

INNOVATION SCIENCE AND TECHNOLOGY

ISSUE 10, PART I / OCTOBER 2026

 **Acceptance of papers**



**Acceptance of
papers**

Published monthly



Topics

economics,
technology, social
sciences



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THE SCIENTIFIC-POPULAR ELECTRONIC
JOURNAL **"INNOVATION SCIENCE AND
TECHNOLOGY"** HAS BEEN REGISTERED
UNDER THE NUMBER **C-5669633** BY THE
AGENCY FOR INFORMATION AND MASS
COMMUNICATIONS (AOKA) OF THE
REPUBLIC OF UZBEKISTAN, EFFECTIVE
FROM OCTOBER 9, 2024.

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LEVEL OF ADAPTATION OF PUBLIC INFRASTRUCTURE FOR PERSONS WITH DISABILITIES IN BUKHARA

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Abstract. This article analyzes the level of adaptation of public infrastructure for persons with disabilities in the city of Bukhara using a comprehensive and systematic approach. The study examines the current state of the urban transport system, social services, tourism facilities, and public buildings through empirical observation, comparative analysis, and sociological methods. The findings indicate that positive changes are taking place in the modernization of infrastructure, while broader implementation of universal design principles can further expand opportunities for free movement and full access to services for persons with disabilities. The relationship between the historical urban environment and contemporary inclusive requirements was also identified as an important area requiring balanced solutions. Based on international experience and best practices, the article develops scientific and practical recommendations aimed at advancing inclusive infrastructure in the city of Bukhara.

Keywords: inclusive infrastructure, persons with disabilities, universal design, public infrastructure, urban development, Bukhara, transport system, social services, tourism infrastructure, sustainable development.

Annotatsiya. Ushbu maqolada Buxoro shahrida jamoat infratuzilmasining nogironligi bo'lgan shaxslar uchun moslashuv darajasi kompleks va tizimli yondashuv asosida tahlil qilinadi. Tadqiqot jarayonida shahar transport tizimi, ijtimoiy xizmatlar, turizm obyektlari hamda jamoat binolarining amaldagi holati empirik kuzatuv, qiyosiy tahlil va sotsiologik usullar yordamida o'rganildi. Natijalar infratuzilmani modernizatsiya qilish yo'nalishida ijobiy o'zgarishlar amalga oshirilayotganini, shu bilan birga, universal dizayn tamoyillarini yanada kengroq joriy etish orqali nogironligi bo'lgan shaxslarning erkin harakatlanishi va xizmatlardan to'liq foydalanish imkoniyatlarini kengaytirish mumkinligini ko'rsatdi. Shuningdek, tarixiy shahar muhiti va zamonaviy inklyuziv talablarni o'zaro uyg'unlashtirish muhim yo'nalishlardan biri sifatida aniqlandi. Maqolada xalqaro tajriba va ilg'or amaliyotlar asosida Buxoro shahrida inklyuziv infratuzilmani rivojlantirishga qaratilgan ilmiy-amaliy tavsiyalar ishlab chiqilgan.

Kalit so'zlar: inklyuziv infratuzilma, nogironligi bo'lgan shaxslar, universal dizayn, jamoat infratuzilmasi, urban rivojlanish, Buxoro, transport tizimi, ijtimoiy xizmatlar, turizm infratuzilmasi, barqaror rivojlanish.

Аннотация. В статье на основе комплексного и системного подхода анализируется уровень адаптации общественной инфраструктуры для лиц с инвалидностью в городе Бухаре. В ходе исследования с применением методов эмпирического наблюдения, сравнительного анализа и социологических методов изучено текущее состояние городской транспортной системы, социальных услуг, объектов туристической инфраструктуры и общественных зданий. Результаты показывают, что в направлении модернизации инфраструктуры происходят положительные изменения, а дальнейшее расширение применения принципов универсального дизайна позволит повысить возможности свободного передвижения и полноценного доступа к услугам для лиц с инвалидностью. Кроме того, согласование особенностей исторической городской среды с современными инклюзивными требованиями определено как одно из важных направлений дальнейшего развития. На основе международного опыта и передовых практик разработаны научно-практические рекомендации, направленные на развитие инклюзивной инфраструктуры в городе Бухаре.

