Developing a Framework to compare the performance of Territories-in-between across Europe: Defining a set of sustainability indicators

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Introduction

'Middle landscapes' or territories in-between urban and rural are prevalent in Europe today. They are characterised by an intermingling of built and open land use, dispersed sprawling urban development and complex infrastructure networks. The sum of individual choices to use this networks results in a combination of both urban and rural land uses and lifestyles, sometimes acting in complementary ways and at other times conflicting. But the form of territories-in-between also varies considerably from place to place in, for example, the density of development, mix of land uses and their level of dependence on the city for services. *Zwischenstadt* (Sieverts, 2001), *Tussenland* (Frijters et al., 2004), *City Fringe* (Louis, 1936), *Città Diffusa* (Secchi, 1997), *territories of a new modernity* (Viganò, 2001), *Stadtlandschaft* (Passarge, 1968), *Shadowland* (Harmers in Andexlinger et al., 2005), Spread City (Webber, 1998) and *Annähernd Perfekte Peripherie* (Campi et al., 2000) are names given to this spatial phenomenon across Europe. This variety of names is an indication of the diversity of territories-in-between which has to be considered when investigating them. The term territories-in-between (TIB) is used in this article and related research to describe those areas in Europe, which cannot be classified specifically as urban or rural.

Research on dispersed urban development has strongly been influenced by American studies and policy approaches and tends to underestimate the specific European cultural and spatial peculiarities (Richardson et al., 2004). There is also little knowledge about the sustainability of European territories-in-between (Couch et al., 2007, Secchi, 2007). One important issue for further investigation is the continuing uncertainty about the sustainable development of territories-in-between and about how that performance can be measured in a valid and reliable way. The 'performance' of the territory refers to the achievement of defined planning goals in general and more specifically the realisation of sustainable development goals. The aim of this paper is to develop a frame work for the comparison of the spatial structure of territories-in-between and their performance. To achieve this the paper investigates a manifoldness of sustainable development indicators (SDI) on their usefulness for this specific comparison. As set of Indicators is selected described and their operability for regional planning and design is demonstrated by testing them in two test cases. Finally an AMOEBA (Ten Brink et al., 1991) diagram is introduced in order to provide a graphical tool for the comparison, which represents the performance of a system.

This paper is build up by five sections. The first defines what a single case for the cross case comparisons is. The second builds the general framework of the comparison introducing indicators and properties used for the comparison, by answering why an indicator based comparisons is used. The third presents as a results of an review of existing sustainability indicators a selection of SDI which in the final section are tested in two test case areas.

Before doing this, the research background the paper is impeded in is briefly explained.

Research Background

This paper is part of a PhD research with the aim to gain a better understanding of (i) the spatial conditions and performance of the territories-in-between and (ii) the relations between the spatial structure of territories-in-between and the policy-making concerning regional planning and design. Messages for planners and policy makers are derived based on this better understanding in order to support planning sustainable territories-in-between in a networked city region.

The investigation includes a first level analysis of twelve cases to achieve an overview of the variety of spatial structures and performance of TIB in Europe and a second level of analysis of three cases, to investigate how the local planning culture is influencing this performance. The value of an international comparison is that it provides an opportunity to define measures and methods that are appropriate for different types of territory-in-between, and it exposes the effect of varying planning cultures and practices. The framework developed in this paper applies to the first level of comparison.

The key hypothesis of the PhD research is that the network characteristics of territories-in-between determine their spatial development and performance. A deeper understanding of territories-in-between begins with an appreciation of which

networks and flows are active, how they are related to each other and how they interact with the territory itself. Therefore the framework for the comparison is based on Dupuy's (2008) levels of network operators (technical networks, production/consumption and households) and the two additional levels (first nature and the interface governance) introduced by Rocco (2007)

Defining a case

Yin (2003) described a case study as an empirical inquiry where the focus is on a contemporary phenomenon within its real-life context where the boundaries between the phenomenon and context are not clearly evident. Gerring (2007) states that a 'case connotes a spatially delimited phenomenon (a unit) observed at a single point in time or over some period of time. It comprises the type of phenomenon that an inference attempts to explain'. He also makes a clear and helpful distinction between case study, multiple case study and cross case study and explains their limitations.

