

Editorial

INNOVATION PROCESSES RESEARCH IMPLICATIONS FOR PUBLIC POLICY

INTRODUCTION

THE PURPOSE of this special section of this TRANSACTIONS is to present a range of different perspectives on the empirical study of technological innovation in social organizations. For some years the Innovation Processes Research Section¹ of the National Science Foundation has sponsored such research, with the general aim of improving the Federal government's ability to understand the consequences of its many and varied policies toward technological change and consequently improving the efficiency of the policy setting process. In the course of this research program, which has spanned many different kinds of technologies and organizational settings, a few consistent themes have emerged. The articles in this section present empirical treatments of some of these themes.

POLICY VERSUS PRACTICE

The first, and overriding, contention is that policy setting, and consequently policy research, is no better than the organizational base on which it rests. Over the past twenty years, research on innovation has evolved into two fairly distinct types of analysis. The dominant approach has been externally oriented, focusing on events in organizations' environments, particularly those subject to pressure by Federal actions or market forces. This traditional approach to policy analysis and research is best represented by aggregate economics. A second approach to innovation research has, by contrast, directed primary attention to the process of innovation within and between organizations at a distinctly micro-level of analysis.

Both approaches recognize that government policy is conceived and executed at an aggregate level, with the aim of effecting broad ranges of firms or agencies in similar ways through single government actions. But it is assumed under the latter approach that such policies must always find their effects through the intervening mechanisms of individuals and organizations—that is, national policies must succeed or fail at the level of the firm or even an operating unit within the firm.

Unfortunately, debate and discussion concerning industrial innovation has focussed excessively on macro-variables to the general exclusion of organizational-level variables. But innovation is always a process that involves people, organizations, and programs. Market forces never operate with certainty and

information is never perfect. We believe that the basic lesson of all our research to date is that effective analysis of innovation policies must eventually be based on clear understanding of the organizational and environmental phenomena which shape and direct behavior in response to policy. If research is to fulfill its potential for improving the efficiency and effectiveness of policies, its focus must be increasingly on those factors which translate incentives into practical behavior.

All of the papers presented here illustrate this contention in various ways. Gold, for example, explicitly considers the range of firm and industry factors which condition responses to policies intended to affect international competitiveness. Roitman *et al.* discuss the limits on and possibilities for diffusing specific advantageous technologies (either developed by government or not) among a population of potential beneficiaries. The other papers, likewise, present organizational conditions which mediate the innovation process.

ADOPTION VERSUS IMPLEMENTATION

A second theme in our research program is the inherent complexity of innovative behavior in practice. Traditional macro-analysis of innovation has generally defined "adoption of innovation" as the critical criterion of interest, and has tended to elide the distinction between adoption and actual implementation, or translation of the innovation into practice. In recent years, converging streams of analysis emerging from sources as diverse as education, economics, political science, and operations research, have led to the definition of implementation behavior itself as a legitimate subject for study, not simply noise, error variance, or other exogenous irrelevance.

Despite considerable research, however, much remains to be accounted for in understanding implementation. Partly, as Scheirer's paper illustrates here, this is because the field of implementation analysis itself suffers from so many conceptual and methodological flaws as to imperil any generalizations significantly. However, this need not be; the research of both Pelz and Roitman *et al.* reported here shows how rigorous analysis can be made of phenomena which may seem at first glance to be approachable only in the most qualitative sense.

SIZE, STRUCTURE, AND INNOVATION

Even as we improve our sensitivity to what our dependent variables actually mean, we must improve our understanding of the dimensions of organizational and environmental forces which we expect to affect those outcomes. Two major dimensions are important here: the meaning and role of size as it influences innovation and the operational definition of organizational structure and environment in terms clear enough to be replicable but broad enough to be generalizable.

Size has long been a major variable of interest in innovation

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¹ As of December 1982, our section's name has been changed to the Productivity Improvement Research Section; its research mandate remains essentially unchanged.

studies, but its meaning has been widely debated. Size, as such, is probably a proxy for two distinct features of organizations: resources and structural complexity. Untangling which of the correlations between "size" and innovation are due to which of these effects is still in process. Ettlie's paper suggests that resources may interact critically with external stimuli in non-linear ways. Unfortunately, as Scheirer's work suggests, it is not clear that structural dimensions have been measured any more replicably than has innovation utilization itself.

