

# Technology for post-disaster damage and needs assessment: a tale of two municipalities in South Africa

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## Abstract

**Purpose** – Post-disaster damage and needs assessments (PDDNAs) play a critical role in guiding disaster response and recovery efforts. This study investigates the role of technology in enhancing PDDNA processes, focusing on two municipalities in South Africa. The research aims to evaluate the effectiveness of Disaster Information Management Systems (DIMS) in facilitating post-disaster assessments and to identify key barriers and opportunities for improvement.

**Design/methodology/approach** – A qualitative research approach was employed, incorporating an online survey to identify municipalities using digital tools for PDDNA, followed by semi-structured interviews with disaster management officials in the selected case study municipalities. Additionally, relevant policy documents and system-generated reports were analysed to triangulate findings.

**Findings** – The study reveals that while technology has the potential to improve PDDNAs, its adoption remains uneven across these municipalities. Key challenges identified include continued reliance on paper-based assessments, poor integration of geospatial tools, and inadequate digital literacy among disaster management personnel. Findings underscore the need for standardised, well-integrated, and user-friendly digital solutions that align with municipal capacities and disaster management needs.

**Originality/value** – This study provides one of the first comparative analyses of municipal-level digital PDDNA systems in South Africa. It offers practical recommendations for improving digital assessment methodologies and bridging the gap between policy intent and operational reality. The findings are relevant for disaster risk management practitioners, policymakers, and researchers seeking to enhance post-disaster assessment frameworks in South Africa and similar contexts.

**Keywords** Post-disaster assessment, Technology, South Africa, Information management, Local government

**Paper type** Research article

## Introduction

Disaster response and recovery in developing countries are often hampered by delays in collecting and disseminating critical information. Timely and effective decision-making during and after disasters plays a significant role in improving response capabilities (Zhou *et al.*, 2018). However, in the immediate aftermath of a disaster, damage and needs assessments are frequently inefficient (Begum and Momen, 2025), leading to information bottlenecks that impede quick relief and recovery actions. South Africa, which faces numerous natural and human-induced hazards, is no exception. Post-disaster damage and needs assessments (PDDNA) are a critical tool for guiding decision-makers in such contexts (South Africa, 2005). Yet, municipalities in South Africa continue to experience challenges in conducting rapid assessments and sharing information efficiently after disaster events (Botha and van Niekerk, 2013; NDMC, 2024). Although the use of modern technology is not without challenges, there is growing evidence that it offers substantial benefits for expediting PDDNA and improving the accuracy of information for decision-making.

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In light of these challenges and opportunities, this study aims to enhance post-disaster data collection and information dissemination methodologies at the municipal level in South Africa. By analysing existing technology used in two municipal case studies – a district (Capricorn District Municipality – CDM) and a local municipality (Witzenberg Local Municipality – WLM) - this research evaluates how information management systems can support rapid PDDNA in practice. The article expands on theoretical frameworks in disaster risk reduction and information management, reviews international best practices in employing technology for post-disaster assessments, details the research design and methods used, presents in-depth analyses of two South African case studies, compares South Africa's experiences with international benchmarks, and proposes recommendations for strengthening post-disaster assessment processes.

### **Information technology for post-disaster damage and needs assessment**

Information and communication technology (ICT) has become a cornerstone of modern disaster risk reduction (DRR) and response strategies. The Sendai Framework for Disaster Risk Reduction 2015–2030 (SFDRR) emphasises the importance of understanding disaster risk through improved data collection and sharing. In particular, national governments are required to report on indicators of disaster losses and impacts as part of the global and continental targets of SFDRR (UN, 2015). This mandate underscores that effective capture of damage and needs data is critical to assess the impact of disasters globally (Rajalakshmi and Periyasamy, 2015). By providing accurate, real-time information, technology can help ensure that post-disaster interventions contribute to reducing future vulnerability and enhancing resilience (Vatsavai *et al.*, 2011).

