Integrating Artificial Intelligence into Crisis Information Management Software: White Paper

Christopher Zak
Buffalo Computer Graphics, Inc.
4185 Bayview Road
Blasdell, NY 14219
716-822-8668
czak@bcgeng.com
www.buffalocomputergraphics.com

Contents

Introduction

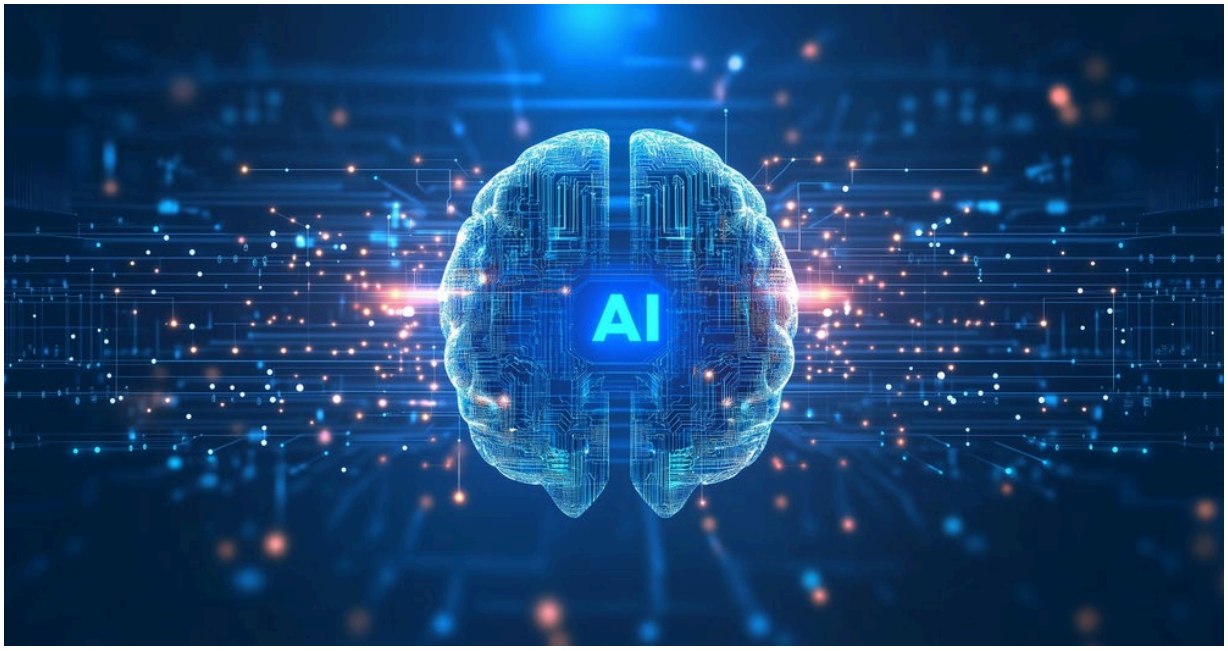
Artificial Intelligence, known colloquially as AI, is increasingly becoming a vital tool in a variety of industries, including crisis management, due to its ability to process vast amounts of data quickly and accurately. Artificial Intelligence (AI) refers to the simulation of human intelligence by machines, enabling them to perform tasks like decision-making, problem-solving, and language understanding. AI can revolutionize Crisis Information Management Systems (CIMS) by enhancing situational awareness, speeding up decision-making, and improving overall efficiency during emergencies or events. However, incorporating AI into CIMS requires an understanding of AI and careful consideration of its benefits, pitfalls, and best practices. That is the purpose of this paper. I hope you enjoy this introduction to AI and its potential uses in Crisis Information Management Systems (CIMS) and Event or Emergency Management.

What is AI

So, what exactly is AI? That depends upon who you ask. Even as AI is taking off with rocket-ship speed, there is not one universally agreed upon definition of for AI. While AI is part data science, it is actually an entire field of study. In general, AI is the simulation of human intelligence processes by machines, especially computer systems, that can do specific tasks better or quicker than humans. With the onset of Chat GPT and other Large Language Models (LLM) that support Natural Language Processing (NLP), many associate AI with being a digital companion or a superpower assistant.

