Intermediate Learning and the (Re)creation of Knowledge:

How Firms Use Imitation to Introduce New Organizational Routines

HELENA BARNARD
Gordon Institute of Business Science
University of Pretoria
26 Melville Road, Illovo, Sandton, 2191 South Africa
Fax: 27 (86) 638 0545
barnardh@gibs.co.za

DANIEL Z. LEVIN
Management and Global Business Department
Rutgers Business School – Newark and New Brunswick
Rutgers University
1 Washington Park, Newark, NJ 07102
Tel: (973) 353-5983
Fax: (973) 353-1664
levin@business.rutgers.edu

Working Paper

May 2013

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Abstract

We examine the learning processes of firms that use imitation to introduce a new routine. Prior research has emphasized the importance of imitation as a learning strategy, yet the actual elements of how firms imitate has rarely, if ever, been studied. In an inductive study of four firms introducing the same routine, we find that, although imitation is distinct from replication (copying exactly) and innovation (creating anew), imitation is in fact a hybrid, with elements of *both* replication (e.g., use of templates) and innovation (e.g., incremental learning, experimentation). Imitation is thus an example of an "intermediate" learning strategy, where content is neither altogether new nor already well-known to a firm. Moreover, we present evidence suggesting that imitated routines do not get fully routinized or learned unless elements of both the replication and innovation processes are present.

Keywords: organizational innovation, organizational change, knowledge, organizational learning, replication, routines, processes, imitation

When firms learn and acquire new knowledge or know-how—a critical activity for firm survival and competitiveness (Grant, 1996; Levitt and March, 1988)—the knowledge acquired can span a wide range in terms of how novel it is. On one end of the spectrum is radical innovation, knowledge that is new not only to the firm, but also to the world. On the other end of the spectrum are small incremental advancements made to the firm's existing knowledge base. Falling somewhere between these two extremes, a good deal of organizational learning involves extending knowledge that already exists in some form to new contexts or new uses. For example, firms may seek to adapt and apply their existing routines into new contexts, or may seek to adopt the admired routines of other firms. Yet these types of "intermediate" learning have thus far received relatively little scholarly attention.

One example of intermediate learning is imitation. There is general agreement on the importance of imitation: scholars have long noted its critical value both to national economies and to individual firms. Yet our understanding of the process of imitation—how the learning process actually works—is surprisingly rudimentary. Prior research has identified predictors and outcomes of imitation, but analysis of the actual phenomenon of imitation has been largely lacking from the literature. In this paper we propose to begin filling this gap in the field's understanding by examining how imitation has been treated in the literature and then describing the results of an in-depth study of the imitation of a specific management routine by four large firms.

Background

Imitation can be defined as occurring "when one or more organizations' use of a practice increases the likelihood of that practice being used by other organizations" (Haunschild and Miner, 1997, p. 472). In other words, imitation involves one firm's copying or learning from another firm. We extend this definition, however, to include a theory of action that says that firms are not limited in a binary way to either imitating or not imitating (Beckman and Haunschild, 2002), but rather that an organization can imitate a practice to a greater or lesser extent. That is, our focus is on how an imitated practice gets to be more versus less deeply embedded in an organization, a process of implementation, i.e., routinization, involving elements of organizational learning (Levitt and March, 1988). From the perspective of the imitating firm, then, imitation

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is a prime example of intermediate learning, where the knowledge acquired is less novel than something radically new but more novel than just a minor advancement in a domain already well understood by the firm.

Imitation in the Literature

Imitation has been studied in a wide range of literatures, but almost all of these prior streams of research have focused either on the importance, antecedents, or outcomes of imitation. As Haunschild (1993, p. 567) has noted, "most studies of imitation provide only indirect evidence that imitation is occurring." Research in the economics tradition, for example, has confirmed that imitation is an important driver of economic growth (Rosenberg, 1994). Yet this literature has tended to examine imitation at a very high level, looking at factors such as trade balances or changes in the extent of economic development (Connolly, 2003; Kim and Nelson, 2000; Lall, 2001). Even case studies that confirm the importance of imitation as a learning strategy tend not to examine the specific mechanisms of imitation (e.g., Hobday, 1995; Kim, 1998). Thus, while researchers in economics have long recognized that imitation requires purposeful effort (Mansfield, 1961; Teece, 1977), the types of effort required have thus far not been examined.

In the strategy literature, too, imitation is seen as an important learning strategy. Indeed, having resources that are "inimitable"—i.e., cannot be imitated—has been recognized as characteristic of sustainable competitive advantage (Barney, 1991). There is very little empirical work, however, as to what actually renders a resource inimitable (or imitable). Moreover, what research has been done on (in)imitability tends to rely on proxies that are removed from the actual process of imitation; e.g., R&D spending, advertising expenses, patenting activity (e.g., Knott, Bryce, and Posen, 2003; Markman, Espina, and Phan, 2004). In contrast to this line of research reporting on the outcomes of imitation, Korn and Baum (1999), Zander and Kogut (1995) and others have focused on predictors of imitation, such as when a firm loses key employees to an imitator. This line of research helps us to understand better what makes imitation more or less likely, but we are still left with the question of how the learning process associated with imitation actually works.

Studies in organizational sociology and organizational theory have sought to uncover the dynamics involved in the imitation process, but much of this work is mathematical in nature (e.g., Rivkin, 2001), involving computational simulations that model organizations' behaviors. For example, Strang and Macy (2001, p. 148) use such simulations to "describe a process of 'adaptive emulation' where actors [firms] respond to perceived failure by imitating their most successful peers." While this line of research looks at why firms imitate, it does not address our question of *how* they imitate. Similarly, much of the research on new institutional theory has focused attention on the similarity of organizations, highlighting the reasons for the apparent conformity and widespread imitation among firms (DiMaggio and Powell, 1983). Some scholars in this area have looked at the predictors and outcomes of this type of widespread imitation, finding for example that early imitators are more likely than late imitators to imitate for reasons of efficiency (Tolbert and Zucker, 1983), to reap efficiency gains (Westphal, Gulati, and Shortell, 1997), and to be less swayed by external monitoring of their imitation efforts (Levin, 2006); or that social network ties increase the likelihood of imitation (Galaskiewicz and Wasserman, 1989; Beckman and Haunschild, 2002). Yet, once again, while the predictors and outcomes of imitation are a key focus of this literature, the actual imitation process has remained largely unexamined.

Research in related areas has similarly neglected the actual process by which imitation occurs. For example, some studies have used a learning-curve methodology to investigate inter-firm knowledge transfer, or "spillovers." Such knowledge spillovers occur when one organization's performance is correlated with the cumulative production experience of another organization (Argote, 1993; Darr, Argote, and Epple, 1995; Irwin and Klenow, 1993) or with the passage of time in an industry (Levin, 2000). This research demonstrates that "vicarious learning" (Huber, 1991; Levitt and March, 1988) does occur and that it can improve performance, but it does not directly address *how* this occurs. Another research area related to imitation that has followed this pattern is the literature on diffusion of innovation. For example, the empirical work on diffusion has been divided into research that examines the time to adoption and the number of adopters (Baptista, 1999). In his classic work on the subject, Rogers (1995) describes generic stages of diffusion (e.g., decision, implementation, coordination), but the specific details of how a borrowed

practice is integrated into a firm remain largely unexamined. Similarly, Lee and Pennings (2002) identify institutional and organizational predictors of diffusion, but set aside the issue of how exactly a diffused practice is brought into a firm and routinized.

