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THE SOURCES OF MANAGEMENT INNOVATION:**When Firms Introduce New Management Practices**

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Abstract

Management innovation is the introduction of management practices new to the firm and intended to enhance firm performance. Building on the organizational reference group literature, this article shows that management innovation is a consequence of a firm's internal context and of the external search for new knowledge. Furthermore the article demonstrates a trade-off between context and search, in that there is a negative effect on management innovation associated with their joint occurrence. Finally the article shows that management innovation is positively associated with firm performance in the form of subsequent productivity growth.

Key words: Management innovation, management practices, performance, knowledge sources

THE SOURCES OF MANAGEMENT INNOVATION:

When Firms Introduce New Management Practices

The phenomenon of innovation continues to attract enormous interest among management scholars. Beyond the ubiquitous technological and product innovation, a number of subfields have emerged, concerned with aspects of innovation, such as business model innovation (e.g., Markides, 1997), service innovation (e.g., Gallouj and Weinstein, 1997) and process innovation (e.g., Pisano, 1996). This article focuses on one subfield, namely management innovation (Birkinshaw, Hamel, and Mol, 2008) and its antecedents in and consequences for individual firms. Hamel (2006; 2007) in particular has forcefully argued that in today's age management innovation may represent one of the most important and sustainable sources of competitive advantage for firms because of its context specific nature among others. That makes any study into this topic particularly relevant for practice but also important from the perspective of the study of sustainable competitive advantage, a key domain of strategic management and other academic areas.

For some researchers, management innovation refers to a practice or structure that is "new-to-the-state-of-the-art", meaning that it has no known precedent (e.g., Chandler's (1962) description of the invention of the M-Form structure); for other researchers, management innovation refers to something that is "new to the firm" and is adapted from another context, such as a peer firm (e.g., Zbaracki, 1998). Each approach has its own body of literature and, while both fit under the banner of management innovation, it is to the latter body of literature this article contributes. This research defines management innovation as the introduction of management practices that are new to the firm and intended to enhance firm performance.

The introduction of new management practices is an important issue for firms as they seek to upgrade their productivity, improve the quality of customer offerings and retain competitiveness (Ichniowski, Shaw, and Crandall, 1995; Pil and MacDuffie, 1996). Policymakers see such practices as important drivers of sector-level or national improvements in productivity. For example, the DTI Innovation Survey and “Porter Report” (published in 2003) highlights the poor adoption of best practices as contributors to the UK’s relatively weak productivity levels (Leseure, Bauer, Bird, Neely, and Denyer, 2004). Examples of management innovation by UK companies would be BP’s introduction of peer groups (Ghoshal and Gratton, 2002) and the business-cell structure at Litton Interconnection Products (Birkinshaw and Mol, 2006). In the UK context management innovation may be particularly important, given its leading role in shifting from products to services. In services, a company’s management and innovation therein is more likely to provide competitive advantage than technological prowess.

The literature focusing on why firms introduce new management practices contains gaps. Many studies focus on the diffusion of specific practices across firms over space and time (Abrahamson and Fairchild, 1999; Burns and Wholey, 1993; Teece, 1980; Westphal and Zajac, 2001); and the literature on the dynamics of the “fashion driven” market for management practices expands (Abrahamson, 1991; 1996; Clark, 2004; Gill and Whittle, 1993; Jackson, 1986); but studies looking specifically at the firm as the level of analysis, with a view to understanding the causes or consequences of its implementation of new practices more generally, are small and relatively old (e.g., Damanpour, 1987; Kimberly and Evanisko, 1981). Furthermore these older studies focus on the internal structural context. The current article identifies the key gap in the literature as a lack of attention on how relations with external and internal partners can deliver knowledge that helps firms implement a wide range of management practices, which then may or may not improve the firm’s performance.

The article addresses this gap by considering two questions. First, under what conditions do firms introduce new management practices? The focus is on two sets of variables, around context and search. The search concept is particularly novel in the context of new management practices, where authors have not previously argued that building up knowledge-based relations affects the ability to successfully introduce new practices. Furthermore this article investigates whether and how context and search interact in producing new practices. Second, how is the introduction of new management practices associated with future productivity improvements? Do firms that introduce new management practices tend to outperform those that do not, or does no observable relationship exist? An answer to that question helps to assess Hamel's argument discussed above. The rest of the article is structured as follows. First it focuses on the concept of management innovation and prior literature in this area and builds a set of hypotheses around its antecedents and performance consequences. The empirical analysis is based on over 3,600 establishment level responses from the UK. The article then discusses the findings, the research limitations, and possible directions for future research.

BACKGROUND

An operational definition of management innovation has to address four core issues. First, what is being innovated? The focus in this article is on innovation in management practices, processes and structures which affect the day-to-day work of management at an operational level (Alänge, Jacobsson and Jarnehammer, 1998; Guillen, 1994), as this is where observable changes take place, rather than management ideas or ideologies (Abrahamson, 1996; Barley and Kunda, 1992; Kramer, 1975). Second, is management innovation something new to the state of the art (Abrahamson, 1996; Hamel, 2006), or simply new to the firm that is implementing it (Stjernberg and Philips, 1993; Zbaracki, 1998)? Both definitions are valid but this study focuses on the latter definition. Such innovations are typically incremental in nature, and include new approaches to

structuring the firm, new management techniques and new marketing methods that firms pick up from other organizations.

Third, does management innovation involve conceptualizing a new practice, implementing a new practice, or both? Building on the UK Department of Trade and Industry definition of innovation - the successful exploitation of new ideas (DTI, 2005), management innovation involves both an idea (typically taken from another context) about what might work and the implementation or introduction of that idea.

Fourth, this study views innovation as a goal-oriented activity (rather than as an activity undertaken for its own sake; Staw and Epstein, 2000), so innovation is done with the intention of furthering the firm's performance. Taken together, these elements produce the following definition of management innovation: the introduction of management practices that are new to the firm with the intention to enhance firm performance.

Bodies of literature examine management innovation, each with a different unit of analysis. The first body focuses on specific management practices or structures, such as the M-Form or Total Quality Management, and examines patterns of diffusion across firms, industries, or countries, including broader institutional conditions (e.g., Abrahamson & Fairchild, 1999; Cole, 1985; Guillen, 1994; Guler, Guillen, and MacPherson, 2002; Kogut & Parkinson, 1993; Westphal, Gulati, and Shortell, 1997). A second, large, body of literature focuses on what one might call the market for new management practices, and in broad terms seeks to understand why and how certain practices become popular including work on the the suppliers of new management practices (e.g. Benders and van Veen, 2001; Clark, 2004) and the attributes of managers who buy into them (e.g. Gill and Whittle, 1993; Huczynski, 1993; Jackson, 1986) through to comprehensive theories and discussions of how management fashions emerge (e.g., Abrahamson, 1991; 1996; Kieser, 1997; Sturdy, 2004).

The third body of literature, which includes the current article, focuses at the firm level, and examines a range of organizational, individual, and situational factors that influence a firm's propensity to introduce new management practices. This body of research does not focus on the introduction of a particular practice and explanatory factors specific to that practice, but instead investigates a wider range of practices. This research emphasizes the role of specific internal features as facilitators of management innovation: for example, Kimberly (1981) and Kimberly and Evanisko (1981) link the adoption of management innovations to highly educated and cosmopolitan managers, large organizations and high levels of competition, while Damanpour (1987; 1991) examines a range of predictor factors including specialization, functional differentiation, external communication and centralization of decision making.