In a disaster context, a resilient community is one that can eliminate, reduce or minimise the adverse impacts of a hazard event and restore or even improve its pre-disaster state in the shortest possible time (Folke *et al.*, 2010). Quick and effective post-disaster assessments are a key component of resilience, as they enable responders and decision-makers to identify needs and allocate resources efficiently (Rajalakshmi and Periyasamy, 2015). From a resilience perspective, the flow of timely and reliable information is as important as structural and non-structural measures in supporting adaptive capacity (Adib and Jenab, 2010; Kitagawa, 2021; Ansari *et al.*, 2022). Technology can bolster resilience by improving situational awareness and coordination immediately after a disaster. For example, fast damage assessments supported by mobile applications or satellite data allow quick decision-making at local government level and for communities to prioritise emergency repairs and relief (Ahmed *et al.*, 2018). In essence, leveraging technology for PDDNA contributes to a system's adaptive capacity and learning, which are core aspects of resilience in disaster risk management (Adib and Jenab, 2010).

### **Disaster information management principles**

Effective disaster information management rests on principles of timeliness, accuracy, completeness, and accessibility of data (Adib and Jenab, 2010; Morton and Levy, 2011). The primary objective of any emergency information system is to improve decision-makers' capacity to act by providing them with the right information at the right time (Rajalakshmi and Periyasamy, 2015). Timeliness is crucial: delays in data collection can cost lives and prolong suffering. Accuracy and completeness of data ensure that responders understand the true scope of damage and needs. Incomplete or erroneous data can lead to misallocation of resources (Cimellaro *et al.*, 2014). Information sharing and accessibility are equally important, as disaster response typically involves multiple stakeholders who must have a common operating picture (Bjerge *et al.*, 2016). According to Adib and Jenab (2010), an emergency information system must enable timely and accurate capture and sharing of post-disaster information to support needed actions. Morton and Levy (2011)

note that effective disaster response requires rapid gathering of critical data, highlighting that slow or paper-based processes can hinder situational analysis. [Bjerge et al. \(2016\)](#) similarly underscore the importance of information sharing in the immediate aftermath of a disaster to facilitate coordination. These principles are echoed in humanitarian information management best practices ([Altay and Labonte, 2014](#)), where the goal is to collect once and use many times.

Modern technology directly supports these information management principles. For instance, mobile data collection platforms can significantly reduce the time required to gather field information compared to traditional paper forms. Studies have demonstrated that using smartphones or tablets for data entry improves data quality by minimising errors and omissions, as automated validation can be integrated into digital forms ([Ahmed et al., 2018](#)). [Ahmed et al. \(2018\)](#), in a comparative study in Sudan, found electronic data collection to be more effective and efficient than paper-based methods under challenging field conditions. Similarly, [Zelege et al. \(2019\)](#) reported significantly improved data quality when employing electronic tablets instead of pen-and-paper in a health survey in rural Ethiopia. These findings suggest that adopting electronic tools for PDDNA could yield more reliable and complete datasets. However, technology is not a cure-all. It introduces considerations such as power supply, connectivity, and user training. [Suzuki et al. \(2015\)](#) point out that online systems may be hindered by power outages or network failures and that entering information can initially be slower than using paper. They argue, however, that since disaster data ultimately must be digitised for effective sharing and analysis, even partial use of online entry will save labour and time overall. Thus, a balanced approach: utilising technology where it adds value while ensuring backup methods for extreme conditions, reflects sound information management practice.

### **South African disaster risk management laws and regulations**

South Africa's policy frameworks recognise these principles of information management. The Disaster Management Act 57 of 2002 (as amended in 2015) (DMA) mandates establishing an integrated and uniform information system for disaster risk management across government levels (national, provincial and local). Local government level in South Africa consists of three components: local, district and metropolitan municipalities. A district municipality typically consists of a number of local municipalities, whereas a metropolitan municipality is a stand-alone contained entity. Each has different functions as per the Constitution of the Republic of South Africa. The National Disaster Management Framework (NDMF) of 2005 calls for establishing an integrated information management and communication system to enable rapid and effective disaster response. Until recently, however, South Africa lacked formal guidelines for conducting post-disaster assessments. The introduction of the *Guideline on Conducting an Initial On-site Assessment* by the National Disaster Management Centre (NDMC) in 2019 filled this gap. This guideline provides a standardised approach for the first assessment after an event to determine its magnitude and severity, and it defines the process for classifying an incident as a disaster at the local, provincial, or national level. As part of this, the NDMC developed a Disaster Assessment and Classification Template. This template is currently a paper-based form used by municipalities to capture damages and needs. The move toward a uniform assessment form is a positive step, but paper-based methods have well-known drawbacks ([Zelege et al., 2019](#); [Ahmed et al., 2018](#)). They can be time-consuming, prone to transcription errors, and delay the consolidation of information. The theoretical imperative, in line with both global frameworks and national policy, is to leverage technology to overcome these drawbacks. The following review explores how various technologies have been applied in the Global South to achieve these aims.

