

Budget Allocation for Emergency Management in Flood-Prone Mining Regions: A System Dynamics Perspective

Review Comments

This paper describes the development and use of a system dynamics model for investigating resource allocation for improved mine operations when impacted by a extreme disruption. The model and paper show promise but requires significant work before being ready for a complete review or publication.

The Use of System Dynamics

Despite the use of “System Dynamics” (SD) in the title and the use of a modeling platform that readily supports the application of system dynamics, the current work does not appear to use system dynamics. Unlike many other modeling methods (e.g., statistics, linear programming), system dynamics is a modeling approach and not just a simulation modeling tool. More specifically, applying system dynamics uses causal feedback, accumulations and flows, and decision making to explain how system structure impacts behavior and performance and vice versa. The current work does not clearly show or explain this or use these model structures to explain behavior. The work must go beyond showing SD structures (stocks and flows and auxiliaries) and use them to explain simulations. This does not mean that the use of a SD based simulation modeling tool such as Vensim to build the simulation model is inappropriate. **The authors should seriously consider dropping the “SD perspective” from the title and system dynamics aspects from the paper and just use the Vensim platform to build a simulation model for this work.** It does not diminish the potential contribution to this domain journal to do so, but requires dropping the brief claim of contribution to system dynamics. Alternatively, the authors can learn and apply the “philosophy” part of SD (see Sterman, 2000) as well as the simulation modeling tool part of SD to rigorously apply SD. Regardless, the authors need to use model structure to explain behavior and performance.

The Model

This is a model-based paper and the usefulness of the results depend upon the model. An adequate review cannot be done with the information provided. To review the work and therefore the paper this reviewer must inspect the basis for the model as well as the model structure. This requires a complete model support file. The authors should find, read, and apply Rahmandad, Hazhir and Sterman, John D (2012) “Reporting guidelines for simulation-based research in social sciences”, System Dynamics Review, 28(4): 396-411 and use it to develop a complete model support file. Those requirements and guidelines apply whether the authors are applying system dynamics or not. That support should include model structure description, validation test results, as partially described in Sterman, 2000, sensitivity analysis results, etc.

A cursory review reveals potentially serious problems with the model as submitted, including:

- Vensim's built in model checking tool identified 117 errors in unit consistency. Good models (SD or otherwise) have consistent units across the LHS and RHS of all equations. The authors must create and provide a model for review with consistent units of measure.
- Good modeling practice includes documenting the meaning of all variables and the rationale for all equation formulations. General model structure descriptions are included, However, the model appears to have no such documentation in the Comments fields of the model. The authors must provide complete model structure documentation.
- Model validation requires many tests in addition to similarity to a case study. See Sterman, 2000 The authors should use a diverse set of many tests to validate the model. The authors describe the case study as a basis for model calibration (not validation) but do not provide a comparison of the simulated behaviors to observed, or at least estimated, behaviors of the system being modeled. The authors should collect data from the case study about actual behavior that can be compared to the simulated behavior and performance to support model validity.
- It is suggested, but not required, that the authors also use SDM-DOCS.