

Brownfield Regeneration in Sarajevo – Sustainable Growth Towards a Polycentric City

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1 ABSTRACT

Urban planning and design processes generally follow standardised procedures that have been tried and tested by generations of experts. However, due to the local context and changing framework conditions in each city and project site, processes always need to be adapted and result in unique planning histories that take into account the specific political, spatial, social, cultural and economic conditions of a place. Adverse circumstances might challenge ambitious process designs and lead to slimmed-down planning processes and unsatisfactory results, while an enabling environment can enrich the process and inspire the outcome. The reality, however, is not always black or white. There are multiple influential factors and it is the task of the planners not to lose sight of the goal and to use the circumstances in the best possible way to achieve high-quality design results. Urban design may be defined as “the process of providing quality contextual places for people” (Black & Sonbli 2019, 21). This indicates the contextuality of place and process and highlights the need to adapt to the local context in order to achieve an adequate result.

Within the framework of a consultancy for the European Bank for Reconstruction and Development (EBRD), an international and interdisciplinary planning team composed of architects, spatial planners, economists, and sustainable resource managers, made the effort to implement an integrated and participatory urban design process for two brownfield sites in Sarajevo. This paper explores the manifold challenges and obstacles that the team was confronted with and the creative approaches to overcome these hurdles. It takes a critical look at the adjustments in the process and the results, and gives an outlook and recommendations for the next steps towards implementation and development.

Keywords: Land Consolidation, Sustainable Design, Integrated Urban Design, Brownfield Regeneration, Microclimate Simulation

2 A CITY OF CONTRADICTIONS: SARAJEVO AND BEYOND

2.1 Political and administrative context and the lack of trust

The City of Sarajevo is the capital and largest city in Bosnia and Herzegovina (BiH) with a population estimated at 276,000 inhabitants, according to the latest census (Statistika, 2013). The area of the city is 141.5 km² and it consists of four municipalities: Stari Grad, Centar Sarajevo, Novo Sarajevo, and Novi Grad. The city is represented by the Mayor of the City of Sarajevo and the City Assembly. Along with five other municipalities, it is part of Sarajevo Canton, which has its own legislative, executive and judiciary powers. It is governed by the Assembly of the Canton and the Prime Minister. Moreover, every municipality has its own Municipal Mayor and Municipal Assembly. The complex hierarchy of this governance system is reflected in all spatial processes and jurisdiction is often (mis)used in the planning of the city’s development and urban growth.

The complex political-administrative structure of the Canton of Sarajevo, which is reflected in the management of the city itself, resonates at all levels of government, and complicates the management of the city, its territories and resources (Zupcevic & Causevic 2009). The frequent overlapping of responsibilities and the exclusion of certain levels from responsibilities, often supported by unclear or conflicting legal regulations, reduces public confidence in the abilities and intentions of those involved in management processes. The spatial planning authorities are particularly challenged, since private capital has been driving construction activities rapidly since the political system change, while strategic planning can hardly keep up with the definition of the necessary framework conditions.

Under these circumstances, and in view of the post-war reconstruction of the city, non-transparent developments of large spatial reserves were carried out, mostly at the sites of former industrial areas, but also in the central urban fabric, which shook trust in both political and professional goodwill of the actors involved (Tzifakis & Tsardanidis 2006). In many cases, planning documents were changed on investors' requests without the participation of the public. This was facilitated by the law on spatial planning at the time, which gave Municipal Mayors the opportunity to change existing planning documents through abbreviated procedures and for individual locations without holding a public hearing and presentation (Spatial Planning Act, Canton Sarajevo Gazette, 7/05, Article 46). Real estate developments without a legal basis or contrary to valid planning documents were not uncommon either.

Over the past two decades, the development of Sarajevo has led to the creation of large shopping centres and monofunctional residential areas. Unfortunately, many of these projects failed to comply with basic urban planning parameters, neglecting important factors such as fire safety standards, road width, and lighting. Private investments dominated the real estate sector, as public institutions lacked the capacity to actively participate in real estate development. Limited public budgets, the need to invest in socio-economic measures, and the absence of a resident-focused development strategy have profoundly influenced urban development in Sarajevo. Furthermore, the city's urban planning has been characterised by a lack of vision and strategy, driven by the imitation of global and regional trends, such as the separation of functions and a car-centric approach. Planning regulations often prioritised these trends rather than considering local potentials and the overall quality of life for Sarajevo's residents.

The wider public and planning professionals had limited influence on urban development in Sarajevo due to prevailing circumstances. Following the war, private ownership took precedence over public ownership, with land becoming a valuable asset for obtaining investment benefits. Consequently, private investors wield significant influence, sometimes overshadowing the concerns of the wider public and planning experts. This has led to a loss of faith in effective spatial planning, as responsible institutions often prioritise meeting the desires of investors over improving residents' quality of life (Botic 2013). Although current urban planning legislation recognizes public involvement, participation typically occurs towards the end of design processes, and public hearings often serve as justification for changes that have already been decided upon.