We also see this same pattern in research on adaptation, which has much in common with imitation. The literature on organizational adaptation falls into two broad categories: In the first category, organizations adapt to exogenous changes in their external environment, such as market or economic conditions. These studies tend to be at a fairly high level and demonstrate *that* organizations adapt to changing environments—e.g., by changing product offerings (Kraatz, 1998), internal routines (Massini, Lewin, Numagami, and Pettigrew, 2002), or policies (Keister, 2002)—but not *how* organizations adapt. One exception is Eisenhardt and Tabrizi (1995), who examine the adaptation process in more detail, including variables such as supplier involvement, rewards for schedule attainment, and the number of design innovations, but still at a fairly high level in terms of describing the process itself. In the second category of adaptation research, organizations adapt to endogenous changes arising out of relationships with customers or suppliers. This stream of research emphasizes reciprocal relationships, focusing particularly on the notion of mutual adaptation between developers and user groups (Leonard-Barton and Sinha, 1993) or between firms (Hallén, Johanson, and Seyed-Mohamed, 1991). However, this research on mutual adaptation is less helpful to the problem of understanding imitation, because imitators rarely have the cooperation of the firm being imitated. In fact, one of the key tensions in the process of imitation is that firms seek to introduce—as precisely as possible—another firm's practices to which they, almost by definition, have only limited access.

Another related stream of research is on the use of analogies in strategy (Gavetti, Levinthal, and Rivkin, 2005; Gavetti and Rivkin, 2005). Like imitation, analogy requires detailed attention to source practices and source organizations, but the intention of the two learning strategies differs: The aim of analogy is to inspire a new solution, whereas the aim of imitation is to import an existing solution. Thus analogy differs fundamentally from imitation in that analogies are considered successful to the extent that they are not too similar to their source (Gavetti et al., 2005).

In sum, research on imitation and related processes has outlined the importance—as well as various predictors and outcomes—of the phenomenon. However, scholars have paid surprisingly little attention to the phenomenon itself: How does imitation operate in practice? What kinds of processes are involved?

The Imitation Puzzle

So if we are not quite sure how imitation works, perhaps we can at least say what it is most like. Scholars have highlighted imitation's similarity to two other phenomena: innovation and replication. Specifically, some scholars of innovation have argued that imitation is largely indistinguishable from innovation, as innovation can be defined as the use of knowledge previously created elsewhere but new to its current context (Nelson and Rosenberg, 1993). At the same time, other scholars have argued that imitation is actually closer to replication: "Pioneering efforts in evolutionary economics identified replication and imitation as brethren phenomena [and c]ase studies bear out the proposition that replication and imitation are closely related" (Rivkin, 2001, p. 275). Given that replication (an exact copy) and innovation (a creation from anew) seem like such *opposite* learning strategies, it is surprising that scholars would emphasize how similar each of them is to the third strategy of imitation.

Our solution to this puzzle is to suggest that imitation is actually a hybrid of both replication and innovation, containing elements of each. Indeed, we argue that intermediate types of learning do not take place unless elements of both replication (copying) and innovation (creating from anew) are present. In this paper we examine this argument in the context of the imitation of a specific management routine by four large firms. After describing our methods of data collection and analysis, we review the evidence in these four firms, along with the relevant literature, on the replication and innovation elements of imitation. We conclude with implications for research and practice.

Methods

Research Setting

This study was conducted at four U.S.-based industrial firms. A pilot study, sponsored by a consortium of manufacturers, was first conducted and consisted of a series of academic-practitioner roundtable discussions with representatives from six interested firms from the consortium. In the pilot study

meetings, common technology management processes and problems were identified, and some attempt made to systematize them. Consistent with grounded theory principles (Strauss and Corbin, 1998), a theoretical sample of firms was chosen for further study. All the chosen firms were large engineering-oriented manufacturing firms in relatively mature industries, although they served unrelated markets of industrial customers or consumers. All four firms indicated that they were highly affected by technological change, and that they were trying to improve their ability to manage technological advances. Thus they all recognized the importance of technology management issues and strategies. Three firms were chosen as an outcome of the pilot meetings, and one new consortium member was added.

The firms were experimenting with various strategies to improve technology management, and to that end, all four firms had adopted *technology roadmapping,* the routine that is the focus of our study. Technology roadmapping—a management program in the spirit of total quality management and six sigma—is a technique to improve technology forecasting and planning, in other words, to help firms deal with the time dimension of technological change (Kappel, 2001). It was first developed by Motorola and described in a 1987 article aimed at technology managers (Willyard and McClees, 1987). Assisted by Motorola's reputation as a technological leader, the roadmapping routine was eventually imitated by a wide range of firms, including the four in our study. Like Motorola, these four imitators were large and mature companies, and so it is reasonable to assume that they all had sufficient managerial talent and technological capacity to be capable of implementing the routine in question.

The purpose of the technology roadmapping routine is to improve organization-wide technology planning, and specifically to connect priorities and activities in R&D departments with those in business units. In practice, the routine typically involves having participants meet as part of a cross-functional effort over a period of weeks or months to develop a plan for what technologies will be needed for a given product line in the next few years. This is usually done on an annual basis and thus meets the definition of an organizational routine: "a repetitive, recognizable pattern of interdependent actions" (Feldman and Pentland, 2003, p. 96). The resulting "technology roadmap" can be anywhere from a few pages to a few dozen pages long, but usually involves multiple charts showing economic and technological trends, lists of

product features, and sometimes product diagrams. Because various departments are involved, it is not an easy routine to implement. Nevertheless, many of the participants involved in imitating this routine at the four companies expressed their hope that technology roadmapping would raise the profile of technology issues within their firm, and do so in a more systematic way than the ad-hoc approach often used in the technology-management domain.

In order to protect the anonymity of the firms in the study, they are called Company A, B, C, and D. Company B had started to do technology roadmapping about a year prior to the interviews. Companies A and C had started company-wide technology roadmapping about four years earlier, while Company D had started about four to six years prior to the interviews.

Data Gathering and Analysis

Once the four firms were identified, data were gathered in individual face-to-face interviews, from company documentation, and in roundtable discussions that brought together representatives from the different companies. Four roundtable discussions, involving 26 participants, focused on comparing and contrasting the process of implementing technology roadmapping in different organizations. In addition, over the course of a five-month period, two researchers jointly conducted interviews with 68 people, with the average interview lasting 75 minutes. To reduce bias, notes from each interview were typed up separately by each interviewer, and then merged into a single document. Interviewees were chosen in conjunction with a company contact person (a senior R&D manager) to provide a balanced view of technology management at each company. Interviewees ranged from new employees to vice presidents. In each firm, approximately equal numbers of business and R&D people were interviewed, since it has been shown that these two groups often see the world differently (Dougherty, 1992). Interviews were also conducted across multiple divisions and geographic locations (e.g., in different cities across the U.S.) to be able to identify patterns of routinization throughout each company. Even within a given location, there were often multiple buildings visited on a single sprawling corporate campus, thereby providing further geographic diversity.

The interviews covered a range of issues related to technology management. Topics discussed

included technology roadmapping, technology transfer, R&D portfolio management, environmental scanning, and the voice of the customer. Of the total group of 68 interviewees, 50 mentioned the technology roadmapping routine. This high proportion suggests that roadmapping was indeed a salient topic in these companies.

[Insert Table 1 about here]

Using standard practices for qualitative analysis, we "open coded" the interviews to uncover possible categories, then sharpened the categories, and eventually integrated them into a theory (Strauss and Corbin, 1998). For example, we soon noticed how many interviewees invoked Motorola. In many interviewees' comments, the Motorola reference served to justify or motivate the use of roadmapping, but not always. At times the Motorola comments simply described the functioning of the routine. Conversely, some of the comments that were clearly concerned with justifying the use of roadmapping were internally focused, with no reference to an outside company. Over the course of numerous iterations, we realized that roadmapping trailblazers like Motorola served both as inspiration and as working model for the imitators, and so we went back to re-code the interview data using these two categories.

