Densification of station areas in order to promote sustainable mobility, health, well-being and energy efficiency - opportunities and obstacles. The case study of Mölnlycke urban centre in Gothenburg region, Sweden

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Densification of station areas in order to promote sustainable mobility, health, well-being and energy efficiency - opportunities and obstacles. The case study of Mölnlycke urban centre in Gothenburg region, Sweden.

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Abstract. The Mistra Urban Futures project “analysis of urban station communities” different forms of co-creation have been a common denominator for transdisciplinary collaboration between a wide range of stakeholders related to a number of planning cases on different levels [13]. Densification in combination with mixed-use, spatial configuration and other aspects, increases the options for sustainable mobility with public transportation, bicycling and walking, thus contributes to at least five of the SDGs: goal 11, goal 3, goal 7, goal 8 and goal 13 [6]. The options for densification were extensively investigated during a series of co-creation workshops among stakeholders that are involved with the regeneration of Mölnlycke urban centre, located to the West of the City of Gothenburg. A number of different planning and design tools were used throughout this process. The result of the co-creation is an experience-based assessment of strengths and weaknesses, a desired density structure from different perspectives and evaluated density scenarios for the station area. The co-creative approach using a combination of planning and design tools has the potential to raise a number of different perspectives and experiences of the stakeholders involved, when considering density and associated ecological, socio-cultural and economic factors. The results for this process can serve as a valuable supplement to desk top analysis of density and related factors when planning urban areas around transportation nodes.

1. Introduction

During the process of analysing urban station communities a sub-project was initiated regarding the analysis of density around the transit station located in Mölnlycke urban centre. This was investigated in order to understand the potential for densification around the station, based on both a desk-top analysis of the urban area and also on a co-creative process. Relevant stakeholders in the municipality were invited to contribute with their local and general experience with density and other related spatial factors. The starting-point for the study was both general research results referred to above, but also an urban design study regarding Mölnlycke centre itself. The co-creative process has been documented in a report co-written by practitioners and researcher which will serve as a basis for the formal profound comprehensive and detailed planning in the municipality [1].

2. Why is densification important for the aim of reaching sustainability goals?

The process of gathering people, activities and resources on confined areas is considered as the most important driving force for urbanization. Due to this reason it is very important to define the concept of density and also to understand the mechanisms and consequences of densification in urban areas. Even if urban density as a concept has played a central role in the theory and practice of urban planning there is some uncertainty regarding methods for calculation and for comparisons [2]. One important distinction to be highlighted is between density as an experienced characteristic in contrast to a technical parameter. The experience of urban density and the measured FAR (Floor Area Ratio) in urban areas do not necessarily need to coincide. An urban area can be perceived as relatively dense in
spite of a moderate FAR and also reversed, while other urban areas can be comprehended as not so dense in spite of a relatively high FAR. This statement by two Swedish researchers of urban planning was based on results from a comprehensive R&D project about urban typologies [2].

The views on the consequences of density on ecological, social, economic and other spatial parameters differ among researchers and practitioners. There is strong evidence that suggests how density in combination with other spatial factors such as diversity (functional mix), design, destination accessibility and distance to transit, has the potential to contribute to a reduced demand of transportation along with an increased resource and transportation efficiency with 10-20% [3]. As for other factors such as air quality, biodiversity, microclimate and health, researchers emphasize both advantages and disadvantages with high density [4]. However, a high concentration of companies, financial resources and intellectual capital in dense urban areas can encourage a dynamic economic development, thus contributing to innovations and also to a sustainable society [5]. If densification by developing cities and city districts inwards can be combined with the development of mixed-use of working places, housing and service functions, a network of public spaces and urban paths (high-streets) there can be a high probability of achieving the relevant sustainability goals [6].

TOD (Transport Oriented Development) is a set of policies to synchronize urban life, cities and urban activities with public transportation systems, infrastructure and operations [7]. TOD is often defined as a design and development of moderate and high-density mixed use urban areas at strategic points along the regional transit system [8]. TOD as a planning policy is often combined with the station proximity principle based on the results from Danish research about the influence of the walking distance to transit stations on the modal split. The share of public transportation in terms of walking and bicycling to and from stations increases considerably if working places with knowledge intense activities are located closer than 600m from stations [9][10]. In the original TOD - guidelines there is a general principle of a circular or semi-circular development with a minimum FAR (Floor Area Ratio) for mixed-use areas around stations [8].

