From Situated Action to Model Abstraction—*and Back Again*

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Extended Abstract

The system dynamics grammar of accumulations and activities provides clues to how we can construct models that *invite* implementation of the policies identified through simulation analyses. The only way to alter accumulations and their behaviors-over-time is by changing their respective inflows and outflows (Forrester 1961). The flows represented in a model, therefore, link to the verbs that people can *actually do* to alter the trajectory of a complex system. It makes sense, then, to represent these flows in a language aligned with the language of clients / decision-makers on whose behalf we undertake model building and model analysis.

I propose there are three approaches to ensuring model representations remain accessible to the people expected to act on any policy insights resulting from analyses:

Name the flows as verb participles. While naming flows as nouns, especially using the term *rate,* can help cue the modeler to formulate the flow equation so that its units are consistent with the units of its related accumulation, clients and decision makers seldom look at the equation view of a model. Since they most often look at the stock-flow map view, we can name flows with verb phrases that relate to their own experiences and actions.

Name the flows to signal a consistent locus of action for altering the respective accumulation. We often leave the subject taking action to alter a flow unstated, expecting viewers of the stock-flow map to infer whether they themselves are the subject or object of the action indicated by a flow-verb. Consider, for example, a common representation of flows that alter the accumulation of Employees in Figure 1a (borrowed from Sterman 2000, p. 200); here the subject of each flow-

verb is unstated and sometimes implies Employees are the subject of the action and sometimes the object. Compare this with Figure 1b, whose flow variables indicate consistently that Employees are the *objects* of actions, and with Figure 1c, whose flow variables indicate consistently that Employees are the *subjects* of the actions.

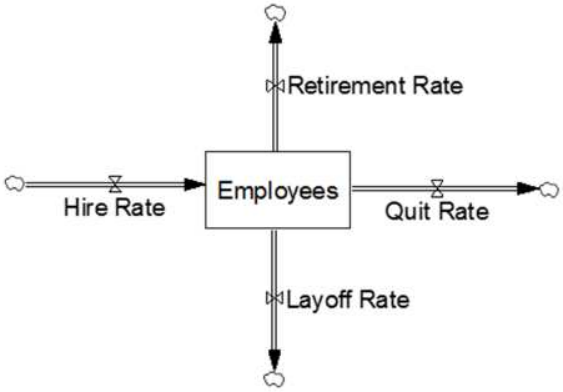

Figure 1a. Diagram showing activities altering accumulation of Employees (Sterman, 2000, p. 200)

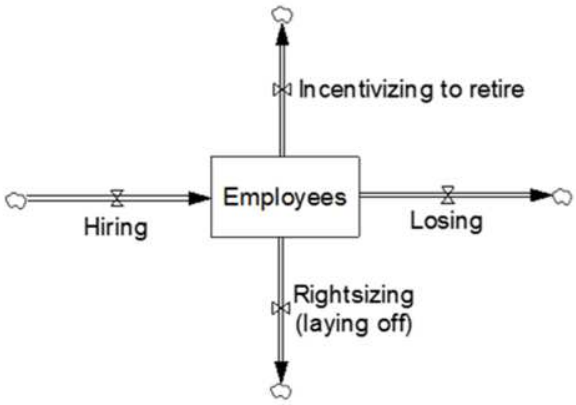

Figure 1b. Adaptation of diagram showing activities altering accumulation of Employees (relevant to employing organization)

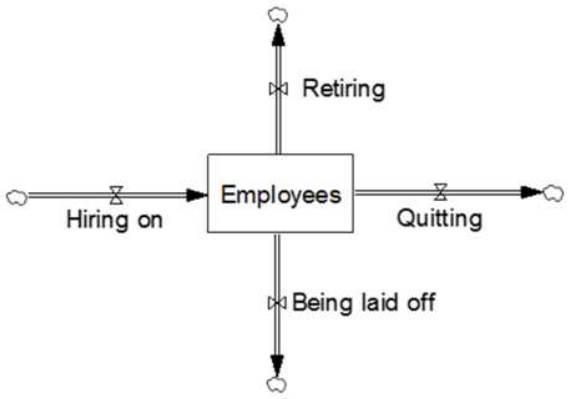

Figure 1c. Adaptation of diagram showing activities altering accumulation of Employees (relevant to employees)

