondents

Individual characteristics	Share of respondents
Gender	
Female	57.8%
Male	40.3%
Other	1.9%
Age	
20 years or less	9.2%
21-23 years	30.6%
24-26 years	19.4%
27 years or more	40.8%
Nationality	
Luxembourgish	24.8%
German	10.7%
French	8.7%
Belgian	5.8%
Italian	5.8%
Portuguese	5.3%
Other EU	11.2%
Asian	14.1%
Other	13.6%
Study level	
Bachelor	35.9%
Master	26.7%
PhD	36.4%
Place of residence	
Esch-sur-Alzette	43.7%
Esch-centre	*25.2%*
Belval	*18.4%*
Sanem	9.7%
Belval	*7.8%*
Luxembourg (city)	10.2%
Elsewhere in Luxembourg	25.7%
Elsewhere	10.7%
Residence type	
Student residence	39.3%
Shared residence	26.2%
Privately rented residence	27.2%
Other	7.3%

Regular activities of the respondents

Activities	Share of respondents doing the activity at least once a month…			
	in Belval	in Esch-centre	in Luxembourg City	elsewhere
Study or work	79,1%	7,3%	19,4%	29,1%
Run personal errands[26]	62,1%	35,9%	46,1%	36,9%
Activities within an association or club	9,2%	4,4%	4,9%	11,2%
Visit family or friends	28,2%	23,8%	27,2%	48,1%
Physical leisure activities[27]	42,2%	31,1%	34,5%	55,8%
Socialising leisure activities[28]	53,4%	25,2%	55,8%	29,1%

Appreciation of physical-environmental features

Appreciation of physical-environmental features	Weighted scale from -3 (negative) to 3 (positive)			
	Belval		Esch-centre	
	M	SD	M	SD
Shopping opportunities	0,49	1,45	-0,07	1,29
Restaurants and bars	0,77	1,49	0,24	1,31
Nightlife	-0,69	1,42	-1,03	1,21
Parks and green spaces	-0,73	1,83	0,32	1,56
Access to nature	-0,24	1,84	0,77	1,53
Organisation of cultural and popular events	-0,08	1,48	-0,21	1,33
Attractiveness and accessibility of public spaces	0,03	1,83	-0,06	1,40
Architecture and landmarks	0,38	1,64	-0,16	1,35
Presence of services and leisure facilities	-0,18	1,68	-0,01	1,40
Bicycle infrastructure	-0,14	1,54	-0,27	1,21
Accessibility for cars	0,80	1,28	0,15	1,19
Connection to public transportation networks	1,02	1,86	1,23	1,59

[26] Shopping or personal services
[27] Go for a walk or doing sports
[28] Have dinner, have a drink, go to a party or nightclub, go to the cinema or theatre, or go to a public events

Personal feelings

Statements related to personal feelings towards Belval	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
I like this area	16,0%	36,9%	19,4%	13,6%	14,1%
I feel at home	10,7%	24,3%	20,4%	18,4%	26,2%
I feel safe	47,6%	35,0%	12,1%	3,4%	1,9%
It is an attractive area	17,0%	28,2%	23,8%	14,1%	17,0%
I feel proud to tell people about it	13,6%	25,7%	28,2%	14,1%	18,4%
When family or friends from abroad come to visit me, I show them around	17,5%	30,1%	22,8%	12,6%	17,0%
It would be hard for me to move away from this area[29]	18,5%	18,5%	14,8%	18,5%	29,6%
I am always pleased to go back	16,0%	25,7%	28,6%	14,1%	15,0%
I would like to move to this area[30]	4,5%	8,4%	16,2%	19,5%	50,0%
I like to take a walk through this area	19,4%	26,2%	19,4%	16,5%	18,4%
As a university campus, I could not imagine any better place	11,7%	17,0%	12,6%	22,8%	35,9%
I strongly identify with this area	11,2%	14,1%	24,8%	23,3%	26,7%

[29] Only applicable to respondents residing in Belval (n=54).
[30] Only applicable to respondents not residing in Belval (n=152).