**Technology for post-disaster damage and needs assessment**

A growing body of literature documents the use of technology to improve post-disaster damage and needs assessments worldwide (Nugraba and Damen, 2013; Patnaik *et al.*, 2009). This section reviews key studies and case examples, demonstrating how ICT tools are employed in different countries and what benefits and challenges have been observed.

*Global use of technology in post-disaster assessments*

*Indonesia:* Indonesia's disaster-prone environment has driven the development of innovative mobile applications for Rapid Damage and Loss Assessments (Setyawati *et al.*, 2019). A number of mobile apps have been developed and trialled for post-earthquake damage surveys in Indonesia. Setyawati *et al.* (2019) evaluated several such applications, including tools originally developed in other countries and adapted for local use. The *EDIM* (Earthquake Damage Information Matrix) app from Italy and the *Clarinspect* app from New Zealand were used to collect structured data on building damage with photos and GPS coordinates. Drawing on the strengths of these tools, Setyawati *et al.* (2019) proposed a conceptual design for a mobile rapid assessment system tailored to Indonesia's context. The proposed system comprises five components: (1) mobile devices, (2) users, (3) an internet network, (4) a data centre with a web server and database, and (5) a data processing centre for managing and analysing incoming data. Field tests of this conceptual system showed promising results. Notably, the offline data capture capability and later synchronisation were seen as essential features, given that early post-disaster environments often have damaged communication infrastructure.

*Philippines:* The Philippines is frequently cited as a leader in adopting disaster information management systems in developing country contexts (Rajalakshmi and Periyasamy, 2015). One early example is the use of *Sahana*, an open-source disaster management system originally developed in Sri Lanka, which was deployed in the Philippines after the 2006 Southern Leyte mudslide (Rajalakshmi and Periyasamy, 2015). *Sahana* provided a web-based platform for coordination during the relief phase, including modules for tracking relief distribution and victim registration. Building on such tools, Rajalakshmi and Periyasamy (2015) proposed a Mobile Disaster Management System using Android technology to address coordination gaps in disaster response. Their concept, *MyDisasterDroid*, would use an Android smartphone's GPS and communication features to guide responders along optimal routes to reach affected people in the shortest time. More recently, the Philippine Department of Education, in partnership with other agencies, developed the Rapid Assessment of Damages Report (*RADaR*) system (UNOCHA, 2021). *RADaR* is a web and mobile application designed to quickly assess and report the impacts of disasters on school infrastructure and the education sector. It allows school officials to input data on damages and interruptions, which then feed into a centralised Disaster Risk Reduction Management Information System. Reports generated by *RADaR* provide estimates of damages and inform the allocation of resources to restore schooling and ensure learning continuity. The Philippines' experience demonstrates a key lesson: sector-specific information systems (like for education, health, etc.) must be integrated into broader disaster risk management platforms to ensure that post-disaster needs are assessed comprehensively.

*India:* Hanspal and Behera (2024) explore how innovative information technologies enhance disaster management across India's diverse and disaster-prone landscape. Their research highlights various technologies, including Artificial Intelligence (AI), GIS, drones, and mobile communication systems. AI significantly improved predictive analytics, enabling early warnings and optimised resource allocation, especially evident in flood and cyclone forecasting. Meanwhile, GIS played a crucial role in providing precise hazard mapping and damage assessment, as demonstrated during the 2018 Kerala floods and Cyclone Fani in 2019. Drones contributed by delivering aerial data and supplies to hard-to-reach areas, a strategy effectively employed during the floods in Kerala and Himachal Pradesh in 2023.

Additionally, mobile technology and social media, bolstered by initiatives like Digital India, facilitate real-time communication and encourage crowdsourced data collection. This was particularly important during the COVID-19 response through the *Aarogya Setu* app. Collectively, these case studies illustrate a significant reduction in casualties and improved coordination. However, the study also identifies persistent challenges, including technical limitations, ICT infrastructure gaps, and regulatory barriers. To fully harness the potential of these technologies, policy reforms, training, and public-private partnerships are needed.

