

A knowledge-driven approach to urban transformations: densification strategy of the central parts of Bergen, Norway

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Abstract: The municipality of Bergen has launched a radical strategy for densification. A total of 50 percent of the need for new housing should be covered within Bergen's central parts. Bergen is the second largest city in Norway and it is known for its intimate relations between a beautiful west coast landscape and, from a Norwegian perspective, a dense urban structure. Much is at stake when introducing a radical program for densification. A report has been prepared that records the area's character and identifies and analyses potential transformation areas. With assistance from Western Norway University of Applied Sciences and consulting firm Asplan Viak, GIS is used as a tool for obtaining operational information and analysis models. The work has been financed by the Ministry of Local Government and Modernisation. Information is provided about what characterises and distinguishes Bergen's central parts. A new analytic GIS-based tool is developed for measuring the spatial attributes that constitute an area's attractiveness. This tool combines the Space-Syntax and Spacescape methods. Eleven major transformation areas are identified and issues such as ownership, possible obstacles to implementation and overall potential for development are analysed. A step-by-step implementation is proposed and recommendations are made which address critical obstacles.

Keywords: densification, transformation, Space Syntax, Spacescape

Introduction

In 1990, the dominating planning paradigm focused on transforming the inner-city public spaces from car-dominated areas to pedestrian-oriented areas. As a starting point, the question was raised: What are the basic characteristics of the cityscape? To answer this, a study was implemented showing the overall and local relationships between the natural landscape, the built-up environment and the public spaces. The method used was handmade black-and-white sketches carried out by skilled architects (Hansteen, 1991). The gained knowledge was important for establishing a successful long-term process of transforming dilapidated public areas into attractive, lively urban places. The municipality of Bergen has received several national and international prizes for this turn-around operation.

Today, almost 30 years later, the challenges are different. In the light of sustainable urban development, the task is to find out where and how to implement profitable and environmentally friendly densification. Since the 1990s, a revolution has taken place within information technology. Instead of handmade sketches in black and white, we have a number of electronic tools at our disposal for analysing complex environmental situations.

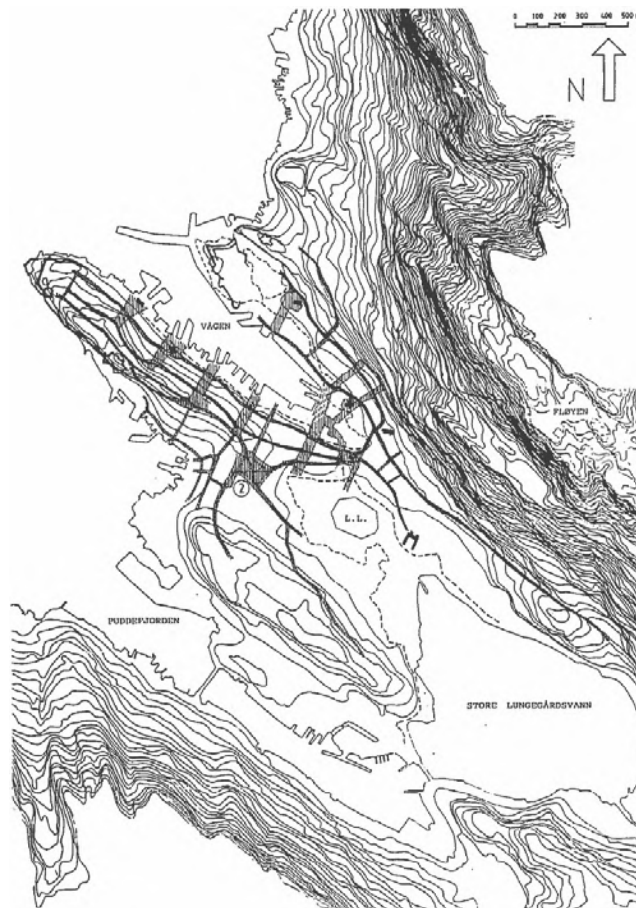


Figure 1 The character of Bergen drawn in 1991. Plan- og bygningsetaten, municipality of Bergen

In Bergen, a number of overall resolutions have been approved in order to enhance the urban environment. The major goals of the earliest resolutions are to reduce greenhouse gas emissions and to stop the growth of private car transportation. The time of urban sprawl is history. The city structure of the future is the compact city, where the inhabitants have short walking distances to their daily activities and public transport hubs. As a result, the city council has ordered an overall and long-term strategy for densification within the central parts of the municipality.

The central parts of Bergen are expected to facilitate half of the new housing stock, which is approximately 10,000 new dwellings until 2030, and another 5,000 later on. This is supposed to take place within that is already the most compact part of Bergen, an area that is already largely filled with different kinds of building structures. It contains protected heritage objects of local, national and international importance. The city's dense structure, resulting from its situation between steep mountains facing the fjords, forms the basis for a special urban atmosphere, which many regard to be Norway's most beautiful city. By introducing a radical vision for densification, much is at stake.

This leads to the necessity of a thorough investigation on urban standards and qualities. Considering these severe challenges, the question was raised: can environmental values be measured, and can geographic information systems as part of a positivistic tradition serve as a reliable tool for analyses and feasibility studies, or are we still better off with hand-drawn maps as part of a hermeneutic tradition?