2.2 Environmental challenges and the new urban plan

At the same time, the Sarajevo urban area faces pressing challenges amidst multiple crises like climate change and social division. The quality of housing has declined and although the number of units is steadily growing, there is a lack of affordable housing for middle- and low-income groups. Public spaces and social infrastructure are lacking in existing and new settlements. Environmental problems, such as air pollution, worsen due to high private car usage and reliance on wood and coal for heating. Authorities' efforts to address these issues are slowly entering public discourse, but time and initiatives are needed for noticeable changes in daily life (Hewlett & Gallego-Lopez 2020).

Sarajevo's location in the valley allows only limited air flow, leading to frequent smog, particularly during winter months. Within the urban fabric, specific areas are more susceptible to pollution, causing significant impacts on the surrounding regions. Historical urban planning documents, spanning from the 1960s to the 1980s, acknowledged the importance of mitigating winter smog by implementing measures such as city gasification, promoting sustainable public transportation, and imposing height limitations in the central area where the valley is narrowest. However, as urban growth intensified in the 2000s, these policies proved insufficient to accommodate the pressures of urban growth. Irregular developments on vacant lots and abandoned industrial sites further exacerbated the environmental conditions in Sarajevo. Buildings of unfavourable height and position further impair the already problematic state of Sarajevo's air pollution.

The change in perspective and new understanding of social, economic and ecological urban needs are reflected in some important documents that have been developed over the last few years and are also used in preparation for the new Urban Plan. The Study on Ventilation Corridors was developed along with the Green Cantonal Action Plan for Sarajevo in 2020 (Hewlett & Gallego-Lopez 2020). The document proposes regulations for the positioning and height of the buildings along the main ventilation corridors in the city and has been adopted by the Government. The planning and construction needs of the Canton and the City of Sarajevo are subject of a new Urban Plan, which is currently being drafted. The last Urban Plan was created in 1986 and has long become inadequate and ineffective to address contemporary urban challenges. The lack

of a high-quality urban strategy was consequently reflected in the detailed planning documents (regulatory plans, urban projects), which were supposed to be based on the overall Urban Plan. However, the ongoing process of developing a new Urban Plan is leading to a number of problems as several major development projects in the city are halted awaiting its adoption. In such a stalemate, all efforts to activate and improve the urban space depend on the willingness of decision-makers to act and advocate for the incorporation of new solutions into the Urban Plan and their subsequent elaboration within the detailed planning documents. At this point of time, planning is a matter of building trust between the profession, the public, decision makers and investors, which requires a great deal of skill and time, as well as a change in the mindset of all stakeholders involved.

2.3 Brownfields as a potential for polycentric development

During the after-war period, large areas of former industrial complexes were abandoned. The regeneration of these brownfield sites holds great potential for future urban development and the emergence of new qualities in Sarajevo. In times of high land use and rapid soil sealing in the urban peripheries, brownfields represent an attractive opportunity to enable urban growth in a more sustainable way. Additionally, most brownfield sites already have access to basic infrastructure such as water, electricity and sewer connections. Due to the city's expansion over time, many brownfields in Sarajevo are located in high-density environments and in central positions within the city area today. The regeneration of these sites and a general focus of urban development activities on urban voids are significant in order to prevent urban sprawl and to generate a city of adequate density.

The development of brownfield sites in Sarajevo also offers the potential to create new mixed-use centralities in a largely monofunctional urban fabric that evolved along the valley and has its main administrative centre and business hub around the old town in the east. As a growing city, it is time for Sarajevo to develop new urban centres that fulfil multiple functions, offer job opportunities as well as recreational spaces, educational and cultural institutions. In a polycentric vision of the city, the numerous brownfield sites across the urban tissue are anchor points and incubators for such developments. The elaboration of a clear vision for Sarajevo's brownfield sites is crucial in order to induce the release of these high-potential land and encourage investments in their development.

The task of developing two brownfield sites in Sarajevo was at the beginning of the planning team's intense interaction with the city. Against the background of a complex political and administrative situation and a general lack of trust in urban planning processes, it was crucial to apply a professional approach, a transparent planning process and comprehensible, fact-based decision making.

3 CREATING TRUST THROUGH COMPREHENSIBLE PLANNING

3.1 Application of a good practice urban design process

Although each urban design process is unique in its procedure and outcomes, there is a broad consensus in scholarship and practice as to what basic stages should be followed (cf. Black & Sonbli 2019, Carmona 2013, Lloyd-Jones 2001). In order to create "quality contextual places for people", the design process should start with a multi-layer analysis that includes the urban context on different spatial scales as well as the policy framework and socio-demographic aspects. Based on the findings, a strategic design framework is developed. It informs the development of the design through concepts and scenarios before acting as an evaluation matrix for the outcomes. The design phase as such is circular rather than linear as it reverts to the concept through several evaluation loops and should be tested by local stakeholders. The stage of delivery and implementation adds another layer to the design that needs to remain flexible and adapt to the various demands that arise during realisation (Black & Sonbli 2019). The design process is rational and experimental, it works through a process of deduction, where a design solution is an early hypothesis to be tested, drawing on pre-existing models and exposing it to multiple realities (Lloyd-Jones 2001). It is important to stress that the designers do not act in isolation but are exposed to power relations that shape the process and its outcomes through agency and political structures. The history of place and the contemporary political situation influence the process along with numerous stakeholders ranging from policy makers, investors, space users, etc (Carmona 2013). Acknowledging the importance of all these actors is the first step towards enabling participatory design processes. The inclusion of local stakeholders in planning processes

has steadily increased in recent decades and numerous tools for co-creation and participatory design have been developed that can be integrated into tried and tested processes (cf. Krebs & Mayr 2023, 550ff.).

