**Rationality in the Analysis of Behavioral Simulation Models**

*Morecroft, 1985*

* Discusses how to test and describe behavior of a simulation model using *Premise Description* and *Partial Model Testing*
* Presented a stripped-down version of a larger model from a previous work and used the rational behavior and responses of subcomponents in isolation to describe macro ‘irrational’ behaviors
* **KEY: “**decision making is rational within the context of the premises supplied to the decision maker and the limits of his computing capacity”. I.e., Premise Description and Partial Model Testing is essentially repeated application of bounded rationality to a model.
* **Notes on Bounded Rationality:** The author dives into sources of bounded rationality that can lead to compartmentalization. They include:
  + *Factoring:* Information is subdivided and distributed in an organization (blind men and the elephant example)
  + *Goals and Incentives*: Here, goals simply decision-making by replacing all other potential metrics (example was pushing out shipments at end of quarter to make sales goals, despite negative economic effects)
  + *Authority and Culture****:*** Basic values and traditions limit and direct decision making
  + *Routine*: Heuristics and standards help simplify the decision-making process, speed it up, but by necessity restrict possible outcomes
  + *Basic Cognitive Processes*: Even given full information, people have limited ability to fully think out the optimization
* **Side note**: The model presented here uses difference equations, and references the DYNAMO language for SD modeling, which doesn’t entirely match compartmental model formulations. I recreated the model as best I could from the description in the paper (which still had implied structure from the larger model this one was stripped down from).

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**Loop Polarity, Loop Dominance, and the Concept of Dominate Polarity**

*Richardson, 1984*

* Contains a technically detailed and rigorous definition of ‘polarity’, ‘loop dominance’, and ‘dominance shifts’.
* Formally defines loops as having at least one stock
* Formally defines loop polarity, with respect to some level variable *x* as:
* In other words
  + if the change in the level, is increasing as the level increases, this is a positive loop (with exponential growth or decay)
  + if the change in the level, is decreasing as the level increases, this is a negative loop that is approaching some goal
* Extensive examples given of various modes of behavior common to SD (including two loops interacting to give logistic behavior) and how loop polarity and dominance shifts play out.

**A System Pathology of an Organization: The Rise and Fall of the Old Saturday Evening Post**

*Hall, 1976*

* The main focus of the paper is to explain the rise and fall of print publications (specifically focusing on the Old Saturday Evening Post over the 1940’s – 1970’s), but in doing so this paper also contains an excellent summary of why systems models are useful, and also where they make assumptions
* The model developed is complex, and honestly not fully documented in this paper
  + More full documentation is in the author’s dissertation, on which this article is based, titled: “A Systems Model of a Magazine Publishing Firm”
  + Also, while the diagrams are compartmental models, the model is built on DYNAMO and thus uses difference equations to express stocks
* Listed advantages of System Dynamics modeling:
  + One-to-one correspondence between verbal description of the real world system and the flow diagram (ie, CLD) in the model and the equations in the computer program
  + Flow diagram (ie CLD) provides good tool for communicating with Managers and eliciting feedback
  + Rapid feedback and updating from the simulation results (less novel now I suppose), coupled with rapid updating and modification of the diagram and underlying equations
* CRITICISMS (from Brewer and Hall 1973 page 347):
  + **A MODEL IS A THEORY**. As such, it has assumptions baked in by the theorist.
  + Where there are theoretical relationships not empirically obtained, the relevance is decreased
  + Computer models can appear to be quite scientific, and disguise the assumptions as a result
* RESPONSE FROM HALL: Above is a criticism of the modeler not making their assumptions explicit, not the methodology itself
  + Addressed this by making all assumptions clear in the paper, and by creating empirically derived links from well written research
  + The man literally did a physical count of pages of the magazine!!!!
* THE MODEL
  + Broke industry in to four sub groups based on accounting flows, measures of performance, managed variables, and relationships with the environment
  + Functions are not defined here, but left for his dissertation
  + Does series of experiments by changing or pulsing key managerial levers (subscription rate) and environmental factors. Showed how each had both indented and unintended consequences
  + Highlighted that management was making decision in complex and dynamic environment with interactions
* Created timeline of rise and fall of the magazine that directly incorporated discovered mechanisms and behaviors. Key outcome was production costs outstripping revenues as physical size of magazine exploded as additional advertisements were sold. My take: Charging to ship magazines but were shipping bricks!
* Then did policy intervention experiment (showing how the magazine could have lived)

***ASIDE: “A Systems Model of a Magazine Publishing Firm”***

Dissertation by Hall

* Makes explicit the modeling choices seen in the above referenced article
* Gives DYNAMO difference equation relationships. Some notes on reading DYNAMO expressions:
  + Expression 7 from the dissertation:
  + The subscripts *J* and *K* refer to the variable at different time steps, separated by DT. This is implied Euler integration/linearization of a differential system. In other words:
* The SAMPLE functions are simply reporting functions, sampling the current value of level variables (like total revenue above) at the end of each reporting period to keep track for reporting.
* The outflow above, RCB, is not expenses (that is tracked via a separate expense level variable), but rather a pulse train designed to *totally empty out* the level variable for revenue each reporting period after it is recorded. Ie, the revenues and expenses in this model are *not* cumulative but rather reset each year!