

¹ SitCoM: Modular framework for the integration of (extreme) events and their impacts in Unity

³ **Niklas Suhre**  ¹

⁴ 1 Technical University of Darmstadt, Germany

DOI: [10.xxxxxx/draft](https://doi.org/10.xxxxxx/draft)

Software

- [Review](#) 
- [Repository](#) 
- [Archive](#) 

Editor: 

Submitted: 08 January 2024

Published: unpublished

License

Authors of papers retain copyright and release the work under a Creative Commons Attribution 4.0 International License ([CC BY 4.0](#)).

⁵ Summary

⁶ Given the increasing prevalence of extreme events due to climate change, it becomes imperative ⁷ to be prepared for their impacts. Simulations of events in virtual environments can be used for ⁸ the evaluation of these effects. The Situation Control Menu (SitCoM) provides a framework ⁹ for this. This software package and the corresponding manual enables users to integrate ¹⁰ customized scenarios and their impacts into the game engine "Unity". The scenario part can ¹¹ be done without any coding experience, while for the impacts a basic knowledge of C# is ¹² required. Both multiple scenarios and impacts can be combined independently of each other, ¹³ according to the user's needs.

Statement of need

¹⁵ As extreme events are a growing trend due to climate change ([Francis & Hengeveld, 1998](#); ¹⁶ [Huber & Guldge, 2011](#)), it is important, to understand their effects on anthropogenic ¹⁷ environments. These effects can only be on monetary level, but also e.g., physical damage to ¹⁸ humans and other lifeforms. ([Jentsch et al., 2007](#)) Therefore, it is imperative to develop and ¹⁹ evaluate appropriate countermeasures for the mitigation and withstand of these events.

²⁰ Currently, there is no wholistic approach for simulations of extreme events in virtual environments, but only stand-alone simulations of single (extreme) events (e.g., [Morelli & Cunha \(2021\)](#)). The Situation Control Menu SitCoM is a modular framework for the game engine ²¹ Unity (Version: 2021.3.6f1), which enables researchers to integrate and run customized scenarios and impacts."Scenario" refers to a visual representation of an event, while "impact" is an ²² effect on objects in the environment.

²⁶ The visual simulation of events is useful for public participation. This especially applies ²⁷ to combined usage with Virtual Reality (VR). Participants then can experience an event ²⁸ immersively and express their opinion well considered. Feasibility tests showed, that the ²⁹ integration of scenarios is easy even for people without coding experience.

³⁰ The impact side of SitCoM can especially be used for the testing of technological solutions ³¹ under different circumstances. By creating a digital twin of a solution and implementing its ³² behavior during an impact, the functionality can be evaluated afterwards. As impacts can ³³ differ greatly (e.g., electrical outages, physical damage, etc.), it is not possible to provide a ³⁴ manual for this. Hence, coding experience is required for this step.

³⁵ The main advantage of SitCoM is, that the user can select the scenarios and/or impacts ³⁶ that should occur in the virtual world before starting (s. [Figure 1](#)). Hence, a large variety ³⁷ of combinations can be created and used for research. This is important for scenarios that ³⁸ can have various forms or impacts. E.g., extreme wind events can be hurricanes, tornados, ³⁹ etc. Therefore, SitCoM does not couple scenarios and impacts to ensure a maximum of flexibility.