The Norwegian Ministry of Local Government and Modernisation financed this work. The Ministry has demonstrated particular interest in whether and how the GIS-based Space Syntax and Spacescape methods could be integrated into one common methodology for identifying densification potentials in the study area. A special feature of Space Syntax and Spacescape methods is that they enable correlations between spatial configuration and socio-economic parameters related to city planning. This forms the background for the feasibility study: Densification strategy of the central parts of Bergen.

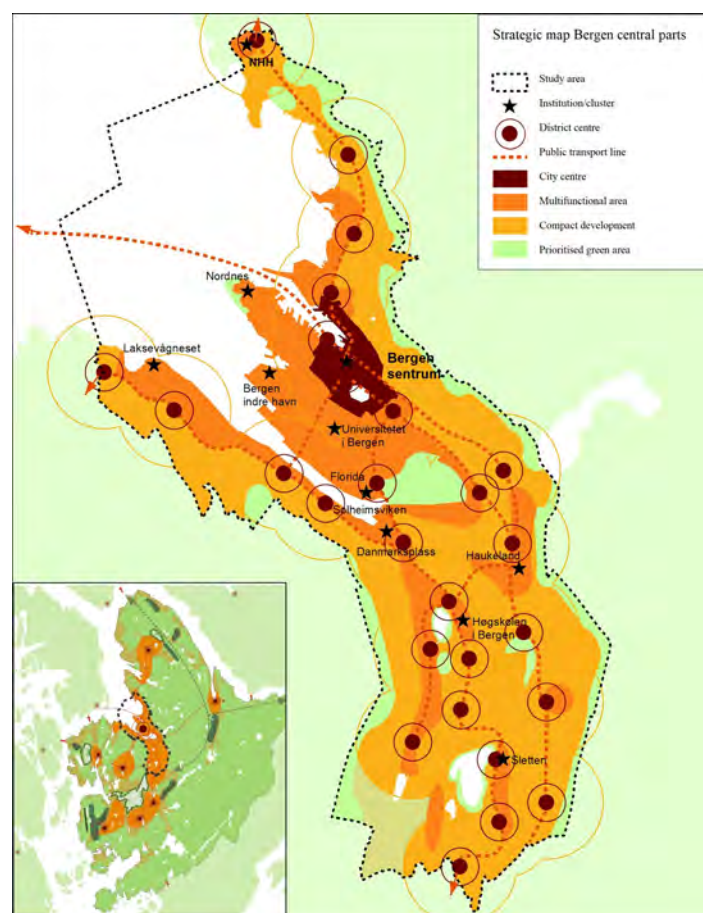


Figure 2 Strategic map for Bergen's central parts containing the city centre core, smaller subcentres, a high-priority network for public transportation, multifunctional areas and other areas prioritising compact urban development. Plan- og bygningsetaten, municipality of Bergen

The authors' contributions

Hans-Jacob Roald has been the project leader within the municipality of Bergen, during the project's constitution and implementation. He worked spare time at the Western University of Applied Sciences and is now full-time associate professor (Dosent) at the university. He was also project leader analysing the cityscape of Bergen in the 1990s. Remco de Koning has contributed to the project with Space Syntax analyses of the area as part of his doctoral research work. Acknowledgement goes to Asplan Viak AS with Trygve Andresen, who has been the project's main external consultant.

Methods

This section sets out the used methods, which are organised in two stages:

- Preliminary studies
- Applicable GIS analyses.

The preliminary studies consists of five parts:

- Clarification / appraisal of the investigation
- Creating a basemap
- Mapping building typologies
- A provisional Spacescape analysis
- A Space Syntax analysis

The applicable GIS analyses are delivering the feasibility results and are organised into four levels:

- Statistics and registrations of population trends
- Mapping individual characteristics
- Designing analyses in the form of overlapping maps
- Advanced numerical analyses of different characteristics

Preliminary studies

Densification was categorised into three different strategic approaches, following Sandkjær Hansen (2015):

- Expansion: expanding the development of the city beyond the municipal plan boundaries, i.e. towards the waterfront and the green areas in and around the city;
- Transformation: changing the structure and function within the built areas;
- Intensification: achieving higher utilisation within existing structures.

Our area of investigation is located in a valley of about 7 kilometres in length and 2 kilometres across, between steep mountainsides and the fjord. All major and important communication lines are located at the lower parts of the valley. It proved difficult to establish satisfactory access between the overall public transport network and suitable areas for city expansion on the mountainsides. Regarding expansion towards the waterfront, the most relevant areas were already in planning processes categorised as expansion. Possibilities for intensification are addressed in a later stage. The task for this study was therefore to focus on identifying and analysing possible larger transformation areas.

Creating a basemap

A basemap was created from 160 basic statistic units (called *grunnkrets*, see Figure 3). Each of these units can refer to and convey data from the National Statistics Agency and to planning and property information with the municipality of Bergen as source. By designing maps based on these units, it became possible to overlap and convert information and thus gain new knowledge. One challenge was

to assess what kind of information is relevant for co-relating with a view to gain relevant new knowledge. The second challenge related to the amount of information that can be shown in one map. A map that contains too much information can lose its meaning.

A variety of building customs

The project integrated and refined a map produced as part of a master thesis at the Norwegian University of Science and Technology (NTNU) (Lindau, 2015). The map shows that our area contains a conglomerate of building traditions. This diversity is a value in itself. The map forms a good basis for discussions addressing all new building projects, how they will interact with the established surroundings.