2.1. Relationship to the UN SDGs
There are several linkages between the topic of this paper and the UN SDGs. Densification around railway and bus stations in combination of other spatial factors as urban form and a proper balance between the built environment, green areas and infrastructure relates strongly to goal 11 (make cities and human settlements inclusive, safe, resilient and sustainable). “Public transport is an essential service for urban residents and a catalyst for economic growth. Moreover, with an increasing number of people moving into urban areas, the use of public transportation is helping to mitigate air pollution and climate” [11]. Within the UN SDG structure there is also a great emphasis on the need of making stronger efforts to implement sustainable transport systems available to vulnerable populations such as children, seniors and persons with disabilities [11]. A strengthening of the connection of high streets together with a system of public spaces bound to transportation nodes such as railway stations contributes to an inclusive city [11]. Thus, there are also connections to goal 5 (gender equality) and goal 10 (reduced inequalities).

As reduced air pollution and the increased options for walking and bicycling may have considerable impact on health, there are also strong linkages to goal 3 (good health and well-being) [11]. At the same time railway traffic generates noise pollution which is important to address in order to utilize the other positive impacts of densification around stations. As the development of workplaces and economic centres around stations may be a catalyst for economic growth there is a direct linkage to goal 8 - Decent work and economic growth. Systematic efforts to achieve an integration of transportation and the built environment by the development of an appropriate urban form combined with densification have also great importance for the energy efficiency and thus relationships to both goal 7 (affordable and clean energy) and goal 13 (climate action).
3. Research method applied

3.1. The conception of co-creation

The research method applied in the Mölnlycke case study has its roots in the overall direction of the urban station communities knowledge process within the Mistra Urban Futures platform, that is co-production in action and contributes towards realizing well planned cities. Co-production is a solution to the need of bringing together researchers, practitioners and other experts in transdisciplinary teams to handle and find solutions for complex challenges [12]. In the urban station communities knowledge process co-creation was used as the main premise to describe and label the transdisciplinary collaboration which is essential for there to be co-production. The incentives for co-creation as a research concept and method can be found in communicative planning, interactive action research, design theory, research by design and participative back casting [13]. The transdisciplinary creative process encompasses five stages, including co-initiation, co-analyses, co-design, co-evaluation and co-reflection. With co-creation as an “umbrella” for the research, the case study is an example of interactive action research combined with research by design, as the stakeholders involved have worked together and created a common result in the four phases of co-creation presented above. The inspiration for this research is taken from research related to citizen engagement in urban planning, urban governance and urban living labs [14] [15] [16]. An important part of the research method is to use tools that allow the practitioners involved to express their tacit knowledge and to mobilise their creativity thus achieving new, innovative solutions and conclusions in strong interaction and collaboration in a transdisciplinary way. Donald Schön asserts that in general, professional practitioners know more than they can express in words (“tacit knowledge”) and demonstrate what he calls “knowing in practice” [17].

3.2. Co-creative methods and tools being applied

The basic tools applied in the case study are related to a larger toolbox or model known as the 4/20 methodology and the SymbioCity Approach [18] [19] as well as to specific applications of the toolbox in urban station communities [20] [21]. The following tools are explained more in detail in these reports. **Tool 1** The walking tour for place and path analysis facilitates the investigation and collects participants’ experiences of an urban station.

**Tool 2** Map-based SWOT-analysis has been used for the compilation of qualities, deficiencies and ideas collected during the walking tours on maps of the urban centre.