Finally, it is worth noting that this literature offers very little evidence of the empirical relationship between the introduction of new management practices and firm performance. Many assertions and arguments exist about the likely impact that new management practices will have on performance. For some researchers it is an article of faith that management innovation is a good thing (e.g., Chandler, 1962; Hamel, 2006; Tichy and Sandstrom, 1972), while others are much more skeptical, viewing the introduction of new practices as a way of reaffirming control over workers (Knights and McCabe, 2000) or as a fashion-driven process that benefits only the consultants selling the new practices (Staw and Epstein, 2000). This study develops a theoretically-grounded argument about the innovation-performance relationship, tested on objective performance data.

THEORETICAL DEVELOPMENT

As an organizing framework, this article proposes the notion of a reference group in influencing the introduction of new practices. The reference group is the set of comparator firms that the focal firm looks to when making choices about its conduct, and serves two key functions:

providing the performance benchmark against which the focal firm evaluates itself; and revealing a range of practices and behaviors the focal firm can learn from (Greve, 1998). Defined in this way, it should be clear that some reference groups are potentially more valuable than others. For example, a small Yorkshire-based packaging company might define its reference group as other small Yorkshire packagers, or as all packagers across Europe, and it is very likely that the latter will offer a greater diversity of practices and behaviors, as well as a higher performance benchmark.

The reference group concept is now fairly well established in the organizational literature (Cyert and March, 1963; Festinger, 1954; Wood, 1989), and authors use it to understand how firms make strategic choices such as how to position themselves in a market, how much to pay their CEO, and whether to innovate (Bromiley, 1991; Greve, 1998; Massini, Lewin, and Greve, 2005; Porac, Wade, and Pollock, 1999). In this article, the reference group serves as a means to interpret the overall model through which management innovation levels are determined.

In this study the reference group provides the means for conceptualizing when managers of firms will introduce new management practices. This study argues there are two means for doing so. First, managers can introduce practices based on knowledge about management practices their firm already possesses, which is shaped by the reference group their firm is a member of. This reference group, or set of outside comparator firms, can be higher or lower in its quality depending on the competitiveness and competence level of the group. The reference group also determines the 'context' in which the focal firm acts. Context is the set of organizational attributes and presents a passive approach to the introduction of new management practices; the firm learns from and aspires to the practices from its reference group whether, for example, it is a Yorkshire-based packager or part of an international group.

Alternatively, managers of a firm can attempt to actively look out for new knowledge on management practices above and beyond those presented to the firm through its immediate reference group. This study will use the term ‘search’ for such attempts. Search results in deliberate links made to actors inside or outside the organization with a view to helping managers address their problems or performance gaps, and shows a conscious desire by managers to seek out new practices in other adjacent areas. In the example managers of the firm look for practices beyond those adopted by small Yorkshire-based packagers. Context and search are not entirely independent, and the data will confirm they are correlated, but they can be separated conceptually. After examining each in turn, the article will consider how they interact. Figure 1 clarifies the overall conceptual model.

Figure 1 here

This overall organizing framework finds support in various theories. Other work which uses the reference group framework, like Massini et al (2005), similarly draws upon multiple theories. Some of these theories are more closely related to context while others are more suggestive of active search, but there is no clear-cut division. The institutional perspective sees the introduction of new practices as driven by the desire to emulate the practices of high-status peers, and thereby gain legitimacy (DiMaggio and Powell, 1983; Meyer and Rowan, 1977; Scott, 1987). According to this view, managers pick up on rational and progressive practices (Abrahamson, 1996) from peers and high-status firms, and they introduce them to their own firms primarily for their symbolic value. So institutional theory suggests some clues as to where managers look for inspiration – some may interact with their local contacts, while others search more widely on a national or international basis. This institutional perspective to an extent also incorporates arguments around social networks in general and interfirm networks in particular, where it is argued that network members are more likely to adopt practices adopted by firms they

have relations with in general, and network members in particular (Ghoshal and Nahapiet, 1998; Guler et al, 2002).

A second perspective is the behavioral theory of the firm (Cyert and March, 1963; March and Simon, 1958), in which the desire to close a performance gap drives the introduction of new practices. According to this view, managers will engage in a process of problematic search in which they search for ways of addressing their performance gap through interactions with their closer or more well-established contacts, and once a satisficing solution has been found and implemented, they move on to address other issues. New practices, in other words, are introduced specifically to address performance concerns, but typically to a satisficing rather than optimizing level. A related argument appears in the form of the resource-based and knowledge-based views, which argue that firms in possession of large stocks of resources and knowledge due to their context are more likely to successfully introduce new practices (e.g., Barney, 1991; Grant, 1996; Hitt, Bierman, Shimizu and & Kochhar, 2001). Because such resource-rich firms also have more interorganizational relations and knowledge, they are more likely to succeed in search processes (Leiponen and Helfat, 2005). This study combines these various theories to argue for the hypotheses below.

Hypotheses

Context. Authors typically view the reference group as a subconscious cognitive frame rather than as an objective construct. Prior studies use the reference group as an unobservable concept or make assumptions about a group's likely scope and so avoid direct measurement (e.g., Greve, 1998; Massini et al, 2005). This study likewise treats the reference group as an unobservable concept and argues it is possible to identify firm-level attributes that collectively determine the reference group and shape the context in which decisions are made about who to

emulate. Specifically, this study identifies three important attributes: size, education of the workforce, and international scope. So firms within a given size class, with similarly educated workforces, and operating in a similar market tend to see one another as reference group members, as in the example of small Yorkshire packagers.

Size influences the introduction of new management practices in various ways. Larger firms face a wider variety of challenges than smaller firms, and they face a greater number of competitors of all sizes (Kimberley and Evanisko, 1981). To overcome these challenges and competitors, larger firms are more likely to want to take up new practices. But there is a supply side argument as well. Larger firms hold a larger stock of resources, including knowledge on management practices and human capital and will therefore be more likely to introduce new practices (Hitt et al, 2001; Leiponen and Helfat, 2005). Thus larger firms are both under more pressure to introduce new practices, when compared to smaller firms, and more capable of doing so.

Hypothesis 1. The larger the firm, the higher the level of introduction of new management practices.

The Education of the Workforce, measured as the percentage of employees with a degree, is also potentially an important attribute of the firm and represents one of its key innovation resources. Well-educated employees are more likely to read widely, which increases the extent to which they are aware of issues beyond their immediate location of employment. Well-educated employees are also likely –all else being equal– to travel more, to join professional organizations, and to seek out advancement within their firms (Alvesson, 1995; Blundell, Dearden, Meghir, and Sianesi, 1999). Hence firms with such employees are more prone to develop a broader and/or more international reference group.

Chandler's (1962) description of the introduction of the M-Form structure in four US firms in the 1920s includes some specific thoughts on the types of individuals who are most likely to be management innovators. With one exception, these individuals were recent university graduates. As Chandler (1962: 317) puts it "[p]ossibly the rigor required in working out scientific and engineering problems led these men to approach management needs in somewhat the same way" and (1962: 318) "[w]hat Taylor, the Ford engineers, the engineering journalists and professors, and the organization builders here studied had in common were not specific ideas, techniques, or methods, but rather the same rational, self-conscious approach to the management of men".