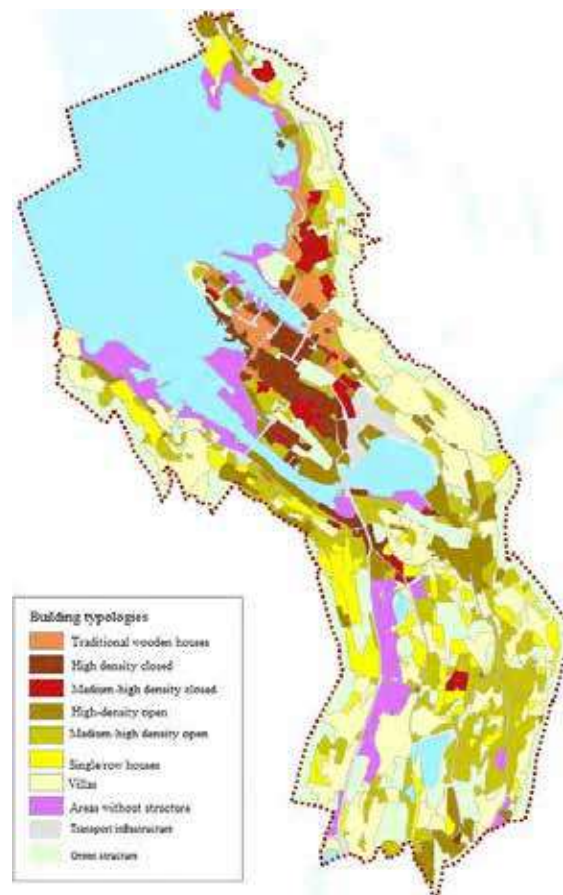


Figure 3 Base map showing building typologies

Spacescape

The consulting firm Asplan Viak conducted a feasibility study of the area based on the Spacescape methodology. Spacescape was developed by the Royal Institute of Technology (KTH) in collaboration with the Stockholm-based company Spacescape (2013). Spacescape operates with what is called the densification matrix (see Figure 4). The densification matrix is a model for carrying out comprehensive and holistic analyses based on a number of issues within the main themes *Driving forces* and *Obstacles*. In our case, a study done according to the densification circle, appeared not to be operational in the context of Bergen. This does not suggest that the model is wrong in itself. The

Swedish examples using the densification circle have been used on far larger areas than ours in a different geographical context.

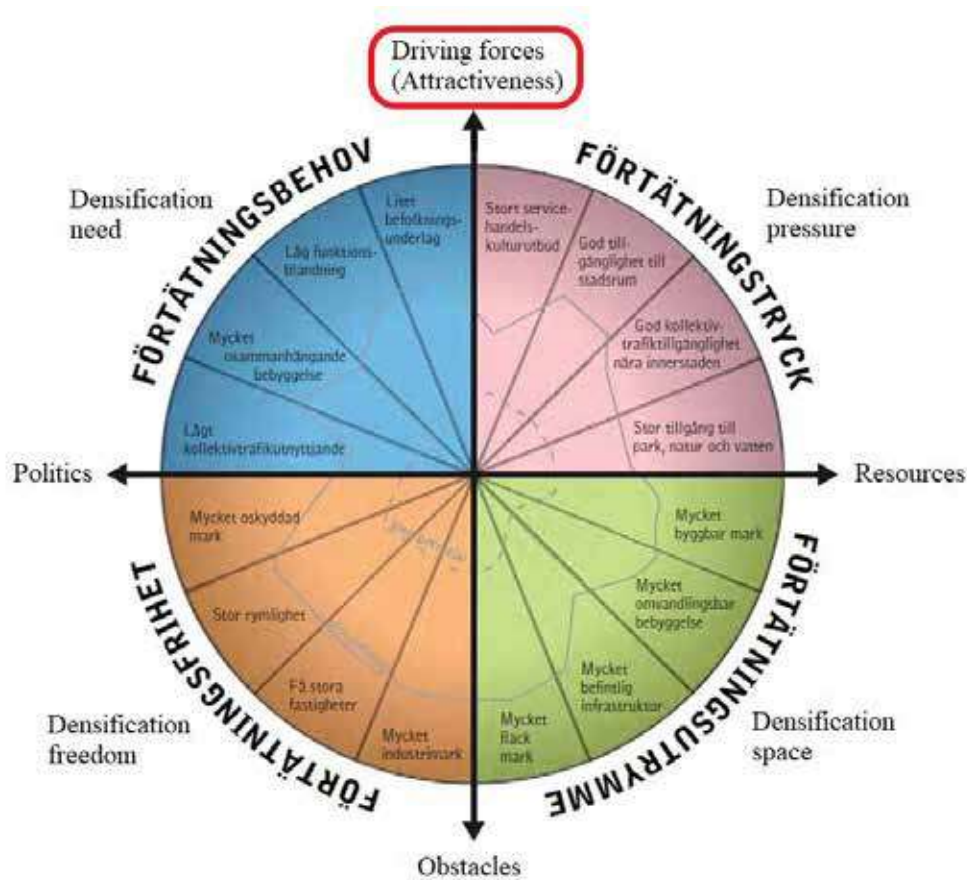


Figure 4 Densification matrix by Spacescape (2013)

Another experience is principal. Is it possible, or even desirable, to implement holistic comprehensive analyses for a city? Our statement was that no, one can never commit a city to any kind of formula once and for all. As a result, we chose to pick elements from one half of the circle, which are the themes identified as *Driving forces*. We decided the name *Attractiveness* to be more appropriate.

