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Tipping Point Dynamics

Research Project Descriptions

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Ford, David N, I. Damnjanovic, and S. Johnson. "**Public-Private Partnerships: A Study of Risk Allocation Design Envelopes**". Governance in the Information Era: Theory and Practice of Policy Informatics. Erik Johnston, Ed. Routledge Press. New York. 2015

Taylor, T. and Ford, D.N. "**Managing Tipping Point Dynamics in Complex Construction Projects**" *ASCE Journal of Construction Engineering and Management.* Vol. 134, No. 6, pp. 421-431. June, 2008.

Taylor, T. and Ford, D.N. "**Tipping Point Failure and Robustness in Single Development Projects**" *System Dynamics Review*. Vol. 22, No. 1. pp. 51-71. Spring, 2006.

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Public-Private Partnerships: A Study of Risk Allocation Design Envelopes

Ford, David N, I. Damnjanovic, and S. Johnson

The purpose of this chapter is to illustrate the application of policy informatics using the system dynamics modeling approach. The setting is a Public-Private Partnership (PPP) between a government agency and a private developer to deliver and operate a large toll-road transportation infrastructure project. While the PPP framework offers a broad range of contractual arrangements to produce successful outcomes, significant challenges remain with achieving equitable risk allocation among the stakeholders. The current work describes how a system dynamics simulation model was used to evaluate the risk allocation envelop (i.e., extreme risk allocation scenario where the risk is allocated to a single stakeholder) through the integration of stakeholders perspectives, objectives, and performance criteria. Transparency and evidence based explanations are achieved by explicitly modeling critical information flows of traffic, money, and information to demonstrate their causal linkage to project performance. Tipping point structures are used to explain project performance. The model and those explanations generate new PPP theory and provide support for policy analysis and policy informatics.

Keywords: Public private partnership, risk allocation, public policy, informatics, infrastructure, simulation, system dynamics

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Managing Tipping Point Dynamics in Complex Construction Projects

Timothy R. B. Taylor and David N. Ford

Complex construction projects are vulnerable to tipping points. Tipping points are conditions that, when crossed, cause system behaviors to radically change performance. Previous research identified tipping point dynamics as capable of explaining the failure of some nuclear power plant construction projects. These dynamics can also threaten the success of other large, complex construction projects. The current work uses a dynamic project model to test policies for managing tipping point dynamics. The Limerick Unit 2 nuclear power plant project is used to test model usefulness. Sensitivity analysis reveals the rework fraction, strength of subsystem interdependence, and sensitivity of the project to schedule pressure as potential high-leverage points for policy design. The model is used to test policies for managing tipping points that were used to complete the Limerick Unit 2 nuclear power plant after a tipping point threatened project completion. Implications for construction project design and management and research opportunities are discussed.

Keywords: Project management; dynamic models; Simulation models; Change management; Errors; Nuclear power plants

Taylor, T. and Ford, D.N. Managing Tipping Point Dynamics in Complex Construction Projects ASCE Journal of Construction Engineering and Management. Vol. 134, No. 6, pp. 421-431. June, 2008.

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Tipping Point Failure and Robustness in Single Development Projects

Timothy R. B. Taylor and David N. Ford,

Tipping point feedback structures can push a series of product development projects into fire-fighting mode in which rework overwhelms progress. Similar dynamics also threaten the performance of individual development projects. The current work extends previous tipping point dynamics research to single projects and demonstrates how a simple, common feedback structure can cause complex tipping point dynamics, trap projects in deteriorating modes of behavior, and cause projects to fail. Basic tipping point dynamics in single projects are described, demonstrated, and analyzed with a model. The concept of applying robustness to project design is preliminarily tested and system robustness to tipping point-induced failure is quantified for a simple project and analyzed with sensitivity analysis. Impacts of tipping points on project performance and future research opportunities concerning tipping point and robustness in project management are discussed.

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