It took another number of iterations working through the data before we concluded that many of the interviewees' more internally focused comments served these same two identical purposes. We had noticed early on that there were references to both external and internal models, but we were initially unclear about how the two related to each other. For instance, of all the firms, the weakest imitator made the most extensive comments about external models—a puzzle that challenged our thinking about how imitation takes place. There were also striking differences in terms of which respondents pointed out that roadmapping was a work-in-progress. Comments like "we're still more trying to get it working right, the way it is supposed to" (Company C) were far more common at firms that had *more* successfully routinized roadmapping than at the less successful imitators. Clearly, the imitation process required more than just a focus on the external model. These seeming contradictions stimulated us to consider more seriously the role of internally focused comments and ultimately led to the realization that these, too, followed the pattern of relating to either inspiration or a working model.

Thus, as we repeatedly cycled back to the data, we began to articulate recurring themes, then re-categorized the data based on these themes, and finally developed a framework that would explain what had appeared at first glance to be contradictory evidence. Once our basic framework had been developed through this process of open coding the interviews, the roundtable discussions were similarly analyzed. Because roundtable participants were themselves trying to articulate commonalities and differences in their firms' experience of roadmapping, their contributions were used primarily to confirm the dimensions and categories derived from the previous coding sessions. This subsequent round of analysis confirmed that there were two main and apparently mutually exclusive categories—replication and innovation. The theory that we present in this paper emerged from our efforts to find an explanatory framework that could account for both of these two main categories.

While we were not able to observe a technology roadmapping meeting in action (due to legal and confidentiality concerns by the companies), we have followed the well-established practice of interviewing key participants in an organization as a reliable method for uncovering key dimensions and dynamics of organizational activities and informal structure. Thus, we are confident that the interviews, roundtable discussions, and documentation analyzed for this study offer meaningful insights into the activities, practices, and interpretations of these organizations with respect to the imitation and routinization of the roadmapping routine.

Results

We provide evidence below that some of the companies were more successful than others at imitating Motorola's technology management routine, in terms of having the routine better integrated into the fabric of the imitating organization. Thus, in analyzing the imitation process at each imitating firm, we first attempt to identify differences across the firms in the degree of routinization of roadmapping. We then show that the more successful imitators drew upon elements of both replication and innovation, whereas the less successful imitators appeared to rely on only replication (Company A) or innovation (Company B) but not both. In other words, imitation appears to require both replication and innovation. As part of our analysis, we outline the relevant elements of replication and of innovation and describe their usage at each

of the four imitating firms.

Degree of Routinization

Our purpose in this study is not to validate the benefits of imitating the technology roadmapping routine, either in general or in a given firm, but rather to study roadmapping as an exemplar of how an imitated routine becomes routinized. Thus, our focus is on the degree of routinization of this routine within each firm; i.e., how well was the imitated routine integrated into the fabric of the imitating organization. This focus on the degree of routinization is consistent with prior research and theorizing on organizational routines (Cyert and March, 1963; Miner, 1991; Starbuck, 1992; Rura-Polley and Miner, 2002; Winter, 1994) and diffusion (Rogers, 1995).

Accordingly, we looked first at interviewees' subjective assessment of how roadmapping was functioning within their organization: Most people in Companies C and D thought that roadmapping was functioning well, or at least improving. Statements like the following were typical:

> The key thing about roadmapping's success is that the business units took it over. Now it is just part of their planning process; the first time, many were just going through the motions because they had to. It no longer has to be forced. (Company D)

> Most of the roadmapping emphasis has been on products, not manufacturing processes. We don't have a lot of progress there yet, but we're working on it. (Company C)

The first quote, from Company D, suggests that roadmapping had become routine, and that units knew how and where it contributed to their operations; i.e., roadmapping was no longer simply about "going through the motions." Although Company C was not as far along in terms of routinizing roadmapping, the quote indicates that there was an understanding of the routine and a sense of progress in its use: The firm had been able to work out how to use roadmapping for products, had been able to identify the need for expanding it to manufacturing, and was working on doing so.

Interviewees from Company B were not quite as positive as interviewees from Company C and D about the degree to which roadmapping had been integrated into their organization; specifically, roadmapping—despite its heavy emphasis on cross-functional coordination—was limited to the R&D labs, with little or no business unit involvement at Company B. Interviewees from Company A were even more

negative, indicating unanimously that roadmapping was not functioning well. The following quote by a Company A interviewee indicates that two of the central benefits of roadmapping—its ability to coordinate across different units, and its introduction of a longer-term perspective—were wholly absent:

> Coordination has not been impacted by roadmapping. The vision-linking conversations happened before the roadmaps arrived. And it doesn't change decision making much. (Company A)

[Insert Table 2 about here]

Table 2, which includes only interviewees who offered an assessment of the routine, provides additional examples. In fact, another potential indicator of the degree of routinization is an interviewee's having adequate familiarity with the routine to feel able to make a meaningful assessment of it. I.e., the more people in the technology management area who feel capable of assessing a routine like technology roadmapping, the more likely it is that the practice has been routinized. Half of the interviewees in Companies A and B were not aware or familiar enough with the roadmapping routine to even express an opinion on its functioning (and thus were excluded from Table 2), whereas fully two-thirds of the interviewees in Companies C and D were able to offer an assessment.

The content of assessments is also telling. For example, not only did more than half of the Company D assessments suggest that the routine functioned well (see Table 2), but interviewees were also able to identify specific benefits, such as the way the routine allowed decisions to be made on merit and not seniority. The fact that participants from Company D provided more concrete and specific details when they discussed technology roadmapping suggests that they had personal and more extensive experience with the routine than did participants from the other companies, who tended to offer more general assessments. Indeed, even when Company C or D interviewees had a less positive assessment, their comments were still very specific. For example, the complaints, "Our group did it wrong this year. It was dumped on me a week before it was due" (Company D) or "We still need another presentation of roadmaps to communicate the business unit strategy to the whole organization" (Company C), are far more concrete assessments than "there is no connection with roadmaps yet" (Company A) or "lessons learned are not so relevant across technology areas" (Company B), typical comments from Companies A and B. Overall, then,

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based on both the amount and content of interviewee assessments, it appears that more routinization occurred in Companies C and D, with somewhat less routinization in Company B and a great deal less in Company A.

Written contributions from company representatives provided another measure of roadmapping's degree of routinization within each organization. Specifically, each company's representative (an R&D manager very familiar with roadmapping) was asked to write a description of how roadmapping functioned at his company, as well as provide answers to 10-15 questions (e.g., "How are roadmaps updated and kept current?") along with any relevant documentation. There was a marked difference in the quality of these written contributions from the four companies. Companies C and D handed in many documents—generic outlines of a roadmap, masked examples, detailed guidelines, and so on—in addition to answering in depth the common questions posed to all four companies. In contrast, companies A and B provided only minimal information, and often answered the questions only superficially. The page count of each company's written contributions reflected this pattern.

[Insert Table 3 about here]

We considered the possibility that the differences in degree of routinization might be due to a firm's years of experience with the routine, since the passage of time allows a firm to implement a routine more extensively (Keister, 2002; Levin, 2006). However, we ruled this out as the central explanation of the degree of routinization, as roadmapping was actually better known and more routinized in Company B than in Company A, even though Company B had less experience with the routine. Moreover, roadmapping was significantly more routinized in Company C than in Company A, yet both had been working with the routine for the same number of years. Thus, each firm's level of experience with the imitated routine could not explain the differences in degree of routinization that we observed.

