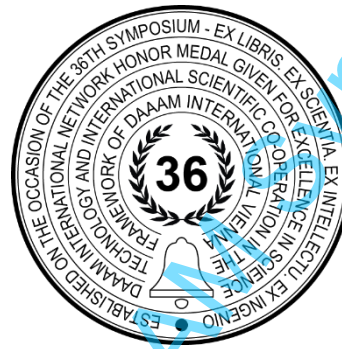


Digital Technologies for Crisis Documentation and Analysis: Benefits, Limitations, and Challenges

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Abstract

This paper analyses the use of digital technologies in the documentation and assessment of crisis situations, focusing on their practical applications, benefits, and limitations. The aim is to evaluate selected digital tools and identify suitable approaches to their effective use in crisis management. The analysis covers audiovisual recording, photographic documentation, unmanned aerial vehicles (UAVs), and geographic information systems (GIS), with particular emphasis on their role in incident documentation, spatial analysis, information sharing, and operational decision-making. The paper also examines the application of digital cameras in major traffic accidents and considers the broader potential of digital technologies in emergency response and post-incident evaluation. In addition to technical aspects, attention is given to legal and ethical challenges, including personal data protection, cybersecurity, and the responsibilities associated with the collection, processing, and storage of digital records. By comparing the capabilities and limitations of the technologies examined, the paper identifies key factors influencing their effective and responsible implementation in crisis management. The analysis provides a basis for selecting appropriate digital tools according to the specific requirements of crisis situations.

Keywords: crisis management; digital technologies; audiovisual recording; photographic documentation; geographic information systems

1. Introduction

Crisis situations, including major traffic accidents, technological disasters, natural hazards, and large-scale fires, pose significant challenges to public safety and emergency response systems. Their effective management requires rapid decision-making, coordination among the organisations involved, and access to accurate and up-to-date information. The ability to collect, process, and share reliable data is therefore an essential factor in both the immediate response to an incident and its subsequent evaluation.

Recent advances in digital technologies have created new opportunities for documenting and analysing crisis situations. Audiovisual recording, digital photography, unmanned aerial vehicles (UAVs), and geographic information systems (GIS) enable the collection of detailed visual and spatial data, support situational awareness, and facilitate the

assessment of incident scenes. These technologies can also contribute to the reconstruction of events, the evaluation of response procedures, and the identification of potential shortcomings. Their practical value depends, however, on the specific circumstances of an incident, the technical capabilities of the equipment, and the ability of personnel to interpret and use the collected information effectively.

Despite these advantages, the application of digital technologies raises important technical, legal, and ethical issues. These include personal data protection, cybersecurity, data accuracy, and the responsible handling and storage of digital records. Such considerations are particularly relevant when technologies are used by emergency services, the Police of the Czech Republic, and other public authorities.

This paper analyses the benefits and limitations of selected digital technologies used in the documentation and analysis of crisis situations. It focuses on audiovisual recording, photographic documentation, UAVs, and GIS, considering their practical applications as well as the legal and ethical challenges associated with their use. The aim is to identify key factors that influence the effective and responsible application of these technologies and to propose suitable approaches to their use in crisis management.

2. Phases of Crisis Management

Crisis management is understood as an integrated process consisting of several interconnected phases. These phases enable a systematic response to emerging crisis situations while also establishing the conditions necessary for their prevention and effective management. Each phase differs in its focus, timeframe, and the types of measures implemented. However, they share the common objective of protecting human life, health, and property. Dividing crisis management into distinct phases provides a clearer management framework and contributes to greater overall effectiveness. [1]

The **prevention phase** comprises a set of activities aimed at preventing crisis situations from occurring. During this phase, risks are identified and analysed, the vulnerability of territories, infrastructure, and populations is assessed, and long-term systemic measures are implemented to reduce the likelihood of crisis situations arising. Preventive approaches are applied primarily through spatial planning, technical measures, the regulation of hazardous activities, and the establishment of conditions for safe territorial development. Public awareness and the strengthening of societal resilience to potential threats also play an important role. [1]