**Tool 3** Back-casting is a methodology that facilitates a long-term view on the urban centre and also to discern possible alternative paths from the present situation to a future. Participative back casting was used together with scenario technique as the stakeholders involved create the long-term scenarios in an intense creative process. **Tool 3** is the scenario-matrix that is a useful way of structuring different scenarios by choosing two important structural aspects as axes in the matrix. By combining extreme positions for each aspect four different scenarios can be conceptualised. The scenarios were evaluated using **Tool 4**, a multi-criteria analysis (MCA) where chosen criteria for evaluation were given weights by distributing 100 points between eight criteria extracted from comprehensive sustainability criteria defined in the municipal planning process. The intention of the **Tool 5**, the density puzzle is to enhance the understanding of what density really means both in the planning of new and the transformation of existing urban areas. It is also to facilitate the creation of conceptual urban structures by combining different urban typologies, see figure 1. The research group has made a wider application for a new urban area Landvetter Södra in Härryda, which will be presented in a research report in 2020 [22]. The empirical base for the density puzzle is urban typologies for a large number of Swedish urban areas being documented and analysed both visually and by-using urban density numbers [2]. The distribution between different urban functions as housing, workplaces, service functions, green areas and traffic areas is also considered in the density puzzle.
4. The application of the chosen methods and tools in the case study of Mölnlycke

The options for densification have been investigated in co-creation workshops among stakeholders involved in the renewal of Mölnlycke centre in the Gothenburg Region using a combination of the planning tools described above. The case study was co-initiated by a common discussion between planners in the Härryda municipality and process leaders within the urban station communities knowledge process. The municipality experienced a need to further analyse the potentials for densification around the railway and bus station as a deepening of the urban design study for the area. After a number of planning meetings a workshop day focusing on co-analyses, co-design and co-evaluation took place in October 2018. Stakeholders both from the municipality along with other communities and the regional agency GR (Gothenburg Region) involved in the urban station communities knowledge process were invited. The five tools presented in section 2 were applied in the workshop. After the workshop a co-reflection process followed, including the compilation of the workshop process and results as well as conclusions and reflections on the results. The process and the results have been documented in a comprehensive report in Swedish [1].

4.1. The Application of the density jigsaw puzzle (Tool 5)

The workshop process started with tool 5 – the density puzzle, see figure 1. The point of departure for this exercise was to look upon different ways of densifying the urban centre by testing the possibility to find space for 8400 inhabitants within the urban structure (approximately 3400 existing and 5000 new inhabitants). The intention was to find optimal urban structures for the future urban centre of 2050, as seen from the views of the participating stakeholders working in four multidisciplinary groups. It was decided that each density puzzle piece should include 200 inhabitants so each group had 42 pieces for each of the seven chosen urban typologies (in total 294 pieces to choose among) spanning from villa area typologies with low urban density (17.6 ha/200inh) to very dense and high block/grid patterns (0.7ha/200inh.)

Figure 1 The seven chosen urban typologies of the density jigsaw puzzle used in the densification study of Mölnlycke urban centre

Four different density structures were discerned as a result of this exercise which were merged to one picture, see figure 2. A higher density was proposed in the most central locations and the station area. Four “circumferential rings” could be discerned with the highest density in an oblong area parallel to the railway tracks, connecting the station area and the urban centre. The second highest density could be found around the highest density northwards but also east of the centre at the Mölnlycke factory area. According to the participants, a certain densification was also possible in the surrounding villa areas. The results give a hint of a possible future strategy for distribution of the densification, but with no specific urban density figures. The photo from the workshop in figure 3 illustrates the way of working with the density puzzle.
4.2. The potential for densification based on walking tours and Map-based SWOT analysis (Tool 1 and Tool 2)

While the exercise with the jigsaw density puzzle was based on the judgements and discussions by the participants, the use of maps and earlier professional and/or experiences from the site, next step also was based on direct observations of the area. This step started with a walking tour in four groups with the aim of discussing and investigating the options of densifying the actual urban area. Each group looked at a certain sub area where they looked at certain places that were selected before the exercise. Strengths and weaknesses of the places at hand were pointed out but ideas for densification and improvement of site qualities were also identified. The walking tours contributed to a more balanced and varied comprehension of densification for the area. All groups also compiled their findings on maps after the walking tours, using a map-based SWOT-analysis as a tool.