Built on neuro-networks, machine and deep learning, AI is a data driven, probabilistic and creative technology. AI can generate novel, original, or unexpected outputs that are not limited by the existing data, rules, or formulas but rather influenced by the goals, preferences, or emotions of the user or system.

Contrast this to traditional rule-based algorithms that are technically not AI. Traditional algorithms are static (deterministic), providing consistent repeatable results, whereas AI is dynamic. AI algorithms are creative, whereas traditional algorithms are mechanical and not creative. Traditional algorithms can only produce predictable, conventional, or expected outputs that are strictly determined by the input, rules, or formulas, without influence from the user or system. Unlike AI, these "expert" systems do not adapt or learn from new inputs but follow predefined logic. Be careful not to let unethical software vendors claim to be providing AI solutions when in fact their solutions do not meet the definition of Artificial Intelligence.



Types of AI

Modern AI systems are typically broken down into two categories – Generative AI and Predictive AI.

Generative AI is capable of creating content such as reports, summaries, or visualizations and is known for doing a reasonably good job of generating content. For example, Generative AI can draft emergency response plans, summarize data, or simulate crisis scenarios. With proper human oversight, Generative AI can provide significant benefits to Emergency or Event Managers.

Predictive AI, on the other hand, focuses on anticipating future events based on historical data, such as predicting weather patterns or traffic congestion. Unfortunately, the current state of predictive AI is known to be less than desired with high error rates; and many AI researchers caution strongly about utilizing predictive AI in life-safety domains such as Emergency or Event Management.

While Generative and Predictive AI are the two most common types of AI, you may have heard of AI being referred to as Narrow or General in scope. Narrow AI refers to a tool typically designed for specific tasks whereas General AI is deemed capable of performing any intellectual task that a human can. Most of today's AI systems are Narrow and designed to perform certain tasks such as virtual assistants (e.g., Siri, Alexa). As AI systems continue to evolve, the hope of engineers is to create more capable General AI systems.

All current AI systems lack collaborative intelligence and don't work or talk to each other. Individual AI systems can do one task well, but there is no way to bring together results from multiple AI systems. AI systems can't take initiative or coordinate real-world actions. Humans must spend time coordinating fragmented information from various AI systems. This is where Agentic AI comes into play. Agentic AI can understand a goal, take initiative, communicate between multiple AI systems, and accomplish actions to achieve a goal. And since Agentic AI uses persistent memory, it can learn and improve over time.

Agentic AI

Agentic AI refers to Artificial Intelligence systems that integrate with external tools (e.g., email, calendar, APIs, databases) and demonstrate autonomy, adaptability, and decision-making capabilities. Unlike simple single-purpose AI tools - which are programmed to complete predefined tasks, such as chatbots or automated data entry systems - Agentic AI can perceive, reason, plan, act and learn based on evolving circumstances. This makes it particularly valuable for fields requiring rapid responses and complex multi-step problem-solving, such as emergency management.

As stated earlier, traditional AI applications excel at narrow tasks, such as weather predictions, traffic monitoring, or incident reporting. However, they lack flexibility and context awareness. Agentic AI, on the other hand, continuously evaluates situations, adjusts its strategies, and autonomously initiates actions - without requiring constant human intervention. This level of sophistication enables Agentic AI to function as a trusted decision-making partner, not just an automated assistant.

The following table displays some of the differences between Agentic AI and traditional AI:

Traditional AI	Agentic AI
Predefined Tasks - Follows programmed instructions, handling specific tasks like language translation or image recognition.	**Autonomy** - Operates autonomously, assessing situations and making independent decisions.
Static Models - Often fixed in scope, meaning it requires retraining to improve performance.	**Adaptability** - Continuously learns and adapts based on real-time data, evolving its responses dynamically
Reactive Thinking - Responds to inputs but doesn't anticipate future needs.	**Proactive Thinking** - Predicts outcomes, identifies patterns, and initiates proactive actions, making it especially useful in dynamic environments like emergency management.
Decision Making - Can analyze data and generate outputs.	**Complex Decision Making** - Capable of reasoning through uncertainties, prioritizing objectives, and even coordinating multiple systems and teams autonomously.
Single Tool – A single AI tool is developed to solve a specific task and works alone.	**Multi-Agent** – Multiple AI tools can work together to solve complex tasks and workflows.