The **preparedness phase** follows the prevention phase and focuses on establishing the conditions necessary for an effective response when a crisis situation occurs. This phase includes personnel, organisational, technical, and material measures designed to ensure operational readiness within the crisis management system. An essential component of this phase is crisis planning, which involves the preparation of emergency and crisis management plans, the allocation of responsibilities among the relevant entities, and the development of scenarios for addressing potential crisis situations. This phase also includes training, professional development, and practical exercises for personnel involved in crisis response, as well as testing the effectiveness of crisis management plans through exercises and simulations. [1]

2.1 Crisis Planning

Crisis planning is a systematic, long-term process aimed at establishing the conditions necessary for managing crisis situations affecting the security of the state and society. It is based on the analysis of potential threats, available resources, and the definition of the powers and responsibilities of crisis management authorities, while taking into account organisational, legal, economic, and territorial conditions. The outcome of crisis planning is a comprehensive set of planning documents that establish procedures for the prevention, preparedness, and management of crisis situations in both peacetime and military scenarios. Crisis planning provides a framework for coordinating the activities of individual stakeholders, enables flexible decision-making in the event of a threat, and contributes to maintaining the essential functions of the state, protecting the population, and minimising damage during crisis situations. [1]

2.2 The Response Phase

The response phase involves reacting to an actual crisis situation and is characterised by the immediate implementation of rescue, protective, and emergency management operations. During this phase, crisis measures are carried out to protect human life and health, prevent property damage, and stabilise the situation. The response phase includes the coordination of the Integrated Rescue System (IRS) components, the exercise of public administration under crisis conditions, and the provision of essential services and basic necessities to the population. The speed and coordination of actions, together with effective decision-making during the response phase, have a significant impact on the extent of the consequences of a crisis situation and the subsequent course of its management. [1]

2.3 The Recovery Phase

The recovery phase aims to gradually eliminate the consequences of a crisis situation and restore normal functioning. This phase includes the restoration of essential infrastructure, transport, energy, and communication systems, as well as the remediation of damage to property and the environment. Recovery also involves evaluating the course of the crisis, identifying shortcomings in the crisis management system, and implementing measures to improve preparedness for future events. Recovery is not merely a technical process but also an important source of knowledge that contributes to strengthening system resilience and preventing future crises. [1]

3. Digital technologies in the analysis of crisis situations

Digital technologies have become an important component of crisis situation analysis. Therefore, the third section provides an overview of selected digital technologies used in the analysis of crisis situations, outlining their basic operating principles and practical applications in the context of crisis management.

3.1 Audiovisual Equipment

A digital camera is one of the digital devices used to document crisis situations, particularly for capturing static information at the scene of an incident. Its primary benefit lies in its ability to record the current state of the environment, the positions of objects, the extent of damage, and evidence relevant to subsequent analysis quickly and accurately. Its advantages include ease of use, relatively low technical complexity, and high evidential value when images are captured using appropriate procedures. When documenting crisis situations, particular importance is placed on the accuracy and authenticity of the recordings, sufficient image resolution, and the ability to preserve image data in an unaltered form. These characteristics are essential for subsequent analytical and investigative purposes. [2]

The technical operation of a digital camera is based on converting optical information into digital data through electronic image processing. Light reflected from the scene passes through the optical elements of the camera lens, which direct it onto an image sensor, typically a complementary metal-oxide-semiconductor (CMOS) or charge-coupled device (CCD) sensor. Individual photosensitive elements of the sensor respond to the intensity of the incoming light by generating electrical signals, which are subsequently digitised and converted into numerical data. The camera's internal image processor then performs further processing, including colour interpolation, exposure correction, noise reduction, and, where applicable, image compression. The resulting image is then stored on a memory medium in the selected file format. [5]

The operating principle of a video camera involves the successive conversion of optical information into a digital video signal, which is then processed and stored. Light reflected from the scene passes through the lens and reaches an image sensor, typically a charge-coupled device (CCD) or complementary metal-oxide-semiconductor (CMOS) sensor. The individual photosensitive elements of the sensor respond to the intensity of the incoming light by generating an electrical charge. This charge is subsequently converted into digital values and processed by the camera's electronic circuits, which perform colour correction, noise reduction, dynamic range adjustment, and, where applicable, data compression. The result is a continuous sequence of frames recorded in chronological order, making it possible to capture not only static information but, more importantly, the dynamics of events as they unfold. [5]

