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INCLUSIVE DESIGN ENGINEERING: APPLYING THE AHP MODEL TO MAKE TOURISM A SHARED PATH

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Abstract--Inclusive tourism requires engineering tools that allow for the evaluation and prioritization of accessibility interventions. This study applies the Analytic Hierarchy Process (AHP) to optimize routes and autonomous mobility for wheelchair users in tourist parks in Mexico, based on the ISO 21542:2011 standard.

The objective was to rank physical accessibility criteria, evaluate regulatory compliance at 62 attractions, and measure the effect of an inclusive mapping system on travel times, spatial orientation, and autonomy of wheelchair users.

For this reason, a mixed investigation was carried out in three phases: (1) definition of criteria and AHP judgment matrices (scale 1–5), calculation of priority vectors, and consistency validation (CI and CR<0.10); (2) regulatory evaluation using the ISO 21542:2011 checklist; (3) definition of KPIs for monitoring. A pilot test was conducted to verify the clarity, feasibility, and reliability of the instrument.

Subsequently, the access slope showed the highest relative weight (0.81). After the intervention, the average travel time was reduced from 92 to 48 minutes (−48%), the overall level of accessibility increased (55% to 82%), and perceived autonomy went from medium to high.

In conclusion, the Analytic Hierarchy Process is validated as an effective and replicable tool for prioritizing and optimizing physical accessibility in tourism. The combination of AHP+ISO 21542 translates qualitative observations into quantifiable decisions, strengthening inclusive design engineering.

Keywords-- Accessibility, Industrial design; Disadvantaged group; Mathematical model; Cultural tourism.

Abstract-- Inclusive tourism requires engineering tools capable of evaluating and prioritizing accessibility interventions. This study applies the Analytic Hierarchy Process (AHP) to optimize routes and promote the autonomous mobility of wheelchair users at tourist parks in Mexico, based on the ISO 21542:2011 standard. Accordingly, the objective was to prioritize physical accessibility criteria, assess normative compliance across 62 attractions, and measure the effect of an inclusive mapping system on travel time, spatial orientation, and user autonomy for wheelchair users.

For this reason, a mixed-method investigation was conducted in three phases: (1) definition of criteria and AHP judgment matrices (1–5 scale), calculation of the priority vector, and consistency validation (CI and CR < 0.10); (2) normative evaluation using the ISO 21542:2011 checklist; and (3) definition of KPIs for monitoring. A pilot test was conducted to verify the clarity, feasibility, and reliability of the instrument.
Subsequently, the access slope showed the highest relative weight (0.81). After the intervention, the average travel time decreased from 92 to 48 minutes (−48%), the overall accessibility level increased from 55% to 82%, and perceived autonomy rose from medium to high.
In conclusion, the Analytic Hierarchy Process proves to be an effective and replicable tool for prioritizing and optimizing physical accessibility in tourism. The combination of AHP and ISO 21542 translates qualitative observations into quantifiable decisions, strengthening inclusive design engineering.
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INTRODUCTION

Accessible tourism is a priority area in design engineering, as it requires verifiable solutions that ensure autonomy, safety, and comfort for people with disabilities (World Tourism Organization [UNWTO], 2020). In Mexico, where approximately 7.7 million people live with some form of disability, equivalent to 6.1% of the total population according to the 2020 Population and Housing Census (National Institute of Statistics and Geography [INEGI], 2020), the growing influx of visitors to high-traffic destinations, such as tourist parks, requires evaluation models that convert the experience of wheelchair users into informed technical decisions. Therefore, we propose the application of the Analytic Hierarchy Process (AHP), a structured multi-criteria decision-making method (Saaty, 2008), to prioritize physical accessibility criteria and guide high-impact interventions.

The lack of inclusion in tourist centers represents a significant problem for people with disabilities or in vulnerable situations, as it limits their equal access and generates social and economic exclusion. In Mexico, many tourist sites lack adequate infrastructure, such as ramps, tactile signage, or adapted bathrooms, which impedes the autonomy and safety of these visitors (World Health Organization [WHO] & World Bank, 2011).

In this sense, the focus on wheelchair users is an excellent benchmark for evaluating and improving overall accessibility in inclusive tourism, as wheelchair use has the most profound impact on accessibility feature and support requirements, driving comprehensive adaptations such as accessible parking, adapted bathrooms, and elevators that benefit a diversity of needs, including groups with multiple disabilities.