As AI continues to evolve, Agentic AI will become indispensable in Event and Emergency Management, improving resilience and response effectiveness in disasters. This is why I believe that Agentic AI is the future.

Why Use AI

In the fast-paced world of Event and Emergency Management, where every second counts, Artificial Intelligence (AI) is emerging as a powerful tool to enhance efficiency, communication, and decision-making. While AI may seem complex, its applications are straightforward and can significantly benefit emergency managers in critical situations.

- ***Potential for Increased Productivity:*** AI automates routine tasks, allowing Event or Emergency Managers to focus on high-priority decisions. Whether it's streamlining paperwork, managing logistics, or coordinating resources, AI can handle repetitive tasks with precision, freeing up valuable time for teams to concentrate on urgent needs.

- ***Potential for Quicker Decision-Making:*** During emergencies, swift and informed decisions can save lives. AI processes vast amounts of information in seconds, providing insights that help Event or Emergency Managers act faster. For example, AI-driven simulations can predict the spread of natural disasters, allowing teams to allocate resources effectively before a situation escalates.

- ***Analyzing Data and Spotting Patterns:*** AI excels at detecting patterns that humans might overlook. By analyzing weather reports, social media updates, and historical data, AI can identify trends and predict potential risks. This capability is invaluable for proactive planning, helping Emergency Managers anticipate and mitigate disasters before they occur.

Enhanced Communications: Clear communication is crucial in emergency response. AI-powered chatbots, automated alerts, and real-time language translation tools ensure vital information reaches the right people at the right time. This technology facilitates better coordination among emergency teams, government agencies, and the public, reducing confusion and improving response efforts.

Improved Data Analysis: Emergency Managers rely on data to make informed decisions. AI can analyze large datasets, highlighting key insights that might otherwise go unnoticed. Whether it’s tracking supply chains, monitoring evacuation routes, or assessing damage estimates, AI transforms raw data into actionable intelligence, enhancing the overall effectiveness of emergency response operations.

AI Uses in Emergency Management

Beyond the core benefits listed above, as AI continues to evolve, it has the potential to revolutionize emergency management in several other ways providing even more innovative solutions to protect lives and property.

- ***Predictive Analytics for Disaster Preparedness:*** AI models can forecast potential disasters by analyzing historical data (past events), climate patterns, and real-time sensor inputs (current data). This allows emergency teams to forecast potential risks and prepare in advance thus minimizing damage.

- ***Automated Resource Allocation:*** AI can optimize the distribution of emergency supplies, personnel, and medical aid based on real-time needs, ensuring efficient deployment.

- ***AI-Powered Surveillance and Monitoring:*** AI systems can continuously monitor real-time data feeds from various sources (e.g., social media, sensors, satellites) to detect anomalies, wildfires, floods, and other hazards before they escalate enabling rapid response.

- ***Public Health Crisis Management:*** AI assists in tracking disease outbreaks, predicting infection spread, and optimizing healthcare responses during pandemics.

- **AI-Assisted Recovery Efforts**: AI can provide decision-makers with real-time insights and recommendations, helping them respond more effectively during a crisis. Artificial Intelligence can help assess damage, prioritize rebuilding efforts, and streamline insurance claims, accelerating post-disaster recovery

- **Natural Language Processing (NLP):** NLP capabilities can facilitate communication, such as translating languages or summarizing key information. NLP can be used to process and understand large volumes of text data, such as emergency reports and social media posts.

- **Automated Alerts:** AI-driven systems can generate alerts based on predefined criteria, helping responders stay informed of emerging situations.

- **Chatbot Assistants:** AI-powered chatbots and virtual assistants can assist with public inquiries during emergencies, freeing up human resources for critical tasks.

- **Help Systems:** AI-powered chatbots can assist users of CIMS in navigating, using, and maximizing the use of system features.

- **Training Simulations:** AI can be used to create realistic crisis scenarios for training purposes, helping emergency responders prepare for a wide range of potential emergencies.

With proper implementation, AI can be a transformative tool for CIMS, aiding Emergency and Event management professionals in achieving faster, smarter, and more effective responses while ensuring ethical and secure practices. However, Emergency and Event Managers must remember that there is no magic wand that can do their job for them. There is no substitution for human knowledge and experience. Every incident is unique, presents with its own unique challenges, and requires a response unique to the challenges at hand.

