D7.1 - Large-Scale Accessibility Assessment Tool v1

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Executive Summary

This work focuses on the design and implementation of the AccesS Large-Scale Accessibility Assessment Tool, a digital platform developed to support the systematic evaluation of accessibility features in buildings and built environments. The tool enables accessibility assessments aligned with established accessibility guidelines while facilitating the implementation of the AccesS accessibility assessment framework developed in Work Package 8 (WP8). By combining simulation-based testing with structured evaluation mechanisms, the platform supports the rigorous analysis of design alternatives and assists stakeholders in identifying potential accessibility barriers during the planning and evaluation stages of the built environment.

A key contribution of this work is the introduction of a quantitative and scalable assessment model that enables structured accessibility evaluation across multiple dimensions. The model is based on a hierarchical scoring framework composed of Disability Types (DT), Assessment Dimensions (AD), and Evaluation Criteria (EC), allowing the systematic representation and evaluation of accessibility requirements. Through the use of weighted scoring mechanisms, the framework produces a multi-dimensional representation of a building's accessibility performance, enabling detailed analysis across aspects such as physical accessibility, usability, safety, comfort, and social inclusion.

To operationalize this assessment methodology, the tool provides a modular architecture that integrates assessment workflows, evaluation templates, scoring mechanisms, and visualization dashboards. The platform supports the creation and management of accessibility assessments, enabling users to define evaluation criteria, perform structured analyses, and visualize results through interactive reporting interfaces. These capabilities facilitate large-scale assessment processes and allow the systematic comparison of accessibility performance across different building configurations and design alternatives.

Ultimately, the Large-Scale Accessibility Assessment Tool constitutes a key component of the AccesS digital ecosystem. By enabling scalable, structured, and data-driven accessibility evaluations, the tool contributes to the early identification of accessibility barriers and supports the development of safer, more inclusive, and accessible built environments.

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List of Terms and Definitions

Terms	Definitions
Accessibility	The quality of being easily reached, entered, or used by people who have a disability
End-users need	Any need that has been expressed by first responders or similar profession, public or private.
Disability	Long-term physical, mental, intellectual, or sensory impairments that hinder full societal participation
Disability Types	Mine disability types include: Physical: Affects mobility, stamina, or dexterity (e.g., cerebral palsy, amputations, spinal cord injuries). Sensory: Affects senses, such as vision loss (blindness, low vision) or auditory impairment (deafness, hard of hearing). Intellectual/Cognitive: Affects learning, adaptive behavior, and cognitive functioning (e.g., Down syndrome, learning disabilities). Mental Health/Psychiatric: Conditions impacting day-to-day functioning (e.g., depression, anxiety, schizophrenia). Neurological: Conditions affecting the nervous system (e.g., autism spectrum disorder, epilepsy, Alzheimer's). Chronic Health/Immunological: Conditions affecting energy and health (e.g., HIV/AIDS, asthma, diabetes).
Design for All approach	An approach to designing products, services, and environments so they are accessible and usable by the widest possible range of people, regardless of age, ability, or background, without the need for adaptation.
New European Bauhaus (NEB)	An initiative by the European Commission merging sustainability with aesthetics and inclusion to transform living spaces, supporting the European Green Deal. It focuses on making communities more beautiful, sustainable, and inclusive by blending, for example, circularity with design to improve everyday life and fight climate change.

List of Acronyms and Abbreviations

Term	Description
API	Application Programming Interface
AD	Assessment Dimensions
CIS	Cumulative Impact Score
DT	Disability Types
EC	Evaluation Criteria
EN	European standard
GUI	Graphical User Interface
IAM	Identity and Access Management
ImpoAD	Importance Value of Assessment Dimension
ImpoDT	Importance Value of Type
JWT	JSON Web Token
NEB	New European Bauhaus
OBS	Overall Building Score
ODM	Object Data Modeling
ROPC	Resource Owner Password Credentials
TIS	Total Impact Score
UI	User Interface
WP	Work Package

1 Introduction

In recent years, significant progress has been made toward creating more inclusive and sustainable built environments. Guided by the principles of Design for All and universal accessibility, improving accessibility for persons with disabilities and older individuals has become a key priority in urban planning and architectural design. These efforts have contributed to the gradual removal of architectural barriers and have promoted easier access to public spaces, buildings, and transportation systems.

Despite the advances achieved in accessible infrastructure, the availability and adoption of digital tools that can effectively support accessibility assessment and decision-making during the design and evaluation phases remain limited. Technology offers significant opportunities to strengthen inclusion by enabling designers, engineers, and urban planners to better understand and address the diverse needs of users with varying abilities. Such tools can facilitate systematic accessibility evaluations, helping stakeholders anticipate potential barriers and integrate accessibility considerations early in the design process rather than addressing them retrospectively.

In this context, the present work introduces the AccesS Large-Scale Accessibility Assessment Tool, a digital platform designed to support the systematic evaluation of accessibility features in buildings and built environments. The tool enables structured accessibility assessments aligned with established guidelines, while supporting the analysis of multiple accessibility dimensions such as physical accessibility, usability, safety, comfort, and social inclusion. Through a scalable assessment framework and a structured scoring methodology, the platform provides a comprehensive view of accessibility performance across different evaluation criteria.

This work forms part of Task 7.1 - Large-Scale Accessibility Assessment (T7.1) of the AccesS project, which aims to develop the AccesS accessibility assessment tool and integrate it within the broader AccesS digital ecosystem. The task focuses on enabling systematic, scalable, and technology-supported accessibility evaluations, supporting the implementation of the AccesS accessibility assessment framework and facilitating data-driven analysis of accessibility conditions in built environments.

1.1 Scope and objectives of the deliverable

The objective of this deliverable is to present the design and implementation of the AccesS Large-Scale Accessibility Assessment Tool, developed within Task 7.1 of the AccesS project. The tool enables the systematic evaluation of accessibility features in buildings and built environments according to established accessibility guidelines and the assessment framework defined within the project. This deliverable describes the accessibility assessment approach implemented in the tool, including the hierarchical evaluation model, as well as the architecture and functionality of the software platform.

1.2 Structure of the deliverable

The present document is organised to provide both the conceptual background and the technical details necessary to understand the design and implementation of the AccesS Large-Scale Accessibility Assessment Tool and its associated services. Following this introductory chapter, this report includes the following chapters:

- **Chapter 2** provides background information on accessibility assessment in built environments and highlights the need for digital tools that support systematic accessibility evaluation.
- **Chapter 3** presents the accessibility assessment approach implemented in the tool, including the hierarchical assessment model based on Disability Types, Assessment Dimensions, and Evaluation Criteria.

- **Chapter 4** describes the implementation of the AccesS Large-Scale Accessibility Assessment Tool, including its technological stack, system components, user interface, and assessment workflows.
- **Chapter 5** concludes the document by summarizing the main outcomes and remarks of this Report.

1.3 Relation to other Tasks and Deliverables

This deliverable reports the work carried out in Task 7.1 – Large-Scale Accessibility Assessment of Work Package 7 (WP7). The work contributes to the development of the AccesS digital toolbox by implementing the accessibility assessment capabilities required for evaluating accessibility features in built environments. The accessibility assessment methodology implemented in the tool is aligned with the broader accessibility assessment framework developed in WP8 - Development and Harmonization of Accessibility Assessment Scheme, while the implemented services support interoperability with other components of the AccesS Suite. The results presented in this deliverable also support subsequent activities related to system validation, and integration within the AccesS platform (WP7) as well as project demonstration and evaluation activities (WP10-WP12).

2 Background

2.1 Accessibility in Built Environments

Ensuring accessibility in the built environment has become a central objective in contemporary urban planning and building design [2]. The adoption of the Design for All approach promotes environments that can be used by all individuals, regardless of age, physical ability, or functional limitations. This concept is closely aligned with the principles of universal design, which advocate for the creation of environments and products that are usable by the widest possible range of people without the need for adaptation or specialized solutions [11], [5].

Over the past decades, significant efforts have been made to remove architectural barriers and improve access to buildings, public spaces, and transportation infrastructure. These efforts have been supported by international policies and accessibility frameworks that emphasize equal access to the built environment as a fundamental right for persons with disabilities and other vulnerable groups [4], [12].

Accessibility in the built environment encompasses a wide range of aspects, including physical access to buildings, safe and intuitive navigation of spaces, usability of facilities, and overall comfort for diverse user groups. Contemporary accessibility frameworks emphasize that accessible environments should address not only physical barriers but also usability, safety, and the interaction between users and the spatial environment [5], [11].

In the context of smart cities and sustainable urban development, accessibility considerations are increasingly integrated into the design and operation of buildings and infrastructure. Human-centered urban design approaches highlight the importance of designing cities that accommodate diverse user needs and enable inclusive access to urban services and public spaces [2]. These efforts support the broader goal of creating inclusive communities where all individuals can interact with their environment independently and safely [12].

2.2 Accessibility Standards and Assessment Practices

The design of accessible buildings and infrastructures is typically guided by national regulations and European/international standards that define accessibility requirements and design principles. These standards aim to ensure that buildings and public spaces provide adequate access, usability, and safety to individuals with diverse abilities. Examples include international and European accessibility standards and guidelines (i.e. EN 17210:2021 Accessibility and usability of the built environment, under revision, New European Bauhaus (NEB) Self-Assessment Method) that address elements such as entrances, circulation paths, elevators, signage, and other essential building features [9], [10], [11].

Despite the existence of such standards, accessibility evaluation practices are often fragmented and vary across regions and regulatory frameworks. Accessibility assessments are commonly performed through manual inspections, checklists, or expert evaluations during the design or post-construction phases. While these approaches can identify accessibility barriers, they often rely on qualitative assessments and may lack a systematic methodology for evaluating accessibility performance across multiple dimensions [5].

2.3 Towards Comprehensive Accessibility Assessment

Accessibility in the built environment extends beyond the removal of physical barriers. Contemporary approaches increasingly recognize the importance of addressing additional dimensions such as

usability, safety, comfort, and social inclusion. These aspects contribute to creating environments that are not only accessible but also supportive of diverse user needs and experiences [8].

The AccesS project aims to contribute to this direction by promoting a comprehensive accessibility assessment approach that considers multiple dimensions of accessibility within a unified evaluation framework. Such an approach enables the systematic assessment of accessibility conditions in buildings and infrastructure, supporting the identification of barriers and the development of more inclusive design solutions. The accessibility assessment scheme developed within the project introduces structured criteria and performance indicators that facilitate consistent and measurable evaluation of accessibility features.

2.4 Digital Tools for Accessibility Assessment

While significant progress has been achieved in improving accessibility standards and guidelines for the built environment, the availability of digital tools capable of supporting systematic accessibility assessment remains relatively limited. Accessibility evaluations are often conducted through manual inspections, checklist-based approaches, or expert-driven audits, which may be time-consuming and difficult to scale across complex built environments. Despite the growing emphasis on inclusive design and universal accessibility, several studies highlight the need for more structured tools and methodologies capable of supporting professionals in embedding accessibility considerations throughout the design and evaluation processes [1], [4].

Research has also shown that many buildings and urban spaces continue to present accessibility barriers despite the existence of accessibility regulations and universal design guidelines. These limitations are often related to the insufficient integration of accessibility considerations during the early design stages and the lack of systematic evaluation mechanisms capable of capturing the diverse needs of users with different physical, sensory, and cognitive abilities [5], [6].

Recent research efforts have therefore explored the development of structured evaluation methods and audit-based tools that support evidence-based decision-making in the design and management of accessible environments. These approaches aim to capture both objective design characteristics and subjective user experiences, providing valuable insights for identifying accessibility barriers and prioritizing design improvements within buildings and urban spaces [7].

In parallel, urban design research has emphasized the importance of adopting human-centered and inclusive approaches in the planning of built environments. Such approaches recognize that accessibility extends beyond physical infrastructure and includes broader aspects such as usability, comfort, safety, and social inclusion within public spaces [2], [3].

Within this context, digital technologies and data-driven platforms offer new opportunities for improving accessibility assessment and supporting more systematic evaluation processes. The integration of structured assessment models and digital tools can enable large-scale analysis of accessibility conditions across buildings and urban environments, facilitating more informed design and planning decisions.

In response to this need, the AccesS project introduces a set of digital innovations integrated within the AccesS Suite, a comprehensive platform designed to support the design, evaluation, and operation of accessible and sustainable built environments. Among these components, the Large-Scale Accessibility Assessment Tool plays a key role in enabling the systematic evaluation of accessibility features in buildings and infrastructure according to the accessibility assessment framework developed within the project. The tool provides mechanisms for structured evaluation, scoring, and analysis of accessibility conditions, supporting stakeholders in identifying barriers and improving accessibility in the built environment.

3 Accessibility Assessment Approach

The AccesS Large-Scale Accessibility Assessment Tool implements a structured methodology for evaluating accessibility in buildings and built environments. The methodology builds upon the comprehensive accessibility assessment framework developed in Work Package 8 (WP8), particularly within Task T8.1, which defines the structured accessibility assessment scheme, including measurable criteria, guidelines, and performance indicators for the built environment. The tool operationalizes this framework by translating the conceptual assessment scheme into a scalable digital evaluation mechanism capable of supporting large-scale accessibility assessments.

3.1 Overview of the AccesS Accessibility Assessment Methodology

The AccesS Accessibility Assessment methodology adopts a multi-layered evaluation approach designed to capture the complexity and diversity of accessibility requirements across different user groups and building contexts. As accessibility is considered a multidimensional concept that extends beyond the removal of physical barriers and encompasses aspects such as usability, safety, comfort, and social inclusion, consequently, the assessment framework integrates multiple evaluation perspectives to provide a holistic representation of accessibility performance within the built environment. To facilitate this, the methodology relies on a hierarchical evaluation structure that links user needs with measurable accessibility indicators. The assessment model combines different accessibility perspectives with a quantitative scoring mechanism that enables the structured evaluation of accessibility performance across multiple criteria. Weighted scoring allows the relative importance of different accessibility aspects to be considered, enabling the assessment process to be adapted to specific building functions, demographic contexts, or policy priorities.

Within the Large-Scale Accessibility Assessment Tool, this methodology is implemented through a structured workflow that allows evaluators to define assessment parameters, evaluate accessibility criteria, and generate quantitative accessibility scores.

3.2 Hierarchical Accessibility Assessment Model

The AccesS Accessibility Assessment model approach implemented in the tool follows a hierarchical model that organizes accessibility evaluation into multiple analytical layers. This hierarchical structure enables the systematic decomposition of accessibility requirements into progressively more detailed elements, facilitating structured analysis and quantitative evaluation.

The model is composed of three primary layers:

- Disability Types (DT)
- Assessment Dimensions (AD)
- Evaluation Criteria (EC)

These layers form a structured hierarchy in which high-level user perspectives are progressively translated into specific and measurable accessibility requirements.

3.2.1 Disability Types

At the first level of the model, Disability Types (DT) represent categories of users whose interaction with the built environment may be affected by functional limitations or contextual barriers. Accessibility is not experienced uniformly, and therefore the assessment framework considers multiple disability profiles to ensure that the evaluation process reflects the diversity of user needs.

