ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

TARGETED ANALYSIS //

DIGIPLAN – Five Thematic Practice Papers on digital plans and plan data

Annex 1 of final report

Final report // June 2021

This Targeted analysis was conducted within the framework of the ESPON 2020 Cooperation Programme, which is partly financed by the European Regional Development Fund.

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States, the United Kingdom and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

This deliverable does not necessarily reflect the opinions of members of the ESPON 2020 Monitoring Committee.

Coordination and Outreach:
Christian Fertner, University of Copenhagen and Piera Petruzzi, ESPON EGTC

Authors
University of Copenhagen (Denmark): Christian Fertner, Sara Folvig, Andreas Aagaard Christensen

Norwegian University of Life Sciences (Norway): Marius Grønning, Daniel Galland, Bjørnar Rutledal, Marc Le Diraison

Swiss Federal Research Institute WSL (Switzerland): Anna Hersperger, Silvia Tobias, Corina Wittenwiler

Nordregio (Sweden): Julien Grunfelder, Alex Cuadrado

Cite as
ESPON DIGIPLAN (2021) DIGIPLAN – Five thematic practice papers on digital plans and plan data. Annex 1 of final report. https://www.espon.eu/digiplan

Advisory group
Stakeholders: Ole Pagh Schlegel and Bent Lindhardt Andersen, Danish Housing and Planning Authority, DK | Hilde Johansen Bakken, Ministry of Local Government and Modernisation, NO | Silvia Jost, Yves Maurer and Marc Pfister, Swiss Federal Office of Spatial Development, CH

ESPON EGTC: Piera Petruzzi (Senior Project Expert), György Alföldy (Financial expert)

Acknowledgements
We would like to thank the experts who participated in the interviews.

Information on ESPON and its projects can be found at www.espon.eu.
On the website, it is possible to download and read the most recent documents produced by completed and ongoing ESPON projects.

ISBN: 978-2-919795-63-5

Published in June 2021

Graphic design by BGRAPHIC, Denmark

Contact: info@espon.eu

ESPON

EUROPEAN UNION

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

TARGETED ANALYSIS //

DIGIPLAN – Five Thematic Practice Papers on digital plans and plan data

Annex 1 of final report

Final report // June 2021

Table of contents

List of figures and tables

List of figures

List of tables

Foreword by the research team

In the DIGIPLAN project, we explored the development and state of digital plans and plan data in several European countries. It is the first of its kind; no similar research has been conducted before and the topic of inquiry was spanning wide from the beginning. An explorative approach was necessary to shed light on more or less advanced digital practices in different spatial planning contexts. However, we also present an early systematisation of general concepts, key terms and approaches, describing emerging digital plans and plan data and related practices. Although there is a huge diversity across the cases, they all have in common that there are high ambitions and continuous development in the field of digital plans and plan data.

This annex includes five thematic papers:

1. What is digital plan data?
2. What are the drivers of the digitisation of plan data and what is its purpose?
3. Who can access digital plan data and does it change involvement?
4. Are digital plans and plan data legally binding?
5. Future technical developments and opportunities

The papers are a major outcome of the project, going across the empirical material of the casework, describing patterns, trends and practices with digital plans and plan data. The papers are not meant to represent an exhaustive summary of all the findings, but present important aspects of digital plans and plan data, which we encountered during the project. The topics were chosen and refined in several meetings with the DIGIPLAN steering committee, i.e. the stakeholders from Denmark, Norway and Switzerland, ESPON EGTC, and the research team. Except for paper 1, which is defining and discussing key terms, all papers provide policy recommendations.

Christian Fertner, Sara Folvig, Andreas Aagaard Christensen

University of Copenhagen

Marius Grønning, Daniel Galland, Bjørnar Rutledal, Marc Le Diraison

Norwegian University of Life Science

Anna Hersperger, Silvia Tobias, Corina Wittenwiler

Swiss Federal Research Institute WSL

Julien Grunfelder, Alex Cuadrado

Nordregio

1 What is digital plan data?

1.1 Introduction

The digitisation of plan data is not new. It began to emerge with the availability of GIS software with graphical user interfaces in the 1990s and innovative towns and individuals, who began to explore its potential. However, in the latest development, digital plan data has become embedded within established planning practices. Increasingly, systematic approaches across whole countries are applied. Digital plans are becoming mainstream in planning processes and plan data has been integrated with other sectors and is now used beyond the traditional planning sphere, becoming part of a wider 'integrated digital governance'.

Although plans and plan data have been standardised and harmonised within planning systems, a look across Europe reveals a wide variety of situations and approaches. This results in different forms and formats of digital plans and plan data, which we discuss in this paper. In the first section, we define important terms, followed by a quick overview of plan data that is available in national/regional plan data portals, based on the DIGIPLAN cases. We then discuss the key features and phases of digitisation and the impact of digital plan data on planning practice.

1.2 Defining digital plan data

"Plan" has several meanings, but in the context of planning, it is used to refer to: 1) a (georeferenced) drawing of the intensions or regulations, and 2) the output of the planning and decision-making process in terms of a text and (often) an associated drawing. The focus here is on plan data, which is not the same as planning data. Plan data represents planning intentions and regulations and generally includes a spatial reference (e.g., plans) and a text reference. In contrast, planning data is data that provides input to the planning process (e.g., traffic data, land use modelling data).

In a narrow sense, we define digital plan data as a specific form of geodata. Whereas geodata, in general, is digital georeferenced data that relates to a specific position on the Earth, digital plan data is produced by spatial planning authorities and describes regulations and intentions, rights to the use of land (or space in more general), now and in the future. It includes metadata on, e.g., validity periods. A similar definition of digital plan data is used by the EU initiative INSPIRE for the theme "Planned Land Use" (INSPIRE, 2013). Analogue plan data, in contrast, refers to the traditional output of plan making, i.e., plans that are drawn and printed on paper

Even if we can agree on such a definition, digital plan data includes a wide variety of forms and formats. The data may be available as raster (e.g., georeferenced images) or vector (polygons that are scalable). Different parts of a plan may be available in different technical formats. Moreover, the procedural role and the legal status of digital plan data may range from a simple digital representation of an analogue plan, solely for information purposes, to a fully digital plan, which is the sole legally binding plan.

Figure 1.1 presents the concept of digital plan data on a continuum of digitisation, from zero digitisation on the left, to full digitisation on the right. Analogue plan data (left) refers to traditional plans drafted on paper and their related text (e.g., zoning maps and booklets with zoning regulations). These days, the text is often available in a word processing format. PDFs (or similar universally readable computer file formats) of the drawing and text constitute an intermediate step towards full digitisation. These are generated by scanning or photographing and further processing the analogue plan, and it is often possible to manipulate the PDFs to a certain extent by, e.g., labelling, highlighting using suitable software. However, the data is not in a GIS environment. Plan data in a GIS environment is defined as digital plan data in a narrow sense, whereas plan data in readable file formats (e.g., PDF) together with plan data in GIS environments are defined as digital plan data in a broader sense. Data portals are the common way of visualising georeferenced digital plan data as points, lines and polygons with attributes and links to text such as zoning regulations. Excerpts from geoportals can be produced in the form of readable file formats (e.g., PDF). Fully digital plan data can be produced directly within the GIS environment or by digitising analogue plans.

Figure 1.1
Degree of digitisation of plans

Note: The stage to the right, plans as machine-readable system, is greyed because we have not found any plan or plan data working like that yet; this was mentioned as a possible future in some cases.
Source: Authors

1.3 Plan data on digital portals

The digitisation of plans and plan data occurs at all levels of government in the cases studied in DIGIPLAN. However, digitisation is most widespread at the local level, reaching a coverage of 90% across the investigated cases. Plan data from municipal land use plans are generally available in digital portals across Europe (Table 1.1). Typically, designations for different zoning categories are shown and it is possible to click on the zones to obtain further information on regulations or the PDF version of a plan. The majority of portals include vector data. Some portals provide georeferenced scans of plans, where zooming is limited or results in pixelated illustrations. However, access to data is a different story (see paper on accessibility).

At the national level, about two thirds of the available planning instruments are accessible on the digital portals. Mainly planning instruments with a strategic or framework nature have been digitised, whereas the more visionary ones have not. At the sub-national level, only about half the corresponding regional and inter-municipal instruments were available on the portals.

The plan data typically illustrates the currently valid plans. Historical plan data is not usually available on these portals. It is not possible to look up planning regulations at an earlier point in time. However, depending on the system and the database, this information is available. For example, on the Danish portal, historical data is available in the sense that cancelled plans (since 2007) remain in the database but are marked as having been cancelled. Some planning authorities have separate digital archives for historical plans.

Table 1.1
Examples of digital plan data included in the geoportals

Case	Type of digital plan data included
Austria	Tyrol / Upper Austria: Vector data on planning, nature protection, risk areas Lower Austria: Georeferenced scans of land use plans, heritage zones, wind power Geoland (joint portal): Harmonised and simplified plan data on different themes.
Belgium (Wallonia)	Vector data on sectoral plan, regional planning framework, communal development scheme, local orientation scheme and municipal planning framework.
Denmark	Vector data from all national planning directives and municipal plans.
France	Vector data on public services, local urban plans and municipal maps.
Germany (Bavaria, Baden-Württem-berg)	Data on state/regional development plans and municipal land used plans. For land use plans, the raster-ring method is often used (Scan of land use plan, georeferenced, digitisation of area of validity = “ring”). Legends, etc., are also scanned and linked.
Ireland	Vector data on development plans and local area plans.
Italy (Emilia Roma-gna)	Vector data on regional territorial landscape plan, municipal structure plans.
Lithuania	Vector data on comprehensive plans of the municipality, comprehensive plans of the locality and detailed plans.
Luxembourg	Vector data on sectoral plans, land use plans, municipal land use plans and partial land use plans.
Malta	Vector data on strategic plan of the ministry and local plans (boundaries only).
Norway	Vector data on municipal plans, area zoning plans and detailed zoning plans.
Portugal	Vector data or images on coastal area spatial plans, nature protected area spatial plans, regional spatial plans, intermunicipal spatial plans, municipal master plans, ur-ban development plans, detailed plans.
Slovenia	Vector data on national spatial plans, municipal spatial plans, detailed municipal spatial plans.
Switzerland	Vector data on sectoral plans and building zones; raster data on concepts (e.g., wind energy).
The Netherlands	Vector data on zoning plans at the national, regional and municipal levels.

Source: Authors, based on expert interviews and desk research

1.4 Features of digital plans and plan data

When generating digital plan data, important properties of the data are determined. There is a great deal of discretion in this process. **Error! Reference source not found.** presents selected topics and typical options a nd features. It is impossible to discuss this issue exhaustively in this thematic paper. Rather, the table gives some indications regarding what aspects should be considered when creating or using digital data. For example, standards facilitate data exchange and allow plan content to be compared between geographical units (e.g., municipalities), but they also combined analyses on plan data and geodata to be conducted. While strict standards and high degrees of harmonisation allow more sophisticated data analysis, they limit the contextualisation of plan data and can be very difficult to attain, if not impossible.

When transitioning from analogue plan data along a continuum of increasing digitisation, issues of quality and performance arise. Most digital plan data is based on the use points of vector data models and their associated X, Y coordinate pairs in order to represent spatial features. The quality of digital plan data de-pends on the accuracy of the vector data, the accuracy of the data on planning intentions and regulation, and the link between these two data sources. Coordinates from the surveying cadastre are often used to

generate digital land use plans and to display zoning regulations in geoportals. However, the geographical accuracy of cadastres, the update and generally the quality can vary. The creation of digital plan data in the GIS environment requires absolute precision and leads to correspondingly high quality, whereas the creation of analogue plans is more 'forgiving', but may, therefore, contain more errors.