Space Syntax

A Space Syntax analysis was carried out. The Space Syntax method was developed by Bill Hillier and his colleagues at London's Global University. The methodology analyses the spatial conditions of the streets and road network at different scale levels, based on the total number of directional changes for each street segment relative to all other streets. It is a form of accessibility analysis. The methodology has been tested in different parts of the world. Streets with high spatial integration values tend to have the highest amount of people using them as a destination or as part of a shortest route to their destination. This is also known as the theory of natural movement (Hillier, 1998). It is also an indicator for the attractiveness for economic activities, and a mutually reinforcing process called the natural movement economic process (Hillier *et al.*, 1993). Moreover, highly integrated areas often have a high degree of functional mix and building density. The latter finding has been subject to theory building in recent years, and given the title the theory of the natural urban transformation process (Ye and van Nes, 2014).

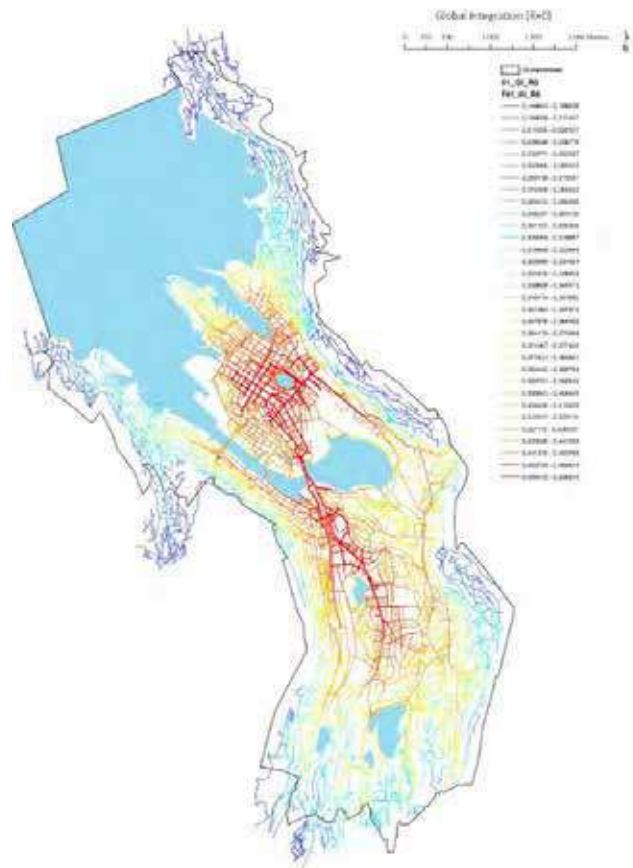


Figure 5 Space Syntax analysis of the study area – Global Integration ($R=n$)

Results

First, population trends, age distribution and relocation were examined. First, the period 1980 – 2000 was addressed. The registrations show a decline in the population of 7 000 residents across the area. The geographical dispersal of the decline was surprising. It was during this period that the Government and the municipality invested large resources in order to upgrading renewal of the city centre with award-winning projects, as a result. This did not result in immediate population growth. When considering the period 2000 - 2017, the picture is completely different with a rise of 15 000 residents (Bergen Kommune Plan- og bygningsetaten, 2018). Here too, the trend took place well distributed throughout the area. An explanation might be that the rise of housing standards that took place in the centre core in the 1980s and 1990s resulted in an increasing positive image of urban living in general. In addition, a broad range of radical environmental measures were carried out from the year 2000 onwards. A number of institutions for higher education were either reinforced or established. All these efforts might have laid a broad foundation for a rise of residents throughout the area.

Who are these new inhabitants? An answer might be found in Figure 6 showing the population profile of 2017, comparing the population profile within the study area with the entire municipality of Bergen. The differences are significant. For the study area, the share of the population between the ages of 1 and 20 is far lower than the average, while the share of the population between 20 and 40 years is far higher. Where do they come from?

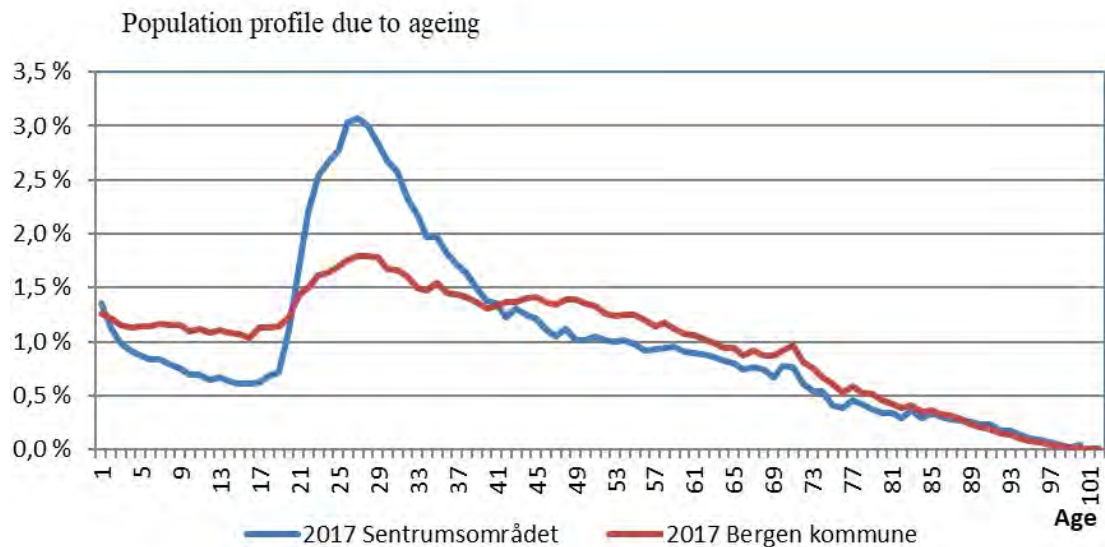


Figure 6 Population profile due to aging for the study area (blue) and Bergen municipality (red)