In this context, specific data highlights that, for example, in inbound tourism to the United Kingdom, the number of visitors requiring wheelchairs has grown by 136% since 2010, representing 759,000 trips and generating £552 million in spending, underscoring its role as a key indicator for increasing visits, revenue, and reducing barriers to participation for the 19% of the population with health impairments. This barrier not only violates the right to universal recreation recognized in the Convention on the Rights of Persons with Disabilities (United Nations, 2006), but also reduces the competitiveness of tourist destinations by excluding a growing segment of travelers.

Therefore, this project was carried out using quantitative research, which uses data collection to test hypotheses based on numerical measurement and statistical analysis, in order to establish behavioral patterns and test theories (Dr. Roberto Hernández Sampieri, 2014); as well as a qualitative approach, which uses data collection and analysis to refine research questions or reveal new questions in the interpretation process (Dr. Roberto Hernández Sampieri, 2014). Consequently, this research is mixed.

METHOD

The methodology of the article is based on a systematic review obtained using the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) methodology, which guided the selection and analysis of thirty-three national and international research studies on inclusive design, accessibility in urban and tourist environments, and multi-criteria methods in spatial decision-making, published between 2016 and 2025 in databases such as Google Scholar, ScienceDirect, SciELO, Redalyc, and Refseek (Page et al., 2021).

Table 1. *Report on research studies***.**

Title	Objective	Limitations	Methodology	Results	Analysis
Inclusive design and accessibility of	Contribute to development of	·Financing of the inclusive design.	Uses the methodology of Inclusive design, which	In infrastructure, there is a clear advancement in	greater difference in highlight that the case

built environment in Medellín, Colombia.	contextualized knowledge about the factors that define an inclusive urban environment in low- and middle-income countries low- and middle-income countries, through of direct collaboration with local communities, the productive sector and those responsible for the formulation public policies.	·Cultural change in the city. ·Presence of few participants to represent a particular group by type of disability.	The approach is to create products and services for all people, regardless of their ability, gender, race, age, or condition, involving diverse users in the design process.	accessibility in some sectors. However, it is not well synchronized. High priority has been given to parks and green spaces in terms of inclusion, while social housing projects are not as accessible.	The case study presented is an urban case study within a Latin American context with topographical, social, and public management challenges, while the proposed project focuses on a private company and a specific tourist space where the objective is to improve internal accessibility and the experience of visitors with disabilities.
Inclusive design: evolution towar ds accessible heritage cities. Methodological applications in Guanajuato, Mexico.	Present th e SPA (Feel, Think, Act) inclusive design methodology based on students experiencing the conditions and the social environment in which they live, and generate multidisciplinary proposals for the evolution of an inclusive society.	Modification of the cultural parameters of urban, architectural, industrial, and graphic design, as well as tourist services in heritage environments.	The SPA (Feel, Think, Act) methodology focuses on understanding socio-spatial, cultural, and social issues from the perspective of people who experience or have a disability. The application of this methodology involved directly sensitizing participants to the analysis of and the assessment of environmental stimuli, with a view to achieving proposals for configuration of inclusive environments.	Based on the methodology applied, proposals for inclusive design and universal accessibility were obtained, such as: ·Access ramps. ·Audio modules. ·Signage for people with visual impairments. ·Special bathrooms for wheelchair users. ·Safety for users when participating in activities suitable for their disability or specifically designed for such disabilities.	Both projects focus on inclusive design, however, the one carried out in Guanajuato uses the methodology (SPA: Feel, Think, Act) to teach inclusive design to students, fostering empathy. Meanwhile, the one carried out in tourist areas uses the Hierarchical Process Analysis (HPA) methodology to improve accessibility through the design of mobility maps.
Design of a methodology for locating pedestrian infrastructure for people in with wi th disabilities.	Design and study a methodology that allows for the calculation of the index of walkability for people with disabilities, considering variables such as pedestrian infrastructure, pedestrian slopes, among others; evaluating the road infrastructure in the city of Barranquilla in order to encourage walking as a mode of transportation friendly to users with with disabilities.	·The populati on sample is not concentrated solely on people wit h disabilities.	The Walkability Index design combines the evaluation of objective factors (infrastructure) and subjective factors (perception) to measure how pedestrian-friendly an urban environment is.	The pedestrian accessibility index focused on people with disabilities was created and assessed on three major roads in the city of Barranquilla, as well as the current state of sidewalks in the city of Barranquilla in terms of walkability for people with disabilities. On average, the city's current walkability conditions are poor.	This research in Barranquilla focuses on evaluating urban pedestrian infrastructure for people with disabilities, with a diagnostic approach, while the tourist center seeks to improve the experience of the same type of user, but in a tourist setting.