Table 1.2
Typical features of digital plan data for selected topics

Topic	Key features
Standards	Digital plan data can adhere to more or less strict standards: no standard, mainly technical standards (e.g., INSPIRE), strict standards across many administrations or other units. High inclusion vs high harmonisation
Data collection	Digital plan data can be collected by different means: • Scanning analogue plans, digitising analogue plans • File exchange by e-mail • Specific data upload, incl. automatic technical checks • Data creation directly in a geoportal (e.g., by drawing and snapping or choosing existing parcels)
Data format	Digital plan data can be presented in various formats: • Scans (raster images) of plans • PDF with plans as images • Raster ring method data (plan boundaries as vector, otherwise georeferenced image) • Full vector data
Accessibility	Distinction of accessibility for different user groups (e.g., intern/extern); different types of access: viewing only, analysis or manipulation functions, restricted download of data, free download, metadata listings
Time dimension	Digital data can display current regulations, alerts that planning is in process for a certain area, plans under revisions, potential future planning intentions, historical plan status
Collaboration	Digital plan data can be conceived as stand-alone approaches by interested authorities, relying on voluntary contributions, or required by law (e.g., to foster data exchange)
Relationship to analogue data	Digital plan data represents some aspects of the analogue plans; parallel systems exist (common in the transition period); There is no analogue plan data but prints and excerpts are possible.
Legal status	• Only for information purposes • De facto binding (e.g., because they are widely used in formal planning processes) • Legally binding PDF • Legally binding plan data • Both analogue and digital plans are binding

Source: Authors

Care must be taken when generating digital plan data by digitising analogue plans. Different scenarios have been experienced: a decrease in the level of accuracy can occur during the digitisation process because it represents a transfer process and mistakes are possible despite excellent quality control. However, the digitisation process has resulted in an increase in quality, in some cases in Switzerland, as it prompted the involved parties to go through the archives to find all the scattered, inaccessible and partly forgotten regulations and rulings to produce an up-to-date consolidated digital plan.

Digital plan data allows the immediate communication of intermittent partial plan updates in the geoportal. This is more user friendly than in analogue plans, whereas small updates are often shown in a supplementary document before a new version of the land use plan is printed after the plan has been subjected to a general revision (e.g., every 10 years). Furthermore, digital plan data allows a direct and user-friendly link

to be established between the geographical entity and the relevant regulation, e.g., the legend, the PDF of the plan/regulatory document, or all specific paragraphs in the document that refer to the geographical entity. While there are obviously many advantages to digital plan data compared to analogous plans, some planners prefer to work with analogue plans because they represent a whole. In contrast, the digital plan data seems to result in the plan fracturing into its constituent parts.

1.5 Phases of digitisation

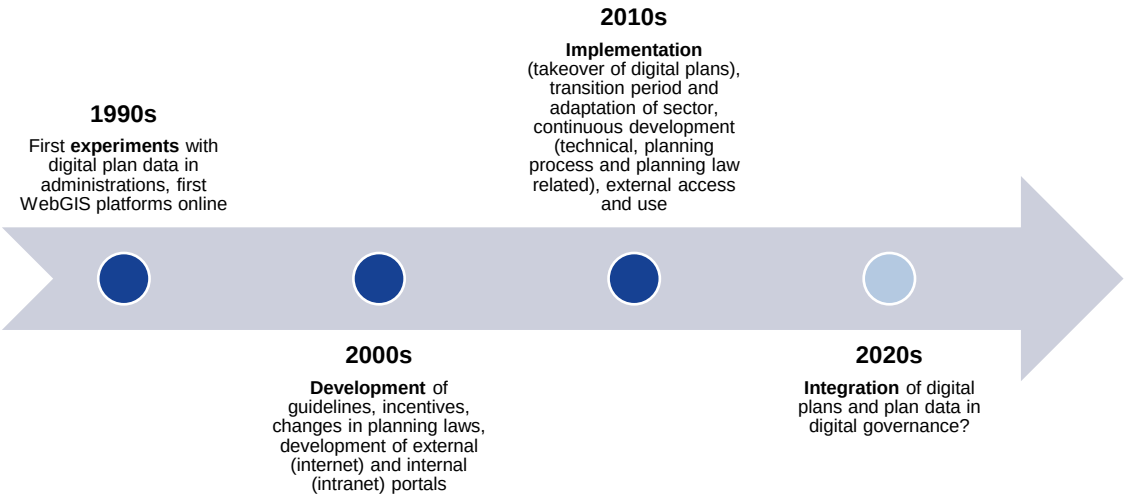
Although all the cases studied in DIGIPLAN have their own story and are digitising with different priorities, we can identify four, common phases of the digitisation of plans and plan data in recent decades (Figure 1.2). Firstly, experiments with digital plan data in administrations started in the 1990s. Digital databases of plans may have existed before, but they were rarely connected to a GIS environment. In the second half of the 1990s, the first WebGIS platforms went online, some of which also included plan data.

In the 2000s, the first guidelines for data formats were developed. This often occurred as a result of voluntary collaboration between different planning authorities. To encourage the use of these guidelines and the digitisation of plan data by local planning authorities, funding or services (e.g., INSPIRE services) were sometimes provided. Subsequently, guidelines and standards were implemented formally in planning laws. The digital portals were developed further for internal and external use.

The past ten years can be considered as the implementation phase. Laws were in place, but a transition period of several years was (or still is) necessary in many cases to reach full coverage. In parallel, the development of the portals continued with improved plan data submission methods, new functions for users, or the adaptation to planning processes (or also the other way around). As the quality and accessibility of data and portals improves, interest and use from external users increases.

This leads us to call the current phase integration. Previously, it seems, digital plan data was mainly used within the administration, the view was restricted to less data, and download was rarely possible because of technical constraints. However, today, digital plans and plan data are becoming increasingly integrated in digital administration and governance and plan data is available on open geoportals and is also being increasingly used by the public. An important aspect here is the distribution of data via open standards, i.e. data can be read by any system.

Figure 1.2
Simplified development in digital plans and plan data in the past decades



Source: Authors

1.6 The impact on planning

For planning authorities, digital plans and plan data have primarily increased efficiency (i.e., reduced the time needed for the same task) of workflows. Digital plan data, and associated standards and data models, also enable data exchange. This means, for example, closer integration with the building sector, nature management, and infrastructure and service provision. The standardised data also increases the potential for analysis and innovative practices, e.g., to follow-up on the implementation of plans. Many planning authorities are only now beginning to conduct more structured analyses and are still exploring this potential.

In general, the digital format allows questions to be asked of the data, which had not been considered when the data was produced. Open and structured data supports innovation in a wide sense. However, this poses the risk that plan data is used out of context. Certain plan regulations only make sense when seen in a bigger picture, such as a regional setting. An analogue plan can present the necessary context. Digital plans and plan data can be disaggregated, divided, and split without limitations.

Nevertheless, this also allows users, e.g., citizens, to obtain the exact information they need. Many plan data portals allow users to select and analyse plan data, create excerpts, or download geodata, often additionally listed in open data portals. This increases transparency and involvement in planning matters, especially of professional interest or lobby groups, but it also limits access for potential users, e.g., citizens without specific knowledge of planning, when technical barriers are too high. In this respect, digital plans and plan data can support participatory processes when used appropriately. The formal participatory processes related to a plan (official hearing) have, in some cases, already been integrated into digital plan data platforms.

Planners need to provide highly detailed data, which is often much more detailed than what was necessary for the equivalent analogue plan with a fixed scale and no possibility to overlay with other data. Requirements for plan accuracy are changing, even if not stated in planning laws. Issues of scale, fuzziness, ambiguity, context, accessibility and legal status also illustrate that traditional plans were not designed for a digital format. In some cases, planning processes have been adapted to new digital routines. Nevertheless, not all planning instruments (especially those of a more visionary or strategic character) are digitised to the same degree as, e.g., municipal land use plans.

Finally, digitalisation has an impact on planning in the same way as it effects other parts of society. It leads to a subjectivation and objectivation (Nassehi, 2019) of planning at the same time. Subjectivation because we can get exactly what we need, e.g., planning information for one specific plot, while avoiding having to access the whole plan behind. Objectivation because digitisation implies the standardisation and harmonisation of plans and plan data and increasing comparability, but with the risk of limiting ways of planning that have not yet been defined.

2 What are the drivers of the digitisation of plan data and what is its purpose?

Across Europe, municipalities, regions and countries have started digitising plan data. This digitisation process, defined throughout this paper as the transformation of data from an analogue to a digital format, has reached different stages, depending on, amongst others, the amount of resources allocated to it, its start date and the level of competence in spatial planning of the involved public authorities.

With these differences in mind, this thematic paper starts by discussing the main purposes and drivers behind the digitisation of plan data, which were identified by a qualitative survey conducted at different administrative levels across Europe. The paper then focuses on two practices, which were made possible by having access to plan data in a digital format. The first is metadata sheets, which illustrates the advantages of a high level of transparency and easy access to plan data. The second practice is planning excerpts, which help to reduce the workload and costs and speed up the planning process.

2.1 Main purpose

Table 2.1 lists the main purposes identified in some of the cases. Having plan data available online makes such data more easily accessible than when it was in an analogue format. Providing plan data with a high level of transparency to potential users has been an explicit purpose of many such digitalisation processes and is closely connected to key notions such as open data and open governance. For instance, providing transparency of governmental processes is the main purpose in the Netherlands. Easy access to digital plan data also addresses the need to provide easy access to metadata online. The desire for transparency, including access to metadata is, for instance, one of the main purposes in both Denmark and the region of Tyrol (Austria). The elaboration of metadata sheets, based on the case of Wallonia (Belgium), is discussed in this paper. Digitising plan data provides an opportunity to establish standards that determine how such data should be digitised, and consequently, allow to publish such standardised plan data on a single platform. The creation of a nation-wide or region-wide digital portal containing harmonised plan data has been one of the main aims of the digitisation process.

Table 2.1
Examples of main purposes

Case	Main purpose
Tyrol (Austria)	Efficiency (digital processes), transparency (accessibility), combination with other data.
Denmark	To establish a digital register for spatial planning which ensures that plan data is unambiguous and digitally accessible; in compliance with the law on planning.
France	Data availability for public services, planners and citizens on a unified geoportal.
Ireland	To provide data for analysis and to give a national overview of digital plan data.
Lithuania	To integrate national datasets and harmonise previously scanned data plans.
Luxembourg	Access to high-quality plan data (i.e., standardised and with limited number of errors) from all municipalities on a single platform.
Switzerland	Open government: visualise and communicate spatial information for the population (Federal Office for Spatial Development).
The Netherlands	Open governance through increased transparency of government processes due to legal and current digital plan data on the portal.

Source: Authors, based on expert interviews and desk research.

2.2 Main drivers

The following three main drivers behind the digitalisation of plan data have been identified: a top-down process, the INSPIRE Directive and the general movement towards digitalisation and technological development. The ministry or authority responsible for spatial planning is usually the lead actor in such top-down processes. In general, the lead actor reflects the spatial planning context and the administrative structure: the national actor in spatial planning is the main driver in centralised states, whereas the regional actor is the main driver in federal states. For instance, the Ministry of the Interior is the clear driving force in Luxembourg as was the Ministry of the Environment and Spatial Planning in Slovenia, which combined all the plan data provided by the municipalities. In Switzerland, the regional actors, i.e., the Cantons, demand digital plan data from the municipalities. In Tyrol (Austria), the 2011 spatial planning law was changed, stipulating that land-use plans had to be published online from 2013. In Bavaria (Germany), an amendment to the Building Code in 2017 meant that the municipalities had to publish their land use plans on the state's central internet portal.

Table 2.2
Examples of main drivers

Case	Main drivers
Belgium (Wallonia)	- The regional level through the internal organisation (transversal function of the Department of Geomatics since 2010). - The INSPIRE Directive.
Germany (Bavaria)	- The Project "Establishment of a Geodata Infrastructure in Bavaria" was launched in 2003 due to e-government initiative to publish geodata via the internet. - The INSPIRE Directive was crucial for the state and regional planning (RISBY). - The amendment of the Building Code in 2017 had the consequence that the municipalities should publish their land use plans on a central internet portal of the state.
Italy (Bologna)	The INSPIRE Directive and a planning reform
Malta	Technological developments improving quality, effectiveness, and efficiency.
Norway	- Large municipalities' request for adequate information, and to some extent small municipalities with motivated individuals. - The national authority (i.e., the Ministry of Local Government and Modernisation).
Portugal	- Strong political decision from DGT (Directorate-General for Territory) to create the SNIT (National System of Territorial Information) and digitise all plans in force at that time. - National and European financial resources.
Slovenia	The Ministry of the Environment and Spatial Planning implemented an initial rough digitisation of all municipal spatial plans in 2003.

Source: Authors, based on expert interviews and desk research.

Even though the INSPIRE Directive (INfrastructure for SPatial InfoRmation in Europe)[1] does not mandate the digitisation of data, it is clearly connected to the digitisation of plan data as the two processes run in parallel. The Directive contributed to making the authorities responsible for plan data consider digitising their

[1] A European Union directive, the aim of which is to establish infrastructure for spatial information in Europe that makes geographical information more accessible and interoperable for a wide range of purposes, thereby supporting sustainable development.

data. Therefore, the Directive was identified as being either one of the main drivers in the beginning of the digitisation of plan data or at a later stage in the process. An example is the production of metadata sheets in Wallonia (Belgium), which is discussed in this paper, where the INSPIRE Directive was mentioned.

