Organizational Improvisation and Learning: A Field Study

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An inductive study of improvisation in new product development activities in two firms uncovered a variety of improvisational forms and the factors that shaped them. Embedded in the observations were two important linkages between organizational improvisation and learning. First, site observations led us to refine prior definitions of improvisation and view it as a distinct type of real-time, short-term learning. Second, observation revealed links between improvisation and long-term organizational learning. Improvisation interfered with some learning processes; it also sometimes played a role in long-term trial-and-error learning, and the firms displayed improvisational competencies. Our findings extend prior research on organizational improvisation and learning and provide a lens for research on entrepreneurship, technological innovation, and the fusion of unplanned change and order.●

Organizational theory reveals a growing interest in extemporaneous organizational action and its potential value to organizations. Outside the organizational context, scholars have observed improvisation in fields as diverse as theater and music (e.g., Spolin, 1963; Bastien and Hostager, 1992; Weick, 1993b; Berliner, 1994), education (e.g., Borko and Livingston, 1989; Irby, 1992), and psychiatry (e.g., Embrey et al., 1996). Researchers have analyzed improvisation by organizations in especially fast-moving competitive settings, such as new product development (Eisenhardt and Tabrizi, 1995; Moorman and Miner, 1998a, 1998b), a changed political context (Alinsky, 1969), and during emergencies such as a strike (Preston, 1991), a failed navigational system (Hutchins, 1991), and a firestorm (Weick, 1993a). Others have focused on the aesthetic virtues of improvised action (Weick, 1993c; Hatch, 1997b). Work to date thus provides ample evidence that the construct of improvisation can generate lively discussion and that instances of improvisation are found in organizations.

One recurring theme of both research and lay observations is that stored knowledge and skills shape improvisation in important ways. Weick (1993a) noted that experience played a role in successful and unsuccessful improvisation by firefighters. Moorman and Miner (1998a) found that organizational memory moderates the impact of improvisation on new product outcomes (see also Moorman and Miner, 1998b, for related theory). Brown and Eisenhardt (1995) theorized that learned routines shape improvisation in new product development (see also Eisenhardt and Tabrizi, 1995). Hatch (1998) observed that skilled improvisers often recombine existing routines (parts of memory) to create novel action, much as a musician reassembles previously performed bundles of notes into a novel melody.

At the core of prior work is the argument that the result of prior learning, organizational memory, shapes the skillful and fruitful improvisation of novel performances. Research is less clear, however, about whether and how improvisation affects learning, focusing instead on the outcomes of improvisation itself, such as saved firefighters or firms. We wondered whether improvisation would result in a different set of behaviors or insights relative to what firms would have expe-

rienced under normal planning and execution. Because improvised activities often occur outside organized routines or formal plans, we also questioned whether they could be accepted and incorporated into future organizational activities. At an even higher level of organizational learning, it is not clear whether an organization can learn to plan such an unplanned event as an improvisation.

In examining these issues, we considered two sets of ideas. First, we focused on the extemporaneous quality of improvisation, drawing on a large body of prior work across disciplines (e.g., Pressing, 1988; Borko and Livingston, 1989; Preston, 1991; Bastien and Hostager, 1992; Weick, 1993a, 1993b). Specifically, we build on the view of improvisation as the degree to which composition and execution converge in time (Moorman and Miner, 1998b: 698). In addition, we accepted the notion that preexisting routines do not constitute improvisation; there must be some degree of novelty in the design. We took "composition" or "design" to mean that improvisation refers to deliberate, as opposed to accidental, creation of novel activity.

Second, although we had very little sense of the specific interconnections we would find between improvisation and learning, we developed a framework for thinking about organizational learning and how we would recognize it. This, too, was grounded in a considerable body of prior scholarly work that defines learning as a systematic change in behavior or knowledge informed by experience (e.g., Levitt and March, 1988; Huber, 1991; Cyert and March, 1992; Glynn, Lant, and Milliken, 1994; Argote, 1999). This view of organizational learning embraces both behavioral learning models, which emphasize shifts in the mix of organizational routines and action patterns, and cognitive learning models, which emphasize shifts in ideas, causal models, and cognition. In pure behavioral learning, an external stimulus could generate a new balance in internal routines without any change in the organization's shared mental models or causal theories (Miner, 1989; Cyert and March, 1992; Burgelman, 1994). The key learning outcome resides in the new mix of routines enacted. In cognitive learning, a change outside the organization could stimulate reflection and revision of shared cognitive assumptions and causal models, even with no change in the organization's current routines (Glynn, Lant, and Milliken, 1994). The key learning outcome resides in the organization's knowledge base.

Early work on organizational learning tended to describe it as a single process (e.g., Cyert and March, 1992), but contemporary research elucidates many types of learning processes, such as an organization's learning from its own experience versus learning from others, experimentation, trial-and-error learning, refinement versus exploration, forgetting, knowledge sharing, and knowledge generation. Common to all forms, however, is that the learning experience generates change in some fashion. It may, for example, refine prior knowledge or reduce variation in activity (Argote, 1999). It may generate new activities, knowledge, or insight (March, 1991). Experience-induced changed behavior may or may not be retained; we follow other work that emphasizes the reten-

tion of change as a potential, but not inherent, part of learning (Glynn, Lant, and Milliken, 1994; Argote, 1999). Further, change may be short-term or long-term and may involve either local or higher-level organizational patterns, competencies, or knowledge (Argote, 1999).

With these core concepts as a starting point, we first describe patterns we found in improvisation and how they led us to conclude that improvisation can fruitfully be seen as a special type of short-term, real-time learning. Specifically, in improvisational learning, experience and related change occur at the same time. We then report empirical findings that reveal how improvisation can influence long-term organizational learning and adaptation. Taken together, the findings imply that improvisation not only draws on prior learning but may be both a special type of short-term learning and a factor that influences other, longer-term organizational learning activities.

METHOD

Prior observations of improvisation in a single organization (e.g., Preston, 1991; Hutchins, 1991; Weick, 1993a) often began with a specific improvisation and traced its links to other organizational actions and theories. Rather than starting with a prominent improvisational event and working backwards, we wanted to observe a consistent flow of regular activity over time in two different organizations and track the ebbs and flows of potential improvisation. We chose product development projects as the context in which to conduct our examination. Product development represents an important process through which organizations adapt to—and, in some cases, help to create—their own environments (Schoonhoven, Eisenhardt, and Lyman, 1990; Dougherty, 1992; Brown and Eisenhardt, 1995). Although some previous research on new product development has provided suggestive evidence that links improvisation and organizational learning, this work has not thoroughly explored their interconnection (Nonaka, 1990; Eisenhardt and Tabrizi, 1995; Moorman and Miner, 1998a). Thus, product development represents a fertile but only partially mined territory for examining improvisation and its potential links to learning.

