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Circumscribing system dynamics modeling and building confidence in models
A personal perspective

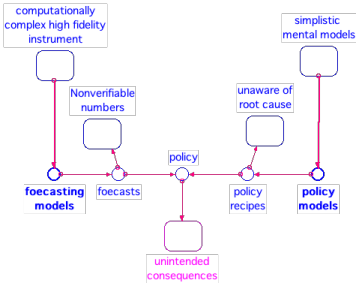
Khalid Saeed
Professor of Economics and System Dynamics
Worcester Polytechnic Institute
Worcester, MA, USA

Extended abstract

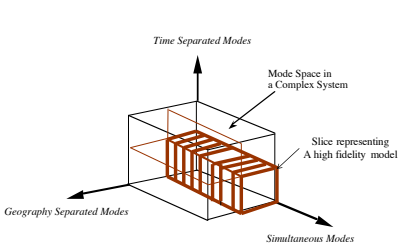
This paper revisits the problem of confidence in system dynamics models addressing policy and attempts to carefully describe their qualification and the process that practitioners must follow to arrive at them.

While there is a consensus among system dynamics scholars that the dichotomous term validity must be replaced by the term confidence for system dynamics models, it is unclear what qualifies as a system dynamics model – a computational instrument for forecasting, or an experimental tool to inform the policy process? And what exactly needs to be done to build confidence in a model? Confidence building process is described in the system dynamics writings at a rather philosophical level that can be used to justify almost any model. The confidence building procedures provided in the text books are sketchy, do not distinguish between forecasting and policy models and do not adequately describe the iterative process subsumed in the various steps of model construction that might yield confidence. Confidence in forecasting models is an article of faith no matter how detailed they might be and how diligent is their calibration. Forecasting models are albeit irrelevant to system dynamics practice, which must focus on policy.

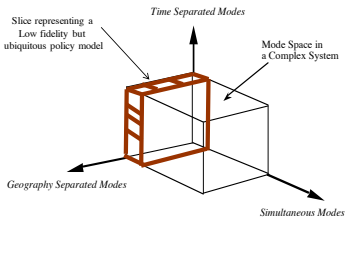
Figure 1 shows a map of a typical policy process. Forecasting models provide estimates of the impending future. Policy models create recipes for dealing with the impending future. The first type of models is computationally complex instruments whose output is not verifiable. The second type is simple constructs that may or may not be cognizant of the structure underlying the need for policy. Use of an elaborate forecasting instrument together with a simplistic policy construct is a fatal recipe that will invariably lead to unintended consequences, which system dynamics modeling is expected to remedy. While both types of models are suitable for the purpose they are built, their confidence building procedures would differ since the two represent different slices of reality as I have discussed in Saeed (1992).



Policy process



a) Slice: Forecasting model



b) Slice: policy model

Figure 1: The policy process and the slices of reality it uses as models

The forecasting models represent a slice of reality that subsumes history as it unfolds in specific situations (1a). They should replicate the complex behavior arising out of simultaneous occurrences of patterns like growth, oscillation and other multiple trends. A policy model maps into a different slice of reality (1b). Creating such a model requires partitioning complex historical patterns into simpler parts, but constructing long term dynamics that subsume time separated modes as well as multiple outcomes and the hope and fear scenarios subsuming geography separated modes. The model resulting from such a reference mode does not fit any specific situation. It will not replicate any recorded history, but might produce the variety of specific patterns, including multiple equilibria, appearing in recorded history and in fear and hope scenarios that project past trends into future. It will also not give quantitative forecasts of future, but it can create future scenarios and identify policies leading to them.

Confidence is built in the two types of models differently. While forecasting models must replicate history point by point, the policy models have been sliced and diced to a point that historical time series are irrelevant. For the policy models,

1. Reference mode is not historical time series but an abstract representation of system behavior.
2. Dynamic hypothesis is not a complex feedback map, but an abstract and aggregate mental model of system structure expressed in terms of a simple feedback map that can explain reference mode
3. Structurally valid model is not a complex stock and flow model with an arbitrary boundary, but a stylized and reality checked computer representation of the decision process in each aggregate subsystem in the dynamic hypothesis
4. Behaviorally valid model is not a model that merely replicates history and creates future scenarios, but a robust, stylized and reality checked structure that can create the many behavior modes delineated in the reference mode.
5. Policy design is not a normative statement, but an abstract metric of real life interventions that can be mapped into the model and simulated to assess their performance.

Unfortunately, there is no straight-forward way of arriving at any of the abstract concepts these steps aim to create. I have made an attempt in this paper to map the processes driving the iterations for implementing each of the above parts. In doing so, I might have circumscribed System Dynamics modeling, which I think is needed.

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