Finally, the general move towards digitisation and technological developments have also been key drivers of the digitisation of plan data, as for instance enhancement of the quality of the digital plan data, and a more efficient integration of digital plan data into one system. Table 2.2 provides a non-exhaustive overview of the main drivers identified in some of the investigations in Europe.

2.3 The digitisation of metadata

Metadata is key to understanding how a specific type of plan data has been produced and what it means. It aims to provide all the necessary information to the user of digital plan data to avoid potential misinterpretation. Therefore, its purpose corresponds with that of providing transparency as previously mentioned. Having a digital interface for plan data allows the integration of metadata on that same interface, thereby making the digital version of metadata more easily accessible than the analogue format.

The digitised metadata information can be presented in different ways. It is usually stored in a catalogue that includes a search function and references all the relevant digitised plan data (or more generally all available geo-data). For instance, such a catalogue has been created in Germany[2], Switzerland[3] and Wallonia[4]. The latter also presents the metadata in specific metadata sheets[5], the elaboration of which is discussed below.

The elaboration of metadata in Wallonia (Belgium)

Figure 2.1 presents an example of the metadata sheets (in French: *fiche descriptive*) that are available on Wallonia's geoportal (left: html version; right: pdf version). It includes a summary of the selected plan data, information on how to access it on different platforms, a description of the actual data, elements on the quality of the data (e.g. conformity test and spatial resolution), related digital geodata and other online resources as well as contact persons. It is available in html format on Wallonia's geoportal and can also be easily exported in four different formats (pdf, rtf, xml and url). For instance, the generated PDF version of the sheet shown on Figure 2.1 is a ten-page document.

The elaboration of metadata sheets containing plan data in Wallonia involves two main actors. The first is a transversal Department of Geodata Integration (in French: *Direction de l'Intégration des Géodonnées*). This department designs, develops, manages, and promotes the geodata infrastructure of Wallonia. The second actor is the plan data manager, who is either the plan data producer or the supervisor of a project that needs to disseminate plan data. Such metadata sheets have the following three main aims:

- to inform the user of the geoportal containing plan data about the actual content of the plan data, and any available geodata more generally.
- to improve the referencing of plan data, while making it accessible online.
- to function as a link between the user and the plan data that can be found online (mapviewer, visualisation webservices or downloadable services).

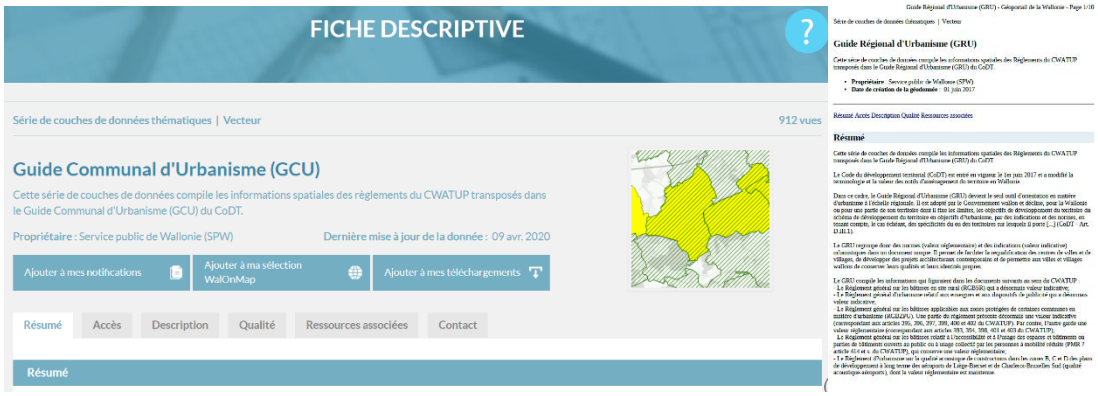
[2] https://metaver.de/startseite, access on 15.12.2020

[3] https://www.geocat.ch/geonetwork/srv/ger/catalog.search#/home, access on 15.12.2020

[4] https://geoportail.wallonie.be/catalogue-donnees-et-services, access on 15.12.2020

[5] https://geoportail.wallonie.be/catalogue/e140607a-cfeb-445f-a551-22816c06c72f.html, access on 15.12.2020

Figure 2.1
Screenshots of the metadata sheet on Wallonia's geoportal



Source: Wallonia's geoportal, https://geoportail.wallonie.be/catalogue/e140607a-cfeb-445f-a551-22816c06c72f.html, accessed 2 February 2021

The type of information contained in the sheets is guided by the INSPIRE Directive and framed by the ISO19139 and 19115-3 standards. For instance, such sheets should include a title, a summary, keywords, INSPIRE theme, dates linked to the resource (e.g., date of creation, updates), data models, legend used, contact information, etc. The data manager is responsible for the content of the metadata. Some fields are automatically updated by automated processes. For example, the date when data was updated is modified automatically when the corresponding visualisation on the web service is updated. The thematic content of the metadata sheet is entered by the data manager and validated by the metadata catalogue administrator or an expert from the Department of Geodata Integration. The metadata catalogue administrator is responsible for the technical content, i.e., related to ISOs.

Figure 2.2 summarises the main steps in the production of metadata sheets from content creation to validation.

Figure 2.2
The production of metadata sheets in Wallonia

Source: Authors, based on expert interviews.

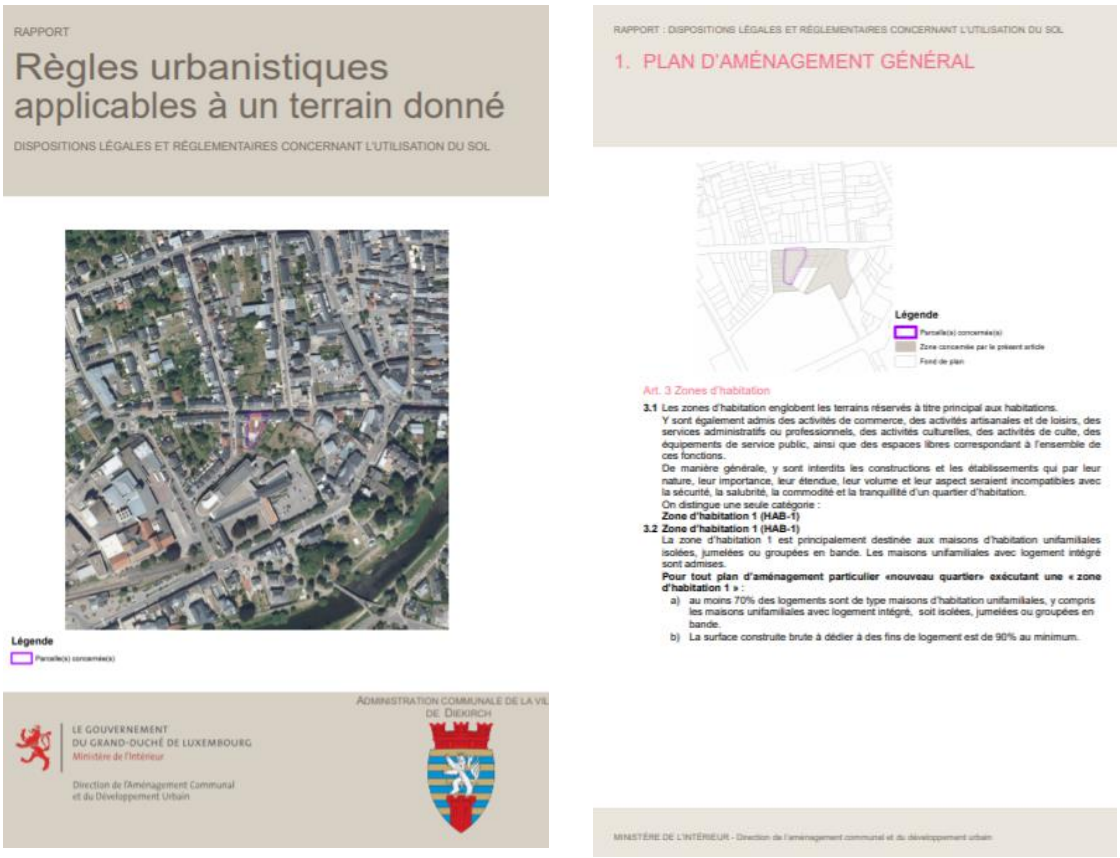
The main difficulty for the Department of Geodata Integration is to convince the producer of the data of the usefulness of the metadata. The latter occupies an important place in the process of disseminating digital data. Metadata is, for example, an essential step in the creation of the unique identifier of the digital data within the infrastructure. The Department of Geodata Integration has bypassed this obstacle by making the provision of metadata mandatory for any digital data that is stored and disseminated through web services. This process is accompanied by comprehensive training sessions and guidelines to make it as effortless as possible.

The digitisation of metadata has brought new challenges. For instance, more automated quality controls need to be implemented when disseminating plan data and its corresponding metadata. However, some steps in the quality control still must be done manually. Finally, the work with metadata sheets in Wallonia presents opportunities in the near future, especially in connection with the need to publish additional information on the life cycle of plan data, such as the traceability of historical plan data and the links between plan data.

2.4 The digitisation of excerpts

An excerpt in this paper is defined as a document that extracts all relevant plan data and planning information for a specific area and usually for a specific parcel. The digitisation process facilitates the creation of excerpts, which users of a geoportal containing plan data can easily access. The elaboration of such excerpts has a clear impact on planning practices. For instance, the owner of the plan data does not have to manually extract plan data to prepare requested planning reports for parcels located in their territory. Such reports can even be autogenerated through, e.g., a national geoportal, which reduces the workload for public authorities, especially municipalities. Excerpts containing planned data can, for instance, be easily accessed on the geoportal for Luxembourg[6], Wallonia in Belgium[7], the canton of Thurgau in Switzerland[8] and France[9].

Figure 2.3
Screenshots of the excerpt generated on Luxembourg's geoportal



Source: Luxembourg's geoportal, https://map.geoportail.lu/theme/pag, accessed 2 February 2021

[6] https://map.geoportail.lu/theme/pag, access on 15.12.2020

[7] http://geoapps.wallonie.be/webgisdgo4, access on 15.12.2020

[8] https://map.geo.tg.ch/apps/oereb/?egrid=CH410692667770 (example for PLR cadastre in the canton of Thurgau, show the current public law restrictions), access on 15.12.2020

[9]https://www.geoportail-urbanisme.gouv.fr/map/#tile=1&lon=-2.6681373&lat=48.50029620432463&zoom=15&scot_=1:0.8&mlon=-2.670364&mlat=48.501365, access on 15.12.2020

The creation of excerpts in Luxembourg

Two main actors are involved in the elaboration of excerpts in Luxembourg: the Ministry of the Interior, which is the national actor in spatial planning, and the Cadastral and Topography Administration, which is responsible for the geoportal. The municipalities submit municipal plan data. The purpose of the excerpt in the case of Luxembourg is to include all restrictions and obligations related to building permissions for a given parcel into a single document. Such documents are mostly used by landowners and planners.

The actual excerpt, translate from French into *Planning regulation for a specific parcel. Legal and regulatory land use provisions* (in French: *règles urbanistiques applicables à un terrain donné. Dispositions légales et réglementaires concernant l'utilisation du sol*) includes both text and illustrations (see Figure 2.3). For instance, it includes the text from municipal land use plans (in French: *Plan d´Aménagement Général*) and partial land use plans (in French: *Plan d´Aménagement Particulier*), which affect the chosen parcel. It also includes the map extracts illustrating the different restrictions for a given parcel, including the legends and the description of each zone and methodological elements. The last page of the excerpt is a disclaimer, which guides the user regarding the value of such documents, i.e., informative and no legal basis.

The data model for the excerpt was prepared by the Ministry of the Interior. The municipalities, acting alone or with the assistance of private companies, must deliver all the information contained in the municipal plan using the data model prepared at the national level. The delivery, in zip format, contains a GML file containing geometries and a docx file containing texts and illustrations for the given geometry[10].

Once received, the plan data is uploaded onto a centralised database, which covers the entire territory of Luxembourg. Finally, the Ministry of the Interior and the organisation that is responsible for the Geoportal cooperate to develop a script that generates the excerpt containing plan data. When it comes to updating the plan data, the municipality is responsible for sending the latest version of the plan data to the Ministry of the Interior, which then checks and validates the data before publishing it on the geoportal via the centralised database.

