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Mapping Accessibility in Norway – A Tool and Method to Register and Survey the Status of Accessibility in Urban Areas and Recreational Areas

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Abstract. The Norwegian mapping authority has developed a standard method and an easy and flexible tool for mapping accessibility mostly for people with limited or no walking abilities in urban and recreational areas. We choose an object-orientated approach where points, lines and polygons represent objects in the environment. All data are stored in a geospatial database and are presented as web map and can be downloaded and analysed using GIS software. By the end of 2021, more than 250 out of 356 municipalities are mapped using that method. The aim of this project is to establish a national standard for mapping of accessibility and to provide a geodatabase that shows the status of accessibility throughout Norway. The data provide a useful tool for national statistics, local planning authorities and private users. The results show that accessibility is still low and Norway and faces many challenges to meet the goals for Universal Design.

Keywords. Accessibility; Barrier Free; Inclusive Design; Regional Management; Diversity

1. Introduction

In 2009, the Norwegian Government issued "Norway universally designed by 2025", an action plan for universal design and increased accessibility [1]. The plan shows how the government will lay the foundation for achieving this goal through different time stipulated targets and measures.

The Norwegian Mapping Authority's (Kartverket) was commissioned to collect and standardize data about the current situation in municipal centers and recreational areas and make these data accessible for statistics. The mapping project started in 2009 as a tool to establish the status of accessibility in Norway. In the beginning, the data should be used essentially for statistical purposes. However, we soon realized that the data could also be used by the districts in planning processes, for raising funds and awareness and for communicating the topic of accessibility within administration and towards the public. Local and regional administrations as well as organisations can apply for funding for mapping. Kartverket trains the project participants in the methodology, provides support during and after mapping and is responsible for data maintenance and data distribution.

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Regular meetings with our users showed that the field mapping tool still needed a better user-interface, updating and more functions. In 2021, we therefore started to develop a new APP based on a simplified data model. The following paper will introduce the overall project and its results as well as introduce you to our new mapping tool.

2. Methodology

We have set up a project design based on a Finnish study [2]. The requirements were that all objects are saved together with their object features and their geographical information and the validation of accessibility should be based on measurable values.

The object had to be representative for the accessibility of an area. The number had to be high enough to get a relevant picture of the situation but not too high to handle the data amount from a national project. The choice fell on the following elements:

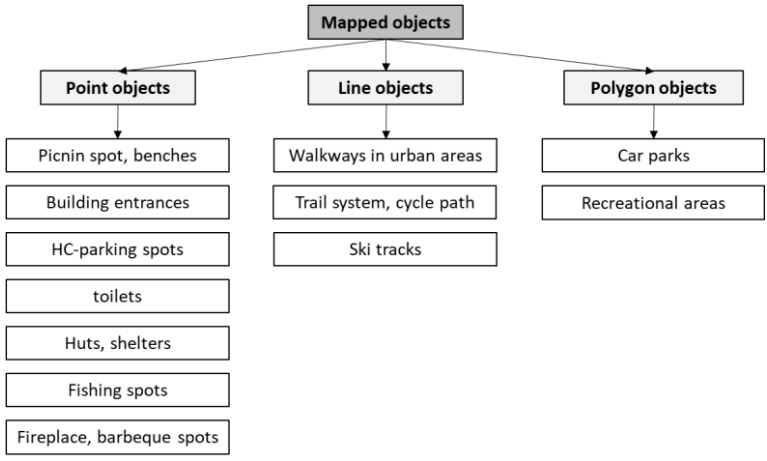

Figure 1. Overview over objects mapped in urban areas and recreational areas.

As main target group, we choose people with limited or no walking abilities. This is the group for which technical standards exist, that contain precise measurable values. We register also characteristics for blind and the partially sighted, but this is not our main focus. The existing technical standards are difficult to use in a practical survey, especially by voluntary field workers.

As a next step, we had to develop guidelines for mapping of objects including a classification for the assessment of accessibility following the Norwegian Standard [3] and the Guidance document for structural engineering [4]. Concerning people with impaired mobility these standards focus on manual wheelchairs as the group with the highest requirements and therefore the key group for Universal Design, hence areas accessible to manual wheelchair users are accessible for all people with limited or no walking abilities. We added the category electrical wheelchair, based on a wheelchair type for outdoor use [5], currently the most common wheelchair type in Norway.

Based on these technical standards we developed a classification scheme for the validation of accessibility for each object. The Classification scheme combines several object features into an overall assessment value for that single object, (e.g. features as

inclination of ramp, door width, height of beam, height of door opener etc. define the accessibility the entrance to a building). Each object is assigned to one of the following categories: accessible, partially accessible, not accessible or not assessed.

Mapping in the field is carried out with an APP that sends data directly into a database from where they are distributed via Geonorge.no, Norway's platform for geodata. Here data can be downloaded, access a Web Map Service or Web Feature Service, as well as yearly reports.

