

Accessible Disaster Management: Information-Based Solutions for Individuals with Disabilities

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To Cite This Chapter:

Uzun, Y., Uzun, F. N., & Kumcu, Ş. Y. (2025). Accessible disaster management: Information-based solutions for individuals with disabilities. In F. Z. Saltan, H. Arıkan, & Y. Uzun (Eds.), *Current Studies in Technology, Engineering and Science* (pp. 1–12). ISRES Publishing.

Introduction

In recent years, due to climate change and environmental factors, the frequency and severity of natural disasters have increased significantly worldwide. Disasters such as earthquakes, hurricanes, wildfires, and floods cause significant loss of life and property, leaving a profound impact on societies. Floods, in particular, pose significant risks due to their sudden onset and their capacity to affect large areas. These disasters, caused by heavy rainfall, dam overflows, or rivers breaking through floodplains, can inundate residential areas, damage critical infrastructure, and pose a serious threat to human life.

Floods are not limited to physical destruction; they also cause economic, social, and psychological impacts. The inundation of agricultural lands, damage to infrastructure, and destruction of homes lead to long-term economic hardship. This can be particularly devastating for vulnerable communities and disadvantaged groups, such as individuals with disabilities. Individuals with disabilities often face greater challenges than others during disasters. Factors such as accessibility issues, communication barriers, and the inability to participate in disaster response processes jeopardize the safety of these individuals.

In this context, the importance of information technologies is increasingly recognized for mitigating the impacts of natural disasters, especially floods, on individuals with disabilities and increasing their resilience to disasters. By offering a wide range of solutions, from early warning systems to accessible communication tools, information

technologies can help protect individuals with disabilities in disaster management processes and ensure their social integration.

When natural disasters strike a community unexpectedly, they create significant challenges for all individuals. However, these challenges can be even more complex and devastating for individuals with disabilities. Individuals with visual, hearing, mobility, or cognitive impairments face significantly greater risks than others in disaster situations. Factors such as accessibility issues, communication barriers, and the inability to participate in emergency response processes seriously threaten the safety of these individuals.

Individuals with disabilities are often placed closer to danger during disasters. For example, due to physical disabilities, they may have difficulty exiting a building in a situation requiring rapid evacuation, or visually impaired individuals may struggle to understand complex emergency signs and instructions. Individuals with hearing impairments may not receive emergency alerts and instructions promptly, making them more vulnerable to danger. Furthermore, individuals with cognitive disabilities may struggle to understand the complexities of disaster situations, which can hinder their ability to navigate safely.

Disaster response processes also present significant accessibility challenges for individuals with disabilities. Emergency evacuation plans often fail to adequately consider the specific needs of individuals with disabilities. Communication tools and information systems used in disaster areas are often unsuitable for individuals with disabilities. For example, audio warnings are ineffective for a hearing-impaired individual, while visual signals are useless for a visually impaired individual. This restricts individuals with disabilities' access to vital information during emergencies, placing them at greater risk.

Information technologies can play a vital role in overcoming these challenges and increasing the resilience of individuals with disabilities to disasters. Solutions such as accessible early warning systems, specialized evacuation plans for individuals with disabilities, and post-disaster support services are essential to better protect these individuals in disaster situations and strengthen their social integration.

Although natural disasters are devastating events that affect all segments of society, individuals with disabilities face greater risks in such situations. Accessibility issues, communication barriers, and difficulties in participating in emergency response processes seriously jeopardize their safety. However, the innovations and solutions offered by modern information technologies can play a significant role in overcoming these challenges.

Information technologies have the potential to revolutionize disaster management and response processes. Information technology solutions specifically designed to meet

the needs of individuals with disabilities can facilitate their access to vital information and services during disasters. For example, technologies such as mobile applications that provide audio notifications for visually impaired individuals, visual and text-based early warning systems for hearing impaired individuals, and location-based emergency assistance requests for individuals with mobility impairments can be quickly activated during disasters and prevent loss of life.

These technologies are critical for meeting the needs of individuals with disabilities, not only in emergencies but also in the post-disaster period. Providing accessible healthcare, shelter, and support services after a disaster can be achieved more effectively and quickly through information technology. This can help integrate individuals with disabilities into post-disaster recovery processes and increase social resilience.

The significance of this study lies in its evaluation of information technology solutions that will increase the resilience of individuals with disabilities against disasters and meet their needs in disaster management processes. Alleviating the challenges faced by individuals with disabilities during natural disasters and ensuring their full participation in society is not only a human rights issue but also a critical requirement for strengthening social solidarity and resilience. In this context, exploring and applying the potential offered by information technologies can provide great benefits at both individual and societal levels.

