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Developing post-disaster resilience decision support system user interface for enhancing post-disaster response

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Abstract

Effective resource allocation for resilience after a disaster is hindered by delayed assessments and outdated situational data. This research demonstrates how a mobile, location-based user interface (UI) for a Post-Disaster Resilience Decision Support System (PDRDSS) enhances real-time situational awareness and enables efficient decision-making. The key features of UI include user-centered design built with Expo for React Native, geospatial visualization for dynamic mapping of disaster affected areas with GPS-based location, and structured reporting allowing responders to submit impact reports and receive actionable recommendations via an intuitive dashboard. The backend infrastructure uses a scalable, serverless architecture to ensure reliability during critical operations. By integrating live reporting, real-time risk assessments, and automated coordination tools, the PDRDSS reduces emergency response times, improves equitable resource distribution through data-driven insights, and enhances cross-agency collaboration with centralized communication channels. Future work will focus on completing the full implementation of the backend infrastructure as well as usability testing and integrating AI to refine predictive risk assessments for the areas affected by disasters.

Keywords: post-disaster decision support system, disaster response, resilience, location-based services, geospatial visualization, user interface, resource allocation

Introduction

During the aftermath of a disaster, effective resource allocation is necessary in order to restore normalcy and minimize any further potential damage that can occur to the environment and the affected populations. Currently, the traditional methods of managing disasters mostly rely on manual coordination and delayed assessments from first responders (Elkady et al., 2024; Palmieri et al., 2016). In a rapidly evolving disaster situation, first responders often work with outdated or incomplete information. This can lead to inefficient decision-making, suboptimal resource allocation, and prolonged recovery efforts (Ahmadi et al., 2022; Kant et al., 2023). In order to address these challenges, implementing a location-based support system can improve post-disaster resource management by providing a near real-time awareness and data-driven decision-making user interface (Majumdar & Awasthi, 2025; Palmieri et al., 2016). Integrating live geospatial data, user-input impact assessments, and a UI-friendly interface allows first responders to receive up to date information more easily and can enable them to allocate resources more effectively (Jung et al., 2020; Cioca & Cioc, 2010).

The primary objective of this research is to develop a location-based user interface that will be used for real-time post-disaster decision support systems (known as RDSS) to improve situational awareness and resource allocation. The main goal of this study is to design and implement a user interface that enables real-time disaster impact reporting, geospatial data visualization, and resource tracking. Implementing automated impact assessments and live data collection will reduce any delays that can occur for a post disaster response and enhance decision-making efficiency for emergency responders.

The research will also focus on improving the resource allocation by prioritizing the disaster severity, affected populations, and what resources are available to be provided. The user interface is developed to be cross platform, working on mobile devices as well as a web-accessible version. This will allow not only first responders but also citizens in affected areas to contribute critical information and receive updates. The effectiveness of such a large-scale system will be tested through simulations in order to ensure that the solution is practical and can be effective for post disaster responses.

Literature Review

Effective disaster response and resource allocation depend heavily on systems that can support timely, data-driven decision-making. In recent years, a growing body of research has explored the use of Decision Support Systems (DSS), Location-Based Services (LBS), and user-centered interface design to improve post-disaster resilience (Elkady et al., 2024; Phillips-Wren et al., 2021). This literature review examines existing work in these domains, highlighting how current systems manage disaster data, visualize geospatial information, and support emergency responders in the field.

Decision Support Systems (DSS) have become integral to modern disaster management, offering structured methods for processing data and assisting decision-makers during high-pressure emergency scenarios (Ahmadi et al., 2022; Kant et al., 2023). Elkady et al. (2024) emphasize that DSS platforms have evolved to incorporate advanced analytics, geospatial technologies, and multi-criteria decision-making methods such as AHP and fuzzy logic. Jung et al. (2020) similarly note that intelligent DSS frameworks leverage real-time environmental sensing and predictive modeling to assist urban resilience planning.

Despite these advances, many DSS platforms still fall short in terms of usability—particularly for first responders who need real-time access in the field (Cioca & Cioc, 2010; Moulaei et al., 2022). Most existing tools prioritize computational accuracy but overlook the importance of intuitive, mobile-accessible interfaces. This research aims to bridge that gap by developing a location-based, user-friendly interface that makes advanced decision-making tools more accessible and effective in real-world disaster response operations.