A case study may be understood as the intensive study of a single case where the purpose of that study is – at least in part – to shed light on a larger class of cases (a population). Case study research may incorporate several cases, that is, multiple case studies. However, at a certain point it will no longer be possible to investigate those cases intensively…. …where the emphasis of a study shifts from the individual case to a sample of cases, we shall say that a study is cross-case. Evidently, the distinction between case study and cross-case study is a matter of degree (Gerring, 2007: 20).

Therefore, the selected frame work has to take into account the limitations in detail a cross case study implies. For the following frame work of comparisons one territory-in-between and the related strategic spatial policies in one European region is a single case.

A framework for the case comparison

The aim of the cross case comparison is on the one hand to highlight and investigate the diversity, differences and similarities concerning the spatial structure and the performance of territories-in-between across Europe, on the other hand to investigate which influence the specific planning culture on this structure have. Four steps build the spatial analyses and comparision. The first is to visualise basic spatial properties (see appendix for details) for each case. The second is to calculate and visualise the performance indicators. The third is to explore whether there are spatial and statistical relations among respectively between the properties and the indicators. The fourth step is to investigate whether there are (dis)similarities between the cases concerning the results of the steps one to three. The result of the comparison is going to be presented in an atlas. Therefore map making is the main method used.

MacEachren and Kraak (1997) describe four functions of map making, exploration, analyses, synthesis and presentation. Exploration and analyses are used in the early stage of map making, They require visual thinking supported by the interactive setting of a geographic information system (GIS). The goal is to get to know the data and then to perform the analysis using the properties and indicators mentioned above. During the synthesis combinations of indicators and properties are selected and visualised which give extra information. Two methods are used to find those combinations. The first is spatial analyses. It uses the 'Gestalt' of the visualisation to analyse, aspects of proximities, similarities, (dis)continuities as well as basic spatial properties like densities and diversities. One exemplary question to answer is: Do areas with a higher diversity of inhabitants to jobs overlay with a permeable street network? Technically speaking the analysis and spatial analysis toolbox of the ESRI ArcGis are used for this step. The second is spatial data analyses this is the 'application of statistical theory and techniques to the modeling of spatially referenced data' (Krivoruchko and Gotway, 2002) Pattern and cluster as well as correlations between the indicators an properties are analysed and tested on their statistical significance. The spatial statistical analysis toolbox (ESRI ArcGis) is the technical tool to perform this analyses. The results of this analytical processes are going to be presented in the form of maps, tables, graphs and diagrams. This allows a comparison cross cases. Figure 1 gives and overview of these steps.

To compare the performance of territories-in-between an AMOEBA (Ten Brink et al., 1991) diagram is used. An AMOEBA diagram (see Figure 2) provides a graphic representation of the performance of a system.

The performance of the system is assessed through a number of sustainability indicators. It is assessed visually by comparing the expected (desired state) and actual values of each indicator. The desired state is from case to case differently as it is the result of a shared vision and strategy. Exactly this relation between performance and strategy and the role indicator play is in the core of the next part of the paper which aims to select a set of indicators for the cross case comparison.

Selecting a set of Indicators for the cross case comparison

The aim of this section is to define a set of indicators that can be used to compare the performance of TIB. To select a set of indicators certain criteria and limitations have to be defined. Those are related to the objective of the research project the article is

part of. The first is the hypotheses of the research, that the network structure of the TIB is the driving force behind their spatial development. Therefore, only indicators that can be related to networks will be considered. The second is that the outcome of the research should inform policy makers and other stakeholders involved in regional strategic planning. This defines on the one hand the scale the indicators should be relevant for and on the other hand that they have to be policy relevant for regional development. The third is that the indicator should allow a cross European comparison, which is especially relevant concerning the data availability and reliability.

Definitions
Before going on to review existing indicators three definitions are important to be able to select a set of indicators:

What is an Indicator?
What is strategic spatial planning?
And what is the network structure of TIB?

