Accessibility in Planning Practice

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Introduction

There have been plenty of applications of accessibility analysis techniques since Hansen introduced the issue of accessibility to the spatial planning sphere in 1959. Several methodological approaches with a great number of variations have been developed and tested in various case studies. Most of these case studies focus on issues concerning the mathematical accuracy of different accessibility indicators to address real-world planning problems.

Consequently, the ability of modelers today to measure different aspects of accessibility with sophisticated, highly specific indicators is very advanced. The constant increase of computer-based calculation and data storage capacities allow highly disaggregated analyses to be carried out on normal office computers.

Chapter 1 of Report 1 – Accessibility for Planning Practice has provided a detailed overview on the state-of-the-art of accessibility modeling, addressing the common indicator types as well as a number of accessibility planning software tools.

A question less often addressed by planning research is the usefulness of the available tools. In other words: are the available concepts of measuring accessibility and their implementation in the form of planning tools helpful for planners and decision-makers in making good plans and decisions? Do planning and communication processes benefit from these tools? Can they understand and interpret different kinds of accessibility indicators with regard to these planning contexts? Are the available software tools helpful in the sense that they enable planners to make use of accessibility analysis techniques in their everyday work?

This chapter of the report intends to deliver an overview of the knowledge that is available on these questions concerning the usefulness and applicability of accessibility planning methods and tools. To reach this goal, this chapter will sum up the relevant scientific literature and present a variety of relevant case studies. It must be pointed out though, that this chapter cannot provide a final and comprehensive overview of case studies since knowledge about these studies – especially regarding usefulness issues – is often scarcely documented, anecdotal and subjective. Therefore, this study rather tries to extract a number of hypothetical conclusions that may be drawn from those case studies that are known to the authors and have thus been taken into consideration for this report. These hypotheses may be used later on in the process of this COST action and beyond as a starting point for further research into the addressed issues.

Planning context

Planning practice is a quite diverse activity, and offers a variety of planning contexts where accessibility instruments can be useful in different ways. The planning contexts define what is required from the accessibility instrument in order to be useful. Here we will present a broad framework of planning contexts, within which the usefulness and usability of different accessibility instruments can be discussed. The chapter is heavily based on the works conducted in a previous COST action (Fischer et al., 2010).

These planning processes are usually highly complex and often marked by controversy. Complexity is enhanced by issues of multi-layer governance, with transport decisions normally affecting different administrative levels (e.g. national, regional, local), systematic tiers (i.e. policy, plan, program, project) as well as sectors (e.g. transport, land use, energy).

Strategic – tactical – operational dimensions

Planning can normally be classified along strategic - tactical - operational dimensions. A number of decision making systems are organized along these dimensions. Land use and planning acts are often organized in this way (national guidelines, municipal land use plans, zoning plans), and the same could be said about sector plans (National transport plan, regional transport planning, local transport plans). Whether the planning process
is strategic, tactical or operational will matter to determine which kind of accessibility instrument might be useful in a specific situation.

Decisions made at the **strategic level** are long-term decisions about what to do in order to achieve something. This could be generic decisions about how to e.g. reduce GHG emissions from transport, or more specific decisions about how to solve traffic and environment problems, like congestion on major roads or health problems caused by transport at the municipal level. Municipal overall plans would be classified as strategic plans, since they often strive at being strategic as well as comprehensive. The national transport plan would also be a strategic plan.

The **tactical level** is of a more medium term nature and considers how to achieve what is decided on at the strategic level, including decisions on alternatives.

**Operational planning**, finally, is more short term and concerns the actual implementation in ways that maximize the positive outcomes and minimize and mitigate negative effects and impacts. Zoning plans may often be considered as operational plans.

### Various tasks in planning processes

The understanding of planning has changed over the past decades. Through the shifting discussions, however, some tasks seem to define planning and to be unavoidable in a practice defined as planning (Friedmann, 1987). Based on among others Friedmann *(ibid)* and Banfield (1959; 1973), the tasks involved in planning and decision-making may be listed as in Figure 1. These tasks are carried out in overall land use and transport planning as well as in zoning plan processes (at least they are supposed to be).

Planning and decision-making processes will normally not follow a direct course of action from task number one to task number nine. Rather, they are iterative processes, more to be understood as continuous discussions regarding where we are going, what needs to be changed, where we want to go, how to get there and whether a proposed project contributes to take us there or not.

![Figure 1](image1.png) The classic description of tasks involved in planning and decision-making (based on among others BANFIELD (1959; 1973) and FRIEDMANN (1987))

Accessibility instruments can be applied in different ways and play different roles in several tasks of planning. For instance, when analysing the situation and defining the problems, accessibility instruments can be applied in a descriptive way illuminating the lack of accessibility to important services in certain areas. When assessing the effects and consequences of different alternatives, accessibility instruments can be used as analytical tools, helping to predict whether implementing a certain action would contribute to achieving defined objectives, as well as disclosing unwanted consequences. In feedback and post-auditing, accessibility instruments can be applied when comparing a previous situation, planned situations and the existing situation after implementing the action in question.