The model includes a broad spectrum of disability categories covering mobility disabilities, sensory limitations, cognitive and neurodiverse conditions, communication disabilities, and other contextual accessibility challenges. Examples include mobility, visual, hearing and cognitive disabilities; neurodiverse, mental health and chronic health conditions; age-related, speech and communication limitations; as well as temporary and situational disabilities.

Each disability type can be assigned a specific importance weight, reflecting its relevance to the context of the assessment. For example, certain disability profiles may receive higher importance in environments such as healthcare facilities, educational buildings, or public service infrastructures. This weighting mechanism enables the model to adapt to different demographic contexts and functional requirements while maintaining a consistent evaluation structure.

3.2.2 Assessment Dimensions

The second level of the hierarchy consists of Assessment Dimensions (AD) which represent the functional domains through which accessibility is evaluated. Each dimension corresponds to a specific aspect of building accessibility or user interaction with the environment. These dimensions organize accessibility requirements into structured categories that reflect different elements of building design and operation.

Examples of assessment dimensions include physical accessibility, circulation and navigation, communication and information accessibility, safety and emergency response, environmental comfort, and user interaction with building services. Each dimension captures a distinct area of accessibility performance and provides a framework for organizing related evaluation criteria.

Within the model, each assessment dimension may be associated with different levels of importance depending on the disability type under consideration. This enables the evaluation process to account for the fact that certain accessibility features may be more critical for specific user groups.

3.2.3 Evaluation Criteria

Finally, Evaluation Criteria (EC) represent the most detailed level of the assessment framework. These criteria correspond to specific, measurable accessibility features that can be evaluated during the assessment process. Each criterion defines a particular condition, design element, or operational feature that contributes to accessibility performance.

Examples of evaluation criteria include the presence of accessible entrances, the availability of ramps or elevators, tactile guidance systems for visually impaired users, visual alarms for individuals with hearing loss, accessible signage and information systems, and emergency evacuation mechanisms designed to accommodate diverse user needs.

Each evaluation criterion is assessed using a standardized scoring scale that reflects the degree to which the accessibility requirement is satisfied. Scores typically range from non-compliance (0) to exemplary implementation (5), enabling the quantification of accessibility performance across different criteria.

Disability Types, Assessment Dimensions, and Evaluation Criteria form a structured evaluation framework that links user needs with measurable building characteristics. This structure enables the AccesS Large-Scale Accessibility Assessment Tool to perform systematic accessibility evaluations while maintaining flexibility to adapt to different building types, user populations, and assessment objectives.

4 Implementation of the AccesS Large-Scale Accessibility Assessment Tool

The AccesS Large-Scale Accessibility Assessment Tool provides a Graphical User Interface (GUI) to support a user-friendly and structured process for creating and managing accessibility assessments. To this end, a modern web-based interface has been developed, enabling users to interact with the accessibility assessment framework through an intuitive and accessible environment.

The interface has been designed as part of the broader AccesS digital ecosystem and is deployed online to ensure easy access and integration with the other components of the AccesS platform. Through this interface, authorized users can create, configure, execute, and manage accessibility assessments in a systematic manner. The tool is accessible through the AccesS platform at https://euproject-access-forth.eu/uaa.

The development of this software addresses several technical and methodological objectives such as:

- **Accessibility and Usability:** The platform provides a clear, intuitive, and responsive user interface that supports the creation and management of accessibility assessments.
- **Data Consistency and Integration:** The interface ensures seamless communication with the underlying database that stores the information related to accessibility assessments. Built-in validation mechanisms verify the correctness and completeness of submitted data, helping users create valid and consistent assessment entries while preventing potential errors during the evaluation process.
- **Security and Interoperability:** The access to the platform is controlled through an authentication and role-based authorization mechanism. The system integrates with Keycloak[1] for identity and access management, ensuring secure authentication and alignment with the unified security framework adopted within the AccesS project.
- **Scalability and Sustainability:** The system is implemented using modern web technologies, including the Next.js[2] framework, which provides high performance, maintainability, and support for future extensions. This technological choice facilitates the long-term sustainability of the platform and allows the system to evolve as additional functionalities are introduced within the AccesS Suite.

The following sections describe the technological architecture of the platform, the main system components, and the user interface functionalities that support the accessibility assessment workflow.

4.1 Core System Components Overview

The AccesS Large-Scale Accessibility Assessment Tool has been implemented as a web-based software platform designed to support scalable and structured accessibility evaluations. The system architecture follows a modular design that separates the graphical user interface, backend services, and data management components. This architecture enables efficient communication between system modules while ensuring flexibility, maintainability, and extensibility of the platform.

At the core of the system, the graphical user interface provides users with the necessary tools to create and manage accessibility assessments, configure evaluation templates, and analyze assessment results. The interface communicates with backend services responsible for handling data storage,

[1] https://www.keycloak.org/

[2] https://nextjs.org/

processing evaluation logic, and managing accessibility-related entities such as assessment templates, evaluation criteria, and scoring parameters.

The communication between the frontend interface and the backend services is achieved through REST-based APIs, enabling structured data exchange and ensuring interoperability with other components of the AccesS digital ecosystem. This approach allows the platform to integrate seamlessly with the broader AccesS Suite while supporting future system extensions.

In addition, the platform incorporates authentication and authorization mechanisms that ensure secure access to the system. Through role-based access control and identity management services, the platform restricts access to authorized users and supports controlled interaction with the accessibility assessment functionalities.

The following subsections present the main technological components of the system, including the design approach, the frontend implementation, the communication mechanisms with backend services, and the authentication framework used to manage user access.

4.1.1 Design Process

The design and development of the AccesS Large-Scale Accessibility Assessment Tool followed an iterative and collaborative process that enabled continuous refinement of the system design and ensured that the implemented functionalities effectively support the accessibility assessment methodology developed within the project.

During the design phase, particular attention was given to aligning the software platform with the accessibility assessment framework defined in WP8. The theoretical model introduced in WP8, including the hierarchical structure based on Disability Types (DT), Assessment Dimensions (AD), and Evaluation Criteria (EC), constituted the conceptual foundation upon which the software architecture and data structures of the tool were developed. As a result, the system was designed to support the structured representation of these elements and to facilitate the implementation of the scoring methodology associated with the accessibility assessment process.

The development process involved multiple design iterations in which the technical implementation was continuously evaluated and refined in collaboration with the partners responsible for the methodological aspects of the framework. Feedback obtained during these iterations allowed the development team to adapt the user interface, data models, and assessment workflows to better reflect the requirements of the accessibility evaluation approach.

This iterative and collaborative design strategy ensured that the resulting platform accurately operationalizes the accessibility assessment framework while providing a practical and user-friendly environment for conducting large-scale accessibility evaluations within the AccesS ecosystem.

4.1.2 Frontend: Next.js

The graphical user interface of the AccesS Large-Scale Accessibility Assessment Tool has been implemented as a web application using the Next.js[3] framework, a modern React-based technology for building interactive and scalable web interfaces. The framework supports a component-based architecture, enabling the development of modular and reusable interface elements that facilitate the implementation of the assessment workflows, including assessment creation, template configuration, and visualization of results. The use of Next.js provides a flexible and maintainable frontend architecture, allowing for the integration of the authentication mechanisms utilized in the AccesS family projects, ensuring high performance and supporting the future evolution of the platform within the AccesS digital ecosystem.

[3] https://nextjs.org/

4.1.3 Backend Communication

Communication between the frontend interface and the backend services is achieved through a set of RESTful API endpoints. The frontend application performs API calls to the backend in order to retrieve, create, update, and manage the data associated with accessibility assessments and their related entities.

Data exchange between the system components is performed using structured JSON messages, enabling efficient and standardized communication between the user interface and the backend services. Through this mechanism, the platform supports the management of core entities such as assessments, templates, evaluation criteria, and scoring parameters.

This architecture ensures a clear separation between the presentation layer and the backend services, while enabling interoperability with the broader AccesS digital ecosystem.

4.1.4 Authentication and Role Management

Access to the AccesS Large-Scale Accessibility Assessment Tool is managed through the integration of the Keycloak[4] identity and access management system, which is used across the AccesS digital ecosystem. Keycloak is an open-source identity management platform that provides centralized authentication, user management, and secure access control for web-based applications.

Through this integration, users authenticate using centralized credentials that enable secure access to the platform and other components of the AccesS Suite. The system also supports role-based access control, allowing different levels of permissions to be assigned to users depending on their responsibilities within the platform.

This mechanism ensures secure user authentication, controlled access to system functionalities, and consistent identity management across the different components of the AccesS digital ecosystem.

4.2 User Interface Overview

The AccesS Large-Scale Accessibility Assessment Tool provides a web-based graphical user interface that supports the creation, management, and execution of accessibility assessments. The interface has been designed to guide users through the different stages of the assessment process, allowing them to configure evaluation parameters, manage assessment templates, and analyse accessibility results within a structured environment.

The following subsections present the main components of the user interface, including the dashboard used for navigating the platform, the workflow for creating accessibility assessments, the configuration of assessment templates, and the execution of evaluation processes.

4.2.1 Core Assessment Entities

To support the practical use of the theoretical model within the software environment, several core system entities were introduced. These entities encapsulate the theoretical components of the accessibility assessment model and enable users to configure and manage assessments through the graphical user interface.

The following subsections describe the main entities used within the system, including Assessments and Assessment Templates, which form the basis of the accessibility evaluation workflow.

[4] https://www.keycloak.org/

4.2.1.1 Assessments

The Assessment entity represents the central data structure used for performing an accessibility evaluation of a building or built environment. An assessment contains all the information required to configure and execute an accessibility evaluation according to the framework defined in WP8.

Each assessment incorporates the hierarchical elements of the accessibility model, including Disability Types (DT), Assessment Dimensions (AD), and Evaluation Criteria (EC), along with their corresponding weights defined by the user. In addition, the assessment includes a unique name assigned by the user and optional descriptive information related to the evaluated building or environment.

This information enables users to organize and differentiate multiple assessments, allowing them to categorize evaluation scenarios and associate descriptive metadata with each assessment instance. Within the platform, assessments are divided into two categories:

- **Draft Assessments**: Draft assessments represent evaluation configurations that have been created but have not yet been scored. These assessments contain the structural configuration of the accessibility model and the associated weighting parameters but do not yet include evaluation results.
- **Scored Assessments**: Scored assessments correspond to assessments for which at least one scoring process has been performed within the platform. These assessments contain the complete scoring history as well as the calculated results and accessibility metrics derived from the evaluation methodology defined in WP8. The scoring process and the corresponding evaluation outputs are further described in the following sections of this chapter.

4.2.1.2 Assessment Templates

Creating a new accessibility assessment requires the configuration of a set of weighting parameters associated with the hierarchical components of the accessibility model. These include weights assigned to DT, AD, and EC.

More specifically, the configuration process involves defining weights for five (5) Disability Types. For each type, five (5) Assessment Dimensions are defined, resulting in a total of twenty-five (25) Assessment Dimension weights. Furthermore, each Assessment Dimension contains a set of Evaluation Criteria, resulting in a total of sixty (60) Evaluation Criteria weights distributed across the different Disability Types and Assessment Dimensions.

In a fully customized assessment configuration, users may therefore need to define up to eighty (80) weighting parameters, making the creation of assessments potentially time-consuming.

To simplify this process and improve usability, the platform introduces the concept of Assessment Templates. These templates allow users to define configurations that can serve as a starting point for creating new accessibility assessments.

An assessment template contains the structural configuration of the accessibility model, including weights for Disability Types, Assessment Dimensions, and Evaluation Criteria. Users can utilize these templates to quickly generate new assessments and subsequently adjust only the parameters that require modification. This functionality reduces significantly the effort required to configure assessments while promoting consistency across multiple evaluation scenarios. It also allows the users to create a custom pipeline for creating accessibility assessments for different buildings.

4.2.2 Assessment Creation Workflow

The AccesS Large-Scale Accessibility Assessment Tool provides a structured workflow that guides users through the process of creating a new accessibility assessment. The workflow is designed to reflect the

hierarchical accessibility assessment model introduced in WP8, while ensuring that all required information is entered in a consistent and valid manner.

The assessment creation process is organized into three sequential steps. Each step corresponds to a specific level of the accessibility evaluation model and must be completed before the user can proceed to the next stage. This approach ensures that the assessment configuration follows the correct logical structure and prevents inconsistencies in the definition of evaluation parameters.

The system incorporates validation mechanisms that continuously verify the correctness of the entered information. Mandatory fields must be completed before moving to the next step, while incorrect or incomplete values are clearly highlighted in the interface. In cases where errors occur, explanatory messages are displayed to guide the user in correcting the identified issues.

By enforcing this sequential workflow, the platform prevents users from progressing with incomplete or inconsistent configurations. This design minimizes the risk of errors and avoids situations in which users would need to revisit earlier steps after entering a large amount of information.

In addition to creating an assessment from scratch, the platform also allows users to initiate the assessment creation process using an existing assessment template (Figure 1). When a template is selected, the system automatically populates the assessment configuration with the predefined parameters stored in the template, including the corresponding weights for Disability Types, Assessment Dimensions, and Evaluation Criteria. Users can then proceed through the assessment creation workflow in the same way as when creating a new assessment manually. The pre-filled values remain fully editable, allowing users to modify any parameters as needed to adapt the assessment to the specific characteristics of the evaluated building or environment. This functionality significantly reduces the time required to configure assessments while maintaining flexibility in the evaluation process.

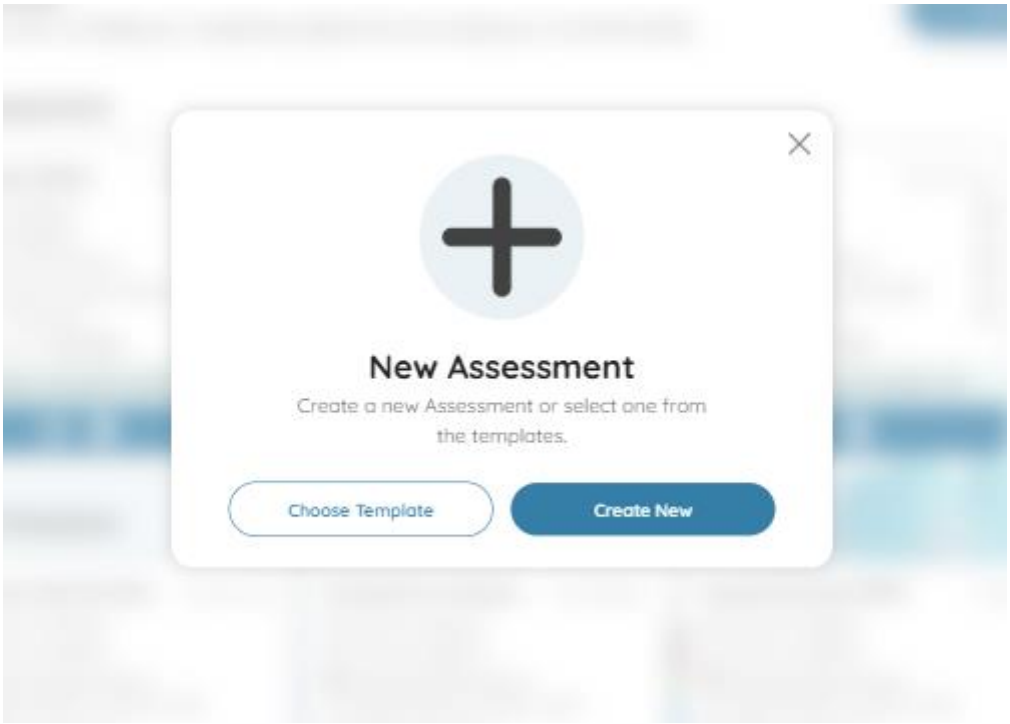


Figure 1. Option to create a new Assessment or choose an existing Template

The following subsections describe the three stages of the assessment creation process.

