



# Definitive Logic: Mass Evacuation Simulation

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## Overview

Mass evacuations are a very real possibility in our world today. Whether initiated by a natural disaster or a terrorist attack, the ability to evacuate hundreds of thousands of people in a very short amount of time can save lives. When planning evacuations, it is critical to ensure that processes are streamlined and available resources are ideally allocated.

However, what looks good on paper may not work very well in real life and full-scale testing of a mass evacuation is normally not feasible. Even when organizations such as the Federal Emergency Management Agency (FEMA) conduct evacuation exercises, these exercises require a fair amount of cost and time to perform and do not always yield the desired information. How can an emergency response organization test their mass evacuation procedures in a rapid, cost-effective manner to make sure they will succeed when a crisis occurs?

## Strategy and Approach

Definitive Logic's mass evacuation simulation capability provides a cost-effective and rapid way to plan for a crisis and determine what will likely occur as a result of this plan. Our flexible and scalable simulation model allows an organization to streamline their process, maximize their resources, and minimize costs. We customize our model to each organization's existing processes and resource estimates. Where appropriate, we use past data from real evacuations to determine resource estimates, arrival rates, and other key input parameters. We then analyze the output of our model to identify bottlenecks, resource shortfalls, and costs. We present our results to our clients and continually refine the model until the optimal evacuation process (and resource allocation) is identified for each scenario.

## Software

Definitive Logic evaluated several different simulation packages and selected Pro Model's Process Simulator software to build our simulation model. The software runs as a plug-in to Microsoft Visio and uses shapes and actions that are familiar to all Visio users. During the simulation, our model is animated to help visualize what is happening in real-time. Furthermore, the software collects numerous statistics, which our team analyzes to understand what is happening and help make decisions about what process and resource changes might be needed.



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## Model

Definitive Logic built our evacuation simulation model by examining our client's existing evacuation process documents and working closely with the organization to make the model as realistic as possible. We presented the model in an intuitive and interactive manner to our clients, which allowed them to understand our input data and assumptions and provide feedback on what changes they might like to see.

In our latest use of this model, Definitive Logic worked with a large client to identify several model scenarios, including a mass evacuation of 50,000 people in 24 hours, a mid-size evacuation, and a small live test of 100 people. We initially used the organization's planned process and resource allocations and continuously refined these until we had identified the optimal model. Once we had arrived at this model, we presented the model statistics in tables and charts that helped our clients understand where the bottlenecks existed. Our model is sophisticated enough to simulate resource breaks (i.e. 15 minute breaks for evacuation staff members) and size constraints. For example, if the evacuation area can handle no more than 10,000 people at once, then the model will not allow more people to enter the area until other people have cleared out. In addition, our model's parameters are very easy to modify, which allows for simple, ad-hoc changes that enable real-time interaction between us and our clients. As an example, in our most recent engagement, Definitive Logic was able to show our clients how seemingly small changes (like removing 5 resources) can have a huge impact on the evacuation.

Our simulation model uses several established mathematical distributions to simulate evacuee arrival and processing. These include the Exponential, Gaussian, and Uniform distributions. In addition, based on feedback from our clients, we varied evacuee arrival times to simulate more evacuees arriving later in the evacuation. This models a known real-life situation where the number of evacuees increases as a hurricane gets closer to the impact area.

In our last engagement, our model was able to easily scale between a small 100 person evacuation and a huge 50,000 person evacuation. The 100 person simulation helped the organization determine how long it would take to conduct a live test of the process.

## Analysis

The software collects a wide-range of statistics during the simulation, which we then analyze to identify areas for further refinement. Some of the data that we review during our analysis phase include the total amount of time for each evacuee to go through the system, the wait time at each process point, the processing time for each step, and the utilization rate for each resource.



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### Answers

Definitive Logic has helped an emergency response organization streamline their evacuation process and optimize their resource allocations. Our simulation model helped the organization prepare for a range of evacuations, from a small 100 person test evacuation to a huge 50,000 person evacuation. The simulation of the small evacuation helped the organization realize they needed to allocate significantly more time to the test than previously planned.

