

Methodological Note

# Measurement issues in empirical research: improving measures of operations strategy and advanced manufacturing technology

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## Abstract

Our objective in this paper is to examine measures used in survey-based research in operations management. Specifically, we examine measures commonly used to assess operations strategy and advanced manufacturing technology in survey-based research. Examining two measures provides the ability to examine problems common to many of the measures used in operations management research. In addition, the two measures are addressing two different levels of strategic analysis: competitive priorities and a specific structural decision that (should) support these priorities. This should give us a broader understanding of the measurement issues we are facing as a field. We argue that while many of the commonly employed measures display many worthwhile properties, further refinement of measures and methods is needed to improve the field as a whole. Suggestions to improve measures and methods used in the field are then offered. © 2000 Elsevier Science B.V. All rights reserved.

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There has been a substantial increase in the use of field-based, empirical research methods in operations management over the past decade. Research methodologies such as case studies, panel studies, focus groups and surveys have been successfully applied to a variety of topic areas. While each of these methodologies has unique strengths and weaknesses that make them most appropriate for certain applications, by far the most commonly applied methodology has been surveys.

Our objective in this paper is to examine measures used in survey-based research in operations management. We use commonly accepted measures of competitive priorities and advanced manufacturing technology to explore the state of development for measures used in survey-based research in OM. We focus on these measures for three reasons. First and foremost, these measures provide a broad spectrum of the type of measures used in survey research. The competitive priorities measures address the macro-level construct of strategy. The AMT measures address a micro-level construct that is representative of the many structural or infrastructural investments a firm must make to support its strategy. While the AMT measures focus on a single structural decision area, they are among the better devel-

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oped measures and the characteristics associated with the AMT measures are readily generalizable. Secondly, both sets of measures have been used in numerous replications and are deemed reliable and valid. Our final reason for choosing these specific measures is the authors' familiarity with them. Many of the issues we raise are the result of our own work with these measures.

The choice of measures is a critical component of research design when employing a survey (Malhotra and Grover, 1998). In this paper we argue that while many of the measures that have been employed in operations strategy research display many of the necessary characteristics of valid and reliable measures, there is still much work to do. Specifically, we will argue that while both measures are indeed reliable and display elements of construct validity (they both converge and diverge as expected) they may be lacking on other validity criteria. Equally important, we note that many of our validity concerns have as much to do with how the measures are used (methods) as with what the measures do or do not accomplish. Therefore, the following sections will briefly discuss operations strategy measures in general. Next, we specifically examine the competitive priorities and AMT measures from the standpoint of which important measurement criteria they do and do not meet. These sections will examine reliability, validity and methodological issues. Finally, we synthesize the data from these two measures and use this information to suggest ways to improve many of the measures and methods used in operations strategy research.

## 1. Competitive priority measures

Operations strategy research has evolved significantly in the past 10–15 years with an increasing quantity of high quality articles being published. Recent examinations of the published literature base suggest that the field has progressed beyond an exploratory stage to a point where there is a core set of basic terminology and models (Swink and Way, 1995; Ward et al., 1998). Along with the formation and solidification of a core terminology, there is an increasing emphasis on developing and employing a

set of reliable, valid and reproducible methods for conducting research on operations strategy (Vickery et al., 1994; Verma and Goodale, 1995).

There is general consensus regarding the composition of the key competitive priorities (cost, quality, flexibility and delivery) which comprise the content of a corporation's operations strategy (Anderson et al., 1989; Leong et al., 1990). Similarly, it is commonly agreed that the effectiveness of a company's operations strategy can be measured by assessing the degree of linkage or consistency between the competitive priorities which are emphasized and the corresponding decisions regarding the structure and infrastructure of operations (Leong et al., 1990). In essence, the degree of fit between an organization's competitive priorities and its key decisions regarding structural and infrastructural investment provides the key to developing the full potential of operations as a competitive weapon.

While existing theory and models of operations strategy are conceptually sound and commonly accepted, the measures and constructs employed to assess an organization's operations strategy using empirical data are generally not as well developed. In this review, we will focus on the measurement challenges associated with assessing an organization's competitive priorities. We will also examine one set of common structural/infrastructural measures — those used to assess investment in advanced manufacturing technologies (AMTs). This choice is made because AMT measures are relatively common and well developed. Focusing on a single structural measure allows us to analyze micro-issues in greater depth, but may sacrifice some generalizability to measures of other micro-issues.

## 2. Competitive priority constructs

A common approach to measuring competitive priorities involves using a multiple item list and asking respondents to rate the relative importance of each priority. For example, Table 1 shows the priorities assessed by Boyer (1998) using items originally developed for use in the Boston University Manufacturing Futures Survey (Miller and Vollmann, 1984). These measures have been employed in numerous

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