A survey of migration to the municipality again presents a clear picture. The municipality of Bergen consists of eight districts. Two of these districts are situated within the study area. The vast majority of people moving to the municipality prefer to live in these two districts. For the other six, the changes are marginal.

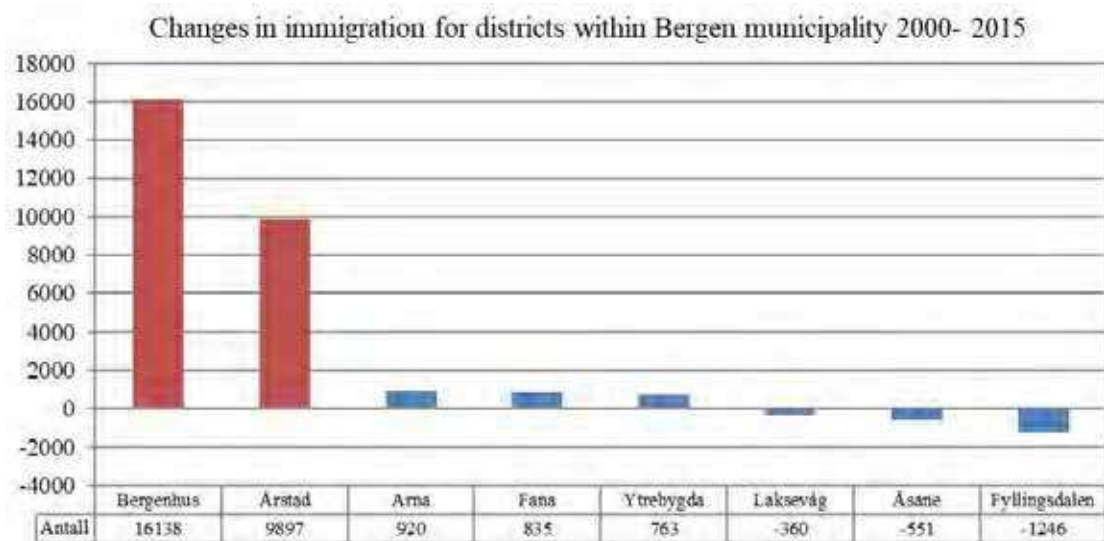


Figure 7 Changes in immigration for districts within Bergen municipality 2000-2015

Mapping single characteristics

A number of thematic registrations have been conducted. Knowledge related to issues such as density of working places, housing, service provision and more, has been produced and presented on maps. Information related to current planning strategies, production of plans, communications has been produced and presented.

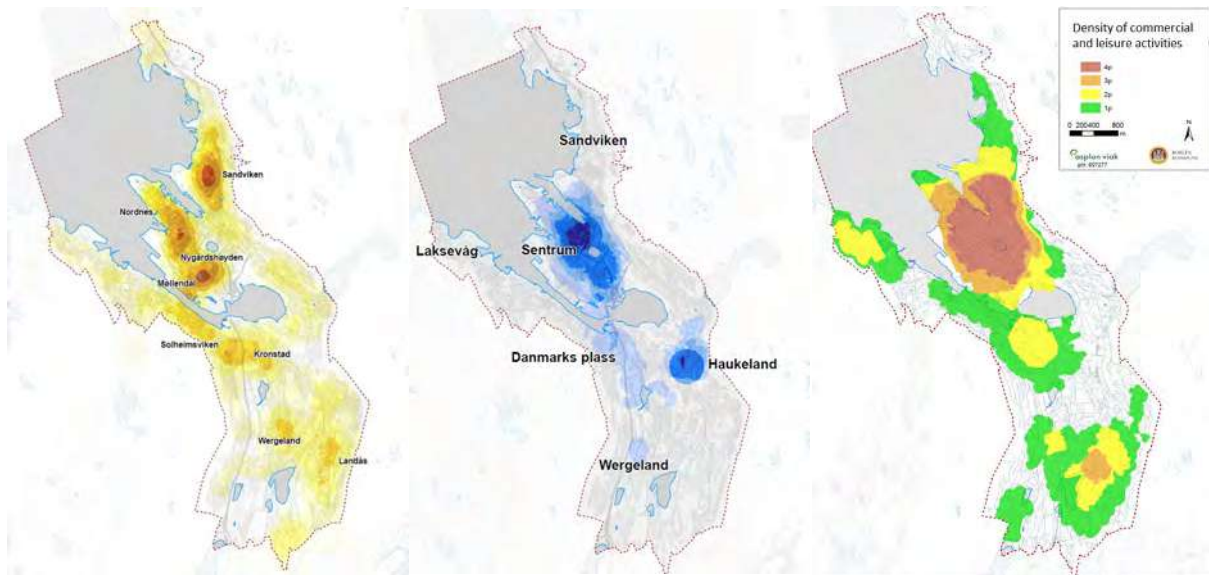


Figure 8a housing density (left), 8b workplace density (middle), 8c density of amenities (right)

Designing analyses

The easiest way to conduct map-based analyses is to add two or more maps to each other. An example is an analysis in order to define the compact city. Four topical maps were added to each other. The first three dealt with functionality and density. Figure 8a shows housing density, Figure 8b density of working activities, and Figure 8c urban activities such as trade, public and private service, culture and education.