Hypothesis 2. The more highly educated the workforce of the firm, the higher the level of introduction of new management practices.

Finally, a firm's Geographic Scope is an important predictor of its propensity to introduce new practices. Prior studies of reference groups have underlined the importance of geographical proximity as a factor in defining a reference group (Lant and Baum, 1995), which suggests simply that the more internationally-focused the firm, the more likely it is to view itself as having a global reference group, for two reasons. First, participation in international markets may be a source of insight for management innovation, since it exposes firms to a much broader set of management approaches and opportunities in different contexts than they would get in their domestic market (Kogut and Parkinson, 1993). Previous research has shows that a broader external environment provides firms with more information cues (Geletkanycz and Hambrick, 1997) and also more generally that firms which establish ties to other, geographically proximate, firms can use these to acquire and develop capabilities (McEvily and Zaheer, 1999). Second, the broader the firm's geographic scope, the greater the number and size of competitors it faces, and the broader its reference group. For example, when Toyota failed to compete successfully in the

U.S. market in the 1950s and discovered the need for a radical new approach, this stimulus, among others, led to the development of the lean production system which derived important cues from the U.S. supermarket industry (Udagawa, 1995). Firms operating in such a broader environment therefore typically discover more practices because they observe both more and more diverse organizations whose practices they can mimic, in line with institutional theory. Hypothesis 3. The greater the geographical scope of the market the firm is operating in, the higher the level of introduction of new management practices.

Search. The other side of the reference group framework is the aggregate search behaviors of managers in the firm as they seek out new knowledge and insight on management practices. This study argues active search should be a significant contributor to the introduction of new practices. Such search behavior can potentially take many forms. For instance, managers can search for new to the firm ideas from their own previous experiences outside the organization, read the management literature or bring in consultants who market and implement their practices. Another form of search involves looking at practices, or parts of practices, which have previously been implemented in other contexts and organizations. So at least some of the search will need to target specific organizations in possession of knowledge on management practices. These organizations can be referred to as knowledge sources.

Authors recognize search for new knowledge sources as a key component of technological innovation - for accessing new knowledge and recombining it with existing knowledge (Fey and Birkinshaw, 2005; Katila and Ahuja, 2002; Laursen and Salter, 2006; Rosenkopf and Nerkar, 2001). This article applies similar concepts to management innovation, in that managers search for new ideas, combine these with existing knowledge and conditions in the firm, which then leads to the introduction of new practices. Active search, in other words, is an important part of the framework. The specific, and often somewhat idiosyncratic, nature of

management innovations complicates knowledge transfer from one organization to the next. Thus it may be necessary to establish relations, however informal, with these outside organizations or internal units in order to facilitate such knowledge transfer¹.

But how do ties with sources of knowledge affect the implementation of new practices? This study argues that having more such ties and having ties with a variety of knowledge sources both affect the implementation of new practices positively. The technology innovation literature focuses on actors like lead customers and suppliers (Utterback, 1994), as well as on a more diverse set of external knowledge sources as a driver of innovation (e.g., Hargadon, 2002; Katila and Ahuja, 2002). By using more knowledge sources firms increase their chances to find something useful – they draw from the pool of knowledge more often, which improves the odds of being lucky, and they stand a greater chance of gaining access to complementary knowledge because of the diversity of sources they consult (Leiponen and Helfat, 2005). More contacts with knowledge sources should therefore lead to more insights into new management practices that have worked in other settings and hence to more successful implementations.

Moreover, the greater the diversity of sources the firm has access to, the more likely it is that the insights gained from these sources are recombining in creative and valuable ways (Hargadon, 2002). Anecdotal evidence from Kaplan (1998), Kleiner (1996) and Whitsett and Yorks (1983) suggests that external parties often play a critical role in the early stages of introducing new management practices and Birkinshaw et al (2008) likewise stress the role of external actors in the management innovation process. Therefore this study argues that the greater

¹ In order to establish such relationships, it may be helpful to build trust between the focal firm and the knowledge source but this is not strictly needed. Trust, and social capital more broadly, may facilitate interorganizational relations and the exchange of knowledge (McEvily and Zaheer, 1999; Nahapiet and Ghoshal, 1998). This study does not directly study trust or assume trust between the focal firm and its knowledge sources.

the breadth of knowledge sources used by the firm, the higher the level of introduction of new management practices.

But which categories of knowledge sources ought to be considered? This article investigates three such categories - internal sources (i.e., anyone inside the legal boundaries of the firm), market sources (customers, suppliers, competitors, and consultants), and professional sources (industry bodies, professional associations, and trade fairs). The fashion literature (Abrahamson, 1996; Staw and Epstein, 2000) has stressed the role of market-based sources of knowledge as the primary driver of the uptake of new management practices. Thus, firms mimic their competitors by implementing management practices that appear progressive (Abrahamson and Rosenkopf, 1993), customers provide incentives to encourage firms to adopt new practices (e.g., Guler et al., 2002), suppliers push management innovations down the value chain, and consultants promote their own solutions (Abrahamson and Fairchild, 2001).

This study accepts this line of argument, but building on the behavioral theory of the firm and the social network perspective also recognizes the importance of internal sources and professional sources. Problemistic search has two important characteristics: simple-mindedness, proceeding on the basis of a simple model first; and bias towards the prior experiences of those individuals pursuing search. Thus when looking for new management practices, managers with a problem first speak to trusted internal colleagues, and only once those colleagues have been exhausted look outside firm boundaries (Hansen & Løvås, 2004; Nahapiet and Ghoshal, 1998). Moreover, managers put considerable faith in professional peers outside the firm because they are trusted and neutral. This is particularly likely in the UK where many managers belong to a professional association, such as the Chartered Institute for Personnel and Development. These professions represent a source of information about what is happening across firm boundaries, without the competitive consequences or costs of working with market-based sources such as

customers and consultants (Rosenkopf, Metiu, and George, 2001). In sum, all three categories of sources should have some direct effect on the level of introduction of new management practices.

Hypothesis 4a. The more internal sources the firm interacts with, the higher the level of introduction of new management practices.

Hypothesis 4b. The more market-based sources the firm interacts with, the higher the level of introduction of new management practices.

Hypothesis 4c. The more professional sources the firm interacts with, the higher the level of introduction of new management practices.

Interaction between Context and Search.

Finally, it is important to consider how the attributes of context and search interact with one another. Both dimensions should be expected to share antecedents and therefore ought to correlate positively. This implies large firms likely interact with more knowledge sources of various types. But does their joint application produce an interaction effect separate from the main effect, and if so is that interaction effect likely to be positive (i.e., context and search are complements) or negative (context and search are substitutes)? This study argues that the attributes of context on the one hand, and the process of active search on the other, are partial substitutes: they essentially represent different operational ways of getting to grips with a desirable reference group. According to the behavioral theory of the firm (Cyert and March, 1963) search transpires in a simplistic and biased way, so that when faced with a performance problem managers will start looking for solutions close to home, inside their reference group. Only when these referents cannot help do managers look further afield, through active search.

