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Strategies for sustainable densification along new light rail stops

Option testing with Space Syntax at Skjoldskiftet in Bergen, Norway

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ABSTRACT

The municipality in Bergen, Norway has since 2016 a policy for enhancing compact urban development consisting of a network of centres located around the light-rail stops. The aim is to reveal how the areas around the light rail stop Skjoldskiftet can be transformed according to these policies. The challenge is to apply knowledge from existing urban theories and methods for making the spatial foundation for a sustainable urban transformation. Analysis of the existing situation and of the new planning proposal is presented in this short paper/poster presentation. As the analysis show, the degree of spatial integration of the street and road network sets the framework for where and how to densify in the vicinity of the light rail stop.

This short paper presents how thorough analysis of the spatial and functional relationships in urban areas can be used as the basis of comprehensive land use plans in transformation areas. Space Syntax, Spacematrix, MXI, Street function, and street constitutedness is used to reveal how the street network, building morphology, and the dispersal of functions can contribute to transform Skjoldskiftet from a car-based towards a pedestrian friendly area.

KEYWORDS

Compact city, light rail stop, option testing, densification, walkability

1 INTRODUCTION

In 2016 a change took place in the planning practice in Bergen municipality. The land use plan of 2016 (KPA2016) proposed a more compact urban development consisting of a network of local urban centres located around the light rail public transport stops, than promoting new dwelling

areas in the unbuilt outer areas of the municipality. In 2017 the light rail line between Bergen centre and the airport was finished. There are several local areas rapidly transforming as a result of densification along the light rail line. Skjoldskiftet is one of them. The area adjacent to this stop is used to illustrate how existing urban methods and theories is used as a basis for option testing and to find sustainable solutions for a TOD development.

The city's location between the mountains provides a natural basis for a linear shaped town, consisting of a network of local centres located at the light rail stops. According to the municipality, a compact city implies short walking distances to the centre and to public transport stops (Bergen municipality, 2017a pp. 8 - 9). In addition, there is a forecast that the population will grow in Bergen with 2300 new inhabitants per year. This leads to a need for 1200-1500 new dwellings within2030. The challenge is to find suitable locations for these dwellings in a sustainable manner (de Koning et al 2020).

The purpose of this short paper is to demonstrate how different analysis methods can be used as a basis for the preparation of land use plans, in densification areas in line with KPA2016. The study area is chosen because of the area's location along the light rail, and that Skjoldskiftet is pointed out as an urban densification zone in KPA. At present, the area is a thoroughfare for vehicles from Bergen city centre to the south of Bergen and Bjørnafjorden municipality. The new highway between Bergen and Os (E39 Svegatjørn-Rådal) is in the construction phase and will relieve the heavy traffic that today passes through Skjoldskiftet. Fewer cars provide the opportunity to create a long-term plan to change the area, from private car dependency towards the use of walking, cycling and public transport usage. Skjoldskiftet was a former agricultural society, located ca. 10 km outside the historic centre of Bergen. Today, the area consists of detached single-family houses and some terraced houses built between 1970-2000. The light rail stop was finished in 2014. Since then, a densification transformation process is taking place in the area with a lack of an overall local plan. This leads to constructions of new randomly scattered locations of apparent buildings with car-parking in the basement and ground floor level.

The following questions are at stake: How can objective, spatial analysis methods lay the foundation, and be used for planning in densification areas in Bergen?

2 THEORETICAL SETTING

In order to test out various options, one is dependent on urban theories with high degree of predictability. As various Space Syntax research has shown, there exist two theories that have a high degree of predictability (van Nes and Yamu 2020). 'The theory of the natural movement economic process' (Hiller et al 1993, Penn et al 1998) states that the spatial configuration of the street network structure influences the movement pattern of people and location of economic activities. Research has shown that if this spatial structure of the street network is changed, the location of economic activities and movement pattern will change too (van Nes 2021a).