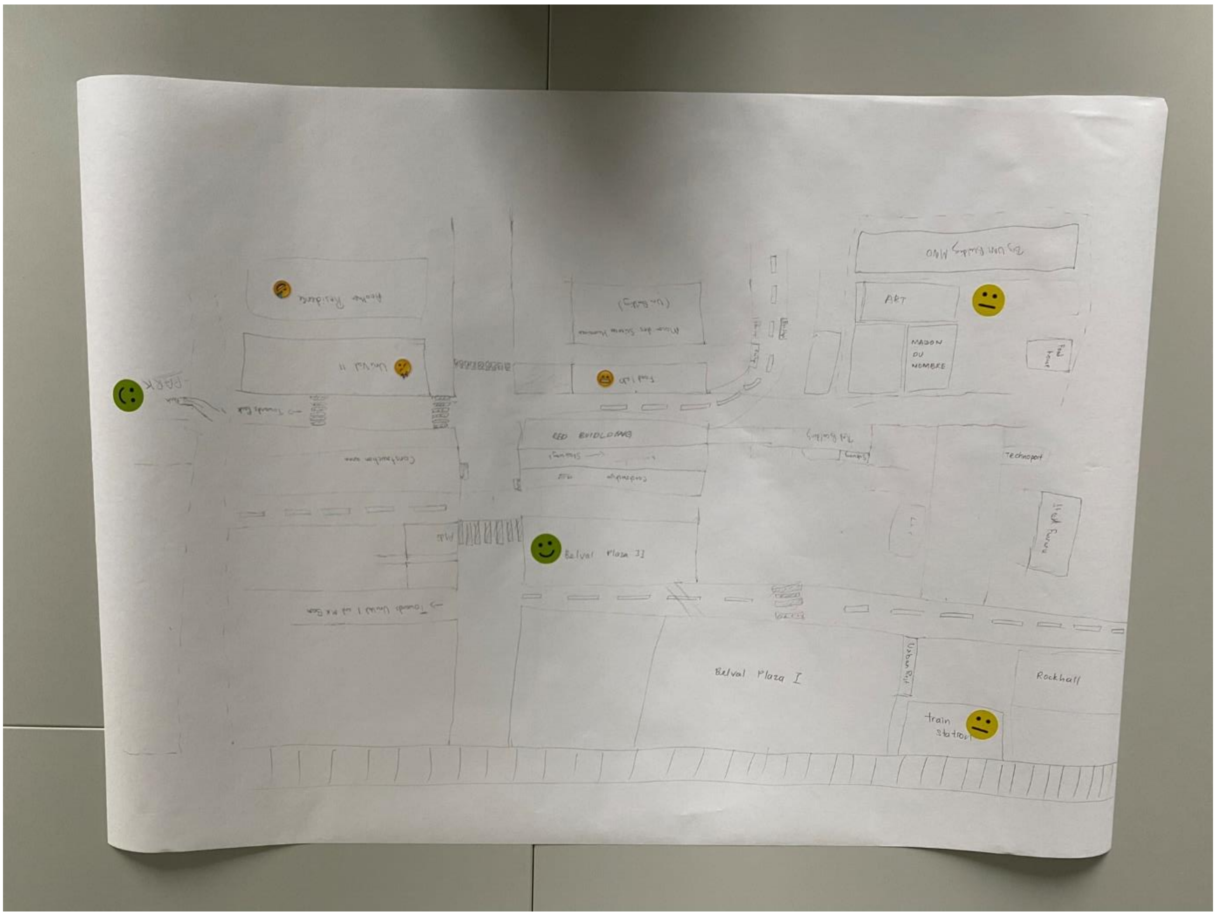
Statements related to personal feelings towards Esch-centre	Strongly agree	Slightly agree	Neither agree nor disagree	Slightly disagree	Strongly disagree
I like this area	7,8%	27,7%	35,0%	16,5%	13,1%
I feel at home	7,3%	13,1%	21,4%	25,2%	33,0%
I feel safe	11,7%	22,3%	24,3%	21,8%	19,9%
It is an attractive area	1,9%	18,0%	27,2%	30,6%	22,3%
I feel proud to tell people about it	2,4%	8,7%	35,4%	27,7%	25,7%
When family or friends from abroad come to visit me, I show them around	4,9%	19,4%	22,3%	16,0%	37,4%
It would be hard for me to move away from this area[31]	1,9%	7,7%	25,0%	26,9%	38,5%
I am always pleased to go back	5,3%	18,9%	35,9%	18,9%	20,9%
I would like to move to this area[32]	2,6%	7,8%	18,2%	24,7%	46,8%
I like to take a walk through this area	7,3%	29,6%	28,6%	15,5%	18,9%
As a university town, I could not imagine any better place	1,5%	5,8%	15,0%	25,7%	51,9%
I strongly identify with this area	3,4%	10,7%	18,4%	25,2%	42,2%