To be more specific, the attributes of size, education level and scope create a context in which firms that rate high on some or all of them are automatically up to speed on management innovation: their high quality reference group gives them access to new ideas and practices as

they arise. Active search, in contrast, is more useful for a firm that for whatever reason has a reference group of lower quality than expected given the firm's attributes, and is therefore *not* well linked into the latest management thinking. So a firm with a high-quality reference group is likely – all else being equal- to need less active search, whereas a firm that is actively engaged in search does not need the same size, education levels, or market coverage. This, again, is consistent with the notion of satisficing behavior in the behavioral theory. Therefore this study hypothesizes a negative interaction effect between the contextual attributes on the one side and the dimensions of search on the other.

Hypothesis 5a. The effect of internal sources on the introduction of new management practices is mitigated by size, education of the workforce, and geographic scope of the firm.

Hypothesis 5b. The effect of market-based sources on the introduction of new management practices is mitigated by size, education of the workforce, and geographic scope of the firm.

Hypothesis 5c. The effect of professional sources on the introduction of new management practices is mitigated by size, education of the workforce, and geographic scope of the firm.

Introduction of New Practices and Firm Performance.

The behavioral logic above suggests that the choice of reference group shapes the performance levels the firm aspires to (Greve, 1998): some firms are content with mediocre performance, while others seek to achieve a higher level, and the aspiration-reality gap lies at the heart of this phenomenon. Many studies link single management innovations or at most innovation within one area of management to specific measures of performance. By contrast this article aims to link the introduction of a wide range of practices to the performance of the company as a whole. There are contrasting points of view in the literature about the impact of management innovation on firm performance. Some view the introduction of new practices as driven by the need to conform, rather than to achieve superior performance (Abrahamson, 1996).

There is indeed some research evidence that firms claiming to adopt new techniques improve their reputations but not their financial results (Staw and Epstein, 2001). And it has been suggested that many costly implementations may need to occur before an efficient innovation is discovered (Abrahamson, 1991). Counter to that runs the argument that the introduction of new management practices is linked positively to performance, which proponents of the behavioral theory of the firm and of a managerial perspective propose (Chandler, 1962; Gruber and Niles, 1972; Tichy and Nisberg, 1976). This study argues for the latter effect and links it to the reference group framework.

Specifically, the introduction of new management practices is directed towards closing performance gaps, as indicated by the firm's reference group. One way of visualizing this is in relation to Porter's (1996) concept of the "productivity frontier". Only a few of the most productive companies operate on the frontier, while many others do not. Firms operating on the frontier may seek to push the frontier out further, by introducing innovations which are new to the state of the art (or even completely new to the world). But the large majority of firms do not operate on the frontier, and they are more likely to focus on getting closer to the frontier through the introduction of practices new to the firm, but adapted from others. Although not all new practices will be successful, on the aggregate these firms will move closer to the frontier. The introduction of new management practices, therefore, ought to help many firms get closer to competitive parity. From a resource-based perspective it helps firms catch up with the current state of the art in performance terms.

This line of reasoning has two important implications for the type of performance associated with the introduction of new management practices. First, since this is a gradual process a dynamic measure that captures changes in firm performance over an appropriate period of time is better than an absolute measure. Second, the measure of performance should relate as

directly as possible to the consequences of introducing new practices. Accordingly, firm productivity growth appears to be the most appropriate measure. Productivity is a measure of the efficiency of conversion of inputs into outputs, and for the most part the introduction of new management practices aims to create either superior outputs or more cost-efficient inputs (e.g. MacDuffie, 1995). In colloquial terms, management practices are introduced with a view to do “more with less”. Productivity growth is a superior measure to stock market-based measures here, because it excludes exogenous factors, such as market conditions.

Hypothesis 6. The introduction of new management practices is positively associated with future firm performance, in the form of productivity growth.

DATA AND METHODS

The UK Innovation Survey is a national survey of firm-level innovation conducted as part of the Europe-wide Community Innovation Survey (CIS). CIS3 data were gathered in 2001 and cover the 1998-2000 period. The UK survey is administered by the Office for National Statistics (ONS) and commissioned by the Department of Trade and Industry (DTI). The full survey can be found through http://www2.dti.gov.uk/iese/cis_quest.pdf (last accessed on September 5 2005). Earlier work published with CIS data for instance includes Cassiman and Veugelers (2002) and Laursen and Salter (2006). Dozens of articles have been published using the CIS. Stockdale (2002) contains an overview of the methodology and basic descriptive findings of the survey. The sample of firms was taken from the Interdepartmental Business Register at ONS and stratified by country (England, Scotland, Wales and Northern Ireland), industry (two digit level), and number of employees (five size bands)(Stockdale, 2002). In all, almost 12% of the firms on the register were selected and the sample was skewed towards larger firms. The UK survey was sent to 19,602 firms employing 10 or more people of which 8,172 (41.7%) responded.

These responses form the basis for the empirical analysis. About half of these responses proved complete enough (3,668 firms). A firm in the CIS database is an “establishment” which may either be an independent firm or a subsidiary of a larger parent firm. Firms in the sample tend to be larger than the average firm in the UK and indeed the average firm that responded to the survey.

The survey was the third in the series and lessons from CIS1 and CIS2 were implemented to improve the data collection process. The core questions in the CIS are based on the OECD’s Oslo manual, which adds to the comparability of findings across industries and countries. The CIS sample includes manufacturing, construction and services firms. The survey includes a page of definitions, which respondents could refer to, and a help service was provided (Stockdale, 2002). Respondents received a postal survey and two reminders as well as a follow-up telephone call in some cases to maximize the number of responses. The survey was sent to the person responsible for filling out official government surveys. Respondents were higher level managers, often Managing Directors, Chief Financial Officers and heads of Research and Development.

A potential problem that arises with survey data is common method bias, where the strength of correlations between variables is inflated because the method of data collection and the sources are the same. This potential problem was addressed in various ways. For the firm performance hypothesis (H6) an entirely separate database was used to measure the independent variable. For the other hypotheses, Podsakoff and Organ (1986) suggest multiple approaches: Harman’s one-factor test established that multiple factors emerge from a factor analysis (if common method variance is a problem, one dominant factor will emerge); and the data used for most independent variables were objective in nature, such as firm size and employee education, which reduces significantly the possibility of bias in the results (Podsakoff & Organ, 1986).

Measures

All variables were measured using items taken from the CIS3 and the UK's Annual Respondents Database (ARD). Specific wording is as follows.

Introduction of new management practices. There is a separate header called 'wider innovation' in the CIS3 survey, which stands out from product and process innovation. Under this header respondents were asked "did your enterprise make major changes in the following areas of business structure and practices during the period 1998-2000? And how far did business performance improve as a result? (a) Implementation of new or significantly changed corporate strategies e.g. mission statement, market share, (b) Implementation of advanced management techniques within your firm e.g. knowledge management, quality circles, (c) Implementation of new or significantly changed organizational structures e.g. Investors in people, diversification, and (d) Changing significantly your firm's marketing concepts / strategies e.g. marketing methods (0 = not used; 1 = used). Because item a, on changed corporate strategies, is not clearly concerned with management innovation as defined here, it is not included in the analyses (including it does not materially change the findings). In order to capture the breadth of management innovation undertaken in each firm, a single scale is applied with the value of 0 for no effective management innovation activity at all, with 1 added for each type of management innovation the firm engaged in, such that the maximum value is 3. For all practical purposes the measure can be thought of as a count measure that provides an indication of the number of areas of innovation a firm engages in. This measure reveals actual implementations, helping to overcome the decoupling problem Zajac and colleagues (Westphal and Zajac, 2001; Zajac and Fiss, 2001) identify as common to some studies of management practices and performance (e.g., Staw and Epstein, 2000). An alternative approach is to use dummy variables as dependent variables, for management innovation on the whole or for each of the three types of innovation. Logit models for each of these dummies show outcomes consistent with the findings presented

here. The current variable is a more accurate portrayal of management innovation as a phenomenon, not specific forms of management innovation, and contains more information.