Modern camera systems enable high-resolution video recording and are often equipped with audio recording, time synchronisation, and real-time video transmission capabilities. These features enhance their usefulness in incident management by providing command and coordination centres with up-to-date information. Camera footage can also serve as evidential material in subsequent investigations. Video recordings can be analysed frame by frame, allowing for a detailed assessment of decision-making processes and the identification of critical moments. Another important aspect of camera footage is its use in the retrospective evaluation of emergency response operations and in improving the preparedness of response units. Video analysis makes it possible to identify both the strengths and weaknesses of the procedures employed, thereby contributing to the continuous improvement of operational methods. [13]

3.2 Drones and Aerial Monitoring

Unmanned aerial vehicles (UAVs) are an important tool in crisis management for acquiring spatial and situational information in real time. Their main advantage is the ability to be deployed rapidly over affected areas without directly exposing response personnel to danger. Drones enable responders to assess the extent of a crisis, identify critical areas, and monitor the ongoing development of an incident, thereby supporting timely and informed decision-making by command authorities. [7]

Modern unmanned aerial systems are equipped with various types of sensors that expand their potential applications in crisis management. These systems may incorporate optical cameras, thermal imaging cameras, multispectral sensors, and other specialised instruments capable of detecting thermal anomalies, locating individuals, and identifying environmental changes. The subsequent integration of the collected data into other information systems supports a more comprehensive situational awareness and improves the accuracy of analytical outputs. [3]

From the perspective of crisis management development, unmanned aerial systems are regarded as a promising technology whose importance is expected to grow alongside continued technological advancements. Studies examining the future use of unmanned systems in civil protection indicate their increasing significance in crisis monitoring, decision-making support, and automated data processing. However, these studies also highlight the need to address issues related to data protection, operational safety, and the regulatory framework governing the use of unmanned aerial systems in crisis situations. [8]

To ensure the effective use of drones in crisis situations, they must be integrated into the organisational structure of crisis management, supported by clearly defined operational procedures. Documents addressing the use of unmanned aerial vehicles in civil protection emphasise the importance of coordinating aerial operations with other components of the Integrated Rescue System (IRS) responding at the incident scene. They also stress the need for trained personnel capable not only of operating the equipment but also of correctly interpreting the information obtained. The absence of these prerequisites may limit the effective deployment and practical benefits of unmanned aerial systems. [9]

3.3 Mobile Devices

Mobile devices, particularly smartphones and tablets, have become important communication tools in crisis management and emergency response due to their widespread availability and ability to transmit data instantly. The expansion of mobile networks enables rapid information exchange between affected individuals and emergency response units, thereby reducing response times and improving the coordination of emergency operations.

3.4 Geographic Information Systems (GIS)

Geographic Information Systems (GIS) are valuable tools for analysing and assessing crisis situations, as they use spatially referenced information within a digital environment. GIS makes it possible to integrate information about a geographical area, its infrastructure, and its population, and to place this information in the context of an ongoing incident. The result is a clear visual representation of the situation that facilitates spatial orientation. In crisis management, GIS is used to identify areas at risk, visualise hazards, and support decision-making at both operational and strategic levels. The main advantage of GIS lies in its ability to combine different data layers and analyse the relationships between them. For example, in crisis management, map data can be integrated with information on critical infrastructure, population distribution, transport accessibility, and observations from the field. This makes it possible to model potential crisis scenarios, estimate their impacts, and identify appropriate response measures, including the deployment of emergency response units and the evacuation of residents. [4]

GIS also plays an important role in coordinating the activities of different organisations. Map outputs generated using GIS enable consistent data sharing among crisis management authorities, Integrated Rescue System (IRS) units, and other organisations involved in the response. A clear visualisation of the crisis situation improves spatial awareness and supports faster decision-making under time pressure. [4]

In recent years, GIS technology has continued to advance, enabling the use of up-to-date data. Data from remote sensing, unmanned aerial vehicles (UAVs), and mobile devices can be incorporated into GIS, improving the accuracy and timeliness of analytical outputs. This approach is particularly important when managing large-scale crisis situations in which geographical conditions can change rapidly. [4]