'The theory of the natural urban transformation process' states that the spatial configuration of the street and road network is the spatial armature on how cities will transform in terms of building density and the degree of land use diversity (Ye and van Nes 2014, van Nes et al 2012). As research has shown, older neighbourhoods have a more integrated street network, high building density and multifunctional land uses than newer ones. Old urban areas tend to have high levels of socio-economic activity which, among others, Gehl (1971) and Jacobs (2000) discuss in their work.

For generating safe and walkable build environments, research has shown that the integrated streets need also to be constituted by building entrances with windows on ground floor level (Shu 2000, van Nes and López 2010, 2013, Miranda and van Nes 2020, van Nes 2021b).

3 OPTION TESTING

Due to that the spatial configuration of the street and road network is the fundamental driver for urban transformation, three different alternatives for a new street network in the area is tested with Space Syntax. The potential locations for new local centres can be identified by applying Space Syntax through option testing. The path network needs to be solved first (Seamon 1994). Figure 1 shows an angular segment integration analysis with a low metrical radius (R=500 m) of the three options. In order to enhance walkable compact neighbourhoods, the local integration matters (van Nes 2021b).

In the conservative alternative, the street structure will have little effect for creating a vital local centre (Figure 1 top). This alternative implies no demolishing of existing buildings. Shortcuts and connections between existing roads have been added to make it easier to walk towards the light rail stop. The Space Syntax analysis conducted on this option shows a slight improvement from the current one situation. Even with the few changes added, this leads to a slightly improvement of the area. However, this alternative will continue to enhance an urban transformation facilitating owning a private car.

The radical alternative shows large changes in the street structure (Figure 1 middle). This alternative is made to demonstrate the maximum potential of the area. The focus is on making good cross-connections to roads directly connected to the light rail stop and to the surrounding areas. As the results from the Space Syntax analysis show, it will be easier to walk instead using the private car. The radical alternative can be implemented in a plan with a long-time perspective, and then let the area transform incrementally. As the analysis show, the potential for a vibrant urban centre is present in the radical alternative. Therefore, it might be an incitement for the property owners to contribute to such a development.