Our observation focused on two companies in two different industries whose names, but not core features, we have altered for purposes of confidentiality. The first company, FastTrack, develops and sells advanced technology products to industrial clients as well as to public and private research laboratories. The second company, SeeFoods, develops and sells food products to consumers through supermarkets and institutional channels. Both companies are well established and have formalized structures but vary in size ($2.4 million and $2.6 billion in annual sales, respectively).

In each firm, we attended approximately 50 product development meetings that spanned the product development cycle: concept and prototype development stages at SeeFoods and product design through launch at FastTrack. We informed employees at each site that we were conducting a study of product development. To avoid demand effects, we did not use the word "improvisation" in our work and consistently

described our project as general exploratory research on product development. We did not ask participants what they thought about the construct of improvisation or solicit comments about the link between planning and execution, but, instead, we used several data sources and modes of inquiry to explore concrete product development activities, processes, and outcomes (Denzin and Lincoln, 1998; Strauss and Corbin, 1998).

Our field data collection period lasted for more than one year, with the most intense data collection occurring during a nine-month period. This window of observation provided prolonged interaction, and the data sources permitted some triangulation in our analyses (Frankel, 1999). Findings reflect our direct observations of organizational activities, our repeated reviews of approximately 1,500 pages of meeting and interview transcripts to challenge our initial assumptions, and our discussions and shared writings about these data.

Data Sources

Observation and transcripts of team meetings. We observed and tape-recorded approximately 25–30 team meetings for one new product development project at each site over a nine-month period. Research team members also kept meeting notes, both as a safety precaution in the event of equipment failure and as a device for recording impressions. Meetings were an important data source for fine-grained analysis because they represented the principal means by which members exchanged information about actions that affected the product development process and its outcomes (Adler and Adler, 1998). To ensure that meetings captured a representative set of actions by the team, project team members were asked to list all the things they had done on behalf of the project during a sample period, early in the field observation phase. When we compared these lists to meeting agenda, field workers' notes, and meeting transcriptions for the sample period, coverage was deemed adequate. Audiotapes of the meetings were transcribed and reviewed more than once by the research team member who attended the meeting. These transcripts provided shared data that was available to all research team members, as well as much of the raw data we used for analysis of specific improvisational activities we had observed. Although we did not intend to use the tapes for discourse analysis, we reviewed the transcripts carefully for accuracy because of their central role as a shared, detailed record of project activities. Transcripts also included observers' notes of unusual body language or other nonauditory signals of major changes in meeting content or tone.

Interviews. We interviewed team leaders and executives throughout the research process. Initial interviews covered a broad range of topics: company history and structure; current and future projects; development philosophies and processes; and competitors, suppliers, and customers. We also conducted interviews with team leaders after each of several development phases, as well as on-the-spot interviews before and after many team meetings. One goal of these ongoing interviews was to gather additional information

about project-related actions and events; another was to avoid such problems as poor recall, hindsight bias, and halo effects (Hawkins and Hastie, 1990; Fontana and Frey, 1998). We also wished to elicit more general information on company history and practices as seen by the informants, such as other ongoing product development projects and their links to the current projects, previous projects and policies, and perceived strengths and tensions within the firms. Interviews were semistructured, with some questions informed by our prior research questions and others suggested by developing themes within the interview itself (Fetterman, 1989; Crabtree and Miller, 1999). In total, nine interview schedules were developed to reflect management levels (e.g., senior-officer level, team leader) and different timing considerations (e.g., beginning of the project, weekly meeting, long-term learning follow-up).

Archival data. We examined such archival information as *organization charts, company brochures, formal new product development procedures, project planning documents,* and *project information.* This provided information on company history, structure, policies, technical competencies, and product markets as well as data on project dates, formal planning steps, and decisions related to the projects we observed directly (Denzin and Lincoln, 1998).

Procedures

To explore our research questions, we used a process of recursive scrutiny (Barley, 1986; Ragin, 1987; Borkin, 1999) of all data sources. One important form of this occurred during the data collection phase, when research team members would meet to review the progress of the project and examine new transcripts to consider whether and how we could identify improvisation. We tried, for example, to identify improvisational actions at the level of whole project phases but found we could not do that in a satisfactory way. These discussions represented an open-coding process in which observers examined and reexamined the same traces of activity in search of regularities in behavior (Strauss and Corbin, 1998; Denzin and Lincoln, 1998). Thus, we focused in this early period on identifying improvisational actions within specific projects.

The second overlapping form of iterative data examination occurred through ongoing reviews and discussions of transcripts and other data over a period of more than four years. Keeping in mind that events reported in interviews and archival data cannot be taken as a transparent representation of past or future observable behavior, we tended to focus on patterns that arose from transcript data or that appeared in *one or more data sources. Research team members repeatedly* and independently examined transcripts of meetings and interviews and then exchanged illustrations of improvisation in an iterative process for more than a year, with later periodic repetition of this process. We used repeated examination of our data, critical exchange among team members, and interchanges with readers about working papers to seek robustness and plausibility (Ragin, 1987; Eisenhardt, 1989; Strauss and Corbin, 1998; Borkin, 1999). *The long-term itera-*

tive review was especially important in considering higher-level patterns in the firms, contrasting different types of activities, and refining definitions. In this study, we did not use semiotic, deconstruction, or dramaturgical techniques (Feldman, 1995), although we did pay attention to some areas in which team members expressed surprise or frustration.

Our analysis of the data revealed that both organizations engaged in thorough strategic planning processes to identify and prioritize broad classes of potential products and markets. The companies typically assessed new product development projects in the context of longer-term priorities, and both had written procedures for any new product development project to which resources would be allocated. In both firms, the actual design process did not officially occur until these analyses and resulting plans had been formally approved and funded, clearly making the normal product development process one of formal planning rather than improvisation.

IMPROVISATION IN ORGANIZATIONS

The first focus of our field observations was simply to observe carefully the activities that appeared to embody improvisation and the patterns that might emerge in these activities (Denzin and Lincoln, 1998). This agenda revealed several different forms of the "execution" aspect of the improvisations. It also revealed varied foci of the organization's attention during the improvisation process, which shaped the "composition" aspect of improvisation. Through our analyses we came to see improvisation as a special type of learning that differed from the experimental learning we observed in these firms.

Forms of Improvisation

As we reviewed instances of improvisation, we noted that something was produced in each case, but the variety was interesting and unexpected. We term these direct outcomes "improvisational productions." Like an improvised song or theatrical skit, these productions were themselves irrevocable—they were "on-line" events—but they might or might not have other consequences or lasting impact on the organization. We do not make any claims here about the effectiveness or retention of these products of improvisation. Rather, here we describe the range of new behaviors (behavioral productions), physical structures (artifactual productions), and new interpretive frameworks (interpretive productions) improvised by the organizations.