The different tasks in a planning process hence call for different kinds of accessibility instruments.

### A framework for defining planning context when discussing the usefulness of accessibility instruments

Usefulness of accessibility instruments should be discussed in relation to the planning context.

Table 1 illustrates a framework for defining the planning contexts.
The baseline – literature review

To develop a baseline of understanding and knowledge on usefulness aspects with regard to accessibility analysis methods and tools Geurs and Van Eck’s work “Accessibility Measures: review and applications” (2001) is the relevant text. In their report, the authors introduce and test as well as evaluate different techniques of measuring accessibility.

While the focus of Geurs/Van Eck’s work lies rather on methodological aspects of different types of accessibility indicators, they also cover the aspect of usefulness on a general level. Categories they use for this evaluation are:

- Interpretability;
- data need and;
- usability.

Their main finding is that “the most simple activity-based measures are the most easy to interpret, (...) the potential accessibility measure is somewhat less easily interpreted” whereas “more theoretically and methodologically sound accessibility measures (...) are even more difficult to interpret” (ibid, p.135). It is not surprising that this ranking turns out to be vice versa for the issue of data need: apparently ease of interpretation is a direct consequence of a small variety of information being subject to a very limited and simple series of data processing steps. (For more detailed discussions of advantages and disadvantages of different indicator types, see e.g. Handy and Niemeier, 1997; Geurs and Van Eck, 2001; Bertolini et al., 2005.)

The term “usability” is used by Geurs and Van Eck in the sense of a measure’s ability and validity in capturing and adequately representing certain aspects of the real world. They point out that some measures (e.g. utility-based measures) are most usable in the context of economic appraisals due to their methodological proximity to economic welfare theory, whereas others (e.g. activity-based measures) are most usable with regard to social evaluations and the analysis of equity issues.

Finally, Geurs and Van Eck conclude that “there seems to be trade-off between the ‘common-sense’ interpretability and methodological soundness of the measure” (ibid, p. 138).

In a more recent work, Geurs and Van Wee (2004) discussed four criteria to evaluate usability: (1) theoretical basis, (2) operationalisation, (3) interpretability and communicability, and (4) usability in social and economic evaluations.

Thus, from the theoretical basis side, these authors argue that an accessibility measure should firstly be sensitive to changes in the transport system, secondly, an accessibility measure should be sensitive to changes in the land-use system and, thirdly, a measure should be sensitive to temporal constraints of opportunities. Finally, a measure should take individual needs, abilities and opportunities into account. These criteria are not considered absolute; applying the full set of criteria would imply a level of complexity and detail that can probably never be achieved in practice. Thus in practical applications, different situations and study purposes
demand different approaches. However, it is important to realize the implications of ignoring one or more of these criteria.

Operationalisation is the ease with which the measure can be used in practice, for example, in ascertaining availability of data, models and techniques, and time and budget. It is interesting that the authors highlight that this criterion will usually be in conflict with one or more of the theoretical criteria described above.

In regard to interpretability and communicability, researchers, planners and policy makers should be able to understand and interpret the measure, otherwise it is not likely to be used in evaluation studies of land use and/or transport developments or policies, and will thus have no impact on the policy making process.

Geurs and Van Wee (2004) uphold that infrastructure-based accessibility measures are easy to interpret and communicate but they lack the land-use component, and temporal and individual elements. More complex location- and utility-based accessibility measures can be considered effective measures of accessibility, which can also be used as input for social and economic evaluations. That is they overcome the most important shortcomings of infrastructure-based measures, but they exclude individuals’ spatial–temporal constraints typically included in person-based accessibility measures. Furthermore, these person-based measures are, in Geurs and Van Wee opinion (2004) potentially very useful for social evaluations, and may also be tied to the utility-based approach, which gives the practitioners the possibility of using them in economic evaluations. On the other hand, person-based measures have some disadvantages related to data availability and complexity, hindering their application.

Moreover, if we look at activity-based transport models, they don’t link daily activity patterns with long-term spatial behavior of household and firms, which does not facilitate their use in land use and transportation investments decision making.

Despite the relevance of methodological soundness, Ross brings into the debate that the purpose of an accessibility indicator is not only to adequately measure but also to “communicate a trend of events, and to simplify our understanding of these.” (Ross, 2010, p. 3)

These aspects of simplification and communication refer to a more process-oriented understanding of accessibility indicators. According to this indicators should not be expected to contain an objective truth that we can extract with the adequate mathematical method, but rather to be a means towards establishing a common language for planners from different domains (e.g. land use and transport) as described by te Brömmelstroet (2008) and Straatemeier and Bertolini (2008).