4.2.2.1 General Information Stage

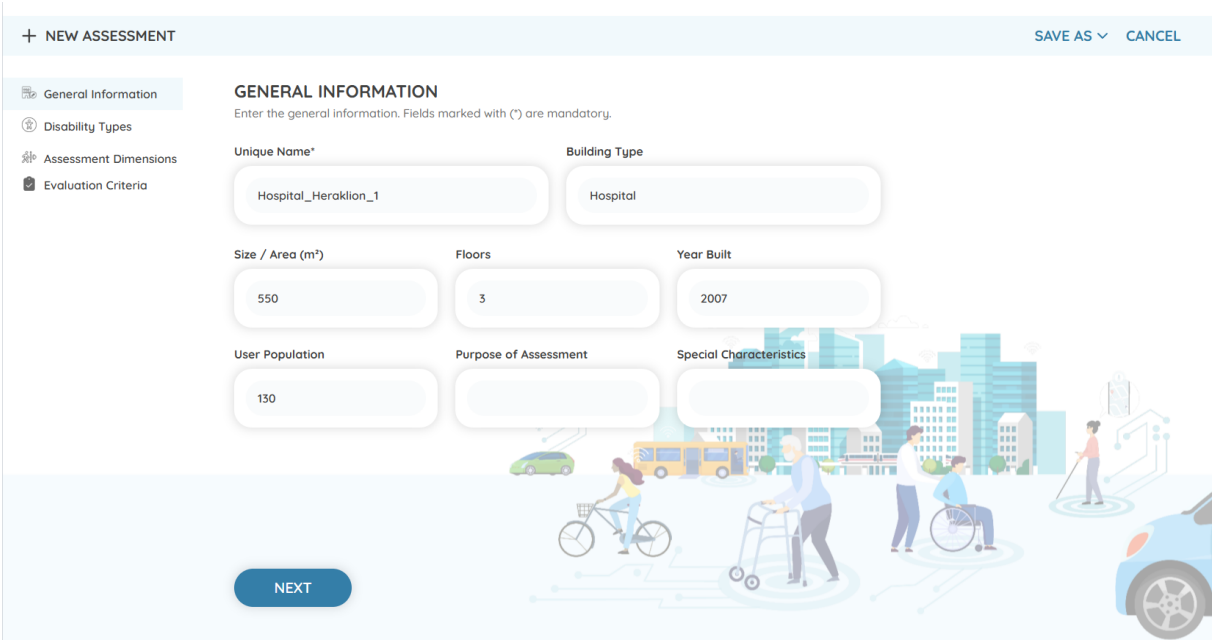


Figure 2. Preview of the General Information section

The first step of the workflow (Figure 2) involves entering general information about the assessment and the evaluated building or environment. In this stage, users provide basic descriptive information that allows the system to uniquely identify and organize the assessment.

This information includes a unique assessment name, the building type, and additional contextual information such as building size, number of floors, year of construction, user population, and other optional characteristics related to the purpose of the evaluation.

Certain fields are defined as mandatory and must be completed before the user can proceed to the next stage. The system performs validation checks to ensure that the required information is correctly provided. If mandatory fields are missing or contain invalid values, these are implying that they are required in order the user to proceed to the next section.

Once all required information has been correctly entered, the user can proceed to the next step of the workflow.

4.2.2.2 Disability Types Weights Stage

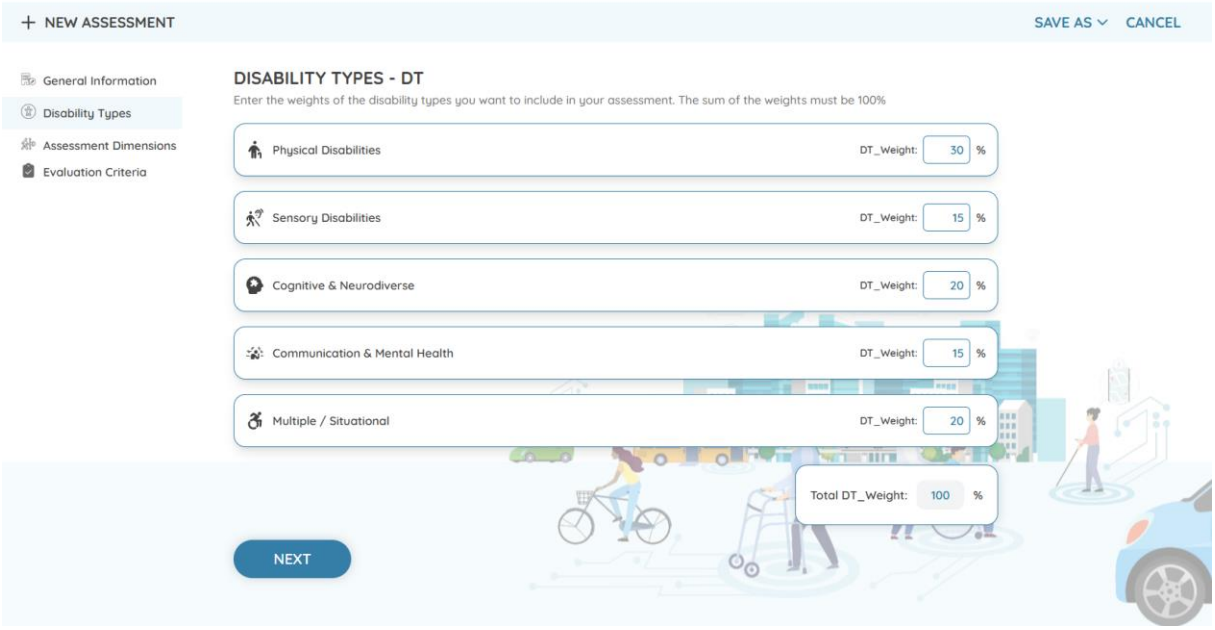


Figure 3. Preview of the Disability Types Weights section

The second step of the workflow (Figure 3) involves configuring the weights assigned to the Disability Types (DTs) defined in the accessibility assessment framework. These disability categories represent different groups of users whose accessibility needs are considered in the evaluation process.

Users assign a weight to each Disability Type, expressing the relative importance of the corresponding user group in the specific assessment context. The interface provides a clear overview of all available Disability Types and allows users to adjust the corresponding weighting values.

To ensure the validity of the assessment configuration, the system verifies that the total weight assigned to all Disability Types equals 100%. If the entered values do not satisfy this condition, the interface highlights the relevant fields and displays a message indicating the inconsistency (Figure 4). The user is not allowed to proceed to the next step until the weighting configuration is corrected.

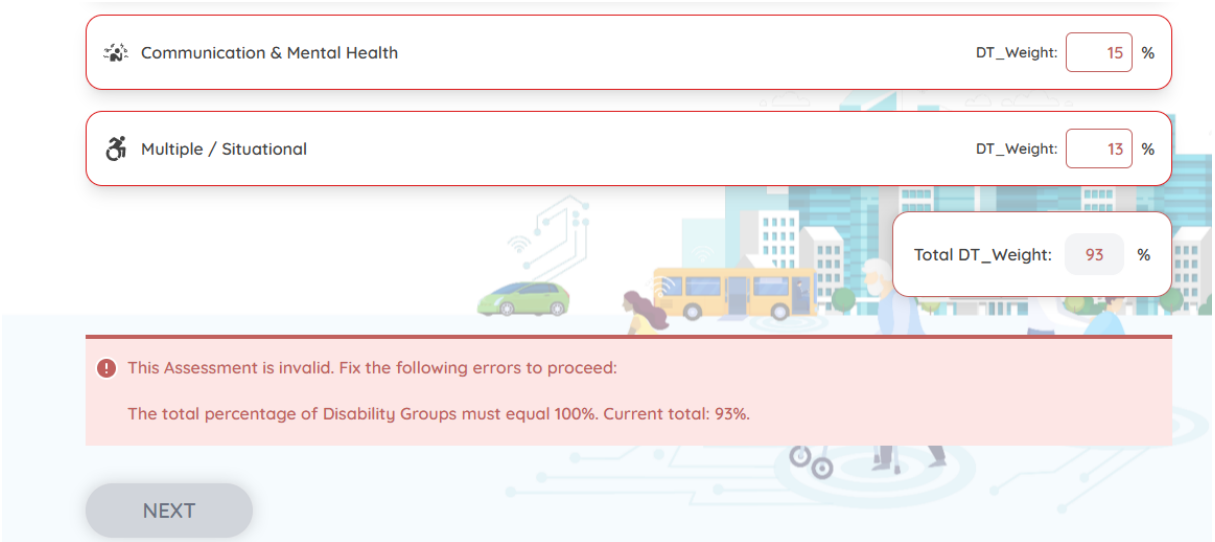


Figure 4. Highlighted error in the DTs weights

This validation mechanism ensures that the relative importance of the disability groups is consistently defined before proceeding to the more detailed levels of the accessibility model.

4.2.2.3 Assessment Dimensions and Evaluation Criteria Section

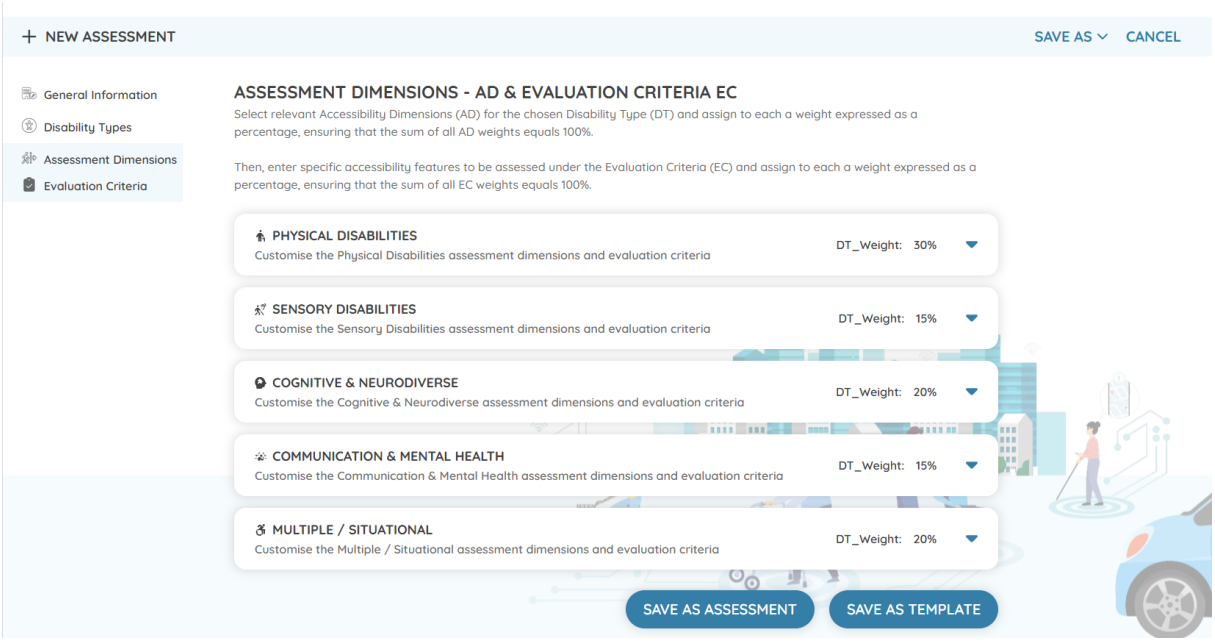


Figure 5. Preview of the Assessment Dimensions and Evaluation Criteria section

The final step of the workflow (Figure 5) focuses on configuring the weights associated with AD and EC for each DT. This step represents the most detailed level of the accessibility evaluation model.

For each Disability Type, users assign weights to the corresponding Assessment Dimensions, ensuring that the total weight of the dimensions equals 100%. Each Assessment Dimension can then be expanded to display the associated Evaluation Criteria (Figure 6), which represent the specific accessibility features to be evaluated. Users assign weights to these criteria in a similar manner, ensuring that the total weight of the Evaluation Criteria within each dimension also equals 100%.

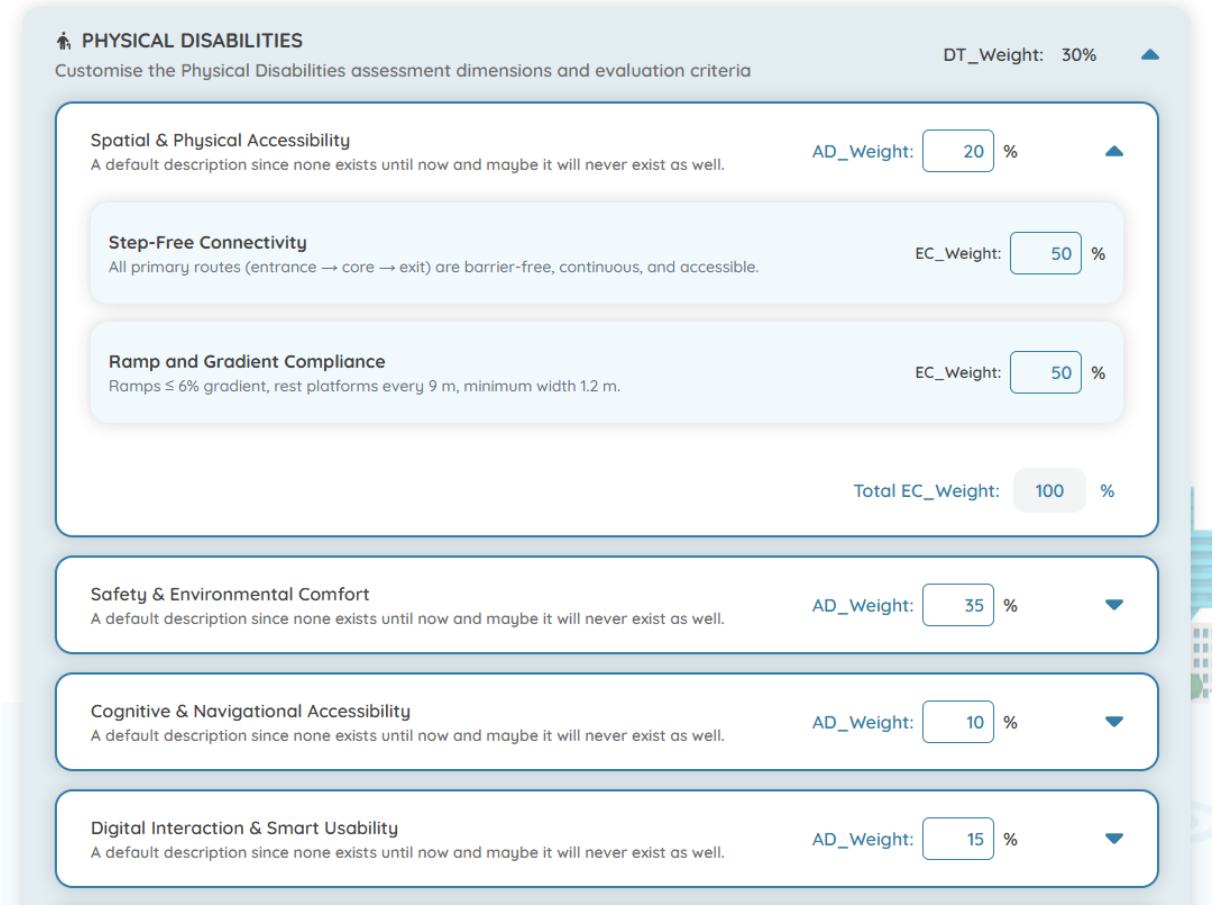


Figure 6. Expanded view for a Disability Type and an Assessment Dimension

The interface provides a hierarchical and expandable view of the assessment structure, allowing users to navigate between Disability Types, Assessment Dimensions, and Evaluation Criteria in an intuitive way.