In sum, we saw that people in two of the organizations—Companies C and D—felt quite confident about their ability to perform, or at least learn to perform, the imitated routine of technology roadmapping. In contrast, Companies A and B, particularly Company A, were less able to imitate the technology roadmapping routine. The following sections explore why these differences existed. In our explanation, we

draw on the dual role of replication and innovation.

The Replication Elements of Imitation

Replication, which often takes place within a firm, involves the creation and operation of copies that are as close to the original as possible; for example, in the creation of franchises or the company-wide introduction of new operating models. To the casual observer, replication may appear to require little more than the simple repetition of a formula; however, research on replication suggests that it is a much more complex process (Jensen and Szulanski, 2007; Rivkin, 2001; Winter and Szulanski, 2001). Winter and Szulanski (2001) introduce the concepts of a "template" and "Arrow core" (so named to recognize Kenneth Arrow's contribution to information economics) in their analysis of replication. A template, under their definition, which we follow, is a "working example" within a given company of the routine(s) being considered for replication. Though this term is sometimes used (e.g., in studies of pattern recognition) to indicate cognitive prototypes—in the sense of "frameworks representing the most typical member of a category" (Baron and Ensley, 2006, p. 1333)—this in not the meaning of template used here. Rather, a template in replication is an actual example that people can go and see. The Arrow core, meanwhile, is "the complete answer to the question, 'what, how, and where should the replicator be trying to replicate?' " (Winter and Szulanski, 2001, p. 733). In a sense, it is like the ideal "how-to" manual for the routine(s). It is perhaps closer to the notion of a prototype (Baron and Ensley, 2006), but with a stronger normative component. Winter and Szulanski (2001) give the example of the precursor to Starbucks coffee shops, where opera was played to create the atmosphere of an Italian espresso bar—until the owner realized that opera was not key, and in fact distracting, to the "what, how and where" of his successful business. This illustrates how one's knowledge of the Arrow core is expanded in interaction with the template. A key task of the replicator is to develop as much knowledge of the "what, how and where" as possible, which successful replicators do by identifying the key success factors of an existing operation. In a way, this duality of action (the template) and reflection (knowledge of the Arrow core) is reminiscent of the action (performative) and reflection (ostensive) dimensions of stable routines (Feldman and Pentland, 2003).

[Insert Figure 1 about here]

In successful replication, the known part of the Arrow core is as extensive as possible, while the template itself is stable. The stability of the template is important because replications that attempt to combine different templates or draw on still-evolving templates introduce imperfectly understood interdependencies into the replication process (Winter and Szulanski, 2001). The template serves two specific replication functions (Jensen and Szulanski, 2007): First, it acts as a persuader of those people performing the replication, persuading them that the proposed replication is appropriate and do-able in the new context. For would-be replicators, being able to see a successful, working example of the routine(s) can be very convincing; in replication, "seeing is believing". Second, the template allows for "seeing in action" the routine(s) to be replicated. That is, because of their access to the template, replicators need not transform an abstract vision into a set of practices; rather, they have direct access to those practices, because the template acts as a referent. Replicators can visit the site where the routine is functioning, see for themselves how the routine works in practice, and discuss it with the people who have first-hand experience of the routine. Thus, a template acts as both a persuader and referent.

Imitation differs fundamentally from replication in terms of access to this working example. All of the research on replication (e.g., Jensen and Szulanski, 2007; Nelson and Winter, 1982; Rivkin, 2001; Szulanski and Winter, 2002; Winter and Szulanski, 2001) takes as a point of departure that replication occurs within a given organization. Replication involves the organization's managers wanting to share best practices across geographic boundaries, or roll out a new initiative to different units, or open new branches, or develop franchises, etc. In all of these cases, replicators can assume that they will have access to an actual working example. They do not have perfect access, of course, a fact which explains why it is necessary to develop their knowledge of the Arrow core in an iterative process of action and reflection. But their access to the practice is nonetheless far superior to the access that outsiders can hope to have. This distinction is significant, because Jensen and Szulanski (2007) demonstrate that access to an actual template is much more effective—as both persuader and referent—than access to purely conceptual knowledge of the Arrow core that merely describes the routine(s) in great detail.

Imitation, in contrast, occurs across organizational boundaries; i.e., it is about one organization

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trying to copy practices in use at another organization. This means that imitators, almost by definition, lack access to a template, a working example (Rivkin, 2001). Indeed, with imitation, the originator of a routine— who would be considered the knowledge sender in other forms of organizational learning—is likely to be either indifferent (in the case of a non-competitor) or even hostile (in the case of a competitor) towards potential imitators. Even if there is indifference rather than direct competition, the originating firm is unlikely to invest a lot of time and energy in demonstrating the functioning of the routine to a would-be imitator. As a result, while "imitation and interorganizational learning can be an important adaptive mechanism and can lead to the transfer of successful innovations, [this process] involves drawing inferences from noisy data" (Denrell, 2003, p. 227). This begs the question of the extent to which replication and imitation are comparable processes after all.

The data presented in this paper suggest that imitation follows the logic and shape of replication, although with some important differences. Imitators glean what they can about a routine from the routine's originator—in the case of technology roadmapping, mainly Motorola, but also other roadmapping success stories like Sony and even industry associations. Imitators piece together snippets from conferences, industry associations, trade fairs, the insights of employees hired from the originating organization, and published information. One interviewee's comment indicated the central role that Motorola played for would-be roadmapping imitators:

> Motorola is the father of roadmapping. But they regret their lone publication on it. They have been swamped by people trying to learn from them. (Company A)

The centrality of Motorola is also evident from Table 4, where interviewees constantly invoked how Motorola approached technology roadmapping. In the terminology of Baron (2006), Motorola's routine acted as a prototype. Imitators clearly attempted to recreate a prototype or template of the routine as it was enacted in the originating organization. This "external template" in the originating organization serves a similar function that the template does in replicating organizations—i.e., as a persuader and referent (Jensen and Szulanski, 2007). References to this "persuader function" contained the implicit message that Motorola is successful, that Motorola uses technology roadmapping, and that if a firm wishes success, it

needs to also use roadmapping. A variation on this message invoked comparable firms:

> I'm not aware of any exceptional company that does not embrace roadmapping. Hewlett-Packard does it. Sony. IBM. When I look at the high technology, rapidly evolving, technology-based industry in which we participate, it is not possible to be successful without roadmapping. (Company C)

These messages are used, in the words of one interviewee, to "raise the competitive anxiety of management"; i.e., to persuade managers to implement the routine.

[Insert Table 4 about here]

The external template can also have a "referent" function by providing a reference example of how the routine functions in practice. Interviewees cited details of how technology roadmapping at Motorola functioned, although their comments suggested that they lacked an understanding of a coherent system. Rather, they knew about a number of isolated "tidbits"; e.g., they referred to mechanisms for including minority points of view on a roadmap, graphic representations, and the need for specificity (see Table 4). Given the lack of easy access to Motorola by these roadmapping imitators, such examples were disjointed, yet they were nonetheless used as referents for what imitating firms needed to do to achieve Motorola's success. So, for instance, knowing that Motorola roadmaps used color-codes to designate the status of different technology projects is a fact that could be helpful for an imitator trying to work out how to assess and keep track of various projects. But how did this color coding at Motorola tie into the way such projects were managed? How did Motorola analyze new opportunities in light of the color-coded information? The imitators we interviewed appeared to have no idea.