Consequently, Ross expects the following principles to be met by a useful accessibility indicator: “it should be simple to use and understand; it should identify the means of improving accessibility; and it must be based on credible data with a convincing and rational method of calculation”. (Ross, 2000, p. 3)

This statement finally includes a further very interesting aspect of an indicator’s usefulness: its ability to indicate starting points for accessibility-improvement measures.

In conclusion, it can be stated that the usefulness of accessibility indicators is determined by the following aspects: an indicator should be

- methodologically adequate;
- understandable / interpretable;
- solution-oriented and;
- supportive of interdisciplinary communication.

These aspects bear the potential of being in conflict with each other to a certain extent. Consequently, a useful indicator would be one that achieves an ideal trade-off between these aspects with regard to a specific planning problem and within the technological boundaries of data need and computing speeds.

This very issue of a trade-off between methodological and process-oriented criteria is also confirmed by Straatemeier and Bertolini (2008) as a key finding from a series of accessibility planning workshops with practitioners from the Netherlands: they conclude that “that making accessibility useful means finding the right balance between relevant perceptions of accessibility without sacrificing appropriate standards of rigor” (ibid, p. 10) and that useful indicators need to be developed in close cooperation with the practitioners.

Less focused on accessibility but more generally looking into Planning Support Systems in the field of Land-Use and Transport Planning is the research conducted by te Brömmelstroet (2010). A survey among 450 Dutch planning practitioners brought up some interesting findings: the Planning Support Systems typically used by the surveyed practitioners
• “do not sufficiently support the generation of new strategies” but;
• adequately support the evaluation of strategies”;
• are “not providing enough insight in crucial Land-Use and Transport relationships”;
• are “used to justify existing positions”. (te Brömmelstroet, 2010, p. 32).
• The survey identified the following issues as the most severe obstacles towards a more successful use of Planning Support Systems. They are perceived to be “not transparent”, “not user friendly”, “not interactive” and to have a “low communication value” (te Brömmelstroet, 2010, p. 33).

Accessibility as part of planning guidelines and laws

Accessibility Planning in the UK

One of the most well-established examples for a systematic integration of accessibility indicators and analysis into legal planning procedures is the UK’s Accessibility Planning scheme. Since 2006, English counties are required by the UK Department of Transport (DfT) to incorporate Accessibility Planning into their Local Transport Plans.

The origins of developing Accessibility Planning in the UK lie in the discussion on social exclusion. Therefore “the primary purpose of accessibility planning is to promote social inclusion by improving the ability of disadvantaged groups and areas to access the job opportunities and essential public services that they need. It should be based on an improved assessment of accessibility problems and the joined-up planning and delivery of transport and other services.” (DfT 2004, p.19)

With “Accessibility Planning Guidance”, the DfT has documented the approach that local actors are supposed to pursue, providing information and assistance on the process as a whole, the use of accessibility indicators and the integration of different stakeholders into the planning procedure.

The guidance recommends that Accessibility Planning should be organized as a continuous process consisting of 5 stages:

- Strategic Accessibility Assessments;
- Local Accessibility Assessments;
- Option Appraisal;
- Accessibility Plan Preparation;
- Performance Monitoring and Evaluation.

The DfT calculates a variety of core accessibility indicators that are available on a small geographic scale for the whole country. It recommends the additional calculation of local accessibility indicators to be used for assessment and monitoring purposes.

The following figure illustrates how accessibility indicators are supposed to be used in the accessibility planning process.

![Figure 2: Usage of accessibility indicators in the UK Accessibility Planning scheme (Source: DfT 2004)](image-url)
Due to Accessibility Planning being a large-scale project initiated by the central government and applicable to all of England, it is one of the very few accessibility-based planning approaches that is being evaluated systematically, not only from a technical perspective but also from a user perspective.

Bishop presented some first conclusions on Accessibility Planning at the European Transport Conference 2007. Key findings were:

- Accessibility analyses are “generally too transport-focused and (...) lacking a depth of understanding”;
- “Partnerships (are) limited to ‘easy to reach’ stakeholders such as other council departments; neighbouring local authorities; and those with existing contact.” (Bishop, 2007, p.10).

The University of Leeds has evaluated Accessibility Planning and carried out a survey among local planners within a PhD project. The following are some key results from this survey:

- Accessibility Planning as an independent planning approach is conceived to be useful by a majority of respondents, despite only half of respondents thinking that the contents behind the approach were particularly new (Envall, 2007);
- Despite some doubts on the reliability of the nationally calculated walking and cycling indicators, “planners identified the use of accessibility indicators as a key strength of the new planning concept.” (ibid, p. 210) Unfortunately, the survey does not allow deeper insights into why the indicators are perceived so positively;
- Data availability is not a serious obstacle towards detailed accessibility assessments;
- The hypothesis “that there is a significant problem in specifying useful accessibility indicators and that this is a barrier to effective Accessibility Planning”(ibid, p. 216) was confirmed.