Firm size. This variable is calculated as the logarithm of the number of employees in 2000, since the distribution of firm size tends to be highly skewed. For the performance test the logarithm of turnover in 2000 is used, to predict changes from 2000 to 2003.

Degrees. This variable measures the workforce education level. The ‘degrees’ variable is calculated as the number of employees with degree level education or above, as a percentage of all employees of the firm.

Geographic scope. This single-item question identifies the firm’s largest market as ‘local’ (0), ‘regional’ (1), ‘national’ (2) or ‘international’ (3).

Knowledge Sources. For the three groups of knowledge sources three separate count variables are calculated, one for each type of sources. The wording of the scales is as follows: “Please indicate the sources of knowledge or information used in your innovation activities, and their importance during the period 1998-2000”:

Internal sources: (a) Within the enterprise, (b) Other enterprises within the enterprise group (not used, low importance, medium importance, high importance)

Market sources: (a) Suppliers of equipment, materials, components or software, (b) Clients or customers, (c) Competitors, (d) Consultants, (e) Commercial laboratories / R&D enterprises (not used, low importance, medium importance, high importance).

Professional Sources: (a) Professional conferences, meetings, (b) Trade associations, (c) Technical / trade press, computer databases, (d) Fairs, exhibitions (not used, low importance, medium importance, high importance).

In each case, any degree of importance indicated by the respondent is coded as “1” while not used is coded as “0”. Given the number of items, the measures take on values between 0 and

2 for internal sources, between 0 and 5 for market sources and between 0 and 4 for professional sources.

Firm performance. The ARD provides the performance measure. The ARD is the government's official census data exercise and is executed by ONS. Although the CIS contains perceptual performance indicators, it has two problems: one is the common method bias problem that arises when a respondent evaluates both the dependent and independent variables; the other is the lack of a time-lag between the measures of innovation and performance. The ARD helps to overcome both problems, as it is collected separately and measures firm performance for the three-year period following implementation. Implementing a management innovation takes time, and for the effects of this implementation to come to light takes even longer. Therefore a time lag is appropriate and preferable over a cross-sectional analysis. The main drawback of using the ARD is that not all CIS observations are available in the ARD database, due to differences in sampling procedures. Using ARD data over three years worsens this situation, again primarily because of sampling but partly because of firm exit as well. There are 1,048 observations for testing hypothesis 6.

The specific performance measure is the change in the firm's productivity, measured by the relative difference between the firm's sales per employees in 2003 and in 2000. This implies an automatic control for prior performance. This performance measure contains information on both the firm's ability to become more effective by increasing its turnover with a similar number of employees and its ability to become more efficient by reaching similar turnover numbers with fewer employees. To summarize:

$$\text{Productivity growth} = \left(\frac{2003 \text{ sales}}{2003 \text{ number of employees}} \right) / \left(\frac{2000 \text{ sales}}{2000 \text{ number of employees}} \right) - 1$$

Control variables. 'Capital intensity' is measured as 1998 capital expenditures over 1998

sales. Management innovation is not concerned with capital in the traditional sense of the word. Firms that have high capital intensity might therefore be expected to direct their attention more towards other forms of innovation, like product and process innovation.

‘Export intensity’ is measured as 1998 export levels over 1998 sales. Export intensity may have a positive impact on the management innovation because firms that supply to international markets generally have to be more innovative to overcome their liability of foreignness.

While knowledge sources are an informal mechanism for understanding innovations, technology alliances are a more formalized means for doing so. Such cooperation agreements aim to exchange knowledge between parties like knowledge on management innovations. ‘Alliances’ with other firms is a dummy variable which takes on the value of 1 if the firm has any cooperation arrangements with other enterprises or institutions.

A further control variable is ‘structural change’. Rapid growth and structural growth can be important stimuli for management innovation. Firms typically grow through a process of punctuated equilibrium (Tushman and Anderson, 1986) and during the periods of upheaval as they shift from one structure to another some level of management innovation is often required. Equally, divestments can cause upheaval in the internal workings of the firm and can sometimes lead to management innovation. Respondents were asked “did any of the following significant changes occur to your enterprise during the three-year period 1998-2000?” Possible responses are: (a) the enterprise was established, (b) turnover increased by at least 10% due to merger with another enterprise or part of it, (c) Turnover decreased by at least 10% due to sale or closure of part of the enterprise, (d) None of the above. The results are coded as follows: firms recording major structural changes by responding (b) or (c) are coded 1; firms recording no major change by responding (d) are coded 0; firms responding (a) were removed from the sample because they did not exist throughout the entire time period under investigation.

'Innovation inhibitors' is a count variable and measures the number of factors inhibiting a firm's ability to innovate. Respondents were asked "please rate the importance of the following constraints during the period 1998-2000: (a) Excessive perceived economic risks, (b) Direct innovation costs too high, (c) Costs of finance, (d) Availability of finance, (e) Organizational rigidities within the enterprise, (f) Lack of qualified personnel, (g) Lack of information technology, (h) Lack of information on markets, (i) Impact of regulations or standards, (j) Lack of customer responsiveness to new goods or services". Respondents were asked to specify "no effect" or "low", "medium", "high" for each item. The number of cases where the respondent gave a positive response is summed, resulting in a measure varying from 0 to 10. The introduction of new management practices is one plausible way of overcoming the obstacles that hinder innovation.

Further control variables are product innovation and process innovation. Ettlíe (1988) dubs the simultaneous use of management innovation and technological innovation 'synchronous innovation', and argues that the use of appropriate forms of management innovation made technological innovation more effective in manufacturing firms in the United States in the 1980s. 'Product innovation' is a dummy variable, with a value of 1 for firms that introduced 'any technologically new or significantly improved products (goods or services) new to the firm during 1998-2000'. 'Process innovation' similarly is a dummy, measuring the introduction of 'new or significantly improved processes for producing or supplying products'.

‘Public support’ is a dummy variable measuring whether firms participated in ‘Management Information Programmes (e.g., Industry CLUBs)’. These potentially aid in the introduction of management practices. Finally, an industry dummy variable is included for each of the 43 2-digit industries.

RESULTS

Table 1 contains the means and standard deviations of and correlations between key variables. Firms in the UK CIS sample were actively involved in management innovation during the 1998-2001 period, although substantial variance existed between firms.