Newton (2001:17) states that an indicator 'is actually a kind of a small model in its own right, implying elements of cause and effect, of social norms that constitute progress, and of policy actions and outcomes'. He emphasizes that the difference between indicator and data is the connection to policy. 'Indicators are not data, rather they are models simplifying a complex subject to a few numbers which can be easily grasped and understood by policymakers and the public' (ibid). Indicators therefore should not be understood as neutral or objective numbers but as measures that allow to assess the development of a system. They are based in an common understanding of a desired future of the involved stakeholders. Therefore, an indicator based approach is chosen to investigate the relations between the performance of TIB and the planning culture. As it allows to compare the spatial performance through the value of the indicator as well as aspects of the planning culture, through investigating the defined thresholds respectively benchmarks for the indicators. Figure 3Figure 3 explains how this relation can be used in a cross case comparison.
As a next step the policy field has to be defined the indicators should be used for. For this research it is strategic (regional) (spatial) planning. 'There are (sic) no single universally definition for strategy and strategic planning'(Albrechts, 2004:746). Albrechts (ibid.) nevertheless provides us with the following definition of what strategic spatial planning is:

Strategic spatial planning is a public-sector-led (Kunzmann, 2000) socio-spatial (see Healey,1997a for the emphasis on the social) process through which a vision, actions, and means for implementation are produced that shape and frame what a place is and may become.

In the same article he "summarizes" the "how" of strategic planning in an halve page long sentences (Albrechts, 2004:747). To finally state that, 'in fact, it is a set of concepts, procedures, and tools that must be tailored carefully to whatever situation is at hand if desirable outcomes are to be achieved (Bryson and Roering, 1996)' (ibid). His definitions helps in this respect that strategic spatial planning has to focus on certain key issues and that a use full set of indicators has to reflect these key issues. Another characteristic of strategic spatial planning is that it is, respectively should be, flexible concerning changing circumstances, this means that indicators have to be of an easily and fast calculable nature. A further relevant aspect of strategic spatial planning is that a number of stakeholders are involved in an negotiated form of governance. This leads to the condition that the set of indicator should be easy to grasp and understand for people from different fields and levels of education.
Figure 4{Formatting Citation}, which is based on Newton's (2001: 19) policy indicator model, illustrates the relation between Indicators and strategic planning process. It widens Newton's model in that it adds the negiotiative aspect of strategic planning. Illustrating that indicators can also be used in evaluating and discussing different alternatives of actions and plans during a strategic planning process which is, if a manifoldness of actors is involved, rather common.
The third definition that is necessary is to define the filed for the selection is what the network structure of TIB is. In the territories-in-between the network character and the different time-space dimensions of places as well as the different 'Lebenswelten' which create them are especially evident. According to Shane (2005: 305), 'the city is a chaotic situation of competing systems … produced non-centrally by actors designing systems across vast territories without regard for each other's decision, each adding their own system as a new layer to existing topography, historic structures, and landscapes.' While administrative borders become less and less crucial for urbanizing processes and the driving actors of urban development, planning and other spatial policies are often bound to legal and administrative boundaries. Allmendinger and Haughton (2009: 619) propose that 'adopting the tactics of "soft spaces" and "fuzzy boundaries" 'is one way of delivering the objectives of planning.
If it [planning] is to reflect the more complex relational world of associational relationships which stretch across a range of geographies, planning

also needs to operate through other spaces, and it is these we think of as `soft spaces'. The argument here is not that planners are shifting from one set of spaces to another, but rather that they are learning to acknowledge that they must work within multiple spaces… (Allmendinger and Haughton, 2009: 619). This relates the network characteristic of territories-in-between with strategic planning which often works over administrative and discipline borders.