Additionally one can get access to the data via our information page https://www.kartverket.no/en/geodataarbeid/tilgjengelegheit-og-universell-utforming and our open map-client "Norgeskart" http://norgeskart.no/tilgjengelighet/

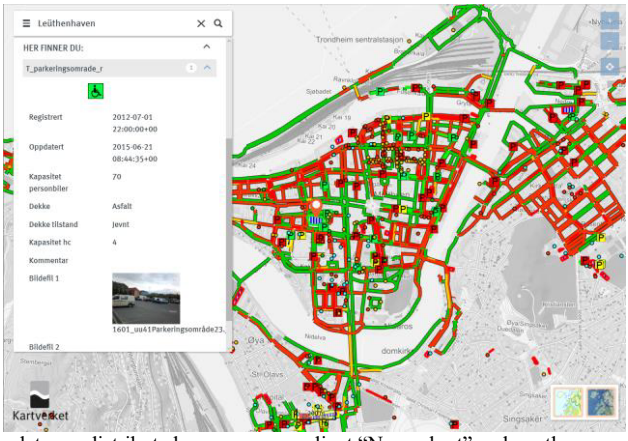

Figure 2. The data are distributed over our map-client "Norgeskart" and are there accessible for the public. (red = not accessible, yellow = partially accessible, green = accessible). By clicking on an object the object features show.

That all data are stored with their spatial information and measured values allows for:

- Spatial analysis, for example availability of accessible accessible-parking-spots in a distance of 50m around the entrances to public health buildings.
- Feature analysis that can determine why certain objects or a group of objects is not accessible.

Additionally storing objects with all their values and geographical information instead of just interpreted or derived information on accessibility has the following advantages:

- Evaluation of accessibility can be adjusted to possible future changes in standards/technology.
- The validation of accessibility can be calculated automatically from the measured values.
- The database can be expanded, for instance with more categories (wheelchairs for outdoor use, walking aid rolator etc.).

The focus on measurable values standardizes the evaluation process and therefore increases the objectivity of the data. That makes it possible to analyze change within a

municipality, sum up data into bigger units like federal or national and compare accessibility status between areas.

3. Results

By the end of 2021 mapping had been completed for urban areas in 172 municipalities and recreational areas in 255 municipalities.

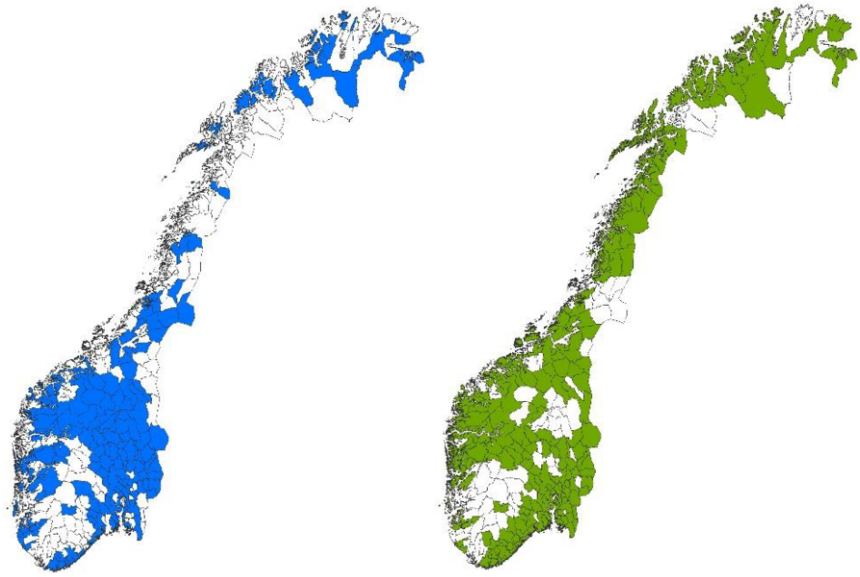

Figure 3. Map of districts with data in the accessibility database from the Norwegian mapping Authority. The map on the left shows data in district centers and towns, the map on the right data in recreational areas.

Analysis of the data shows that the overall accessibility in Norwegian municipalities is rather low. Only 6% of all accessible-parking-spots, 27% of all car parks, 11% of all entrances to public buildings and only 37% of all walkways are accessible for manual wheelchairs.