Thus, in spite of the best efforts by imitators, the external template remains essentially inaccessible. Imitators can attempt to extract as much knowledge as possible of an imitated routine's Arrow core, but with rare exceptions (and none that we saw), imitators simply do not have adequate access to the "nuts and bolts" of how the routine operates in the external template to be able to develop a detailed understanding of the Arrow core. Moreover, while replicators can expand their knowledge of the Arrow core by making small changes to the original template and observing the effects of changes, this strategy is obviously impossible for imitators. Thus, the inaccessible external template can play little more than a symbolic role, acting as a kind of metaphor (Cornelissen, Kafouros, and Lock, 2005), reminding imitators of what they

are trying to imitate (referent) and why (persuader). Whether the external template reminds imitators of the potential benefits of the routine—playing a persuasive function—or whether it reminds imitators of what it is that they are hoping to imitate—acting as a referent—the external template keeps in focus the as-yet imperfectly understood new routine.

However, the imitating firm still needs a template that can provide a more detailed guide to the new practice, and to this end, imitators create an internal template. These internal templates resemble the external template in that they serve the same two functions: both as a persuader ("seeing is believing") and as a referent ("seeing in action"). As shown in Table 5, in our coding of the persuader function of the internally created template, we looked for evidence that an internal template was used to galvanize support for the roadmapping routine, whereas for the referent function, we looked for comments that emphasized teaching or learning how to do roadmapping based on an internal working example. The internal template, then, is the initial attempt by imitators to recreate the routine in their own organization.

[Insert Table 5 about here]

As we shall see, the successfully imitating organization uses both an external template and an internal template to expand its knowledge of the Arrow core. In replication, when there is access to a functioning template, there can be an iterative process, whereby knowledge of the Arrow core (e.g., a sense of what works and what doesn't) leads to changes and possible improvements to the template. These changes (see Figure 1) in turn lead to an increase in knowledge of the Arrow core (Winter and Szulanski, 2001). With imitation, though, there are two templates, but only the internal one is under the control of the imitating organization and so only the internal template can be changed as a result of increased knowledge of the Arrow core. With little concrete knowledge of the Arrow core or external template to go on, beginning imitators may struggle to create an internal template that can function usefully. Thus, neither of the templates used by the imitating organization is particularly satisfactory, as the external template is inaccessible, and the internal template, inadequate. This model of imitation is illustrated in Figure 2.

[Insert Figure 2 about here]

The model is perhaps best explained by comparing the companies that had routinized technology

roadmapping the least versus the most. Company A acted as if it were a replicator, and people there extensively discussed roadmapping details from Motorola and industry associations, but there was no evidence that the company had developed its own set of specifications for how to handle technology roadmapping (i.e., an internal template)—even when interviewees seemed to realize that the external template was inadequate for the specific needs of the company. By conflating replication with imitation, technology roadmapping in Company A remained very weakly routinized. In contrast, Company D explained roadmapping by referring both to an external template, notably Motorola, but also to its own efforts. Interviewees described roadmapping in significant detail—e.g., describing the layout of spreadsheets or enumerating its five goals—indicating the presence of a very strong internal template, too.

If we look across the four companies seeking to imitate the technology roadmapping routine, we see that, relatively speaking, the elements of replication—awareness of an external and internal template—were identified more frequently and in greater detail in Companies C and D. Yet if we were to limit our analysis solely to these replication elements, we would be left with a bit of a puzzle: Why were the ultimate routinization results so much stronger in Company D than in Company A, especially since the disparity in the degree to which they each focused on different elements of replication were not nearly so dramatic? Even more puzzling, why was the degree of routinization in Company A so much lower than in Company B? By all rights, it should have been reversed. After all, although Company A did not articulate an internal template, it did refer much more extensively to an external template; in fact, it did so more often than any of the other companies. In contrast, both types of templates in Company B seemed inadequate: there were no references to an external template, and only skeletal references to an internal template. Yet the evidence suggests that the technology roadmapping routine was actually much more routinized in Company B than in A—contrary to what one might predict from looking solely at the replication elements of imitation. In the next section, we attempt to solve this Company A versus Company B puzzle by introducing the notion of innovation elements of imitation.

The Innovation Elements of Imitation

Although imitation follows the logic and shape of replication, its substance is essentially one of

innovation and invention. As we shall see, in uncovering the success or failure of an imitation, it is not enough simply to identify the different replication-type elements. Innovation connects these elements, describes their interplay, and explains their improvement.

In the case of both innovation and imitation, there is a continual refinement of elements through a process of problem solving, learning, and discovery (Nelson and Rosenberg, 1998; Pavitt, 1988). Even replication has innovative elements at the beginning of the process: According to Winter and Szulanski (2001), replication is characterized by an initial period of exploration in order to determine the optimal template of a routine, and to arrive at as detailed an understanding of the Arrow core as possible. But once the organization determines that it has identified the key success factors, it finalizes the template and starts to copy that template as exactly as possible. In other words, beyond a certain point, replicators do not create anything new, but simply exploit what has already been created.

Unlike replication, though, where there is an end to the process of innovation and exploration early on, the fact that imitators have such weak access to the practice means that they cannot reach a similar "lock-in" point. Rather, according to our data, imitation remains an innovative process throughout. Table 6 suggests that innovative behaviors were recognized as important in all firms except in Company A. None of the interviewees in Company A referred to positive innovative behaviors in the area of roadmapping, although fully half of them mentioned their absence, with comments like the following being typical:

Roadmapping hasn't taken root very quickly. There have been errors in timing and the decisions on the roadmaps. (Company A)

Coordination has not been impacted by roadmapping. The underlying processes are the same as always. The process was not even specified formally. (Company A)

In contrast, a significant number of interviewees from Companies B, C, and D mentioned some type of innovative behavior in regards to technology roadmapping. Even in Company D, where technology roadmapping had been largely routinized, innovation-related behaviors remained prevalent, providing further evidence of the similarity between the processes of imitation and innovation.

[Insert Table 6 about here]

In the firms we studied, innovative behaviors took the form of an ongoing incremental process of

learning, as well as a more deliberate, explorative process of experimentation. "Experimentation is a trial-and-error process in which each trial generates new insights on a problem…. Learning by experimentation is fundamental to solving problems for which outcomes are uncertain and where critical sources of information are nonexistent or unavailable" (Edmondson, Bohmer, and Pisano, 2001, p. 310). When firms experiment with an imitated routine, they recognize that they as yet imperfectly understand the routine, and that what they do may fail. In our coding, we looked for comments that indicated that participants were conscious of this process of trial and error. Most people will revise a set of actions if they fail; we wanted evidence that they anticipated the possibility of failure, and yet still chose a given set of actions. For example, we looked for participants casting their attempts as possibilities explored and lessons learned, rather than as failures. The Company C interviewee below communicated that, with hindsight, introducing roadmapping was a potentially disruptive activity, and that it may have been too ambitious to introduce the routine together with another new process. However, the fact that one of Company C's divisions nonetheless took the chance is presented neutrally, not as a failure:

> Creating roadmaps at the same time as the business unit is creating platforms is probably too difficult. The ABC division tried to do so, though. (Company C)

A Company D interviewee recognized that, when his company first started roadmapping, one of the routine's key elements—integrating different functional perspectives—was absent. Yet the experience provided a shared goal that helped roadmapping in the future:

> The first year, XYZ group [in R&D] did technology roadmapping on its own. I remember one meeting where the business units said, "These are great roadmaps. They just don't have anything to do with our product plan and business drivers." So the goal was to get both groups to participate in planning. (Company D)

Once again, the experiment with R&D-focused roadmaps, while basically a failure, is used as an opportunity leading to a more integrated, cross-functional routine.