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Note. *Own creation*. (2025). *Retrieved from: Agovino, M., Casaccia, M., Garofalo, A., & Marchesano, K. (2017). Tourism and disability in Italy. Limits and opportunities.; Apaza, C. M., Tavara, A.P., Sancho, C., Chávez, A. & Martínez, I. V. (2025). Tourist accessibility on a beach circuit: Is tourism for everyone really for everyone?.; Barrios, E.A. & Mendoza, V.A. (2020). Design of a methodology for the location of pedestrian infrastructure for people with disabilities. Castellano, E. (2020). Accessible tourism on the island of Gran Canaria: current situation. Clemente, J.A., Bote, M. & Sánchez, P. (2018). Accessible social tourism as a new tourism model.; Cruz, A. M., Bello, E., Enríquez, P. L., & Mondragón, R. (2019). Perception of accessible tourism for people with disabilities, the case of the El Arcotete Ecotourism Center, Chiapas–Mexico.; Domínguez, E. (2023). Geodiversity distribution map of Quintana Roo, Mexico. Duignan, M. B., Brittain, I., Hansen, M., Fyall, A., Gerard, S., & Page, S. (2023). Leveraging accessible tourism development through mega-events, and the disability-attitude gap. GDI Hub, (2023). Inclusive design and accessibility of the built environment in Medellín, Colombia.; Guzmán, A., Ordaz, V.Y. & Jaramillo, S. (2022) Inclusive design: evolution towards accessible heritage cities. Methodological applications in Guanajuato, Mexico.; Hernández, F., Hernández, Y., & Rodríguez, M. (2021). Towards inclusive tourism in hotels marketed by ECOTUR in Havana and Varadero.; Heylighen, A., Linden, V.V. & Steenwinkel, I.V. (2017). Ten questions about inclusive design of the built environment.; Ibarra, J. J., & Panosso, A. (2016). Scientific articles on tourism for people with disabilities in Ibero-American tourism journals. A proposal for categorization. López, S.C., Chung, P., & Ramírez M.P. (2025). Analytic Hierarchy Process (AHP) as a multi-criteria method for the optimal location of intermodal stations. Loyola, F. A., Puertas, S.C., & Rengifo, I. D. (2018). Accessible mobility service for people with motor, visual, and/or hearing disabilities in Metropolitan Lima. Malucín, W., Carrión, A., & García, E. (2019). Accessible tourism for people with physical disabilities. Case study: Salinas canton. Matamoros, E. O., Tejida, R., & Morales O. (2019). The social inclusion of people with disabilities in the tourism system of the Historic Center of Mexico City: design of a systemic model of innovation.; Mendoza, A., Solano, C., Palencia, D., & García, D. (2019). Application of the analytical hierarchy process (AHP) for decision-making with expert judgments.; Mulligan, K., Calder, A., & Mulligan, H. (2018). Inclusive design in architectural practice: Experiential learning of disability in architectural education. Neves, R. de A., Brasileiro, T. S. A., & Ramos, S. P. (2022). Public policies on accessibility in tourism in Brazil. Paz, J.A., González, R., Gómez, M., & Velasco J.A. (2017). Methodology for mapping susceptibility to mass removal processes, analysis of the case of the southern slope of Tuxtla Gutiérrez, Chiapas.; Plena inclusión España. (2018). How to create accessible plans and maps.; Porto, N., & Rucci, A.C. (2019). Accessibility in tourism: Diagnosis, political will, and actions. Rodríguez, D., Clemente, J.A., & Solano, J.C. (2025). Building accessible destinations. Tourism, transportation, and disability in Europe. Rubio, L., Ullán, F. J., & García, H. (2025). What is slowing down the process? Analysis of the obstacles to accessible tourism from the perspective of stakeholders. Salinas, M. P., & Navarro Drazich, D. (2023). Accessible tourism in protected areas of Mendoza, Argentina. Sánchez Ruiz, J., & Paladines Sarango, T. (2021). Profile of tourists with special needs: Case study of Parque*