To support the correct configuration of the assessment, the platform continuously validates the entered values. If inconsistencies occur, such as weights that do not sum correctly, the interface clearly highlights the corresponding fields and displays informative messages describing the detected problem (Figure 7 and Figure 8). Users can immediately identify where the error occurs and receive guidance on how to correct it.

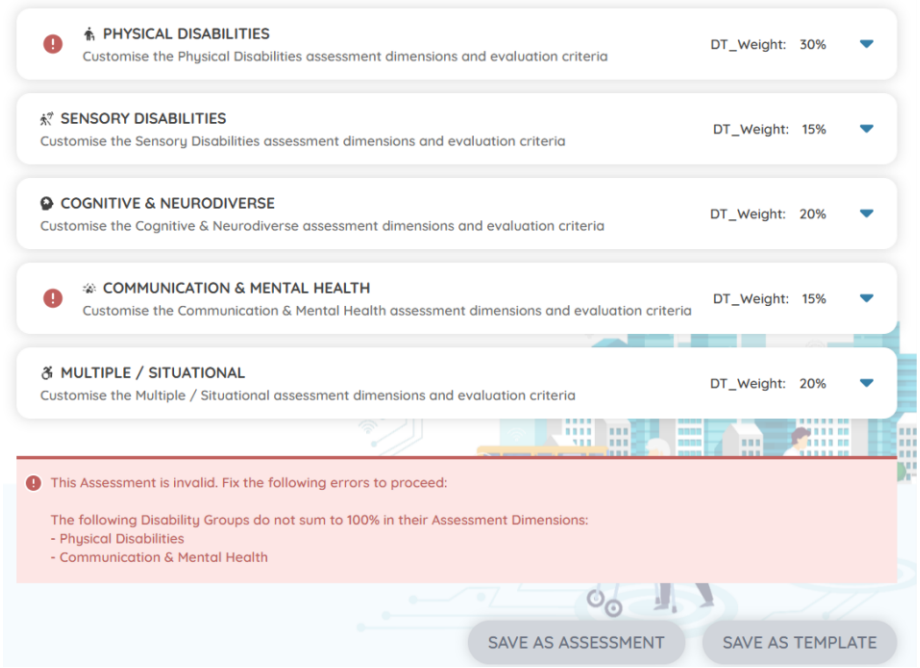


Figure 7. Examples of highlighted assessment errors

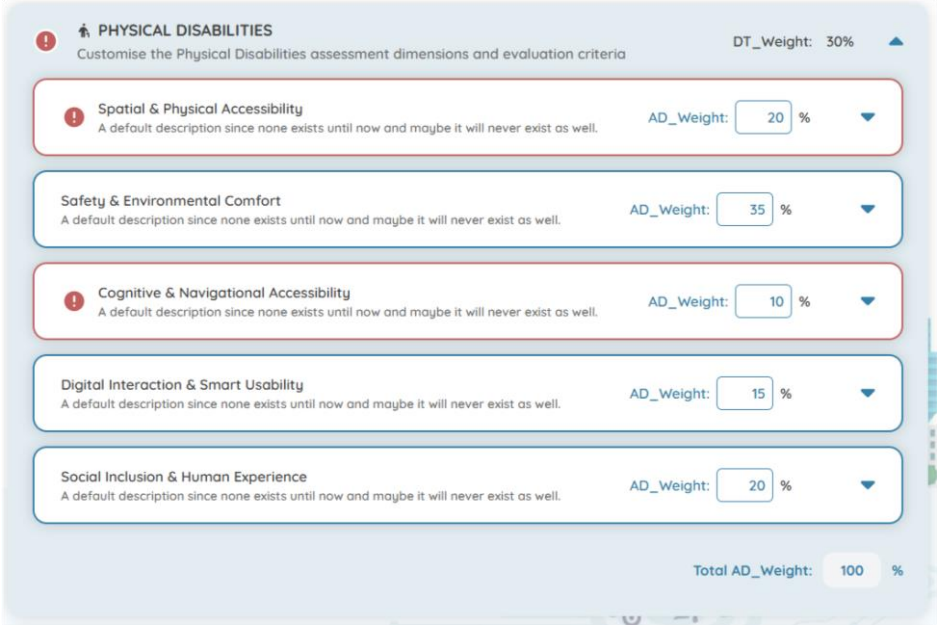


Figure 8. Examples of highlighted weight errors

These validation indicators remain visible throughout the configuration process, allowing users to monitor the correctness of their assessment at all times. The system prevents the assessment from being saved if unresolved inconsistencies remain (Figure 9), ensuring that only valid and complete assessment configurations can be stored.

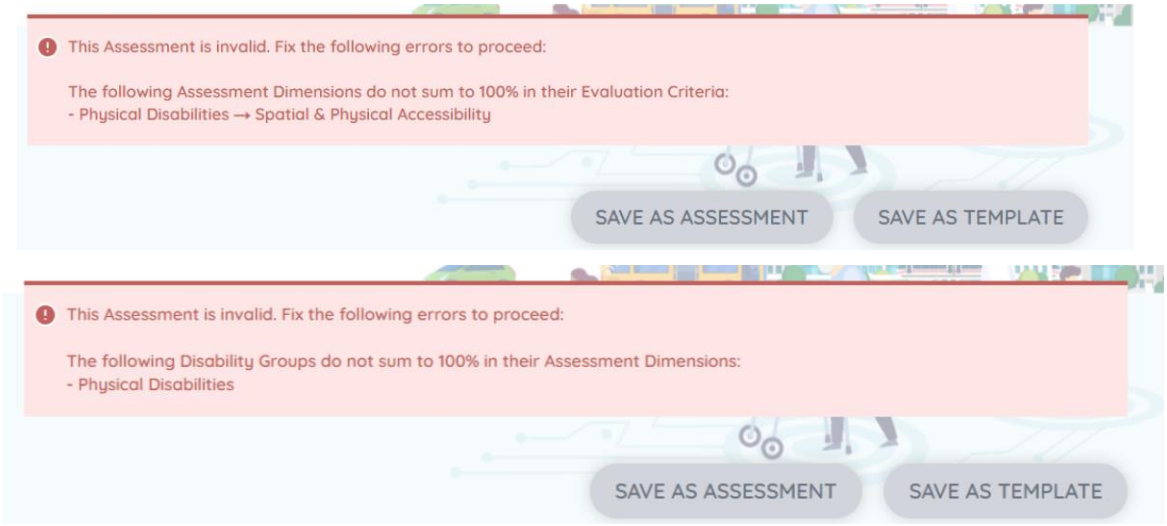


Figure 9. Saving is disabled in case of user mistakes in the AD and EC weights stage

This design provides immediate feedback to the user and significantly reduces the likelihood of configuration errors. By guiding users step-by-step and preventing invalid inputs, the platform ensures that the resulting accessibility assessments remain consistent with the hierarchical evaluation methodology defined in the AccesS framework.

4.2.3 Running Assessments

Once an assessment has been configured, users can proceed to perform the scoring process, which evaluates the accessibility performance of the building according to the framework defined in WP8. The scoring interface (Figure 10) allows users to assign evaluation scores to the individual Evaluation Criteria that compose the accessibility model.

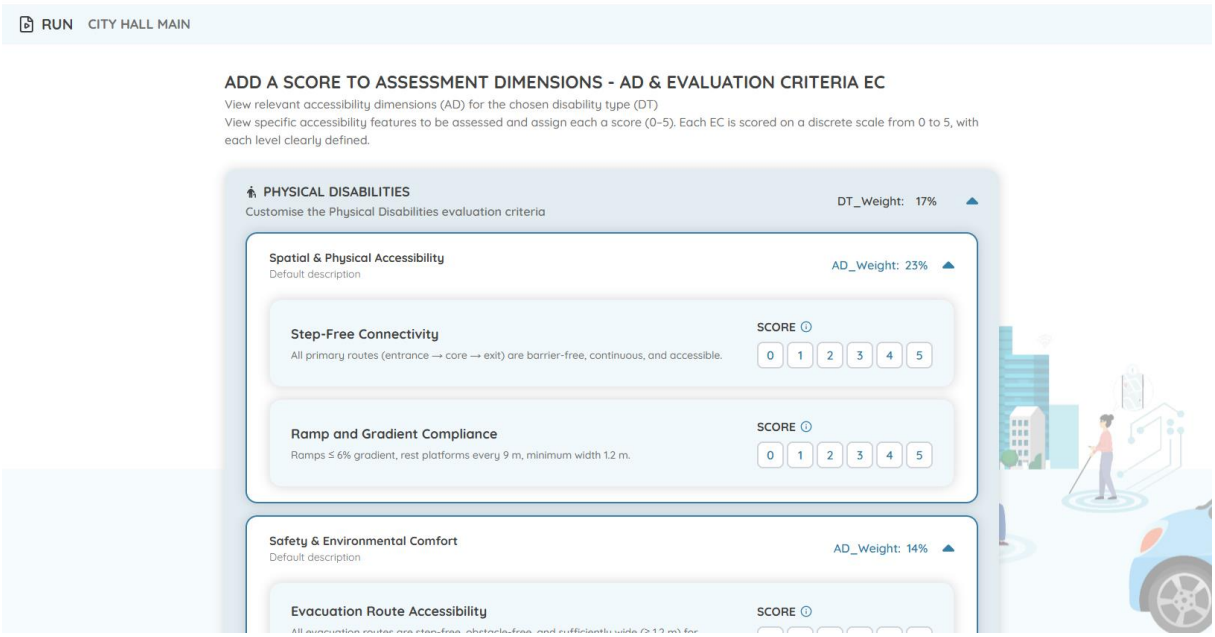


Figure 10. The User Interface for scoring and Assessment

The interface organizes the evaluation according to DT, which contain the corresponding ADs, and within each dimension the relevant ECs are presented. The scoring process follows the hierarchical structure used throughout the platform and mirrors the folding and unfolding design (Figure 11) that is used during the configuration of AD and EC weights. This hierarchical structure allows users to

systematically evaluate the building's accessibility characteristics across all relevant accessibility aspects.

During the scoring process, users assign a score to each Evaluation Criterion based on the observed accessibility conditions of the evaluated building. The scoring values follow the 0-5 scale defined in WP8, which provides a standardized interpretation for each level of accessibility performance.

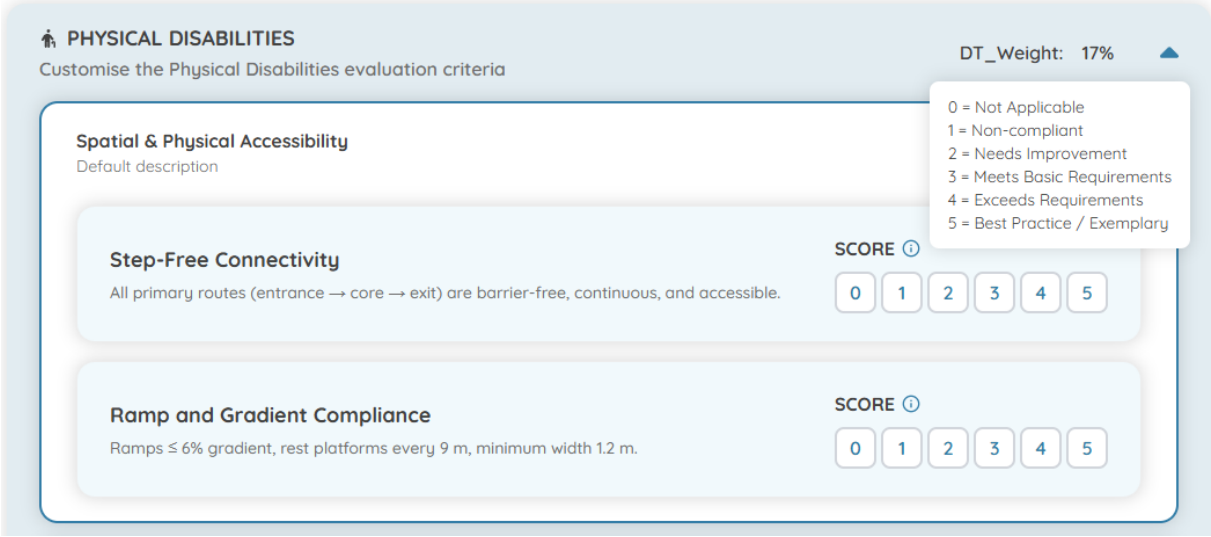


Figure 11. The expanded design for scoring an EC inside an AD inside a DT

To ensure completeness and consistency in the evaluation process, the platform requires that **all Evaluation Criteria be assigned a score** before the assessment can be submitted. When the scoring interface is first opened, the score fields for each Evaluation Criterion are intentionally left in an invalid state, requiring the user to actively select an appropriate score value.

The system continuously verifies the completeness of the scoring process. If any Evaluation Criterion has not been assigned a score, the system prevents the submission of the assessment and prompts the user to complete the missing evaluations. This validation mechanism guarantees that all accessibility aspects defined in the assessment configuration are considered during the scoring process.

Once all Evaluation Criteria have been assigned valid scores, the user can submit the evaluation. The system then processes the collected scores and calculates the corresponding accessibility indicators, including the Overall Building Score (OBS) and the associated metrics presented in the results section.

This structured evaluation process ensures that accessibility assessments are performed in a consistent and systematic manner while maintaining alignment with the accessibility evaluation methodology developed within the AccesS project.

When an evaluation has been submitted from the UI, the finalization of the assessment via the calculation endpoint is triggered. This endpoint serves as the transition mechanism that locks the assessment from a "Draft" state into a "Calculated" state, rendering it immutable to preserve the integrity of the historical audit record.

Upon invocation, the endpoint passes the structured assessment data into the backend's calculation engine. This engine strictly implements the hierarchical accessibility assessment model, executing a multi-step aggregation pipeline to generate both the final score and the advanced statistical context required for the exported assessment report.