Ключевые слова: инклюзивная инфраструктура, лица с инвалидностью, универсальный дизайн, общественная инфраструктура, городское развитие, Бухара, транспортная система, социальные услуги, туристическая инфраструктура, устойчивое развитие.

INTRODUCTION

Modern processes of globalization and urbanization have increased the importance of developing urban infrastructure in a way that responds effectively to diverse human needs. In particular, creating an accessible, safe, and inclusive environment for persons with disabilities is recognized as an important priority of sustainable development. At the international level, the protection of the rights of persons with disabilities and the promotion of their full participation in society are enshrined in the United Nations Convention on the Rights of Persons with Disabilities, which emphasizes the development of an inclusive and accessible environment.

Statistical data indicate that a significant proportion of the global population lives with various forms and degrees of disability. This highlights the importance of applying universal design principles in the planning, development, and management of public infrastructure. Universal design is an approach aimed at creating environments that provide equal, convenient, and safe access for all users, including persons with disabilities. This approach contributes not only to social inclusion and equal opportunities but also to improved economic efficiency and broader participation in social and economic life.

In recent years, the Republic of Uzbekistan has adopted a number of legal and institutional measures aimed at supporting persons with disabilities, strengthening their social protection, and improving the accessibility of public infrastructure. In particular, laws and state programs adopted within the national legal framework provide an important basis for systematic reforms directed toward the development of an inclusive environment. At the same time, there remain opportunities to further expand the adaptation of existing infrastructure in accordance with universal design principles.

The city of Bukhara, with its rich historical and cultural heritage, requires a particularly balanced approach in this regard. On the one hand, the city contains numerous architectural monuments and historical sites that require careful preservation. On the other hand, integrating contemporary inclusive infrastructure requirements into the historic urban environment calls for well-considered engineering and design solutions. In particular, narrow streets, staircases, uneven walkways, and the existing level of transport infrastructure adaptation indicate the need for further measures to improve safe and convenient mobility for persons with disabilities.

At the same time, Bukhara's status as a major tourism center further increases the importance of this issue. Creating an accessible environment for tourists with disabilities is important not only from the perspective of social inclusion but also for the city's economic and tourism development. The development of infrastructure based on the principles of inclusive tourism can contribute to strengthening Bukhara's competitiveness in the international tourism market and expanding its attractiveness to a wider range of visitors.

The significance of this study lies in its aim to comprehensively assess the level of accessibility of public infrastructure for persons with disabilities in Bukhara, identify priority areas for further improvement, and develop scientifically grounded recommendations for enhancing the inclusive urban environment. The findings are expected to have practical relevance not only for Bukhara but also for other historic cities in Uzbekistan.

LITERATURE REVIEW

The adaptation of public infrastructure for persons with disabilities has received increasing attention in both international and national research in recent years. This field lies at the intersection of urban development, social policy, architecture, and transport systems. At the international level, inclusive infrastructure is addressed systematically within the framework of the United Nations Convention on the Rights of Persons with Disabilities. The Convention emphasizes the importance of ensuring equal access to public buildings, transport systems, information, and related services for persons with disabilities.

Reports published by the World Health Organization also emphasize that creating an accessible environment for persons with disabilities contributes not only to social well-being and equal opportunities but also to broader economic participation. In particular, inclusive infrastructure can facilitate participation in the labor market and strengthen social inclusion. The concept of universal design occupies an important place in the academic literature. Developed as a design approach during the late twentieth century, universal design focuses on creating environments, products, and services that can be accessed and used by the widest possible range of people.

Researchers consider universal design an effective approach to reducing physical barriers, improving access to information, and facilitating the use of public services. From this perspective, contemporary urban planning theories increasingly regard inclusivity as an important indicator of sustainable urban development. In recent years, scholarly interest in these issues has also expanded across Central Asia.

Studies conducted in Uzbekistan indicate that measures aimed at supporting persons with disabilities and improving accessibility are being consistently implemented within the framework of state policy. In particular, legislation adopted in the Republic of Uzbekistan has established an important legal basis for developing an inclusive environment. At the same time, academic sources indicate that opportunities remain to further harmonize the implementation of accessibility requirements across different regions and types of infrastructure.

