

IPRO 317 Project Plan

Spring 2008

Design & Build Chicago Scale Model for Dynamic Disaster Simulation

Advisor: Dr. Ahmed Megri

1.0 Objectives

The objective of this project is to design and construct a 3-D, reduced scale model for a portion of downtown Chicago. The model will be primarily used to test and simulate the likely performance of fire defense strategies in case of fire or other catastrophes related to public health.

- Identification of the scale, materials, technologies, and strategies of construction.
- Physical mapping and computer modeling of the downtown built environment.
- Design of the physical model and computer/electronic components.
- Construction of a reduced-area mock-up for final approval by the City of Chicago.

2.0 Background

- A. The project will be advised by Dr. Ahmed Megri of the IIT CAEE Department. The project will be sponsored by the Fire Department of the City of Chicago, under the approval of the Chicago Fire Department Commissioner.
- B. The problem includes design and building of the Chicago City scale model. The basic concept for the model is a modular, acrylic structure sitting atop a rigid base with opaque sides. The components of the model will be base, streets, city blocks, and buildings. The highlight of the model will be lighted by a projector with the use of mirrors and lenses built into the base structure, which will illuminate the various acrylic features of the model based on input from a computer interface.
- C. The base of the model is to be constructed of durable wood or aluminum. The base should be entirely opaque at the sides and bottom, so that light from within does not suffer interference or leakage, which would undermine the presentation quality of the model.
- D. The street system will form the primary organizing and spatial system of the model. As downtown Chicago is a relatively stable and highly built environment, it is not foreseen that any substantial changes to the roadway system will occur during the lifetime of the model. Roads and alleys thus will be affixed permanently, and will give order and rigidity to the other elements.
- E. The city blocks within the model scope are to be built to fit within the street and alley system affixed to the model base. The blocks will be constructed of double-thick, clear acrylic. The bottom layer will be uncut, providing a stable base. The top layer will be identical, but will have cutouts to accept the model buildings that are to be placed on the model. These cut-outs will stabilize the buildings and will prevent buildings from shifting when the model is in use.
- F. Individual buildings will be constructed of acrylic. The acrylic is to be laser-cut, and joined together at edges with typical means. Care should be taken to not mar the surface of the acrylic with adhesives, as the model buildings will remain unpainted.

- G. The model will portray various disaster scenarios through the use of the building models and projected light display beneath.
- Attack on Water Facilities: The primary water facilities for Chicago and many suburbs lie within the model area.
 - Bomb: These devices would likely be triggered downtown, possibly near mass transit.
 - Fire: The spread of flame and / or smoke.
 - Large-scale Evacuations: Time-varying analysis of evacuation strategies and potential conflicts.
 - Utilities: Many critical power utilities are within the downtown area.

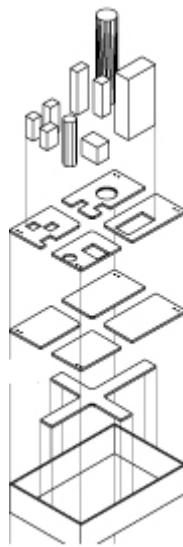


Figure 1. Schematic View of Model Assembly

3.0 Methodology/ Brainstorm/ Work Breakdown Structure

- A. Design and building of Chicago City Scale Model.
- B. To effectively work on the model, different teams were designated to perform different tasks regarding the various aspects of the model.
 - Scenario: Team will explore the disaster scenarios and inquire with proper city departments on determining safety procedures.
 - Model Team: Team will define the physical characteristics regarding scale, sizes, orientation, and various material choices and costs. Team will also be heavily involved with the actual construction of the model.
 - Equipment Team: Team will develop scheme to properly portray computer simulated disaster scenarios using the project lights on the base of the model.
- C. All teams will find it necessary to coordinate and work together throughout the entire progress of the project.
- D. IPRO deliverables will be monitored and assigned to individual team members.

- E. Through collaboration, the entire group must determine the appropriate construction techniques for creating the model, based primarily on the recommendations outlined above. However, it is understood and anticipated that the project team will develop more refined, specific recommendations during the research phase, and that other ideas will generate other needed means of construction. At a minimum, the team will need to address the following construction techniques:
- a. Materials
 - b. Process for Creating Base
 - c. Process for Creating Block Insets
 - d. Process for Creating Buildings
 - e. Adhesion
 - f. Serviceability

4.0 Expected Results

- A. The Chicago Fire Department is the Nation's leading fire department in terms of disaster preparedness and event forecasting. This scale model of downtown Chicago will serve as an invaluable tool in a growing collection of advanced technology employed by the department, and will be a very understandable means to communicate and decipher complex systems. The Department may also use the model as a means of community outreach, as it can be transported to various meetings with community groups.
- B. The Chicago Fire Department model will be built in two distinct phases:
 - a. Full-scale Mock-Up
 - i. A complete execution of the model (as discussed above in *Phases*), constructed to include the area bounded by Madison, Adams, LaSalle, and Dearborn Streets
 - b. Complete Model
 - i. Boundaries to include the full area between Division and 14th Streets to the north and south, and from Navy Pier to Canal Street at the east and west.
- C. The representation in the model shall include all city blocks, streets, and all structures greater than 6 stories or 55 feet in height.
- D. It is foreseen that the model will become a primary tool for the Chicago Fire Department, and one of the goals of the project is to produce a construction that can be of benefit to the department for many years to come. Hence, consideration shall be given at all times to the longevity of the model and means to maintain its working condition.