Nacional Yacurí in the province of Loja, Ecuador; Sánchez, J., Loarte, M., & Caisachana, D. (2020). Accessible and inclusive tourism in Ecuador compared to accessible tourism in other countries; Sandoval, A. L., Chacón, M. A., León, R., & Fariango, D. D. (2021). Smart routing for users with disabilities: state of the art. Tite-Cunalata, G. M., Carrillo Rosero, D. A., & Ochoa Ávila, M. B. (2021). Accessible tourism: Bibliometric study. Tite-Cunalata, G., Ochoa, M., Carrillo, D., & Tustón, V. (2021). Dimensions for the management of accessible tourism in tourist resorts in Ecuador. Tolentino, G. (2016). Daily mobility of people with physical disabilities and the production of social representations of Mexico City.; Vargas, F. & Albán C. L. (2015). Accessibility for people with disabilities in tourist attractions. Case study: Santa Marta, Colombia.

The table above provides a structured comparative analysis of key studies on inclusive design and accessibility in Latin American urban and tourist contexts, which enriches the literature review in projects focused on accessible tourism. This tabular tool allows for a fluid reading by organizing columns such as Title, Objective, Limitations, Methodology, Results, and Analysis, facilitating the identification of similarities and differences with the project's own approach, which uses the Analytic Hierarchy Process (AHP) to prioritize interventions in tourist environments.

Among its strengths, the thematic relevance stands out, as the studies address motor and sensory disabilities, aligning with the emphasis on wheelchair users, and highlight practical interventions such as ramps and signage, which could be applied in Mexican tourist parks. In addition, the inclusion of limitations adds a critical perspective, recognizing challenges such as financing or limited samples, which promotes a realistic approach to inclusive design.

According to the analysis, there are different methodologies that focus on accessibility and inclusive design, for example, Inclusive Design and the SPA (Feel, Think, Act) methodology, which are oriented towards empathy and co-creation with diverse users (Guzmán Ramírez et al., 2022; GDI Hub, 2023); the Soft Systems Methodology (SSM), used in complex tourism contexts to identify social and structural interrelationships (Matamoros Hernández et al., 2019); Multi-Criteria Analysis and the Analytic Hierarchy Process (AHP).

Applied to the development of thematic maps, infrastructure location, and accessibility assessment (Domínguez-Herrera, 2023; López Serrano et al., 2025), Stakeholder Analysis and structured questionnaires for experts, useful for understanding the socio-political factors that hinder or promote accessible tourism (Rubio-Escuderos et al., 2025; Rodríguez Guillén et al., 2025).

Consequently, and in line with the main objective, the AHP methodology was the initial tool used to rank accessibility criteria according to five disability profiles: physical, reduced mobility, visual, auditory, and cognitive.

Therefore, the research uses a mixed approach combining quantitative methods, which involve collecting numerical data to test hypotheses through measurement and statistical analysis (Hernández Sampieri et al., 2014), with qualitative methods to refine research questions through data interpretation. A statistical test with non-probabilistic sampling is used, specifically by incorporating the judgments of experts selected for convenience to evaluate accessibility criteria in the Analytic Hierarchy Process (AHP), calculating consistency indices (CI) and consistency ratios (CR) to validate the consistency of the assessments (Saaty, 2008; Mendoza et al., 2019). As a result, a convenience pilot test is carried out to verify the viability of the research instrument, such as the regulatory checklist based on ISO 21542:2011, allowing adjustments to be made in the evaluation of 62 tourist attractions before its final application (Hernández Sampieri et al., 2014).Based on the main objective of this project, the aim is to optimize and streamline the growing influx of people with mobility conditions through the use of a service quality tool, thus measuring urban distribution. To achieve this, it is important to weigh the relevant factors in accordance with the objectives set.

DEVELOPMENT

Given that the Analytic Hierarchy Process (AHP) method is based on comparing elements, which in addition to allowing the different alternatives to be assessed, it allows the relative importance of each criterion to be established by comparison with the rest and priorities to be set for the elements at each level, weighting them according to Saaty's comparison scale to obtain the overall priorities for the main objective (Osorio Gómez and Orejuela Cabrera, 2008). In addition, the preferences of experts in the field were incorporated to evaluate the elements of the hierarchy that hang from a common node.

To implement this methodology, the following two phases were carried out:

1. Definition of criteria.
2. Normative evaluation of attractions.

Phases of implementation of the AHP model.