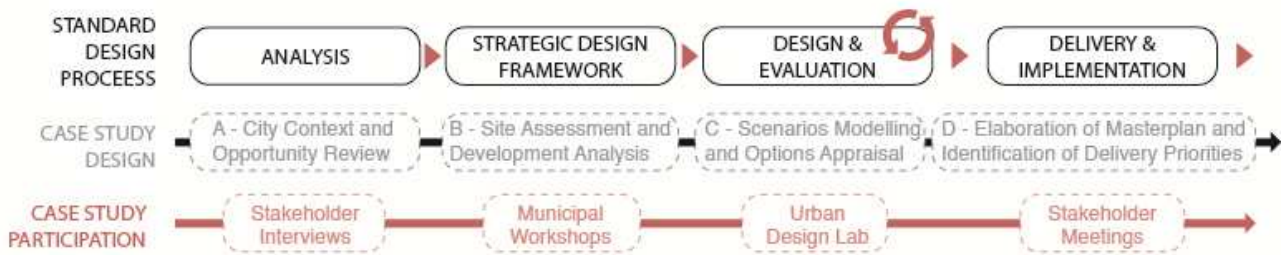


Fig. 1: Stages of a standard urban design process as compared to the case study in Sarajevo. Source: Author's own figure based on Black & Sonbli 2019.

In Sarajevo, the work process was organised in four main phases. The first task was to understand the urban context of Sarajevo and review the many opportunities for brownfield development that the city had to offer. The result of a multi-criteria analysis of 24 brownfield sites was the selection of two target sites for further analysis and development: Kvadrant B in Marijn Dvor and the former Central Railway Workshop Vaso Miskin Crni (VMC) in Novo Sarajevo.

Kvadrant B is an eight hectare central location in the city of Sarajevo. The area is partially developed with new shopping malls, business buildings and services and is part of the city's new business and public centre, with old heritage buildings from the Austro-Hungarian period which are currently in private ownership. The rest of the site, near the Miljacka River, is used as a parking space, owned by the Canton of Sarajevo. The connection to the public transport system and the road network is excellent and high density surroundings are a good precondition for the implementation of mixed uses in the area. The redevelopment of the site has been subject of discussion for over 20 years and has evolved to a controversial topic.

The former Central Railway Workshop Vaso Miskin Crni was partially and poorly transformed into shopping malls after the 90s. The twelve hectare site is centrally located, with good connection to all the main traffic lines and the tram line in walking distance. It consists of both newly built facilities as well as old warehouses, which are currently abandoned. The central location and the high-density surrounding form an ideal condition for the implementation of a mixed-use neighbourhood. The high number of involved owners, among which there are both private and public entities, is a challenge to the development of the site.

The selected brownfield sites were assessed and a spatial analysis was carried out. In parallel, a Real Estate Demand Study was prepared to inform the planning process and decision-making. In order to test development opportunities, different spatial and mixed-use scenarios were drafted for both sites. They were discussed with the Working Group comprising representatives from all involved administrative levels to agree on the way forward. In parallel, the Sarajevo Urban Design Lab was conducted. The program included a series of academic workshops, public events, and stakeholder meetings that enabled a broader discussion about brownfield development in Sarajevo. At the same time, the different mixed-use scenarios for both project sites were evaluated, and their financial viability assessed against the backdrop of the previously conducted market analysis. A microclimate simulation analysed the impact of the design on the immediate environment in terms of heat and wind effects. Finally, clear design visions were developed for Vaso Miskin Crni and Kvadrant B, including a detailed design strategy, technical information, infrastructure plans, as well as environmental and social impact appraisals. The final design also made a strong case for the benefits of the proposed projects from the perspectives of urban regeneration and sustainable 'green' development.

The process was carried out by an interdisciplinary team of architects and urbanists, environmental and financial experts, as well as trained participation specialists. The clear process designed on the onset of the project increased transparency and provided a flexible and holistic approach where each stage informed the other. The clear structure was the basis for the involvement of public and private stakeholders throughout the process and promoted the trust and accountability needed in the Sarajevo context.

The following sections go into more detail on some of the components of the design process that were particularly important in order to respond to the diverse challenges we encountered in Sarajevo: public participation, market demand, sustainable urban design, microclimate simulations and land consolidation.