5.0 Project Budget

- A. Budget for this project is to be determined.
- B. Costs for the project will include materials of various quantities:
 - a. Durable wood or aluminum
 - b. Acrylic boards
 - c. Projectors & mirrors/lenses

6.0 Schedule of Tasks and Milestone Events

The model project is complex, involving a good degree of materials consumption and labor, and will require many disciplines working together to produce a consistent and seamless result. With this in mind, careful planning and consistent progress are paramount to ensure the successful completion of the project.

The following phases are suggested to help ensure the best results of this very exciting project:

Phase I: Research and Design

- Step 1. The team is to assemble talented team members in various disciplines (discussed at the end of this document). The team members will begin concentration on the following issues of the project:
 - o Acquaintance with objectives and methodologies.
 - o Agreement on scale(s) of streets and city blocks within the model.
 - o Definition of overall construction practice (including rough decisions about materials, technologies, and so forth. Many suggestions on these topics follow in this document).
- Step 2: Research will commence by various teams of the project.
 - o Electrical engineers will begin investigation of technologies required for the illumination (and any other chosen technologies).
 - o Computer Science students will discuss the computer technologies and I/O interface(s).
 - o Architects will begin to establish guidelines for physical construction of the individual structures that comprise the main model.
 - o Other team members will research within their respective areas.
- Step 3: Research will be compiled and final decisions about the methods and components will be finalized. Design of the model in schematic form will be completed in CAD, so that each part of the project team can verify that physical needs within the model are met in an ideal fashion.

Phase II: Mapping / Planning

- During this phase the individual disciplines will break into groups, to plan and develop their respective areas.
 - o Architects will begin to map the city blocks. Standard methodologies for drafting standards, construction techniques, and level of detail will

- be established. CAD drawings for all downtown buildings within the scope of the trial model will be created during this time.
- Other disciplines (engineers, computer scientists, and so forth) will begin to design their respective interfaces.
 - Prior to any physical construction commencing, meetings will be held between various parties to approve the plans of any particular group.

Phase III: Construction of a Mock-Up Model

- All team members will coordinate to produce the trial mock-up model. Depending on the size of the team and project budget, and also primarily based on the desires of the client, the mock-up model may consist of solely the execution of the street system, city blocks, and buildings. Alternatively, the mock-up may demonstrate the full capabilities of the model, with the computer interface and software being developed at this time as well. Finally, the client and budget will determine to a great extent the materials chosen to implement the mock-up.
- The Chicago Fire Department will investigate the project at this time, and will give go-ahead to create the full model at the Department's discretion.

Phase IV: Documentation

- The documentation of the project is very important, for future maintenance, adaptation of the model over time, and construction of future phases. For more information on specifics needing to be addressed.
- This phase concludes the likely scope of the initial IPRO class.

Phase V: Construction of a Complete Model

- The complete model will be constructed at this time, taking into consideration any input given by the client after review of the mock-up, and also considering any aspects of the initial design that need improvement. As before, the full model being built may consist solely of streets, blocks, and buildings (with the intention of creating the computerized parts of the model at a later date), or may be a full build-out of the project as designed. The material choice will depend on selected functionality, portability, durability, and client budget.

Phase VI: Completion of Complete Model (Optional)

- This phase would include the construction and integration of the electronic components of the model, in the event that the full model is not constructed in Phase V.

7.0 Individual Team Member Assignments

- A. Students are divided into 1 of 3 subteams.
 - a. Scenario Team
 - b. Model Team
 - c. Equipment Team

B. Breakdown of students within IPRO 317.

Student	Dept	Team
Jodi Balido	CAEE	Scenario
Mary Cryriac	ECE	Equipment
Brandon Macklin	CAEE	Scenario
Sonya Martin	MMAE	Equipment
Donald Myers	CS	Equipment
Daniel Sochor	CAEE	Model
Grahm Balkany	ARCH	Model
Hana Fakhouri	CHBE	Scenario
Daniel O'Brien	ARCH	Model
Marco Trusewych	ARCH	Model
Michael Brassil	ARCH	Model
Dung Luu	ARCH	Model
La Luce Mitchell	ARCH	Model
David Parry	ECE	Equipment

8.0 Designation of Roles

Minute Taker.....	Brandon Macklin
Agenda Maker.....	Grahm Balkany
Time Keeper.....	Daniel Sochor
Weekly Timesheet Collector/Summarizer.....	Brandon Macklin
Master Schedule Maker.....	Jodi Balido
iGroups.....	Jodi Balido