Location-Based Services (LBS) provide a critical technological backbone for modern disaster management systems, particularly in supporting real-time geospatial awareness, responder localization, and data-driven coordination (Palmieri et al., 2016; Huang & Rafiei, 2019; Majumdar & Awasthi, 2025). These services utilize GPS, mobile sensors, and communication networks to deliver actionable insights during crises. Palmieri et al. (2016) proposed a cloud-based architecture that demonstrates how LBS can be used to localize first responders and emergency teams in smart city environments. Their system works by integrating cloud computing with LBS and sensor technologies to improve decision-making and field coordination. The authors note that "supporting of First Responders (FRs) represents one of the most critical activities during crisis events, requiring the timely collection of relevant location-aware information for the command & control centers" (Palmieri et al., 2016, p. 811). They designed a hybrid system using both landmark-based and sensor-driven localization, allowing responders to place reference nodes in affected areas and use motion sensors (e.g., gyroscopes, accelerometers) for navigation in environments where GPS may be unreliable.

A key advantage of this system is its ability to operate without relying on pre-installed infrastructure—critical in post-disaster settings. "No assumptions can be made about the working conditions," Palmieri et al. (2016) explain, which justifies their use of fallback landmark-free motion inference (p. 811). However, the authors acknowledge limitations such as sensor noise and positioning inaccuracies, particularly in indoor or obstructed environments. These issues support the argument that LBS should be directly integrated into real-time decision-making interfaces for field personnel (Majumdar & Awasthi, 2025).

Palmieri et al.'s work demonstrates how hybrid LBS systems integrated with cloud platforms can enhance crisis response. However, their focus is primarily on backend architecture and sensor frameworks, offering limited consideration for front-end usability or mobile interface design. This research builds on their system by shifting the focus toward real-time, user-facing UI development that improves situational awareness and supports faster, data-informed decisions for emergency responders in the field (Cioca & Cioc, 2010).

Methodology

This research follows a development-based methodology that focuses on the design and initial testing of a real-time, location-based user interface for a post-disaster resilience decision support system (PDRDSS). This research utilizes a user-centered design approach, integrating iterative prototyping and evaluation to ensure that the final system meets the needs of emergency responders. The user interface is accessible via both mobile devices and the web, increasing accessibility for not only first responders but also citizens. The interface uses geospatial data and user-submitted impact reports to support real-time decision-making. Overall, the development process combines frontend UI design, backend data management, and mapping services to simulate real world disaster operations and test system performance and usability.

User interface development

For developing the UI of PDRDSS, this research utilizes a combination of frontend frameworks, backend infrastructure, mapping services, and version control tools that support scalability, modularity, and most importantly cross platform deployment such as Android and IOS. The interface, built using built with Expo for React Native, allows for quick mobile prototyping and live testing on both IOS and Android devices. For accessibility and usability, the component of the application features quick-access buttons, alert indicators, and intuitive navigation for responders in the field, as shown in Figure 1(b).

The application incorporates Google Maps API to enable real time geospatial visualization of areas impacted by disasters. This feature is primarily used by emergency responders so that they can interact with the live map for faster decision-making and situational awareness, as illustrated in Figure 1(a).

The users can view incident locations as they are stored in the database and check what areas have already been reported as impacted zones in order to prevent duplicate tickets. This is a vital feature that can support the use of dynamic map markers, which is important because the status of an incident can be updated at any time.

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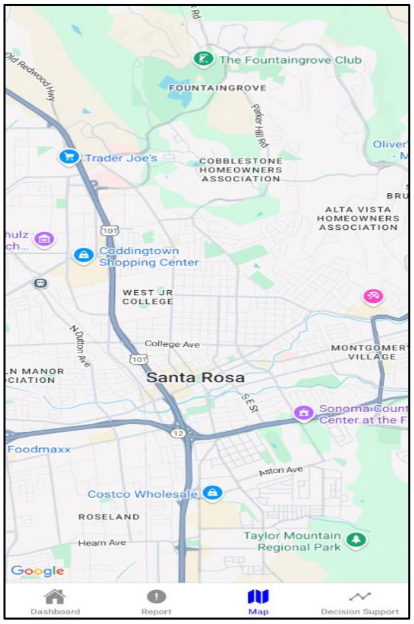
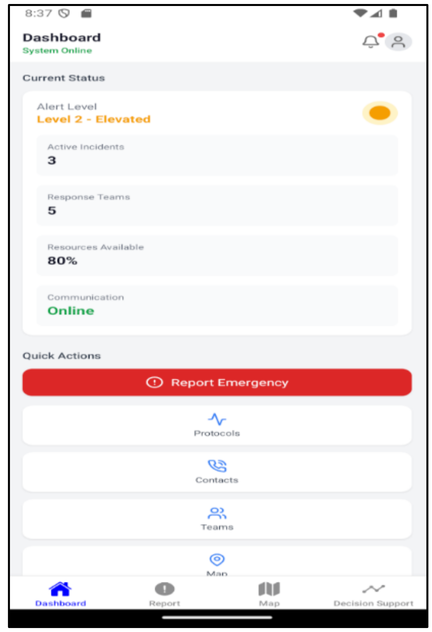