3.2 Public participation in a complex environment

The concept of public participation is often explained along Sherry Arnstein's ladder of participation (1969). The model describes eight levels of participation ranging from manipulation to information and partnership all the way up to citizen control which is presented as the ultimate form of participation. This conception of citizen involvement, however, has also been criticised. Collins and Ison suggest that "[T]he linear conceptualization of participation does little to emphasise the importance of either the process or the existence of feedback loops, which shape understandings of the situation" (2009, 362). While a high level of public involvement is generally desirable, it is questioned to what extent power should be shifted from elected decision makers to small groups of people who have the capacity to engage. Moreover, the possibilities and range of participation vary according to the design question, scale of the problem, and local context. Therefore, the level, range and tools of public participation must be adapted to the specific parameters of each project.

In the case of Sarajevo, public participation in planning processes is usually limited to the legally required public hearings prior to adoption of a planning document. Involvement of local stakeholders throughout a design process is rare or virtually non-existent. There is, however, an emerging public interest in the spatial development of the city. Driven by the professional and academic community a public discourse on urban development is developing, which criticises the undesirable developments of the past and calls for a new style in urban planning. The focus is on issues such as quality of life, public space and social participation, while issues of sustainability and resilience are less present. Both selected brownfield sites have been in the focus of public attention for a while due to specific developments and expectations related to them. At the same time, there is limited experience with public participation processes and a lack of trust in the system of political decision making. This challenging situation is further complicated through the powerful position of private landowners and investors who try to influence the public discourse to their advantage.

In the midst of this complex situation, the planning team for the development of Kvadrant B and Vaso Miskin Crni endeavoured to involve decision makers, experts and the public in the planning process. In a first step, and in order to take account of the multilayered administrative and political situation, a Working Group was set up. Members of this group included representatives and decision makers of all administrative levels included in the planning process: Canton, City and the Municipalities. Regular meetings with this group formed the basis for transparent communication across administrative boundaries and hierarchies and aimed to achieve broad political support for the developed design proposals.

In a stakeholder analysis, the planning team identified key players in the professional and academic field of planners and architects in Sarajevo who should be involved in the process in order to contribute their expertise and act as multipliers to make the discussion accessible to a broader public. The Stakeholder Core Group comprised experts and academics, representatives of the Association of Architects in BiH (AABH), and local practitioners. They were invited to planning workshops to discuss ideas for urban design, functions and possibilities for implementation. Additionally, interviews were conducted with selected stakeholders from different fields of expertise related to the economic, spatial, and socio-cultural development of the city.

The centre piece of participation and exchange was the four-day Urban Design Lab (UDL), which was carried out in cooperation with the University of Sarajevo. It included an urban design workshop with local students on both project sites, professional workshops with municipal staff and the Stakeholder Core Group, as well as public events like a movie night, panel discussion, and final presentation of the academic workshop. Since the urban design process was on a mere conceptual stage, the idea was to reach out to a wider public while staying in a professional context. The events were advertised through the networks of the University, AABH and Days of Architecture, a local architecture festival. The professional exchange during the UDL was very valuable for the design process and supported the development of robust masterplans that would respond to the urban context and local needs. The participation process also revealed broad support for the work of an 'external' planning team that would bring in new ideas and possible solutions to the development of two sites that have been much discussed and disputed in the past.

The entire planning process was thoroughly documented and the results were submitted for the National Architecture Award (Collegium Artisticum). It was selected as winner in the category urbanism and presented in a public exhibition. Moreover, the project report was published by the University of Sarajevo with a clear presentation of the design process and full disclosure of all plans and development proposals

(Krebs & Pavlović 2023). The planning team has thus guaranteed a maximum degree of transparency on the process and its results. It is now up to the political decision makers to initiate implementation and involve the public in a continued discourse on the design and its realisation in the urban context.

3.3 Market demand study and financial analysis

The aim of the market demand study and financial analysis was to understand the current situation of the real estate market in Sarajevo in order to base the design proposal on actual needs and respond to adverse trends. The approach was chosen in response to the uncoordinated real estate development of the last decades that has led to monofunctional housing estates on the urban fringes and underused spaces across the urban fabric.

As a first step, a detailed market demand analysis was prepared to understand the investment and development activity and trends in each real estate segment (residential, office, hotel and retail market) in Sarajevo and BiH. One of the key findings was that due to the unavailability of large lands for development within the urban fabric, most new development is on the suburban, greenfield land. The migration of residents to the outskirts resulted in the need for expansion of the city's infrastructure (communal infrastructure such as roads, sewerage, pedestrian paths etc.). In addition, the remote location of the new suburban neighbourhoods leads to long commutes to the downtown business district every day, mostly by car. This has a negative impact on the quality of air due to high CO₂ emissions. Furthermore, the distance of the new residential neighbourhoods to main public facilities (e.g. hospitals, schools, elderly homes etc.) and lack of mixed uses exacerbates social exclusion. The market demand study supported the case for regeneration of central dormant brownfield sites such as Vaso Miskin Crni and Kvadrant B. The two selected sites have access to the communal infrastructure (roads, public transportation – tram and bus lines, access to sewerage, electricity, water, telecommunication etc.) and they are close to the central business district and public institutions. In case of a reuse of the brownfield sites the greenfields might remain undeveloped and pollution could be decreased and social inclusion ensured. Moreover, given the sites' central location and connectivity, the utilisation of the existing urban infrastructure would be improved (more users and direct and indirect financial benefits).