Literature Review

Obstacles Encountered in Disaster Management for Individuals with Disabilities

Evacuation plans in emergencies often fail to consider the needs of individuals with disabilities. For example, the inaccessibility of emergency exit routes for wheelchair users poses a significant obstacle in disaster situations. The design of buildings, the location of shelters, and the lack of disability-friendly emergency shelters make safe evacuation difficult. Warnings and information provided during disasters are often not tailored to the needs of individuals with disabilities. The lack of visual signals for individuals with hearing impairments and the inadequacy of audible warnings for individuals with visual impairments pose significant risks. Furthermore, individuals with cognitive disabilities can have difficulty understanding complex information.

Disaster management plans often overlook individuals with disabilities. If pre-disaster preparations are not structured appropriately for the specific needs of these individuals, effective response during a disaster is impossible. Mass evacuation plans, in particular, are inadequate to ensure the safe evacuation of individuals with disabilities. Personnel and volunteers working in disaster management processes often lack sufficient training in the needs of individuals with disabilities. This lack leads to inadequate support provided to these individuals during disasters.

Individuals with disabilities may face discrimination due to societal prejudices during disasters. These individuals may be overlooked or relegated to the background in post-disaster relief and reconstruction processes. In some communities, individuals with disabilities are marginalized in terms of social roles and duties. These cultural perceptions can make it difficult for disaster management plans to be inclusive of these individuals.

Studies on accessible disaster management focus specifically on how to make evacuation plans and warning systems more accessible to individuals with disabilities. This research emphasizes the need to adopt universal design principles in disaster management processes. For example, UNISDR (United Nations Office for Disaster Risk Reduction) and other international organizations have developed policy recommendations to reduce disaster risks and ensure the safety of individuals with disabilities. These recommendations encourage inclusive planning and the participation of individuals with disabilities in disaster management processes.

Studies on the development of early warning systems tailored to the needs of individuals with disabilities emphasize the importance of specialized technologies that will enable these individuals to be notified of disasters. For example, vibrating warning devices are being considered for individuals with hearing impairments, while systems equipped with audio signals are being considered for individuals with visual impairments. International conferences such as the Global Platform for Disaster Risk Reduction have presented recommendations for the development and dissemination of accessible communication tools. Such studies demonstrate the need to make communication technologies more inclusive.

Disaster education studies provide important information on how individuals with disabilities should prepare for disasters. These studies highlight the need to develop specialized training programs for individuals with disabilities and raise public awareness. For example, studies conducted by Japan's Disability Information Resources indicate that disaster education for individuals with disabilities in Japan increases their resilience to disasters and enables them to actively participate in disaster management processes.

The Impact of Information Technologies on Accessibility

Information technologies can help individuals with disabilities overcome many physical and cognitive barriers. For example, screen readers enable visually impaired individuals to use computers and mobile devices; subtitling technologies enable access to media content for individuals with hearing impairments. Information technologies can be customized to meet users' individual needs. For example, various solutions have been developed for individuals who struggle with keyboard and mouse use, such as alternative input devices, voice-activated systems, or technologies that can be controlled through eye movements.

Making digital content such as websites, mobile applications, and digital documents accessible significantly increases access to information for individuals with disabilities. Standards such as the Web Content Accessibility Guidelines (WCAG) have provided guidance in ensuring that digital content is accessible to individuals with disabilities. Information technologies make it easier for individuals with disabilities to maintain independent lives. For example, smart home technologies allow them to control their daily activities. Voice assistants enable individuals with disabilities to move more independently in the home environment (Anaç et al., 2010).

The use of information technologies in education has expanded the access of individuals with disabilities to educational opportunities. Online education platforms, in particular, enable the active participation of individuals with disabilities in the learning process. In the employment sector, information technologies support flexible working models that allow individuals with disabilities to work remotely. Social media and digital communication tools have increased the participation of individuals with disabilities in social life. These platforms allow individuals with disabilities to interact with communities and expand their social circles.

The literature emphasizes that information technologies should be developed in line with inclusive design principles. Inclusive design aims to ensure that everyone, especially individuals with disabilities, can use technology equally. Studies in this area argue that the needs of individuals with disabilities should be considered from the technology design stage onward.

Research examines the challenges individuals with disabilities face in using technology and the solutions developed to overcome these challenges. For example, it focuses on the factors that hinder the use of technology by individuals with disabilities. Research has revealed that the cost of access to technology, user training, and ease of use of devices are the primary factors affecting technology use (Kaye et al., 2008). The literature also includes studies on how information technologies support the social integration of individuals with disabilities. It is stated that social media and digital communication tools are effective in expanding the social networks of individuals with disabilities and reducing social isolation (D. Chadwick et al., 2013).