The various cooperating actors encountered some challenges when attempting to produce excerpts in Luxembourg. For instance, obtaining the plan data from the municipalities for the common data model was not straightforward. Figure 2.4 below summarises the main steps in the elaboration of excerpts from content creation to generation.

Figure 2.4
The production of excerpts in Luxembourg

Source: Authors, based on expert interviews.

[10] See, for instance: https://data.public.lu/fr/datasets/r/5191e439-b06c-4f77-a7f6-c2803071cf0b, access on 08.12.2020

2.5 Potential and challenges

Potential	Challenges
The digitisation of plan data facilitates national or regional analyses due to the greater coverage of plan data (e.g. what is the extent of development in urban zones?), but also harmonised datasets (e.g. land use zoning). Digitisation also improves the workflow and planning practices. Indeed, municipalities often benefit directly from digitisation, as it is easier to submit digital plan data than analogue. The auto-generation of plan data, as in the example of excerpts in Luxembourg, reduces the workload of municipalities. These improvements generally help to reduce costs, mostly thanks to more efficient processes.	A lack of experience with the digitisation of plan data and the relative absence of technical expertise among public authorities and private consultancies was one of the main initial challenges. Indeed, it can still be a challenge, e.g., with the introduction of new processes. A lack of knowledge about transforming plan data in specific models is one example. Low quality input data is another challenge, making the digitisation process time-consuming and resource intensive as it requires as the following steps: vectorising complete datasets, creating new standards, correcting data specifications, and gathering plan data from various sources. A lack of financial resources was an initial challenge in countries or regions where digitisation had not been prioritised in the preceding decade. Furthermore, limited financial and human resources at municipalities slowed the digitisation process.

2.6 Policy recommendations

Take advantage of opportunities offered by digital plan data

What opportunities does the digital format of plan data offer users? This question should be answered and new features and tools should be created that will benefit users of plan data, such as making it possible for them to customise and select digital plan data and create excerpts.

Convince the data producer about the importance of metadata

Digitising plan data provides the opportunity for connecting each data entry with metadata, i.e., a set of data that describes and provides information about a specific data entry. Entering such information may seem like a lengthy process for data providers who are unfamiliar with digitisation processes. However, complete metadata does make digital plan data more accessible. Presenting the benefits of metadata and assisting the data providers would improve the overall experience of using digital plan data.

Facilitate the entry of plan data in digital format

Entering plan data in a digital format appears to be a challenge for data producers, both in the public and private sectors. Therefore, solutions that make this process easier should be prioritised. An open communication channel between the data producer and the data publisher as well as the availability of guideline documents and tutorials contribute to a good workflow.

3 Who can access digital plan data and does it change involvement?

3.1 Digital portals as a tool

Digital plan data is accessed through digital portals. As defined in the final report (ESPON DIGIPLAN, 2021), a digital portal is any electronic tool for communication where the key functions are to visualise plan data, support analyses and hearing processes, encourage participation and interaction, and options to report errors. In addition, key functions for professionals include being able to edit and create digital plan data. WebGIS is the most common user interface for these digital portals.

An important element of a digital plan portal is the user interface for which usability should be considered as early as the portal developmental stage. The complexity of digital plan data necessitates a user-friendly interface, with intuitive commands and graphical visualisation (Gkonos et al., 2019). If usability is not addressed, it may result in inefficient usage (Herold et al., 2016), which may subsequently make the digital plan data less accessible to all users regardless of their level of expertise (Gkonos et al., 2019).

Range of digital plan portals

Today there is a broad range of digital portals in terms of thematic scope, interactivity and accessibility. The scope of the portals ranges from those that only contain plan data to those that also include environmental data and, finally, those that contain broader data such as statistical information. Furthermore, portals may only contain current data, while others may also include historical data.

Table 3.1
Level of platform digitisation

	Basic	Intermediate	Advanced
Austria			X
Belgium		X	
Denmark		X	
France		X	
Germany[1]	X	X	
Ireland		X	
Italy		X	
Lithuania		X	X
Luxembourg		X	
Malta	X	X	
Netherlands	X		
Norway		X	
Portugal		X	
Slovenia	X	X	
Switzerland		X	

[1]Germany: varies across platforms, from basic to intermediate
Source: Authors

Interactivity in the digital plan portals can vary with the level of digitalisation of the platform, which again ranges from more general/technical to more plan specific solutions. For the most basic portals, the user can only see plan data in a digital format, i.e., a visualisation of the plan data, possibly with access to detailed plan information via clicks on the portal or a link to further information, e.g., as a PDF. Intermediate portals allow the user to perform a limited number of simple operations based on the available plan data, e.g., make requests for permits or customise the available information to their needs. Here it may be possible to download the digital plan data (e.g., as vector data, WMS or WFS) or conduct metadata searches, while technical services may be available. In advanced portals, formal planning processes are supported, and the user can interact with the planning authority and the digital plan data, e.g., through online participation or evaluation of the plan data. As seen in Table 3.1, the platforms included in the 15 case studies range from basic to advanced, though most platforms have an intermediate level of digitalisation. The level of digitalisation of a platform is not always clear-cut and the interactivity of the platforms may span multiple levels for different functions.

In most cases, digital plan data is publicly accessible due to the EU's INSPIRE Directive. However, the level of access to specific digital plan portals may vary. Some portals are accessible to the general public, while others can only be accessed by professionals, e.g., planners and planning authorities. With regards to the portals that are accessible to everyone, there can still be differences in whether the digital plan data is free or only available against payment.

3.2 Access to digital plans and plan data

Available digital plan data

The analysis of the 15 case studies highlights that the type of digital plan data available in each country reflects the planning competences of the various administrative levels in each country as well as the nature of the planning instrument. Digital plan data at the national level is available in all unitary countries included in the analysis[11] (with the exception of Ireland), while for the federal countries in the analysis[12], digital plan data is usually available at the sub-national level (e.g., Belgium) but not necessarily at the national level. As can be seen in Table 3.2, the administrative level at which digital plan data is available varies between the countries.

Example: platform with several entry points

In Denmark, all plans prepared in the framework of the Danish Planning Act have to be registered in the public digital plan register "Plandata.dk". The platform allows users to download plan data as PDFs or as geodata (directly from the portal or WMS/WFS). Anyone with an internet connection has access to and can download all digital plan data and planning documents.

The platform has several entry points depending on the purpose. The primary platform gives access to all plan data (national, municipal, and local); the interface can appear overwhelming with vast amounts of data layers available, which are often only of relevance to public authorities. The local plans are the only plans that are of direct relevance to citizens. Another entry point for the register is, therefore, solely for local plans. This interface is simpler; the data layer with current local plans is activated as default and a link to the relevant local planning documents appears by clicking on them. The last entry point to the register is a search module for all municipal and local plans. Here it is possible to obtain a list of relevant plans within certain parameters, e.g., municipality, plan status, dates, and type of plan, with links to the legally binding planning document and the map via Plandata.dk.

[11] Denmark, France, Ireland, Italy, Lithuania, Luxembourg, Malta, Netherlands, Norway, Portugal, and Slovenia.

[12] Austria, Belgium, Germany, and Switzerland.

Table 3.2
Planning instruments included in the digital portals

	National level	Sub-national level	Local level
Austria	-	Partially	Partially
Belgium	-	Partially	Yes
Denmark	Partially	-	Yes
France	Partially	No	Yes
Germany	-	Partially	Partially
Ireland	-	-	Yes
Italy	-	Partially	Yes
Lithuania	No	No	Yes
Luxembourg	Yes	-	Partially
Malta	Partially	-	-
Netherlands	Yes	Yes	Yes
Norway	Partially	No	Yes
Portugal	Partially	Partially	Yes
Slovenia	Partially	-	Yes
Switzerland	Yes	Yes	Partially

Source: Authors

Example: barriers to access

In Switzerland, geodata from the cantonal structure plans in the canton of Thurgau became available in around 2013 for a fee via the ThurGIS Shop. Since 2018, this data has been available free of charge via the shop and, since 2019, all geodata from the cantonal structure plans can be obtained directly from opendata.swiss as a WFS service. To obtain data via the ThurGIS Shop, interested parties must first create a free account. This may be considered a small barrier to the acquisition of data. Prior to 2013, the data was also shared with planning offices as shapefiles on request.

Example: request for data

In Norway, digital plan data is public. When a private actor proposes a plan, they have to request the latest geodata, herein plan data, from the municipality. In the majority of cases, the data is not free and must be paid for, but once it has been paid for, the new owner can use it as they please. When a plan is submitted to the municipality, it must be made accessible to the public. The plan data produced in the planning process is now the property of the municipality, and as the plan is adopted, the existing data needs to be updated using the new plan data.

Example: sensitive data and legal discrepancies

In Germany, all geodata should be available via the German geodata infrastructure (GDI-DE) as far as possible. The GDI serves as a collection portal for the metadata, with the data providers being responsible for providing the datasets. This means that the data providers are also responsible for protecting access to any sensitive data. However, such protection is not coordinated by a national regulation or strategy.

In Stuttgart, some legal discrepancies still exist in the binding land use plans. This has inhibited publication of the plans on the Internet. However, Stuttgart aims to resolve the discrepancies in the current binding land

use plans and make them available on the central internet portal in Baden-Wurttemberg as soon as possible. Legal difficulties connected with binding land use plans may also exist in other municipalities.

In the city of Freiburg, the preparatory land use plan (de: Flächennutzungsplan) has been available in a digital format internally within the administration for several years. However, the plan was initially only published digitally as a PDF as the preparatory land use plan is at a scale of 1:25.000. Therefore, the publication of the geodata at a parcel scale is undesirable as this could lead to erroneous conclusions being made. By providing the PDF, a parcel-by-parcel interpretation was avoided. After about seven years, the preparatory land use plan was published in 2020 on Freiburg's new geoportal. External users cannot zoom in and view the dataset at the level of the individual parcel to avoid the potential problem discussed above.

3.3 Digital plan data and involvement of actors

Users of digital plan data

There are three important aspects when it comes to the type of users of digital plan data in each of the 15 cases studied in DIGIPLAN: the profiles of users, the monitoring of users, and the permissions given to use digital plan data. In terms of the profile of users, there are five main types of user of plan data in the case studies: planners, public authorities, researchers, companies, and individuals. Other users include notaries, who use the plan data to check the existence of any pre-emptive rights, land registries, or architects, who need the plan data to list all the planning related rules for a parcel. The same types of users generally used analogue plan data prior to digitisation. However, planners and local or regional authorities are the most common users in almost all cases. They may, for example, use the digital plan data to prepare reports on planning permits and assess municipal and private plans.

Few of the case studies examined have a reliable way of monitoring to see who uses their digital plan data. In some cases, they offer assumptions based on communications through the channels between users and the portal such as contact forms, emails or even statistics. The latter is the case in Norway, where the type of users can be as identified planners and architects, public authorities, and the general public through statistics regarding internal use. Bavaria and Baden-Württemberg also state that they do not monitor their users. However, they assume that their users are the same as their target group, i.e., planners, the public administration and the general public.

There are several models for regulating access to data. For instance, in France, the following licenses are issued to users: anonymous, service provider, delegated, local authority, and local administrator. Anonymous users can see and collect data but cannot modify it. Service providers are professionals who can check the data and validate it. Delegated users are professionals who have the right to send planning documents on the behalf of a local authority. Finally, the local administrator profile has a technical license. In St. Gallen (Switzerland) and Austria, a distinction is made between internal and external users. Internal users are those within the municipal administration, while external users comprise planners or interested citizens.

Benefits of digital plan data

Two main aims behind the digitisation of plan data were identified in the 15 case studies. The most commonly mentioned, in twelve cases, was to provide easy access to planning data and a high level of transparency. This aim was expressed in different ways in the interviews through phrases such as 'open data', 'open governance', 'provide transparency', and 'easy access to data and metadata'. The other main aim was a desire to create a national (or regional) digital portal, containing harmonised plan data or plan data of a better quality than the analogue format.

Improved workflow and planning practices are some of the most common benefits of the digitisation of plan data mentioned in the 15 case studies. These improvements are mostly seen at the municipal level in the case studies. For instance, for the municipalities in Denmark, submitting plans to the State digitally is simpler than submitting analogue plans. In addition, the national platform also provides a better overview of all municipal plans across the country. Similarly, municipalities in Luxembourg do not have to manually extract plan data to prepare requested planning reports for parcels located within their territory. Such reports can now be auto-generated through the national geoportal, which reduces the workload of municipalities.