3.5 Information-Sharing Systems

Information-sharing systems (hereinafter referred to as “ISS”) are an important component of crisis management, as they facilitate the collection, processing, and distribution of data among crisis management authorities and emergency response units. Their primary purpose is to establish a common information base that provides an up-to-date overview of the crisis situation, supports decision-making, and improves the coordination of activities during crisis response. In crisis situations, information sharing has a significant impact on response times and the effectiveness of the measures implemented. [10]

In the Czech Republic, information sharing in crisis management relies on a combination of centralised and sector-specific information systems. An important initiative is the planned Crisis Management Information System (hereinafter referred to as “CMIS”), which aims to unify currently fragmented data flows among crisis management authorities at the national, regional, and municipal levels. CMIS is intended to support the recording of crisis management measures, the sharing of situation reports and documents, and decision-making throughout crisis situations. [2]

Information-sharing systems also include electronic public administration systems, such as the Data Mailbox Information System (hereinafter referred to as “DMIS”), which enables the exchange of documents between public administration authorities, as well as sector-specific crisis management portals at regional and municipal levels. These systems help ensure effective communication, the transmission of decisions, and the archiving of documentation related to crisis situations. [11]

In the operational management of emergencies, information systems used by the Fire Rescue Service of the Czech Republic play an important role, particularly those employed at its operational and information centres. These systems record emergency incidents, share information on the progress of response operations, facilitate communication with Integrated Rescue System (IRS) units, and provide situational overviews. They are also integrated with GIS and mapping applications, enabling the visualisation of the situation across the affected area. [2]

3. 6 Artificial Intelligence and Automated Data Analysis

Artificial intelligence (hereinafter referred to as “AI”) has become an important tool in crisis management in recent years, particularly in the processing and evaluation of large datasets. In crisis situations, AI enables the automated analysis of data from various sources, including images and video footage, sensor data, satellite imagery, and textual reports. It therefore contributes significantly to the faster development of a situational overview and reduces the workload of personnel operating under time pressure and facing information overload. [5]

When processing visual and spatial data, AI is used primarily through computer vision algorithms. These algorithms enable the automatic detection of objects, the identification of changes in an area, and the assessment of damage based on aerial and satellite imagery or footage captured by unmanned aerial vehicles (UAVs). In crisis management, AI thus supports the rapid mapping of affected areas, the localisation of people at risk, and the identification of critical locations requiring priority intervention.

Automated data analysis based on machine learning and deep neural networks makes it possible to identify patterns, trends, and anomalies that can help detect threats and predict the development of crisis situations. Such analyses are used, for example, to model the spread of natural disasters, estimate the extent of damage, and assess risks to the population and critical infrastructure. The ability to continuously update analytical outputs as new data becomes available enhances the capacity for timely operational decision-making. [6]

To ensure effective integration and analysis, raw data from heterogeneous sources must be standardised before being combined. UAV thermographic imagery, Geographic Information System (GIS) layers, and speed recorder data differ in format, spatial and temporal resolution, and information content. Their integration therefore requires consistent metadata, synchronised timestamps, standardised data formats, and, where applicable, a common coordinate reference system. Appropriate preprocessing and validation can help identify inconsistencies, remove redundant information, and improve the reliability of the resulting situational overview.

To prevent information overload at command centres, processed data should be filtered, prioritised, and presented according to operational relevance. Instead of displaying all collected information simultaneously, integrated systems should highlight critical findings, significant changes, and potential threats while retaining access to the underlying data for verification. This approach can support faster interpretation, improve situational awareness, and facilitate decision-making during emergency response. Nevertheless, automated processing and data integration require appropriate technical infrastructure, trained personnel, and procedures to ensure data quality and interoperability.

3. 7 Cybersecurity in the Use of Digital Technologies

With the widespread adoption of digital technologies, cybersecurity has become increasingly important in crisis management. Cybersecurity is understood as a set of measures designed to protect information, maintain the confidentiality, integrity, and availability of data and information systems, and ensure the continuity of information flows even when infrastructure is disrupted during a crisis. In practice, this involves building resilience against cyberattacks and minimising risks that could compromise crisis management systems. [11]

Cyberattacks and cyber incidents can escalate into crisis situations if they significantly disrupt the operation of essential digital services or critical infrastructure. It is therefore essential that crisis management plans also include cyber incident scenarios incorporating prevention, monitoring, detection, response, and post-incident recovery.