Behavioral productions. Consistent with past research (Dougherty, 1992; Hatch, 1998), we saw teams improvising processes (sequences of behavior) in new product development. Sometimes these processes were coupled with the creation of artifacts (see following section), but we also observed pure behavioral improvisations as well. SeeFoods, for example, improvised new-product-development micro-actions. Although development teams were required to visit stores that sold products similar to their own, a SeeFoods development team changed its behavior during one such trip

to include stores selling products that were dissimilar in content but similar in packaging. Therefore, although the broad practice of visiting stores remained the same, the team designed a new activity during completion of that task (SF 01/16/95).[1] Teams also improvised new-product-development processes. At SeeFoods, for example, company policy mandated the use of external focus groups at specific points during the development process. During the process of planning one such external focus group, the team created an internal focus group of company employees to call in on an as-needed basis, thus permitting more frequent feedback (SF 02/22/95).

Another example of improvised processes occurred as Fast-Track's product development team was developing a software interface between its product and one of the company's flagship products. While that interface was being written, the older product's software came under revision. This meant that the new product development team continually had to change its test schedules and sequences to correspond to software revisions. As the team struggled to follow the process and timing of the team revising the older product, frustrated team members improvised an approach and set of routines to develop and test their interface: "It seems that they are finding new bugs in the old software and that they might issue a new release. This is our chance to slip in our changes" (FT 11/28/95). This "slipping in" of changes surreptitiously reversed roles. The product development team had improvised a method to get its changes tested by the other team now in charge of compatibility testing.

We also observed several instances of SeeFoods' improvising organization-wide processes. In one case, a breakfast product had been put on hold by the project team because the leader felt the team was being spread too thinly. When a competitor introduced a breakfast product, SeeFoods temporarily dropped its lunch projects to focus exclusively on several very underdeveloped breakfast prototypes. The entire organization, across functions, created a fast-response strategy as it worked through the problem (SF 05/31/95).

Finally, we observed one situation at FastTrack when the firm appeared to be improvising entry into a whole new product market, responding to a new material capability. We did not have sufficient data to substantiate unequivocally that this highest-level strategic improvisation occurred during our period of observation, although other work has documented the improvisation of the whole mission or goals of an organization (Follett, 1930; Mintzberg and McHugh, 1985; Preston, 1991; Weick, 1993b).

Artifactual productions. In addition to improvising behavioral productions the teams we observed actually created new physical structures without prior design. At a micro-level, teams sometimes improvised new product features, as documented by one example from our field notes:

FastTrack's design engineers were conducting a series of unrelated tests. During this process, it occurred to them that the product's safety and performance would be enhanced by adding a cover, and they quickly improvised a mock-up cover not in the product's plans.

They developed the mock-up as they went along, without going back to the drawing board. No external stimulus, such as information describing a new type of effective cover material, prompted the action, nor any exogenous request for this feature. Instead, their ongoing actual interaction with the specific materials and behavior of the product itself stimulated their design and simultaneous production of the cover mock-up. The mock-up persisted, received formal approval, and was included in the final product. [FT 11/21/94]

In another instance, the FastTrack team received cables that did not meet specifications. They needed to move the product along and did not want to fix the cables, so they improvised a new circuit board to accommodate the faulty cables (FT 01/16/95). In a final instance at FastTrack, a software upgrade on a FastTrack research instrument caused a moving arm to shift too frequently when taking measurements, which damaged the arm. Because an upcoming major product redesign would eliminate the entire arm, the team did not want to do a redesign of the arm itself to resolve the problem. Instead, they improvised a temporary "fix" with a small nylon washer (FT 6/30/95). This washer had never been part of any product design or specifications. The new feature was conceived, designed, and implemented as team members worked together to solve the perceived problem.

Many of the improvisational activities observed at SeeFoods also created new product features. The team often worked around a table or in the firm's kitchen, configuring products into various packages and designing prototypes as they went along. On one occasion when the team was in the process of working with product components for a new breakfast pizza, it developed several new features that had not previously been considered. These included product form (flat, rolled), various toppings (icing, sprinkles), and the temperature of the product (whether eaten hot or cold) (SF 12/19/95).

Occasionally, we observed artifactual productions at higher levels that improvised entire products. At FastTrack, engineers sometimes designed and physically generated products themselves without the help of marketing or manufacturing personnel. Such material improvisations were referred to as "scientist specials" and typically unfolded through interaction with specific customers or, in some cases, as part of scientists' ongoing activities while working on other projects. For example, one team learned from an established customer that the customer wished to analyze samples of a radically different nature than FastTrack's regular products could handle. Team members simultaneously designed and produced the new device during spare moments in their own labs, often using parts on hand while negotiating what the product would do. There was no separate product design and production phase.

Is this really improvisation? We argue that it is, for two reasons. First, during our period of observation, FastTrack developed new products principally using highly formalized procedures. These procedures required substantial written analyses of both market potential and technical issues that were reviewed by senior committees with full budgetary authority to authorize the project for development or to "kill" it. FastTrack planned practically every product in advance fol-

lowing these steps and evaluated them against the framework of the overall strategic plan. In contrast, creation of scientist specials evolved through ongoing interactions with customers and, in some cases, with materials or elements at hand of formally approved products. Some individual actions might be preplanned within the improvised projects; scientists, for example, might plan to call a potential supplier to see if a part was available and then carry out that plan the next week. The entire product, however, was improvised from the viewpoint of the top level of the organization's set of global priorities because it was designed at the same time it was produced. Crucially, the same team that was designing the product also physically produced it and actually handed it over to the customer. This contrasted with all other products that, once finalized, were physically produced by a separate manufacturing group.

Interpretive productions. We observed several instances in which teams improvised new interpretations or frameworks during intermediate stages of the planning process. In these cases, the production seemed to be the reframing of an event from one general framework to another. At FastTrack, for example, an engineer reported that correcting a program error unrelated to speed created an unanticipated outcome: an information search that had previously taken 22 seconds could now be completed in two seconds. While discussing the "bug fix" at one of the meetings, the team turned it into a speedy reporting feature that could be emphasized in marketing efforts (FT 12/05/94). This shift in interpretation marked the beginning of a process to work through the details of how to present it to customers. All of this was reportedly done without a plan, using only the team's interaction with the program as a guide.

Another new interpretation involved a FastTrack part that performed extremely well in some instances but was average to poor in others. It was particularly unsettling that there was no way of knowing in advance which parts would be good performers. One engineer explained during a team meeting that variability was inevitable for this sort of item and that nothing could be done to prevent it. The team then discussed whether customers who received a "hot" (high-performing) item in one shipment and an "average" item in the next would feel short-changed, regardless of the fact that both items performed at or above published specifications. Suggestions ensued. One person proposed that they test each part as it was received; another suggested that the vendor perform testing in return for a sorting fee. Either way, quality control would be costly. One of the engineers then proposed, "If you see a hot one, let me know. I can phone the customer and tell them we have this hot item and do they want it. Then they think: 'Oh yeah, FastTrack's really good guys. They look out for me'" (FT 11/21/94). At least from the team's perspective, a problem that might have threatened the perceived quality of their products was transformed through an interpretive improvisation.