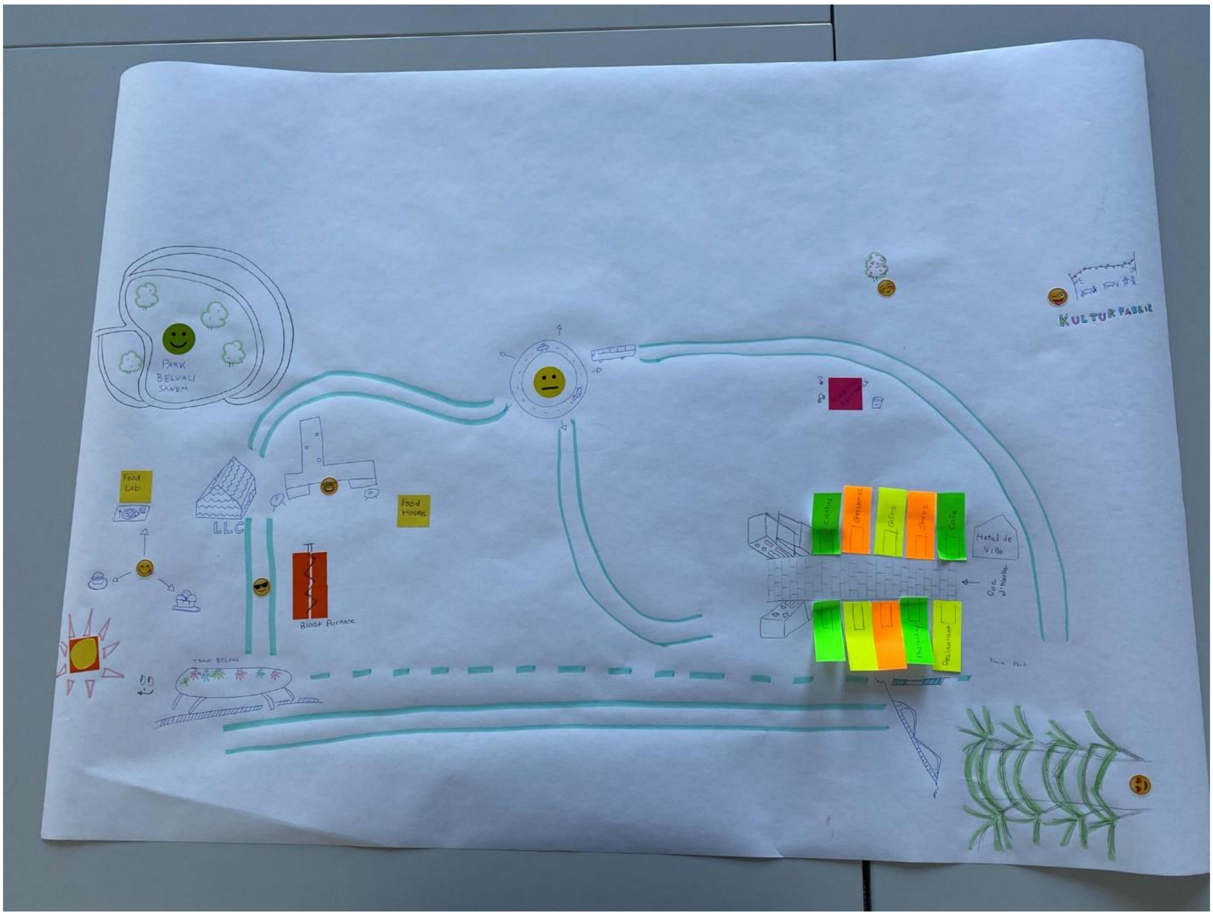
Self-projection

Self-projection	Definitely	Possibly	I don't know	Probably not	Definitely not
After my studies, I will be living in Belval	1,5%	8,2%	11,2%	27,0%	52,0%
After my studies, I will be living in Esch-centre	2,0%	8,7%	16,3%	26,5%	46,4%
After my studies, I will be living in Luxembourg, but neither in Esch-centre nor in Belval	13,3%	36,9%	22,1%	16,9%	10,8%
After my studies, I will work in Luxembourg, but live in a neighbouring country	4,6%	24,5%	18,4%	23,0%	29,6%
After my studies, I will leave Luxembourg and go live somewhere else	12,3%	33,8%	20,5%	16,9%	16,4%

[31] Only applicable to respondents residing in Esch-centre (n=52).
[32] Only applicable to respondents not residing in Esch-centre (n=154).

