

ABSTRACT**THEORETICAL ANALYSIS OF DYNAMIC BEHAVIOURS
IN SYSTEM DYNAMICS**

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While the number of advocates of system dynamics has been gaining, many of the original criticisms leveled against it, valid or otherwise, persist to this date. These criticisms can be separated into three basic types. They consist of criticisms created by (i) the application, or rather mis-application, of competing sets of theories, standards and procedures on system dynamics, (ii) the underdevelopment of the theories, standards and procedures for assessing system dynamic model objectively, and (iii) the lack of rigor and elegance in the processes of model building, analysis and validation.

Each modeling school defines a particular way of looking at the real-world system and provides a set of tools for working on particular kinds of problem. None is comprehensive enough to encompass all that might be observed about the real-world system or to solve all problems. And, of course, very many observations and problems fall far outside the range of any formal modeling method. Therefore, the essential points of important criticisms of system dynamics do not consist in its methodological character but the relentlessly native form of, and the lack of precision in, the ideas that it uses. We may then ask whether we cannot, by a refinement of our geometric intuition, resolve system dynamics criticisms with a stock of ideas and procedures subtle enough to give satisfactory qualitative representations to a given problem.

This report studies the following problems. First, we intend to expose, as the axiom system of system dynamics, the mathematical principles which should guide judgement in modeling of systems. Second, we attempt to adequately express the essential mathematics of system dynamics. Accordingly, we investigate, with the tools of the Catastrophe Theory, the structural stability, the classification and the discontinuities of dynamic behaviours of systems. Finally, we explain that, by adopting our line of reasoning, we can lay the groundwork of a theoretical investigation of a means to systematize any results in the past articles of system dynamics.