These two reviews of the UK accessibility scheme apparently do not allow a definitive assessment of its usefulness. Nonetheless, it is interesting to observe, that criticism is targeted less toward issues like interpretability or data needs but rather to what Geurs and Van Eck (2001) referred to as usability. In other words, there are serious doubts concerning whether the used indicators adequately reflect the complexity of the planning problems to be solved, that they ‘lack depth of understanding’ and that there is a ‘significant problem’ in specifying useful accessibility indicators.

In the light of this finding, it is interesting to quote Halden (2011), who describes a “widespread abuse” of accessibility measures. This abuse includes that

- “National measures are adopted by local authorities (...) without questioning whether the assumptions are relevant”;
- “Planning decisions have been made (...) without sufficient thought about what indicator might be relevant or useful”;
- “Indicators have been used tactically, to make the case for a development look artificially strong or weak” (Halden 2011, p.15).

Halden refers these problems to the enormous amount (468 different types) of national indicators and sees a need for “a clearer typology of measures which may help to overcome past difficulties.” (ibid, p. 18) Yet, it should be noted that the types of accessibility measures used to calculate the UK National Accessibility Indicators mainly belong to the family of threshold measures (e.g. opportunity available within travel time threshold, number of people or opportunities within certain catchment areas) supported by some continuous measures and a so-called frequency score (representing the varying transport service qualities throughout a day) (cp. Halden, 2011). These measures are usually considered to have a low to moderate level of complexity and thus a rather high level of interpretability. Nonetheless many planners do not work with these indicators in an appropriate manner. There is an obvious barrier between theory and practice of accessibility indicators. Using these indicators – in this case very simple and “interpretable” ones – does not guarantee good planning.

Further input to this discussion might be given by a project on “Process and Impact Evaluation of Accessibility Planning” that is being carried out by Loughborough University and is still going on. Results are expected within 2012 but were not available for this report.

**Accessibility Standards in German Planning Law**

An important backbone of Spatial Planning in Germany is the “System of Central Places” which requires regional planning authorities to assign different levels of centrality to certain cities. For the different centrality levels
there are a variety of standards regarding the services that should be available in the city (e.g. education, health facilities). This System of Central Places is supposed to ensure a basic level of service provision for the population and to concentrate spatial developments. The transport-related legislation in Germany defines certain standards of accessibility that should be met with regard to the accessibility of these central places and thus to the services provided by them. These standards are defined in terms of travel time. A binding network planning guideline provides some fundamental standards with regard to the System of Central Places is the “Richtline für Integrierte Netzgestaltung” (RIN) which is discussed in more detail in section 3 of this report.

For Local Public Transport Plans in Germany, the usage of accessibility standards belongs to the state-of-the-art. The following types of indicators are mostly used (cp. Schäfer-Sparenberg et al., 2006; Schwarze, 2005):

- Indicators that define travel time standards with regard to the above-mentioned central places (rural areas) or to central areas of cities (urban areas);
- Indicators describing the areal coverage of the public transport system (percentage of population within a certain distance threshold of a public transport stop).

Methodologically, these accessibility measures belong to the type of “contour measures” which are generally assumed to have a high degree of interpretability. Data and software requirements depend on the degree of precision of the calculations but are also limited. Schwarze criticizes that these stated accessibility indicators, although used to evaluate the existing public transport supply, are only rarely used to evaluate planning scenarios, thus reducing the understandability and transparency of the planning process and its conclusions. Hence, the problem in this case is not a lack of usefulness of the indicators but rather an inconsistent usage of the indicators within the planning process.

Whilst the general objectives and standards of public transport and service provision as well as the appropriateness of the System of Central Places for present-day planning issues are frequently debated in Germany, the literature review conducted here did not result in specific findings on the usefulness of accessibility indicators in planning processes.

**Accessibility Standards in Sweden**

In Sweden there is a growing interest for accessibility analysis in a wide range of urban planning issues brought forward by the use of GIS in Swedish municipalities and an extensive access to geographic data. Beside the use of transport models for analyzing car transport systems municipalities and regions have analyzed access with public transport and have started to use these analyses as a background for guidelines. For example the municipality of Gothenburg has proposed guidelines for car parking standards based on the access to public transport.

There are some Swedish cities that use accessibility guidelines for park planning, such as the required distance to a park or playground from residential entrances. The guidelines define different distances for different kinds of parks and their staying values. They are based on Swedish research where a strong correlation between pedestrian distance and people habits of using the parks have been observed. One example is the Stockholm park program. (cp. Sociotophandboken by the Municipality of Stockholm).

**Single-case practice examples of accessibility tools and instruments**

Innumerable case studies on accessibility measures and analyses have been performed in the last years and decades using a wide variety of methodologies and addressing all kinds of planning questions. Several tools that have been developed and are being used more or less systematically are presented Chapter 1 of this report.