Example: Market changes

In Austria, the digitisation of plans has not affected the small municipalities as private planning consultancies assist them with the preparation of plans and conduct planning processes. However, increased digitisation has led to a market shakeout in the consultancy sector as well as a few software providers taking on an increased role in some regions. In the actual planning process, private planning offices play an important role. Small municipalities often work with the same planning consultant for many years. Some small offices were unable to adapt to the new requirements regarding GIS data and either dropped out or sub-contracted this task to other consultancies. Today there are only very few companies serving the majority of the planning offices. The fear of a potential market shakeout may also have delayed digitalisation in some of the other Austrian states or may have contributed to long transition periods.

Example: empowered public through participation

In Germany, the public has been empowered by participatory processes in which digital data is used and plan information is combined and displayed, e.g., with large data tables that act like a giant tablet. At the so-called "digital campfire", various pieces of information can be placed directly on top of each other and viewed, which is useful in participatory procedures. Digital plan data can facilitate evaluations and analyses, which can be presented to politicians and provide a solid foundation for projects or planning. In Hamburg, a digital participatory project (DIPAS) is currently being implemented in which the public can be involved in the conception of land use plans. However, the effects of digitisation on participatory processes and planning are difficult to determine, although criticism due to a lack of transparency in the preparation of plan data decreased with the digitisation and provision of plan data.

In Hamburg, a transparency portal was established on the basis of the Transparency Act. In addition, Hamburg provides digital plan data and strives to provide the planning regulations in digital form. However, it is not yet clear whether planning practice has been changed as a direct result of digitisation. At least increased transparency has been achieved by making the digital plan data accessible to the public.

Example: transparent plan data

Overall, the case study from Switzerland showed that, in most cases, everyone has access to the digital plan data, which strengthens all actors. In the context of the public law restrictions cadastre (PLR-cadastre), the transparency of plan data with public law restrictions on ownership is an objective that has been achieved in practice. There are advantages to public data for the authorities, investors, but also private parties, as easy access simplifies planning. Thanks to the transparent plan data, the authorities can appear more visible to private parties. In the canton of Thurgau, it was observed that private companies (planning firms, etc.) are more progressive than the municipalities, as they have to position themselves on the market and, therefore, take advantage of consulting opportunities. In addition, the public is becoming more aware of the issue of digital plan data as they have easier access to it.

Cooperation within the authorities has changed in various ways. On the one hand, the overlapping work on geodata has led to closer cooperation, as is the case in Thurgau. On the other hand, cooperation may decrease because the digital data can be easily sent and commented on digitally, which means that less human interaction is required, as in Basel-Stadt. Thus, cooperation within the authorities may increase or decrease as a result of digitisation depending on the approach adopted by the authorities.

Development of the PLR cadastre facilitated a collaboration between the cantons and the federal government. In order to create this cadastre with digital data, intensive cooperation was required in working groups and experience exchange groups.

Case example: digital citizen involvement

In Denmark, the digital plan register does not directly support the actual planning process, hearing or communication between actors or the implementation. This is intentional, as it is not seen as the state's task to provide such a solution on behalf of the municipalities. Nevertheless, plans are made public on plandata.dk, and mandatory and optional hearing parties are notified automatically by the system when a plan is in hearing or has been approved. However, the hearing process from this point on leaves the system, hearing parties do not reply in Plandata.dk. Instead, the process is managed by the municipalities.

A Danish planner said that they reach more citizens with digital plans, but that some people still struggle with the digital world. It is important that municipal employees have time to help citizens who feel insecure

about the digital platforms. The municipality has experience with helping people who lack IT skills access the digital plans, e.g., over the phone. In addition, both the municipality and citizens save time and resources as a result of plans being in a digital format.

The Danish Town Planning Institute, which is a private, independent institution that aims to showcase planning in Denmark, has started online courses that aims to give inspiration to digital citizen involvement. The courses are targeted the municipalities' planning departments. The courses focus, among other things, on how to facilitate digital citizen involvement through e.g., debates, polls, group work, and questionnaires[13]. In 2020, four courses were fully booked, while one course in 2021 was fully booked at the time of writing (January, 2021), which demonstrates that there is significant interest from the municipalities in learning more about digital participation.

3.4 Potential and challenges

Potential

Accessible digital plan data has considerable potential. By having a digital plan portal, it is possible to visualise the plan data, which supports hearing processes and increases participation. For planning professionals, a digital portal can also facilitate the creation and editing of digital plan data.

Improved workflow and planning practices are some of the most common benefits of the digitisation of plan data mentioned in the 15 case studies. Digital plan data can be accessed much more easily and more quickly than analogue plan data, with the additional benefit that there can be more transparency with regards to the existing planning documents. Transparent governance and increased participation are other advantages that were apparent in the case studies, e.g., in Switzerland and Germany, where the public was empowered through participatory processes when digital data is used, and information is combined and displayed.

As it is necessary that the digital plan data conform to the same technical requirements for it to be available through a single digital portal, it is in addition possible to achieve higher data quality and data accuracy.

Challenges

One of the advantages of digital plan data is also one of the challenges. It can be a challenge to develop, comply with, and maintain the technical requirements for digital plan data as it requires an extensive and coordinated effort to ensure data quality and accuracy. Even when the technical requirements have been met, delivering the data on time and of sufficient quality can be a challenge. A coordinated data review may be necessary to ensure quality.

Regarding the digital plan portal, a user-friendly interface with intuitive commands and graphic visualisation is necessary to ensure accessibility. While digital plan data has often been a significant improvement for experienced users, some portals can be very complex and confusing for non-experts and there is a possibility that citizens can be overwhelmed by the myriad of digital tools, which can cause them to lose focus on what is relevant for them. It is important to consider the barriers to availability, such as the requirement to create an account to see or download plan data or the cost of plan data. Another aspect of the portal is map representation. This is especially important with plans designed at a specific scale or more strategic plans where viewing the plans at different scales is undesirable, as this could lead to misleading conclusions based on the scale. Furthermore, the possible discrepancy between digital plans and analogue plans can be confusing.

[13] See, e.g., https://www.byplanlab.dk/digital_borgerinddragelse, accessed 25.01.2021

3.5 Policy recommendations

Provide a digital plan portal

This may sound banal for those who have already have a digital plan portal. However, not all countries have easily accessible portals covering the whole or a part of the country available yet. The portal can be a central entry point to find plans, visualise them or event support hearing or participation processes. In addition, digital plan data can be accessed much more easily and more quickly than analogue plan data, with the additional benefit that there can be more transparency with regards to the existing planning documents.

Develop technical requirements to ensure data quality and data accuracy

To increase the accessibility of digital plans, it is important to develop, comply with, and maintain technical requirements for the digital plan data. This may require an extensive and coordinated effort to ensure data quality and accuracy as well as a clear system and process to ensure data is delivered on time and at the right quality. The establishment of a coordinated data review may be necessary.

Consider the purpose and target group of the digital plan data

An important aspect to consider regarding digital plans is the establishment of a close dialogue with the expected user group to ensure that the digital plans are used to their full potential. To increase the accessibility of digital plans, it is important to consider plan data from a planning perspective as well as user needs, not only the technical requirements. In addition, the purpose of the digital plan portal needs to be considered and whether special entry points, e.g., thematic portals for specific user groups would increase accessibility and use of digital plan data. It is, however, also important to limit the number of platforms to as few as possible to ensure accessibility and unambiguous digital plan data. A digital plan portal containing a user-friendly interface with intuitive commands and graphic visualisation is necessary to ensure accessibility.

Allow time for transition to digital plan data and digital processes

It is important to be aware of the multiple uses of digital data and that the way this data is used can and will change over time. The use of digital data is increasing and the use will certainly change in the future as digital plan data and processes are developed and refined. However, the transition to more digital plan data and processes can take time, both regarding planning authorities integration with digital data as well as citizen involvement and participation.

4 Are digital plans and plan data legally binding?

4.1 Introduction

While in most countries, detailed digital plan data is available over publicly accessible geoportals, it is not usually legally binding. Instead, it is only a representation of the actual plan (data). The legally binding plan is often still the paper version; sometimes the version that is available at the municipal office. In Denmark, the centrally saved PDF version of a plan is legally binding, although some plan data is also published as geodata. In the Netherlands and Portugal, the geodata is also legally binding.

However, today, formal plans are mainly produced digitally, which means plan data, whether it be legally binding or not, is often available at very high quality. This high quality, along with high accessibility (see Thematic Paper 3), means digital plans and plan data are *de facto* legally binding: the digital plans and plan data are used in practice as if they were the legally binding plan.

Before providing some examples, we briefly address the more general question of how geographic information is currently handled by our legal systems.

4.2 Digital representation of legally binding geography

Maps in laws

Many laws, directives, or legal regulations refer to specific locations. A study from Denmark (Baaner et al., 2019) found that geographical references are made in 80 % of Danish laws. Baaner et al. (2019) identified different types including laws that reference existing geographical features (e.g., forests, lakes, coastlines, etc.), have maps attached, use specific coordinates, or refer to a specific geographic register, e.g., a parcel of land in the land registry. All the methods have some disadvantages and show that there is no standard way of referring to geography in Danish law. Also, while all laws are published on a digital platform for Denmark (www.retsinformation.dk), the system has no inbuilt function to present geodata and digital maps.

Similarly, in Austria, all laws have had to be published electronically since 2004 (Kanonier and Weninger, 2019), but there are exceptions. If publishing (a part of) a provision electronically would entail too much effort, a paper version can be published instead, accessible to the public. Plans and maps are mentioned explicitly as possible exceptions. In practice, this means that in 8 out of 9 federal states, the paper plans are the legally binding plans. However, in some states, parallel processes have been established, putting digital plans on par with the legally binding plans.

Standardisation

The fact that digital plans and plan data, despite their availability, are not legally binding in many countries may be related to several challenges involved in digitising analogue plan data. It is important to consider that plans consist of a text and a map part. Depending on the plan type (e.g. a strategic plan or a land use plan), those also have different character and require different digital formats. One challenge hereby arises on the way, how plans have to be done is not standardized. To illustrate this, we could imagine a digital spatial plan portal for the whole of Europe. The differences in planning systems would mean that the data would have to be standardised, but important data might get lost in the process. This would not be acceptable for legally binding information.

In some countries, legislation does not define all details of how a plan needs to look. For example, in Denmark, the planning law primarily defines general goals and requirements, the formal process and a plan's implications. It does not define how building densities should be stated or only defines general land use categories. In the Danish plan database, only a selected number of variables are attached to geodata. These might not mirror all relevant regulations. The legally binding plan is in PDF and is available online in the plan database. In other countries, e.g., Norway, Austria, and Germany, this is not a problem, e.g., when there are regulations defining the notations and units used for the maps. However, even in this case, standardisation

may become an issue if older plans, which applied different notations, have to be integrated into a digital system.

The fuzziness of plans

Traditional spatial plans were made to be read at a certain scale. Map symbols, line widths or the accuracy of various plan objects were all adapted accordingly. When plans and plan data is digitised, this relationship between scale and plan gets lost. Elements become definite in space. This can lead to a level of accuracy that can be undesirable or even misleading, e.g., if the plan is not supposed to go into such detail.

However, there are different ways of addressing this challenge. For example, the scale can be technically locked, as is the case in Freiburg, Germany, where land use plans are locked at a scale of 1:25,000. The publication of geodata would allow users to inspect the plan at the scale of individual parcels, which is undesirable. In Freiburg's geoportal, the zoom level is restricted accordingly for external users. Another option is to define, e.g., line widths to scale with different zoom levels. Both options entail restrictions on the amount of data that can be downloaded which, in the age of open data, is considered rather regressive. Therefore, in several cases, plans are only available as georeferenced scans, despite the fact that the original source is digital.

Accessibility

A crucial feature of legally binding plans is their accessibility. This includes two aspects: the means by which the plan map can be accessed and whether access demands that members of the public have specific skills. If the digital version is legally binding and probably the only available version of a plan, accessibility becomes more than just a technical issue. For example, municipalities need to offer terminals where people without access to the Internet at home can obtain the material. Another aspect is how a comprehensive form can be accessed, that means how a plan, which in print would fill A0 size, can be comprehended if only section can be shown at the same time on a screen. A screen has stricter physical limitations than a paper plan. When a user needs to understand not only what is binding regarding a specific parcel, but also the surroundings and the intentions of the plan, an appropriate print of the plan might be necessary. Web content accessibility guidelines are typically not that specific.