In both cases, the team noticed a deviation from expectations. It could have been ignored, although the part variability would probably have to be explained to customers. Instead,

team members did two things: they actively reframed the meaning of the unexpected events in a novel way, and they infused the prior events with new meaning. The initial moment of improvisation occurred in the reinterpretation, although the entire improvisational activity included later steps—like calling customers about the hot items—that executed the new meaning. Some of these episodes resembled musical improvisation in which a musician plays an unintended note but goes on to play additional notes that create a pattern in which the previous wrong note now appears meaningful and melodic (Berliner, 1994).

It is important to note that if the interpretations had not been acted upon by the teams, they would not qualify as improvisation in our view, because there would be no "on-line" activity or production involved. Including interpretive improvisation among the types of improvisation identified to date is consistent with the literature. Preston (1991) described how a plant management team improvised new activities to deal with a strike, in part, through reinterpreting what kind of business they were in, which made different actions possible. Moreover, our observations indicated that these presumably rare events appeared to be an important part of improvisation in new product development.

Implications for the Improvisation Construct

Although prior reports of improvisation in the arts, therapy, and teaching emphasize behavioral improvisation, both artifactual and interpretive improvisations have also been described in varied settings. Our observations revealed a rather complex and nuanced combination of all three and convinced us that improvisation represents a special type of learning. Our close review of actual improvisational activity in multiple settings and our repeated interchanges about these observations caused us to reflect on prior definitions of improvisation and to propose two important refinements or clarifications about the definition of improvisation and our conceptualization of its link to other related constructs.[2] We had started with prior research's general description of improvisation as involving "no split between composition and performance . . . no split between design and production" (Weick, 1993b: 6). Moorman and Miner (1998b) specified that one good measure of improvisation would be the narrowness of the time gap between design and execution, but such a definition would also fit a firm outside our sample that used to generate one-of-a-kind products for specific customers following a three-week design and production process. This same firm now uses computer-aided design and computer-aided manufacturing systems that have reduced the process to about one day. The result is substantial temporal convergence between design and execution but is not improvisation, in our view, because each stage is still substantively distinct.

In our study, we saw products being designed and created as the teams enacted them. This means that production had an impact on composition in a way quite different from what might be expected if only temporal convergence of design and action occurred. With only temporal convergence, design

could take place just prior to an action, yet action would little influence how the design might unfold. Repeated review of our transcripts eventually suggested that the inseparability of the two processes could be much more fundamental: we saw them fused to such an extent that we could not disentangle them. Designing the nylon washer to fix the damaged FastTrack research instrument arm, for example, meant that assembly informed design at the same time that design informed assembly.

These field observations underscore an important defining quality of improvisation that has been described only generally in prior literature: improvisation requires material or substantive convergence. Substantive convergence implies temporal convergence because actions in which design and production converge with each other substantively also converge in time. Temporal convergence, however, does not guarantee substantive convergence. Using these observations as a guideline, we offer a refined definition: improvisation is the deliberate and substantive fusion of the design and execution of a novel production. This revised definition helps to illuminate improvisation's standing relative to other organizational constructs. It implies that an organization could, at any given moment, do nothing, enact preexisting routines in their usual patterns, plan an activity, execute a prior plan, or improvise. Table 1, which compares improvisa-

Table 1

Discriminant Validity among Improvisation and Related Constructs (Extending Moorman and Miner, 1998b)

Comparative constructs	Features of Improvisation		Novel	Deliberate	Comments about comparison and/or field quotes revealing differences
	Material convergence of design and execution	Temporal convergence of design and execution			
Improvisation: Deliberately and materially fusing the design and execution of a novel production	X	Implied by material convergence	X	X	
Adaptation: Adjustment of a system to external conditions (Campbell, 1969; Stein, 1989)			X		Adaptation does not necessarily involve temporal or action convergence. Adaptation can, in fact, be achieved through planning or deploying existing routines appropriately (e.g., adjust number of fire trucks to match size of fire). Some improvisations may involve adaptations to external events, but improvisations can also embody created opportunities.
Bricolage: Making do with the materials at hand (Levi-Strauss, 1967; Weick, 1993a)*	X			X	Improvisation increases the chances that bricolage will occur because there is less time to obtain appropriate resources in advance. They are not the same construct, however, as bricolage can occur in nonimprovisational contexts. Being skillful at bricolage may help produce valued improvisation.

Table 1

(Continued)

Comparative constructs	Features of Improvisation				Comments about comparison and/or field quotes revealing differences
	Material convergence of design and execution	Temporal convergence of design and execution	Novel	Deliberate	
Compression: Simplifying and shortening steps to reduce the time it takes to complete each and the total process (Eisenhardt and Tabrizi, 1995)*		X			Improvisation contrasts with compression in which the steps move faster but are still distinct. We observed compression in the field as this example suggests: "This is one where we are not just winging it. This is one where we are trying to follow the process and do it quickly" (FT 9/27/94).
Creativity: Intentional novelty or deviation from standard practice (Amabile, 1983)*			X		Creativity may involve absolutely no improvisation, as when an "off-line" plan or design is itself creative. A creative idea might never be executed. Creativity may, however, represent an unusually valuable competence for improvising organizations.
Innovation: Deviation from existing practices or knowledge (Zaltman, Duncan, & Holbek, 1973; Van de Ven and Polley, 1992)†			X		Innovation may be created through improvisation, but innovation can also be created by planning. Innovation is a necessary feature of improvisation, but this does not imply that all innovation is improvisation—only that improvisation is a special type of innovation.
Intuition: Typically examined at the individual level and conceived of as choices made without formal analysis (Crossan and Sorrenti, 1997)*					Intuition is a part of some improvisation, but improvisation can occur without using intuition, such as in the collective improvisation described by Hutchins (1991).
Learning: Experience informs a systematic change in behavior or knowledge (Argote, 1999)†	X	X			Improvisation is a special case of learning, but learning from the organization's own experience can also be achieved through experimentation, trial-and-error learning, and refinement or variance reduction (March, 1998).

* This process or activity may be a frequent or even universal element of improvisation but is conceptually distinct and may occur in activities other than improvisation.
† Improvisation can be seen as a special case or type of this much broader process.

tion with related constructs, modifies and extends a discussion in Moorman and Miner (1998b).