The question is now how to relate the different networks with indicators, therefore it needs a concept that connects network space with spatial indicators. Dupuy (Dupuy, 1991) proposes three levels of network operators (technical networks, production/consumption and households). This three levels were extended by Rocco (2008) by the two levels, first nature and the interface governance. The suppliers of technical networks, such as streets, highways, cables, and so on form the first level. Based on the first level, second level operators provide services, production, consumption and distribution to the third level. At this third level people in their daily live operate. Using the first and the second level they create their personal networks by selecting and linking activity places, spaces, services, desires and needs and create their 'personal city'. This three levels do not operate dissolved from their geographical setting. Even if they are virtual, they can be located and leave their traces in the first nature. These traces form the spatial structure of the territories-in-between. This spatial structure are the elements the indicators should be related to. The Interface governance describes the power play which is described as 'the processes that create a positive tension between the public sector, the private sector and the civil society'(Rocco, 2007: 142). Spatial policies are one field of this power play and connects the levels of network with strategic spatial planning again.

To summarise the set of indicators should have a background in common European norms and values, should be applicable on the regional and local scale, relevant and useful for regional strategic spatial planning and concentrate on the networks that drive the spatial development of TIB.

Review of existing Indicators

If common values and goals are an essential part of indicators, what are this common values and goals for a European cross case comparison? A first source is The Sustainable Development Strategy of the European Union (EU SDS), as revised in 2009. It defines sustainability following the general agreed principals of the concept.

Sustainable Development stands for meeting the needs of present generations without jeopardizing the ability of futures generations to meet their own needs – in other words, a better quality of life for everyone, now and for generations to come. It offers a vision of progress that integrates immediate and longer-term objectives, local and global action, and regards social, economic and environmental issues as inseparable and interdependent components of human progress.(European Comission, 2011)

The general goals and objective defined in the EU SDS are regularly monitored by the European statistical agency EUROSTAT with a system of eleven headline indicators (see Figure 5) and 100 indicators feeding this headline indicators.

Already the headline indicators show, that the indicators selected by EUROSTAT hardly fulfill the preconditions defined in the above paragraphs. Most are aggregate for national states and hardly any of them can be related to urban development let alone to spatially manifested networks. Nevertheless, some indicators like, the volume of passenger transport relative to GDP, car owner ship, quality of rivers have a certain relation to spatial networks in general but not in the way the indicators are calculated for the monitoring of the EU SDS.

Nevertheless, what the EU SDS provides is a common framework of goals, norm and values, which allows to assume that sustainability indicators which are developed under the framework programs of the European Commission share. Adelle & Pallemaerts (2009) give an overview of sustainability indicators developed within 47 Framework 6 and Framework 7 funded projects with around 800 different sustainability indicators. They also relate them to the above mentioned indicators of the EU SDS, the core indicators of the European Environment Agency (EEA) as well as to indicators used by the OECD and UN-Habitat.

Among the projects reviewed seven had an urban respectively local scope: STATUS, TISSUE, INSURE, SENSOR, REFIT, TRASNFORUM and ELME. These were the primary sources to identify feasible indicators. Additionally two projects with the focus on Eco innovation, MEI, and ECODRIVE as well and the project RUBICODE which investigated indicators based the concept of ecosystem services and PASSO a project developing indicators for good governance were investigated in detail. Table 1 gives an overview of the FP6 and FP7 projects which were the major source to identify sustainable development indicators for the comparison of different TIB

Several Indicators, respectively very similar ones, are used by more than one project. In the next paragraphs a set of Indicators coming out of the projects stated above, which fit the conditions described before in general are represented.

Selection of a set of sustainability indicators for TIB.

All project use different frameworks of categorization

for the indicators they examine and propose. Most of them use the classical separation of economic, environmental and social indicators, TISSUE for example uses a different approach and classifies indicator into the five categories, urban transport, urban design, urban construction, urban management and urban environment. The more transport orientated projects include also indicators that measure the properties of the network itself and name them operation indicators. This seem in a case where the different networks of the TIB are in the center of attention a useful extension to the traditional separation. Therefore, the preselected indicators are presented in Table 2 along four categories: Network indicators, economic indicators, environmental indicators and social indicators.