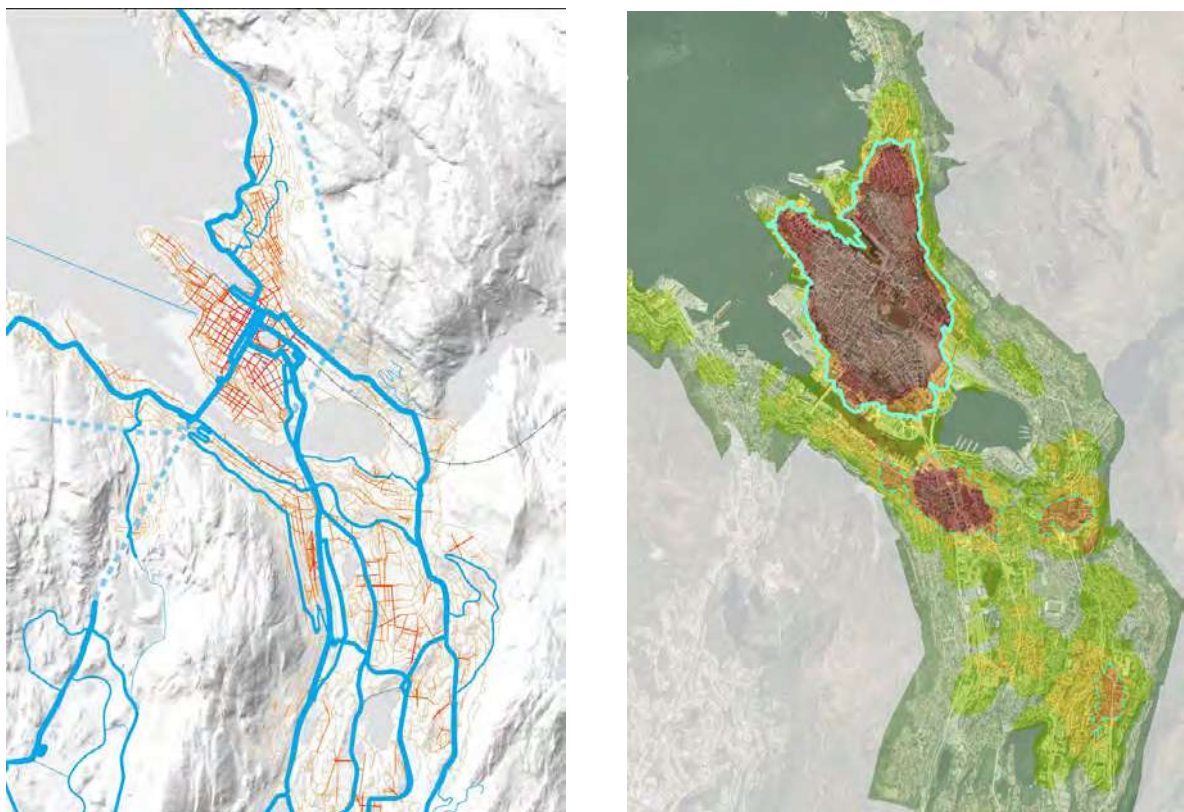


Figure 9a (left): high-frequency public transport (blue) and local integration ($R=3$);
Figure 9b (right): proximity to multifunctional areas

Figure 9a shows the degree of accessibility to high-frequency public transport combined with the Space Syntax analysis. Our hypothesis is that the combination of density of functions and good accessibility produces a picture of the compact city (Figure 9b), in this case the compact city of Bergen, and the picture is quite clear. The city centre is undisputed the most compact part within our area.

Analysing attractiveness using numerical analyses

To analyse the attractiveness of Bergen, eight variables were analysed. The choice of these variables was a result of discretionary assessment. The Spacescape method operates with seven variables. The difference is that contrary to Bergen, sun conditions were deemed irrelevant in Stockholm. Furthermore, a regular street structure was considered important for Stockholm, whilst Bergen has a more pluralistic urban structure. In addition, the population's socio-economic status and living conditions were considered relevant for Bergen, and not for Stockholm.

The following topics were mapped and weighted.

- | | | |
|----|---|--------------------------------------|
| 1. | Proximity to the city centre core | Very important 0-4 points (17%) |
| 2. | Proximity to urban businesses | Very important 0-4 points (17%) |
| 3. | Proximity to public transportation hub | Important 0-3 points (13%) |
| 4. | Exposure to sunlight | Important 0-3 points (13%) |
| 5. | Socio-economic living conditions | Important 0-3 points (13%) |
| 6. | Proximity to a waterfront | Important 0-2 points (13%) |
| 7. | Access to a park | Moderately important 0-2 points (9%) |
| 8. | Proximity to an integrated street structure | Moderately important 0-2 points (9%) |

The summary map of Figure 10 shows great variations. The main message is that the centre and its immediate surroundings have high and above average attractiveness. The other areas in orange and yellow have medium attractiveness, with the exception of the areas that lie to the west, which are below average attractiveness. There is a clear similarity between the most attractive areas and the map showing the compactness of Bergen; the more compact, the more attractive city. Furthermore, the city has a clear, more attractive “east end” and a less attractive “west end”. Especially in winter, the east side has far better sun exposure than the neighbourhoods on the shaded slopes to the west, something which is reflected in the areas’ socio-economic performance.