An assembled analysis of the results of the four groups indicates important deficiencies, qualities and ideas for improvement. The qualities that were lifted forward were the access to green areas and water along with location with attractive urban environments and mixed-use. Examples of deficiencies were inefficiently used but centrally located, unsafe areas with closed facades but also noise and risks along the railway line were identified. Even if there are some locations with mixed-use, large parts of the centre and the station area is populated only at daytime with schools, the town houses and small companies. There are risks in terms of safety and security in the urban centre during the evenings and weekends due to few on-going activities, as there are few workplaces and service functions open, combined with a lack of housing. The participants found there is a considerable potential for densification in large parts of the urban centre of Mölnlycke. Several possible passages/paths/linkages were identified for example over the stream and the railway line in order to bridge over the separated parts of the area. Walking and bicycling paths as well as new buildings along high streets were pointed out as a way of transforming car dominated spaces to public open and green spaces. The options of building new floors on top of existing buildings were also proposed as well as increased mix of functions, to mention a few examples of the presented ideas.

4.3. Development and evaluation of density scenarios (Tool 3 and tool 4)

A third approach on the densification challenge in Mölnlycke was to develop density scenarios which were evaluated using multi-criteria analysis as a tool. A scenario matrix was used as a tool in order to test principally very different options for densification by looking at alternative distributions of new housing, workplaces and service functions, see figure 4. One scenario axis included “even distribution of the built environment within the urban centre” versus “densification close to the station area”. The other scenario axis had the included “Maximum densification” versus “Medium-high densification”. A more detailed presentation of the scenarios can be found in [1]. The scenarios with medium-sized densification included blocks of buildings with 4-7 floors, while the scenarios with maximum density included buildings with 5-9 floors except from certain nodes with 8-13 floor buildings (scenario...
evenly distributed) and a concentration of 8-12 floors close to the station and the core of the urban centre (scenario close to the station area).

The scenarios were evaluated by using eight criteria which were selected from four decided strategies for the urban centre combined with four generally important criteria for urban development according to the UN SDGs and the Swedish certification system City Lab Action. The assembled weights on the criteria which the groups distributed within 100 points indicated a relatively even distribution of points, even if there were considerable variations within the different working groups, see figure 5. Mölndal as a destination and service hub, place identity, attractive urban environments including social (especially functional mix) and ecological aspects and risk aspects (including climate adaptation) were given the highest ranks, approximately 15 points each. Transformation of barriers to meeting places, accessibility, economic aspects (including both investments and maintenance costs) and resource efficiency achieved slightly lower points, approximately 10-12 each. It is apparent that place identity and the experience of an attractive urban environment are ranked as high as more specific quantitative criteria.

The results of the evaluation of the scenarios varied due to groups ranking but also due to the distribution of the weights between the eight criteria which is exemplified below.

**Scenario A** (medium-high densification, even distribution of the built environment) became the most favourable scenario in a group where risk aspects including climate adaptation and resource efficiency were given the highest weights.

**Scenario B** (maximum densification, even distribution of the built environment) became the most favourable in a group where transformation of barriers to meeting places and accessibility were considered as the most important criteria.

**Scenario C** (medium-high densification, close to the station) became the most favourable scenario in a group where place identity, Mölndal as a destination and service hub were given the highest weights but also in a group where all eight criteria were given approximately the same weights.

**Scenario D** (maximum densification, close to the station) became the most favourable scenario in a group where Mölndal as a destination and service hub, resource efficiency and economic aspects were given the highest weights.

The assembled results of the scenarios indicate that scenario D (approximately 295 points) in total is considered slightly more favourable than scenarios C and B (approximately 270 points). Scenario A is evaluated as apparently less favourable as the other three scenarios (approximately 155 points).

5. **Results, conclusions and future research**

The densification of urban environments in general, and in this specific case, around a train station, can as many types of societal and spatial challenges be labelled as a “wicked problem” [23]. Urban densification as a challenge is difficult to define exactly, it is also difficult to find optimal solutions
and to clearly describe the consequences. As the practical results of the proposed scenarios and measures will appear during many years, the possibilities to follow-up and analyse the implications in a long term perspective will be limited. Anyhow, the approaches on urban densification in Mölnlycke exemplifies that the use of different types of tools may be valuable for both illuminating and addressing wicked problems. It also exemplifies a possible method for further refining and developing the TOD principles which were briefly introduced above.