The use of technology in education has expanded the educational opportunities of individuals with disabilities. For example, it has been stated that online education platforms provide flexible and accessible learning environments for students with disabilities (Phipps, 2012). Similarly, it has been shown that digital tools used in education increase the participation of individuals with disabilities in the learning process. Information technologies have increased the accessibility of healthcare services for individuals with disabilities (Côté-Douyon, 2016). It has been stated that telehealth

services facilitate access to healthcare services for individuals with disabilities and help them monitor their health status (Guo et al., 2005).

The role of information technologies in employment for individuals with disabilities also holds a significant place in the literature. It emphasizes that individuals with disabilities can increase their participation in the workforce by taking advantage of remote working opportunities thanks to information technologies. At the same time, adaptive technologies used in the workplace increase the job performance and productivity of individuals with disabilities (Kregel, 2008).

Although information technologies offer significant benefits, there are also studies indicating that not all individuals with disabilities have equal access to these technologies. They highlight the digital divide among individuals with disabilities. This divide stems from the high cost of technological devices, inadequate user training, and the inaccessibility of technology. Privacy and security concerns also play a significant role in the use of information technologies developed for individuals with disabilities (Mann et al., 2013). They discuss the challenges faced by individuals with disabilities regarding the protection and security of their personal information when using social media and digital platforms (D. D. Chadwick & Fullwood, 2018).

Early Warning Systems and Accessibility

For individuals with disabilities to effectively benefit from disaster warning systems, these systems must be accessible. Individuals with visual, hearing, motor, or cognitive disabilities each have different needs. Successful examples of systems developed to meet these needs can be found in the literature. It is emphasized that accessible early warning systems should offer multiple warning channels tailored to the needs of individuals with disabilities. For example, audible alerts are used for individuals with visual impairments, while vibrating or visual alerts are used for individuals with hearing impairments.

Many mobile applications make early warning systems accessible to individuals with disabilities. For example, applications developed by FEMA (Federal Emergency Management Agency) provide alerts tailored to users' individual needs. Wearable devices are also used in early warning systems. These devices can provide warnings with vibration, sound, or visual signals in the event of a disaster. Web-based platforms offer personalized alerts for individuals with disabilities. For example, CAP (Common Alerting Protocol) is used to provide customizable alerts for different disability groups (Yılmaz et al., 2014). Many studies argue that early warning systems should be developed in accordance with international accessibility standards. Standards such as WCAG (Web Content Accessibility Guidelines) play a critical role in ensuring that these systems are accessible to individuals with disabilities. The literature focuses on warning systems that can be customized to the individual needs of individuals with disabilities.

These systems can provide differentiated warnings based on the type of disaster, the individual's disability, and their geographic location. Various studies emphasize the need to test developed early warning systems based on user experience and feedback. This can increase the effectiveness of the systems and ensure better performance in real-world disaster scenarios (WAI Initiative, n.d.).

Developed in the US, the ShakeAlert system is an early warning system designed to improve the safety of individuals with disabilities during disasters. Developed specifically for earthquake warnings, this system provides accessible alerts across a variety of devices and platforms (ShakeAlert – Because seconds matter., n.d.). SIGN is a warning system specifically designed for individuals with disabilities during disaster management and can be customized to the needs of local communities and individuals. EENet is a platform that provides alerts tailored to different disability types, enabling faster and more effective response in the event of a disaster.

These studies and applications demonstrate how information technologies can be used in early warning systems for individuals with disabilities and how they play a role in increasing the effectiveness of these systems. Studies in this area contribute significantly to making disaster management processes more accessible.

The Effectiveness of Information Technologies

Information technologies offer systems designed to facilitate access to information for individuals with disabilities before, during, and after disasters. Early warning systems provide critical disaster information in formats suitable for individuals with disabilities (e.g., audio notifications for the visually impaired and visual alerts for the hearing impaired). This allows individuals to respond more quickly and effectively to disasters. Information technologies provide mobile applications tailored to the needs of individuals with disabilities, providing access to critical information during disasters. These applications can be customized to meet user needs and provide significant support in disaster management processes.

Information technologies allow individuals with disabilities to be tracked and identified during disasters. For example, GPS-based tracking systems can locate individuals with disabilities, allowing emergency responders to reach them more quickly. These systems also facilitate communication with family members and aid organizations. Virtualized rehabilitation programs can be used to help individuals with disabilities recover and reintegrate into society after a disaster. These programs provide physical therapy or psychological support, helping individuals recover more quickly from the adverse effects of the disaster.

Information technologies can be used to raise awareness about people with disabilities

throughout society. Before and after disasters, awareness campaigns can be organized about the needs and rights of individuals with disabilities. These campaigns enable all members of society to be more sensitive and supportive of individuals with disabilities. Individuals with disabilities can engage in digital participation and social media through information technologies. These platforms allow them to have their voices heard, stay connected to their communities, and participate in disaster management processes. Social media is a particularly important tool for post-disaster support and solidarity.

