Proceedings of the 2017 Winter Simulation Conference
W. K. V. Chan, A. D'Ambrogio, G. Zacharewicz, N. Mustafee, G. Wainer, and E. Page, eds.

INTEGRATING CAMPUS OPERATIONS DECISION SUPPORT MODELS AT THE NATIONAL INSTITUTES OF HEALTH (NIH)

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ABSTRACT

At the National Institutes of Health (NIH), a federal agency supporting basic biomedical research, decision makers are faced with the challenge of identifying ways to improve the efficiency and effectiveness of research support services and challenges of doing “more with less” resources. The Office of Research Services (ORS), Office of Quality Management (OQM) provides support in solving these challenges through development of the Campus Operations Decision Support (CODS) simulation model. The model consists of a variety of software tools and techniques to model a campus 3D “virtual world” that can be used in a variety of applications to better understand and enhance the delivery of services to support the research mission at NIH. The project includes sub-models that aid in analyzing pedestrian and traffic movement onto and within the campus, visitor screening, the NIH shuttle bus network, and provides for future extensibility to additional research support activities.

1 INTRODUCTION

The NIH Office of Research Services (ORS) and Office of Research Facilities (ORF) are tasked with providing responsive and dependable support to the NIH research mission. ORS and ORF support the NIH in a wide variety of ways that are necessary for the efficient and safe operation of the largest biomedical research facility in the world. The myriad of services ORS and ORF provide have a significant impact on the ability of all NIH Institutes and Centers (ICs) to deliver on their research missions.

Today, both ORS and ORF face the challenge of doing more for the NIH community with fewer resources. Over the last several years, the demand for the services and infrastructure that ORS and ORF provides and maintains has remained relatively unchanged, and in some cases, has even increased; however funding levels have remained relatively flat, or account for modest inflation. There is increasing pressure to deliver the same levels of service quantity and quality. Subsequently, ORS and ORF must constantly identify ways to improve the efficiency and effectiveness of the services it delivers to the NIH community now and in the future.

To support these improvements, the ORS Office of Quality Management has designed and implemented a Campus Operations Decision Support Model using simulation technology. Initially this project consists of a 3D Model of the NIH Bethesda campus, including the road network and buildings, parking locations, NIH shuttle bus network, pedestrian and traffic movement on campus, and entry/exit of pedestrians and vehicular traffic into campus via smartcard access and visitor screening points. The intent is that this model will be used to experiment with changes in services to better match capacity with demand, thus contributing to the cost-effective use of limited budget resources.

2 SIMULATION DESIGN

The system consists of a realistic 3D NIH Bethesda campus “virtual world” that can be used in a variety of applications to better understand and enhance planning and improve delivery of services. From a visual perspective, the model is designed to be viewed and interacted with via computer screen or VR hardware. In addition, quantitative output can be provided through experiments/scenarios.

The model also provides for the exercising of an emergency scenario or particular campus operations process in greater detail. The emergency scenarios considered initially are a building/campus evacuation and an active shooter scenario. The system is designed in such a way as to provide for the user to understand how such a scenario could play out in a particular campus building and the manner in which the scenario impacts and interacts with operations throughout the campus.

The initial campus operations systems included are staff and visitor access, and the shuttle bus system. The system is designed in a way to represent accurately the inputs and outputs of these processes and the interaction with the whole campus, and has the capability to track an individual throughout the entire system (e.g. a visitor drives onto campus, proceeds through security inspection, parks, proceeds to a building, participates in an evacuation drill, returns to building, returns to vehicle, and exits campus.)

This model is used to experiment with changes in services to better match capacity with demand, thus contributing to the cost-effective use of limited budget resources and plan for emergent scenarios, such as a shutdown of campus roads, an evacuation of buildings, or part of or the whole campus, or an active shooter scenario.

3 MODELING APPROACH

A base model is developed at a high level, so that particular processes or operations can be represented at a granular level and greater levels of detail can be added when necessary, both from a visual and analytical perspective. The more detailed models help develop and inform processing time parameters to be used in the main model. In this way, detailed models can be developed and built where necessary.

This base model consists of a realistic 3D model of the campus road and pedestrian circulation network, campus buildings with building entry/exits depicted. This base model includes several campus sub-systems developed previously as independent models that are now integrated into a single model. These systems include campus access, a shuttle bus system, campus traffic (both typical flow and during an evacuation), and active shooter scenarios.

For example, in the base model, a building is represented as a “black box” with defined inputs and outputs. In this way a building has a defined number of locations where occupants can enter/exit, and more detailed processes within the building can be developed in a separate sub-model that can be run independently or interface with the larger model (e.g. a building evacuation or an active shooter scenario.)

The current model has been developed using *Simio* simulation software in conjunction with *Simio* partner, *Mosimtec, LLC*. 3D modeling was done with *Trimble Sketchup* and data from ORF and *Open Street Maps*. Prior approaches to modeling these subsystems were developed in *Arena*.

4 CONCLUSIONS AND NEXT STEPS

This simulation tool has contributed to significant cost-avoidance throughout the NIH and enhanced emergency planning efforts impacting life and well-being at the NIH. Projects performed have enabled research to continue uninterrupted and informed decisions impacting the security and safety of NIH and the surrounding community.

Developing and analyzing output metrics provided by the simulation have enabled decision makers to better understand the impact changes to the system on service delivery, as well as to better identify, understand, and mitigate risks identified through experimentation with the wide range of scenarios the simulation is capable of providing.

Through use of this scalable and modular approach, there is significant potential for integrating other campus and research systems into this model, and allow decision makers to have a greater understanding of how systems interact with each other and impact broader objectives. Though these models have been developed specifically for NIH, other agencies and organizations can leverage these approaches to solve related challenges.

ACKNOWLEDGMENTS

The OQM team would like to acknowledge the NIH and ORS/ORF leadership and numerous staff that have supported this project.

REFERENCES

Joines, J. A., S. D. Roberts. 2015. Simulation Modeling with Simio: A Workbook. 4th ed. Pittsburgh: Simio LLC

Smith J. S., D. T. Sturrock and W. D. Kelton. 2017. Simio and Simulation: Modeling, Analysis, Applications. 4th ed. Pittsburgh: Simio LLC

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