How is AI Implemented

Artificial Intelligence (AI) tools are implemented across a wide spectrum of industries and applications; each tailored to solve specific challenges or automate complex tasks. AI can be implemented as a standalone tool or as an integrated tool built-in to other software solutions.

Some of the most common implementations include:

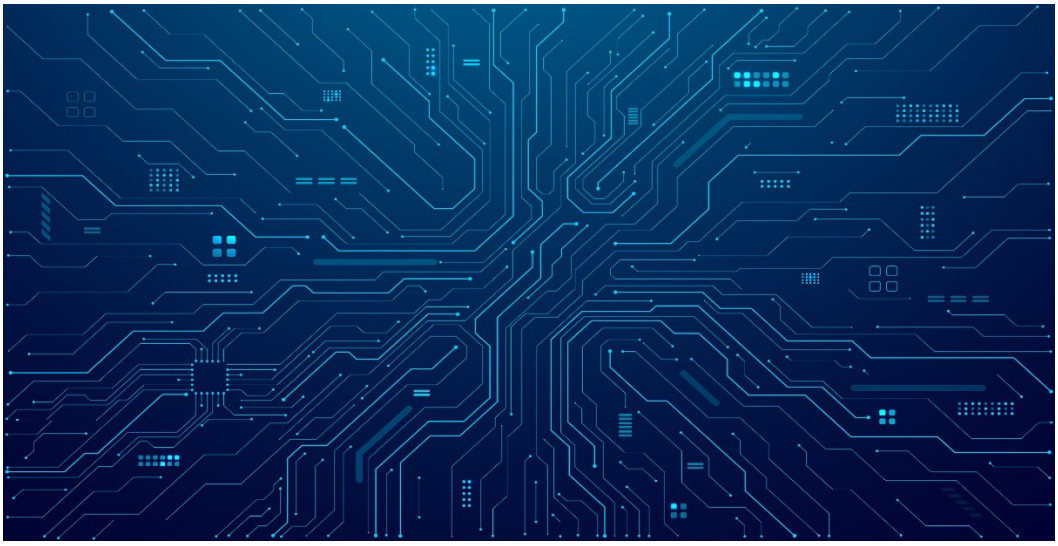
- **Natural Language Processing (NLP):** Used in chatbots, virtual assistants, and translation tools, NLP enables machines to understand, interpret, and generate human language. Applications range from customer service automation to real-time transcription.

- **Computer Vision:** AI systems can analyze visual data - such as identifying objects in images or video, facial recognition, and medical image diagnostics. This technology is widely used in security, healthcare, and autonomous vehicles.

- **Predictive Analytics:** AI analyzes patterns in data to forecast outcomes. It's heavily used in finance for fraud detection, in retail for inventory optimization, and in marketing to anticipate customer behavior.

- **Machine Learning & Deep Learning Models:** These algorithms learn from data and improve over time. They're used in recommendation engines (like those on Netflix or Amazon), credit scoring, and scientific research.

- **Robotics and Automation:** AI powers robots in manufacturing, warehousing, and even surgery. These systems can adapt to new conditions and operate autonomously, improving efficiency and precision.



How are AI Models Trained

Before we discuss the strengths and weaknesses of Artificial Intelligence, it's important to first understand how AI Models are trained.

Artificial Intelligence (AI) models are trained much like how people learn - from experience. But instead of classroom lessons or real-world practice, AI learns by analyzing large volumes of data. Frequently, publicly accessible data is utilized to train AI models. In some cases, specific proprietary data is required since the data required may not be publicly accessible.

- **Data Collection:** The process begins with gathering lots of information. For instance, if you're training an AI to recognize patterns in emergency response reports, you'd feed it thousands of such documents.
- **Learning from Patterns:** The AI scans this data to find patterns and relationships. For example, it might notice that certain keywords often appear in reports about flooding versus wildfires.
- **Training Algorithms:** This is where machine learning comes in. The model uses algorithms (step-by-step instructions) to make predictions or decisions based on the patterns it detects. Each time it makes a mistake, it adjusts and tries again - over and over - until it becomes more accurate.
- **Evaluation & Fine-Tuning:** Once trained, the model is tested with new data it hasn't seen before. Developers check how well it performs, adjust settings if needed, and continue to refine it.
- **Deployment:** After training and testing, the model is put to work—whether it's providing situational awareness, scanning satellite images for damage, or forecasting risks.

