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RESEARCH NOTE

SYSTEM DYNAMICS MODELING FOR INFORMATION SYSTEMS RESEARCH: THEORY DEVELOPMENT AND PRACTICAL APPLICATION

Yulin Fang
Department of Information Systems, College of Business, City University of Hong Kong,
Kowloon Tong, HONG KONG {ylfang@cityu.edu.hk}

Kai H. Lim
Department of Information Systems, College of Business, City University of Hong Kong,
Kowloon Tong, HONG KONG {iskl@cityu.edu.hk}

Ying Qian
Department of Information Systems, School of Management, Shanghai University,
Shanghai CHINA {qian.ying@t.shu.edu.cn}

Bo Feng
Department of Management, School of Business, Soochow University,
Soochow CHINA {bofeng@suda.edu.cn}

Appendix A

Comparing SD with Other Systems Simulation Methods in IS and Management

SD differs from other simulation methods commonly used in the IS and management field, such as agent-based modeling (ABM) (Axelrod 1997; Carley 1992; Epstein 2006; Lomi and Larsen 2001), discrete-event (DE)/process-centric modeling (Banks et al. 2005; MacDougall 1987; Zeigler et al. 2000), Monte Carlo method (Fishman 1995; Kroeses et al. 2014), and genetic algorithm (Bruderer and Singh 1996; Zott 2002). The theoretical logic of SD, ABM, and DE is explanation, while Monte Carlo and genetic algorithms focus on optimization. Herein, simulation with explanatory theoretical logic can be a powerful tool for specifying and extending existing theories. Both ABM and DE are well-known and commonly used system simulation methods for theory development in the IS and management fields; SD is distinguished from them in important ways.

The ABM method focuses on how a phenomenon emerges and evolves in an adaptive system (e.g., bilateral collaborative network) where multiple agents interact with and adapt to the actions of other agents. The typical purpose is to simulate a large number of autonomous agents that interact with each other, within a simulated environment and observe emergent patterns from their interactions. The common research question is often framed as: *How does interaction among agents give rise to a phenomenon*?

The DE method simulates a process system (e.g., a queuing system) consisting of a discrete sequence of events in time. Unlike the structural theory of SD, the theoretical base of DE is process theory. This simulation tool is typically used to evaluate strategies for system operations as well as to predict system performance. The research question for DE modeling commonly is: *How will the system perform if the activity, event, or process changes*?

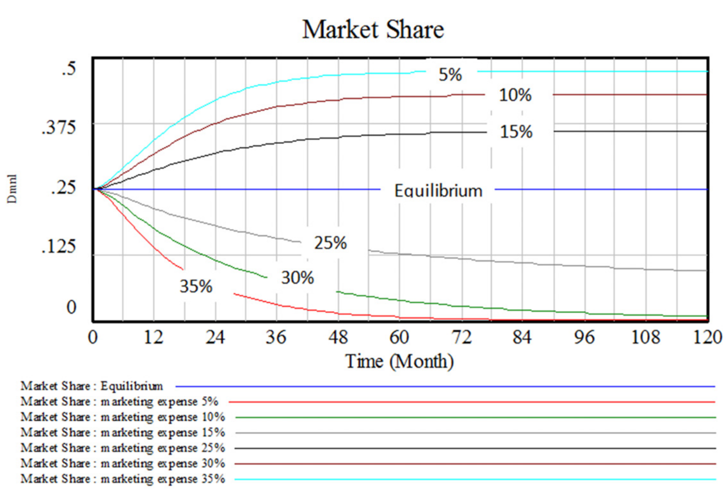
Regarding system theory development in the IS field, the three simulation methods, SD, DE, and ABM differ in terms of system level, scope, time duration, change continuity, and basic mathematical model. We review and compare the three simulation methods in Table A1.

Table A1. Comparison of Simulation Methods for Theory Development

Aspect	System Dynamics	Agent-Based Model	Process-Centric (Discrete-Event, DE)
System classification	Complex feedback system	Complex adaptive system	Process system
Theory base	Structural theory	Behavioral theory	Process theory
Typical purpose	Examine how initial conditions of a system affect the stability of the system over time	Test what occurs after agents interact and how a phenomenon emerges and evolves	Evaluate strategies for operating a system or predicting system performance
Research focus	Modeling a wide range of feedback effects with delayed and circular causality	Modeling interactions among intelligent agents	Modeling one or more stochastic events
System level	Strategic level	All levels	Operational and tactical levels
System scope	Aggregated individuals/ homogeneous	Individual/heterogeneous	Individual/heterogeneous
System key elements	Stocks and flows	Agents, actions	Entities, activities, and queues
System duration	Long-term and mid term	Short-term to mid-term	Short-term
System change	Continuous	Discrete	Discrete