*Haiti*: In the chaotic aftermath of the 2010 Haiti earthquake, various ad-hoc technological solutions emerged to support relief operations (Kawasaki *et al.*, 2013). A collaboration led by Harvard University's Center for Geographic Analysis resulted in a comprehensive data portal for geospatial information sharing (Morton and Levy, 2011). This portal integrated available GIS maps and datasets relevant to the earthquake to support relief and reconstruction planning. By visualising multiple layers of data on maps, responders could identify the areas of greatest need and plan the aid distribution accordingly. The Haiti portal became a prototype for what is now known as the Humanitarian Data Exchange platform (UNOCHA, 2024). Haiti's experience illustrates how a combination of open data-sharing platforms and targeted mobile tools can dramatically improve the efficiency of post-disaster assessments, even in low-income settings.

### Common features of effective PDDNA technologies

Across these international examples, several common features emerge as critical for an effective PDDNA information system. First, mobile data capture devices equipped with cameras and GPS have become almost standard (Setyawati *et al.*, 2019). Many solutions use Android-based devices for their affordability and flexibility. Second, an electronic data collection application with offline capability is highly desirable (Rajalakshmi and Periyasamy, 2015). Third, geospatial integration is important: linking each assessment to a location enables spatial analysis of impacts, which is valuable for identifying hotspots and informing logistics (Nugraha and Damen, 2013). Use of remote sensing and drones is also noted as a complementary approach, especially for assessing areas that are unsafe or inaccessible to ground teams (Adsanver *et al.*, 2025). Fourth, automated reporting tools add value (Bjerge *et al.*, 2016). Systems that can automatically generate summary reports or visual dashboards save time in consolidating data for decision-makers. Fifth, a robust cloud-based data management backend is needed to store and process the incoming information securely and efficiently (Kawasaki *et al.*, 2013). Sixth, communication integration enhances the speed of disseminating findings (Setyawati *et al.*, 2019). Lastly, AI and machine learning are becoming increasingly useful in the field of PDDNA (Al Shafian and Hu, 2024). These features, taken together, form a checklist for any modern PDDNA system. They will be referenced later when analysing the South African case studies to evaluate how well the local systems align with international best practices.

### Methodology

#### *Research design*

This study employed a qualitative, multiple-case study design with a grounded theory approach to investigate how technology facilitates post-disaster damage and needs assessments (PDDNA) in South African municipalities. Two contrasting cases – a district municipality and a local municipality – were examined to provide insights across diverse scales and contexts.

#### *Case selection and sampling*

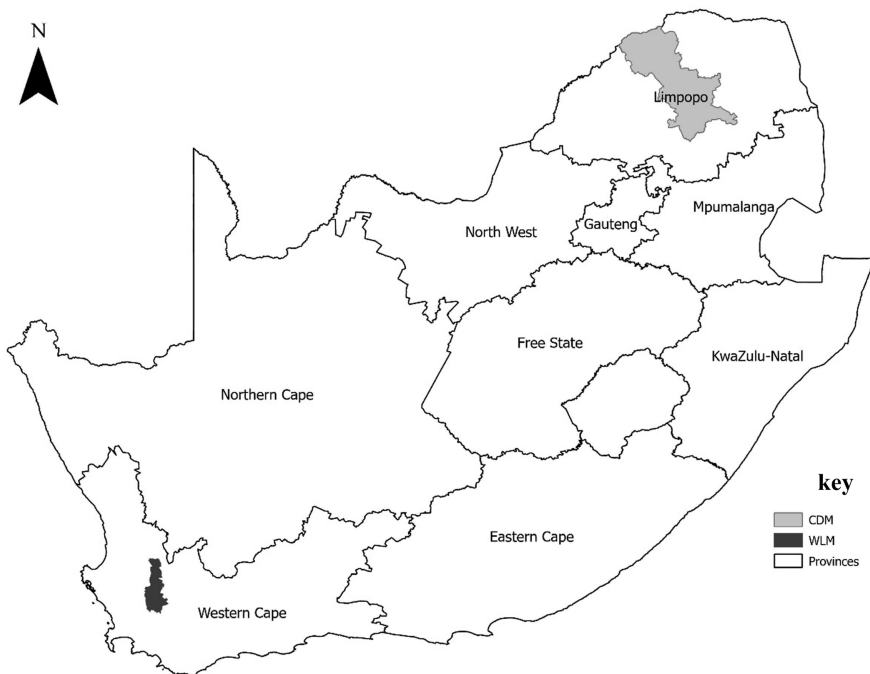
Cases were purposively selected following an online survey of South African municipalities that was aimed at understanding how government entities conduct PDDNAs, including the

processes, legislative frameworks, and technologies they use. Voluntary response sampling were used which means that the sample is composed of self-selected volunteers, which can lead to selection bias. However, the purpose of the survey was to identify Municipalities that have Disaster Management Information System (DMIS) that facilitate PDDNA, to further investigate these systems through detailed interviews.