This section intends to elaborate on how useful accessibility measures and instruments are perceived by those working with them and how planning processes have benefited from the usage of these tools. While section 0 described some experiences with accessibility planning guidelines, this section (0) goes through a couple of case studies where accessibility tools and measures have been used within real-world planning processes. Generally, it can be said that there is hardly any evidence on this topic, be it quantitative or qualitative, scientific or anecdotal.

The following examples have been found to be interesting contributions to the debate on “Accessibility Instruments in Planning Practice” and give some insights on how these instruments have been integrated into processes and/or on the experiences made by the planners with these instruments.
100 station plan

An interesting case in Italy, in Naples, has been described in Papa (2011). The process of integrated planning between the urban system and the transport system started in 1994 with the formulation of the Strategies for Urban Planning. The process continued with the Urban Transport Plan (PCT), approved in 1997, the Primary Road Network Plan, approved in 2001 and the Urban Master Plan, approved in July 2003 and adopted in June 2004. Two fundamental methodological innovations were introduced in the transportation planning process. The first was to bring mobility, transport and urban system under a single planning process. The second was to draw up a systemic plan rather than a list of separate, uncoordinated interventions (Camerlingo, 2000).

This plan, approved by the Town Council on July 2003, is an innovative planning instrument. Defining “metro stations as an occasion for urban renewal”, it governs the transformation processes planning both interventions on the public transportation system and on the urban land-use system. The plan is directed to reduce the Neapolitan metropolitan area with its increasing car dependency, expanding the influence area of each station and increasing the accessibility from the public transportation system to major urban activities.

The analyzed application is an extreme case of integration between transportation and land-use planning. The approach used to define the planning methodology is a holistic approach, according to which the mobility system and the land-use system are integrated as far as the activity locations in the territory and the opportunity of displacements offered is concerned.

The strategies and the effects of the plan are evaluated and measured with the support of an integrated transport model and by a 100 Stations GIS, which integrates transportation infrastructure data, socio-economic data, pedestrian paths times and costs, location of major urban activities and specifications of the major projects of urban transformations in the new stations’ influence areas.

The relevance of this work to planning consists in providing a methodology for the definition of an land-use and transportation plan as well as a decision support tool for governing the urban transformation processes.

The strategies to attain these goals consist of the development of an integrated and balanced transport system, the integration among the transport supply interventions and the travel demand measures, the available financial resources and the system’s economic efficiency. These strategies have been translated into some operational measures. For the public transport system in particular, the plan defines the network integration of the existing lines, the extension of the influence area of the existing lines, through the realization of new stations, the development of new rail axes, the definition for the bus system as the feeder function to the rail transport network (Comune Di Napoli, 1997). The Urban Transport Plan (PCT) faces for the first time in systematic way the problem of the accessibility to the rail lines. The interventions of the Urban Transport Plan are imposed by travel and accessibility demands and vice versa, new urban locations are been influenced by the accessibility offered by the rail lines. In fact, this strong connection was underlined, defining the Urban Transport Plan as an integral part of the Urban Master Plan (PRG). The interrelations between the urban planning choices and the Urban Transport Plan are first of all those to locate trip attractiveness activities in accessible areas. The stations assume the role of central element around which the urban renewal and regeneration of the urban system is reorganized (Cascetta, 2001).

The 100 Stations Plan is inserted into this process of integrated transport land-use planning and represents the last footnote of the planning process. Starting from the programmatic indications of the Urban Transport Plan (PCT), it is oriented to increase the accessibility to the rail transport system stations and to implement processes of urban renewal in the new stations’ influence areas. The 100 Stations Plan proposes to increase and to regenerate the territory served by the rail transport system, with interventions oriented to improve the accessibility from and to the 100 stations, to improve the architectural quality of the station buildings and the urban quality of the areas where the stations are located. The stations are defined as “occasions of urban renewal” and, constituting the point of contact between the urban system and the transport system, they represent some strategic nodes for the integrated planning of the transport and the urban activities system (Comune Di Napoli, 2001).

The tools and the analytical models for the impact verification of the different scenarios and for the management of the transformations are a mathematical simulation model and the 100 Stations GIS.

The decision support tools have been used in the study phase of the present state, in the interventions definition phase and in the scenarios simulation phase.

The Geographical Informative System (GIS) has the purpose to acquire, to integrate, to elaborate and to represent the geo-referenced data concerning the integrated transport-land use system. The Stations GIS includes maps, geo-referenced transport supply data (viability, rail stations, cars and bus stops), activities
system data (census parcels data, location of activities), influence stations areas data (census parcels belonging to the station's influence areas), transport supply and demand interaction data (ingoing and outgoing persons from the stations and the percentage of the access modes to the stations from 7.00 to 9.30 a.m.).

The interrelations between the urban planning choices and the Urban Transport Plan are first of all those to locate trip attractiveness activities in accessible areas. The stations assume the role of central element around which reorganizes the urban renewal and regeneration of the urban system (Cascetta, 2001).