Table 1 here

This study analyzes the antecedents of the introduction of new management practices through ordered logit regression. Standard OLS regression is not appropriate because 4 response categories make up the dependent variable, although a robustness check shows the findings are consistent with applying OLS or tobit (given the double-censored nature of the data). Table 2 contains the results for hypotheses 1 to 5, featuring a base model (model 1) and nine further models, one for each proposed interaction term. None of the independent variables is significant on a Brant test (Long and Freese, 2001), which examines the violation of parallel regression assumptions, indicating the results hold for all levels of the dependent variable.

Table 2 here

Model 1 supports hypothesis 1, confirming the positive effect of size, and hypothesis 2, on the positive influence of the training level of employees. And as per hypothesis 3, the wider the geographic scope of the market, the more likely new practices are introduced. All three of these variables are highly significant (at the 0.1% level). These results show that firms closest to the management innovation productivity frontier are typically larger, have a better trained workforce, and are more internationally focused. Also in model 1 hypotheses 4a, 4b, and 4c all

hold true (again at the 0.1% level), implying contacts with all three types of knowledge sources, internal, market, and professional, matter for the introduction of new management practices. In the other nine models, which include interactions, these findings reoccur. Also note that the model statistics (Wald Chi squared and pseudo log likelihood) are highly significant across all models and that the models explain substantial variance.

For hypotheses 5a, 5b, and 5c mixed support emerges in models 2 through 10. Models 2, 3, and 4 confirm hypothesis 5a (at significance levels of 1% and above), which suggests a negative interaction between firm size and the three types of knowledge sources. Hypothesis 5b suggests a negative interaction effect between workforce education level and the three types of knowledge source, but this only emerges in model 5 for internal sources (at the 0.1% significance level) but not for the other sources in models 6 and 7. Hypothesis 5c, which suggests a negative interaction effect between geographic scope and the three types of knowledge sources, holds true for internal sources in model 8 (at the 5% significance level) and marginally for market sources in model 9 (at the 10% significance level) but not for professional sources in model 10. Ai and Norton (2003) show that the interaction effects produced by logit and probit models do not represent a true test of those interactions. Instead, a test of marginal effects is needed. There is no such test available for ordered logit but a logit analysis on the dummy version of the management practices variable and Stata's `inteff` command, used to test for marginal effects on the interactions (Ai and Norton, 2003), shows that the interaction becomes more negative for higher predicted probabilities of the dependent variable. In other words, the more likely a company is to undertake management innovation, the more the context and search variables act as substitutes, consistent with hypotheses 5a, 5b, and 5c.

Among the control variables some interesting findings emerge. The introduction of new management practices is more likely to transpire in firms that also engage in product and process

innovation (significant at 0.1% and 1%), in line with Georgantzas and Shapiro (1993). Technology alliances, however, are not significantly related to the introduction of new management practices. Export intensity and capital intensity do not play much of a role in predicting the introduction of new management practices. Structural change positively affects levels of new management practices (significant at 1%), as does the presence of barriers to technological innovation (significant at 0.1%). The industry dummies show that industry differences do not explain much variance in the dependent variable, unlike firm specific factors.

Table 3 displays the results of the OLS performance regression. Although the model itself is highly significant, it only explains 8% of the variance in the dependent variable. A key cause of this is that the dependent variable measures change in productivity, and flows are known to be harder to predict than states in models like these. Table 3 shows that the introduction of new management practices coincides with higher future performance in the form of productivity growth, thus providing support for hypothesis 6 (significant at 0.1%). Interestingly, though, the findings indicate that larger firms (significant at 0.1%), and those with higher-educated employees (significant at 5%), have lower levels of productivity growth. These findings are consistent with the framework, in that these larger firms with better-educated employees are likely closer to the “productivity frontier” already, so they have less opportunity for improvement. Neither product innovation nor process innovation has a significant direct relationship with productivity growth.

Table 3 here

A post hoc sector-by-sector analysis of model 1 in five industry sectors (results available upon request) produces a few interesting insights. Internal knowledge sources are significant in all sectors except professional and financial services (NACE codes 65-74). Market sources are significant in all sectors except for construction and utilities (NACE codes 40-45) and other

services (NACE codes 51-64). And professional sources are significant in all sectors except professional and financial services. Batch manufacturing (NACE codes 15-27) and assembly manufacturing (NACE codes 28-37) are the only sectors in which all three types of knowledge sources mattered. Manufacturing firms benefit from a broader-based search for management practices. Services companies on the other hand, especially professional and financial services, can apparently get by with a more limited search. The conceptual framework suggests a reason for these findings, namely that professional and financial services firms are already closer to the productivity frontier due to their employment of well-trained professionals and perhaps other factors like rotation of employees between competing firms, more benchmarking and more clearly defined rules of the game.

DISCUSSION

The strong support for most of the hypotheses suggests that the external search perspective is a useful complement to contextual factors in explaining which firms introduce new management practices. As per hypothesis 4, internal and professional networks, as well as customers, competitors and consultants, provide important sources of new ideas that can have an influence on the introduction of these practices. This finding constitutes an advance in the understanding of management innovation in two ways. First, compared with older literature (e.g., Damanpour, 1987; Kimberly and Evanisko, 1981) it introduces the notion that other than through internal structural factors, management innovation also comes about through interaction with internal and external knowledge sources which contribute important ideas. Second, compared with the existing literature around management fashion in particular (Abrahamson, 1991; 1996) this study shows that firms introduce new management practices not only when ideas are offered by market participants like consultants, but also when they are offered by internal and professional sources.

These knowledge sources often interact negatively with the context factors of firm size, employee education level and geographic scope. Of the nine proposed interaction terms in hypotheses 5a, 5b, and 5c, four turned out to be insignificant at $p < .05$, though all had the predicted negative signs. From this, two primary inferences follow. First, all interactions featuring internal sources were strongly significant, suggesting that the overlap between internal sources of knowledge and the three contextual factors (size, education and scope) is greater than between the other types of sources and the three contextual factors. Internal sources, who will typically have gone through similar experiences and share similar knowledge, possess a more limited diversity in knowledge and ideas. Or in terms of the reference group framework, internal sources can be seen as providing less pull towards high-quality reference groups than market sources or professional sources. Second, the mitigating effect of organizational context on search is consistently seen for education level and geographic scope, but not for firm size. In terms of the framework, size is likely to be a more important factor in determining the reference group than either workforce education or the scope of the market.

The positive effect the introduction of new management practices has on future firm performance in this sample is an important finding but may itself also be subject to moderation by other variables. For instance, recent literature (Luk, Yau, Sin, Tse, Chow, and Lee, 2008), has indicated that the institutional context may moderate the performance results that accrue from organizational innovativeness, including measures of administrative innovativeness. The data presented in this investigation do not allow for a test of this notion, but it is an important research question and worth studying further.

Industry provides little explanation for the introduction of new management practices. The diffusion literature suggests that innovations like TQM spread through competitive mimicking or bandwagoning (Abrahamson and Rosenkopf, 1993), which suggests industry

should be a prominent predictor of the adoption of individual management practices. The current finding could imply that industry is not such a strong force. More likely, it means that although industries have similar levels of management innovation overall, the set of new management practices in use varies from one industry to the next. Marketing innovations could be more popular in the consumer goods sector while human resource innovations perhaps fit particularly well in services.