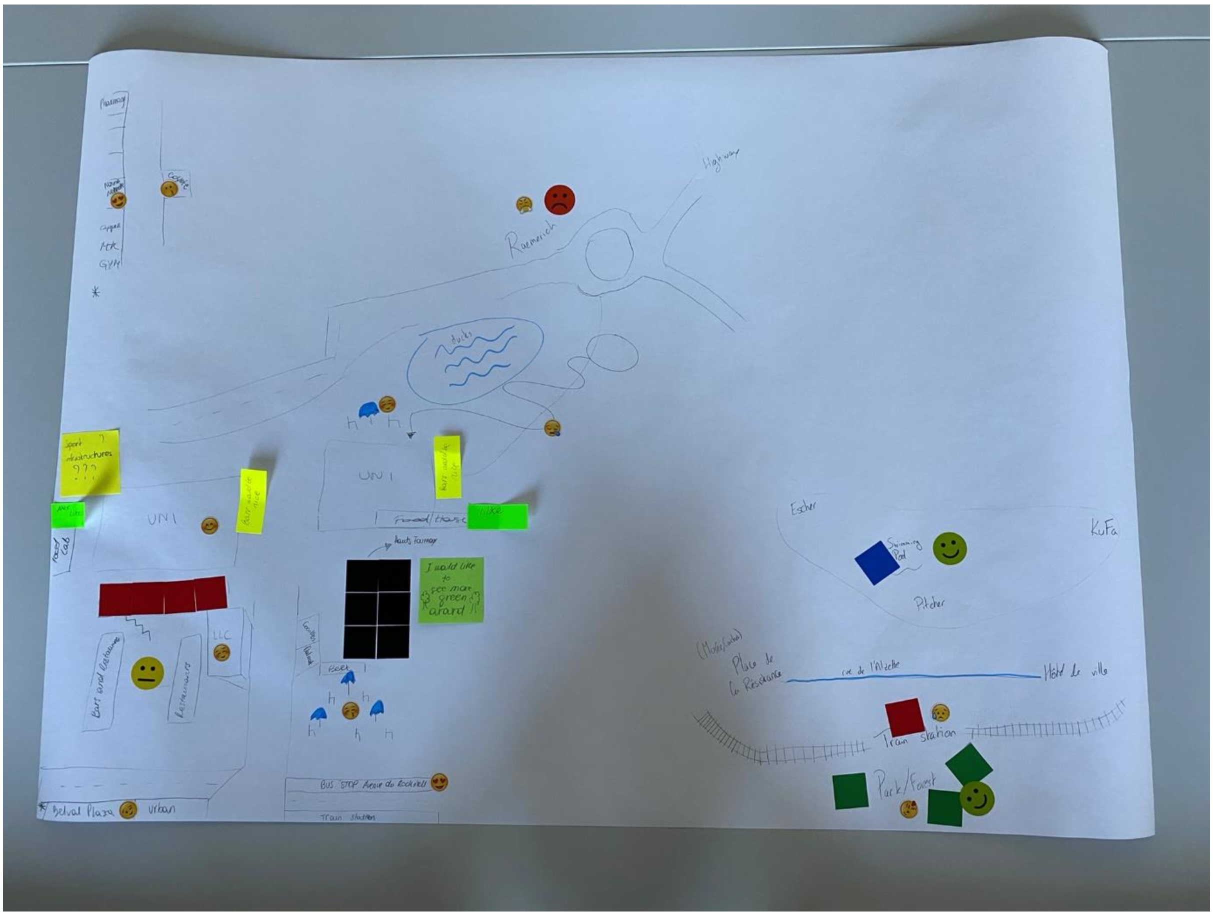
Appendix 4: Maps created during the focus groups