The relevance of this work to planning education and practice consists in providing a methodology for the definition of a land-use and transportation plan as well as a decision support tool for governing the urban transformation processes. In fact, with the aid of this decision support tool, three scenarios for the study case of Municipio station were defined: a "transportation" scenario, an "archaeological" scenario and an "integrated" scenario. This leads to the project of a metro station which is also an outdoors archaeological museum, ensuring the development of the urban environment quality.

**Bahn.Ville 2**

Bahn.Ville 2 was an application-oriented French-German research cooperation on railway-oriented development in the years 2007-2010. Based on the empirical findings of the preceding project Bahn.Ville, Bahn.Ville 2 aimed at verifying these findings through their successful implementation within two case study projects: the railway corridor between St. Etienne and Firminy in the French region Rhône-Alpes and the German Taunusbahn corridor in the metropolitan region Frankfurt/Rhein-Main (cp. L’hostis et al. (2009) for French project; Bahn-Ville2-Konsortium (2010) for German project). Both of these case study projects used accessibility analyses to support the local planning processes.

Methodologically, both teams used quite different approaches. While the French team used a broad set of rather simple accessibility measures (infrastructure and contour measures), the German team aimed at aggregating the available data within one land-use - accessibility index, referring to the Australian Luptai (Land-use and Public Transport Accessibility Index, cp. Pitot et al., 2005). Keller and Leysens (2011) have conducted a comparative review of the two approaches, concluding that accessibility planning frameworks need to deliver differentiated information that are able to provide a “complete picture of a location’s accessibility” (ibid, p. 20) which can only be transmitted by a set of differentiated indicators. These differentiated indicators should be complemented by “guidance and methods that assist planners and decision-makers in aggregating and weighting the different aspects of accessibility” (ibid, p.20). Finally Keller and Leysens (2011, p. 20) conclude that “such tools and methods could also be useful to develop a "knowledge of cooperation" among the planners and decision-makers because they are easily understandable and facilitate the collaborative work and create a "common language"”.

**Scandinavia**

The Denser Stockholm project (Regionalplanekontoret, 2009) is focused on comprehensive planning at the regional level. This uses a densification potential analysis model which can depict how the densification need, densification pressure, densification room, and densification freedom together create the potential for urban development. One of the key analyses for densification pressure potential has been the analyses of spatial accessibility in street networks. The street network links the city’s public spaces and is the basic prerequisite for integration and exchange. Streets, not roads, that link urban districts and neighborhoods may present the strongest driver of future urban development. Another key factor has been the accessibility to green spaces which has been a focus question in terms of the Swedish densification debate. When density is increased in urban areas with little green space, such as on brownfield land, parks must be developed to create dense mixed use. Urban nodes that need park development in conjunction with densification are particularly great, due to limited open space and access to parks and nature areas. Peripheral parts of many other urban nodes, however, are areas with very little need for park development when density increases. The accessibility analysis is produced with the place syntax tool, an application to MapInfo in GIS.
Aalborg University have used accessibility to examine the relationships between town, roads and landscape (Nielsen et al., 2005). The project aimed to analyze the changes in urbanization and landscapes following the investments in motorways in Denmark since the 1960’s - and to set up a vision for future developments and spatial relations within motorway corridors. Accessibility analysis has been used to find out how many workplaces that can be reached within 30 minutes by car.

**Regional and national accessibility in Spain**

There are several cases in Spain (Monzón et al., in press; López, 2009) where some methodologies have been validated to assess the spatial equity or the territorial cohesion impacts of transport infrastructure plans based on the calculation of accessibility indicators.
The authors evaluate different transport infrastructures, such as: High Speed Rail (HSR) extensions or the Spanish Strategic Transport and Infrastructure Plan using different accessibility indicators. The case study applications show that the results are heavily influenced by the selection of the accessibility indicator, each one providing a complementary perspective on equity measurement.

In addition, they evaluate the effects at different planning levels: cities, regions, nations and adjacent regions. They demonstrate that the accessibility improvement and distribution caused by a new transport infrastructure depends on the study area considered.

The procedure uses spatial impact analysis techniques and is based on the computation of accessibility indicators, supported by a Geographical Information System (GIS).

Their main findings are:

The selection of the most appropriate indicator depends on the approach of the study. If the analysis is more focused on the economic implications of equity effects, one should choose an indicator with an economic foundation, such as the potential indicator. If our interest is more inclined towards an evaluation of the transport network quality, we should choose a more infrastructure-oriented indicator, such as the network efficiency indicator.

Accessibility benefits located outside the borders of the country under consideration should not be left out of the planning process. They have shown to constitute important additional benefits, which should justify a co-financing of the corresponding transport infrastructure investments.

In the analysis of HSR networks, there are several variables driving these differences in the cohesion results. First, they are explained mainly by the combination of population density distribution and the location of HSR stations. Second, the relative starting situation – in terms of accessibility – of the area and third, the quality of the access provided by the transport network from cities without a HSR station to the HSR network.