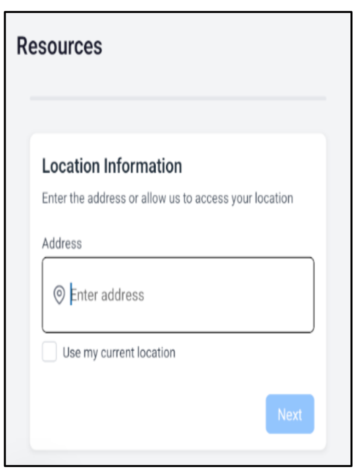
1(a). Geospatial visualization



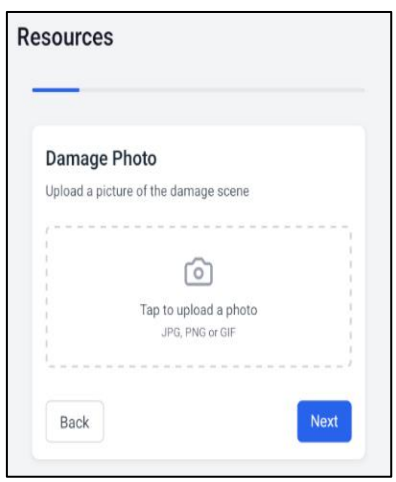
1(b). Dashboard

Figure 1. UI dashboard & Geospatial Visualization

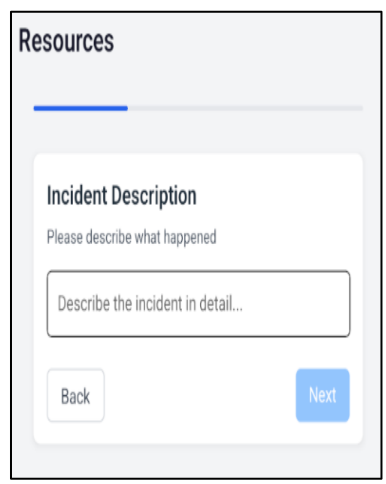
A core feature of the PDRDSS application is its multi-step reporting system. This system collects critical information from users and emergency responders in the field. The reporting system workflow allows a real time submission of critical incident data, which can be used to update a response plan and support resource allocation. The UI for the reporting system is designed so that the users can easily follow a series of steps to ensure a consistent and effective decision making. Figure 2(a), 2(b) and 2(c) demonstrate the user inputs for the location, damage and their descriptions.