Experimentation requires not only a commitment to, but also an awareness of the process of new knowledge creation, and in general, few interviewees articulated such a deliberate process of experimentation. More common was incremental learning, consisting of the identification and resolution of performance challenges through numerous, relatively small changes (Cantwell and Fai, 1999). In this

case, we looked for evidence of incremental changes in the routine that had either happened in the past or were expected to occur in the future. In the case of Company A, such learning was resisted, and interviewees interpreted any inadequacies of the imitated routine as evidence it would not work:

> What happens to technology roadmapping when the technical community begins to ignore the message? They wait for the message to happen again. They keep doing what they are doing, knowing that the next message will probably change. (Company A)

This negative approach towards innovation and change contrasted sharply with descriptions in Company B, and helps explain why technology roadmapping was more routinized in Company B than in Company A, even though Company B's templates were not as extensive. In fact, in all the companies, apart from Company A, there were interviewees who described an ongoing evolutionary process in which the imitated routine was slowly integrated into the pre-existing practices of all the role-players involved. For example, a Company B interviewee diagnosed where important links were not yet as strong as they needed to be, and how those connections could be forged:

> Roadmapping needs to get tied into the business unit's strategic plan. Within the business unit, the pieces are not always tied together as well as they should be. This is the weak connection between R&D and the business unit. (Company B)

Similarly, Company D comments indicate an evolutionary process, such as:

> The process has gained credibility, particularly with the managers. The roadmapping process is kind of evolving at our company. The people using roadmapping right now are managers, not technologists. The technologists haven't bought in yet. (Company D)

The next comment especially demonstrates how Company D at first based roadmapping on product plans, precisely because product plans were "familiar turf"; i.e., already routinized in the firm. The company assessed the use of product plans critically, though, and was subsequently evolving towards the use of a more appropriate set of drivers:

> Roadmaps were driven from product plans initially. Now we are trying to drive them from business drivers. The product plans were familiar turf for the people involved, and so they were a good starting point. But there are blind spots in business unit thinking which were embedded in product plans. (Company D)

Participants in the more innovation-focused imitating companies simultaneously commented on their achievements in routinizing technology roadmapping, as well as the challenges that remained; e.g.,

routinizing technology roadmapping for manufacturing and not just products, using a familiar routine as a starting point and expanding from there, or establishing credibility with one group and not just with another group. In other words, there was a spirit of continuous improvement that translated into action. In fact, one interviewee from Company C commented that "the process of developing a roadmap is a learning process and that is the most important step." These three innovation-focused firms had introduced roadmapping anywhere from one year (Company B) to four to six years (Company D) prior to the interviews—a fact suggesting that innovation is not tied to a particular phase in the imitation process. In sum, apart from the firm that did not innovate at all (Company A), interviewees at the different firms described behaviors that were all similarly innovative.

Moreover, the interview comments suggest an *ongoing* process of innovation. Each achievement allows a firm to better understand the functioning of the routine, but by providing a clearer picture of both how the routine functions and how it probably should function, achievements also continuously uncover challenges that remain. For example, once Company C managers saw the benefits of roadmapping for products, they sought to expand roadmapping to manufacturing, too. Or once one group (R&D managers in Company B, business managers in Company D) can see the benefits of roadmapping, it becomes possible to try and involve other groups. A quote from Company C suggests ways in which the use of roadmapping can be expanded in the future—provided that roadmapping itself is in place:

> Linking technology project selection and funding to roadmapping is still under development. Once we have the roadmaps, then we can do that. (Company C)

These types of comments were much more prevalent in firms that had seen some level of routinization of the imitated routine (Companies B, C, and D), whereas there were no such comments about innovation (except to bemoan its absence) in the company with a very low level of routinization (Company A). This pattern of results is consistent with the idea that ongoing innovation is an essential part of imitation.

Summary of Results

This is an exploratory study of a small number of companies and does not capture the full range of factors that can affect the routinization of imitated practices. The insights from this study must therefore be

elaborated and tested in subsequent research. What the study does contribute is evidence to develop robust hypotheses about how imitation functions. In particular, the importance of having both replication and innovation elements as part of the imitation process is evident from differences in the degree of routinization across firms. Technology roadmapping was the most routinized in Companies C and D, the two companies that relied most heavily on elements of both replication and innovation. In interviews at these more successful imitators, the elements of both replication and innovation were mentioned more often and in greater detail than in the less successful imitators (Companies A and B).

In contrast, Company A did not imitate well, because it mistook imitation for replication. Even though many at the company recognized the need for innovation to integrate technology roadmapping with existing routines, they did not do so. Further, their lack of innovation seemed to hamper the development and improvement of certain replication elements as well, such as the internal template. Instead, people at the firm relied heavily on an external template that they treated as if it were definitive, and so they tried to create as exact a copy of the original routine as they could. Given that the external template on which they relied so heavily was largely inaccessible, however, Company A's experience suggests the dangers of trying to conflate imitation with replication.

To a lesser extent, Company B also did not imitate well, because it mistook imitation for innovation. That is, its replication elements were very limited, depriving the company of a richly textured model of what it was trying to achieve. This limited approach hindered the routinization of technology roadmapping, even though Company B was as committed to innovation as Companies C and D. Company B's experience, then, suggests the dangers of trying to conflate imitation with innovation. After all, unlike imitation, pure innovation is always at least partly blind—i.e., it is not known at the outset what its final outcome will be (Cantwell, 1991; Rosenberg, 1982; Tidd, Bessant, and Pavitt, 1997). Even when there are very clear goals ("a man on the moon before the end of the decade"), the nature and format of the eventual innovative outcome cannot be predicted. In contrast, though, successful imitation is guided by an external as well as internal template. Our data suggest that these templates shape imitation to a significant extent, helping to determine its success. However, although imitation is typified by the presence, and

innovation by the absence, of a clear model of what is being created, the actual behaviors characterizing innovation and imitation appear to be very similar.

Interestingly, one of the interviewees at Company D, reflecting on his company's successful experience with roadmapping, identified many of the themes described in this paper:

> Roadmapping from Motorola had to be adapted over time to our company. Implementing a finished product on an organization will just be resisted, especially in a large organization. Implementing roadmapping requires two champions: a senior person and me at the grunt level to come up with definitions and formats. The senior person generates the buy-in. Mandating things does not work at our company, but you do need enough consensus to at least get the ball rolling. The context of roadmapping is very important. Lay out the issues and let the organization work out those issues themselves. Otherwise they will resist. The complexity of the organization makes it most difficult. (Company D)

The two champions he mentioned (a senior person and a "grunt level" person) reflect the two purposes of a template (persuader and referent, respectively) identified in research on replication by Jensen and Szulanski (2007). This interviewee's comments also confirm the need for elements of innovation (e.g., "let the organization work out those issues themselves") as part of imitation.

Discussion and Conclusion

Imitation is an important knowledge transfer strategy that firms use to add to their stock of knowledge. While prior research has emphasized the economic and strategic importance of imitation (e.g., Barney, 1991; Rosenberg, 1994), the actual elements of how firms imitate has rarely, if ever, been studied. To fill this gap in the literature, we have examined in the current study how managers in four large companies, all imitating the same routine, talked about their practices and interpretations of the imitated routine. Moreover, in trying to uncover how it is that imitation could be described in the literature as being extremely similar to two essentially opposite phenomena—replication (copying exactly) and innovation (creating anew)—we have come to see imitation as essentially a hybrid of these two, containing elements of both. For example, all four companies in this study relied on templates (working examples of the routine) to develop their knowledge of how the routine should function, just as in replication (Winter and Szulanski, 2001). Furthermore, the templates in our study of imitation seemed to serve the same dual purposes—persuader and referent—that Jensen and Szulanski (2007) identified in their study of replication at Rank Xerox. At the same time, though, we also saw evidence in our interviews that imitation contains elements

of innovation. For example, most of the imitators in our study experimented to some extent with new ways of doing the routine. In addition, they were continuously learning and improving in numerous small ways the operation of the routine. Thus, even though the firms in our sample were all "copying" the same routine, the actual procedures and practices involved were often unique to each company as a result of these innovation processes. For example, one company emphasized the role of spreadsheets to track R&D projects; another, the role of visual representations of an actual product to show forecasted changes to the product's components.