The risk of spatial polarization posed by HSR can clearly be seen in the Spanish case study. After the HSR extension, higher accessibility values are concentrated in the surroundings of HSR stations. The presence of HSR stations causes the existence of “islands” with enhanced levels of accessibility, and shadow areas in isolated locations. The size of these “islands” depends on the quality of the transport network from the surrounding cities to the nearest HSR station.

Other studies (Condeço-Melhorado et al., 2011; Gutiérrez et al., 2011) focus on the issue of spatial spillovers of transport infrastructure investment, where spillovers are defined as those accessibility gains felt in one region due to transport infrastructure built in other region.

The main objective of the study is a methodological proposal to measure spillovers based on accessibility indicators. The methodology was applied to evaluate the impacts of roads foreseen in the Spanish transport master plan (2005-2020). However this methodology can be applied to other transport modes. Impacts of the Spanish transport master plan were evaluated as accessibility gains and monetary gains.

The main results show that new roads in Spain will generate important spillovers, that is, accessibility gains will overpass the regional boundaries were they are allocated. On average 59% of the investment made by the Spanish Government in one particular region is exported to other regions due to spillovers. But spillovers are not homogeneous; their spatial distribution is influenced by several factors, such as:

- Distance to the new infrastructure: spillovers decrease with distance to the new road;
- Orientation of new roads: spillovers follow the direction of new roads, if a road has a North-South direction, the regions in the North and South of the section are better off than those located to the West and East;
- Spillovers of central regions are higher than those of peripheral regions, because the former bear more interregional traffic and benefit more bilateral relationships;
- Spillovers have a direct relationship with the amount invested in new roads;
- The location of the new highways within the region is an important factor. Since spillovers decrease with distance to the new roads, they are higher when roads are located in the regional border.

This tool has been applied in a post evaluation study of the Spanish transport master plan (2005-2020) funded by the Ministry of Public Works (Gutierrez et al., 2010). However this measure has only been applied by
academics. In our case we have applied this tool to measure the spillover effects of implementing different toll schemes in the interurban roads in Spain (Condeço-Melhorado et al., 2011) or to evaluate spillovers of TEN-T projects using as case study a motorway linking Poland with Czech Republic, Austria and Slovakia (Gutiérrez et al., 2011).

In every case, results show that investments in one region will generate accessibility impacts outside their boundaries (spillovers). This can be an important issue, especially in decentralized governments, since investment undertaken by individual regions or states may generate spillovers that are higher than the benefits for the region itself. When this occurs, spillovers can be used as a tool to negotiate some kind of national aid or participation of the most benefited regions in funding transport investments.

**Space Syntax**

There are many urban projects in practice where the space syntax methodology has been applied and even more research projects conducted around the world. Most of the urban projects in practice can be found in the websites of the practice Space Syntax Ltd (www.spacesyntax.com), of the practice Spacescape (www.spacescape.se) and a few in the proceedings of the Space Syntax Symposia (www.spacesyntax.net). Just a few representative ones are cited here.

**Jeddah Strategic Planning** (conducted by Space Syntax Ltd for the Municipality of Jeddah, Saudi Arabia, source: www.spacesyntax.com):

Space syntax was commissioned by the municipality of Jeddah to create a spatial development strategy for the city. The accessibility analysis aimed towards an evidence-based development strategy of the city by strengthening the city centre and its immediate surroundings by proposing new developments. The analysis helped first of all to identify and to understand the existing patterns of density, land use and socio-economic settlement and second to test different solution strategies and their impact. The outcome was urban design guidelines for each development area. The Strategic Planning Framework has been adopted by the Municipality of Jeddah in 2006 and is part of the emerging Jeddah Plan.

According to Space Syntax Ltd, questions that are addressed in the accessibility analysis for regional and urban projects like this one are:

- How much beneficial movement can be generated to and through the site?
- Which are the key linkages in a site?
- What impact the new development is likely to have on its setting?
- What are the appropriate kinds and densities of new land uses?

**Beijing CBD** (conducted by Space Syntax Ltd for Beijing CBD Administration Authority Chaoyang District Government, source: www.spacesyntax.com):

The brief for the competition of this project put significant emphasis on the themes of sustainability and people-centred design. The aim of the team of which Space Syntax Ltd was a member was to create a low carbon masterplan for the extension of Beijing’s CBD. The problems of the area included high levels of vehicle traffic, high demands on public transport infrastructure, energy-intensive buildings, shortage of public open space and of convivial, non-commercial activities. Space Syntax contributed both visionary design thinking by setting the guiding principles and objective urban evaluation of the proposed spatial layout. The suggested masterplan includes a sustainable transport system in which pedestrian movement, cyclists and public transport usage are encouraged by connecting key routes for different transport modes at every scale.