From this overview several conclusion for a final selection of the set of indicators can be drawn. The network indicators are probably more use full to describe aspects of the properties of TIB, because it allows to compare network densities and lengths across cases. There is no indicator which describes the resilience of the different networks in the selection. Resilience is a systems 'ability to absorb impacts from disturbances without changing its state or function (Berkes and Folke, 1994; Adger, 2000)' (Graymore, Sipe, & Rickson, 2010: 461). As with the node link ratio a very simple indicator is ad hand it should be added to the set.

In the category of economic indicators the indicators are either not feasible to use, because of the detail of the data availability (Net flows of traded goods per sector) respectively need a rather complex transportation model behind it to use them (Job-housing proximity and commuting flows). Access to airports is suitable but gives just an indication for a very small part of a region's economy. Apparently there is a lack of indicators that relate the intrinsic spatial properties of the infrastructure networks with economic potentials. The theory and tools behind Space Syntax[1] could be one possible source to add to this field.

In the category of social indicators, those related with community involvement are difficult concerning data gathering, but should be considered in the following steps of the research. The accessibility to public transport (PT) is a useful indicator and also simple to produce, it is important though, to add aspects of the network and service quality. As it makes a crucial difference if the closed PT station is a bus stop with two busses a day or a train station with regional trains. Instead of a metric buffer a time buffer could bring more accurate results. The same is true for the accessibility of basic services. This indicator needs more detailed specification what basic services are respectively which basic services are actually in the concern of strategic regional planning. The transport affordability index is difficult to calculate below the size of the municipality. The same is true for the broadband accessibility. To achieve accurate values for the noise exposure measure, specific noise modeling software is necessary. NOISE, the Noise Observation and Information Service for Europe can provide basic input.

The environmental indicators, with exception of the river quality, lack a strong connections to the network approach of the study. The availability of open green space can be seen as a variation of the accessibility of a basic service. Indicators like the amount of sealed soil and percentage of open space can be better expressed by the landscape fragmentation indexes developed by Jaeger this indexes also provide also a measure for the quality of the ecological network of a region.

These conclusions led to a selection of Indicator, presented in Table 3 which will be tested in two case study areas.

Testing the indicators

The aim of the test of the indicators is to find out whether the chosen indicators can also practically be applied to a GIS based spatial analyses. The important questions are whether the data is available in a sufficient detail, the calculation of the indicators is feasible with standard hard and software and if the results if mapped and calculated are easy to understand.

The two cases

The two test cases are the province of South-Holland (NL) and the state of the Tyrol in Austria, the reason for choosing these two is, that because of earlier research major part of the necessary data was already available furthermore, the cases are in the sense of topography, density of inhabitants and urbanization processes extreme cases.

Before presenting the results of the tests of the two case are introduced see 6. The differences are emphasized to explain their qualification as extreme cases.

Landscape fragmentation

Three measure for landscape fragmentation where developed by Jaeger. (2002) and further developed by Girvetz et al.(2008). The effective mesh size m_{eff}, the splitting index (S) and the probability of meeting (C) They are an expression of the probability that any two locations in the landscape are connected, i.e., not separated by barriers such as roads. Figure 7 displays the formulas and a graphic expression of the way the indexes are calculated.

It covers planning goals like the establishing of an ecological network, providing minimum size habitats for endangered species and relates the permeability of land living animals with the barrier

effect of human infrastructure and natural barriers for the spread of species. It is though limited to land living species.
The map of the fragmentation mesh size of the Tyrol shows that the valleys which would be the migration corridor are segregated by a dense network of infrastructure and urbanisation the effective mesh size of the hole province is nevertheless very high (1.590km²) but the median size of 0,5km² shows that some big patches compensate the numbers for the big amount of small ones. The 'Territories in Between' have clearly smaller effective mesh size of 935 km² and median mesh size of 0,15 which is already very small. A special characteristic of the TIB is that very small and very large patches are in ultimate vicinity. The map of the fragmentation mesh size of South Holland shows a much more homogenized picture concerning the landscape fragmentation. With an effective mesh size of 81km^2 for the TIB is still close to the 100.km2, which is considered as unfragmented landscape. The TIB don't show a significant difference to the rest of the area. The median with 2.9km² is much higher than in the Tyrol.
The effective mesh size in TIB is quite different as well as the distribution of the different mesh sizes in both test case. The territories in between are the transition between the smallest patches and the largest, there is often very little distance between the extremes which provides a high potential to generate an ecological network through ecological corridors. The indicator (effective mesh size) as a single number is not very significant, the distribution of the mesh sizes displayed in a map though, especially if brought into relation with specific habitat sizes is useful in planning processes. For investigates in a smaller scale the fragmentation geometry should more detailed as well.
For a further use this means that in a larger scale which is heterotopic probably the median mesh size is a better value than the effective mesh size.