4.3 Examples of different legal status of digital plans and plan data

De jure legally binding digital plans / plan data

From the DIGIPLAN cases, we identified a few examples of legally binding digital plans and plan data (see overview in Table 4.1). Since 2010, all planning authorities in the Netherlands have been obliged to digitise spatial plans and make them available on a national portal. Plans on the portal are legally binding. The portal represents the current and legally binding state. It is also possible for the municipalities to publish digital plans that are still in development, so citizens have the opportunity to react to the proposals before the official procedure starts. These draft plans have no legally binding status but are used to facilitate the participatory process.

In Portugal, digital plan data drafted by the local councils is published on the online portal "Official Journal of Portugal (DR)", which is the main source of legislation in the country. Once it has been published there, the digital plan data becomes legally binding and can be submitted and published on SNIT, the national geoportal for territorial information.

In Denmark (similar to some parts of France), spatial plans as PDF are legally binding and, in the case of Denmark, published on the central portal, plandata.dk. Geodata is, however, only for reference. The recently published Danish Marine Spatial Plan is a legally binding digital plan. Such a plan is new and was designed to be digital from the start; something for which it was necessary to obtain permission from the Danish Ministry of Justice. Such a procedure may become a blueprint for legally binding digital plans in Denmark in the future.

Table 4.1
Status of municipal land use plans in case countries (2020)

Case	Plan name (English translation)	De jure status	De facto use
Austria (Tyrol)	Flächenwidmungsplan (land use plan)	Formal plan process fully digital, print of digital plan must be accessible in municipal offices	
Austria (Upper Austria, Lower Austria)	Flächenwidmungsplan (land use plan)	Not binding	Upper Austria: Parallel formal process with analogue and digital plan.
Denmark	Kommuneplan (municipal plan)	Centrally stored PDF is legally binding, geodata not binding	Digital plan data from central portal widely used.
Belgium (Wallonia)	Guide communal d'urbanisme (Municipal planning framework)	Not binding	Plan data is used as reference.
France	Plan Local d'Urbanisme (Local land use plan)	Depends, PDF has to be published and can be legally binding.	Digital plan data from central portal becoming more widely used.
Germany (Bavaria, Baden-Württemberg)	Flächennutzungsplan (land use plan)	Not binding	
Italy (Bologna)	Piano Strutturale Comunale (Municipal Structure Plan)	Not binding	The plan and process are fully digital, but it is the final printed analogue version that is legally binding.'
Ireland	City / County Development Plan	Not binding	National authorities use a standardised version.
Lithuania	Municipal Master Plan	Not binding	Provision of digital plan data is stipulated by law but is not legally binding.
Luxembourg	Plan d'aménagement general (land use plan)	Not binding	
Malta	Local Plan	Not binding	
Norway	Kommuneplan (Municipal master plan)	Not binding	
Netherlands	Bestemmingsplannen (Land use plan)	Binding geodata and digital documents	
Portugal	Plano de Urbanização (Urbanisation Plan)	Binding geodata and digital documents	Fully binding, however, some maps might be only available as PDF.
Slovenia	Občinski prostorski načrt (Municipla Spatial Plan)	Not binding	
Switzerland	Nutzungsplan / Plan d'affectation (land use plan)	Not binding	Some data is widely used because of the good quality.

Data refers to the situation in 2020, see also ESPON DIGIPLAN Annex 2: Factsheets

In 2013, Tyrol in Austria implemented a fully digital process for land use plans. The entire process from the beginning of planning to legal validity is digital. Expert statements, objections and decisions are integrated as digital documents. The legal approval of a specific plan change is issued as a PDF. At the same time, a current version of the full plan can be downloaded as PDF and printed.

Some cantons in Switzerland are currently in the process of switching to digital plans. The Canton of Thurgau is changing its laws and processes to achieve legally binding digital plan data. In the Canton of Neuchâtel, the digital and analogue versions of plans will become legally binding with the forthcoming revision of the land use plan.

De-facto binding plan data

Even though digital plan data is not legally binding (de jure), it can achieve an almost legally binding status (de facto) when it is, e.g., used by the authorities in the formal planning process. In Upper Austria, municipalities/planners must submit a digital as well as an analogue version of plans. The analogue version is mainly used to check judicial and plan-related matters, while the digital version is mainly checked for technical (data) issues. However, they are manually compared and rejected if not similar. If the plan is approved, a digital version is published on a central portal. Although the paper plan is the legally binding version, the digital data is lifted to a similar status because of the formal comparison.

In the Canton of Neuchâtel in Switzerland, currently, only the analogue land use plans are legally binding. However, due to the high quality of the data, the digital land use plans from the Canton are used in practice as if they were legally binding. This is also true in several other cases, e.g., France, Lithuania and Bologna, Italy.

The new taxation system in Denmark uses digital plan data to calculate taxes, although the legally binding plans are the PDF versions. This meant it was necessary to improve the quality of the plan data significantly. There are still many concerns about that use. A main critique is that digital plan data does not reflect the complexity of what is actually defined in the plan, for example if there are special regulations which cannot be transferred in a database, but only exist as descriptive text. This can lead to misinterpretations of e.g. building densities.

In general, we can assume that once plan data has been made available, whether it be legally binding or not, it will be used. Usage may not have direct judicial consequences but may potentially impact decisions, for example, future plans or legislation. In Belgium, despite not being legally binding, plan data is considered very high quality information, that can be used as reference.

4.4 Potential and challenges

Potential	Challenges
There are several advantages to having legally binding digital plans. Implemented with a **central portal** and data infrastructure will mean there will be a clear entry point for accessing plan data. This does not exclude the possibility of embedding plan data in other portals, but where to find legally binding data from all planning authorities will be clear. At the same time, it will provide security for users and also a clear responsibility for keeping the data up-to-date. A major advantage is also an increase in transparency and accessibility to the plan process as when the process becomes digital, comments, objections, changes, etc., will be documented.	The challenges have been mentioned above. At first, there may be judicial limitations, which may be related to the general judicial system (how can spatial data be integrated into laws?) and the planning process, e.g., who should publish the plans and how? Depending on the planning system, standardisation, which may be necessary when digitising plans, may be incompatible with requirements for legally binding plans. This may also be a challenge when older plans following old standards are integrated and digitised. The fuzziness of many plans or the direct relation to a specific scale needs to be considered prior to the digitisation process. For example, a general

Finally, the 'legalisation' of digital plans might lead to similar processes and data structures, which in turn will increase accessibility across the planning system.	more strategic plan could be zoomed in to parcel scale, which might be undesirable. Finally, accessibility is important for legally binding information. What systems need to be in place to ensure that plans are accessible? Moreover, is it possible to view the full extent of a plan and an appropriate scale, and therefore understand its implications, on a screen?

4.5 Policy recommendations

Understand the planning system

The countries included in ESPON DIGIPLAN have different planning systems and approaches. Relevant differences include regulations on plan notations, scales, units, etc., the way in which planning instruments are used and structured (the text part, the map part) and the responsibilities of planning authorities (e.g. who is responsible for supervising and adopting plans) – all of which mean very different points for the digitisation of plans. Although there are a range of technical questions which have to be answered, it is important not to forget the planning perspective: how will the plan be used in the future and what demands should it fulfil?

Be wary of the possibility of losing plan information when digitising

Although digital and analogue plans are both capable of conveying relevant information, i.e., related to plan regulations, there are different formats and changing from one to the other may involve a loss of information. In Switzerland, redundant information is removed from the land register to make it easier to understand. Digitisation means that plans can be broken up into small pieces of digital information. If one assumes that the whole is more than the sum of its parts, digitisation may be a problem in that we might lose certain insights into the plan.

Adapt existing plan instruments so they are compatible with digitisation

Can existing plan instruments, as they are currently defined in the different countries, be transformed into fully digital versions? This question should be discussed to avoid a dead end. Traditional plan instruments were developed in the pre-digital era. It may well be necessary to create new or significantly redesigned planning instruments, e.g., coming along with new forms of digital cartography.

Parallel systems may be a working compromise – at least during transition

Several countries have established parallel processes that integrate analogue and digital plans. This could be real parallel systems with two versions which need to be compared, or it could be digital versions which are trimmed to produce analogue plans as well, e.g., by providing specific printing options.

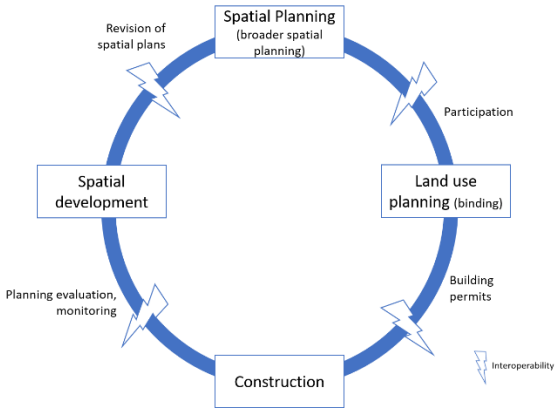
5 Future technical developments and opportunities

5.1 Introduction

The digitisation of plan data and planning processes began years ago and is now in fully underway. In many places, plan data is recorded as geodata with defined standards and is managed in dedicated infrastructure. There is no doubt that the future will bring further technical developments that will lead to new opportunities in the field of digital planning data and digital planning processes. The aim of this thematic paper is to inspire practitioners with ideas on future technical developments. Thus, the thematic paper shows a snapshot of potential future digital developments in terms of work processes and collaboration between actors. It also highlights advanced and innovative technologies and approaches in the digitisation of plan data from the case studies examined. This paper concludes with a discussion of the potential and challenges of the future developments and a recommendation.

Overall, developments are envisaged towards establishing continuous digital process chains. The aim of a digital process chain is to use the same digital and interoperable plan data throughout the process from planning to construction and monitoring. A digital process chain prevents the loss of information between the individual process steps, improves the efficiency of processes and allows plan data to be reused (Figure 5.1). In this paper, technical developments are discussed in the context of these process chains.

Figure 5.1
Digital process chain linking spatial planning, building permits, construction, monitoring, evaluation and plan revision



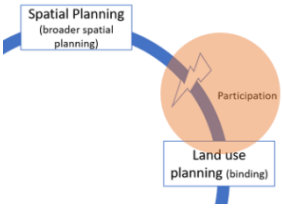
Source: Based on Krause et al. (2020)

5.2 Innovation in spatial planning processes

Implementation of digital process chains

Digital plan data provides the foundation for the development of digital process chains. In order to achieve digital process chains in the context of planning and building, exchange standards are necessary. For this purpose, Germany introduced and defined the standards ‘XPlanung’ and ‘XBau’, which must be implemented. This allows plan data to be digitised so that all stakeholders can continue working with the data without losing information. Thus, digital plan data can be used from the planning stage to the implementation of construction projects (Krause et al., 2020).

Participation and negotiation processes



Improved participatory processes thanks to digitisation and digital plan data

The use of digital plan data and digital tools enables innovative participatory approaches in planning processes. For example, the DIPAS (Digital Participation System) project in Hamburg uses integrated digital systems for citizen participation. Here, digital data is used in addition to participation via the Internet. Citizens can use the data on site in participation processes and work directly with the digital city model. In addition, digital tools such as interactive city models (CityScopes, HCU Hamburg) allow direct digital processing in location-specific contexts. The spatial data and maps enable an objective representation of controversial topics in workshops. In Germany, the project has generated interest in many municipalities, as urban development involves an increasing number of complex participatory processes with many interested parties (Lieven and Schubbe, 2020).