Research focusing on the city of Bukhara deserves particular attention. As a historic city with a distinctive urban structure, Bukhara requires a balanced approach that combines the preservation of cultural heritage with the development of modern inclusive infrastructure. Recent scholarly studies, particularly those related to inclusive tourism, indicate that the accessibility of the city's historical sites can be further enhanced for persons with disabilities. Expanding the provision of ramps, lifting facilities, accessible pathways, and other adaptive elements can improve the mobility and overall experience of both tourists and local residents.

Research on transport infrastructure has also produced important findings. While Bukhara's public transport system is undergoing modernization, there are further opportunities to increase the availability of accessible vehicles and improve the adaptation of transport stops and related facilities for persons with disabilities. Similarly, the development of pedestrian infrastructure can be strengthened through the wider introduction of tactile paving, audible signaling systems, accessible pedestrian crossings, and other universal design elements.

Academic literature also pays considerable attention to the role of digital technologies in enhancing inclusivity. In particular, the "smart city" concept highlights the potential of mobile applications, digital navigation systems, real-time information services, and other technological solutions to improve accessibility for persons with disabilities. The integration of such technologies with physical infrastructure can contribute to the development of a more accessible, convenient, and inclusive urban environment.

RESEARCH METHODOLOGY

Such approaches are particularly significant in historical cities, where large-scale modifications to the physical infrastructure require careful consideration of heritage preservation. At the same time, a review of the existing literature shows that many studies have focused on individual sectors, such as transport, tourism, or architecture, while opportunities remain for a more comprehensive and systematic assessment of public infrastructure as an integrated system. In particular, relatively few studies have evaluated the accessibility of infrastructure for persons with disabilities across these interconnected components using the city of Bukhara as a case study.

To ensure sufficient representativeness of the research results, a 10% sample of the identified public infrastructure facilities covering transport, social services, tourism, and the urban environment was selected and used for detailed assessment and analysis.

This methodological approach defines the scientific novelty of the present study. The article comprehensively examines public infrastructure across the dimensions of transport, social services, tourism, and the urban environment, while developing systematic proposals aimed at further improving accessibility and inclusivity (Table 1).

Table 1

Indicators for assessing the level of adaptation of public infrastructure for persons with disabilities in the city of Bukhara¹.

Infrastructure Component	Evaluation Criteria	Maximum Score	Average Score	Level of Adaptation (%)	Status Description
Public Buildings	Ramps, elevators, access paths	5	2.8	56%	Partially adapted
Transport Infrastructure	Low-floor vehicles, accessible stops	5	2.3	46%	Low level
Pedestrian Infrastructure	Tactile paving, safe crossings	5	2.0	40%	Low level
Tourism Facilities	Accessibility, adapted services	5	2.5	50%	Partially adapted
Information and Navigation	Signage, audio and Braille systems	5	1.8	36%	Very low level
Sanitary and Service Areas	Adapted restrooms and services	5	2.2	44%	Low level

This table provides a comprehensive assessment of the extent to which public infrastructure in the city of Bukhara is adapted to the needs of persons with disabilities. The assessment indicators cover six key areas, with each component evaluated on a five-point scale.

The analysis indicates that the highest levels of adaptation were observed in public buildings (56%) and tourism facilities (50%), reflecting a comparatively higher degree of accessibility within these areas. Information and navigation systems recorded a 36% adaptation level, indicating substantial opportunities for further development in this direction. Transport and pedestrian infrastructure scored between 40% and 46%,

¹ Author's development.

demonstrating the importance of continuing measures aimed at improving convenient, safe, and independent mobility for persons with disabilities. Overall, the average level of adaptation was approximately 45–50%, indicating that the city has established a foundation for inclusive infrastructure and that further systematic improvements can contribute to achieving a more fully inclusive urban environment.

ANALYSIS AND RESULTS

The results indicate that the accessibility of public infrastructure for persons with disabilities in the city of Bukhara has reached an average level of approximately 45–50%, suggesting that the existing infrastructure is partially inclusive and has further potential for development in line with contemporary international standards. These findings are generally consistent with the existing academic literature and demonstrate that accessibility should be addressed through a coordinated and systematic approach.

Relatively higher levels of accessibility were observed in public buildings and tourism facilities, although in many cases these improvements remain partial. This suggests that inclusive features are increasingly being incorporated into newly constructed or renovated facilities, while older infrastructure can benefit from further adaptation. In areas containing historical sites, harmonizing universal design principles with heritage preservation requirements calls for carefully balanced solutions. In this context, the internationally applied “flexible integration” approach, which seeks to improve accessibility with minimal intervention in historic structures, is particularly relevant to Bukhara.