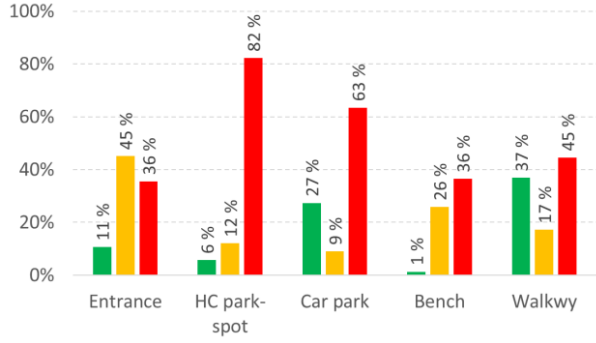

Figure 4. Results for urban areas in Norway (status 2020) for manual wheelchairs. (green = accessible, yellow = partially accessible, red = not accessible)

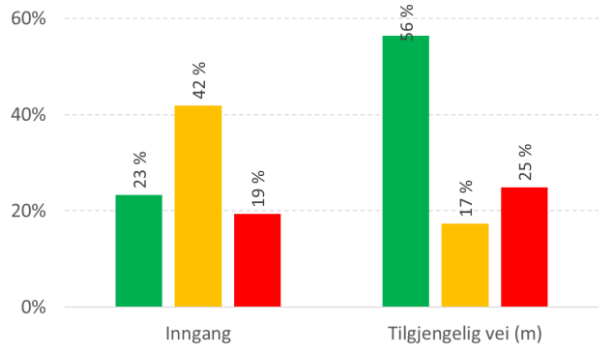

Figure 5. Results for urban areas in Norway (status 2020) for electrical wheelchairs. (green = accessible, yellow = partially accessible, red = not accessible)

The comparison of the results for electrical wheelchair and manual wheelchairs shows a clear difference between both groups for walkways and entrances (Figure 4 and Figure 5). That indicates that gradient and cross-fall of walkways are major problems.

Since all objects are mapped with their features, i.e. length and width for accessible-parking-parking spots gradient and railing for ramps etc. it is possible to precisely evaluate why objects are not accessible. Only 7% of accessible-parking-spots meet the requirements for size and only 29% of car parks have enough designated accessible-parking-spots. Most inaccessible entrances have inaccessible ramps, either manual doors or no accessible door opener or no accessible-parking-spot within 50m. Only few walkways in Norway have tactile or visual guidelines and only a fraction of these have guidelines that are in good condition. The biggest problem with walkways for wheel-chair users is the cross-fall, gradient and width.

Naturally, in recreational areas, some problems are even bigger, as here the surface is often uneven, tracks get washed out after heavy rains and due to Norway's topography the gradient is very rarely below the required value. However, the requirements are also less strict and 44% of all mapped tracks are accessible for electrical wheelchairs but that are often just short sections and not coherent walkways or even round-trips. Of other objects like fishing spots, toilets, huts and accessible-parking-spots less than a quarter is accessible. Here ramps are either lacking, are too steep or lack railing. The threshold of toilets and huts are too high and doors and the inside space is generally too small for wheelchairs. Car parks often have no accessible-parking-spots at all. However, when present accessible-parking-spots are more accessible in recreational area than in urban areas.

4. APP Development

The first generation could be installed on each mobile unit using Android. The APP allows digitizing the objects on a map back-ground, adding object pictures, editing object features and sending data directly to a server. During the years we experienced some problems with the stability of the product and limitations of functionality which necessitated a thorough make-over. The development of the second generation was based

on the user feedback we gather at the debriefings at the end of each mapping season, our experience and technical developments.

The second generation was finished for the summer 2022 mapping season. We went from two separate APPs for urban and recreational areas to one common APP where some objects, e.g. benches are not differentiated after their location. The user is therefore not faced with the decision whether a bench in a park belongs to an urban center or a recreational area and all objects are gathered in a common layer which also makes post-processing and analyses easier.

The APP can now be installed and used on all mobile devices and desktop machines. This allows people to more easily pre- or post-edit their data at the office on a bigger screen and municipal employees in charge of the project can follow the progress in the field easier and in real time. We hope that this change results in more accurate digitalization of objects, a more thorough processing of data and hence a higher data quality. That the App can be used on all operation systems means that users can use their own devices for mapping. This frees funds for actual mapping instead of purchasing extra equipment.

Additionally, we moved many functionalities from the database to the APP. Now the evaluation of accessibility and the assignation of municipality the objects are located in, happens in the APP itself. That gives users more direct feedback whether their accessibility evaluation is according to the technical standards. However, due to upcoming changes in administrative borders and technical standards the same functions have to still be present in the database to allow for massive editing of the whole dataset at once.

The user-interface was stream-lined to be more recognizable for users according to other known map products and we added the opportunity to switch between different colour coding, depending on accessibility or registration status, i.e. mapped this year, older data, error with export etc. (see figure x below). The symbology for the status of accessibility is the same for all data products and therefore easily interpretable for users.