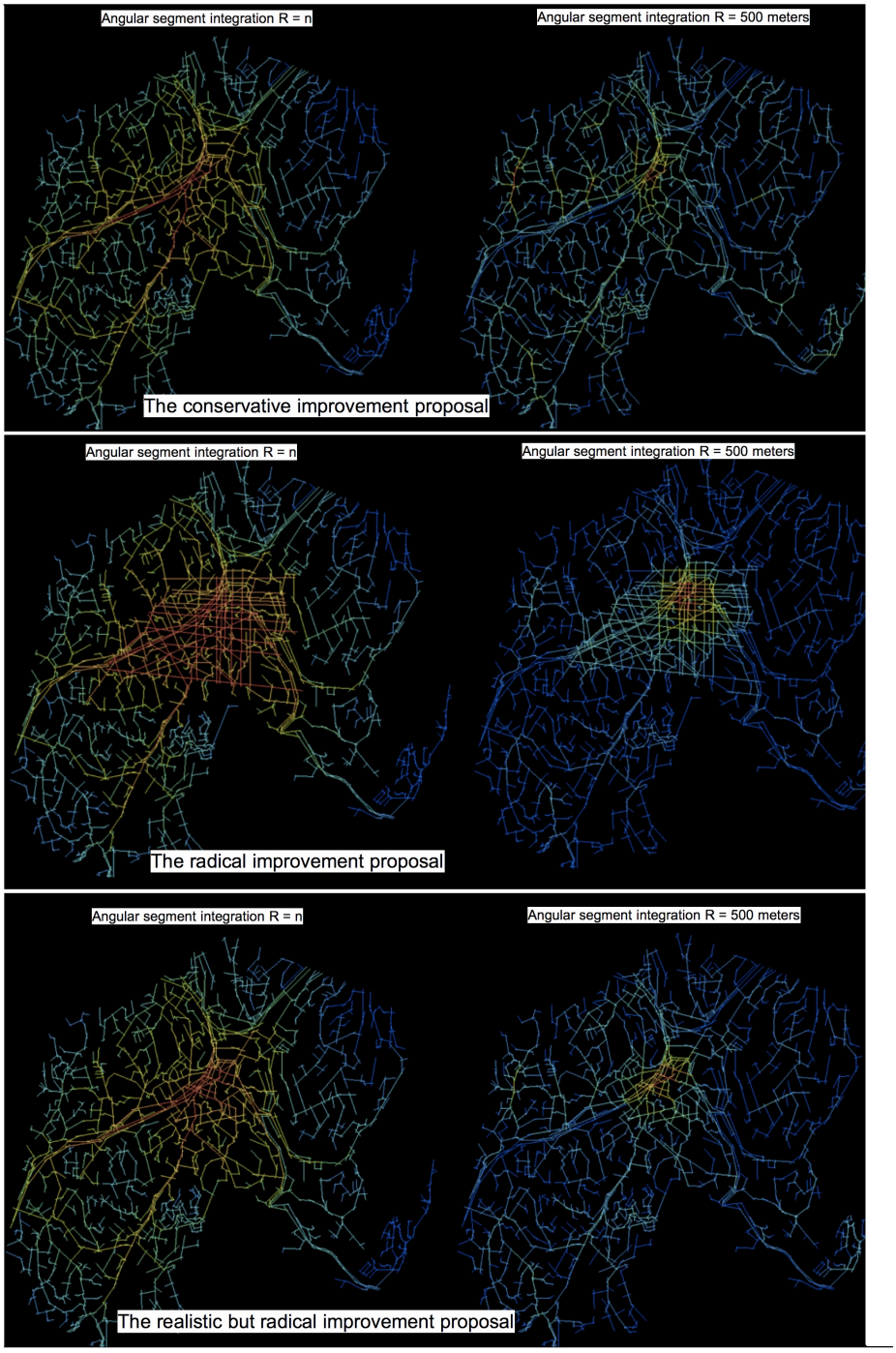

Figure 1: Space Syntax analysis of three different alternatives

The moderate alternative is a mixture between the conservative and the radical alternatives (Figure 1 below). The alternative proposes a network street structure around the light rail stop. This street network structure contributes to good cross-connections throughout the area for pedestrians. In this proposal, the current commercial buildings in Skjoldskiftet are replaced with new buildings with various functions in line with the new street network structure. The Space Syntax analysis for the moderate option shows a potential local centre around the light rail stop, both on a global and local

level. The through traffic potentials in the area has also improved significantly from the current situation.

The three options can be seen as three different phases of upgrading the street network in a long-term perspective at Skjoldskiftet. The next step is to reveal how densification can take place based on the moderate proposal. There will be minimal impact on the surrounding building masses and can thus be seen as a smaller and more feasible intervention than the radical one. If a further upgrading of the street network is needed in the future, connections can be improved towards the surrounding areas in line with the radical alternative.

The new street network at Skjoldskiftet will involve both an upgrade of existing roads, as well addition of new shortcuts with purpose to facilitate pedestrian and bicycle paths and accessibility to public transport. This goal is in line with the national transport policies, national walking strategy policies, regional land use and transport plans, and in the municipal plan's land use plans and policies. The aim is to enhance the use public transport, and to avoid making the roads more attractive to motorists. One strategy is to transform the current car parking areas to pedestrians, bicyclists and public transport users. This can make public transport more attractive than using the private car (Næss 2015b p. 145). Reducing the accessibility for vehicles contributes to reducing greenhouse gas emissions (UN, 2015) and help promote the development of Skjoldskiftet as a sustainable and compact local area.

Infrastructure is one of the most important elements in planning, and forms the basic structure in one area. Jacobs (1958) refers to streets as; ‘The best place to look at first is the street ... [T] he street works harder than any other part of downtown. It is the nervous system; it communicates the flavor, the feel, the sights. It is the major point of transaction and communication’ (p.127).