Based on a detailed market research and analysis of the location of the two selected sites and their characteristics, a highest and best use analysis was conducted. The key conclusions of the analysis supported the elaboration of mixed-use concepts and project phasing schemes. Due to the vast size of the Vaso Miskin Crni site, one of the key recommendations was to keep an element of flexibility in the future planning documents to create the opportunity for a sustainable economic development rather than prescribing the long-term redevelopment according to short-term market projections (Bacon et al. 2008).

Finally, a financial case using a discounted cash flow method was prepared based on the development ratios and vision from the proposed masterplan. The financial case assessed financial feasibility and viability of the proposed concept. The quantification went beyond the typical investment return ratios. An estimation of the favourable environmental implications for the proposed development was also conducted. Some of the analysed implications were obtained by assuming the surface of public greenery per inhabitant and employee, estimating the reduced commute time and quantity of fewer CO₂ emissions.

3.4 Sustainable urban design and smart city innovation

Based on the spatial analysis, inputs from participation, financial considerations and other relevant factors, a robust urban design was developed for both sites as a first proposal for further elaboration.

The site of Kvadrant B is envisioned to be developed as a new business centre that incorporates mixed uses to create a lively and attractive neighbourhood. Ground floor areas will host shops, services, cafes, and restaurants, reviving the streets and public spaces of the area. The inclusion of a variety of new central functions will further support the implementation of business and retail uses. The concert hall which has been anticipated for the past 20 years will be taken into account with a designated plot that is temporarily used as a public park. Moreover, a significant percentage of high-quality housing should be present on site to counteract the decreasing number of residents in the central area of the city. The new urban structure responds to the Austro-Hungarian urban pattern in the east of the site and continues the typical block perimeter system. Existing heritage buildings shall be preserved and restored while the structure of new buildings will gradually transition towards the modernist buildings in the west, organically filling the gap in the urban fabric. Building heights develop with the typology, rising from east to west with a high point next

to the existing tower of the Sarajevo City Center. The area along the river will be transformed into a linear park providing a high-quality green space. The centre of the neighbourhood will be a new green square with multifunctional urban surfaces but many trees to provide shade and cool down the environment during hot summer months.

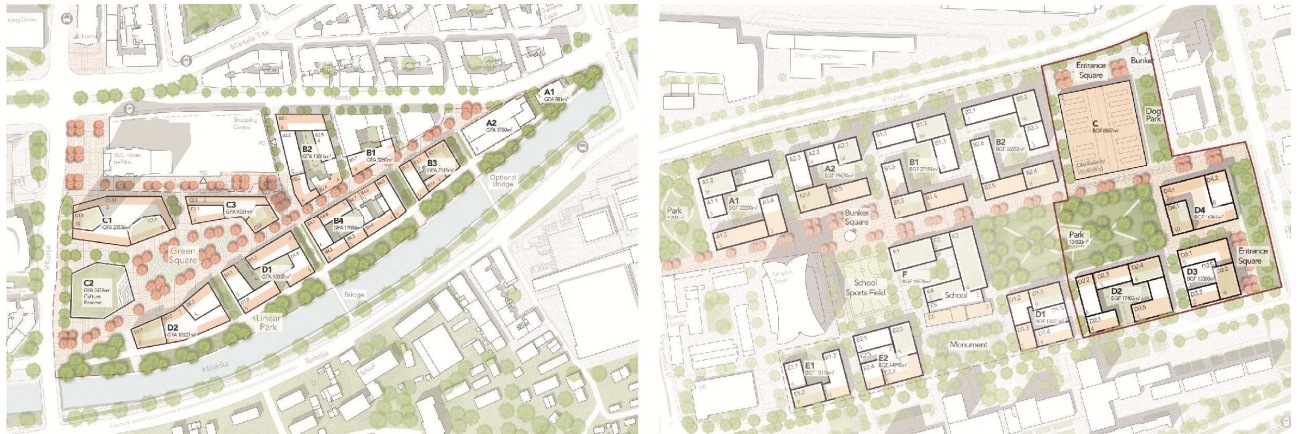


Fig. 2: Development propositions for Kvadrant B (left) and Vaso Miskin Crni (right). Author's own figure.

Vaso Miskin Crni could be redeveloped as a new centrality of Novo Sarajevo that integrates central functions which are currently missing. The development of a mixed-use neighbourhood will include offices, retail, housing, and social infrastructure in a balanced ratio that responds to market demands and establishes an urban business centre. Integrating active uses, like restaurants, cafes, and shops, in the ground floor zones of the buildings will be crucial in order to create a lively centrality that meets the demands of people working, living and seeking leisure in the area. The new urban fabric respects the industrial heritage of the site while responding to surrounding structures. It is recommended to keep two buildings of the old Railway Workshop as valuable assets that preserve the identity of the site. The form of the old production hall was picked up and replicated to shape the urban grid along the east-west axis. The predominant typology is a modern block development with green courtyards. The denser blocks in the southeast of the site have continuous plinths that provide larger spaces for retail and urban workshops. The general building height is five floors with selected high points of up to 16 floors. The main public space is the one-hectare park in the centre of the neighbourhood. It will be designed to fulfil the diverse needs of the new inhabitants and people working or studying in the area. The main east-west axis will be another important public space. Designed as a pedestrian boulevard with shops, cafés, and restaurants along the building fronts, it will be the vibrant spine of the neighbourhood.