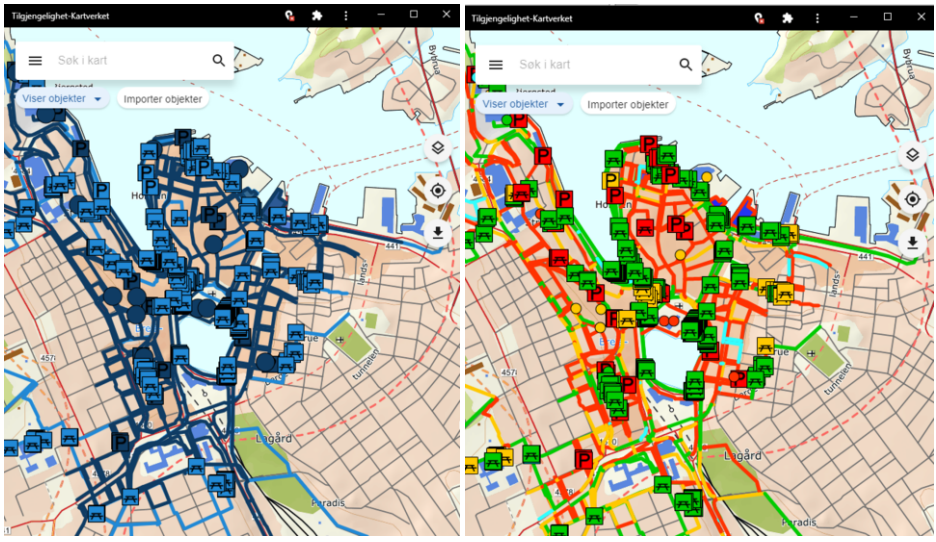

Figure 6. The user surface of the APP during digitizing and editing of objects (left) and during mapping of object features (right).

Another new function is a filter function, where people can use the desktop version to set simple filters, e.g. find all parking spots with no marking, save those filters and share it with other users.

Presently, we are working on adding the possibility to add data that already exist and edit them within the app. That is especially relevant for existing geometry of walkways. In Norway, authorities work towards a unified administration of all geometry for the network of roads, walkways and tracks in order to avoid that the same walkway appears with a different geometry in several databases. Within our project we want to contribute to that effort as well as making mapping easier. Having just one geometry for a walkway additionally allows users to connect the attributes describing accessibility with other attributes like winter service, maintenance status, street lighting of the same walkway.

Another change we are planning to introduce in autumn is the addition of the following objects: information signs, rubbish bins and electrical car loading stations.

5. Conclusion

5.1. Methodology

Even though the method was developed to make the validation as objective and standardized as possible, several factors limit data comparability. The choice of mapped municipalities depended on the municipals interest to take part. Initially, we focused on public buildings and recreational areas in or in the close vicinity of urban centers. However, the final choice of areas and objects is entirely up to the municipalities. That leads to an overrepresentation of interested municipalities in the national statistics.

As the register APP is freely available for administrative users, we have to trust that the method is followed and that all participants feel an obligation towards the data quality and mapping standard requirements of the project. We are also aware of the fact that people perceive and handle technical tools in a very different way and the quality of mapping increases with experience. Under debriefing with field workers we get very different feedback, ranging from rather complicated and difficult to self-explanatory, logical and intuitive. To minimize subjective validation and mapping mistakes we are consistently trying to make the method and the APP as intuitive as possible, require that field workers attend a course before starting to map and offer supplementary training and supervision throughout the whole project. Nevertheless, our experience from several years of fieldwork shows the need to minimize amount of subjective assessments, in order to get reliable results. We therefore calculate validation based on the mapped object features additional to the field workers validation.

5.2. Results

To analyse the results no special skills are required but an understanding of the mapping method is necessary. To be able to interpret the results of data analyses, it is important to have a basic knowledge of the technical standards the accessibility evaluations are based on, i.e. to know which object features are crucial for the assessment of the two target groups and what the critical values are.

When comparing municipalities, it also has to be considered, that some towns are less accessible simply because of old building structure or their topography.

Mapping, keeping the data updated and data use requires a certain continuity in staff responsible for the topic as well as financial support, something municipalities in Norway often do not have.

We are aware that the system is not perfect as it lies in the nature of standardization that complex data are simplified, but we still believe our data will be a valuable contribution to amongst others municipal and recreational planning and development of national statistics.

5.3. Side effects

The mapping project provides a lot of knowledge and awareness about universal design for employees in the municipalities. Often there are several sectors involved in the mapping work. This knowledge and awareness remains in the municipalities even after the survey has been completed. In many municipalities, we see that mapping triggers follow-up projects. The municipalities are not satisfied with the status and work to improve the situation. The information contained in the survey provides good arguments for political discussions and budgeting public and private funds for the future.

These side effects were not planned at project start. However, they show that knowledge and awareness can initiate development. Universal design engages people, and even with very limited resources, it is possible to make progress by working together across sectors and bringing together public and private organizations.

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