2(a) Location Information



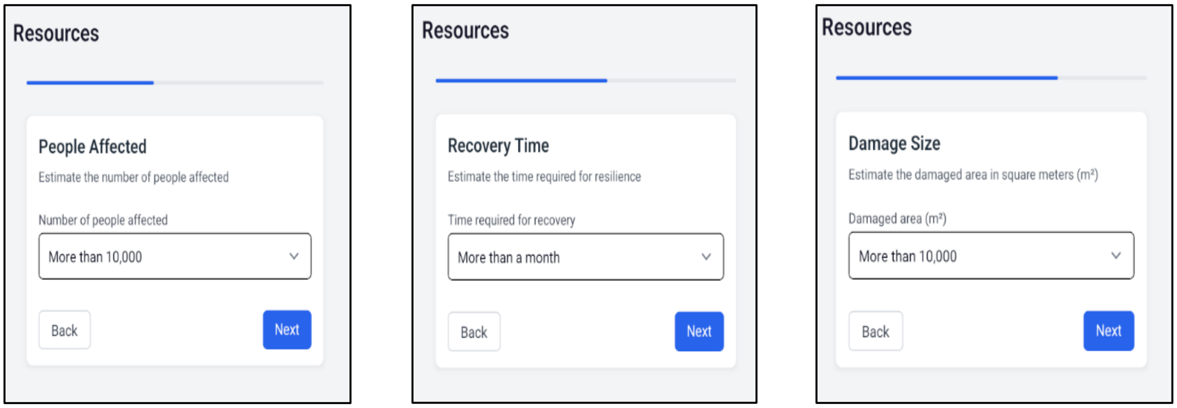
2(b). Damage Photo



2(c). Incident Description

Figure 2. User inputs: location, damage and description

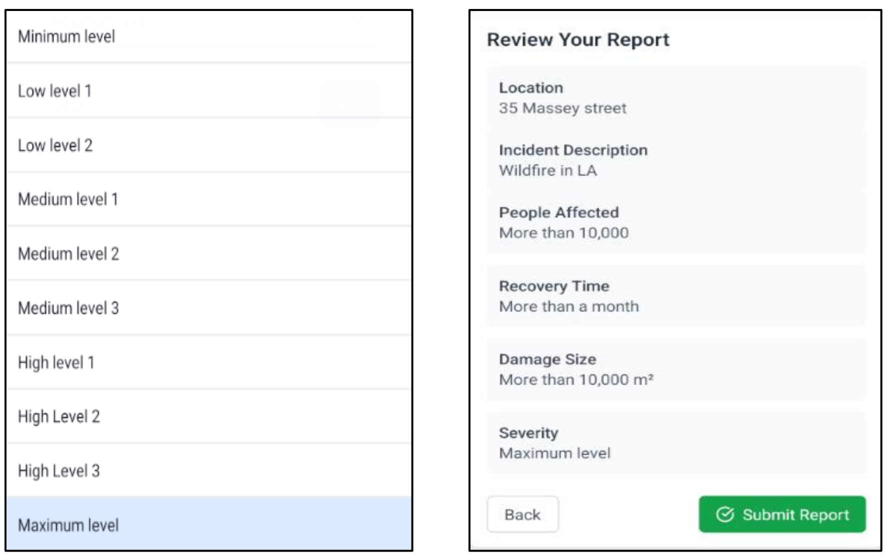
Figure 3(a), 3(b) and 3(c) demonstrate the user inputs for the number of people affected, estimated recovery time and size of damage area. The items for the user inputs and the scales were based on Lawal et al.'s (2024) research findings.



3(a). People Affected **3(b). Recovery Time** **3(c). Damage Size**

Figure 3. User inputs: people affected, recovery time and size of damage

Lawal et al. (2024) categorized the criteria for assessing incidents. Figure 4(a) demonstrates the user inputs for the severity of damage, which the level can be selected from predefined pulldown menu. Once all inputs are entered, the application generates the review page for ensuring input verification as seen in Figure 4(b).



4(a). Damage Severity **4(b). Review of Report**

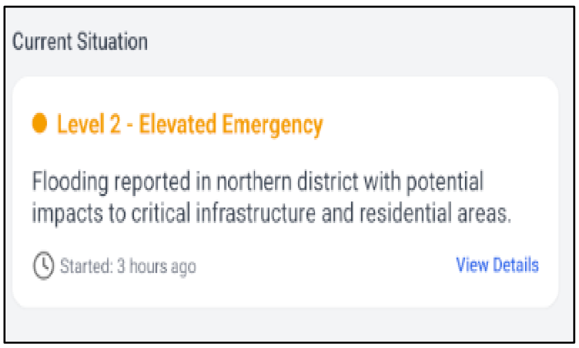
Figure 4. Severity input and report review

The key components of the reporting interface include:

- Location capture: users can either manually enter an address or use GPS to autofill their current location.
- Image upload: users can attach a photo of the damage scene to show responders a visual representation of the severity caused to the area.

- Incident description: a text box allows for an idea of what is happening in the area, giving additional details.
- Structured impact metrics: record data, such as number of people affected, estimated recovery time, size of damaged area, and severity level.