KPA2016's regulations state that place analysis must be conducted in line with a place analysis manual prepared by Bergen municipality. The place analysis manual is a good measure to gain control of the transformation of the densification areas pointed out as urban centres in KPA2016. The use of this manual can help to ensure good urban qualities in new projects implemented in existing areas. The problem with this place analysis manual is that it has an unclear definition of urban space and lacks operational spatial analysis tools. The place analysis suggested in this manual has a place phenomenological approach and consists mostly of making registrations on maps.

What the guide does not show, however, is how the hidden structures in urban spaces can be uncovered. They can be revealed as follows.

1) Space Syntax shows the hidden spatial properties of the street network (Hiller 2001, 1999).
2) The relationship between FSI and GSI through the spacematrix method (Rådberg 1996) shows a classification of the density in the building mass based on building types.

3) MXI show the degree of land use mixture in the area (van der Hoek 2009).

4) The various urban micro scale tools show the street-building interfaces (van Nes and López 2010).

5) The analysis of the street profiles (Eldijk et al 2014) shows on a micro scale level the users of the various streets.

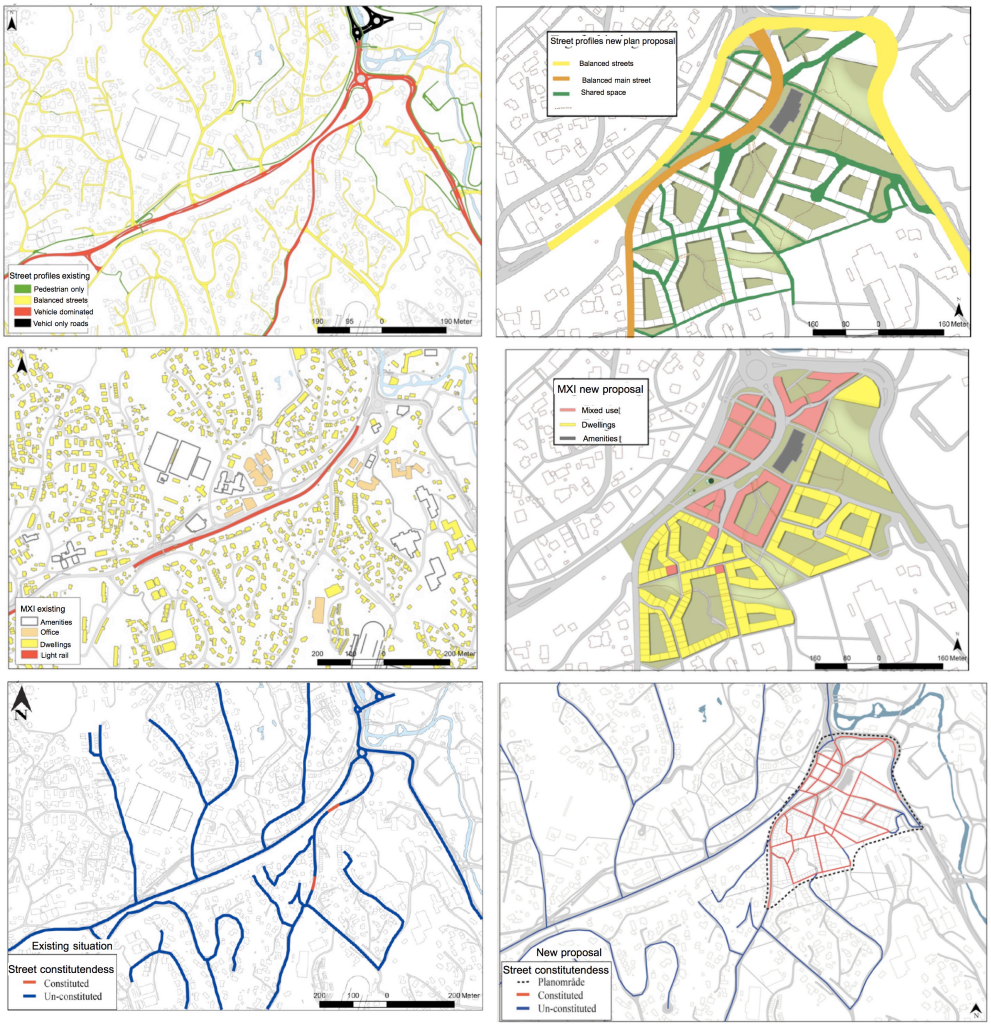

Figure 2: Various analysis of the current situation and new proposal

A combination of all these parameters can thus make a broad diagnosis of the current situation and the new planning proposal (van Nes and Yamu, 2021). Figure 2 shows three analysis of the present situation and from the new proposal. In addition, we conducted a walking distance map from the light rail stop for the current situation and the new proposal. As can be seen in figure 3, the local catchment area is enlarged in the new plan proposal.

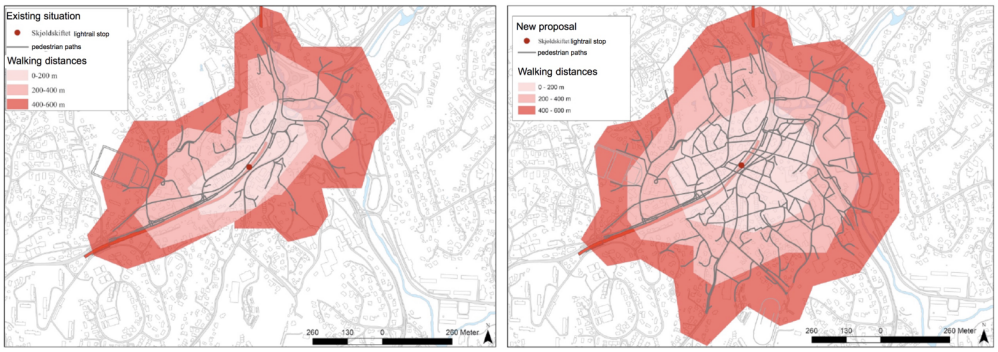

Figure 3: Analysis of walking distances from the light rail stop at Skjoldskiftet for the current situation (left) and in our planning proposal (right).

4 DISCUSSION AND CONCLUSIONS