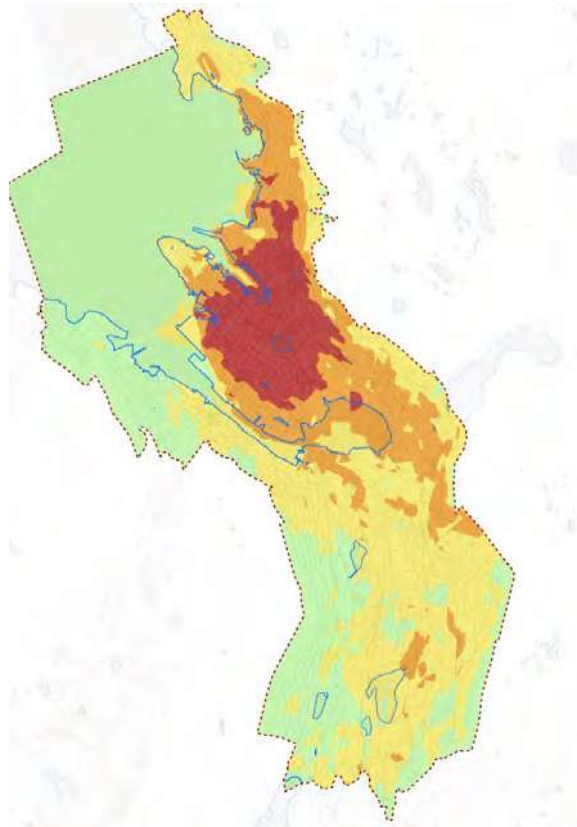


Figure 10 Summary map attractiveness

Findings

Eleven major transformation/development areas were identified. These were analysed according to attractiveness, ongoing planning activities, ownership, potential obstructions related to implementation and capacity. The total capacity for the eleven development areas was summed up. The potential is considerable with room for realising approximately 10.000 new dwellings and 1.000.000 m² public programme. Based on a discretionary assessment, a division was made into 50% dwellings and 50% urban functions. This could increase the total housing stock with as much as 25%. This will in turn trigger a need for several new schools, kindergartens and nursing homes.

When it comes to implementation, all densification projects are difficult to implement. Moreover, some areas are faced with critical factors such as unclear ownerships or underlying diffuse agreements. Such areas are considered immature regarding starting a planning process, or even programming. Most of the critical factors are related to factors outside the power and authority of the municipality.

Two interesting overlapping maps were designed. The first combines the eleven development areas with land ownership (Figure 11a). For some development areas, the public sector is the dominating owner. As for others, the private sector is the dominating owner. When it comes to planning and implementation, the strategy dealing with privately owned land is quite demanding regarding fulfilling public goals, in this case cross-sectoral goals specified by the municipality. A challenge the municipality has to face is that the central government has organised its activities into a large number of companies acting as if they are private and with economic income as a prime objective.