These findings on imitation also inform strategy research on the use of analogies. Of course, in one sense, these two concepts seem very unalike. After all, an analogy is primarily a rhetorical device, whereas imitation is a set of actions and routines. More importantly, the purposes of imitation and analogy are quite different: The purpose of analogy is to extend decision making and to create routines for a novel context; e.g., Circuit City translating its ideas on salespeople training, inventory management, and economies of scale in consumer electronics to the used car market to create a new company, CarMax (Gavetti and Rivkin, 2005). In contrast, imitation aspires to create in another company as precise a model of the original routine as possible. Interestingly, though, our findings suggest that the learning processes associated with analogy and imitation are remarkably similar, suggesting that both are examples of intermediate learning. Gaveti and Rivkin (2005), for example, argue that, for strategists, analogies are particularly appropriate for a "middle ground" that is not so familiar and modular for rational deduction to be useful, and not "so ambiguous, novel, or complex" (p.56) that trial and error learning is required, and yet where the successful use of analogies may involve drawing on both elements. Similarly, we have argued that imitation involves combining elements of replication (akin to rational deduction) and innovation (including trial and error learning). The process of analogy also crucially involves the identification of good representations of a source domain on which learnings can be based. This is akin to the idea that organizational researchers must also develop and select appropriate organizational metaphors (Cornelissen et al., 2005). Representations are deemed good to the extent that they capture the dimensions that are core to the decision at hand. Similarly, in imitation, imitators must invest time and effort in deepening their knowledge of the

Arrow core; i.e., successful imitators come to understand which aspects of the imitated routine are relevant and which are not.

Another contribution of this study is a clearer conceptual description of imitation, particularly in terms of how it relates to both replication and innovation. Our work enables a clear distinction: Replication is the copying exactly of the organizational routine(s), where, once the model to be copied has been stabilized, there is a deliberate absence of trial and error, learning, and experimentation, with a clear model to guide actions (Winter and Szulanski, 2001). In contrast, innovation is a process of trial and error, learning, and experimentation that is always at least partly blind, with only a general outline of the hoped-for outcome (Cantwell and Fai, 1999). As a hybrid, imitation is also a process of trial and error, learning, and experimentation, but with a clear model of the hoped-for outcome. Both analogy and imitation—particularly in their use and refinement of representations (per Gavetti et al., 2005) or templates (per Jensen and Szulanski, 2007)—demonstrate the constant interplay between innovation (the creation from anew) and replication (the use of as exact a copy as possible). This interplay appears to be essential to support the "middle ground" where firms are engaging in new, but not radically new, activities. By highlighting these distinctions, this study paves the way for future work to consider, in greater detail and with greater precision, how each of these processes—imitation and analogy, as well as replication and innovation—can contribute to an organization's base of knowledge.

All of these knowledge-building processes are potentially crucial mechanisms by which firms create and transfer knowledge, a capability increasingly required in a knowledge-based economy (Grant, 1996). As a result, these distinctions matter not only for academics but for firms as well. In our study, for example, the two weaker imitators seemed to have misdefined their task, in one case confusing imitation with replication, and in the other, confusing it with innovation. In both cases the result was less routinization of the imitated routine. In contrast, we found that imitating firms using elements of both replication and innovation were more likely to have the imitated routine integrated into their operations in a successful way. One practical implication of our findings, then, is that companies should consider carefully which knowledge process they will follow in a given instance, since each process likely needs to be managed

differently.

This study does have a number of limitations. First, we have focused in our empirical investigation on only learning strategy, imitation, and only one type of routine, one that is managerial and documented. There are, however, a range of routines, such as those that are more technological, where there is an artifact embodying part of the expertise (Barley, 1986). More work is needed to see if our findings would apply to these other types of routines as well. Second, we have not addressed the more complex dynamic of companies where there may be multiple templates, perhaps differing both in their details as well as their degree of routinization. Future work could expand on our model of imitation to incorporate such a possibility. Third, our findings are based in large part on interviews, and data gathering through interviews relies on the interviewee's ability to articulate processes. While this assumption is typically valid in most organizational situations, the literature does suggest that once processes are *completely* routinized, a person tends not to articulate them—they have become "invisible" (Cohen and Bacdayan, 1994; Suchman, 1996). Our study was therefore limited to more versus less routinized imitated routines and cannot fully address the issue of completely routinized imitated routines. For example, we found that active innovation is ongoing, but it may be the case that innovative activities eventually taper off once the imitation becomes completely routinized (Winter, 1994)—perhaps more closely following the gradual process suggested by Feldman and Pentland (2003) for stable routines. To understand the complete routinization of an imitated routine, then, ethnographic observation may be necessary.

In conclusion, we propose a model specifically of how firms imitate, and more generally, how firms learn when knowledge is neither radically new nor highly familiar; i.e., intermediate learning. The literature has so far lacked a detailed model of the imitation process, a fact which is surprising, given the prominent role of imitation in various literatures such as economics, strategy, and organization theory. We have focused in this study on the imitation of the same complex routine by four large companies. Imitation in this context can be difficult for firms, because they receive little or no help from the original firm being imitated. The more successful imitators in our study confronted this problem by combining elements of replication—where they maintained a clear model of the hoped-for outcome—with elements of

innovation—where they used trial and error, learning, and experimentation to "fill in the gaps." Less successful imitators, however, did not emphasize elements from both processes. Even among the more successful imitators, though, this overall process of imitation was difficult and time consuming. This may be typical, though, as imitators often find themselves in situations where, at least initially, their knowledge of what to do is inadequate, and the knowledge of what others are doing is inaccessible. By treating imitation as a hybrid of both replication and innovation, however, it appears that this hurdle can be overcome.