The first approach was the application of the density puzzle which gave guidance for a possible distribution of the density and four spatial zones of varying form could be discerned. The second approach was the experience based tool walking tour combined with a map-based SWOT-analysis, resulting in a more varied and detailed picture of strengths and weaknesses as well as specific ideas of improvement of the urban environment by densification along passages, paths, urban, public and green spaces. The obstacles and barriers for densification were also elaborated more in depth compared with the density puzzle which tended to inspire the participants to focus more on opportunities rather than threats. The third approach was the use of the scenario matrix combined with MCA (Multi-criteria analysis which gave a more diverse picture of the different options and even extreme alternatives for densification. The MCA exercise facilitated the evaluation of the scenarios and the consequences of the weights given to the eight chosen criteria. It was not possible to present an unequivocal result but this type of interaction between scenario development and evaluation seems to be useful in the future planning and design work. Different elements from the four scenarios may also be combined in new ways to new scenarios which can be further evaluated with more refined criteria based on an additional detailed analysis of the UN SDGs and other criteria systems for urban planning and development as the Swedish City Lab Action.

It would be valuable to test this approach for urban densification on other types of urban centres linked to railway and bus stations in Sweden and elsewhere. A more comprehensive empirical base regarding densification will facilitate comparisons of planning prerequisites, proposals and approaches. By using the same type of tools and exercises for co-creation, as in Mölnlycke urban centre, deeper experiences can also be gained from the transdisciplinary processes with regard to differences and similarities when it comes to factors that promote or prevent the process to be efficient and transparent. Experiences from different phases of co-creation such as co-initiation, co-analysis, co-design and co-implementation should also be compared in different cases in order to refine conclusions about the importance of different types of transdisciplinary collaborations for the developing and evaluating ideas of densification around stations.

Densification around station areas should be seen as part of a wider strategy for achieving both local and regional accessibility related to the UN SDGs and local interpretation of these goals and indicators. The methods and tools presented and discussed in this paper can be related to a strategy for the development of urban-regional networks with strong focus on sustainable transportation modes and also to promote “deconcentrated clustering” as a way of counteracting urban sprawl [24]. The presented approach is scalable to a regional level by looking at the options for densification of different kinds of centres combined with an analysis of the improvement of accessibility between those centres. As the approach promotes the mobilization of knowledge and experiences from many stakeholders, including the civil society, it can contribute to informed policies, programs and plans. Thus, I hope it can shape the decision-making process towards more mixed-use, high dense areas with a variety of mobility choices. The approach is of relevance to many similar cases worldwide.

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References

[1] Svenning M and Ranhagen U 2019 Täthetsanalys Mölnlycke centre. In English: Density Analysis of Mölnlycke Urban Centre (Mistra Urban Futures & Härryda kommun)

[2] Rådberg J and Friberg A 1996 Svenska stadstyper historik exempel klassificering. In English: Swedish urban typologies history examples classification (Stockholm: KTH TRITA-ARK 1996:13) p 35, pp. 21-29

[3] Cervero R and Kockelman K 1997 Travel demand and the three Ds: density, diversity and design (Transportation Research D2) pp. 199-219.

[4] Colding JL, Marcus A, Gren M and Berghauser Pont 2018 Examining the environmental validation behind city compaction Ambio A Journal of the Human Environment August 2018.

[5] Kennedy C 2011 The Evolution of Great Cities Urban Wealth and Economic Growth (Toronto Buffalo London: University of Toronto Press

[6] Ranhagen U et.al. 2017 Attractive Living Environments and Flows. Eight themes in planning good cities of the future (Stockholm: IVA Royal Swedish Academy of Engineering Sciences) pp. 25-39

[7] Stojanovski T 2013 Bus rapid Transit (BRT) and transit-oriented development (TOD). (Stockholm: KTH TRITA-TSC-LIC 13-007)

[8] Calthorpe P 1993 The next American metropolis (Princeton: Princeton Architectural Press) p. 44.

[9] Hartoft-Nielsen P 2003 The station proximity politics in the Copenhagen region, background, effects and implementation (Oslo: paper to the conference bärekraftig byutvikling)

[10] Schön D A 1991 The Reflective Practitioner – How Professionals think in Action (London: Avebury Ashgate Publishing)

[11] Rittel H W and Webber M M 1973 Dilemmas in a General Theory of Planning. Policy Sciences Vol 4 No 2 (Amsterdam: Elsevier)