The target population consisted of the National Disaster Management Centre (NDMC), nine provincial departments (PDMC), eight metropolitan municipalities, 44 district municipalities, and 205 local municipalities. A link to the online survey and a cover letter were emailed to each of the 267 potential participants. A total of 19 respondents successfully completed the online survey and only four out of the 19 respondents indicated having a Disaster Management Information System (DMIS) in place. Of these four, only one district and one local municipality said their system facilitates PDDNA. From the responses, Capricorn District Municipality (CDM) (Limpopo) and Witzenberg Local Municipality (WLM) (Western Cape) (refer [Figure 1](#)) were chosen due to their functional PDDNA technology. The use of voluntary response sampling means that the sample is composed of self-selected volunteers, which can lead to selection bias. However, the purpose of the survey was to identify Municipalities that have Disaster Management Information System (DMIS) that facilitate PDDNA, in order to further investigate these systems through detailed interviews.

#### *Data collection*

Semi-structured interviews were conducted with disaster risk management officials, including managers and operational staff, on a case-by-case basis via video conferencing or telephone. The interviews lasted between one to two hours and covered PDDNA procedures, system



**Figure 1.** Location of the two case study municipalities. Figure by authors

features, benefits, challenges, and the history of implementation. Document analysis (e.g., response plans, Standard Operating Procedures (SOPs), system reports) supplemented the interviews for triangulation.

#### *Data analysis*

Interview transcripts and documents underwent thematic analysis. Open coding (e.g. breaking down raw textual data into discrete parts) identified key themes (e.g., system functionality, challenges, benefits), followed by constant comparison to categorise codes. A cross-case analysis compared themes across municipalities, highlighting both patterns and differences.

#### **Case studies: two South African municipalities**

The contrast between a district municipality like Capricorn District and a smaller local municipality like Witzenberg Local District municipalities can influence the extent and success of a PDDNA. District Municipalities generally have a broader mandate and greater access to resources. While Local municipalities often have a more limited capacity, their success in a PDDNA is often determined by the support they receive from their district municipality.

For each case, a description is provided of the context and historical practices related to post-disaster assessment, the technological system currently in use and its features, how the system is applied in practice, and the perceived outcomes regarding data collection speed and accuracy.

#### *Capricorn district municipality*

*Context and historical practices:* Capricorn District Municipality (CDM), located in Limpopo Province, covers several local municipalities and is responsible for disaster risk management coordination at a district level. Historically, like many South African municipalities, Capricorn relied on paper forms and manual processes for post-disaster assessments. When a hazard occurs, the typical practice is to dispatch a rapid assessment team composed of disaster risk management officials and other relevant department staff. These teams would use printed forms or notebooks to record information on affected households, infrastructure damage, and immediate needs. The data would then be returned to the Disaster Management Centre (DMC) to be collated (often in spreadsheets or word processing documents) to generate reports. This manual approach was labour-intensive and time-consuming, often leading to delays in finalising disaster impact reports. CDM recognised these limitations and invested in a custom-developed disaster information management system in the late 2010s. The system was intended to digitise and streamline the PDDNA process.

*Current system:* In theory, the Capricorn District's information management system is rich in features and aligns well with best practices. It is a cloud-based web application accessible to authorised users via the Internet. Accompanying the web portal is an Android mobile application that field teams can use on smartphones or tablets to capture assessment data, including photographs and GPS coordinates of damaged sites. The mobile app has been designed with offline capabilities. Key features of the system include an interactive dashboard and detailed data views to monitor incoming reports, an online GIS mapping interface that plots incidents and assessment locations for spatial analysis, and automated report generation tools to produce summary statistics and formatted reports in various formats (PDF, Excel, etc.). The system also incorporates integrated communication functions (e.g. using multiple communication channels). Another notable feature is the automated calculation of estimated damage costs for household-level impacts, presumably using predefined formulas or unit costs. In principle, this comprehensive suite should enable the CDM to conduct rapid field assessments, instantly see the results on a centralised platform, and quickly disseminate

information to provincial authorities and relief agencies, thereby significantly reducing the time required for post-disaster reporting and response initiation.