Part of the problem is the inherent complexity of the innovation process itself—a sequence of multilevel events, decisions, and actors—and the consequent difficulties in defining models of that process which adequately reflect that complexity. As Pelz's work suggests, this process is as likely to avoid a neat linear decision sequence as it is to follow one. Models adapted to these phenomena will have to be considerably more sophisticated than those in current practice, particularly in terms of incorporating multiple units and levels of analysis simultaneously, with all the threats to validity which that implies. Moreover, they will have to treat interactions of individuals and phenomena with as much efficiency as they handle discrete behavior.

TOWARD A CONCEPTUAL AND METHODOLOGICAL SYNTHESIS

The purpose of this special section is to suggest a general agenda for future work. Our contention is that a finer focus of research priorities and a closer consideration of organizational-level variables are both needed. Further, we believe that the primary focus should be on "empirical" studies of innovation, such as all the papers in this volume represent. However, as readers will note, a wide range of methods can be used to obtain such empirical findings, ranging from record searches to surveys to ethnographic observation. The papers by Pelz and Roitman *et al.*, in particular, demonstrate that largely qualitative data can be used in ways as rigorous as that obtained by the most structured survey. What is needed is rigor and replicability, not arbitrary commitment to any single data-gathering scheme. The integration of findings derived from a wide variety of approaches will be a challenge to researchers for time to come.

Empirical organizational research raises some interesting

methodological, conceptual, and policy implications. First, innovation research has unit-of-analysis problems to address. We are confronted with multiple units of analysis nested one within another. A firm is not a unitary social unit; it is composed of various departments, subordinate units, informal groups, and individuals within groups. To address any given set of questions, it may be necessary to gather data at any or all of the levels of analysis and to employ multiple statistical or analytical techniques to make defensible inferences. Pelz and Roitman *et al.* illustrate how some researchers are dealing with this issue.

Further, as the innovation research field moves towards a more micro-focus, it needs more rigor, not less. Since the variables involved are often less clear conceptually, we need to be more operational in how we measure them and to take steps necessary to assure convergent validity. Variables at the micro-level tend to be more dynamic and, more importantly, subject to manipulation. Thus we could gainfully employ methodologies that are more robust than the *post facto* approaches that have heretofore dominated the field. We feel that field experimentation is possible and, if so, is the best way to demonstrate the causal effect of an organizational variable on the innovation process. The work reported here is, however, an essential first step toward defining the basis for such experimentation.

SUMMARY

This volume can of necessity report only a few of the salient pieces of research in the tradition described in this introduction. Much of this research is still in process; other pieces have been reported in other media. We feel, however, that the effort to showcase a sample of innovation analyses, and thereby give some idea of the range of topics and approaches which the field requires, will ultimately improve the efficiency of both the research process and its utilization in the policy context. Comments, on both the specific research angles reported here and the research program direction generally, are cordially invited by the authors.

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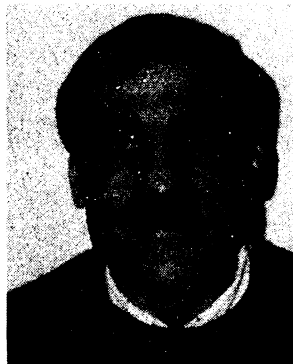
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Performance Gap Theories of Innovation

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Abstract—Although performance gaps have long been assumed to stimulate innovative organizations, the theory has rarely been tested. In a secondary data analysis of 147 food processing firms, it was found that performance gaps are significantly correlated with objective measures of environmental uncertainty but not with innovation among firms in this sample. It was hypothesized that since performance gaps might impinge upon the availability of slack resources to the firm, small firms would be discouraged from innovating after experiencing a performance gap and large firms would be encouraged to innovate in response to a performance gap. Modest support for this proposition was obtained. Three other propositions were strongly supported by these data. Perceived rather than objective measures of environmental uncertainty are significantly correlated with radical innova-

tion in firms that have successfully avoided severe performance gaps, most probably because they are significantly more likely to have formulated and implemented an aggressive technology policy. It appears that environmental change and turbulence that cause performance gaps can promote innovation for an organization if they can be *anticipated*, but will discourage especially radical innovation once they have led to a severe performance gap.

INTRODUCTION

NCESSITY is the mother of invention, although the father is often unknown. Desperate people do desperate things. The apparent contradiction in these two propositions stimulated the investigation reported in the following performance gap theories of innovation in organizations. Performance of an organization below expectation or needed levels has long been discussed as a cause of innovation, but there is relatively little empirical evidence to support this hypothesis. The theoretical foundations of this proposition will be developed

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