Each field is designed with dropdowns or step-by-step logic to reduce input error and guide the user toward submitting their documented data. This reporting system can be used by trained responders, but it also has the potential to support community-driven input from residents within affected zones. Integrating this reporting flow into the PDRDSS allows for a dynamic perspective on disaster conditions, improving response prioritization. Figure 5(a) demonstrates the disaster condition based on current situation. Figure 5(b) demonstrates the risk assessment based on the user inputs. For testing, several manual inputs were performed at different locations.

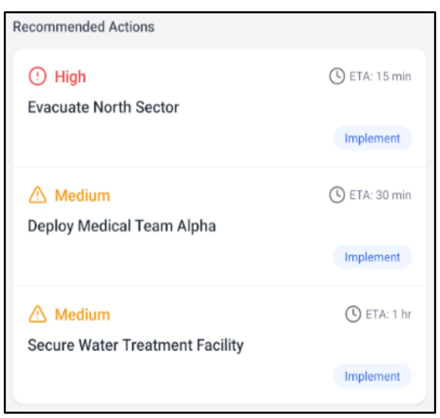


5(a). Current Situations

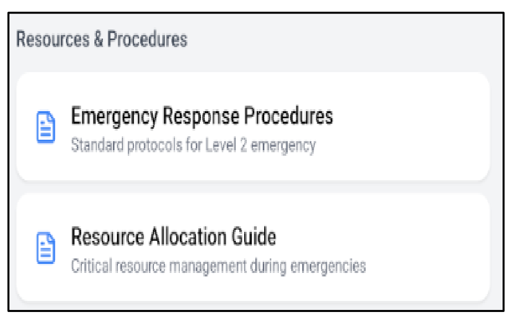
5(b). Risk Assessment

Figure 5. Report: current situation and risk assessment

The decision support tab in the PDRDSS application is designed exclusively for emergency responders and decision makers. The UI presents an overview of the current disaster situation, ongoing risks, and actionable recommendations based on collected data and user reports, as shown in Figure 6(a) and 6(b).



6(a). Recommended Actions



6(b). Resources & Procedures

Figure 6. Report: recommended action and procedures

The key components of support tab include:

- Current situation overview: displays emergency level with a brief description of the incident. It includes a timestamp of the last update to ensure time-sensitive decisions are based on the latest input.
- Risk assessment module: visual indicators of disaster impact such as infrastructure, population, resources, and the environment.
- Recommended actions: generates a list of recommended actions, including the estimated time to arrive and severity level. Decision makers can initiate these actions with a tap, allowing for fast deployment of emergency protocols and evacuation orders.
- Resources and procedures: a quick access to relevant standard operating procedures and available resources for implementation.

This user interface has a minimal yet high-clarity layout for ease of use in high-stress environments. All features shown in the support tab are designed to be actionable and tied directly to the real time data gathered through the reporting system and geospatial inputs. The backend architecture and design for this system consists of a fully serverless and event-driven set up hosted on cloud services. Clients communicate over the network using standard protocols, such as HTTPS and WebSocket through an API that handles TLS termination and JWT validation using an authentication framework, Firebase Auth. The requests will then be routed to stateless functions using AWS Lambda that would be written in python. The functions are meant to handle all core CRUD endpoints needed for performing geospatial queries and fetching risk-assessment recommendations.

The data layer of the architecture makes use of MongoDB and its NoSQL capabilities. The datawould be collected into three primary collections being incidents, resources, and users. To enhance the speed of constantly accessed reads and writes, the system uses Redis cache. User-uploaded photos would stream directly to a cloud object store. The functions in the server generate pre-signed URLs so that clients are able to upload and load images, preventing the overuse of the API itself. The entire stack for the infrastructure and CI/CD of this system include database clusters, queues, cache instances, storage buckets, API, and functions. A GitHub Actions pipeline or an equivalent CI/CD integration would allow the system to automate testing. The integration of computed services, managed data, and automated DevOps delivers a resilient and scalable backend that supports the geospatial decision support necessary to provide first responders with the information they need to take effective action.