With the development of the two brownfields, Sarajevo has the opportunity to implement flagship projects for smart and environmentally friendly urban development. However, sustainable urban development is a long-term transformation process that adds an extra layer of complexity to already complex urban design processes (Thompson 2016). In order to establish an innovative ecosystem in a smart city, numerous stakeholders need to be coordinated. Sophisticated governance with a long-term planning horizon is required, where tasks include management, decision-making and implementation, but also communication and creating transparency and opportunities for participation (Appio et al. 2019). In 2018, the City of Sarajevo launched a Smart City Initiative, developing a vision for Smart Sarajevo 2030. Initial projects have been implemented since, however, a legally binding and comprehensive Smart City Strategy has not been established yet. Measures against air pollution are a top priority in Sarajevo. Hence, reducing road traffic and promoting renewable energy provision and green spaces are the fields to be tackled in any urban development project. Considering the local challenges, the lack of a holistic strategy, insufficient sustainability standards in the building sector and limited public budgets, the recommended Smart City measures for the two brownfield developments focus on affordable innovations in the fields of renewable energy and energy efficiency, sustainable mobility solutions and green city.

The introduction of sustainable building standards in both development areas could be a lever to reduce the high energy demand for heating and cooling and is a prerequisite for shifting energy supply to local renewable energy sources such as district heating, geothermal and photovoltaic energy. Since green building certifications are not yet standard in BiH, the brownfields could be presented as lighthouse projects to be

scaled up in the future. The use of state-of-the-art building rating systems could also become mandatory in quality assurance and create transparency, which in turn supports the trustmaking process. Regarding the costs, which are an obstacle in the implementation of sustainable building standards, investors have to expect an additional 100 euros per square metre of net floor area or a total additional investment cost of 7 percent (Schöfmann et al. 2020; Hu & Skibniewski 2021). On the other hand, the operating costs over the life cycle of a building can be reduced by up to 85 percent (Architektur Online 2020).

Sarajevo's path towards becoming a pedestrian and bicycle-friendly city requires the reduction of motorised vehicles and the promotion of active mobility with attractive public transport and supplementary micro-mobility offers (Appio et al. 2019). The establishment of car-free neighbourhoods with neighbourhood garages at the edge of the area with e-charging infrastructure and a general reduction of parking obligations for project developers have been recommended. Adequate bicycle infrastructure inside and outside the buildings (lockable bicycle parking, etc.) should be implemented. Sharing systems (bicycles, e-cars) can be a valuable complement to the use of public transport, but should be implemented on a city-wide level. Public transport remains by far the most energy-efficient mode of transport for daily use.

Air quality is a top priority in Sarajevo, so developers should prioritise green city solutions and create resilient urban spaces. Landscape planning should be integrated early and throughout the development process to be cost-effective. Greening and shading of public spaces are the most effective measures to avoid urban heat islands in the long term. Intensive planting (trees, façade greening) also has positive effects on the microclimate. Trees with a high crown density can reduce the perceived temperature by up to 18°C during the summertime (Stangl et al. 2019). In addition to heat, heavy rainfall is also one of the noticeable effects of climate change, so the implementation of comprehensive rainwater management is strongly recommended.

3.5 Microclimate analysis

The impact of wind and its relationship to temperature is crucial in a topographical valley like Sarajevo due to the high probability of the Inversion Weather Phenomenon (Walczak 2023). In order to understand and quantify the current urban situation and potential future projects, different simulation frameworks can be applied. “Rhinoceros 3D” with the algorithmic modelling extension of “Grasshopper 3D” allows a real-time bridge between qualitative 3D modelling (architecture and urban design) and quantitative simulation frameworks.

On the one hand, these tools were used to simulate temperature during a period representing the hottest week of the typical meteorological year. As input, historic weather files from the years 2007 to 2021 were used from the location of the International Airport in Sarajevo (Climate OneBuilding 2023). On the other hand Computational Fluid Dynamics (CFD) wind simulations were run through “OpenFOAM” cases. “OpenFOAM” is an open-source CFD software and has an extensive range of features to solve, among others, complex fluid flows and turbulences, which has been made accessible through the “blueCFD-Core” project (Walczak 2023). The simulation results have been calibrated and validated in Sarajevo through on-site 3D wind measurements using a mobile Galion LIDAR system “windRoverII” (Walczak 2023), as part of the 4D Digital Twin for Sarajevo developed within the “Urban Transformation Project Sarajevo - UTPS” (Walczak & Pagani 2022). Additionally, both frameworks required information on building volumes, facade materials, roofs and public spaces, as well as the location of vegetation.