Digital devices used in crisis situations must be covered by data backup and recovery plans. Procedures for reporting and sharing information about incidents among the organisations involved must also be established. These measures help ensure that digital technologies continue to support effective crisis management, even under adverse conditions. [12]

4. Practical Aspects of Using Digital Technologies

Examples from Real-World Cases.

4.1 Documentation of Emergency Response at a Major Railway Accident

On 7 July 2020, in the afternoon, two passenger trains collided head-on on a single-track railway line near Pernink, in the section between Pernink and Nejdek. The collision occurred several hundred metres from Pernink railway station. The accident claimed two lives and left more than twenty people injured, several of whom were trapped inside the trains. The total damage was estimated at more than CZK 25 million. According to the subsequent investigation, the accident occurred after one of the train drivers failed to comply with the timetable and operating regulations after departing the station and did not wait for the oncoming train. [3]

All components of the Integrated Rescue System (IRS) were immediately dispatched to the scene. The first response units arrived shortly after the accident was reported and confirmed the scale of the incident and the large number of casualties. Response operations were complicated by the difficult terrain, which meant that some emergency vehicles had to be positioned away from the railway line and some equipment had to be carried manually up the slope to the accident site. Pernink railway stop was designated as the casualty collection point, and passengers were gradually transported there. Emergency medical services used both ground and air resources. Helicopters operated by air rescue services, including assistance from Germany, landed on a nearby football pitch. Several dozen people were subsequently transported to hospitals. [3]

The response also included a search of the area surrounding the railway line to ensure that no passengers had left the scene in a state of shock. A post-traumatic care team was activated to provide psychological support to those affected and their relatives. Firefighters also established an information hotline for members of the public and the relatives of passengers. [5]

In the evening, a specialised railway unit took over the accident site and began operations to remove the consequences of the collision and restore railway services.

The investigation into the railway accident near Pernink was supported by the evaluation of digital data, which contributed to the reconstruction of the collision. One of the key sources was an automatic data recording device, specifically a HASLER Rail TELOC 2500 electronic speed recorder, serial number 16110268. This device records digital data on train speed, braking performance, direction of travel, and other operational parameters over time. Analysis of the data from the digital speed recorder made it possible to reconstruct the movements of the trains before the collision and assess the train drivers' actions in the moments leading up to the accident. [3]

Another source of information about the sequence of events was the stored operational radio communication between the train drivers and the railway dispatcher. Analysis of these recordings enabled investigators to assess how information was communicated, whether communication procedures were followed, and the chronological sequence of individual

actions. The investigation also drew on electronically recorded operational data from the railway traffic management system, particularly information on traffic arrangements along the single-track section of the line.

Digital photographic documentation of the collision site also played an important role. The photographs show the positions of the trains, vehicle deformation, marks on the track structure, and the terrain in the section of the line that was difficult to access. The digital photographs supported the on-site analysis and also served as evidence for expert assessments and the investigator's final report.

4. 2 Use of Drones During Floods and Fires

The territory of Bohemian Switzerland National Park is particularly susceptible to wildfires during the summer months. The sandstone bedrock retains very little water, precipitation rapidly infiltrates the ground, and prolonged dry periods cause vegetation to dry out considerably. The combination of high temperatures and a lack of moisture creates conditions in which even a minor act of human carelessness can trigger a large-scale wildfire. Long-term observations indicate that fires occur almost every year, with exceptions mainly during periods of above-average precipitation. The most common cause is the careless handling of open flames, whereas natural factors, such as lightning strikes, only occasionally lead to wildfires. [6]

The largest wildfire to affect Bohemian Switzerland occurred in 2022. The extensive forest fire broke out in the Malinový důl area near Hřensko during the night of 23–24 July 2022 and was reported at approximately 7 a.m. the following morning. Firefighting operations continued until 12 August 2022. Subsequent monitoring of the affected area continued on a larger scale until the end of August and, at a reduced level, until mid-September. The fire affected approximately 1,060 hectares of the national park, making it one of the largest emergencies of its kind in the region's recent history. [6]

