

Galois Lattice Quantum Model for NVOs

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INTRODUCTION

A major reason for the failure of rational models (cognitive science, game theory) of organizations is the use of static concepts of interdependence to predict dynamic behavior. In contrast, a quantum model of organizations transforms the traditional model into a model of dynamic interdependence of uncertainty. In this study, we explore Galois lattices as a potential quantum model of networked and virtual organizations (NVOs) based on field and laboratory data.

BACKGROUND

A related article in this encyclopedia (“A Quantum Real-Time Metric for Networked and Virtual Organizations” by Lawless, Howard, and Riegel) reviews details of the reasons to shift from traditional social models of organizations to newer ones based on the quantum model. In brief, traditional models of organizations (Pfeffer & Fong, 2005; Putnik, Cunha, Sousa, & Avila, 2005) predict poorly and do not provide satisfactory metrics of change, whereas the quantum model in the field and laboratory has shown significant promise (Lawless, Bergman, & Feltovich, 2006a; Lawless, Bergman, Louçã, Kriegel, Nicole, & Feltovich 2006b). The quantum model works because it easily models the dynamic interdependence found in the social interaction. In this article, we explore whether the quantum model might be better served with Galois Lattices (Chaudron, Maille, & Boyer, 2003).

Change is characteristic of organizations. Global economic shocks such as the rapid introduction of new technology into a mix of interdependent societies competing under various degrees of stability can produce uncertainties in organizational trade-offs and

risks that affect the ability of organizations to respond and adapt. In our interpretation of May (1973/2001), as environmental volatility increases (e.g., the average volatility or VIX index on stock markets was over 30 during the recession of 2002; see www.cboe.com/micro/vix), environmental threats decrease competition and social evolution even as dynamic stability between organizations increases, for example, the instability among weaker U.S. commercial airlines immediately after 9/11. However, as environmental volatility reduces (e.g., the historic lows in the VIX index in 2005 with its average near 12), social evolution driven by competition increases as the dynamic instability between organizations increases, forcing them to struggle to survive (e.g., the performance in small capitalization stocks in the U.S. stock market over large caps during 2004-2005). Modeling these interdependent dynamic changes is a challenge.

From a traditional perspective, change creates disruptive uncertainties; however, from our perspective, mergers in a market under threat reflect organizational needs to increase efficiency (Andrade, Mitchell, & Stafford, 2001); for example, the increased telephone market share by wireless communications led to a decrease in traditional telephone landlines in the U.S., causing mergers among telecommunication firms like SBC and AT&T in 2005.

Alternatively, there are limits to static knowledge as Campbell (1996) warned for analyses based on convergence processes in the study of humans, or as Macy (2004) warned for analyses derived for agent-based models (ABMs). But if these limitations are trade-offs that can be predicted, the ability to anticipate the complex consequences of change may lead to a better control of organizational dynamics. We know that some organizations are better at managing change—for example, Southwest vs. Delta Airlines in 2005—but

we do not know why. Considering the constituents of a group, Luce and Raiffa (1967) established that game theory mathematically could not distinguish between the members of an organization and a similar aggregation of individuals. Today we know that simply summing the contributions of the agents in an organization does not indicate what an organization will do (Levine & Moreland, 1998).

Our past studies indicate that democracies and autocracies handle large-scale transformations differently. Democracies are more likely to use competition processes like majority rules in their deliberations to generate and process information (Flaig, 2004). In contrast, organizations, coalition governments, and command economies prefer consensus rules, a more cooperative process better aimed at interpreting events to fit a single worldview, often used by authoritarian regimes to marginalize critics; for example, Krushchev's marginalization of Stalin (Taubman, 2004). Earlier we found that the more politically competitive was a society, the more quickly it applied knowledge in responding to natural disasters (Lawless et al., 2006a); for example, according to the World Bank (www.worldbank.org), China has become a financial superpower, but its autocratic government is responsible for 16 of the 20 most dirty cities around the globe, over 5,000 deaths annually in coal mining accidents, and a rural health care system in collapse.

The central problem remains the lack of a mathematical theory of dynamic interdependence for social situations as when forming a dyad between two agents alters the cognitions of both. This problem was recognized at the beginning when Von Neumann and Morgenstern (1953) developed the mathematics of static interdependence in game theory, but Bohr's (1955) criticism of its lack of dynamic interdependence led them to conclude that if Bohr was correct, a rational theory of behavior was "inconceivable" (p. 148).

When the factors of action and observation are dynamically interdependent, complete information can be collected from one factor but not both simultaneously, the flaw with static game theory matrices that bedeviled Kelley (1992) and with convergent analytical methods that caused Campbell (1996) to reject his own methodology, the mainstay of modern social science.

Dynamic interdependence means that an agent's strategy in an interaction shifts with time or measurement, changing the perceptions of risks and uncertainties and the results from measurement, what we have called the "measurement problem" (Lawless et al., 2006b).

Game theory attempts to bracket expected outcomes based on the potential of complete information from all variables, but it has not been able to capture the reactions of society or the costs of a strategy, thwarting attempts with static matrices to predict dynamic outcomes (Kelley, 1992). To ask agents to justify their decisions causes them to construct answers on the fly that are independent of their decisions (Shafir & LeBoeuf, 2002). Dynamic interdependence relies on a random exploration of possible solutions until one is found (stochastic resonance; Nicolis & Prigogine, 1989). To an organization provided with a dynamic interdependent metric (real-time profit and losses), such a solution often is characterized by an unexpected increase in sales (an increasing number of Fourier elements to imply resolution; May, 2001). Nonetheless, in recounting an interaction, humans are left with language which can do no more than to provide a static description or "story." But conjugate interdependence means that a "story" is unable to reconstitute the interaction, creating a paradox.

Although complex in its ramification for mathematical models, ABM models, or to control an NVO, the central idea is easy to grasp with common examples: when you listen to someone else, or when you are angry and another person is not, both of you lose information about each other's states. Moreover, for our purposes, when you and another person are expressing incommensurable views to which both of you are committed for whatever reason, then the two of you become drivers on that topic in any discussion for the purpose of reaching a decision (e.g., an avowed Christian and a Muslim; a GM and a Toyota worker; and an oil executive and an environmental activist). Should other participants in this discussion and decision process be less knowledgeable than the two drivers of the discussion, they become more or less neutral to the discussion as it turns on technical issues.

Main Focus: From Field Research a Hypothesis

The quantum model of uncertainty is based on the assumption from Bohr that social reality is bi-stable, with multiple sources of information mostly inaccessible due to interdependent uncertainties, making social categories arbitrary. To uncover interdependent uncertain information about an organization requires that it be disturbed to generate feedback, a notion alien to rational models. A common perturbation is a hostile

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