Through an iterative process and fast visual feedback mechanisms, multiple scenarios were gradually tested and translated into the architecture and urban design of both brownfield sites. Challenges and opportunities included strategies in larger open spaces regarding urban heat islands and their mitigation through vegetation and non-sealed surfaces. Related specifically to wind, urban design features such as porosity in building volumes, the linear orientation following the wind direction and heterogenous building heights support urban ventilation and natural cooling. Also, the incorporation of water bodies and river streams is benefitting cold air streams.

As an outlook, conclusion and policy recommendation, for resilient planning and implementation, each regulatory plan would require such an analysis since the climatic boundary conditions are changing with every intervention (Pelja-Tabori 2021).

3.6 Towards implementation: ideas for land consolidation

Early phases of analysis have revealed complex ownership structures at both sites. Plot sizes range from very small to very large parcels with a diverse mix of more than twenty different landowners on each site. The largest shares are owned by private companies, followed by different public institutions and individual private landowners. In both cases, the complex ownership situation has been the main reason why a coordinated overall development has not taken place in the past. While large private owners have shown their interest and were willing to buy the parcels of smaller owners, the latter are hoping for higher returns and better opportunities at a later point. Public owners and the local administrations have not yet developed the necessary tools to facilitate and lead the development either.

The study of good practice cases from Vienna, however, offered solutions that could also be feasible for Sarajevo. The central tool for land consolidation would be a cooperation agreement in the form of an Urban Development Contract between all private and public owners that is based on a consensus about the masterplan for development and future cadastre plan of the area. The new cadastre plan redistributes the land according to their value after development. Landowners would own the same share of net gross floor area compared to the percentage of land that they own now. This ensures an equal distribution of the profit that arises from development. At the same time, selected land parcels would be transferred to public ownership to provide access roads, public parks, social infrastructures, etc. These assets are an added value to other landowners who can sell their properties for higher prices due to enhanced amenities in the surroundings. At the same time, they guarantee basic services and improve quality of life also for the people living around the site. The cooperation agreement also includes the founding of a joint Development Corporation that leads the development process from this point on, coordinating all stakeholders and implementing the masterplan as agreed.

The Vienna model of land consolidation has been presented to the local public authorities who showed interest in the approach. Major landowners were contacted to assess their willingness to cooperate in such a process. Overall there have been positive reactions but there were also concerns in relation to the transparency of such processes. The need to create and maintain public trust and to include the wider public in decision making processes related to both brownfield sites that represent key locations in the urban fabric was emphasised. However, the coordination of such a process through international and independent experts was seen as a potential to overcome such obstacles and to move towards implementation of sustainable, mixed-use neighbourhoods in Vaso Miskin Crni and Kvadrant B.

4 CONCLUSION

The elaboration of development proposals for Kvadrant B and Vaso Miskin Crni took place in the field of tension between the interests of different political and administrative levels, landowners and the public, as well as the contemporary demands on modern urban planning, which result from the climate and biodiversity crisis, social inequality and economic development requirements. The textbook approach to urban design was adapted and enhanced to meet the specific challenges that the City of Sarajevo presented to the planning team.

The complex political and administrative system and the lack of trust in public authorities were addressed through a transparent and comprehensible planning process where each step was a logical consequence of previous analysis and which was fully disclosed through a publication that covers the entire design process and final results. Local experts, academia and the professional public were included through the Stakeholder Core Group and open event formats reached out to a wider public for the discussion of concepts and design principles. The many layers of administration were involved in the process through the Working Group that was regularly informed and invited to participate in the design process through co-creative workshops.

The predominant role of developers in urban development in Sarajevo and complex ownership structures on the selected brownfield sites were tackled through the empowerment of the local administration in the Working Group that enhanced their internal cooperation and influence on the design process. At the same time, a comprehensive real estate demand study ensured that the recommended mix of uses was based on empirical facts rather than on personal financial interests or public misconceptions of the situation. The proposed land consolidation approach represents a possible solution for the problem of implementation and the possibility of further independent consultation by the international team has been offered.

Environmental and social challenges can be met through innovative design ideas and smart city approaches that were adopted to the local circumstances and potentials. The microclimate analysis is a new tool to refine urban design that has been used for the first time in Sarajevo and has proven the compatibility of the urban design proposal with the demands of the ventilation corridors. Some suggestions from this work could also find their way into the new urban plan currently being developed.

Overall, the aim of the design process was to elaborate sustainable, resilient and climate-fit development proposals for brownfield sites in Sarajevo and to showcase a design and possible implementation process that could be replicated in other urban voids throughout the city in order to create a polycentric city of short distances. Of course, the team's efforts cannot cease at this point and it will take much more work with a specific focus on stakeholder engagement, public consultation and transparent cooperation with landowners to move these projects towards implementation and "quality contextual places for people".