Artificial intelligence and data analytics can be used to develop personalized disaster preparedness plans for individuals with disabilities. These systems can analyze individuals' needs and provide tailored solutions. For example, the types of assistance they will need during a disaster can be determined in advance, and plans can be made accordingly. Information technologies can create community-based support networks for individuals with disabilities. These networks facilitate mutual aid during and after a disaster and prevent individuals from feeling isolated. Furthermore, through these networks, community members gain information on how to support individuals with disabilities.

Information technologies can help policymakers and governments develop more accessible disaster management policies for individuals with disabilities. Data-based analyses and simulations can be used to assess the effectiveness of these policies. Information technologies support international collaboration and the development of standards to increase the resilience of individuals with disabilities to disasters. These standards can better protect individuals with disabilities worldwide in disaster situations.

Information technologies not only enhance the resilience of individuals with disabilities against disasters but also integrate them into society, allowing them to actively participate in disaster management processes. This plays a critical role in improving the overall well-being of both individuals and society.

Obstacles and Solutions

The design and implementation of information technologies are often optimized for standard user needs, which can lead to accessibility issues for individuals with disabilities. Designs should be developed in accordance with WCAG (Web Content Accessibility Guidelines) and other accessibility standards. User testing should be conducted during the design process, incorporating feedback from individuals with disabilities.

Existing technologies may not be sufficiently optimized for all types of disabilities. For example, some early warning systems may not be effective enough for individuals with hearing impairments. Technologies should be personalized and solutions tailored to different types of disabilities should be provided. For example, voice prompts should be

used for individuals with visual impairments, while visual and vibration alerts should be used for individuals with hearing impairments. Investments should be made in accessibility research and technology development.

There may be a lack of sufficient knowledge and training on how to use information technologies for individuals with disabilities and the general public. Training programs on the use of accessible technologies should be organized for individuals with disabilities and disaster management personnel. Information campaigns should be conducted to explain the advantages of technologies and accessibility solutions.

The development and implementation of accessible technologies can be costly, and some regions may lack infrastructure. Government support and grants should be provided for the development and deployment of accessible technologies. Investments should be made to address infrastructure gaps and ensure technologies reach a wider audience.

Cultural and language barriers can make it difficult to effectively implement accessible technologies in some regions. Collaboration with local experts should be undertaken to adapt technologies to local cultures and languages. Multilingual support for accessibility solutions can facilitate use by individuals who speak different languages. The use of accessible technologies can raise security and privacy concerns, particularly regarding the protection of personal data. Strong data protection and encryption techniques should be used to ensure the security of user data. Users should be informed about how their data is collected and used.

Access to technology can be challenging, particularly in rural and low-income areas. Affordable and accessible solutions should be provided to make technology accessible to a wider audience. Public-private partnerships should be encouraged to disseminate technology and increase access points. Overcoming these barriers will make information technologies more effective and accessible for individuals with disabilities, leading to significant advances in disaster management processes.

Conclusion

This study examined the challenges faced by individuals with disabilities during natural disasters and the potential role of information technologies in overcoming these challenges. Natural disasters, particularly emergencies such as floods, pose greater risks to individuals with disabilities and increase their safety risks. Traditional disaster management systems and response processes fail to adequately meet the needs of individuals with disabilities and have significant accessibility gaps. Information technologies offer significant opportunities to address these shortcomings.

Information technologies can transform disaster management processes through early warning systems, post-disaster support services, and accessible communication tools

developed for individuals with disabilities. Artificial intelligence-based applications, in particular, can create personalized disaster preparedness and response plans, increasing the resilience of individuals with disabilities to disasters. Furthermore, social integration processes are supported through mobile applications and digital platforms, ensuring the participation of individuals with disabilities in society.

However, several barriers must be overcome for information technologies to be fully integrated into the lives of individuals with disabilities. Challenges such as accessibility issues, educational deficiencies, and financial constraints limit the effective use of these technologies. To overcome these obstacles, governments, civil society organizations, and technology developers must work collaboratively. Strengthening technological infrastructure, expanding accessibility standards, and raising public awareness will enable individuals with disabilities to take a more active role in disaster management processes.

Consequently, the use of information technologies is critical for individuals with disabilities to become more resilient to disasters and to access the support they need during disasters. Making these technologies more accessible to a wider audience will contribute to the stronger participation of individuals with disabilities not only in disaster management but also in all aspects of social life. New policies and technological solutions will help ensure greater safety and social integration for individuals with disabilities in the face of disasters.

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