In mid-August 2022, specialists from the Czech Armed Forces' 533rd Unmanned Systems Battalion were deployed to assist Integrated Rescue System (IRS) units in monitoring the fire-affected area of Bohemian Switzerland National Park. Using quadcopters, they conducted systematic aerial surveys to detect hidden hotspots. The drones completed nearly 200 flights, totalling approximately 70 flight hours, and identified several dozen locations with temperatures exceeding 75°C. [6]

The specialists from the 533rd Unmanned Systems Battalion operated under the coordination of the Fire Rescue Service. They familiarised themselves with the terrain and the tactics employed during the firefighting operation before gradually assuming responsibility for monitoring a designated area using drones. Their aerial surveys were conducted mainly in the morning and evening to avoid conflicts with helicopter operations. [8]

The deployment of drones proved highly effective in identifying small hotspots that were difficult to detect visually. Such hotspots would have been extremely difficult to locate through ground inspections alone. The use of drones therefore made a significant contribution to preventing the fire from spreading again in Bohemian Switzerland National Park.

4. 3 Use of GIS in Population Evacuation

In mid-September 2024, the Jeseník region, particularly the area along the Bělá River, was affected by intense rainfall that caused river levels to exceed their maximum recorded values and resulted in widespread flooding. Following the heavy rainfall, rivers overflowed their banks in several municipalities, inundating residential buildings, roads, and other structures and forcing local residents to evacuate. In many locations, the flooding reached extreme levels, with river levels exceeding historical records. In some sections, the Bělá River rose more than three metres above previously recorded levels, and water levels continued to rise beyond the thresholds associated with the third level of flood activity. Strong river currents isolated some municipalities from surrounding areas and caused severe damage to infrastructure, including roads. [4]

Evacuations were ordered in several municipalities, where firefighters and other Integrated Rescue System (IRS) units worked to move residents to safety. Flooding also affected other parts of the Jeseník Mountains, where the rapid rise in river levels caused significant operational difficulties.

Managing the critical flooding situation in the Jeseník region required a rapid overview of the extent of the damage and the current conditions in affected locations. The Population Protection Institute provided technological support for

the collection and analysis of spatial data using drones. These enabled aerial imaging of flooded areas, including locations where ground access was restricted or completely impossible. [4]

The images captured by the drones were subsequently processed into orthophoto mosaics and three-dimensional models. The resulting data were integrated into a comprehensive mapping service accessible through a web application. The aerial survey provided a consistent and up-to-date overview of conditions across the flood-affected area, facilitating the coordination of Integrated Rescue System (IRS) units, rescue operations, and subsequent planning for the recovery of damaged infrastructure. [4]

During this aerial survey, GIS served as a tool for integrating and spatially analysing data collected by drones. It enabled individual drone images to be transformed into accurately georeferenced maps, the creation of clear information layers, and the distribution of these outputs to Integrated Rescue System (IRS) units and other stakeholders through a digital mapping service. GIS therefore helped create a structured overview of the extent of flooding and the resulting damage, which was used both to coordinate emergency response operations and to support recovery planning in the affected areas. [9]

5. Assessment of Benefits and Risks Based on Specific Case Studies

The benefits and risks associated with the use of digital technologies were identified based on the crisis situations described above.

5.1 Benefits of Using Digital Technologies

The investigation into the railway accident near Pernink demonstrates that digital recording devices make a significant contribution to an objective and chronologically accurate reconstruction of events. Data from the Hasler TELOC 2500 electronic speed recorder, radio communication recordings, and information from the railway traffic management system enable a detailed analysis of train speed, braking, communication, and traffic organisation. Digital records allow for a more precise reconstruction of events and reduce reliance on witness statements, which may be influenced by subjective perception or the passage of time. Digital photographic documentation also preserves the condition of the accident site in a format that can be reviewed and analysed repeatedly without the need to revisit the location. [7]

During the large-scale wildfire in Bohemian Switzerland National Park, drones were deployed to identify hidden hotspots with elevated temperatures, including those in difficult-to-access terrain where ground inspections would have been extremely challenging or even impossible. Aerial monitoring using drones made a substantial contribution to preventing the fire from spreading again and helped ensure the efficient allocation of additional resources. Drones also provided an overview of the situation, enabling Integrated Rescue System (IRS) units to work with up-to-date information. [14]