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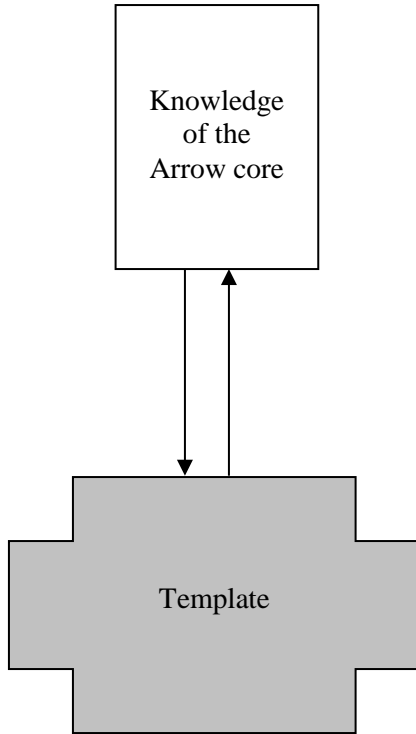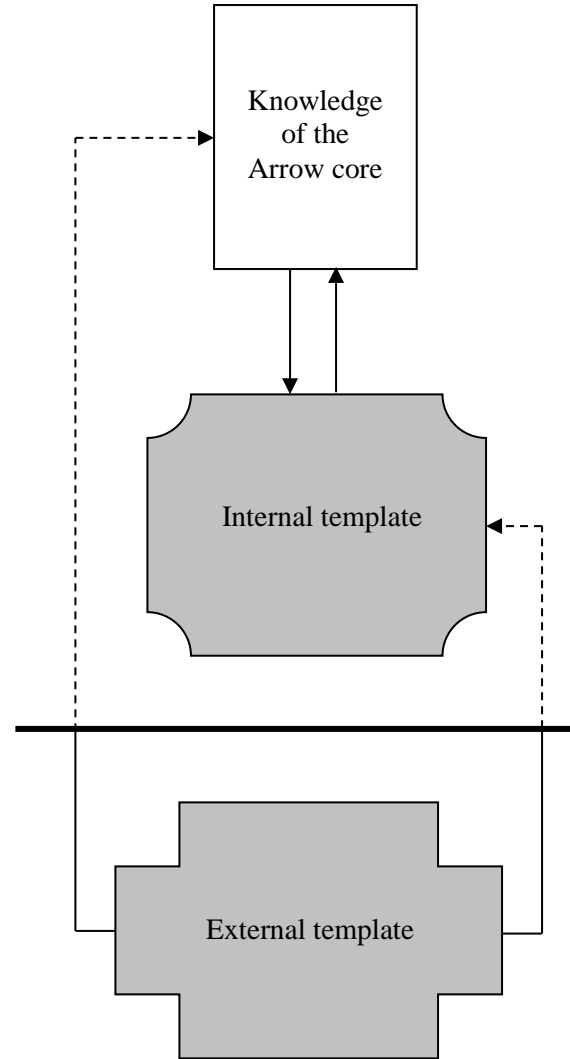
FIGURE 1

FIGURE 2

Model of Replication

Model of Imitation

Note: Arrows indicate interaction between a template (i.e., a working example of a routine) and knowledge of the Arrow core (i.e., knowledge of the ideal, perfect "how to" manual for that routine). Dotted arrows indicate limited input.

TABLE 1

Overview of Interviews

	Company A	Company B	Company C	Company D	Total
Geographic locations covered	1	2	4	5	12
Functional divisions covered	4	2	4	2	12
Interviewees by Function					
• R&D	5	8	6	18	37
• Business Unit	5	7	5	14	31
Interviewees by Level					
• Manager	5	10	2	16	33
• Employee	5	5	8	16	34
Total number of interviewees	10	15	11	32	68
Interviewees who discussed roadmapping	8	10	10	22	50

Note: Unless indicated otherwise, percentages in subsequent tables are relative to interviewees who discussed the topic of roadmapping, not to the total number of interviewees.

TABLE 2

Interviewee Assessments of the Degree of Routinization of Roadmapping

Assessment	Company A	Company B	Company C	Company D
	100%	20%	0%	0%
It is not functioning well.	E.g.: *If you want a product out soon, use little new technology. There is no connection with roadmaps yet.*	E.g.: *Lessons learned are not so relevant across technology areas due to different organizational structures or different technologies.*		
	0%	60%	100%	43%
It is not yet functioning well, but is improving.		*E.g.: In the business unit, the technology roadmaps at R&D are not well known yet. R&D drove roadmapping and is still selling it to the business units.*	E.g.: *We are still trying to get it [roadmapping] working right, the way it's supposed to.*	E.g.: *The roadmapping process is kind of evolving. The people using roadmapping are managers, not technologists. The technologists haven't bought in yet.*
	0%	20%	0%	57%
It is functioning well.		E.g.: *[R&D department heads'] reviews are based on meeting roadmap goals.... They are happier now being held to roadmaps than to P&Ls.*		E.g. *Roadmapping has overcome the seniority system for technology decisions. It eliminates 30 to 40% of the biases.*

Note: Percentages are of interviewees giving an assessment of roadmapping (4 in Company A; 5 in B; 7 in C; 14 in D).

TABLE 3

Amount of Descriptive Material Created by Each Company

	Company A	Company B	Company C	Company D
Number of pages describing roadmapping that were submitted by each company representative to the researchers	4	13	61	38

TABLE 4

External Template, by Purpose

	Company A	Company B	Company C	Company D
	38%	0%	10%	14%
External template used as **persuader**	E.g.: *We take the industry roadmap and use it to justify the budget and internal roadmaps. This raises the competitive anxiety of management, hopefully leading to action.*		E.g.: *To give you an idea how important roadmapping is at Motorola, every single year either the CEO or the COO visits every single division—and there are about a hundred divisions— for a day to review their roadmaps.*	E.g.: *Our senior management has been looking at companies like Hewlett-Packard and Motorola that doubled in size, and one of the success factors was a strong focus on technology. Roadmapping has risen in part as a result of their support.*
	13%	0%	20%	9%
External template used as **referent**	E.g.: *We don't have a 'minority point of view' mechanism for new technologies, as in the Motorola article.*		E.g.: *They [senior management at Motorola] discussed plans, potential breakthroughs, and investments. They used color-coding on the roadmaps for: staffed and funded, planned, and nothing.*	E.g.: *We started roadmapping four years ago, based on Motorola's approach…. It is not enough to say the product will be smaller, faster, cheaper. One has to say: smaller by how much, etc. so that the researchers know what to do.*

Note: Percentage of a firm's roadmapping interviewees who mentioned a given aspect of an external template.

TABLE 5

Internal Template, by Purpose

	Company A	Company B	Company C	Company D
Internal template used as **persuader**	0%	0%	30% E.g.: *I've gotten Sam's staff to include some high-level roadmapping templates. This starts this Monday, when four business unit heads will present. This change will motivate business-unit managers on roadmapping and also get roadmapping better linked to the business.*	18% E.g.: *At the end of the first year with roadmapping, the president asked each senior vice president to present how his roadmap had helped his business. This caused quite a scramble.*
Internal template used as **referent**	0%	10% E.g.: *An auditorium presentation was given to R&D— anyone who wanted to attend—on the technology roadmapping process.*	40% E.g.: *We still need another presentation of roadmaps to communicate the strategy to the whole organization. Not everyone is aware of the business units' strategy.*	23% E.g.: *Frank has a book—about six inches thick—with all the five-year roadmaps. I kind of line myself up with that book.*

Note: Percentage of a firm's roadmapping interviewees who mentioned a given aspect of an internal template.

TABLE 6

Prominence of Innovative Behavior

	Company A	Company B	Company C	Company D
• **Experi-mentation** with routine (i.e., trying out different versions and interpretations of the routine to assess which works best)	0%	10% E.g.: *[After developing an intellectual property roadmap] We are working on how to rank the importance of a disclosure. We're not sure what to do with this IP roadmap yet, besides using it as an action plan for follow-ups.*	20% E.g.: *The senior management notions about roadmapping were proven wrong. It is now supported by people who have a lot of weight.*	9% E.g.: *At the time I thought they [the roadmaps] were pretty good. I laugh at them now because two years ago, we were in the mode of "technology will solve everything". Now I see the roadmap as a vehicle that I use to sell. It's my brochure.*
• **Incremental learning** of routine (i.e., changes that have been made to routine to better suit the organization)	0%	30% E.g.: *Many of the technology roadmaps are owned by a different technology area manager this year compared to last year to increase the multi-disciplinary involvement.*	30% E.g.: *Linking technology project selection and funding to roadmapping is still under development. Once we have the roadmaps, then we can do that.*	27% E.g.: *We get together twice per year to update our roadmap, but we're trying to get that to quarterly meetings. In addition, we're putting this up on our web site for our partners.*

Note: Percentage of a firm's roadmapping interviewees who mentioned a given type of innovative behavior.