The computation engine processes the data through the following sequence:

1. Criterion Normalization and Impact Score Derivation: The engine first evaluates the lowest level of the hierarchy: the Evaluation Criteria (EC). It iterates through every Assessment Dimension to calculate its Impact Score (IS_{ij}). The Impact Score IS_{ij} is the weighted average sum of adjusted scores for Assessment Dimension j for Disability Type i over all k evaluation criteria. Crucially, the engine dynamically handles "Not Applicable" inputs (a score of 0). It first calculates the sum of the weights of only the applicable criteria (where score > 0). It then normalizes the individual criterion weights against this active sum. This prevents N/A scores from mathematically penalizing the building, ensuring the adjusted scores accurately reflect only the relevant features. The normalized scores are then multiplied by the dimension's overall weight factor to produce the final Impact Score.

2. Disability Group Aggregation: Once the dimensions are scored, the engine rolls these values up to the Disability Type layer. The Total Impact Score TIS_i of Disability Type i is the sum of Impact Scores IS_{ij} across all Assessment Dimensions j. This step quantifies how accessible the building is for a specific user profile (e.g., individuals with Visual Disabilities) across all functional domains.

3. Overall Building Score (OBS) Calculation: The Overall Building Score OBS is the weighted average sum of the Total Impact Scores TIS_i across all Disability Types i. Because the raw evaluation criteria are scored on a 0–5 scale, the engine normalizes the aggregated weighted impacts against the maximum possible score (5). It then scales the result by 100 to produce a final, easily interpretable percentage (0–100%) that defines the building's overall accessibility performance.

4. Computation of Advanced Analytical Statistics: Beyond the primary OBS, the engine computes several intermediate statistics that help stakeholders understand the "why" behind the score. These metrics are heavily utilized in the PDF reporting phase to generate actionable visual insights:

- **Importance Values:** The engine calculates the specific contribution of each branch of the hierarchy to the final score. The Importance Value $ImpoDT_i$ of Disability Type i in the Overall Building Score OBS is the percentage of each weighted Total Impact Score TIS_i in the calculation of OBS. Similarly, the Importance Value $ImpoAD_j$ of Assessment Dimension j in the Overall Building Score OBS is the percentage of each Cumulative Impact Score CIS_j in the calculation of OBS.
- **Cumulative Impact Score (CIS_j):** The Cumulative Impact Score CIS_j of Assessment Dimension j, is the weighted average sum of Impact Scores IS_{ij} across all Disability Types i. This isolates a specific building domain (e.g., "Safety") and measures its total performance across all user groups.

Performance Relative to Optimal Maximums: To generate informational comparative bar charts in the report, the engine computes the theoretical maximum scores ($maxTIS$ and $maxCIS_j$) that a building could achieve if every applicable criterion scored a perfect 5. It then divides the actual TIS_i and CIS_j by these maximums. This yields a precise percentage of optimal performance, allowing decision-makers to immediately identify exactly how far a specific dimension or disability accommodation is from being a "Best Practice."

4.3 Assessment Results

The scoring process produces a set of quantitative indicators describing the accessibility performance of the evaluated building. These indicators enable users to analyze accessibility from multiple perspectives, including the overall building performance, the contribution of different disability groups, and the relative impact of individual assessment dimensions.

Immediately after an assessment has been successfully scored, the system presents a summary of the results through a popup notification (Figure 12) that provides a concise overview of the evaluation outcome. The popup highlights the most general scoring indicator, the OBS, which represents the aggregated accessibility performance of the evaluated building. In addition to the OBS, the popup presents summary information regarding the accessibility performance across different disability groups.

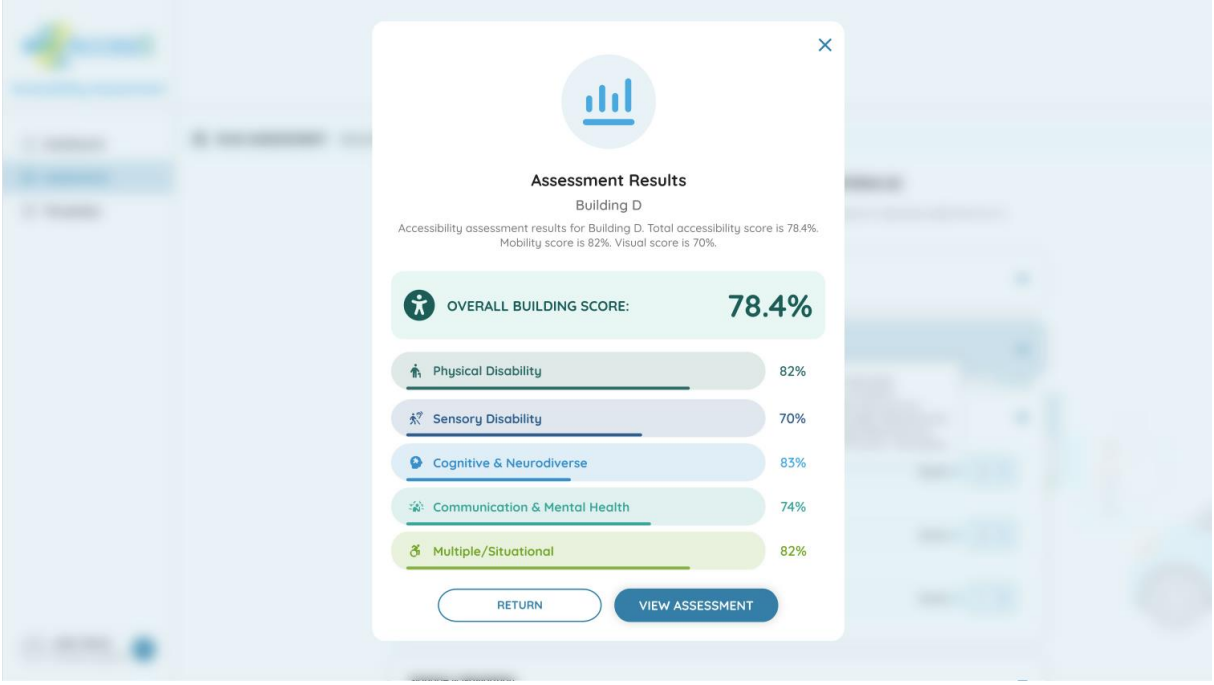


Figure 12. The Assessment Results popup after scoring an Assessment

From this summary view, users may either return to the dashboard or navigate directly to the detailed assessment interface. The same detailed results can be also viewed by selecting the corresponding assessment card from the Dashboard or from the Assessments management page.

The detailed assessment interface is organized into three main tabs that provide complementary views of the assessment results and configuration.

4.3.1 Homepage / Dashboard

The homepage of the AccesS Large-Scale Accessibility Assessment Tool serves as the main entry point to the platform and provides users with an overview of their accessibility assessments and templates. The interface is designed to facilitate quick navigation between the main functionalities of the system while presenting key information related to recent evaluation activities. More specifically, the homepage displays the main dashboard. On the bottom left it displays the current logged-in user. In the top left it shows the currently selected tab for the homepage, among three different options, namely Dashboard, Assessments and Templates.

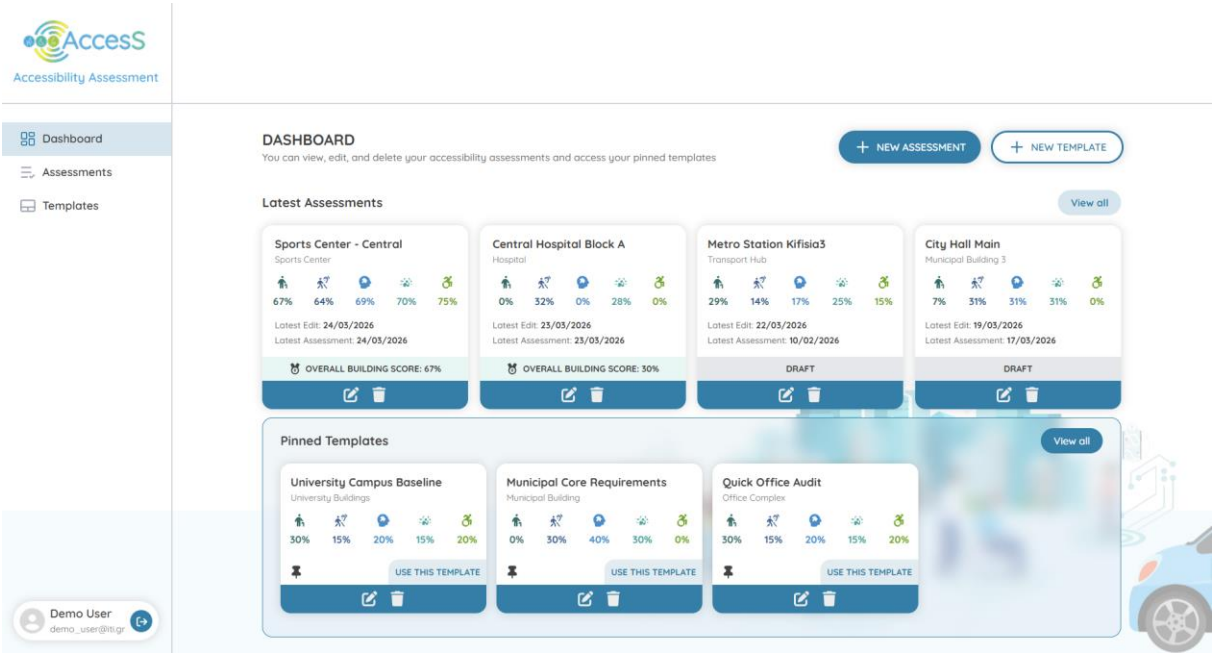


Figure 13. The Dashboard User Interface

The central component of the homepage is the Dashboard (Figure 13), which displays a collection of cards (Figure 14) representing the most recently accessed or created accessibility assessments. Each card summarizes the essential information associated with a specific assessment or template, including the name of the evaluated building or environment, the category of the facility (e.g., transport hub, municipal building, hospital), and the corresponding weights assigned to the different disability categories. In addition, the card displays the Overall Building Score (OBS) of the evaluated building when scoring results are available, as well as the date of the assessment.

These cards also provide quick access to common operations such as editing or deleting an assessment, enabling users to efficiently manage their evaluation projects directly from the dashboard interface. Through this card-based layout, the dashboard offers a compact visual overview of ongoing and completed assessments.

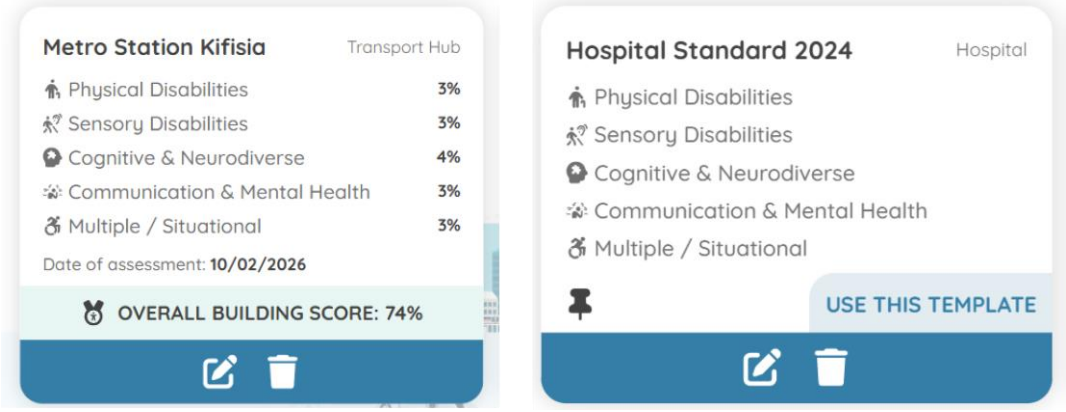


Figure 14. Assessment Card UI for Assessments (left) and Templates (right)

The dashboard also includes a section displaying pinned assessment templates, which allows users to quickly access frequently used template configurations. These templates can be directly applied when creating a new accessibility assessment, reducing the effort required to configure the evaluation parameters.

Navigation within the platform is supported through a sidebar menu located on the left side of the interface. This menu provides access to the main sections of the tool, including the Dashboard, Assessments, and Templates pages.

While the dashboard focuses on providing a summary view of recent activity, the Assessments and Templates pages (Figure 12 and Figure 16) provide a more comprehensive view of the corresponding entities. These sections use a similar card-based interface to present the available assessments and templates in a structured manner. Users can browse, sort, and manage their assessments or templates, as well as create new entries through the corresponding interface controls.