Discussion & Conclusion

The Post-Disaster Resilience Decision Support System (PDRDSS) plays a critical role in ensuring citizens' safety by enabling the rapid restoration of social infrastructure to normal conditions. The PDRDSS integrates real-time geospatial data visualization, a structured incident reporting workflow, and a dedicated decision support dashboard. These features allow for backend data models and field-level usability, which is often not looked enough at for current support systems. The PDRDSS allows responders to report incidents as well as assess risk levels depending on the areas that were affected by the disaster. The proposed UI for PDRDSS shows how a user-centered, mobile accessible interface can significantly improve response times and coordination efforts for first responders. The test showcase of the proposed UI integrated various tools, such as Google Maps for location services, React Native for developing the frontend, and Expo for streamlined testing on Android and IOS devices. In conclusion, the outcomes of this research show that integrating location-based services, real time reporting, and decision support tools into a unified, web- and mobile-accessible system can significantly improve the response time and coordination of disaster response.

The prototype of PDRDSS demonstrates how technology can enhance resilience-building in vulnerable regions.

As future research, the UI will be integrated with the main system, Post-Disaster Resilience Decision Support System (PDRDSS), for the risk assessment. The criteria for the risk assessment include severity, number of people affected, size of area, and other relevant factors as discussed in this research. Based on these assessments, each event will be prioritized so that available resources can be allocated to higher-priority events first. Additional future developments include formal usability testing and the integration of AI-based decision logic. These improvements will enable the system to evolve into a more dynamic, data-driven support tool that can be expanded to incorporate community input through moderated reporting. The addition of AI in the proposed PDRDSS is promising, as it aims to enhance ground-level situational awareness by gathering input data not only from first responders but also from all individuals affected in the area.

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References

Ahmadi, G., Tavakkoli-Moghaddam, R., Baboli, A., & Najafi, M. (2022). A decision support model for robust allocation and routing of search and rescue resources after earthquake: A case study. Operational Research, 1–43. https://doi.org/10.1007/s12351-020-00591-5

Cioca, M., & Cioc, L. (2010). Decision support systems used in disaster management. In Disaster Management - New Applications in Technology (pp. 371–390). IntechOpen. https://doi.org/10.5772/39452

Elkady, S., Wang, H., & Pei, Y. (2024). Decision-making for community resilience: A review of decision support systems and their applications. Heliyon, 10(12), e33116. https://doi.org/10.1016/j.heliyon.2024.e33116

Huang, K., & Rafiei, R. (2019). Equitable last mile distribution in emergency response. Computers & Industrial Engineering, 127(1), 887–900. https://doi.org/10.1016/j.cie.2018.11.025

Jung, D., Tuan, T. V., Quoc Tran, D., Park, M., & Park, S. (2020). Conceptual framework of an intelligent decision support system for smart city disaster management. Applied Sciences, 10(2), 666. https://doi.org/10.3390/app10020666

Kant, P., Machavarapu, P. K., & Natha, A. R. (2023). Evaluation of decision support system for disaster management using multicriteria decision techniques: A case study of Alappuzha, Kerala. Urban, Planning and Transport Research, 11(1), 2262546. https://doi.org/10.1080/21650020.2023.2262546

Kizhakkepurayil, S., Oh, J.-Y., & Lee, Y. (2010). Mobile application for healthcare system – Location based. In T. Sobh (Ed.), Innovations and advances in computer sciences and engineering (pp. 305–310). Springer. https://doi.org/10.1007/978-90-481-3658-2_51

Lawal, N. B., Oh, J.-Y., Hicks, D., Kumar, V., (2024). Decision support system for post-disaster resilience, Issues in Information Systems, 25(2), pp. 214-221. https://doi.org/10.48009/2_iis_2024_117

Majumdar, S., & Awasthi, A. (2025). From vulnerability to resilience: Securing public safety GPS and location services with smart radio, blockchain, and AI-driven adaptability. Electronics, 14(6), 1207. https://doi.org/10.3390/electronics14061207

Moulaei, K. (2022). Diagnosing, managing, and controlling COVID-19 using clinical decision support systems: A study to introduce CDSS applications. Journal of Biomedical Physics and Engineering, 12(2), 213–224. https://doi.org/10.31661/jbpe.v0i0.2105-1336

Palmieri, F., Ficco, M., Pardi, S., & Castiglione, A. (2016). A cloud-based architecture for emergency management and first responders localization in smart city environments. Computers & Electrical Engineering, 56, 810–830. https://doi.org/10.1016/j.compeleceng.2016.02.012

Phillips-Wren, G., Daly, M., & Burstein, F. (2021). Reconciling business intelligence, analytics and decision support systems: More data, deeper insight. Decision Support Systems, 146, 113560. https://doi.org/10.1016/j.dss.2021.113560