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Introduction to the Special Issue on Theory Development in Operations Management

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Rigorous development of theory in operations management has been lacking. Although many theories have been proposed, they are often not developed in a format and depth that can be falsified, refined, or supported. This special issue includes three papers that illustrate rigorous development of theory for future testing using mathematical, simulation, or managerial approaches.

Key words: theory; empirical; operations

1. Why Is Operations Management Theory Needed?

In general, the operations management (OM) field has been weak on theory development that is subsequently tested. Until recently, rather than being theory-driven with empirical testing, it has been problem-driven (Amundson 1998). For example, we need to manage supply chains, so we identify a problem (e.g., contracting with suppliers). Generally, these problems have been attacked by building a mathematical model that is solved optimally, or through simulation or stochastic processes. There is nothing wrong with this approach, but the purpose of the model is to help managers make better decisions, not to gain a greater theoretical understanding of the problem that is ready for empirical testing. There is an implicit theory underlying all operations research models of the rational decision maker along with specific theories regarding the problem context, e.g., queuing theory. There are also boundaries of the theory set by the assumptions of the model. However, until recently, we have not used models to develop and test theory. We used them to help managers make better decisions.

We can combine empirical testing with modeling by first modeling a problem to gain analytic insights and predictions of behavior or hypotheses ready for testing. Then the modeler, or someone else, could study the same problem in practice and determine whether the models are predictive of managerial behavior and whether the hypotheses are true. Of course, this has been done, but not frequently from the standpoint of enriching, testing, and possibly falsifying the underlying theory of models. Often it is assumed that managers are not behaving rationally when their decisions do not follow the optimal path of the model, and yet the model may be limiting in its assumptions and therefore not predictive of the best decision. Many models are proposed but never tested with the parameters estimated from empirical data. Therefore, the loop has yet to be closed between modeling theory and empirical tests in many cases. At first glance, an exception may be the models published in *Interfaces*. However, these models that use real empirical data are meant to help mangers make better decisions and are not used to refute, enrich, or revise the theoretical basis of the model.

There are some exceptions where models have been used to gain a greater empirical understanding of a phenomenon. First, the basic queuing models, in addition to problem solving, offer insights into the nature and characteristics of waiting lines. The exact nature of trade-offs between the service rate and waiting lines is not obvious without modeling. In a recent paper, Chambers and Kouvelis (2006) derive five explicit theoretical insights from mathematical modeling. These insights could be subjected to empirical testing in future studies. Another example is the paper by Dewan et al. (2007) that investigates the risk-return relationship of information technology investment at the firm level. They use option-pricing theory of investments under uncertainty to formulate their models and test the theory with empirical data.

In the last 20 years, the introduction of empirical research into the OM field based on management theories has been more closely related to theory testing and development, e.g., contingency theory and the resource-based view (Swamidass 1991, Gupta et al. 2006). Whether designed to test theory or build theory, managerial empirical research explicitly closes the loop between theory and the real world. Without theory, empirical researchers are accused of raw empiricism or data dredging. A variety of theory-based papers have appeared in empirical OM with some of them stronger on theory than others (Schroeder et al. 2002, Miller and Roth 1994, Flynn et al. 1999). A few "pure theory" papers without any testing have also appeared in the literature, but these papers have been relatively rare and difficult to publish (Anderson et al. 1994, Schmenner and Swink 1998, Sampson and Froehle 2006). Some say they are "thought pieces" or do not add anything to knowledge unless the theory is also tested in the same paper. However, empirical research is only as good as the theory that underlies it. The purpose of this special issue is to present strong pure theory papers in a format that can be readily subjected to future empirical analysis.

2. What Is Theory?

Although there has been extensive writing on the definitions of theory and the philosophy of science, it may be helpful to provide a short review here. Bacharach (1989) defines theory as a set of concepts or constructs and the relationships among them along with boundary conditions, assumptions, and constraints. He argues that a theory should be parsimonious and describe or provide predictions about the phenomena of interest. Wacker (1998) provides a somewhat more detailed description of theory as consisting of four elements: conceptual definitions, domain limitations, relationship building, and predictions.