Implications for Theory and Practice

A number of insights emerge from the research. One is the importance of knowledge sources as stimuli for the introduction of new management practices, consistent with the external search literature on technological innovation, which argues that many of the ideas and implementation skills for innovation come from outside sources. The management fashion literature acknowledges some of these sources, especially outside market parties like consultants and professional associations (Abrahamson and Fairchild, 2001) but other external sources, like suppliers and customers, and internal sources also have an important role to play. These findings are complementary to prior studies of management innovation as a firm-level activity (Damanpour, 1987; Kimberly and Evanisko, 1981) which focused on internal contextual factors. The research emphasizes that while contextual factors are important, it is by combining external search and internal contextual factors that a more comprehensive understanding of management innovation is achieved.

This highlights the usefulness of the reference group concept applied as an organizing framework in this article. The framework shows in particular there are two separate forces at work, one which is all about catching up with the reference group a firm belongs to and the other referring to conscious attempts to broaden the group by undertaking an active search for knowledge sources. While both are familiar processes in the literature, this article applies them

simultaneously to the introduction of management practices, a new empirical area. The two routes are substitutes, not complements.

Future research should focus on how new management practices diffuse inside firms and the role geographically disparate units play in such diffusion processes. The findings hint at the different roles insiders and outsiders may play in the management innovation process. For example, insiders may be more engaged in actual implementation, while outsiders like consultants play a legitimizing role. This role could further depend on the institutional context. An interesting avenue for future research is a comparison between countries. The CIS data potentially lend themselves to such cross-national comparisons because they are collected in many countries. A replication of the findings for a set of other European countries is therefore desirable.

From a practice point of view the findings carry directly relevant implications. Gruber and Niles (1972: 29) argued some time ago that “[t]he quality of management may be more important to success than performance in the R&D of new products and processes”, and the analysis seems to bear this out. The implication is that firms stand to benefit from investing in their capacity for management innovation alongside their capacity for product and process innovation. But one must caution against interpreting this result as indicating that any management innovation in all temporal, geographic, and organizational contexts will produce positive performance outcomes. Indeed, while there will be some highly effective innovations, others may be ineffective or even disruptive. Researchers must continue to investigate how context influences effectiveness.

Increases in the capacity for management innovation can occur by using relevant knowledge, specifically knowledge already available internally and knowledge dispersed through networks of professionals and through markets. A presence in wider and international markets adds further to this capacity as do well-trained employees, who bring in the analytical capacity

needed for management innovation and a broader knowledge base. This study suggests that firms can consciously and systematically invest in management innovation. As argued by two practitioners (Feigenbaum and Feigenbaum, 2005: 96), “[w]e find evidence in a wide range of industry sectors that the systematization of management innovations will be a critical success factor for 21st century companies”.

Limitations

Various limitations of the research apply. By focusing on the introduction of management practices new to the firm, rather than new to the “state of the art” (Abrahamson, 1996; Birkinshaw et al, 2008), this study looks at one aspect of management innovation. The measure excludes various types of innovation, such as those concerned with new accounting or information systems. Moreover, the CIS provides no insight into the how firms implement practices. Bearing in mind these limitations, future research must find ways of tapping into the antecedent conditions under which “new to the state of the art” innovations emerge, and the conditions favoring the implementation of practices in other functional areas. Studies could examine a cross-section of innovations and focus on how similar or different they are regarding the creation process, the conditions under which they were created, the types of individuals who created them, or their impact.

The overall model for predicting productivity growth does not have a very high explanatory value. This outcome probably reflects the use of a hard performance measure that tracks changes over time. In all likelihood a range of other factors influence changes in productivity. Productivity growth is only one possible performance measure and a rather coarse one, although the use of changes in productivity helps to control for biases in the base productivity level and alleviates this problem. Clearly, future research should use additional performance measures where available.

This article includes only a limited set of variables within both the context and the search categories. As noted above, there are various other forms of search for new practices, such as search from previous experience, that are not investigated here. Some variables that are part of the firm's context, but which are missing from the CIS survey, include competitive intensity, firm structure and culture. The use of a single respondent is a further limitation of the study. Using multiple respondents increases the reliability of outcomes, especially for measures that rely heavily on perception - quite a few of the variables, like structural change and geographic scope clearly do not but some do. Finally, these findings emerge from data collected at one point in time, in a single country, which means that the findings may be specific to that context.

CONCLUSION

This article addresses when management innovation (the firm level introduction of new management practices) emerges and how management innovation relates to productivity improvements using a sample of firms in the UK. Building on the organizational reference group literature this study developed and tested a set of hypotheses which links aspects of organizational context and active search to the introduction of new management practices.

Management innovation is an important and fascinating phenomenon that warrants continuing scholarly research, more so than is taking place at present. Future research should focus on poorly understood facets of management innovation, namely the processes of creation and implementation; both new-to-the-firm practices that are adapted from elsewhere and new-to-the-state-of-the-art practices that have no direct precedent need consideration. With such insights academics can provide better advice to practitioners on what they need to do to improve their chances of successfully implementing management innovations.

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FIGURE 1
Overall conceptual model.

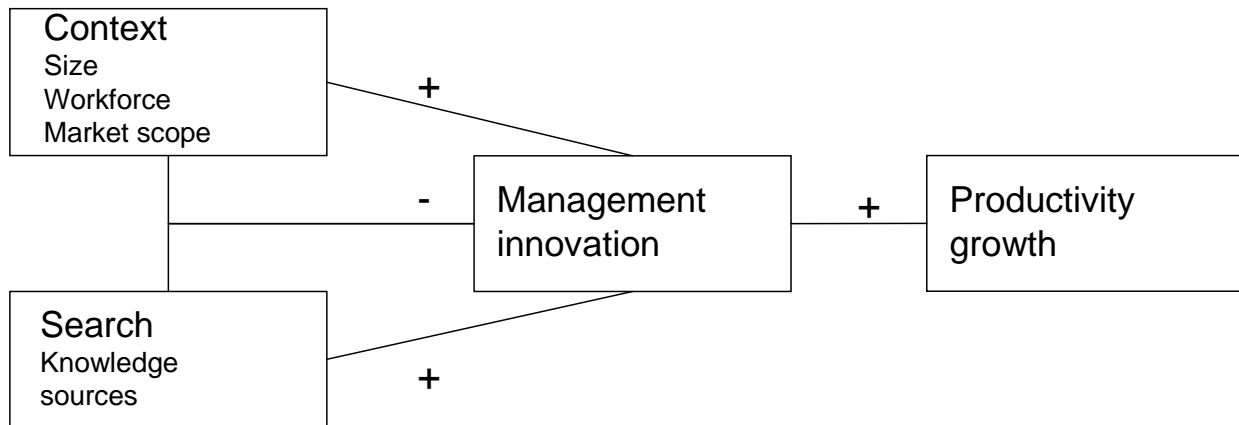


TABLE 1

Means (prior to centering), standard deviations and correlations among variables. N = 3,668.

| | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|--|-------|------|-----|------|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|-----|-----|----|
| 1 Introduction of new management practices | 1.31 | 1.26 | 1 | | | | | | | | | | | | | | |
| 2 Capital intensity | .26 | 9.48 | .02 | 1 | | | | | | | | | | | | | |
| 3 Export intensity | .11 | .22 | .17 | -.01 | 1 | | | | | | | | | | | | |
| 4 Product innovation | .28 | .45 | .33 | .03 | .25 | 1 | | | | | | | | | | | |
| 5 Process innovation | .24 | .43 | .26 | .03 | .11 | .33 | 1 | | | | | | | | | | |
| 6 Alliances | .15 | 2.15 | .19 | .00 | .23 | .28 | .22 | 1 | | | | | | | | | |
| 7 Public support | .02 | .13 | .06 | .00 | .02 | .03 | .04 | .12 | 1 | | | | | | | | |
| 8 Innovation inhibitors | 5.95 | 3.87 | .36 | .01 | .12 | .26 | .21 | .15 | .04 | 1 | | | | | | | |
| 9 Structural change | .12 | .32 | .11 | .05 | .02 | .08 | .04 | .10 | -.02 | .07 | 1 | | | | | | |
| 10 Firm size | 3.98 | 1.36 | .30 | .06 | .21 | .19 | .18 | .21 | .02 | .16 | .13 | 1 | | | | | |
| 11 Education of workforce | 14.68 | 23.5 | .17 | .00 | .18 | .18 | .06 | .15 | .02 | .07 | .08 | .03 | 1 | | | | |
| 12 Geographic scope | 2.54 | .98 | .24 | -.01 | .52 | .24 | .10 | .17 | .00 | .13 | .05 | .31 | .19 | 1 | | | |
| 13 Internal sources | .95 | .85 | .47 | .02 | .26 | .40 | .35 | .26 | .05 | .46 | .10 | .30 | .17 | .27 | 1 | | |
| 14 Market sources | 2.26 | 1.86 | .49 | .02 | .23 | .41 | .32 | .27 | .07 | .51 | .08 | .25 | .14 | .24 | .72 | 1 | |
| 15 Professional sources | 1.87 | 1.68 | .47 | .02 | .19 | .36 | .31 | .24 | .07 | .45 | .08 | .24 | .14 | .20 | .62 | .74 | 1 |

TABLE 2

Hierarchical ordered logit results for predicting number of types of new management practices introduced. Showing coefficients and standard errors.

*** significant at .001; ** significant at .01; * significant at .05; † significant at .10. Industry dummies are not reported to save space but are available upon request. N = 3,668.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--|-----------------|------------------|------------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Capital intensity | .03 .04 | .03 .04 | .02 .04 | .03 .04 | .03 .04 | .03 .04 | .03 .04 | .02 .04 | .02 .04 | .03 .04 |
| Export intensity | -.35(†) .19 | -.29 .19 | -.29 .19 | -.32(†) .19 | -.34(†) .18 | -.35(†) .18 | -.35(†) .18 | -.26 .19 | -.30 .19 | -.33(†) .19 |
| Product innovation | .38(***) .08 | .38(***) .08 | .38(***) .08 | .38(***) .08 | .37(***) .08 | .38(***) .08 | .38(***) .08 | .38(***) .08 | .38(***) .08 | .38(***) .08 |
| Process innovation | .25(**) .08 | .26(**) .08 | .26(**) .08 | .26(**) .08 | .25(**) .08 | .25(**) .08 | .25(**) .08 | .25(**) .08 | .25(**) .08 | .25(**) .08 |
| Alliances | -.02 .02 | -.02 .02 | -.01 .02 | -.02 .02 | -.02 .02 | -.02 .02 | -.02 .02 | -.02 .02 | -.02 .02 | -.02 .02 |
| Public support | .40 .25 | .39 .25 | .38 .25 | .38 .25 | .39 .25 | .39 .25 | .39 .25 | .39 .25 | .40 .25 | .39 .25 |
| Innovation inhibitors | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 | .07(***) .01 |
| Structural change | .28(**) .10 | .28(**) .10 | .28(**) .10 | .28(**) .10 | .29(**) .10 | .28(**) .10 | .28(**) .10 | .28(**) .10 | .28(**) .10 | .28(**) .10 |
| Firm size | .25(***) .03 | .27(***) .03 | .27(***) .03 | .26(***) .03 | .24(***) .03 | .24(***) .03 | .24(***) .03 | .25(***) .03 | .25(***) .03 | .25(***) .03 |
| Education of workforce | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 | .01(***) .00 |
| Geographic scope | .15(***) .04 | .14(**) .04 | .14(***) .04 | .14(***) .04 | .15(***) .04 | .15(***) .04 | .15(***) .04 | .15(***) .04 | .15(***) .04 | .15(***) .04 |
| Internal sources | .31(***) .06 | .32(***) .06 | .30(***) .06 | .30(***) .06 | .30(***) .06 | .30(***) .06 | .31(***) .06 | .32(***) .06 | .30(***) .06 | .30(***) .06 |
| Market sources | .17(***) .03 | .17(***) .03 | .18(***) .03 | .18(***) .03 | .17(***) .03 | .17(***) .03 | .18(***) .03 | .18(***) .03 | .18(***) .03 | .17(***) .03 |
| Professional sources | .22(***) .03 | .22(***) .03 | .22(***) .03 | .22(***) .03 | .22(***) .03 | .22(***) .03 | .21(***) .03 | .22(***) .03 | .22(***) .03 | .22(***) .03 |
| Internal sources x Size | | -.12(***) .03 | | | | | | | | |
| Market sources x Size | | | -.05(***) .01 | | | | | | | |
| Professional sources x Size | | | | -.04(**) .02 | | | | | | |
| Internal sources x Degrees | | | | | -.01(***) .00 | | | | | |
| Market sources x Degrees | | | | | | .00 .00 | | | | |
| Professional sources x Degrees | | | | | | | .00 .00 | | | |
| Internal sources x Geographic scope | | | | | | | | -.11(*) .04 | | |
| Market sources x Geographic scope | | | | | | | | | -.04(†) .02 | |
| Professional sources x Geographic scope | | | | | | | | | | -.03 .02 |
| Wald chi2 | 1525.8 (***) | 1540.1 (***) | 1540.6 (***) | 1532.7 (***) | 1536.5 (***) | 1528.4 (***) | 1528.3 (***) | 1532.0 (***) | 1525.8 (***) | 1529.1 (***) |
| Log pseudolikelihood | -4030.6 | -4023.4 | -4023.2 | -4027.1 | -4025.2 | -4029.2 | -4029.4 | -4027.5 | -4028.9 | -4029.9 |
| Pseudo R2 | .159 | .161 | .161 | .160 | .160 | .159 | .159 | .160 | .160 | .159 |

TABLE 3**Ordinary least squares regression results for predicting 2000-2003 productivity growth.**

*** significant at .001; ** significant at .01; * significant at .05; † significant at .10.

Industry dummies are not reported to save space but are available upon request. N = 1,048.

| | Standardized Beta | t-value |
|--|------------------------------|-----------------------------|
| Constant | | 4.01(***) |
| Introduction of new management practices | .12 | 3.55(***) |
| Export intensity | .03 | .71 |
| Capital intensity | -.04 | -1.34 |
| Education of workforce | -.08 | -2.43(*) |
| Geographic scope | -.02 | -.56 |
| Product innovation | -.03 | -.78 |
| Process innovation | .02 | .48 |
| Structural change | .04 | 1.24 |
| Firm size | -.13 | -3.89(***) |
| F-value 4.97(***) | | |
| R ² .08 | | Adjusted R ² .06 |