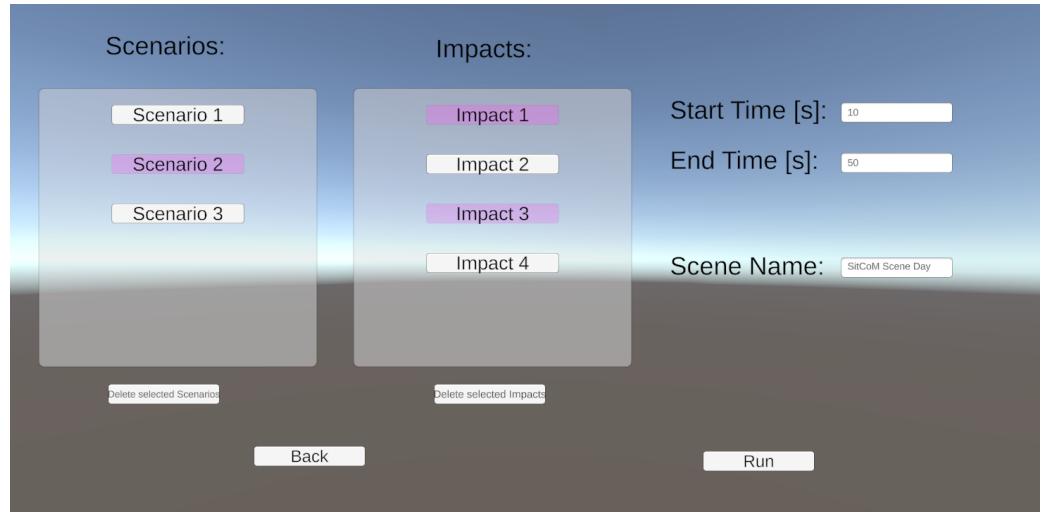


Figure 1: Run Menu of SitCoM. The user can select the desired scenarios and impacts that should occur.

40 Examples

41 SitCoM was tested in the virtual city of Spectra (Rzepecki et al., 2023). As the Unity version
 42 of the city is currently not available to the public, only screenshots can be provided. Due
 43 to the stand-alone character of SitCoM, the functionalities can be ensured for other Unity
 44 projects in the correct version.
 45 As seen in the following pictures, a construction site scenario has been implemented and started
 46 in SitCoM:



Figure 2: City before construction site scenario



Figure 3: City during construction site scenario

⁴⁷ The impact for testing SitCoM is the electrical outage of streetlights:



Figure 4: Streetlights before power outage



Figure 5: Streetlights during power outage

⁴⁸ The construction site scenario and electrical outage impact were tested simultaneously as well:



Figure 6: City before construction site scenario and power outage



Figure 7: City during construction site scenario and power outage

Acknowledgements

This work has been made possible through the support of NUMENA and Spectra Cities.
Funded by the European Union (ERC, scAlnce, 101087218). Views and opinions expressed
are however those of the author(s) only and do not necessarily reflect those of the European
Union or the European Research Council Executive Agency. Neither the European Union nor
the granting authority can be held responsible for them.



Funded by
the European Union



European Research Council
Established by the European Commission

56 References

- 57 Francis, D., & Hengeveld, H. (1998). *Extreme weather and climate change*. [https://meteor.
58 geol.iastate.edu/gccourse/history/trends/ExtremeWxClim.pdf](https://meteor.geol.iastate.edu/gccourse/history/trends/ExtremeWxClim.pdf)
- 59 Huber, D. G., & Guldedge, J. (2011). *Extreme weather and climate change: Understanding the
60 link, managing the risk*. Center for Climate and Energy Solutions. [https://www.patarnott.
com/atms790/pdf_atms790/papers2022/ExtremeWeatherAndClimate.pdf](https://www.patarnott.
61 com/atms790/pdf_atms790/papers2022/ExtremeWeatherAndClimate.pdf)
- 62 Jentsch, A., Kreyling, J., & Beierkuhnlein, C. (2007). A new generation of climate-change
63 experiments: Events, not trends. *Frontiers in Ecology and the Environment*, 5(7), 365–374.
64 [https://doi.org/10.1890/1540-9295\(2007\)5%5B365:ANGOCE%5D2.0.CO;2](https://doi.org/10.1890/1540-9295(2007)5%5B365:ANGOCE%5D2.0.CO;2)
- 65 Morelli, A. B., & Cunha, A. L. (2021). Measuring urban road network vulnerability to extreme
66 events: An application for urban floods. *Transportation Research Part D: Transport and
67 Environment*, 93, 102770. <https://doi.org/10.1016/j.trd.2021.102770>
- 68 Rzepecki, R., Cojocaru, A. I., & Crittenden, M. (2023). *Spectra whitepaper: Building a
69 sustainable, livable, and affordable city for 1 million people through multilayer blockchain co-
70 operatives and extended reality experimentation*. Spectra Cities. [https://www.spectracities.
com/wp-content/uploads/2023/01/Spectra-Whitepaper.pdf](https://www.spectracities.
71 com/wp-content/uploads/2023/01/Spectra-Whitepaper.pdf)

DRAFT