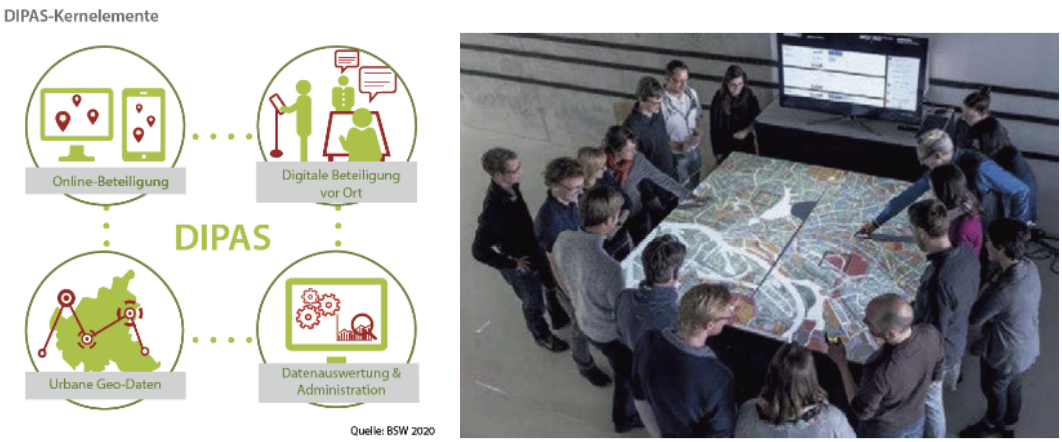


Figure 5.2: Left: The most important elements in the DIPAS project (Top left: online participation, top right: digital participation on site, bottom left: urban geo-data, bottom right: data evaluation and administration). Right: A digital data table and project stakeholders (Lieven and Schubbe, 2020)

Geodesign: an innovative way of negotiating with different stakeholders in spatial planning

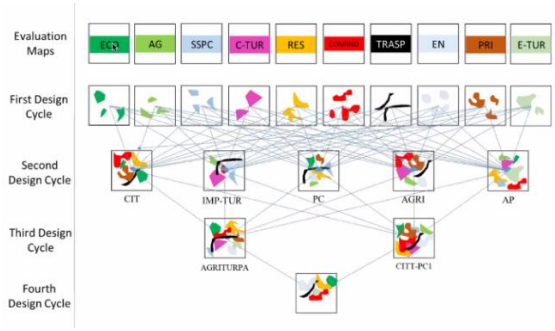


Figure 5.3: Achieving a common vision through design cycles (Ballal, Hrishikesh, 2020)

When considering different stakeholders in planning processes, digital data can be used to facilitate interactive negotiations as part of Geodesign. Geodesign considers the geographical situation as well as individual preferences of stakeholders in project planning or design. It is, therefore, often used in projects in which finding a common denominator among the stakeholders is challenging. In this way, Geodesign supports negotiation between involved parties and facilitates the identification of objectives. The stakeholders' ideas are brought together in a cycle in several joint plans. The process of bringing together the different ideas is repeated until the final objective is found (Figure 5.3). Finally, a map is created which shows the best possible solution in consideration of all interests.

For example, in the municipality of Riehen in the canton of Basel-Stadt in Switzerland, this approach was used to plan the development of an area of around 18 hectares in a participatory process (Gemeinde Riehen and Olloz Ruiz, n.d.). Thus, in 2020, a Web platform and the interactive planning method 'Geodesign' were used to develop visions for future development.

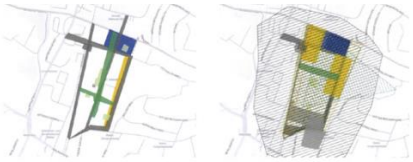
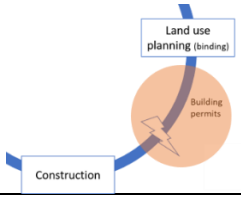


Figure 5.4: Different ideas for the development of Stettenfeld in Riehen (Gemeinde Riehen and Olloz Ruiz, n.d.)

Machine-aided processing of building permits

The digitisation of plan data allows users to consider digital building applications. In the context of digitisation, there are already various examples of building permits being processed digitally or even automatically.



In the Swiss canton of Neuchâtel, building applications have been digitised and managed in the SATAC 2 software since 2016. Access requires a user log-in. The city of Zurich (Amt für Raumentwicklung ZH, 2020) also started the digital submission of building applications in October 2020. Zurich city claims that the e-building application is 'flexible and efficient', 'simple and convenient' and 'transparent and current'. However, the analogue dossier must still be submitted, as the legal basis for a purely digital process flow is still lacking.

In the geoportal (www.pa.org.mt) of Malta, there is a part dedicated to development applications, including planning applications. Anyone with an internet connection can access the Geoserver geoportal. Via a link with a login using a Maltese ID number, the user can then access a website called eTools[14], for which payment is required. eTools allows subscribers to locate the planning application number submitted to the Planning Area Permits Board (formerly the Planning Authority) for the period 1969-1991. The system allows the user to view scans of survey sheets with specific applications plotted manually onto such survey sheets.

[14] https://etools.pa.org.mt/Account/Login?ReturnUrl=%2f

In Sweden, researchers investigated the use of Building Information Modelling (BIM, see also page 38) for digital building applications, and identified the necessary steps for the implementation of automated building permission process. As a result, they expect building permits applicants as a usage group in order to verify their buildings within the existing requirements. Another usage group would be the building permission administrators. Furthermore, a visual representation of the result is crucial in order to understand the details.

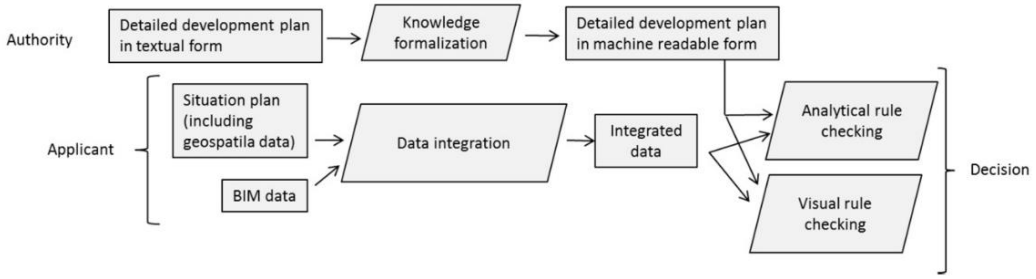
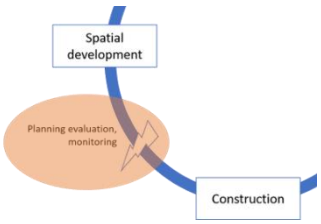


Figure 5.5: Workflow with most important steps in machine-aided building permit process (Olsson et al., 2018)

Evaluation processes

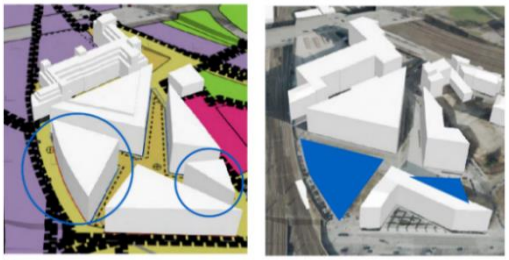
Planning evaluation

With the help of new technology, planning can be more accurately evaluated and monitored.



With the implementation of digital process chains, it becomes possible to use digital plan data in the evaluation of planning. For example, Hamburg is planning to introduce three-dimensional planning shells, that show the three-dimensional existing building rights. This will allow the identification of unused building potential. In this way, the planning can be reviewed and adapted.

Figure 5.6: 3D visualisation of building potential (Krause, Kai-Uwe, 2019)



Digital plan data has also been used to evaluate the conformance of land-use plans with strategic planning in the Canton of Zurich, Switzerland. Specifically, based on digital municipal land-use plans from 1996 and 2016 a study showed that the Cantonal Structure Plan (1995) was very successful in quantitatively limiting the expansion of building zones but a limited active steering capacity regarding their allocation and the regulation of building density (Schmid et al., 2020).

Evaluate locations with digital datasets

In Luxembourg, discussions are currently ongoing about whether digital plan data should be used to calculate the possible areas that can be built-up, which would determine any change in soil sealing. This would be, for example, useful information for the ministry responsible for national planning (Ministry of Energy and Spatial Planning). Another programme uses a solar cadastre to determine the potential of solar energy on the basis of digital plan data and, more precisely, by looking at information about roofs in the local plan (Plan d'aménagement général, PAG) sub-section on geoportal.lu.

Digital datasets are used in Switzerland to locate suitable sites for the production of wind energy. For this purpose, 50 datasets were used to evaluate and assign national interests to different categories in the wind energy concept.

Figure 5.7: Federal government's wind energy interests as a part of the Swiss wind energy concept (Bundesamt für Raumentwicklung ARE, 2020)

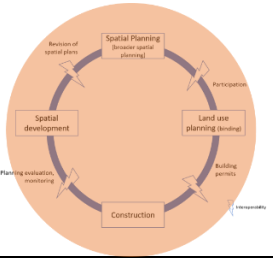
Full sectoral integration

Digital plan data may support integration of sectoral policies. For example, in the Netherlands, digital plan data is available on the national geoportal (www.ruimtelijkeplannen.nl) and is legally binding. The availability of digital planning and environmental data opens up new avenues for policy integration, towards full sectoral integration. The forthcoming Dutch Environment and Planning Act (Omgevingswet) will simplify regulations for projects such as the conversion of former business parks into housing, or the construction of wind farms. With the introduction of the new Environment and Planning Act, spatial plans will be replaced by much more informative and comprehensive environmental plans. New standards will be created for the new environmental plans and new software and portals will be introduced (Geonovum, n.d.). The Bussum municipality has conducted initial experiments and implementations for a demo webpage (Geonovum, n.d.). On this portal, many regulations are bundled in one place and made available. This is a suitable trial for the future comprehensive environmental plans.

5.3 Technological innovations in digitisation of spatial plan data

3D visualisation

By means of technical tools, buildings, land use plans, and entire areas can be represented in three-dimensional models, which can be used in participatory processes to clearly show the planned changes and to support discussions in different phases of the planning process. From the case studies in Switzerland and Germany, it became clear that 3D visualisation will be increasingly used in the future.



During the interviews in Switzerland (Thurgau, Basel-Stadt, Neuchâtel), the future use of 3D visualisation was mentioned several times with a wide range of applications. For example, 3D is used in the city of Zurich for urban planning (Zurich 2050, land use planning), urban development (high-rise model), building design (shadow and visibility, digital competitions), civil engineering (3D underground) as well as in the fields of environment and archaeology.

Figure 5.8: Example of a 3D visualisation (Hürzeler, C, 2018)

Digital plan data enables the creation of three-dimensional objects. In the cities of Zurich (Stadt Zürich, 2021a), Lucerne and St.Gallen (3d.geo-portal.ch/sg) in Switzerland, 3D models already exist in spatial planning. To ensure comparability and interoperability, standards are also needed for 3D data. Raumdatenpool, which operates a portal for the municipalities in the canton of Lucerne, is currently working on generally applicable 3D standards. This leads to a 3D building dataset according to the standards and provide it via the portal (Raumdatenpool, 2020).

Figure 5.9: 3D city model of Lucerne (map.stadtluzern.ch)

In the city of Hamburg in Germany, three-dimensional plan data is used to visualise the regulations of current planning law in the Standard XPlanung. The three-dimensional planning shells can be used to identify unexploited building potential (Krause et al., 2020).

Building Information Modelling (BIM)

Building Information Modelling (BIM) is used in networked planning to model building data. In some places, there are efforts to integrate BIM into land use planning.

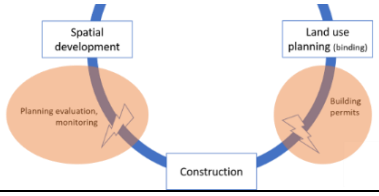


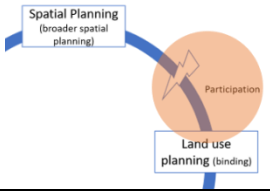
Figure 5.10: Two BIM Models in Google Earth (Olsson et al., 2018).

The use of BIM has also been the subject of research. For example, a study in Sweden (Sun et al., 2019) investigated the use of BIM in spatial planning and found that BIM and GIS can be used to precisely delimit land parcels, cadastral boundaries and visualise complex buildings in more detail.

BIM models can also play a role in digital and automated building permits (Olsson et al., 2018) (see Chapter 5.2).

Augmented Reality (AR) and Virtual Reality (VR)

Virtual reality (VR) creates a virtual world that contains models of objects for simulation in space. However, augmented reality (AR) refers to technology that involves virtual objects being added to real-time images viewed on a mobile phone or by using digital glasses (Dörner, R. et al., 2013).



The Limmattal region in Switzerland has used the 3D model "Limmatstadtmodell" to support urban development. Planned projects can be viewed two-dimensionally on the computer or experienced in three dimensions using virtual reality glasses.

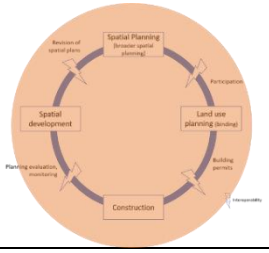
Figure 5.11: Screenshot of the application for viewing the 3D city model of the Limmat region (Limmatstadt AG and Ritz, n.d.)