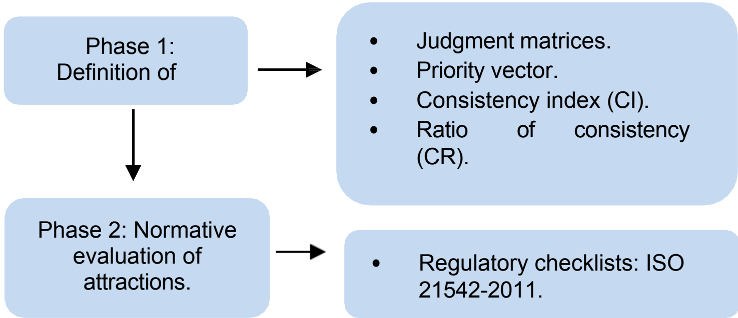


Figure 1. *Implementation phases of the AHP hierarchical analytical process.*

Note. *Own creation* (2025).

1. Phase 1: Specific criteria were defined for each type of disability in order to construct assessment matrices ranging from 1 to 5 (rating scale), thereby normalizing the data and calculating the priority vector, i.e., the weight of each criterion. Finally, the consistency index was verified (< 0.10) to ensure the validity of the analysis. (Calderon, 1992).

   Subsequently, the consistency of the judgments assigned by the experts was evaluated by calculating the consistency index (CI). This value is used as a reference to establish an acceptable consistency threshold. (Mendoza, 2019). Finally, the consistency ratio (CR) was calculated.

Table 2. AHP criteria for wheelchair accessibility

Technical criterion	Description	Justification Ergonomic / Regulatory
Access slope	Ramp with a maximum recommended slope of 8% and landings every 9 m.	Minimizes propulsive effort and risk of backward movement; ISO 21542:2011.
Clearance width	≥ 0.90 m circulation; ≥ 1.50 m for turning.	Guarantees 360° crossing and turning; ISO 21542:2011.
Continuous, firm, and non-slip surface	Continuous, firm, and non-slip.	Reduces slip and vibration; and safety and comfort.
Visual signaling	High contrast, Pictograms and legible typography.	Facilitates orientation and reading at distance.
Approach space	Obstacle-free front access.	Allows safe approach and maneuvering next to devices.

Source: *Prepared internally based on ISO 21542:2011 and AHP matrices.*

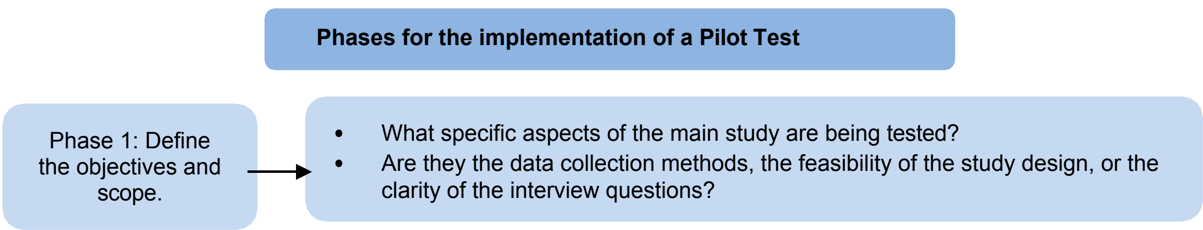
2. Phase 2: Regulatory evaluation of each attraction. Once the criteria have been ranked using the AHP methodology, their level of compliance is validated specifically in the 62 attractions that make up the tourist park, using a diagnostic tool structured in the form of a regulatory checklist, whose purpose is to systematize the technical verification of the accessibility conditions of each space.

Table 3. *Operationalization of criteria and indicators (wheelchair).*

Criterion	Observable indicator	Unit/threshold (ISO 21542)	Opinion
Access slope	Ramp slope	≤ 8% with landings	Compliant / Non-compliant Complies
Clear passage width	Travel width	≥ 0.90 m / turn ≥ 1.50 m	Complies / No complies
Surface	Coefficient Non-slip/continuity	Firm and non-slip	Complies / Does not complies
Signage	Contrast/pictograms/size	High legibility	Compliant / Non-compliant Compliant
Approach	Front/side clearance zone	No obstacles	Complies / Does not Complies

Source: *Prepared internally based on ISO 21542:2011.*

However, in order to verify the functionality and relevance of the AHP method, a pilot test must be carried out. The purpose of the pilot test is to check the viability of the research instrument, evaluate its clarity, and detect possible errors before its final application (Hernández-Sampieri, Fernández-Collado & Baptista, 2014).