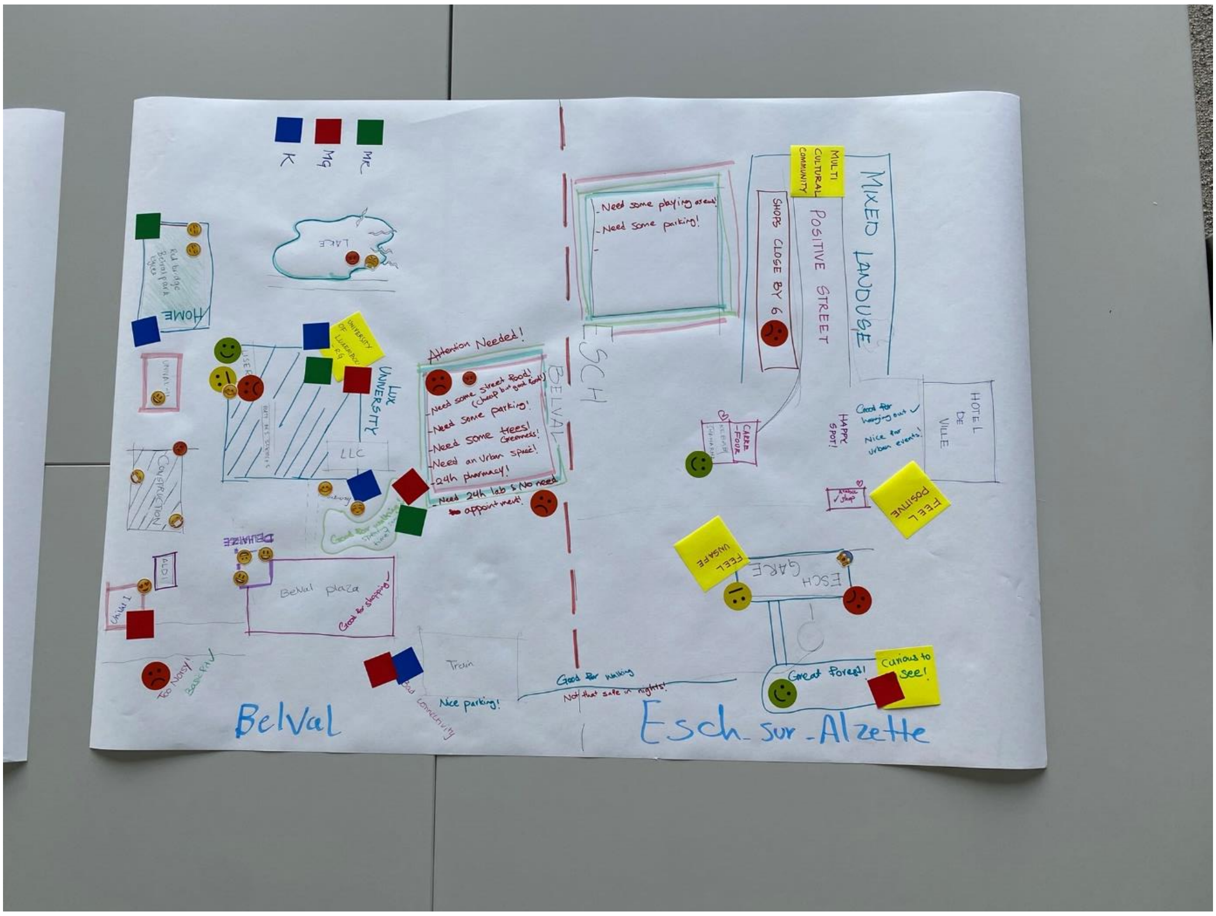

ART
MAISON DU NOMBRE
RED BUILDINGS
Technoport
Belval Plaza II
Belval Plaza I
Rockhall
train station


PARK BELVAL SANEM
Food Lab
Food House
LLC
Blast Furnace
Hotel de Ville
KULTURFABRIK