Focusing on the substantive convergence in improvisation also eventually persuaded us that improvisation, in fact, can be conceived of as a special form of short-term learning. We draw on the well-established view of learning as occurring when experience generates a systematic change in behavior or knowledge (Levitt and March, 1988; Argote, 1999). Our observation of substantive convergence underscores that there is indeed a direct link between experience and changed

action (either behavioral or cognitive in nature) during improvisation. In improvisation, real-time experience informs novel action at the same time that the action is being taken (during the act). This contemporaneous quality contrasts sharply with several other types of learning in which prior experience has the key impact on changed behavior or knowledge. This is not to say that prior experience is not an important factor in the incidence and effectiveness of improvisation, as others have observed (Weick, 1993a; Hatch, 1997a; Moorman and Miner, 1998b), but the impact of real-time experience on action is the defining characteristic of improvisation.

Improvisational Referents

In addition to looking at the different forms of productions, we also reviewed the data with an eye to factors that shaped the specific designs or composition that unfolded in each case. What were the organizations paying attention to as they improvised? We observed several types of these focal points but struggled at considerable length with how best to characterize the variety of these foci related to the improvisational activity we observed. Were they best seen as triggers? Results? Goals? After contrasting them with reports of other improvisations, we came to see them as improvisational "referents," borrowing a term from prior improvisational theory. Pressing (1984: 346) stated that improvisation typically has a referent "to facilitate the generation and editing of improvised behavior." Researchers who have focused on musical improvisation point to referents such as a melody, chord structure, or even a rhythmic structure that provides an implicit starting place and continuing touchstone for the improvisational activity (Weick, 1993c; Berliner, 1994; Hatch, 1997b). As Charlie Mingus is reported to have said, ". . . you can't improvise on nothing; you've gotta improvise on something" (Kernfeld, 1995: 119). The referent both infuses meaning into improvisational action and provides a constraint within which the novel activity unfolds. In our firms, unexpected problems, temporal gaps, and unanticipated opportunities provided crucial referents that anchored and constrained the improvisational episodes.[3] These referents and their impact on the process helped us probe further into the distinct traits of improvisational learning and enabled us to compare improvisational learning with the experimental learning processes we observed in these firms.

The formal plans for the projects we observed included detailed time lines, technical steps, and extensive outlines with subheadings for different aspects of product features, costs, and issues. The plans anticipated many problems in advance, such as dealing with the technical limitations of a particular electrical device or anticipated tensions between known consumer preferences. Despite these exhaustive procedures, unexpected events arose. Improvisation often followed several types of such surprises.

We observed early on that the teams often used improvisation to solve problems created by surprises in bringing a product to market. The FastTrack team faced design problems, materials that did not behave as expected, supply shortages, and faulty parts from suppliers. Missing package

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In many cases, the improvisation activity had other referents as well. This was sometimes a preexisting behavioral routine, product, or interpretive framework. *Organizational improvisations could,* therefore, also involve dual referents, including real-time problems or opportunities as well as preexisting artifacts and behavioral and interpretive routines. The presence of such dual referents may provide a more constrained action space within which instrumental improvisation occurs, in contrast to aesthetic improvisation, although this intuition remains to be tested.

prototypes caused SeeFoods to improvise new ways of conceptualizing food shapes and sizes without guidance about how they might fit into the package (SF 04/25/95). Sometimes the surprise was an unexpected problem that created a problem with timing. For example, improvising the nylon washer allowed FastTrack to keep its product in the market without massive redesign of a part that was to be replaced in the next generation of the product (FT 6/30/95). The value of this and similar jerry-rigged improvisations is that they permitted the organizations to move forward in one area despite unanticipated problems in another or to help solve the thorny problem of migration from one product generation to another (Garud, Jain, and Phelps, 2000).

Unanticipated opportunities produced a different type of surprise. Improvisation was sometimes used to create value from serendipitous conversations and chance encounters with customers, suppliers, and other organizational members. A FastTrack project manager described one such occasion, in which he received an unexpected call from a colleague in another division: "[This engineer] called me and said: 'I know [you have] this company in Boston and I am going to be in the area, a ten-minute drive away.' So [he told me] he could take another day or half-day and make this other visit" (FT 10/31/94). The project manager had not planned to get information from the Boston company but seized the moment and generated a list of questions for his colleague to ask. In other situations, opportunity-linked improvisations were triggered by an interaction with materials and people, as when FastTrack turned the unexpected outcome of a bug fix into a marketing feature (FT 12/05/94).

In some instances, team members initially framed their activity as solving a problem, but as they improvised, they generated novel actions or interpretations that transformed the problem into a perceived opportunity. In the case of FastTrack's parts-variability problem, for example, participants consciously provided a new interpretation and related actions for an unchanging fact (high part variance). SeeFoods' missing packaging prototypes initially posed a problem, but team members discovered during and after their improvisation that, from their perspective, the problem had turned into an unanticipated opportunity. This frame shifting in improvisational referent is interesting and represents an important potential role for improvisation because of its possible role in imbuing the same situation with quite contrasting meanings.

The referents we have described were all instrumental in that they sprang from efforts to advance organizational goals. Although this is harder to substantiate from the direct transcript data, we also concluded that some improvisational activity involved noninstrumental referents. When FastTrack engineers improvised the safety cover, for example, a key referent appeared to be its design value and parsimony, even though they also rationalized the production in terms of a practical opportunity.

Improvisational Learning vs. Experimental Learning

The specific nature of the improvisational referents gave the learning it embodied two distinct features. First, the organiza-

tional focus was on specific problems and opportunities and on the specific medium or materials involved in working with them. Even when improvisational activities involved novel insights or recombinations of past practices, they were tightly linked to the specific local issue and time. Second, knowledge creation itself was never the goal or main focus of any improvisational episode we observed. Insight or understanding, if they arose, were collateral outcomes of the improvisational activity.

Given these characteristics, improvisational learning contrasted sharply with the experimental learning we observed in both organizations, in which controlled situations were designed to produce, and typically did produce, some form of new knowledge. FastTrack prototype validation, for example, required prespecified tests under carefully controlled conditions (FT 10/5/94). Experiments using fish tanks examined temperature (FT 6/19/95) and equilibrium (FT 4/17/95). SeeFoods also deliberately sought information in controlled ways before assessing it, as when it researched the properties of packaging materials (SF 1/18/95) and used focus groups that responded to carefully designed examples and questions (SF 03/14/95). These activities clearly fit standard definitions of experimental learning, in which the learner deliberately creates contrasting situations in order to generate systematic experience (Cook and Campbell, 1979). The deliberate knowledge-discovery in such experimental learning contrasted sharply with improvisational learning as we observed it. Table 2 compares this type of organizational learning with improvisational learning, as well as with trial-and-error learning, which we discuss in more detail in a later section.

In experimenting, the organizations deliberately varied activities and conditions, such as changing the temperature in which a part was tried or giving potential customers different sizes of a product. The nature and degree of this variation was typically planned in advance and was designed to elicit general, explicit knowledge about causal factors. When improvising, however, teams typically sought no more variation than was needed to address the immediate problem or possibility.