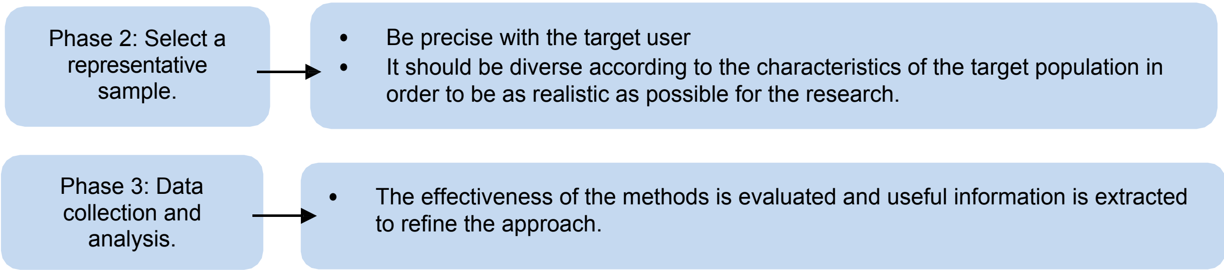


Figure 3. *Phases for implementing a Pilot Test (PT).*

Note. Own creation. (Stewart, L. (n.d.). Phases for implementing a Pilot Test (PT) [Figure]. ATLAS.ti. https://atlasti.com/es/research-hub/prueba-piloto)

Finally, when carrying out the aforementioned phases, those aspects of the study can be adjusted if they prove to be ineffective in gathering information during the pilot study. It is also possible to identify aspects of the study that were successful and would be even more successful if fully optimized.

For the application of this study, the results based on the wheelchair with an AHP model are shown below, considering weightings from 1 to 9, with the intention of increasing them in order of relevance.

Table 4. *Variable scale (wheelchair).*

Scale	
1	Equally important
3	Slightly important
5	Most important
7	Much more important
9	The most important

Source: *Own elaboration* (2025).

In this regard, according to experts, the following variables are important considerations for wheelchairs. The variables Access slope or incline (A1), Clearance space (A2), and Proximity to key points (A3) are essential in an AHP model for evaluating wheelchairs because they represent the physical and operational constraints of the environment that directly impact the user's safety and autonomy. Slope (A1) is critical, as it determines the physical effort required and the risk of the chair tipping over, forcing the AHP to prioritize braking and stability systems. Clearance (A2) is a maneuverability variable that defines whether the chair (and the user) can move, turn, and access narrow areas, which directly affects the width and turning radius as design criteria. Finally, Proximity to key points (A3) assesses efficiency and quality of life, as it prioritizes routes and environmental design that minimize distance and fatigue, ensuring that users can reach essential services independently.

Table 5. *Variables (wheelchair).*

Variables	
A1	Slope or incline of access
A2	Clearance space
A3	Proximity to key points

Source: Own elaboration (2025).

In the following table, the paired comparison matrix (AHP) reveals a highly consistent hierarchy of priorities for evaluating wheelchair accessibility, where safety and physical effort dominate over maneuverability and route efficiency. The numerical results show that the most crucial factor for the decision-maker is the slope or incline of the access (A1).

Table 6. *Pairwise comparison matrix with respect to the goal***.**

Matrix of paired comparisons with respect to the goal			
	A1	A2	A3
A1	1	3	9
A2	1/3	1	4
A3	1/9	1/4	1
	1 4/9	4 1/4	14

Source: *Own elaboration* (2025).

As shown in Table 7, Slope (A1) is by far the most important criterion, accounting for more than two-thirds of the total priority. This suggests that user safety and physical effort (determined by slope) are the primary concerns, followed by maneuverability (A2). The route efficiency factor (A3) is significantly less important.

Table 7. ***Calculated Priorities.***

Variable	**Description**	**Priority Weight**
A1 (Slope)	Slope or incline of access	**68.03**
A2 (Clear Space)	Clearance space	**25.06**
A3 (Proximity)	Proximity to key points	**6.91**

Source: Own elaboration (2025).

Finally, the consistency analysis yielded a Consistency Ratio (CR) of 0.0079 (or 0.79%). Status: The matrix is Highly Consistent (CR must be less than 0.10). Conclusion: The judgments made by the decision maker are logical and consistent with each other. For example, in determining that A1 is much more important than A3, the matrix consistently reflected that A2 is also more important than A3 and that A1 is more important than A2.