This framework helps highlight a key insight: AI is only as good as the data it's trained with. More on this in a moment.

Artificial Intelligence Strengths

Before we discuss some of the limitations or weaknesses of AI, I first want to reiterate some of the strengths of Artificial Intelligence.

- **Speed and Efficiency:** Once trained, AI systems can process large volumes of data at a speed far beyond human capabilities. For Event or Emergency Managers, this means rapid analysis of weather patterns, social media signals, or logistical needs during a crisis.

- **Pattern Recognition:** AI excels at identifying trends in complex data. For example, it can help detect early warning signs of disasters by recognizing correlations humans might miss, such as patterns in seismic activity or flooding risk.

- **Consistency:** Unlike humans, AI doesn't tire or get distracted. It can deliver consistent results 24/7, which is critical during extended emergencies or when decision-making needs to be uninterrupted.

- **Scalability:** An AI system trained well can be applied across regions or departments, adapting to various scenarios without the need for individual retraining.

- **Data-Driven Decision Support:** AI offers real-time insights and recommendations based on data analysis. It doesn't replace human judgment - but it can augment it, giving Event or Emergency Managers valuable tools for faster, more informed responses.

- **Training Dataset Advantage:** When AI is trained on high-quality, diverse, and well-labeled datasets, it becomes highly effective at its task. For instance, if it learns from emergency case studies across different regions and disaster types, it can become proficient at forecasting and response modeling in new scenarios.

Artificial Intelligence Weaknesses

While the use of Artificial Intelligence can certainly benefit Event or Emergency Managers, it's imperative to understand the limitations that AI systems may have.

- **Bias and Inaccuracy:** AI only learns what it's shown. If the training dataset is incomplete, unbalanced, or biased, the model may develop blind spots. For instance, if historical data underrepresents certain communities, the AI might provide skewed recommendations in future events. Since most AI models are trained on data from the Internet, they'll always encode historical biases and may reproduce harmful content

- **Lack of Human Judgment:** AI can't replicate human intuition, empathy, or ethical reasoning. In high-stakes emergency scenarios, decisions often require a human touch - especially where lives and values are at stake. Simply put, human behavior is hard to predict.

- **Data Dependency:** AI's effectiveness hinges on the quality and quantity of its training data. Poor-quality data leads to poor results, often summarized as "garbage in, garbage out." It's virtually impossible to regulate the content that Large Language Models are exposed to during training leading to bad or false information getting into AI models. Also, without a large amount of organization-specific data on prior disasters, AI Models may simply be incapable of providing the type of information Event or Emergency Managers expect or desire. Additionally, even if such data is available for AI training models, organizations frequently raise significant security concerns regarding providing such data to AI Models. This data gap may significantly limit the usefulness of using Artificial Intelligence in Emergency Management or potentially worsen emergency response.

- **Limited Adaptability in Novel Situations:** AI models typically perform well in environments similar to their training data. However, in a truly unprecedented event - like a once-in-a-century disaster - it may struggle to adapt or respond appropriately. Also, since AI training is typically conducted at a point-in-time, AI models typically don't have up-to-the-minute real-time data that might be necessary for making critical decisions. Similarly, stale or outdated information within an AI training model can result in AI providing incorrect information. Finally, AI may struggle to adapt to unpredictable disaster scenarios that require improvisation and real-world experience.

- **Transparency and Interpretability:** Many AI models, especially deep learning systems, are "black boxes." They make decisions without being able to clearly explain how. This lack of transparency can make it hard for Event or Emergency Managers to fully trust or justify AI-driven recommendations. AI-driven decisions can also raise concerns about accountability, especially in cases where lives are lost.
- **Technical and Infrastructure Requirements:** Implementing AI tools requires strong digital infrastructure, continuous maintenance, and technical expertise - resources that may not be readily available in all emergency management settings. Since AI typically requires large cloud-based computing resources, disasters that impact access to such cloud-based computing resources could render AI useless. Similarly, software errors, power failures, or network disruptions could render AI useless in critical moments.

