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System Dynamics Modeling for Information Systems Research: Theory Development and Practical Application

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Abstract

Most information systems (IS) research develops theory for explanation and prediction based on a variance logical structure that assumes one-way, time invariant causal relationships. This approach largely misses the opportunity to extend theory from alternative logical structures that build upon reciprocal and temporal causal mechanisms; for example, the system perspective. This paper introduces system dynamics (SD), a modeling tool capable of capturing the reciprocal and temporal causal mechanisms that underlie many complex and dynamic systems, and demonstrates its ability to extend existing variance theory from a system perspective. To do so, we first describe the basic tenets of SD and discuss the status quo of existing SD applications in the field. Then, we demonstrate how to model SD's unique theoretical logic of *reciprocal* and *temporal* causal structure to extend existing variance theory. To demonstrate the use of SD in theory development, we develop and validate an SD model of the e-commerce resource endowment of a click-and-mortar firm and simulate dynamic causal relationships between the e-commerce resource endowment and firm performance over time, under various scenarios. This case demonstrates how we can extend an existing variance theory by reconciling the inconsistent findings of prior research from a system perspective using the SD approach. The paper concludes by discussing how SD can help IS researchers develop dynamic theories.

Keywords: System dynamics, simulation, theory development, electronic commerce, resource-based view, firm performance, the system perspective