*System in practice:* Despite the robust design, the CDM's practical experience with the system has been fraught with challenges, resulting in only partial and inconsistent usage. A critical issue arose with the mobile application's GPS requirement. The app was configured to mandate a GPS coordinate for each assessment entry, however, users reported that, at times, they could not achieve a GPS lock or signal, and the app would not allow them to proceed without it. This led to immense frustration among field staff. Instead of the system accelerating their work, it led to a bottleneck in data capturing. Consequently, many assessors reverted to using paper forms for initial data recording. The district supplied teams with a carbon-copy booklet template (essentially a duplicate pad of the assessment form) to collect data by hand. This paper form captures the personal details of affected individuals, details of the incident, recorded losses and damages, the economic status of victims, and the relief required or provided. One copy of the form is given to the affected household. Another copy is handed to the on-site South African Social Security Agency (SASSA) officials if immediate relief is needed, and the original is retained by the team. These paper forms are later brought back to the office and manually entered into the web system by administrative staff or volunteers, a process that can be slow given the district's limited human resources. In fact, during the COVID-19 pandemic, the reliance on external volunteers or non-core staff for data entry meant that many assessments were not input for months on end.

Other aspects of the system also experienced suboptimal use. Photographs of damage (although taken by assessors using their phone cameras) were not uploaded through the app and were instead managed outside the system. Staff would download these photos to a computer and then manually insert them into reports. Consequently, the linkage between photos and specific assessments in the database was lost. Similarly, the GIS functionality of the system was largely underutilised. Since exact GPS coordinates were often not captured (assessors instead recorded general location names such as the village or ward number), the incident mapping became unreliable. Furthermore, automated reporting was not functioning to the district's satisfaction. For example, issues with data export meant staff reverted to manually compiling reports in Word/Excel, copying numbers from the system or from paper forms, which was time-consuming. The integrated communication features were also not widely utilised, possibly because the system was not consistently updated in real-time to make those alerts meaningful. Essentially, CDM's high-tech system was being undermined by practical usage problems, leading them to revert to hybrid practices. This represents a significant gap between the system's *theoretical* capabilities and the *real-world* implementation within the municipality.

*Perceptions of data accuracy and timeliness:* According to CDM practitioners, when their disaster risk management staff conduct the assessments, the data's accuracy is relatively high. The simplicity of the paper form and their experience means that mistakes are few in those instances. However, when an incident or disaster is significant, and additional role-players must assist, data accuracy suffers. Those external helpers may not fill in forms correctly or consistently, leading to errors. This suggests that while the current approach yields somewhat accurate data on a small scale, it does not scale well to larger events. CDM's internal policy is to respond on-site within eight hours of an incident report. Initial relief is often provided during these assessments, and referrals to SASSA for food aid are made immediately after the on-site visit. Thus, during the relief phase, the municipality reacts fairly swiftly. However, for longer-term recovery, the process can take a considerable amount of time since external departments are involved, and funding must be secured. The information system, if fully utilised, could theoretically speed up the compilation of the disaster report needed to trigger those processes. In practice, because of the partial use of the system, the time taken to produce comprehensive assessment reports is still longer than ideal (more than 48 h). This delayed information flow can postpone the formal state of disaster classification and declaration steps, subsequently delaying the release of relief and rehabilitation funds. The district's experience emphasises that technology not fully embraced can become merely another layer in an already cumbersome process.

*Challenges:* The case of CDM reveals several challenges. Technical issues have discouraged field use of the mobile app. Insufficient training or digital literacy among staff may have exacerbated these issues. Resource constraints require staff to juggle multiple responsibilities, causing them to view the system as an additional burden rather than a time-saver. Without a dedicated data officer to manage and advocate for the system, it has languished in semi-usage.

*Opportunities:* Conversely, opportunities for improvement are also evident. The system theoretically meets all their needs, so if the existing software bugs can be resolved and if users are properly trained and held accountable, much of its potential value could be unlocked.