- **Hallucinations:** One of the lesser known but critical weaknesses of AI is its tendency to "hallucinate." In this context, hallucination refers to when an AI system generates information

that sounds plausible but is factually incorrect or entirely fabricated. This happens most often in generative AI models, like those used for writing, summarizing, or answering questions. These models are trained to predict the most likely next word or phrase based on patterns in their training data - not to verify facts. As a result, they can sometimes produce confident-sounding statements that are simply untrue. Hallucinations happen for a variety of reasons:

    - **Training Data Gaps:** If the AI hasn't seen accurate or complete information about a topic during training, it may "fill in the blanks" with guesses.

    - **Overconfidence in Language:** AI is designed to sound fluent and authoritative, which can mask the fact that it's making things up.

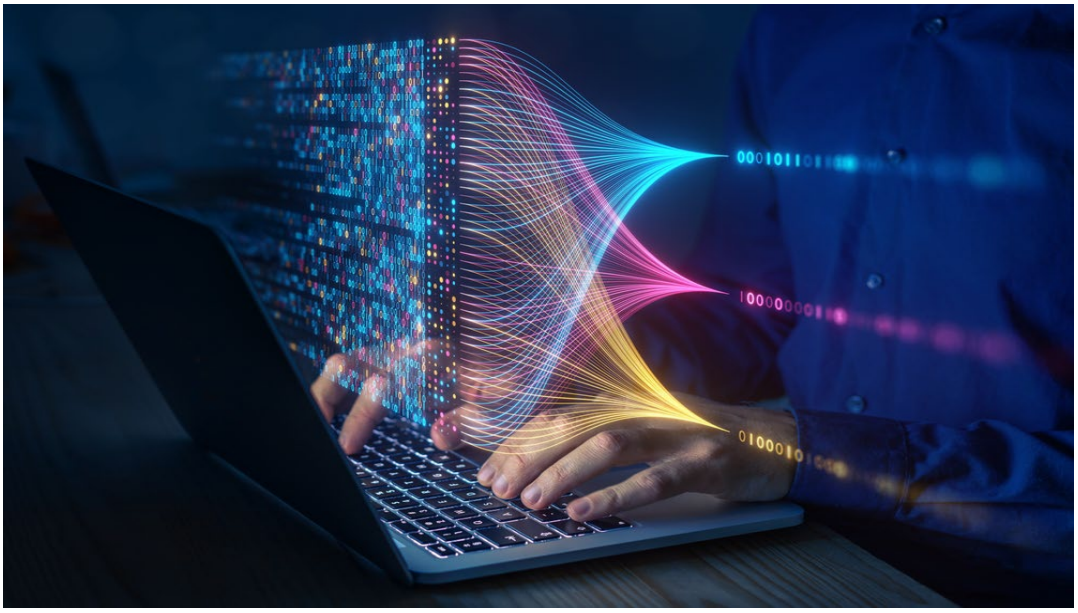
    - **Prompt Sensitivity:** The way a question is asked can influence whether the AI sticks to facts or veers into fiction. Leading or overly confident prompts can increase hallucination risk.

- **Fact Checking:** AI systems lack the ability to fact check their responses and generate probable responses. When dealing with life and safety issues, Event or Emergency Managers need to be careful when relying on probabilistic responses that are not fact checked. If emergency responders trust AI blindly, they might ignore valuable human insights, leading to poor decision-making.

This kind of balanced view helps underscore an essential truth: AI is a tool - powerful, but not infallible. When used alongside experienced decision makers, it can be a real force multiplier. However, in high-stakes environments like disaster response, Event or Emergency Managers must tread lightly and carefully check the results of AI – something that time may not permit during a crisis. Human oversight is essential in high-stakes situations – especially when lives and public safety are on the line.

When it's Appropriate to Use AI

AI is most beneficial when tasks are repetitive, involve processing large volumes of data, identifying patterns, or generating timely insights - especially in situations where speed and consistency are critical. In emergency management, AI can support real-time situational awareness, resource allocation, threat modeling, and communication monitoring. When well-trained on accurate, diverse datasets, and overseen by human experts, AI becomes a powerful decision-support tool that enhances response efficiency and preparedness.