During the floods in the Jeseník region, drones and GIS proved highly beneficial. Aerial surveys of flooded areas enabled the creation of orthophoto maps and three-dimensional models, which were subsequently integrated into a mapping service. GIS facilitated the spatial analysis and precise geolocation of data, as well as the creation of thematic information layers. These resources provided IRS units with a comprehensive overview of the extent of flooding, damaged infrastructure, and evacuation requirements. Digital data and mapping outputs supported coordination among IRS units and subsequent recovery planning in the flooded areas. [12]

5.2 Risks and Limitations of Digital Technologies

The examples presented also highlight certain risks and limitations. In the investigation of the railway accident near Pernink, the process depended to some extent on the functionality and availability of recording devices. If digital data had been unavailable or incomplete, reconstructing the accident would have been more difficult. Digital technologies therefore create a significant degree of dependence on technical equipment and its proper functioning. [9]

The deployment of drones during the wildfire in Bohemian Switzerland National Park was restricted by helicopter operations, which limited drone flights to the morning and evening hours. Aerial monitoring depends on suitable weather conditions and effective airspace coordination. Manned and unmanned aircraft cannot always operate simultaneously; their deployment must be carefully coordinated to prevent mutual interference or collisions.

During the floods in the Jeseník region, a large volume of data had to be processed and integrated into a mapping service, requiring specialised expertise and appropriate technological infrastructure. Without adequate processing, the images alone would not have provided sufficient information for effective decision-making. Digital technologies must therefore be operated by trained specialists, supported by suitable data infrastructure, and used by well-coordinated response units.

The financial costs of acquiring, maintaining, and operating digital technologies must also be taken into account.

6. Conclusion

Digital technologies have become an important part of crisis management, providing tools for documenting emergency incidents, analysing their development, coordinating response activities, and supporting subsequent recovery. As demonstrated by the case studies discussed in this paper, their practical value lies primarily in the ability to collect, process, visualise, and share information quickly and efficiently. The use of digital recording devices in the investigation of the railway accident near Pernink, unmanned aerial vehicles (UAVs) during the wildfire in Bohemian Switzerland National Park, and UAV imagery combined with Geographic Information Systems (GIS) during the floods in the Jeseník region illustrates the broad range of applications of these technologies in crisis management.

The findings indicate that digital technologies can improve the accuracy and objectivity of incident documentation, provide a more comprehensive overview of affected areas, and support operational decision-making. Digital records enable events to be reconstructed retrospectively, while aerial imagery and GIS facilitate the identification of hazards, the assessment of damage, the monitoring of inaccessible locations, and the planning of response and recovery measures. When information is made available in a timely and accessible form, these tools can also contribute to better coordination among Integrated Rescue System units and other organisations involved in crisis management.

However, the effective use of digital technologies depends on several conditions. Their reliability is influenced by the availability and quality of data, the technical functionality of the equipment, weather conditions, airspace restrictions, and the capacity to process and interpret collected information. Raw digital data do not automatically provide a sufficient basis for decision-making; their value depends on appropriate processing, expert evaluation, and integration into systems that support operational activities. The implementation of these technologies also requires trained personnel, suitable technical and data infrastructure, effective inter-agency coordination, and consideration of acquisition and operating costs. Data protection, cybersecurity, and the responsible handling of sensitive information must likewise remain integral parts of their use.

Digital technologies should therefore be understood not as a replacement for professional judgement and established crisis management procedures, but as tools that can strengthen them. Their benefits are greatest when technological solutions are selected in accordance with the specific needs of an incident and are incorporated into clearly defined operational processes. Further development should focus on improving interoperability, accelerating data processing and sharing, strengthening personnel training, and ensuring the reliability and security of digital systems.

In conclusion, the practical examples presented in this paper demonstrate that digital technologies can make a significant contribution to the documentation, analysis, and management of emergency incidents. Their successful implementation requires a balanced approach that combines technological capabilities with professional expertise, organisational preparedness, and appropriate safeguards. When these conditions are met, digital technologies can improve situational awareness, support more informed decision-making, and enhance the overall effectiveness of crisis management.

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