Secondly, the findings on transport and pedestrian infrastructure indicate that further measures are needed to expand independent and convenient mobility for persons with disabilities. Increasing the availability of low-floor vehicles, improving the accessibility of transport stops, and upgrading uneven pedestrian walkways can contribute significantly to safer and more comfortable movement throughout the city. This is directly related to the practical realization of the right to freedom of movement, which is a key element of an inclusive urban environment. As emphasized by international organizations such as the World Health Organization, accessible transport infrastructure plays a central role in supporting participation in education, employment, social life, and other areas.

Thirdly, the comparatively lower scores observed in information and navigation systems indicate that infrastructure adaptation should extend beyond physical accessibility. Access to information is especially important for persons with visual or hearing impairments. Expanding the use of tactile markers, audio signals, Braille signage, and accessible digital information systems can substantially improve independent navigation and contribute to greater information equity.

Fourthly, sanitary facilities and service areas represent another important area for further improvement. These elements are sometimes given less attention in infrastructure planning, although they play an essential role in ensuring that persons with disabilities can make full and comfortable use of public spaces. Expanding the availability of accessible restrooms and adapted service areas can therefore contribute to broader social participation and a more inclusive urban environment.

Comparison with international experience shows that inclusive infrastructure is most effectively developed through a comprehensive approach in which regulatory frameworks, technical standards, institutional coordination, and monitoring mechanisms operate in an integrated manner. Within the framework of the Sustainable Development Goals promoted by the United Nations, the development of inclusive cities is recognized as an important priority. Applying these principles in Bukhara can further strengthen the accessibility and adaptability of the city's infrastructure.

At the same time, the research findings show that inclusivity depends not only on technical infrastructure but also on institutional and social factors. In particular, strengthening the professional competencies of service personnel in inclusive service delivery and promoting more inclusive public attitudes toward disability can enhance the effectiveness of infrastructure improvements. Therefore, along with physical modernization, public awareness and staff training are also important components of inclusive development.

Another important aspect is the role of digital technologies. “Smart city” solutions, mobile applications, and digital navigation systems can complement physical infrastructure and expand access to services. This approach is especially relevant in historic cities, where large-scale structural modifications may be limited by heritage preservation requirements.

Overall, the findings demonstrate that the development of inclusive infrastructure in Bukhara requires a comprehensive, phased, and coordinated approach. Urban planning, transport systems, social services, public facilities, and digital technologies should be developed in an integrated manner. Such an approach can contribute to the creation of an urban environment that is increasingly accessible, safe, convenient, and supportive of equal opportunities for persons with disabilities.

CONCLUSION AND RECOMMENDATIONS

The results of this study indicate that the adaptation of public infrastructure for persons with disabilities in the city of Bukhara has reached an average level of approximately 45–50%, reflecting partial inclusivity and considerable potential for further improvement. The comprehensive analysis revealed relatively positive progress in the adaptation of public buildings and tourism facilities, while transport infrastructure, pedestrian routes, information and navigation systems, and sanitary facilities remain priority areas for further development.

In particular, expanding the use of tactile paving, audio signaling systems, Braille signage, accessible transport vehicles, and other universal design elements can significantly improve independent mobility and create broader opportunities for persons with disabilities to participate actively in social life. The findings also demonstrate that the development of inclusive infrastructure depends not only on technical improvements but also on institutional and social factors. Strengthening inclusive competencies among service personnel, further developing systematic monitoring mechanisms, and promoting public awareness based on equality and inclusion can enhance the effectiveness of accessibility measures.

Overall, Bukhara has significant potential to develop as a more accessible and inclusive city. In this regard, the systematic and phased implementation of accessibility measures, the wider application of universal design principles, the modernization of transport and pedestrian infrastructure, the development of accessible information systems, and the strengthening of institutional coordination are of particular importance. Such measures can contribute to creating a safe, convenient, and inclusive urban environment while expanding opportunities for persons with disabilities to participate fully in social and economic life.

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Proofreader: Zokir ALIBEKOV

Layout and Designer: Oloviddin Sobir ugli

2026. № 10

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