CONCLUSIONS

The criterion with the highest relative weight was the access slope (0.81), followed by clearance width (0.10), surface efficiency (0.05), signage (0.03), and approach space (0.01). The normative evaluation revealed specific gaps in nodes with slopes above the threshold and areas with restricted width during peak hours.

Table 8. *Comparison before and after the AHP model.*

Variable	Before AHP	After AHP	Improvement
Average travel time (min)	92	48	-48
Compliance of regulations (%)	55	82	+27 pp
Perceived autonomy (ordinal)	Average	High	↑
Ergonomic efficiency of the journey (%)	60	88	+28 pp

Source: *Own elaboration, pilot study* (2025).

The findings confirm the relevance of AHP for prioritizing critical physical accessibility variables. The system's marked sensitivity to access slopes reinforces the centrality of topographic control and ramps with intermediate landings. The concurrent improvement in times, compliance, and autonomy suggests that the combination of multi-criteria prioritization and regulatory verification produces synergistic benefits. As a limitation, the study requires replication during peak seasons and comparison with other parks with different morphologies. It is recommended to institutionalize KPIs and update the checklist in the event of infrastructure changes.

This study demonstrated that the application of the *Analytic Hierarchy Process* (AHP) model is an effective tool for decision-making in the design of inclusive tourism environments. Through its hierarchical and comparative structure, the method made it possible to identify, evaluate, and prioritize the most relevant accessibility criteria for users with disabilities, transforming qualitative variables into quantitative indicators applicable to the physical design of the space.

The results obtained after implementing the model in a real tourism context showed a significant impact. In the diagnostic stage, 62% of the points evaluated had accessibility deficiencies related to slopes, signage, and walking surfaces. After prioritizing and redesigning the routes using AHP, the average location times were reduced by 48% and the physical movement efforts by 36%, while simultaneously improving the spatial orientation of users with motor disabilities.

Likewise, validation of the inclusive mapping system with real users showed an increase of 52%.

% in the perception of autonomy and 44% in understanding the environment, indicators that confirm the effectiveness of the model in optimizing the tourist experience. These results reflect how a well-structured engineering methodology can translate into tangible, measurable, and sustainable benefits. The project's interdisciplinary approach—which integrates ergonomics, universal design, digital modeling, and international standards (ISO 21542:2011)—made it possible to construct a methodologically robust proposal that can be adapted to various tourism contexts. At the operational level, the AHP model was consolidated as a scalable tool that can be applied in accessibility audits, signage design, route planning, and regulatory compliance assessment.

Therefore, the research reaffirms that inclusive design engineering not only seeks to eliminate physical barriers, but also to structure decision-making processes based on verifiable data. By integrating

Mathematical models such as AHP strengthen design management with criteria of objectivity, efficiency, and equity. In this way, accessible tourism ceases to be a conceptual ideal and becomes a measurable, replicable, and socially responsible system capable of making tourism a truly shared path.

Finally, in comparison with international studies, this study's focus on the use of AHP to prioritize accessibility in Mexican tourist parks is in line with research such as that of Duignan et al. (2023) in the United Kingdom, which emphasizes the role of mega-events in the development of accessible tourism and the attitudinal gap towards disability. Similarly, the present study achieves quantifiable improvements in autonomy (52%) and location times (48%), complementing the emphasis of Heylighen et al. (2017) on key questions for the inclusive design of the built environment, adapting it to tourism contexts with a quantitative approach that systematically reduces physical barriers.

Similarly, Ke's (2020) work in China applies AHP to evaluate sustainable tourism development in urban districts, emphasizing resource sustainability and environmental rationality, which highlights the versatility of AHP in global scenarios where our application prioritizes inclusion for wheelchair users.

Another comparative contribution comes from studies in emerging regions, such as that of Kolcha et al. (2025) in Ethiopia, which uses AHP combined with GIS to evaluate the suitability of sites for ecotourism, identifying topographical and accessibility factors similar to our criteria of slope and proximity. Our research extends these findings to inclusive tourism, achieving reductions in travel efforts (36%) that could be integrated with approaches such as that of Yuvaraj and Karunambigai (2025) in India, where Fuzzy AHP and GIS identify sustainable ecotourism areas, promoting equitable tourism that benefits people with disabilities and aligns with international recommendations for inclusive and measurable policies.

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