According to Space Syntax Ltd, the main questions that are addressed in the accessibility analysis for masterplan projects like this one are:

- How should a masterplan design respond to the physical and environmental potentials of a site?
- How should the spatial layout be designed?
- How should land use and density be distributed within this layout?
- How can the social, economic and environmental impacts of development proposals be forecast?

**Rotterdam South** (Van Nes et al., 2012):

The project presented in this paper is about the southern part of Rotterdam (more problematic, there is no demand for development, high unemployment, immigrant population) where the municipality wanted to test out
various proposals for new bridges connecting it to the city’s northern (more successful) part. A combination of three spatial analysis tools: Spacematrix (measuring density), Space Syntax (measuring integration) and Function Mix (measuring mix of functions) were used. These were correlated to one another and with socio-economic data through GIS. The analysis of the existing situation showed a correlation between the degree of mix of functions, density and integration meaning that the higher the angular integration, the higher the mix of functions and the density of the built mass. Based on this finding and on the analysis of the existing situation at the city level, the areas which are offering the highest priority for improvements were identified. These were those with high spatial integration of the street network and with low density in built mass. The spatial data of these areas were also combined with social data. Based on all this data a priority map for different types of interventions in each area was defined. Based on this map the location of the new bridge was chosen and this was tested with the same type of analysis to observe the effect it would have in the area.

According to the authors, the planners from the municipality acknowledge that these tools contribute to a much more fine-grained strategic planning for the area than the current Dutch planning practice does (Van Nes et al., 2012, p. 8003).

The main questions that the above presented analysis attempted to address were (ibid, p.8003):

- What are the spatial conditions for the most attractive locations for lively and vital urban areas with a balanced mixture of functions? Which areas are more suitable than others to develop into quiet residential neighbourhoods?
- What are the spatial and functional effects of a new bridge (including public transport) connecting Rotterdam South to the North in relation to the first question? How can it affect the functional and spatial potentials for Rotterdam South?

Conclusions

While there are plenty of projects that apply accessibility measures in one way or another, the amount of research done on their practical value and their usefulness is still rather limited and fragmented.

While accessibility instruments in general are usually considered to bear the potential of providing a “common language” for planners from different fields, there is still a risk of indicators being too complex, abstract and therefore hard to interpret and comprehend for non-modelers. On the other hand, there is also serious doubt to whether the more simple accessibility indicators can really draw an adequately complex picture of real-world planning problems. In a recent study about the practitioners’ perspectives of the use of accessibility measures (Curl et al., 2011), there was recognition that using measures of accessibility only tells part of the story and the real barriers to individuals’ accessibility are much more complex and harder to understand and quantify.

Interpretability generally appears to be in conflict with usability and because more complex indicators aggregate more information with more sophisticated mathematical methods, thus making them more abstract and less intuitively understandable. A first goal must therefore be to make these data aggregation methods more transparent as has been suggested by Keller and Leysens (2011). Nonetheless, at some point a trade-off will have to be found between interpretability and complexity of measures as claimed by Geurs and Van Eck (2001): the measures must provide the process with enough input and stimulation to lead to adequate solutions. This can only happen if the measures contain enough methodological substance to cover the relevant dimensions of a planning problem. But it also needs to be understandable and interpretable for all stakeholders involved.

To reach an ideal balance Straatemeier et al., (2010, p.588) demand “that research in planning should adopt a more experiential case-study design” which means that planning practice and academia should cooperate in order “to strike a balance between rigour and relevance, between knowledge that is on the one hand theoretically and empirically sound and on the other hand also useful for and valued by the practitioners who have to use this type of knowledge.” (ibid, p. 588)

These findings describe the research agenda on how to arrive at useful indicators in the sense of achieving an ideal balance between methodological accuracy and interpretability of accessibility tools and indicators that promise to provide a common language for planners from different fields (e.g. urban, transport, environment). While this is without doubt a very important step towards more sustainable planning practices, several case studies (especially the analysis of the UK Accessibility Planning scheme) have shown that accessibility instruments, like all other planning tools, can also be exploited for individual interests through tactical usage of these indicators in order to support existing positions. A planning tool that can successfully contribute to a more sustainable planning practice will therefore have to address not only planners and experts that may see the
world from different professional viewpoints but generally share the objective of working for public welfare; it will rather have to reach stakeholders from the private domain (companies, affected residents), non-profit organizations (environmental or social interest groups) and certain politicians that tend to prioritize individual interests over cooperative solutions that serve public welfare. A useful planning tool will have to be able to make plain to all stakeholders how individual interests can be reconciled with public interests and why cooperative strategies are more beneficial to all involved players than just defending one’s own positions.

Engagement with local authority practitioners involved in Accessibility Planning in England (Curl, 2011) has highlighted the importance of understanding the local level, household and individual accessibilities in addition to the aggregate, national or regional picture if we are to properly understand the relationship between accessibility and associated outcomes, and therefore target interventions appropriately. Accessibility instruments and measures that help in different levels of planning can be complementary.