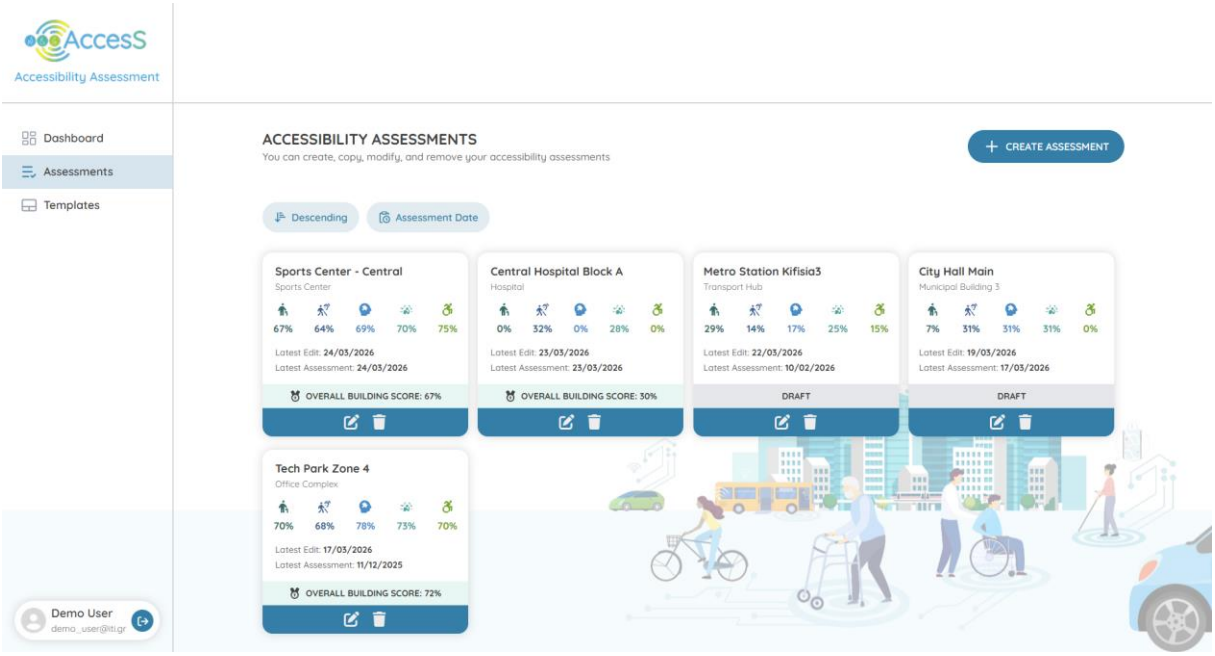


Figure 15. Accessibility assessments

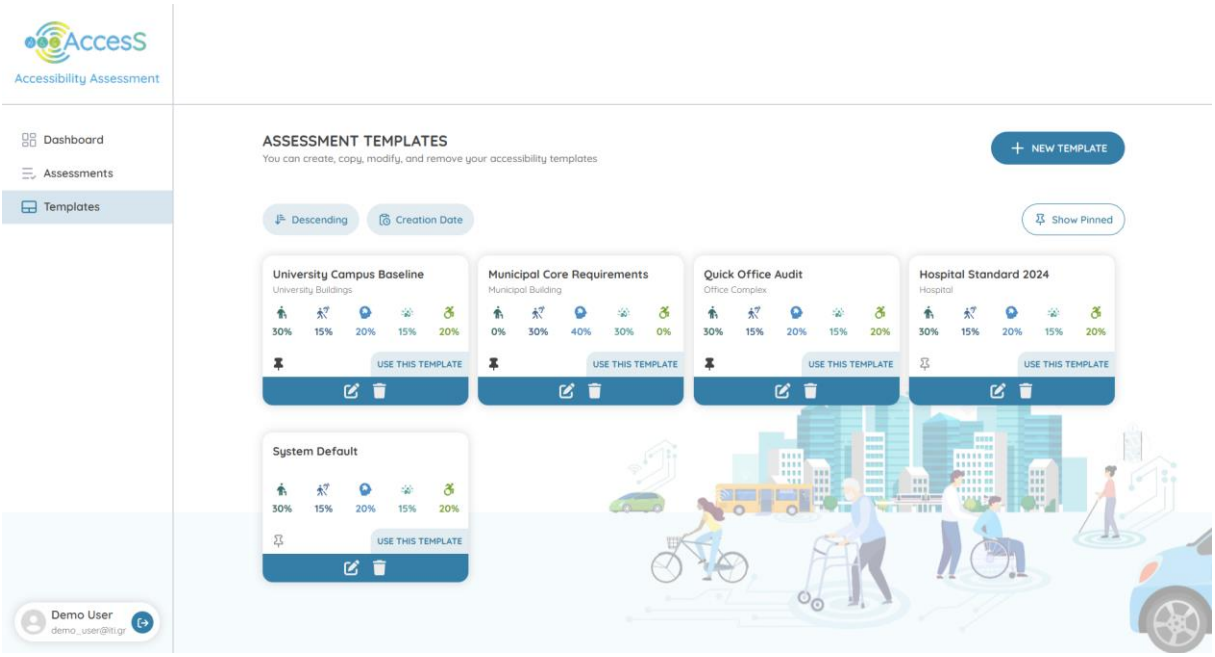


Figure 16. Assessment templates

The consistent visual layout and navigation structure across these sections ensure a coherent user experience and allow users to easily transition between the overview dashboard and the detailed management interfaces of the platform.

4.3.2 Results Visualization

4.3.2.1 Assessment Results Overview

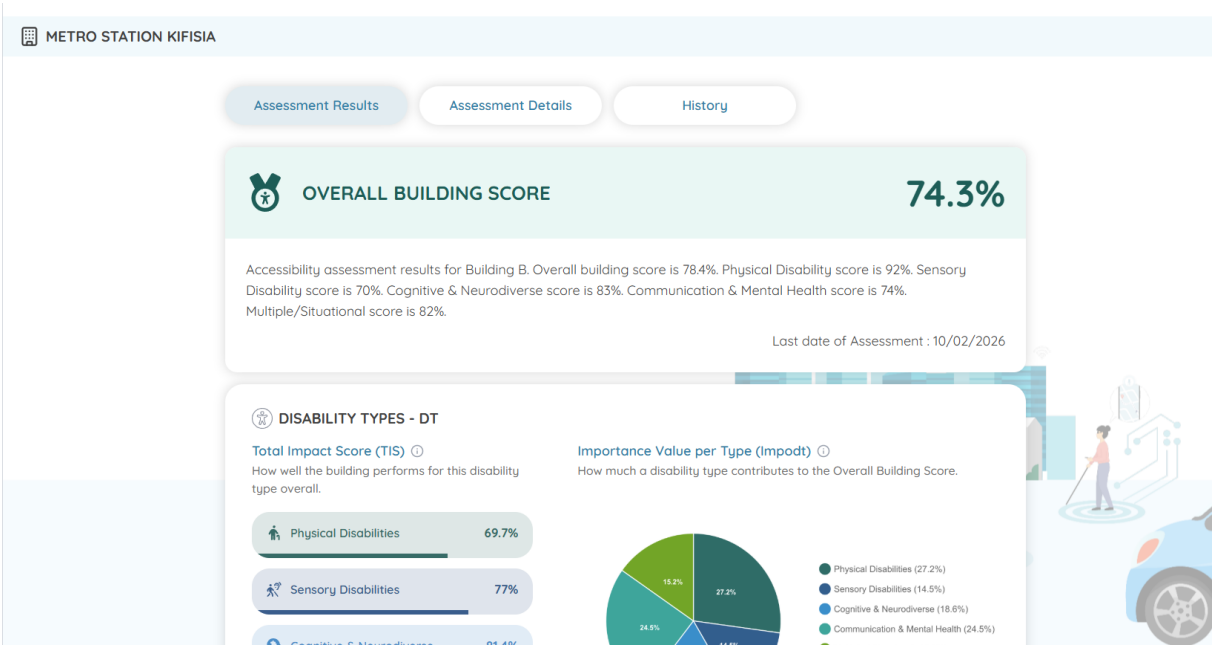


Figure 17. The Assessment Results Overview User Interface

The first tab provides an overview of the most recent evaluation results for the selected building (Figure 17). At the top of the interface, the system displays the OBS together with the date of the most recent assessment execution. This score summarizes the accessibility performance of the building according to the weighted evaluation model defined during the assessment configuration (Figure 18).

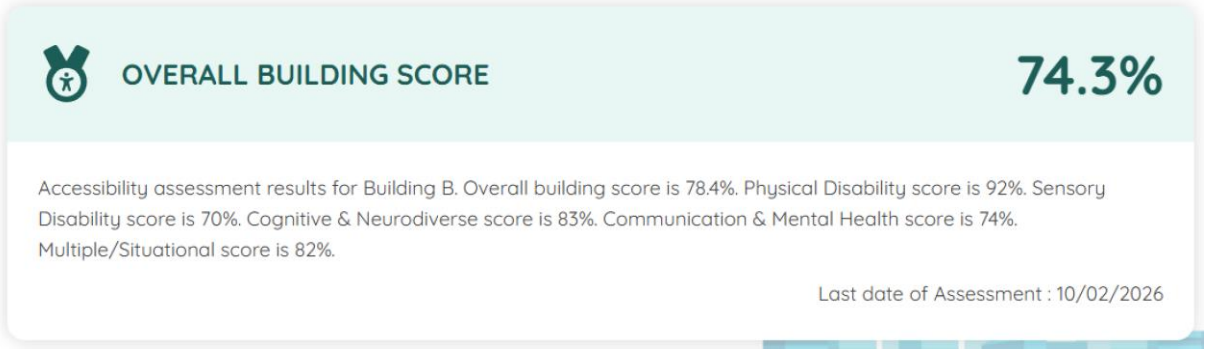


Figure 18. The OBS display at the top of the results overview

Below this summary, the interface presents the results for the DT (Figure 19). Two complementary indicators are displayed:

- **Total Impact Score (TIS):** This metric represents how well the evaluated building performs for each disability group, considering the accessibility features assessed in the evaluation process.
- **Importance Value per Type (Impodt):** This indicator reflects the relative contribution of each disability type to the Overall Building Score, based on the weighting configuration defined during the assessment setup.

These indicators provide users with a high-level understanding of how the building performs with respect to the accessibility needs of different user groups and how strongly each group influences the final evaluation outcome.

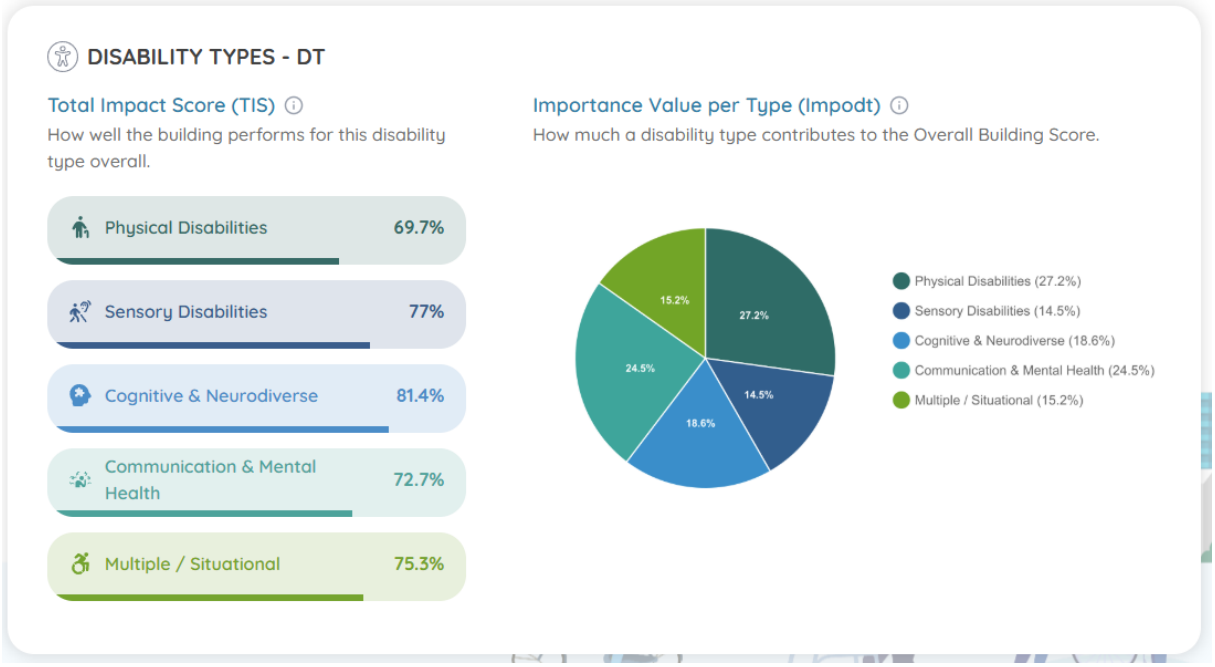


Figure 19. The DT results display

A similar representation is provided for the AD (Figure 20). In this case, the interface displays:

- **Cumulative Impact Score (CIS):** A measure indicating how well the building performs within each assessment dimension.
- **Importance Value per Assessment Dimension (Impoad):** The contribution of each assessment dimension to the OBS according to the configured weighting scheme.

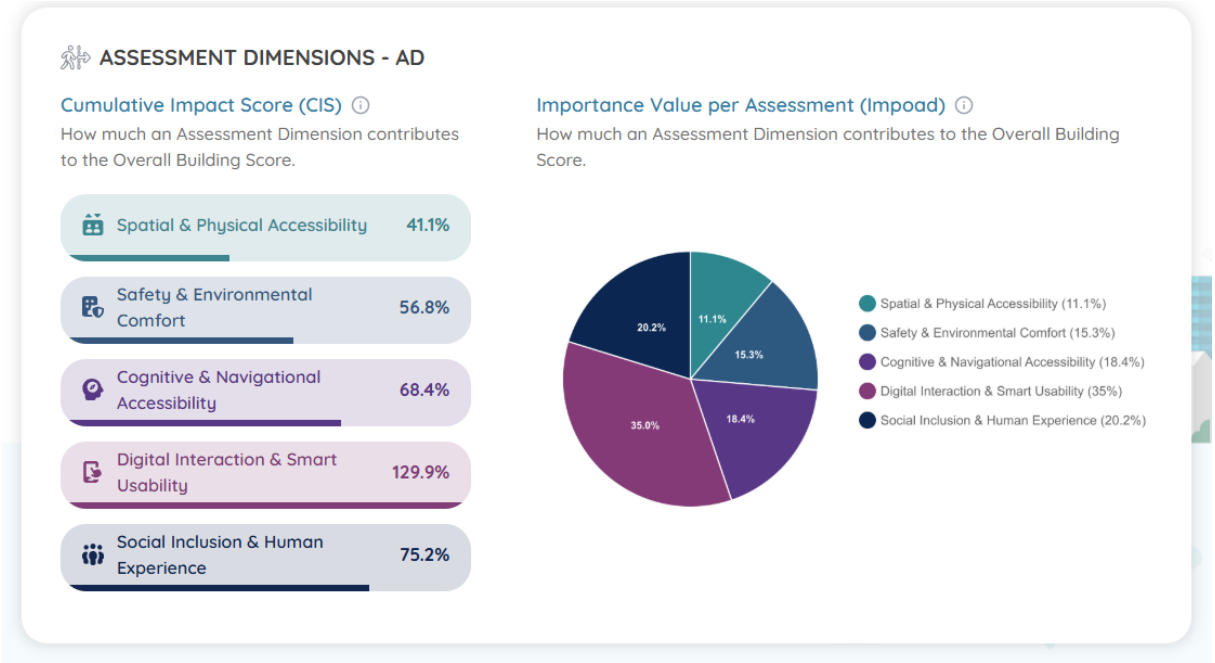


Figure 20. The AD results display

To support interpretability, explanatory descriptions and contextual information are provided within the interface. These descriptions help users understand the meaning of the displayed indicators and the interpretation of the graphs, ensuring that even users without extensive technical expertise can understand the evaluation results and their implications.