### *Witzenberg Local Municipality*

*Context and historical practices:* Witzenberg is a local municipality (WLM) in the Western Cape Province (WCP), encompassing a mix of small towns and agricultural areas. Historically, WLM's approach to disaster assessment was aligned with provincial guidance (e.g. SOPs provided by the WCP). For large incidents, they would follow the national guideline for initial onsite assessment (using the NDMC template), often with support from the district and province. For minor incidents, the first responders would report basic details to the municipal control room – conducting more in-depth assessments does not fall within the mandate of first responders. Before having a dedicated digital system, WLM used a combination of paper forms and rudimentary electronic records to track incidents and relief provided. Communication with the district and province was done via emailed reports or phone calls. In the late 2010s, through an initiative by the Western Cape Provincial Disaster Risk Management Centre (PDMC) and the Cape Winelands District (under which WLM falls), a custom disaster risk management system was implemented. This system was provided as part of a broader provincial strategy to improve disaster and risk information management at all levels.

*Current system:* The WLM's system is a cloud-hosted, custom-developed Disaster Management Decision Support Tool. It functions primarily as a web application. Notably, unlike CDM's system, it does not have a dedicated mobile app, but the web portal is mobile-responsive. Through a mobile web browser, field staff can input data and upload photos as they would on a desktop, provided they have network connectivity. The absence of offline capability is a design limitation, but WLM's context (smaller area, better cellular coverage in settled areas) makes this less of an issue in practice. The system's features include a dashboard for an overview of incidents and a detailed data view for each record. It provides for similar GIS mapping of incident locations on a live dashboard, automated report generation and data export functions, and integrated communication tools. It also possesses a built-in module to calculate and record estimated damage costs for various categories. One feature it lacks is the ability to capture relief distribution data. This was seen as a minor gap. Overall, the system appears to be a scaled-down but still robust tool.

*System in practice:* WLM's disaster risk management staff report generally positive experiences with the system. When a minor incident occurs, they often refrain from dispatching the disaster risk management team(s) (only needed in major events or incidents) if it falls within the capacity of the first responders. In such cases, the information is relayed to the disaster risk manager, who then enters the details directly into the system. If the disaster risk manager or officials do go to the field (for somewhat larger but not major incidents), they can access the system on a smartphone or tablet via the web and input data and photos on-site. The system automatically time-stamps entries and compiles a situation report for every incident or group of incidents. This is especially useful if multiple small incidents occur around the same time (for instance, multiple flooded homes following a local storm). The system can group them together and produce one aggregated report. Photos uploaded via the web interface are automatically linked to the incident records and included in the situation reports. For a larger incident, the process would begin with using the national assessment template as an initial step, but then key information would also be entered into the system. Respondents indicated that if such a scenario arises, the system would be used to log the incident details,

GPS coordinates of impact locations and to attach photos, thus complementing the official paper forms that would be forwarded to higher authorities. This dual approach ensures compliance with national requirements while still leveraging the efficiency of the digital tool for their operational needs. Importantly, WLM's system is connected to the district and the province. It features a common operational environment that enables both the district and province to view WLM's incident data (and vice versa, presumably in aggregated form).

*Perceptions of data accuracy and timeliness:* Respondents in WLM believed that the data captured in their system is highly accurate. The respondents noted that the system has relatively few fields to fill, and incidents are typically within their capacity, resulting in minimal ambiguity or complexity that could introduce errors. Furthermore, since one or two trained individuals handle most of the data entry, consistency is maintained. Regarding timeliness, WLM's average response time to provide basic relief (such as emergency shelter or food) is reported to be under 48 h. For rehabilitation and reconstruction, the response depends on the type of incident. However, because the system shares data with all stakeholders promptly, it has a significant impact on the timely availability of information. Overall, WLM's experience suggests that a well-implemented information system at the local level can make the PDDNA process efficient and integrated. It essentially embeds the information management principles of timeliness and accuracy into their workflow, to the extent that the system's outputs (situation reports, maps, notifications) drive the response actions in near real-time.

*Challenges:* While WLM's case appears largely successful, they have identified some limitations. The lack of offline mobile capability is one. Another limitation is the inability to log relief distribution. Their challenges, akin to CDM, include capacity and funding constraints for disaster risk management in general. They operate with a small team and budget, relying on the district or province for support.

*Opportunities:* An opportunity they recognise is to enhance multi-agency (other sector departments) collaboration through the system by ensuring participation in disaster management structures. Additionally, having pre-arranged contracts for repairs could expedite rehabilitation once the need is identified. These are improvements that complement the technical system. WLM demonstrates that with support and a simpler context, a digital PDDNA system can function as intended.

### Lessons learned

The two case studies, while both within South Africa's municipal disaster risk management sphere, reveal markedly different experiences with technology for post-disaster assessments.

