

Title: Towards the demonstration of principles and practices for a modular approach to system dynamics model building

Authors: Guzzo, D.; Díez-Echavarría, L. F.; Ospino-Ricardo, S. A.; Kite, A.; Chichakly, K.; Pigosso, D. C. A.

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Abstract

Introduction to Problem: Concepts such as modularity, reusability, and generic model structures hold promise for the System Dynamics (SD) field. However, challenges, including conceptualising and developing interfaces between modules, and addressing the inherent trade-offs between the breadth of problems and the depth required for case-specific insight, prevent the field from systematically applying these concepts to deliver timely and precise insights to decision-makers.

Approach to the Work: This work builds on existing concepts, principles, and practices in the SD literature that address modularity in modelling and the reusability of model structures. The approach is demonstrated through the investigation of rebound effects – a dynamically complex phenomenon with core dynamics that occur across various contexts, interventions, and mechanisms.

Results: This work presents a structured process for developing modular models. It details the development of a modular model comprising a fixed backbone and a set of interchangeable mechanisms. The study illustrates how a shared dynamic hypothesis for the phenomenon guided the scope and development of the modular model. Four best practices for applying principles of modularity are recommended.

Discussion: Developing a modular model relies on an integrated set of early-stage decisions: balancing customisation requirements, applying reusable structures, defining a common dynamic hypothesis, and managing the conceptualisation of central interfaces. Advancing this area requires deeper exploration of themes currently under-discussed in the SD community.