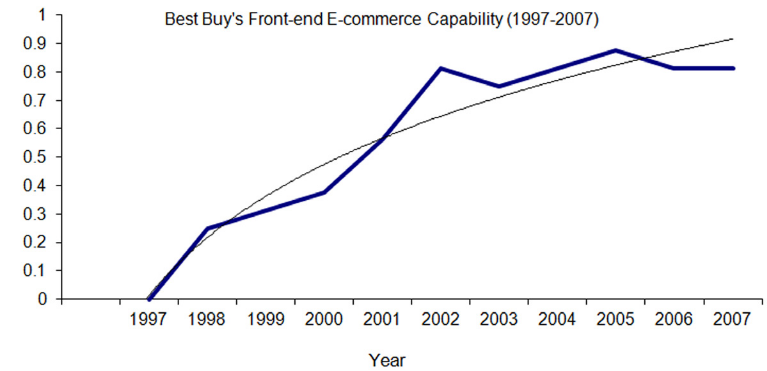
Appendix B

Sensitivity Test of Model Behavior on Market Share



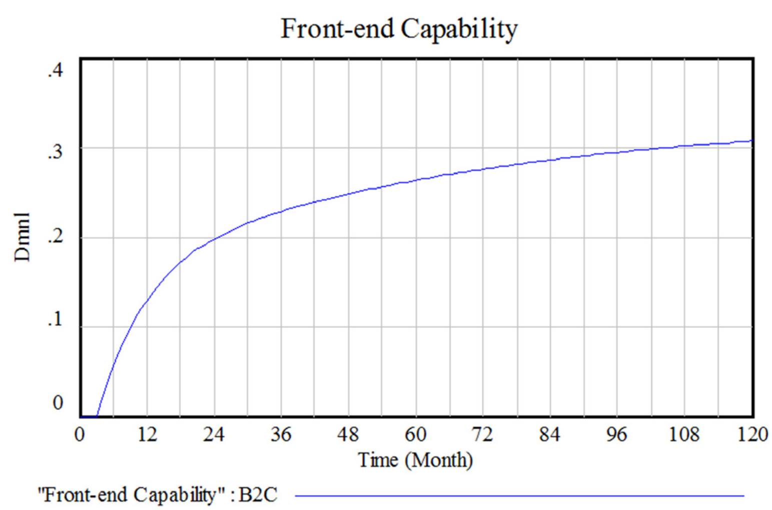
Appendix C

Reference Model Behavior: Best Buy's Front-End E-Commerce Capability (1998–2007) (Trend Line Added)



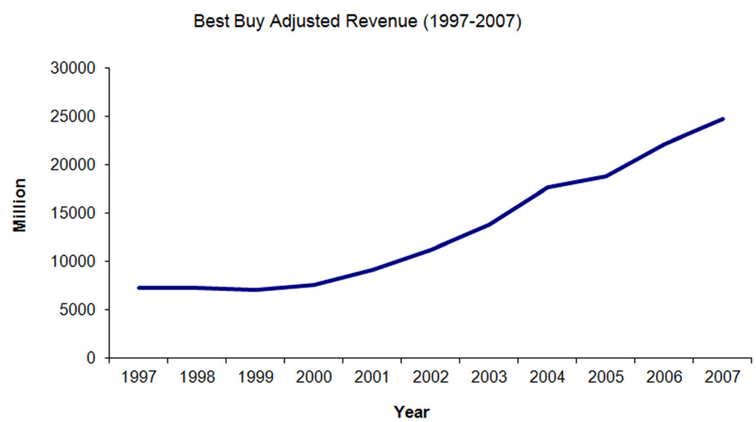
Appendix D

Model-Generated Behavior: Front-End E-Commerce Capability Accumulation Over 10 Years



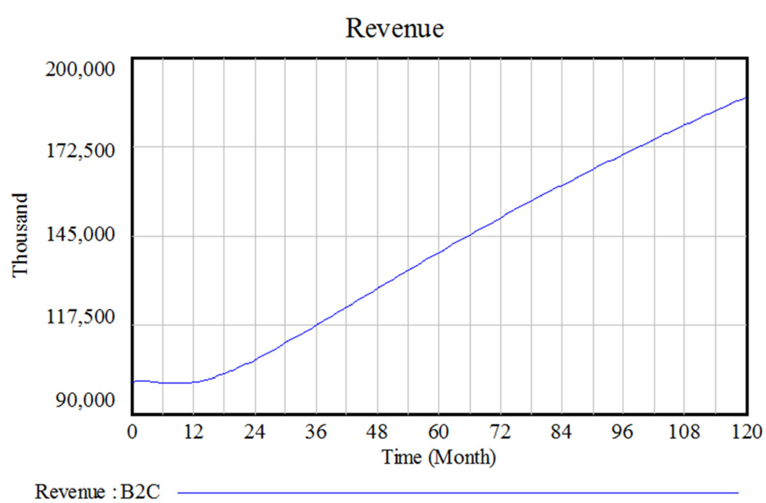
Appendix E

Reference and Model Behavior: Best Buy's Revenue (1997–2007)



Appendix F

Model-Generated Behavior: Revenue Over 10 Years



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