5 REFERENCES

- APPIO, Francesco P., LIMA, Marcos and PAROUTIS, Sotirios: Understanding Smart Cities: Innovation Ecosystems, Technological Advancements, and Societal Challenges. In: *Technological Forecasting and Social Change*, Vol. 142, Issue C, pp. 1-14. Paris, 2019.
- ARCHITEKTUR ONLINE: Lebenszykluskosten: Gebäude ganzheitlich planen und bewerten. Vösendorf, 2012. Available at: <https://www.architektur-online.com/kolumnen/edv/lebenszykluskosten-gebaeude-ganzheitlich-planen-und-bewerten> [Accessed 09.06.2023].
- ARNSTEIN, Sherry R.: A Ladder of Citizen Participation. In: *Journal of the American Planning Association*, Vol. 35, No. 4, pp. 216-224. Chicago, 1969.
- BACON, L. Kevin, DAGENHART, Richard, GREEN LEIGH, Nancey and SKACH, John: The Economic Development - Urban Design Link in Brownfield Redevelopment. In *Economic: Development Journal*, Vol. 7, Issue 2. Washington, 2008.
- BLACK, Philip and SONBLI, Taki Eddin: The urban design process. London, 2019.
- BOTIC, Jurica: Spatial and National Distribution of Foreign Direct Investments in Bosnia and Herzegovina. In: *Hrvatski Geografski Glasnik*, Vol. 75, Issue 1. Zagreb, 2013.
- CARMONA, Matthew: The place-shaping continuum: a theory of urban design process. In: *Journal of Urban Design*, Vol. 19, Issue 1, pp. 2-36. London, 2013.
- CLIMATE ONEBUILDING: Climate Data Files. Available at: https://climate.onebuilding.org/WMO_Region_6_Europe/BIH_Bosnia_and_Herzegovina/index.html [Accessed 07.06.2023].
- COLLINS, Kevin and ISON, Ray: Jumping off Arnstein's Ladder: Social Learning as a New Policy Paradigm for Climate Change Adaptation. In: *Environmental Policy and Governance*, Vol. 19, Issue 6, pp. 358–373. New Jersey, 2009.
- HEWLETT, Mark and GALLEGO-LOPEZ, Catalina: Green Cantonal Action Plan for Sarajevo. London, 2020.
- HU, Ming and SKIBNIEWSKI, Miroslaw: Green Building Construction Cost Surcharge: An Overview. In: *Journal of Architectural Engineering*, Vol. 27, Issue 4. Maryland, 2021.
- KREBS, Roland and MAYR, Stefan (eds.): Future public spaces. Urban design in times of crisis. Berlin, 2023.
- KREBS, Roland and PAVLOVIĆ, Andrea (eds.): Brownfield Development in Sarajevo. Sarajevo Brownfield Urban Regeneration Project. Sarajevo, 2023.
- LLOYD-JONES, Tony (2001) The design process. In: Marion ROBERTS and Clara GREED (eds.) *Approaching urban design. The design process*. New York, 2001, pp. 51-56.
- PELJA-TABORI, Nataša: Sarajevo: The Post-war City in Transition Future Scenarios for the Post-Pandemic City. In: *Annual Review of Territorial Governance in the Western Balkans*, Vol. III, pp. 75-89. Tirana, 2021.
- SCHÖFMANN, Petra, ZELGER, Thomas, BARTLMÄ, Nadja, SCHNEIDER, Simon, LEIBOLD, Jens, BELL, Daniel: Zukunftsquartier. Weg zum Plus-Energie-Quartier in Wien. In: *Berichte aus Energie- und Umweltforschung*. Vienna, 2020.
- STANGL, Rosemarie, MEDL, Alexandra, SCHARF, Bernhard and PITHA, Ulrike: Wirkungen der grünen Stadt. Studie zur Abbildung des aktuellen Wissensstands im Bereich städtischer Begrünungsmaßnahmen. In: *Berichte aus Energie- und Umweltforschung*. Vienna, 2019.
- STATISTIKA (2013) National Census of Bosnia and Herzegovina 2013. Available at: <http://www.statistika.ba/> [Accessed 14.06.2023]
- THOMPSON, Emine Mine: Smart City: Adding to the Complexity of Cities - A Critical Reflection. In: *Complexity & Simplicity - Proceedings of the 34th eCAADe Conference*, Vol. 1, pp. 651-660. Oulu, 2016.
- TZIFAKIS, Nikolaos and TSARDANIDIS, Charalambos: Economic Reconstruction of Bosnia and Herzegovina: The Lost Decade. In: *Ethnopolitics*, Vol. 5, Issue 1. London, 2006.
- WALCZAK, Michael: Impact of Urban Planning on Air Quality: The Consequences of the Mismatch Between Natural Wind Flows and Building Typologies. In: *SDG 11, Transitioning to Sustainable Cities and Communities*, Ed. Hubert Klumpner, Klearjos Eduardo Papanicolaou and Georgeen Theodore, Forthcoming, 2023.
- WALCZAK, Michael and PAGANI, Marco: An Agent-based Digital Twin for Sarajevo. In: *ETH Zurich NSL, Newsletter 54*, June 2022: Artificial Intelligence / Machine Learning, Zurich, 2022. Available at: <https://www.nsl.ethz.ch/urban-transformation-project-sarajevo/> [Accessed 07.06.2023].
- ZUPCEVIC, Merima and CAUSEVIC, Fikret: Case study: Bosnia and Herzegovina. Sarajevo, 2009