*Governance level and support:* CDM, as a district municipality, deals with multiple local municipalities and larger-scale incidents, over a greater geographical area. WLM is a single local municipality with a smaller jurisdiction. This variance in scope impacts resource availability and needs. CDM implemented its own system largely independently, whereas WLM's system is provided through provincial structures. The provincial support for this smaller local municipality likely contributed to better training and integration for WLM. This underscores how institutional support can influence success.

*System Features:* On paper, both systems possess very similar features. CDM's could capture relief data, while WLM's could not log relief, however WLM have not had any major incidents and currently use an excel spreadsheet for this function. This suggests that having more features is not always advantageous. What truly matters is that the features function well and are utilised effectively.

*Usage and user adaptation:* WLM staff actively utilised the system as intended for both small and moderate incidents, whereas CDM staff largely bypassed critical aspects of the system due to frustrations. Training and ease of use appear to have been better in WLM, or the staff were more motivated to employ the tool. In CDM, without enforcement usage declined. This indicates the significance of change management: introducing new technology necessitates careful attention to user experience and ongoing training or incentives to utilise the system.

*Data flow and sharing:* CDM's data flow became linear and delayed (e.g. it followed a dependency path of decision-making), while WLM's data flow was more continuous (less dependencies which allowed quicker decision-making). Consequently, WLM achieved a more integrated information exchange, as envisioned by the DMA and its guidelines, whereas CDM did not fully realise that integration despite having a system theoretically capable of it.

*Challenges:* Both municipalities noted resource constraints. The lack of dedicated personnel for data management in CDM and general funding and staffing limitations in WLM are significant issues. Technical problems were prevalent in CDM, while WLM's challenges were more related to system scope. Both municipalities acknowledge that external factors, such as the preparedness of other departments and funding processes, influence the overall effectiveness of post-disaster response.

*Opportunities:* In CDM, there is a clear opportunity to reinvigorate system usage by resolving technical bugs and instituting performance measures around its use. In WLM, an opportunity exists to expand the network of system users and potentially advocate for enhancements such as an offline mode. Both cases highlight an opportunity for standardisation and knowledge sharing.

## Recommendations

To strengthen PDDNAs in South Africa, a multi-faceted and technology-enabled approach is essential. Central to this is the development and implementation of a nationally standardised Disaster Information Management System that ensures consistency, interoperability, and responsiveness across all levels of government. A modernised PDDNA system should be underpinned by mobile data capturing through smartphones or tablets, allowing real-time, on-site data collection, reducing reliance on paper forms and minimising transcription errors, while supporting offline functionality in low-connectivity areas. Second, the use of electronic data collection through structured digital forms enhances the accuracy and speed of data processing and ensures alignment with national assessment indicators. Third, geospatial integration enables all data to be linked to precise coordinates, supporting spatial analysis and mapping of damage, needs, and vulnerabilities. Fourth, automated reporting tools generate instant dashboards, summary reports, and sector-specific visualisations, reducing turnaround times and enabling rapid communication of findings to relevant stakeholders. Fifth, robust cloud-based computing provides secure, centralised data storage, supports multi-location access, enhances system scalability, and ensures data resilience and integrity. Sixth, communication integration with various platforms facilitates two-way communication, real-time updates, community reporting, and improved coordination among agencies and affected populations. These technological innovations must be supported by dedicated funding streams, including national, provincial, and local budgets. The development of locally appropriate open-source solutions to address gaps in hardware, software, connectivity, and technical support, is needed. Equally important is the institutionalisation of comprehensive cross-sectoral training programmes to build the capacity of officials and stakeholders in using and interpreting data effectively. Finally, a robust monitoring, evaluation, and learning framework must be embedded to measure system performance, inform adaptive improvements, and ensure that PDDNAs continually evolve in response to changing risk environments and user needs.

## Conclusion

Information technology has the potential to transform post-disaster damage and needs assessments in South Africa by making them faster, more accurate, and more collaborative. The study of Capricorn District and Witzenberg Local Municipalities illustrated both the challenges and opportunities in this transformation. The findings highlight that many hurdles currently limit the successful implementation of PDDNA technology. Yet, there are also clear

pathways to overcome these hurdles, as evidenced by both the incremental successes in Witzenberg and the wealth of international experience that can be drawn upon. Strengthening post-disaster assessments in South Africa will require a concerted effort to standardise methodologies, invest in appropriate technologies, and build the human and institutional capacity to use those technologies effectively.

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