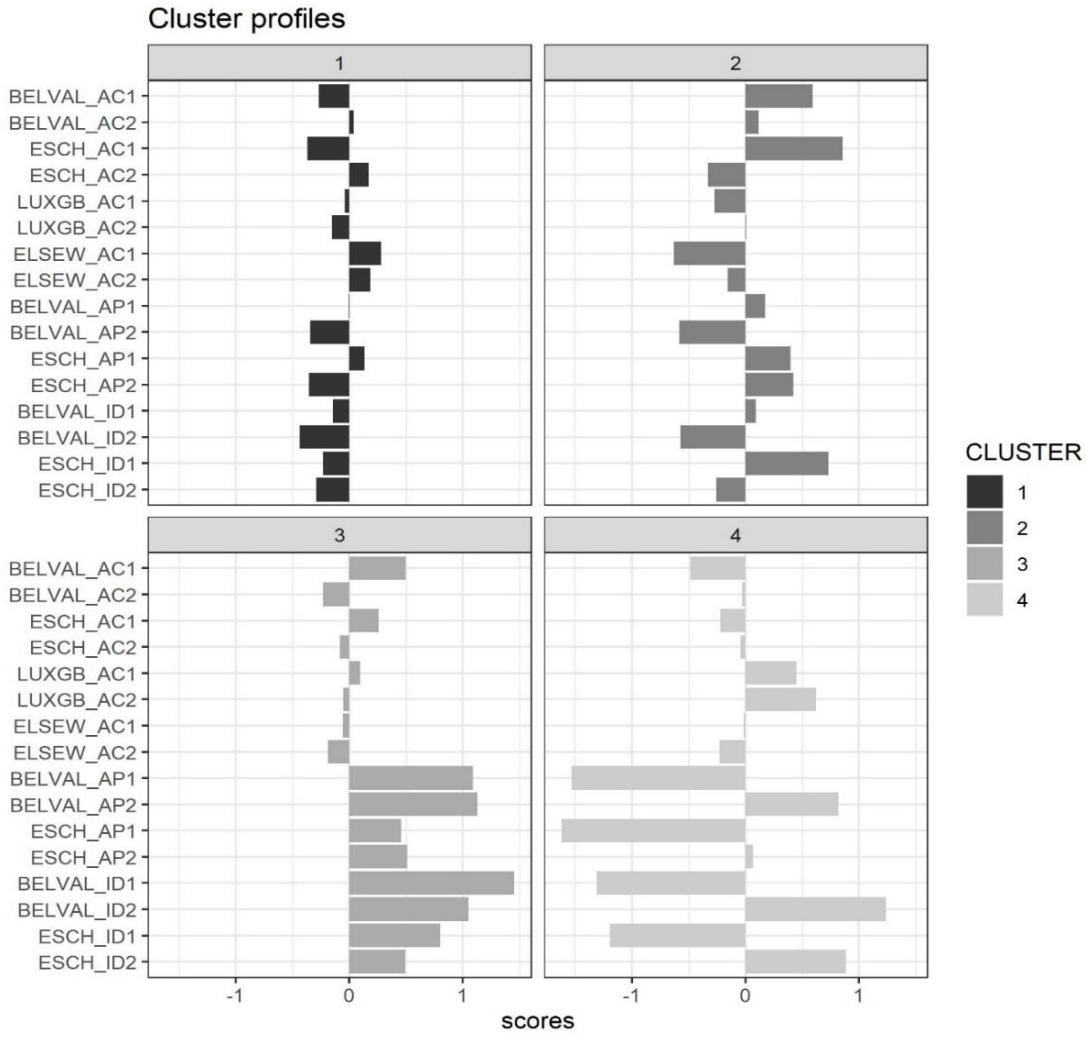

UNI-VAL I
Delhaize
Belval plaza
ALDI
Basic fit
ING
campus
Cocottes
Dalmat
ROCKHAL
MESA
Theatre
Post office
Hotel de ville
Aquasud Pool
Bus stops
Esch gare station


Parking lot
MESA
Bus
Cycle Path
Lycee ...
Match
Food Lux
Food House
OFFICE
Cocottes
Delhaize
Belval Plaza
Big Pause
IBIS
High furnace
NOISYYY!
construction sites
ROCKHAL
Belval Plaza
POST
Saturn
Train Station
Belval-Université
Esch Gare
City Hall
Post
ZEEMAN shop
Restaurants
Church
Belval Parc
pharmacy
to Audun le Tiche




Belval
Esch-sur-Alzette
LAKE
LUX UNIVERSITY
Attention Needed!
Need some street food!
Need some parking!
Need some trees!
Need an Urban space!
24h pharmacy!
MIXED LANDUSE
POSITIVE STREET
SHOPS CLOSE BY 6
MULTI CULTURAL COMMUNITY
HOTEL DE VILLE
FEEL POSITIVE
FEEL UNSAFE
GARE ESCH
Great Forest!
Curious to see!
Belval plaza
Good for shopping
Nice parking!
Train

Appendix 5: Cluster profiles and explanation of the factors used for the cluster analysis



Factors	Interpretation
AC1	Intensity of activities from low (-) to high (+)
AC2	Type of activities from leisure and event-related activities (-) to work-or study-related activities and social involvement (+)
AP1	Appreciation of urban-environmental features from negative (-) to positive (+)
AP2	Appreciation of urban-environmental features from neutral opinions (-) to strong positive or negative opinions (+)
ID1	Identification with the area from weak (-) to strong (+)
ID2	Identification with the area from neutral (-) to very strong or weak (+)