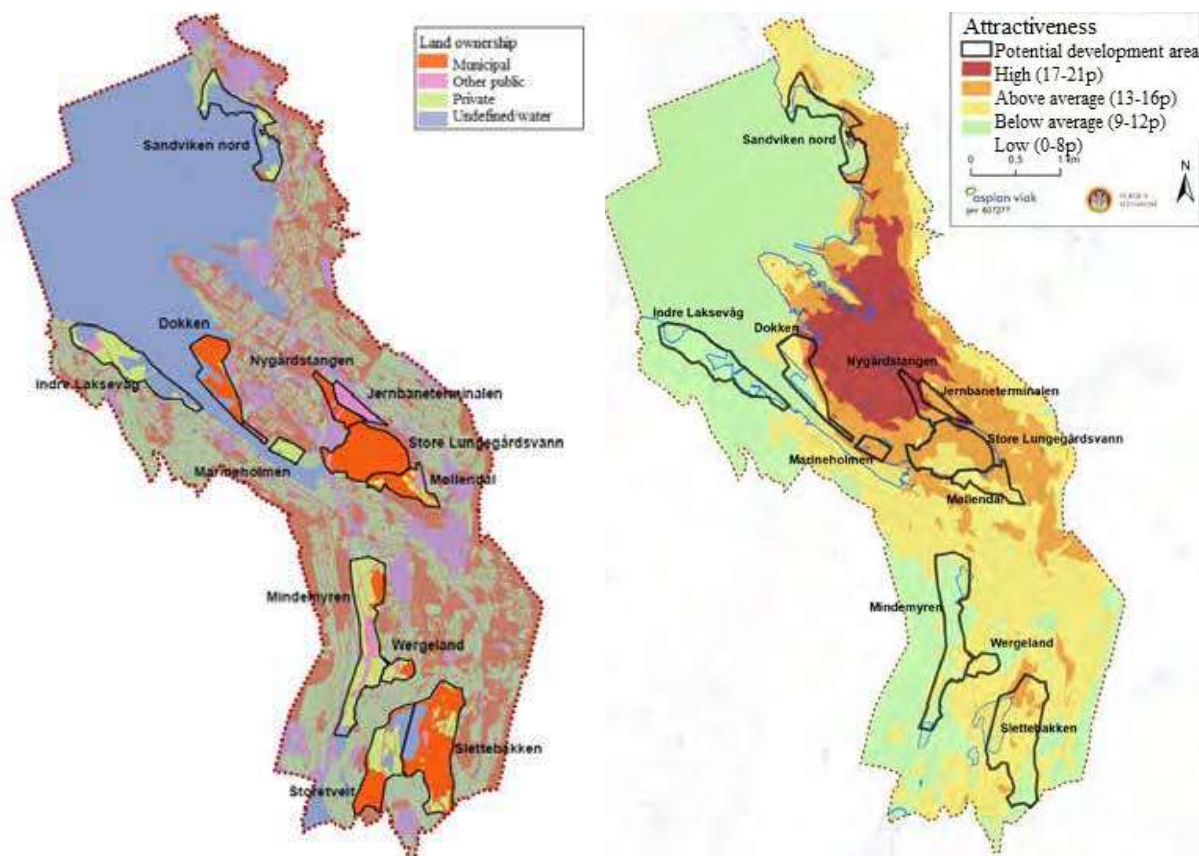


Figure 11 development areas overlapped on a: land ownership (left) and b: summary map attractiveness (right)

In the second map (Figure 11b), the eleven development areas are added to the summarising map of the factors that were determined to contribute to attractiveness. This map demonstrates a great variety of degrees of attractiveness within the different development areas.

Conclusions

The densification strategy study has been interrelated as part of the study program at the Western Norway University of Applied Sciences, both the application of urban analysis in itself and the development of GIS based methods. The relevance of the content of the urban analyses is underlined by the facts that they are a result of a request from the City council and The Norwegian Ministry of Local Governmental and Modernisation. The methods that were used serve as examples on how to use and compose GIS analyses for a given area. Advanced numerical analyses are used to teach and encourage students to design complex analyses that address divergent challenges and use and investigate different sorts of parameters.

The study presented in this paper has delivered on the requests from the central governments. A methodology for investigating potential densification areas in the city of Bergen was put forward, and a new method for analysing attractiveness was produced in which Space Syntax and Spacescape are integrated. The launched densification strategy offers an opportunity for politicians and citizens within the municipality to discuss expectations, preferences and priorities, and subsequently building programmes for each of the development areas seen in a long-term and holistic perspective.

Considering the compact city, attention should be paid to areas outside the compact centre: specifically the three semi-compact areas, the public transportation hubs, and the low-density neighbourhoods in general.

The first recommendation that is made is for the local government to concentrate its attention and efforts on the eleven major development areas that were identified. This is where the potential for development and, in the long term, the benefits will be greatest. This applies to the use of administrative competence and capacity as well as the effect of planning efforts. Second, a systematic implementation is recommended. A timetable for implementation was drafted. The areas that were confronted with critical factors concerning implementation were placed at the end of the time table. The time horizon for implementation is recommended to be extended from 2030 to 2050. Setting a hard target of densifying the compact urban valley by building 10.000 new dwellings, and thus increasing the number of residences in the Bergen valley with 25 per cent within 12 years, could have a negative impact on the standards of quality that are desired. Already, examples of densification projects that do not hold desirable qualitative standards have been seen. Furthermore, a long-term strategy ought to be rooted in coordinated, long-term public budgets. In Norway, many planning activities are initiated by the private sector, leading to a number of examples where the need for social infrastructure has been overlooked. It is evident that if the initial densification projects do not pursue quality and create enthusiasm, the whole linkage between sustainability and densification can fall.

The map showing great varieties of attractiveness within the eleven development areas (Figure 11b) sends an important message to the involved stakeholders, both investors and planning authorities. By deconstructing the attractiveness map, we can uncover which factors score high or low and thereby which factors should be refined or strengthened in order to raise the attractiveness of the area. While topological aspects such as sun exposure and view are difficult to alter, others, such as accessibility, diversity, and access to amenities, public transport and green areas can be improved. For areas with lower attractiveness, these factors deserve extra attention, creative ideas and higher economic efforts.

This raises a major challenge. One basic prerequisite for urban transformation in the Norwegian planning context is that as a rule, developers, mostly private partners, are obliged to cover the expenses on necessary new infrastructure. This is enshrined in a so-called predictability decision, a decision that gives the municipality a mandate to demand financial contributions from the developers through a formalised economic development deal. Here, one is confronted with a dilemma. For the most attractive areas, it can be expected that the developer is willing to accept relatively large investments in new infrastructure. Attractive areas will be even more attractive. For the areas with low attractiveness, the situation is different. It can be expected that the opportunities for profit are lower and, as a result, the opportunities for greater joint contributions to lift the quality of the public domain could be lower. This can result in a negative spiral where the areas that require the most efforts and resources, will receive the least. This finding can contribute to the debate on relations between transformation, the predictability of decisions and living conditions.

Previously, the central government had a policy and a rather high budget for improving living conditions. Grants for public investment in socio-economic vulnerable areas were considerable. Now, the central governments have almost abdicated their earlier obligations and left the responsibility for planning and financing almost entirely to the municipalities and the local private investors. This article invites to a debate about on the state's almost inadequate housing policy.

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