These authors and others go on to describe the characteristics of a good theory. Not only should theory be parsimonious, but it should be falsifiable, useful, and not tautological. A theory can never be proven; it can only be disproved, therefore the necessity of falsifiability. A theory that is tautological cannot be tested by scientific methods and is not specific enough to be useful. A theory must provide some useful predictions or hypotheses to be valuable for scientific inquiry. There are a number of other rules and methods used to evaluate good theory provided by (Whetten 1989; Wacker 1998, 2004; Bacharach 1989).

To advance as a scientific field, operations management scholars must develop "good" theory that can be tested and possibly refuted, confirmed, or refined. This special issue provides good theory papers that are well positioned for future empirical testing.

3. The Three Papers in This Special Issue

In this issue, Xue and Field (2008) write about "Service Coproduction with Information Stickiness and Incomplete Contracts: Implications for Consulting Services Design." This paper is an example of a mathematical theory based on economics and game theory. Their paper draws on the transaction cost theory from economics using the notion of incomplete contracts that are not fully specified at the beginning of an engagement between a service provider and a customer. They also draw on coproduction theory from the operations management service literature, where the customer can perform part of the service (self-service), and they draw on the information stickiness theory from the knowledge management literature. The context of consulting is used to develop a mathematical model drawing from these theories to determine how work should be allocated between the provider (consultant) and the customer who can perform part of the service, along with appropriate pricing decisions. After obtaining analytic results, the authors specify eight propositions that are subjected to further discussion and implications for practice and theory testing.

This paper is a good example of how modeling can be strongly grounded in theory and result in propositions for further empirical testing. The point of the model is not to provide immediate decision support for managers but rather to gain an understanding of the implications of the theory and propositions for future empirical research. Although the authors do not test the propositions in this paper, they use a case study to illustrate the theory developed. This paper is therefore an example of a pure theory paper using mathematical logic and assuming rational decision making.

In this issue, Größler et al. (2008) write a paper entitled "System Dynamics as a Structural Theory in Operations Management." Their thesis is that system dynamics is not only a modeling technique but also a way to represent structural theories about systems in operations. As such, it can be used to test theories and draw theoretical implications—not only to help managers make better decisions. Many problems in operations management can be characterized by the accumulation of resources, feedback, and delays. As a result, system dynamics can provide theoretical insights that are not available from queuing theory or mathematical programming. Using system dynamics for theory development and testing can help explain not only what is happening in a system but also why, how, and when the result is obtained.

The authors point out that modeling and simulation are often viewed as rational approaches that are purely deductive (Meredith 1998). Fuzzy and messy concepts like operations strategy and human behavior are thought to be unsuitable for such modeling. However, systems dynamics models are grounded in empirical observations and theoretical relationships that can be tested and are descriptive in nature. These models and the related theory can be tested or developed by empirical observations from surveys, interviews, or objective data. This particular paper thus describes how the systems dynamics approach can be used to formulate and test theories about operations.

The third paper by Rungtusanatham and Salvador (2008) ("From Mass Production to Mass Customization: Hindrance Factors, Structural Inertia, and Transition Hazard") investigates the organization change that occurs during mass customization. This paper is a theory-building paper (Glasser and Strauss 1967) that uses longitudinal analysis of an organization that is transitioning from mass production to mass customization. They uncover five factors that hinder the transition from mass production to mass customization and provide a theoretical generalization of these factors. Using structural inertia theory, the five factors are mapped into five propositions for future empirical testing.

This paper is a good example of theory building using longitudinal analysis of one organization. Although the theory cannot be generalized from one organization, it can provide insights into the problem of interest, in this case, barriers when transitioning from mass production to mass customization. The paper uses resistance to mass customization implementation as a special case of structural inertia theory.

Taken as a whole, the three papers illustrate different approaches to theory development and the presentation of theory for future empirical tests. The first paper is the development of a mathematical theory using the rational approach to decision making. The second paper argues that systems dynamics can be a useful way to model complex organization systems as a vehicle for testing theories of organizations. The third paper develops a theory from a longitudinal case study (Eisenhardt 1989). These are good examples of how theory can be developed in operations management, but they are merely a sampling of different approaches used and topics. It is hoped that this special section will spawn further pure theory development papers that are ready for empirical testing.

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