This is not to say that improvisational learning never produced new cognitive knowledge. During some improvisational troubleshooting in both firms, the teams sometimes gained new insights into technical facts or consumer preferences they had not known in advance. This new knowledge was a collateral—not an intrinsic or even intentional—outcome of the improvisation and was constrained by the specific material, temporal, and cognitive situation. As shown in table 2, the improvisation we witnessed met the core definition of learning but represented a somewhat unorthodox type of learning: long-term knowledge creation was only a byproduct, if it occurred, and the experience was highly localized in time and context. These unusual features brought us to our second major focus, as we turned to our data to explore how improvisational learning relates, if at all, to long-term organizational learning and adaptation.

Table 2

Characteristics of Improvisation vs. Experimental and Trial-and-error Learning*

Characteristic	Improvisational learning	Experimental learning	Trial-and-error learning
How experience links to change in behavior or knowledge	"Real-time" experience informs the design of performances or productions as they are executed.	Varied "off-line" experiences are deliberately created and examined to see how actions under different conditions at one time produce varying outcomes at a later time.	Actions are taken "on-line" and their consequences occur. The total experience of actions and outcomes informs further action or knowledge.
Typical purpose of learning	To solve a surprising problem and/or create value from an unexpected opportunity.	To acquire new information, knowledge of relationships, or causal laws.	For intentional trial-and-error learning, to carry out regular activities and prior plans, observe outcomes, and then revise future action or understanding as needed. Unplanned trial-and-error learning may also occur (Miner, 1989).
Nature and extent of initial variation in inputs and process	Low: No preplanned deliberate variation in inputs. Organization draws on real-time information to generate a specific new activity pattern focused on local context.	High: Inputs are deliberately varied and contexts compared so outcomes can be attributed to inputs.	Medium: Organizations often repeat activity that appears to produce successful outcomes and avoid activity if disappointed. Contrasts of before-and-after focal behavior are also possible (March and Olsen, 1976; Cheng and Van de Ven, 1996).
Post-hoc reflection on links between actions and outcomes	Absent or low: Little automatic reflection because the focus of the action is to get a problem solved or to take advantage of a specific opportunity.	High: Reflection is high because observing outcomes under varied conditions is the goal of activity. Likely to notice absence of differences as well as contrasts with expectations or the past.	Moderate: Unexpected outcomes of activity may be noticed. Reflection on outcomes of behavior can occur, but is not necessary. Unlikely to notice things expected or similar to past.
Quality of knowledge generated	Behaviors are likely to have local value (tailored to a very specific context) and knowledge to be idiosyncratic to time or place.	Knowledge or behaviors gained are more likely to be generalizable, systematic, and contain information about main and interaction effects.	Knowledge may be general from contrast of before-and-after effects but still be localized and involve simple comparisons.

* We focus on these three types of learning because they are all capable of producing novel outcomes, unlike other types of learning, such as practice learning or variance reduction, which do not involve innovation.

IMPROVISATION AND LONG-TERM ORGANIZATIONAL LEARNING

Repeated review of the transcripts clearly showed that improvisation had a widely varied long-term influence on organizational activities. In some cases, the outcome was fleeting, with little or no lasting impact on the firm or even the project. In these cases, it could be said that there were no long-term learning outcomes, and no substantial change occurred in organizational memory. In other cases, the improvisational production or collateral insights generated during improvisation became a more permanent organizational feature, whether within a particular project or more broadly in the organization. In those cases, improvisation played a role in long-term learning, although we make no assumptions about whether such long-term learning is either adaptive or accurate (Levitt and March, 1988; Levinthal and March,

1993). Some improvisational productions seemed to represent "trials" for long-term organizational trial-and-error learning. In contrast to this positive role, improvisation also sometimes had deleterious effects on both long-term learning and adaptation.

No Long-term Impact of Improvisation

Some improvisational activities were ephemeral and left no trace in the organizations. At FastTrack, for example, a team improvised a computer system, found it did not work as expected, and quickly forgot it (FT 11/23/95). Both the event and any potential lessons from it left no trace that we could detect. Teams also improvised new procedural steps that they did not seem to repeat later or even seem to remember. SeeFoods improvised an unplanned switch to emphasize a line of plain, high-taste, and low-fat products (SF 02/24/95). The improvisation seemed to be critical, but the team did not sustain the approach nor remember it as a rejected alternative. Similarly, SeeFoods' use of internal focus groups did not alter its established product development processes in any permanent manner.

Improvisation as an Element in Long-term Trial-and-error Learning

In other instances, improvisational episodes seemed to have long-term impacts. Reviewing multiple improvisational episodes revealed that improvisational productions sometimes served as grist for higher-level processes of long-term trial-and-error learning, although they did not always do so. Trial-and-error learning refers to a process in which an organization takes action "on-line," and the consequences of that action lead to change in action or knowledge base (March and Olsen, 1976; Cheng and Van de Ven, 1996; Van de Ven and Polley, 1992). In behavioral trial-and-error learning, the organization may simply repeat apparently successful actions. In more cognitive trial-and-error learning, observers may reflect on the consequences to develop new causal models or information. To explore how improvisation played a role in this, we first defined the notion of retention of an improvisational production. Retention in this context refers to the degree to which the improvised production or collateral insights are made a permanent part of the organization's artifacts, processes, or knowledge (Miner, 1989; Van de Ven and Polley, 1992; Moorman and Miner, 1997; Argote, 1999).

Some improvisation productions were retained by the organizations we observed. At FastTrack, the improvised circuit board design and the product's safety cover (artifactual productions), as well as the buried software interface (new organizational process), were retained throughout our study period. Some problem-oriented improvisational troubleshooting produced outcomes that did not work, and the team retained these insights for future reference. In other cases, FastTrack customers became aware of a scientist special and expressed interest in obtaining it. In rare cases, the firm then froze a product's specifications, named it in formal product lists, and transferred production to the manufacturing group. Thus, an idiosyncratic production linked to a specific local set

of constraints became a replicated product embedded in the whole set of standard practices and products of the firm. After SeeFoods successfully moved its breakfast product into the market in a quarter of the typical time, the firm retained several of the strategy's features for use, even in situations not requiring fast response. This retention involved not only repeating some of the improvised steps but reflecting on how they worked and developing new mental models of the product development process (SF 12/9/98).