These methods presented in this paper are far more refined than the municipality's place analysis manual. According to this manual, the urban space analysis shall contain 4 maps with text for specifications of improvements that are necessary in the urban space network. The basis for these maps is various registrations of the area's qualities and deficiencies which, together with landscapes, cultural monuments and transport lines, forming the basis for the urban space recommendation. The guide describes what the urban space analysis should contain, but not which methods are to be used as a basis for uncovering the city's spatial structures. This shows that the guide lacks precision and allows for interpretation of what a good urban space consists of. This has consequences for the level of verifiability, falsifiability, empirical support and the degree of usability of the manual. A lack of objective analysis methods with empirical support makes the content of this place analysis manual recommendation too general and un-operational.

Scientifically grounded analysis methods contribute to a high degree of operationalization in planning practice. By using methods that are built upon precision, strong empirical support, and high degree of operationability, the results will give a high degree of reliability and validity for making well-functioning urban transformation and densification projects. Moreover, the use of various spatial analysis methods to uncover the hidden structure will provide greater insight into the connection between phenomena such as implies that it contributes to greater security and better understanding of phenomena (Troye, 1994 p. 263-264). Therefore, there is a need to upgrade the municipality's current urban place analysis manual for densification of sub-urban areas in a sustainable manner. Our feasibility study of Skjoldskiftet is used to demonstrate how useful scientific grounded analysis methods can be for achieving sustainable transformations for local centres around public transport stops.

Due to the strong property rights in Norway, urban transformation occurs incrementally in sub-urban areas. Therefore, overall spatial strategy plans, proper evaluation tools, and common agreements between landowners is needed to steer urban transformation processes around light rail stops to well-functioning walking friendly neighbourhoods.

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