4.3.2.2 Assessment Details

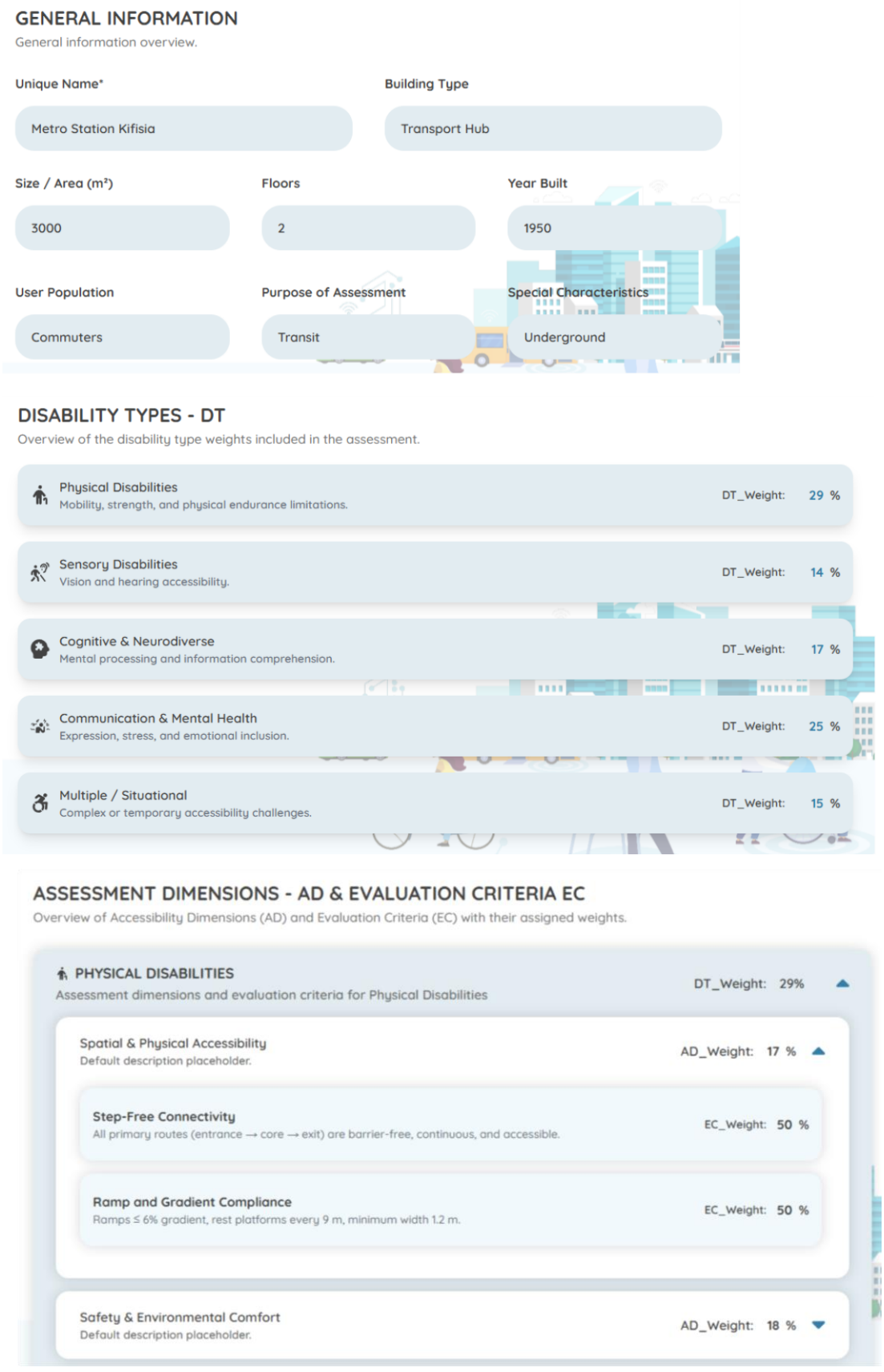


Figure 21. Assessment Details view for General Information (Top), Disability Types (bottom-left) and Assessment Dimensions and Evaluation Criteria (bottom-right)

The second tab presents the configuration details of the assessment, including the general assessment information and the weighting parameters used during the evaluation process (Figure 21).

This section displays the values associated with the DT, AD, and EC weights, together with the descriptive information entered during the assessment creation workflow. Through this interface, users may review and modify the configuration parameters of the assessment.

If changes are required, users can update the assessment configuration through an editing process that follows the same structured workflow used during the creation of the assessment. This ensures that any modifications remain consistent with the hierarchical accessibility evaluation model and that all validation mechanisms continue to apply.

4.3.2.3 Assessment History

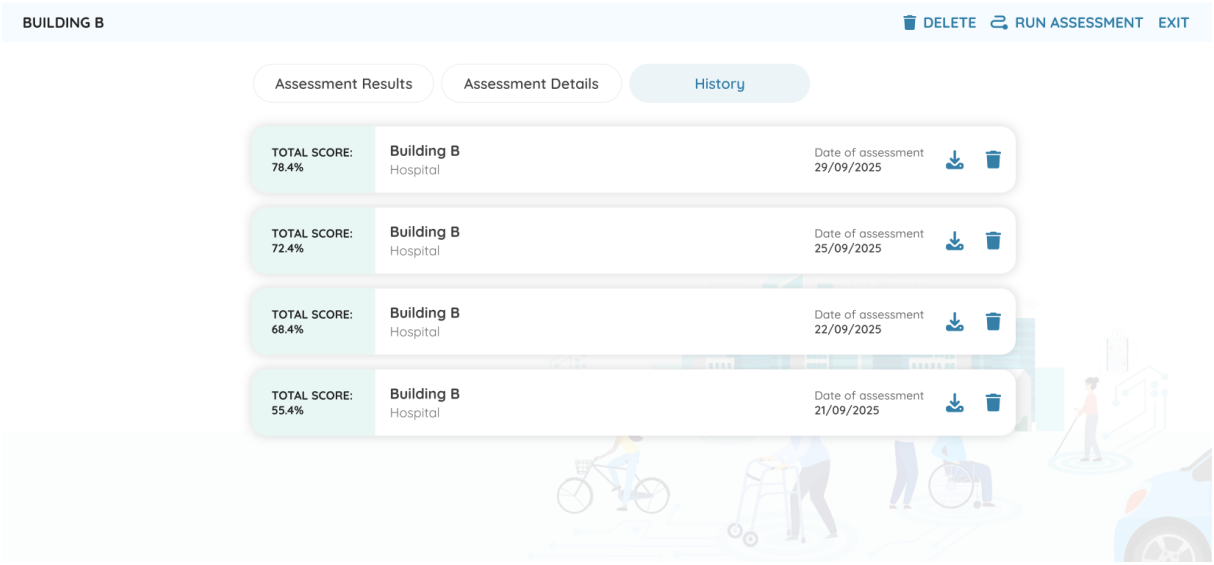


Figure 22. The Assessment History display

The third tab provides access to the scoring history of the selected assessment (Figure 22). Each scoring entry represents a completed evaluation of the building based on the current configuration of the accessibility model.

For each recorded evaluation, the interface displays the date of the assessment and the corresponding OBS obtained during that execution. This allows users to track the evolution of accessibility performance over time and to compare different evaluation results.

From this section, users can perform additional management actions. Individual scoring records can be removed if necessary, and users can also download a detailed report of each assessment execution.

The downloadable report is provided in PDF format and contains a more comprehensive presentation of the accessibility evaluation results. These reports include detailed information about the calculated metrics, graphical representations of the results, and explanatory descriptions of the assessment indicators. The structure and contents of the generated reports are described in greater detail in the following sections of this deliverable.

4.3.3 Assessment Report (PDF)

To facilitate documentation, auditing, and stakeholder communication, the platform features a robust, server-side PDF generation engine. The report generation is handled by a dedicated backend service

utilizing pdfmake[5] for precise, declarative document layout and chartjs-node-canvas[6] for rendering high-fidelity visualizations directly on the server.

The ability to generate printable, standardized assessment reports serves multiple critical purposes. For **facility managers and building owners**, it acts as an official record of the building's current state, highlighting areas of legal compliance and potential liability. For **architects and urban planners**, the report provides a clear diagnostic tool to validate design choices against universal design principles. For **accessibility auditors**, it standardizes the output of their evaluations into an easily shareable, offline-accessible document that can be distributed to stakeholders who may not have direct access to the digital platform.

The generated Assessment Report provides a comprehensive snapshot of the building's evaluation, structured into the following key sections: an executive summary, a visual analysis section and several detailed statistics.

The following figures illustrate a sample report.

[5] http://pdfmake.org/#/

[6] https://github.com/SeanSobey/ChartjsNodeCanvas

City Hall Main

Building Type:
Municipal Building

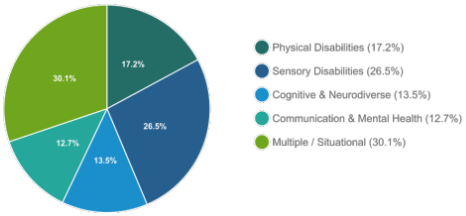
Creator:
demoUser

Assessment Date:
24/12/2025

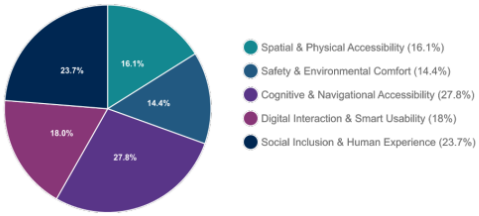
Overall Building Score
88.9%

ASSESSMENT RESULTS

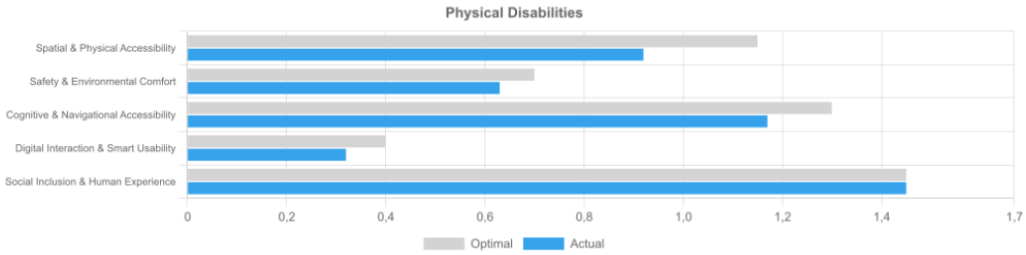
Importance values for disability types

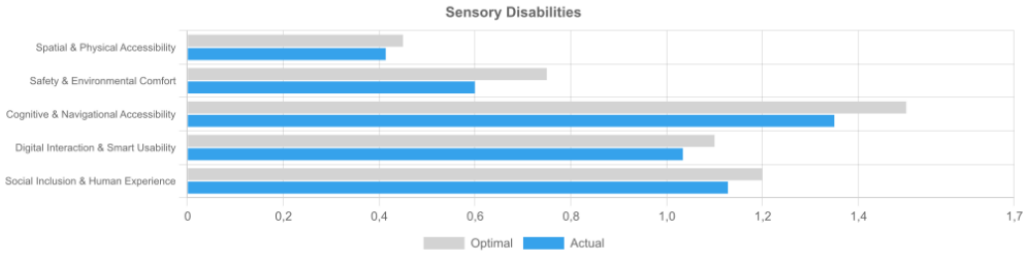


Importance values for assessment dimensions



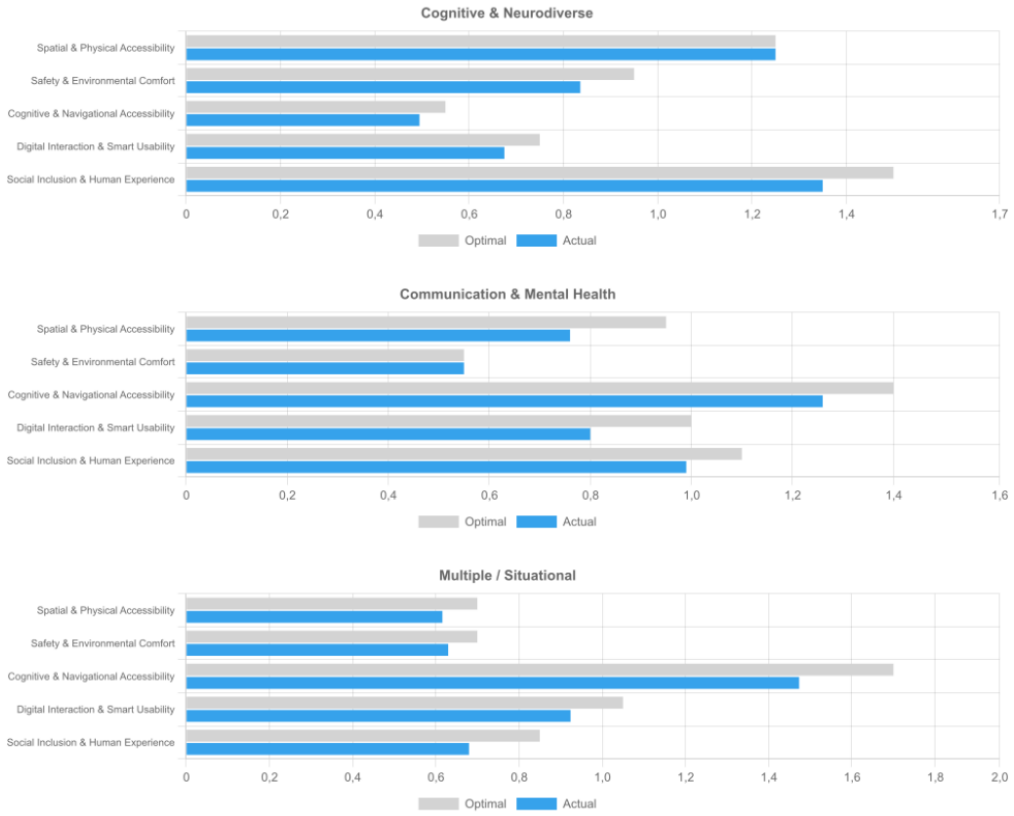
Impact Scores by Disability Group





Generated: 09/03/2026 - Page 1 of 3

Figure 23. PDF report (page 1 of 3)



Note: In the disability charts, gray bars show the optimal score achievable for each assessment dimension, while blue bars show the actual assessed score.

Key Findings

- Overall Building Score: 88.9%.
- Highest contributing disability group: Multiple / Situational (30.15% importance, 86.47 total impact score).
- Most critical assessment dimension: Cognitive & Navigational Accessibility (27.77% importance, 24.70 cumulative impact score).

Generated: 09/03/2026 - Page 2 of 3

Figure 24. PDF report (page 2 of 3)

Detailed Statistics

1. Disability Group Breakdown

Disability Group	Total Impact Score (%)	Weight	Importance
Multiple / Situational	86.47	31%	30.15%
Sensory Disabilities	90.52	26%	26.47%
Physical Disabilities	89.80	17%	17.17%
Cognitive & Neurodiverse	92.12	13%	13.47%
Communication & Mental Health	87.20	13%	12.75%
Total		**100%**	**100%**

2. Dimension Breakdown

Assessment Dimension	Cumulative Impact Score (%)	Importance
Cognitive & Navigational Accessibility	24.70	27.77%
Social Inclusion & Human Experience	21.10	23.72%
Digital Interaction & Smart Usability	16.03	18.03%
Spatial & Physical Accessibility	14.33	16.11%
Safety & Environmental Comfort	12.77	14.36%
Total	**88.92**	**100%**

How to Read the Results

- Overall Building Score expresses the weighted overall accessibility performance of the building.
- Total Impact Score (%) shows the combined impact score for a disability group across all assessment dimensions, normalized to the scoring scale.
- Cumulative Impact Score (%) shows the combined impact of an assessment dimension across all disability groups, normalized to the scoring scale.
- Importance values show the percentage contribution of each disability group or dimension to the total weighted impact.
- In the disability charts, Actual values are compared against the Optimal score achievable for each dimension.

Figure 25. PDF report (page 3 of 3)

4.3.3.1 Report's Executive Summary

This summary displays essential metadata including the building name, type, assessment creator, the date of the assessment, and the final Overall Building Score (presented as a percentage out of 100). This metadata section appears first to enable quick understanding of the evaluation place and score.

Figure 26. PDF report, executive summary and metadata

4.3.3.2 Visual Analysis

The generated Assessment Report translates the complex, hierarchical scoring data into immediate visual insights. At the core of this visual analysis are the Importance Value Pie Charts and the Actual vs. Optimal Impact Bar Charts.

Importance Value Pie Charts: Because the tool allows for dynamic weighting (e.g., a hospital might heavily weight physical and sensory dimensions, while a school might prioritize cognitive and social domains), the raw scores alone do not tell the whole story. These pie charts allow stakeholders to immediately recognize which user groups or building domains are most heavily driving the final rating, guiding targeted improvements.

The chart in Figure 27 divides the overall building assessment into the five core disability types (e.g., Physical, Sensory, Cognitive, Communication, and Multiple/Situational). The size of each slice corresponds directly to the Importance Value ($ImpoDT_i$) calculated by the backend. It represents a combination of the raw accessibility score for that group multiplied by the specific weight assigned to that group.