These patterns of selective retention and replication of certain improvisational productions and collateral insights show that improvisation can serve as the first step in long-term trial-and-error learning (March and Olsen, 1976; Van de Ven and Polley, 1992). The patterns also help clarify how improvisation is distinct from trial-and-error learning itself. Table 2, above, depicts how improvisation compares conceptually with trial-and-error learning. A complete improvisational episode occurs when the improvised production is complete. The improviser cannot and does not wait to know the consequences of the improvised production while executing it. In contrast, a complete episode of trial-and-error learning occurs only after outcomes of action have been experienced, and new actions or inferences arise, specifically based on the consequences of completed action. When a FastTrack team noticed that a new material selected during the planning process didn't perform as expected (the trial and consequence) and revised plans for future products based on this experience, trial-and-error learning—but not improvisation—occurred. As shown in table 2, our data paint improvisation as a special form of short-term, situational learning that can, but does not necessarily, serve as a "trial" in long-term trial-and-error learning.

Table 2 also highlights that both trial-and-error and improvisational learning involve on-line initial activity, in contrast to experimentation, in which different things are typically tried off-line. If trial-and-error learning involves deliberate reflection on the causal processes that produced results, however, then it represents a hybrid that incorporates both on-line and off-line learning activities (Gavetti and Levinthal, 2000). Because experimental learning typically involved more variation in actions and context than either improvisational or trial-and-error learning, it could generate more general knowledge.

Improvisation's Harmful Impact on Long-term Learning and Adaptation

Although we noticed how improvisation could play a positive role in long-term trial-and-error learning, our extended review of field data also revealed several ways in which the improvisational activity impeded other learning processes. For example, the SeeFoods team put the development of a salad line on hold to pursue sandwiches so the team could focus its energy on only one project (SF 05/23/95). Although this improvised activity temporarily focused the team's action, because the action ran counter to research evidence one cost of this focus was the loss of knowledge gained in prior research and prioritization. Improvised activities involving FastTrack scientist specials were also sometimes seen as

distracting from the original plan for a particular product or as likely to create knowledge that would not be integrated well with other activities (FT 11/28/94). We also observed, and senior officers stated, that scientist specials sometimes drew resources from preexisting strategy that was the result of intensive investigation about market potential, broad customer preferences, and firm-level objectives (FT 12/2/94). Table 3 notes this destructive potential of improvisational learning along with other long-term impacts as compared with other types of learning.

In some instances, improvisational activity seemed to replace or foreclose more formal experimentation, as when the Fast-Track team members debated whether to improvise a prototype in the absence of drawings or to wait for the drawings so that they could set up tests and experiments:

Mfg. Rep: We're ready to build but don't have the documents to build.

Table 3

The Impact of Improvisation vs. Experimental and Trial-and-error Learning on Long-term Organizational Learning*

Impact	Improvisational learning	Experimental learning	Trial-and-error learning
Long-term retention of learning outcomes	Low: The focus of the activity is not to generate new knowledge but to get problem solved rapidly or take advantage of specific opportunity.	High: Because long-term learning is the goal of the activity and formal procedures are therefore likely to exist to capture findings.	Moderate: Learning may or may not be the goal. Regardless, the organization may repeat actions with apparently good outcomes, and actors may notice and use systematic outcomes from prior activities.
Impact on other organizational activities	Activity is on-line and impact may be difficult to anticipate and mitigate. If context has high interdependence, improvisation is more likely to have unexpected harmful impact. May draw attention away from prior learning and related priorities.	Action is off-line and experiment is completed before consequential action that has implications for the organization is taken. Can examine and manage potential interdependencies before final action. Likely to be integrated with prior learning and related priorities.	On-line actions and outcomes drive learning, but off-line reflection and/or changes to action occur only after consequences of prior action are known. May be less likely than improvisation to produce unexpected harmful impacts associated with interdependencies, but more likely than experimentation.
Link to higher-level capabilities	Organizations can develop and maintain capabilities at fruitful improvisation. Additional capabilities may be needed to link this short-term form of learning to long-term organizational learning.	Organization can develop and maintain explicit capabilities in experimentation in the form of research skills.	Organization can develop and maintain capabilities at intentional trial-and-error learning through procedures that allow it to observe the outcomes of its own actions (i.e., post-mortems) and derive knowledge and/or different actions from them.
How improvisational learning interacts with these other types of learning to affect long-term learning processes	Improvisational learning itself occurs in real-time, with no intrinsic long-term learning outcomes.	Improvisation can drive out experimentation.	Improvisational episodes can serve as trials for long-term trial-and-error learning process.

* We focus on these three types of learning because they are all capable of producing novel outcomes, unlike other types of learning, such as practice learning or variance reduction, which do not involve innovation.

Project Leader: I'm afraid that if we wait for all the assembly drawings, it will be too late. If, for example, we find a cover that has to be modified.

Mfg. Rep: Our purpose now is to identify everything that has to be done in a pilot build. . . . [V]erifying main bench performance, running through test specs, running to maximum power—any of these may give us action items to resolve. Realistically, there should be a formal test plan written. [FT 12/12/94]

In this instance, the manufacturing representative strongly favored the pre-planned "formal test plan" to generate systematic knowledge. The project leader felt forward motion had top priority and favored improvisation. How and whether improvisation may drive out experimentation obviously has important implications for improvisational learning's impact on organizations.

Even if it did not reduce the value of prior learning or drive out experimentation, both firms observed that processes we would define as improvisation were seductive but dangerous to their long-term strategies because they could fragment firm efforts. As one FastTrack respondent told us, "[The company] was jumping the gun on every new opportunity, and anybody who had an idea for something immediately started pursuing it. We split resources quite a bit, and also we lost focus somewhat from the core business. . . ." (FT 9/25/94).

Beyond the fragmentation of whole product lines, improvisation could potentially produce actual incompatibilities at various levels. At one FastTrack team meeting, the group agreed that a prior team's improvisational activities created problems that reduced the current team's ability to fix other problems (FT 12/05/99). In another session, they considered improvising around a prior design but decided to exercise caution: "I told Dan we want to cut off 3/8 of an inch. That would be ideal. But if it looks like we're going to have to start moving things around . . . which equals time . . . which may mean that more doesn't work because the layout changed . . . don't do it" (FT 01/01/95). Here, the team worried about potentially incompatible physical features of the product. In addition, multiple improvisations of individually attractive product features could also produce specification creep, which made the product no longer match the original market for which it was targeted.

The FastTrack team seemed more comfortable improvising technical features that were part of relatively independent subassemblies rather than improvising elements that were likely to interact with the whole complex product design. Such a pattern is consistent with the notion that improvisational adjustments are more problematic when product features are not independent of one another (see table 3). The danger of improvising whole product features is intuitively clear, because they must all eventually work together in a physical product. Less obviously, improvisation could produce incompatibilities between new product processes underway and/or ways of thinking about the project, although we did not observe such incompatibilities directly.

Last, improvisation sometimes generated organizational conflict. In one team, for example, the manufacturing representa-

tive frequently argued against continuing improvisation that led to changes in product features and expressed dissatisfaction with the lack of final specifications: "There's a lot of work that must be done this week which stems from the fact that the design wasn't frozen" (FT 12/12/94).