Link Node ratio as indicator for the network resilience
Like illustrated in figure the link node ratio is a measure if the network is still able to perform if one element in the network is not serving any more.
Figure 10 shows an excerpt of the road network of the two case studies. The Link node ratio for the Tyrol is 1,25, while the one for South-Holland is 1,45. These calculations where done without differentiating the capacity respectively the hierarchy of the rode network. For further comparison calculating the link node ratio for several hierarchies may give a better picture of the resilience of the system. Like the effective mesh size the link node ratio is scale less.

The Availability of Public Transport
The indicator for availability of public transport is expressed in the ratio of the population respectively jobs that have access to good public transport.
Different modes of public transport have different speed service qualities and acceptance as well as service distances. According to Rob van Nes (2002) the main characteristics of any transportation network from the traveller's point of view are travel costs and travel time, with the latter determined by network characteristics such as space accessibility, time accessibility and network speed.
- Space accessibility: the number and distribution of access points where the traveller can enter and leave the network. Typical examples are bus stops,motorway ramps, and airports;
- Time accessibility: the distribution of opportunities per unit of time for the traveller to use the network. This characteristic is very common for public transport or airline services and can be described by timetables or servicefrequencies;
- Network speed: the average speed while travelling on the network, which is determined by the network structure and the design speed. Since speed is independent of the distance travelled, it is preferred to the perhaps more obvious alternative of travel time.
According to these three levels for every stop or station a weight factors (see Table 4) is calculated. To calibrate the indicator, the factor 1 was chosen when the service of one stop was at least 4 trains/ busses in every direction, which means that every 15 minutes a train leaves. With this interval of service a quality is achieved were customers just go to the station without having a special look at the timetable as they know that any way in the next ten minutes a train/bus will leave. The values of overlapping stations was added. Finally the percentage of people /jobs which are located within an area with a value higher than 1 were summed. The ratio of people within areas of good service and those without is the value of the indicator.
The results for the two test case are summarised in Table 5.
The results show that both test case have a similar general coverage of public transport, but that South-Holland with it's much higher population has also a much higher qualitative coverage. As the other indicators also this one is scale less.

Using the AMOEBA to compare cases
As mentioned above an AMOEBA diagram is used to visualize the different values of the indicators across cases. Therefore the different values of the indicators have to be translated into values between zero and one, where zero stands for negative impact, respectively service and one for best possible value. For the indicators which are

expression in a percentage value of population, area jobs, with a specific level of service or coverage this is simple. For the other values this classification is dependent either from all cases involved in the comparisons or has to be done in relation to values that are generally agreed in the respective field of science. {Formatting Citation} shows one example of the use of an AMOEBA diagram with the values presented above for both cases.

Conclusions

Concerning the availability of existing indicators it can be concluded that there is a rather low number of indicators that can be used for strategic spatial planning on the regional scale that give indications about the networks. The main reason is that the data availability is often not sufficient for the necessary detail. Nevertheless, ten indicators could be selected for a further test in two case studies. Most of them had to be adapted to use them on a regional scale.

For the relevance of the (street) network for economic development no indicator could be found. Indicator for the access to public participation seem specifically difficult to include.

The test was contacted for the territory of two provinces, to be able to make a clearer statement for TIB a smaller scale for example 30km x 30km may be more adequate.

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(Endnotes)

1 Space Syntax is a set of techniques for the analysis of spatial configurations of all kinds, especially where spatial configuration seems to be a significant aspect of human affairs, as it is in buildings and cities.