In Zurich, augmented reality glasses are used in the planning and design process to view future buildings and infrastructure as semi-transparent 3D holograms in the field. The visualisation tool "Holo-Planning" was used for this purpose. With this technology, buildings can be viewed on site before construction begins.

Figure 5.12: On-site augmented reality with digital glasses (Stadt Zürich, 2021b)

Public Data, Current Data and Big Data

Open data, such as Open Street Map (www.openstreetmap.org), is accessible to everyone. This allows authorities operating with tight budgets to use this type of digital data, as external data collection can reduce costs. However, at the same time, data collection is beyond the authorities' control, which results in a certain degree of dependence.



In a geoportal (www.zueriwieneu.ch) of Zurich, the public can directly report damage to infrastructure in real time including its location. The report is forwarded directly to the city of Zurich, which enables the reports to be rectified promptly.

Figure 5.13: Reporting the location of infrastructure damage (graffiti) in the portal.

An ESPON study on “Building the next generation of rehellbalu markiert (und darum wohl verlinkt ist)search on territorial development” showed that big data has great potential for use in land use planning, as it provides information about people's mobility, different security measures or ecological sustainability. This is closely linked to land use, which in turn can be incorporated into land use planning (ESPON, 2019).

5.4 Potential and Challenges

Potential	Challenges
Innovation in spatial planning processes With the implementation of digital process chains, it is possible to reuse the same plan data multiple times. This saves time and resources as data is captured only once and information loss during transformations into different formats can be prevented. In order to achieve efficient process chains, many steps in digitalisation of spatial planning must be taken to create disruption-free processes. The authorities and planning offices involved have to support these steps (e.g. establishing standards for digital plans and metadata), so that they are implemented. In the digitisation of plan data, the question of whether a comprehensive digitisation of all process steps is necessary arises. Can the maximum level of efficiency be achieved by a minimum digitalisation of process steps? This question is difficult to answer in the context of the many different planning systems in Europe. The benefits of digital process chains will only become apparent once they have been fully implemented. For example, planning can only be evaluated efficiently, if the plan data is used all the way through to implementation. The transparency of plan data has already been increased in many places by publishing the digital plan data on the Internet. This has the advantage that the data can be viewed by anyone at any time. However, transparency in planning processes can still be increased by presenting opportunities for participation more clearly via the Internet and by making decision processes transparent.	**Innovation in spatial planning processes** Digital process chains require smooth interaction between all their elements. This requires a great effort of coordination in advance and during implementation. The stakeholders involved must be convinced and must be prepared to implement this approach. A particular challenge is that many different offices, legal bases and persons are involved and have to be coordinated. Finding out which steps are absolutely necessary to implement and which elements can be left to the individual stakeholders is another challenge, particularly if the division of tasks is already regulated by the experts and could possibly be influenced by digitisation. This is why it is very important to examine the legal bases and how they interact. A further challenge is that the processes of spatial planning and digitisation are progressing at different speeds. In the field of digitisation, new systems can be created within two years, whereas the lifetime of a spatial plan may be a decade. This creates the challenge of choosing digital systems that can be used and adapted over a long period of time.
Technological innovations Technological progress holds much potential for digital planning practice. For example, three-dimensional visualisations are still rarely used in planning processes. However, it was mentioned in many interviews in the case studies that this will become increasingly important in the future. The ability to create three-dimensional representations of plans, buildings and entire cities has a lot of potential. Firstly, it means that stakeholders do not have to rely as much on their imagination as they can see the planned changes in front of them in 3D, which supports the discussions in participatory processes. Secondly, these visualisations can be used to evaluate plans to identify unused building potential, which may result in the plans be altered subsequently. As well as having the potential to increase efficiency, digitalisation may also make workplaces more attractive due to more innovative working practices.	**Technological innovations** The variety of technical possibilities can include a wide range of outcomes. It is, therefore, important to define standards in advance so that the data is interoperable and comparable. The challenge is to define the scope of the standards. If the standards apply to a large area with different administrative structures, much data may be lost, as only the most basic data will be standardised and comparable across areas. On the other hand, if standards are applied to a small area with few administrations, it will not be possible to compare the data beyond this area due to different definitions, even though the standards may contain detailed datasets. Therefore, the scope and level of detail of the standards should be carefully considered.

5.5 Policy recommendations

Digitalisation is an ongoing process and evolves with technology

Spatial planning has changed due to digitisation and the use of new technologies. On the one hand, entire processes are being adapted due to new digital possibilities. On the other hand, technical progress can create a basis for the further development of planning processes. Digitisation in planning processes and in planning practice is an ongoing process. For advanced digitisation and the implementation of digital process chains, the standardisation of digital plan data and the interoperability of the data are essential.

Understand the current state and structures

Large **administrative differences** between countries and authorities challenge digitisation in spatial planning. Therefore, it is possible that a centralised approach and implementation of digitisation in spatial planning may be implemented effectively in one country due to a conducive political structure, but that the same approach may encounter many almost insurmountable obstacles in another country with a different structure and distribution of tasks. Therefore, the current state of digitisation in a country and the existing structures and systems need to be well examined in order to guide future development in an effective way.

Define standards and establish metadata

If digital process chains are intended, then this requires careful planning. It is important to find a data basis derived from common data models or standards. In addition, it is also necessary to clarify which regulations apply to data delivery and documentation (metadata). Therefore, it is recommended that **standards** for digital plan data and **metadata** are defined when establishing consistent digital process chains. Furthermore, implementation of the standards should be determined together with the stakeholders. This ensures that not only the use, but also the formatting of the standard is consistent.

Digitisation in planning practice offers many new possibilities and advantages

In addition to the digital approaches in planning practice, there are also various technological tools and methods that can be used in many places. The study revealed that three-dimensional representations of city models, plan data and buildings are being increasingly used in practice. Since the potential and advantages of 3D visualisations are significant, it is recommended that they are implemented. In particular, the 3D visualisation of plans or projects is finding its way into planning and construction processes in many cities and regions. The potential for its use is very wide and is expected to expand even further in the future. There is also the possibility that a 3D representation of buildings with Building Information Modelling (BIM) can find its place in the automation of building permit processes, thereby establishing a digital link between planning and construction. Many of these approaches are also sometimes connected in a digital twin of a city, which is used as an entrance point to all geodata. Finally, stakeholders can be intensively involved in the planning process with the use of virtual or augmented reality.

References

Amt für Raumentwicklung ZH (2020) Digitale Baugesuchseingabe.

Baaner L, Anker HT and Hvingel L (2019) *Stedfæstelse i retsregler i dansk lovgivning [rules on geographical location in Danish law]*. 282, IFRO Report. Frederiksberg: IFRO, University of Copenhagen. Available at: https://static-curis.ku.dk/portal/files/214512813/IFRO_Rapport_282.pdf.

Ballal, Hrishikesh (2020) Keynote on geodesign with digital plan data in spatial planning. In: *unpublished*, online, 25 November 2020.

Bundesamt für Raumentwicklung ARE (2020) Konzept Windenergie. Available at: https://www.are.admin.ch/are/de/home/raumentwicklung-und-raumplanung/strategie-und-planung/konzepte-und-sachplaene/konzepte/konzept-windenergie.html.

Dörner, R., Broll, W., Grimm, P., et al. (2013) *Virtual Und Augmented Reality (VR/AR) Grundlagen Und Methoden Der Virtuellen Und Augmentierten Realität*. Springer.

ESPON (2019) *Building the next generation of research on territorial development. Papers presented at the ESPON Scientific Conference on 14 November 2018 in London, United Kingdom*. Scientific Report. Luxembourg: ESPON EGTC. Available at: https://www.espon.eu/sites/default/files/attachments/ESPON%20Scientific%20Report%202019.pdf (accessed 5 December 2020).

ESPON DIGIPLAN (2021) *DIGIPLAN - Evaluating spatial planning practice with digital plan data*. Final report. ESPON EGTC. Available at: www.espon.eu/digiplan.

Gemeinde Riehen and Olloz Ruiz S (n.d.) Poster: 4.6 Stettenfeld (Riehen BS) – Ein Quartier kommt in Bewegung. Available at: file:///C:/Users/hersperg/AppData/Local/Temp/4-6-stettenfeld-riehen-bs-ein-quartier-kommt-in-bewegung.pdf.

Geonovum (n.d.) Omgevingsplan door een andere bril bezien - Bussum experimenteert met digitaal plan. Available at: https://www.geonovum.nl/over-geonovum/actueel/omgevingsplan-door-een-andere-bril-bezien-bussum-experimenteert-met-digitaal.

Geonovum (n.d.) RO Standaarden - Ruimtelijke Ordening. Available at: https://www.geonovum.nl/geo-standaarden/ro-standaarden-ruimtelijke-ordening.

Gkonos C, Enescu II and Hurni L (2019) Spinning the wheel of design: evaluating geoportal Graphical User Interface adaptations in terms of human-centred design. *International Journal of Cartography* 5(1). Taylor & Francis: 23–43. DOI: 10.1080/23729333.2018.1468726.

Herold F, Henzen C and Bernard L (2016) Using Usability Test Results to create Usability Patterns for Geoportals. *The 19th AGILE international conference on geographic information science* Helsinki, Finland.

Hürzeler, C (2018) 3D-Anwendungen in der Verwaltung. Basel. Available at: https://docplayer.org/110686685-3d-anwendungen-in-der-verwaltung-workshop-3d-informationen-basel-26-juni-2018-christian-huerzeler.html.

INSPIRE (2013) *D2.8.III.4 INSPIRE Data Specification on Land Use – Technical Guidelines, v. 3.0*. 10 December. Thematic Working Group Land Use, European Commission-Joint Research Centre. Available at: https://inspire.ec.europa.eu/file/1521/download?token=rC4oOlLA.

Kanonier A and Weninger K (2019) *Plangenauigkeit - Genauigkeit von planlichen Darstellungen (Plangenauigkeit) im österreichischen Verwaltungsrecht, insb. im Raumordnungsrecht, sowie in der Judikatur des Verfassungsgerichthofes [Accuracy of spatial plan representations in Austrian administrative law]*. Vienna: Vienna UT.

Krause, Kai-Uwe (2019) Die Grenzen von XPlanung?! In: *Dokumentation zur Konferenz XPlanung für die kommunale Praxis im Land Brandenburg*, Potsdam, 27 November 2019, pp. 69–98. Land Brandenburg. Available at: https://mil.brandenburg.de/sixcms/media.php/9/191217_MIL_Konferenz_XPlanung_Dokumentation.pdf.

Krause K-U, Duan X, Horenczuk J, et al. (2020) XPlanung und XBau. *Informationen zur Raumentwicklung* 2020(3): 6–21.

Lieven C and Schubbe N (2020) Digitale Beteiligung am Beispiel von smarticipate und DIPAS. *Informationen zur Raumentwicklung* 2020(3): 66–75.

Limmatstadt AG and Ritz J (n.d.) Digitales 3D-Limmatstadtmodell. Available at: https://www.limmatstadt.ch/standortfoerderung/3d-stadtmodell/.

Nassehi A (2019) *Muster - Theorie Der Digitalen Gesellschaft*. C.H.Beck.

Olsson P-O, Axelsson J, Hooper M, et al. (2018) Automation of Building Permission by Integration of BIM and Geospatial Data. *International Journal of Geo-Information* 7(8): 307.

Raumdatenpool (2020) Projekte RDP 2020. Available at: https://raumdatenpool.ch/Dokumente/Projekte_RDP_2020.pdf.

Schmid FB, Kienast F and Hersperger AM (2020) The compliance of land-use planning with strategic spatial planning – insights from Zurich, Switzerland. *European Planning Studies*. DOI: doi.org/10.1080/09654313.2020.1840522.

Stadt Zürich (2021a) 3D-Stadtmodell. Available at: https://www.stadt-zuerich.ch/ted/de/index/geoz/geodaten_u_plaene/3d_stadtmodell.html.

Stadt Zürich (2021b) HoloPlanning. Available at: https://www.stadt-zuerich.ch/portal/de/index/politik_u_recht/stadtrat/weitere-politikfelder/smartcity/projekte/holoplanning.html.

Co-financed by the European Regional Development Fund

Inspire Policy Making with Territorial Evidence

ESPON 2020

ESPON EGTC
4 rue Erasme, L-1468 Luxembourg
Grand Duchy of Luxembourg
Phone: +352 20 600 280
Email: info@espon.eu
www.espon.eu

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States, the United Kingdom and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

ISBN: 978-2-919795-63-5