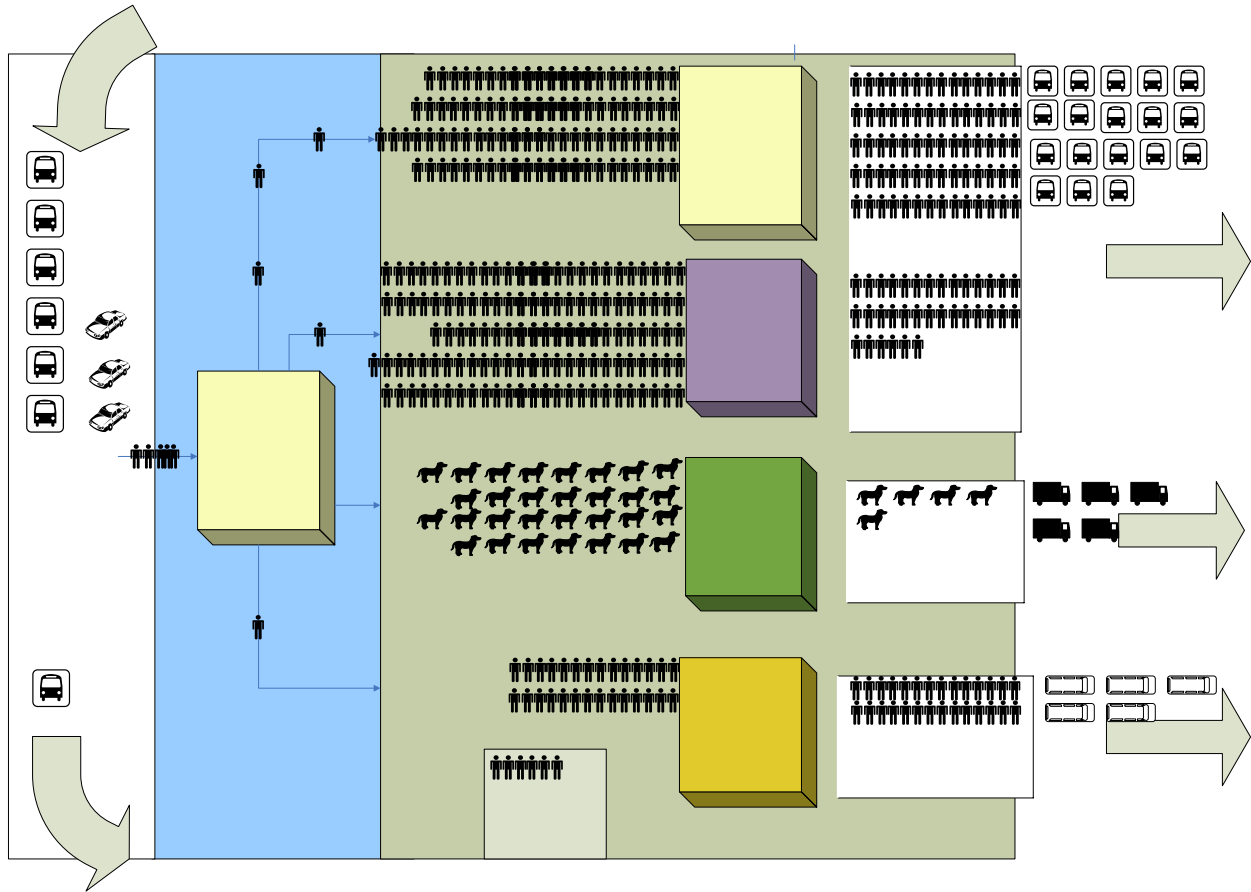
Our simulation model helped the organization streamline its processes based on metrics and visualization of the projected results of various emergency scenarios. Part of the reason why this was successful is the intuitive nature of the simulation and its results, which allow users to understand the complexities of multivariate models. The simulation displays the process as a Visio diagram and presents the results in formats that are easy to digest.

Prior to the completing the simulation, our clients estimated their resource levels by taking the estimated number of evacuees and dividing that figure by the average time to process each one. However, the underlying assumption was that the evacuees would arrive in evenly spaced intervals. The organization readily admitted that was not realistic but had no easy way of calculating the resource levels any other way. Definitive Logic's simulation helped the organization ideally allocate their resources by using a more realistic model of the evacuation process.

The figure below shows a graphical representation of the simulation. The small icons represent evacuees, pets, and vehicles. The boxes represent different processes such as prescreening, enrollment processes, and embarkation points. When the simulation runs, the people, pets, and vehicles move across the screen as they progress through the model. This animation helps clients understand and visualize how the simulation mimics the real-life scenarios. Additionally, the length of each queue and the number of busy resources are displayed in real-time during the simulation.

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Our model can easily be customized to fit your needs. For more information, please contact Nick Incontrera at [nick.incontrera@definitivelogic.com](mailto:nick.incontrera@definitivelogic.com) or 703-599-6266.