These types of charts tell facility managers and owners *who* is most impacted by the building's current state. For example, if "Physical Disabilities" represents a dominant 60% of the pie chart, it indicates that physical infrastructure (like ramps and elevators) is the primary driver of the building's current score. Conversely, if a slice is surprisingly small, it may indicate an area where the building is severely underperforming or where the initial weightings were set too low, prompting a review of priority areas.

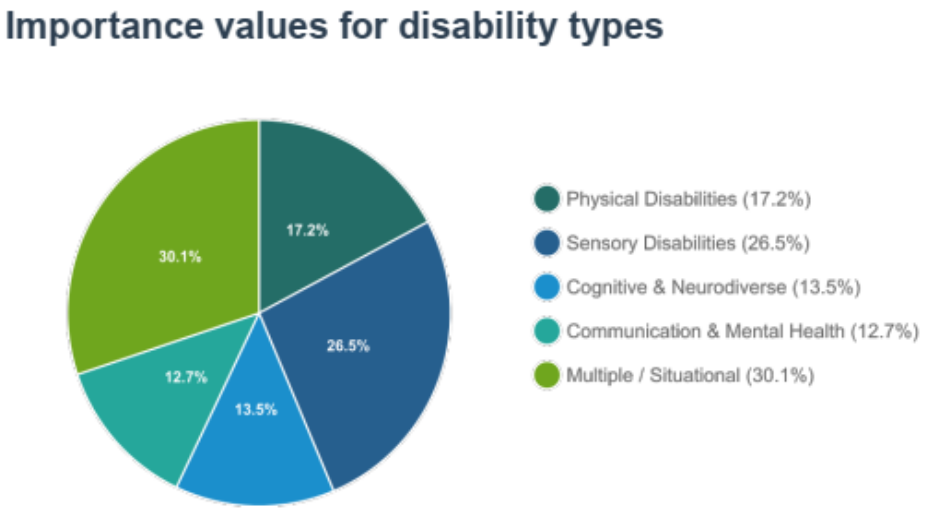


Figure 27. Pie chart showcasing importance values for disability types

The chart in Figure 28 shifts the perspective to the *building's functional domains*. It visualizes the Importance Value ($ImpoAD_j$) across the five structural clusters (Spatial & Physical, Safety, Cognitive & Navigational, Digital Interaction, and Social Inclusion). Each slice shows how much that specific domain contributes to the final OBS, aggregating data across all disability types.

This visualization is highly actionable for architects, urban planners, and renovation teams. It highlights *where* the money and effort should go. If "Safety & Environmental Comfort" takes up a massive portion of the chart, it means the building's score relies heavily on those features. If an organization has a limited renovation budget, they can look at this chart to identify the largest slices—improving criteria within these heavily weighted dimensions will yield the most significant and immediate increase to the OBS.

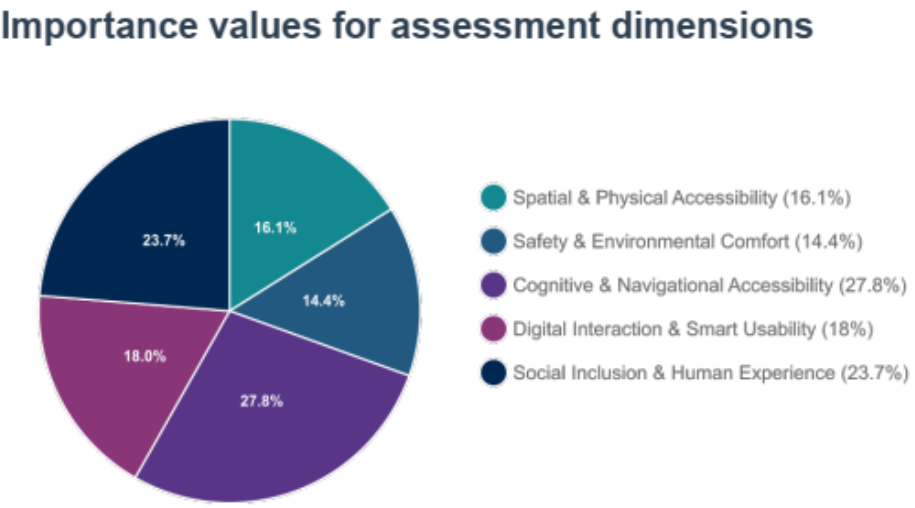


Figure 28. Pie chart showcasing importance values for assessment dimensions

Actual vs. Optimal Impact Bar Charts: These bar charts shift the focus from percentage weights to raw performance gaps. For each Disability Type, the chart plots the "Actual Impact Score" (the mathematically derived Cumulative Impact Score (CIS_j) or Total Impact Score (TIS_i) based on the auditor's real-world evaluation) against the mathematically "Optimal Score" (the maximum possible score if all criteria were perfect) for every dimension.

This visualization (Figure 29) serves as a direct diagnostic tool for identifying critical bottlenecks and performance deficits. While the pie charts show *where the weight is*, this chart shows *where the building is failing*. A large visual gap between the Actual and Optimal bars immediately flags a severely deficient area. For example, if the gap in "Cognitive & Navigational Accessibility" is massive, but the actual and optimal bars for "Spatial & Physical Accessibility" are nearly identical, the building owner instantly knows that adding more ramps will not help; the budget must be prioritized toward clear signage, wayfinding, and acoustic treatments to close the cognitive gap.

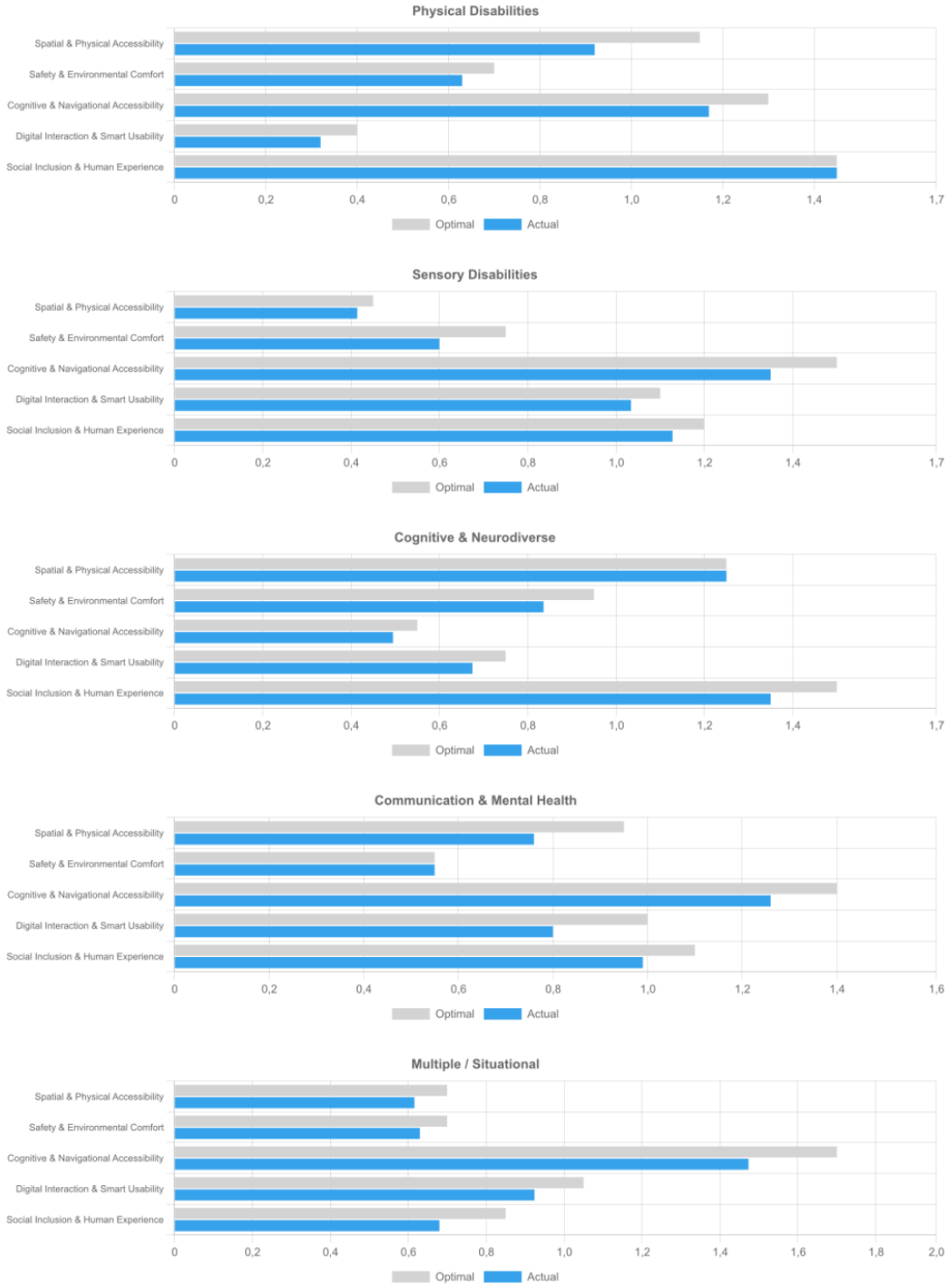


Figure 29. Actual vs. Optimal Impact bar charts

4.3.3.3 Detailed Statistics

While the visual charts provide an immediate, high-level overview of the building's performance, the **Detailed Statistics** section of the PDF report provides the precise, granular data required for deep-dive analysis, auditing, and compliance verification. The tables are automatically sorted in descending order based on their "Importance" value, immediately drawing the reader's attention to the factors that most heavily influence the building's current rating.

Disability Group Breakdown: This table evaluates the building's accessibility performance through the lens of the five Disability Types. It details the mathematical relationship between the assigned priority of a group and how well the building actually accommodates them.

- **Total Impact Score (%):** This value represents the building's raw performance for this specific disability group across all functional dimensions, normalized to a 0–100% scale. For example, a score of 92.12% for *Cognitive & Neurodiverse* indicates that the building meets the vast majority of optimal requirements for this user group.
- **Weight:** This is the baseline priority (w_i) assigned to this disability group in the assessment template. In a hospital, *Physical Disabilities* might carry a massive weight, whereas in the provided sample (Figure 30), *Multiple / Situational* disabilities were prioritized with the highest weight of 31%.
- **Importance:** This is the most critical metric for decision-makers. It represents the actual percentage contribution of this disability group to the Overall Building Score ($ImpoDT_i$). It acts as a balancing metric between performance (Total Impact) and priority (Weight).

In the first table of the generated report shown in Figure 30, *Multiple / Situational* is the highest priority group with a **31% Weight**. However, its **Total Impact Score is 86.47%**, which is the lowest performance among all groups. Because it underperformed relative to the rest of the building, its final **Importance (30.15%)** dropped slightly below its allocated weight. Conversely, *Sensory Disabilities* carried a **26% Weight** but achieved a high performance of **90.52%**, pushing its actual **Importance to 26.47%**. For a facility manager, this table reveals that to improve the overall score, investments should be directed toward resolving the barriers affecting the heavily weighted but underperforming *Multiple / Situational* group.

1. Disability Group Breakdown

Disability Group	Total Impact Score (%)	Weight	Importance
Multiple / Situational	86.47	31%	30.15%
Sensory Disabilities	90.52	26%	26.47%
Physical Disabilities	89.80	17%	17.17%
Cognitive & Neurodiverse	92.12	13%	13.47%
Communication & Mental Health	87.20	13%	12.75%
Total		**100%**	**100%**

2. Dimension Breakdown

Assessment Dimension	Cumulative Impact Score (%)	Importance
Cognitive & Navigational Accessibility	24.70	27.77%
Social Inclusion & Human Experience	21.10	23.72%
Digital Interaction & Smart Usability	16.03	18.03%
Spatial & Physical Accessibility	14.33	16.11%
Safety & Environmental Comfort	12.77	14.36%
Total	**88.92**	**100%**

Figure 30. Detailed statistics tables

Dimension Breakdown: This table details how each functional cluster of the building contributes to the final score.

- **Cumulative Impact Score (%):** This value represents the weighted sum of Impact Scores for this specific building dimension across all disability types, normalized to the scoring scale.

Crucially, because of the mathematical structure of the evaluation model, the sum of all Cumulative Impact Scores precisely equals the OBS.

- **Importance:** This reflects the percentage of the OBS that is derived from this specific dimension ($ImpoAD_j$).

In the second table shown in Figure 30, the Overall Building Score is **88.92%** (derived from the sum of the Cumulative Impact Scores). The table reveals that **Cognitive & Navigational Accessibility** is the strongest pillar of the building, contributing a massive **24.70** points to the total score, which translates to an **Importance of 27.77%**. On the other end of the spectrum, **Safety & Environmental Comfort** contributes only **12.77** points (an **Importance of 14.36%**).

For an architect or auditor planning renovations, this table acts as a direct roadmap. It proves mathematically that the building excels at wayfinding and cognitive support, but lags significantly in safety and environmental comfort systems. By targeting improvements in the lowest-scoring dimensions, stakeholders can achieve the most efficient increase in their building's overall accessibility compliance.

5 Conclusions

This deliverable presented the AccesS Large-Scale Accessibility Assessment Tool, developed to support a systematic and scalable accessibility evaluation of smart buildings and smart city environments. The work contributes to the overall objectives of the AccesS project by enabling data-driven accessibility assessment processes and supporting the integration of universal accessibility principles into digital urban transformation. The presented tool implements a structured methodology for evaluating accessibility in buildings and built environments. The methodology builds upon the comprehensive accessibility assessment framework developed in WP8, particularly within Task T8.1, which defines the structured accessibility assessment scheme, including measurable criteria, guidelines, and performance indicators for the built environment. The tool operationalizes this framework by translating the conceptual assessment scheme into a scalable digital evaluation mechanism capable of supporting large-scale accessibility assessments.

The AccesS Accessibility Assessment model implemented in the tool follows a hierarchical model that organizes accessibility evaluation into multiple analytical layers. This hierarchical structure enables the systematic decomposition of accessibility requirements into progressively more detailed elements, facilitating structured analysis and quantitative evaluation. The model is composed of three primary layers: Disability Types (DT), Assessment Dimensions (AD), and Evaluation Criteria (EC) forming a structured hierarchy in which high-level user perspectives are progressively translated into specific and measurable accessibility requirements. The weighted scoring methodology enables consistent, transparent, and multi-dimensional evaluation of accessibility performance, facilitating the identification and prioritisation of accessibility barriers across different stages of the building lifecycle. This approach supports comparability across building configurations and contributes to the development of evidence-based accessibility improvement strategies.

The deliverable further documented the implementation of a modular and interoperable digital platform that supports large-scale accessibility assessment workflows. The tool integrates user-oriented interfaces for assessment configuration and execution, interactive visualization mechanisms for accessibility performance analysis, and automated reporting functionalities.

Future activities will focus on the validation and demonstration of the tool in large-scale pilot environments, the refinement of assessment criteria and scoring mechanisms based on stakeholder feedback, and the further integration of the platform with complementary digital services and simulation tools developed within the project. These actions are expected to support technology maturity, facilitate exploitation pathways, and contribute to the long-term uptake of the AccesS accessibility assessment framework across European smart city and smart building initiatives.

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