When it’s Not Appropriate to Use AI

AI should be avoided in scenarios requiring moral judgment, empathy, cultural nuance, or interpretation of ambiguous information. It's also inappropriate to rely on AI when training data is outdated, biased, or lacking, as this can lead to inaccurate or inequitable outcomes. In high-stakes decisions - like issuing evacuation orders or making life-and-death calls - AI may inform the process, but human oversight and final judgment must remain firmly in place.

Best Practices & Considerations for Implementing AI in CIMS & Emergency Management

Successfully integrating AI into Emergency Management requires thoughtful planning, responsible data handling, and ongoing oversight. Here are some key best practices and considerations:

- **Define Clear Goals:** Establish the intended specific, measurable outcomes for AI integration, such as faster response times, accelerating damage assessments, enhancing risk forecasting, or optimizing resource allocation. Ask yourself the following questions:
    - What are repetitive tasks that might benefit from AI?
    - Are there any tasks that could benefit from summarization?
    - Are there any tasks that could benefit from classification?
    - Are there any tasks that could benefit from generative AI?
    - Are there any tasks that could benefit from reformatting/editing?
    - What are your biggest pain points?
    - Would an AI tool be better if integrated into your existing systems or as a standalone service?
    - Which tools or processes provide the simplest opportunities for AI integration?
- **Provide Quality Inputs:** The effectiveness of AI depends on high-quality data and well-structured prompts to generate accurate outputs. The strength of any AI system depends on the data it's trained with. Ensure datasets reflect diverse populations, geographic areas, and disaster scenarios to prevent biased outputs and improve generalizability.
- **Collaborate with Experts:** Partner with AI specialists and domain experts to ensure proper system design and deployment.
- **Monitor for Bias:** Regular audits and testing should be conducted to identify and rectify bias in AI systems. Output from AI systems is only as good as the information upon which the AI Model was trained. Ensure high-quality, unbiased data is collected and utilized.
- **Combine AI with Human Expertise:** Integrating AI with human decision-making ensures a balanced, ethical, and reliable approach.
- **Think Security:** Implement robust security measures to protect AI systems. Emergency Management often involves sensitive information - consider what internal data sources can be shared to train and operate AI Models. Use secure systems and follow regulatory best practices to ensure data integrity and protect individuals' privacy.

- **Purpose-built Tools:** Focus on deploying individual purpose-built tools instead of trying to create a single tool that does a lot of things poorly. Individual task-oriented tools are easier and cheaper to implement, utilize, and maintain.

- **Ethical Concerns, Accountability and Transparency:** Address ethical concerns through the development of clear policies and guidelines. Identify who is accountable when AI fails and who is responsible for data governance within your organization. Maintain transparency and explainability in AI models. Choose AI tools that offer explainable results where possible. When using "black box" models, document how decisions are made, and provide fallback strategies if outputs are unclear or flawed.

- **Plan for Training and Adoption:** Emergency personnel need basic training on how to use and interpret AI tools. Foster a culture of digital literacy to maximize the technology's potential while minimizing reliance on it.

- **Test and Simulate Before Deployment:** Before using AI during an active crisis, simulate use cases to ensure reliability. Incorporate real-world conditions, edge cases, and failure scenarios into testing environments.

- **Stay Flexible and Continuously Evaluate:** AI systems must evolve as new data becomes available and as emergency landscapes change. Establish regular evaluation checkpoints to update models and assess their relevance.

- **Maintain Human Oversight:** Balance AI use with human oversight and decision-making. AI should support - not replace - decision-makers. Experts must validate AI-generated outputs, especially in critical, life-or-death situations. Do not delegate critical decisions to AI!

Conclusion

Artificial Intelligence presents both a promising frontier and a complex challenge in emergency and event management. As this paper has outlined, AI can significantly improve decision-making, situational awareness, and operational efficiency. Yet, it is not a magic solution. It requires accurate data, thoughtful design, human oversight, and ethical implementation to fulfill its potential. Event or Emergency Managers who approach AI with a clear understanding of its capabilities and limitations will be best positioned to use it responsibly - leveraging it not as a replacement for human expertise, but as a powerful complement to it. By adopting best practices and maintaining a balance between innovation and caution, Emergency Management Professionals can ensure that AI enhances resilience, responsiveness, and effectiveness in times of crisis.