Manage mindfully the abstraction level of the flow-variable name. Hayakawa's ladder of abstraction (1990, p. 85), reproduced in Figure 2, demonstrates that we can indicate the same denotative objects with a variety of connotative terms at very different levels of abstraction, In choosing verbs at an abstraction level easily accessible to clients and decision makers, we consequently must manage the abstraction level of the stock-nouns. Lower abstraction levels of verbs may indicate a need for lower abstractions levels of the associated stocks, so that the stock-flow map lends itself to plausible, consistent storytelling.

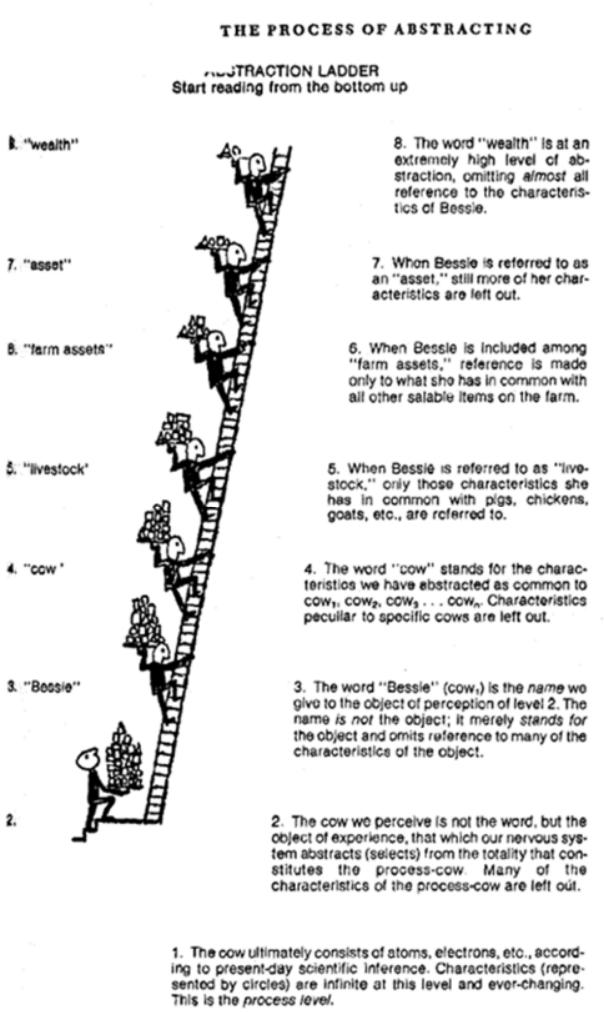

Figure 2. Hayakawa's Abstraction Ladder (Hayakawa, 1990, p. 85)

At the societal level, efforts to improve large systems seems to be shifting from expert-modelers-talking-to-expert-decision-makers to "everybody" working to improve whole systems (Weisbord and Janoff, 2010). In the body of system dynamics literature, we note indications that such a shift may be underway, with a growing corpus of work on group model building (e.g., Vennix 1996, Calhoun et al. 2010), and more recent forays in community-based system dynamics (Hovmand 2014). Engaging broader arrays of constituents in participatory modeling can bode well for implementation of modeling insights.

Ultimately, modelers cannot themselves unilaterally implement the insights gained from modeling. We must engage others to achieve significant implementations to improve complex

systems. And people can act only with the verbs they perceive as within their capacity; therefore altering our model representations to include the verbs that clients and decision makers use because those verbs are viewed as actionable *by them* can help us close the gap between modeled insight to implemented insight.

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