In some prior work on product development, observers have speculated that psychological or cultural differences among scientists and marketing and manufacturing professionals produce different preferences for formalization and early lock-in (Dougherty, 1990; Tushman and Anderson, 1997). Close review of our data suggested that the conflict may also arise from the different ways in which improvisation's value and dangers influenced each group's responsibilities. Manufacturing was where "the rubber hit the road" in terms of any problems with incompatibility and inconsistency. Once the physical product is assembled and shipped, only a product recall permits another change. Marketing and scientific professionals saw improvisational activity as tools for flexibility and adaptability, which sometimes generated conflict at higher levels with financial and manufacturing managers, who tended to see improvisation as a dangerous source of inefficiency and costly errors.

In spite of these dangers of improvisation, both firms permitted and, in some cases, facilitated improvisational activity. This apparent puzzle leads to the final link we observed between improvisation and long-term learning: both firms appeared to have developed several distinctive competencies related to improvisation itself.

Organizational Competencies in Improvisation

Repeated reviews of our data indicated that the organizations had gained something more fundamental from improvisation than the solutions to specific problems, exploitation of new opportunities, and the adaptive gains from repeating useful improvised productions. We observed that the organizations appeared to have learned how to limit the special risks of improvisational learning and/or to facilitate fruitful higher-level improvisational learning. In considering these practices, we concluded that both organizations appeared to have developed organizational competencies related to improvisation in different functional areas. We could not directly observe the actual development of these competencies, which appeared to have unfolded over many years in each firm, but we observed consistent manifestations of these competencies at several levels of analysis.

Generating improvisational activities. We observed meta-routines in each of the organizations that enabled them to generate or facilitate improvisation. It appeared that at one time in FastTrack's history, scientist specials did not have a distinct name or set of norms associated with how they might unfold. By the time we observed the firm, FastTrack appeared to have several ways in which scientist specials could unfold, but informal judgment was involved in how to tackle them. If, for example, an idea for a scientist special approximated a modification of an existing project, it could proceed via completion of a special form. Other scientist specials were simply noted as special projects, although by the

end of our observation period they had received a specific designation indicating that engineers would design and personally produce the product. Not surprisingly, the company was more likely to approve such whole-product improvisation when the proposed scope was small.

SeeFoods also appeared to have institutionalized higher-level routines that were an ongoing source of improvisation. Prior to our observation period, the product design group had retained a consultant who worked with groups to provide new product ideas. Because few of these ideas became products, a vice president developed a model that attempted to avoid segregating planning and execution in product design. We observed several carefully orchestrated interactions between a product team and a host of internal and external visitors who worked together for a day on a particular strategic-level question regarding a new product. The key feature in the context of improvisation was the firm's deliberate effort to merge execution issues, such as material and manufacturing details, with the creation of the entire product line. Therefore, although specific activities were scripted, they were designed to achieve improvisation. Interviews revealed that SeeFoods prided itself on maintaining a culture that condones and even encourages improvisation, without using this term to describe it.

Generating valued improvisations. The firms' practices that facilitated improvisation also influenced the nature of what was improvised. Although it is very difficult to make systematic claims without more controlled comparisons, we thought the firms tended to improvise in certain areas with good results. FastTrack, for example, displayed a competency specifically for technical improvisation at several levels of activity that it deliberately sought to retain in a certification process it finalized during our observation period.

The new administrative standards required that all products follow a formal, written development process that would be audited to ensure compliance, with no exceptions whatsoever. Although scientist specials did not follow linear product development planning, check-offs, reviews, or any formal procedures, the company did not eliminate scientist specials or even add any structure to govern them. Instead, it created, on paper, a new "Track III" official product development process that involved no prior planning, market evaluation, design specification, or production planning. A technical team improvising a scientist special could then label its activities a "Track III" product and continue to improvise an idiosyncratic product with no change in its usual activities (FT 04/17/95). The organization's decision to legitimize product improvisation seemed to reflect its confidence in and evaluation of its own technical improvisational competency. FastTrack records and behavior did not reflect a parallel confidence or apparent skill in other improvisational domains.

Other observations indicated that the firms had developed competencies at generating fruitful improvisation through meta-routines that could reduce the chances of harmful improvisations. FastTrack fostered two types of complementary safeguards against the dangers of improvisation. In par-

ticular, the teams were aware of potential specification creep in regular projects. In addition, scientist specials were constrained by the formal structure of the organization and by engineers' own internalization of the firm's goal of profitability.

SeeFoods dealt with some potential dangers of improvisation by emphasizing certain windows of time in which improvisation was valued and using it during those time periods. This approach resembles the improvisational patterns that jazz musicians follow when allocating blocks of time during which improvisation occurs. As at FastTrack, the evidence pointed not just to organizational channels permitting improvisation but also to a tendency for the improvisation to be productive. SeeFoods considered some procedures for stimulating improvisation proprietary, attesting both to the firm's awareness of its improvisational competencies (although the company would not label them as such) and belief in the potential value of these procedures. Evidence of a complex, routinized improvisational competency was also found in follow-up interviews one year later, when it was discovered that the firm had evolved from the use of ideation sessions to produce improvisations to a more complex process in which team members used a fused design to prepare prototypes that they shared with consumers on the following day. SeeFoods management believed that this process could truncate the development time by half for a new product development effort.

Harvesting valued improvisations. The two firms sometimes retained individual improvisational productions they created and replicated them in other settings. In both organizations, we discovered that improvisational productions—whether a procedure or an artifact—were selectively harvested. In such selective retention, apparently unsuccessful improvisations were not routinized. Therefore, the presence of these competencies involved a complex relationship between real-time improvisational learning during the production of an individual product, feature, or process and later trial-and-error learning, in which the improvisational episode served as a first step. FastTrack's ability to harvest technical improvisational productions within a given project seemed to reside primarily in the observational skills and memory of specific teams and engineers who paid close attention to activities and served as an informal organizational memory. At a higher level of analysis, the deliberate harvesting of the entire scientist-special process to reproduce a previously one-of-a-kind product for a wider market also represented a complex, organization-wide improvisational competency.

SeeFoods also harvested many valued improvisational productions. Management encouraged team leaders to review projects and to document deviations from plans—including any improvisational activity—so that they might be evaluated and, if valuable, possibly be incorporated into future projects. SeeFoods' senior management also reviewed and theorized about the micro-dynamics of formal and informal product development processes, including how the organization could encourage teams to learn from one another. Reports on procedural changes in product development over time suggest-

ed that SeeFoods had a skill in recognizing fruitful process improvisations, including those generated in response to surprising events, along with skill in trying to deploy them in other settings. Consistent with industry trends toward deliberately trying to codify more organizational knowledge, upper management appeared to systemize cross-project learning through formalized interteam knowledge transfer procedures. During the period of our observation, however, the informal organizational competencies developed to detect and retain apparently useful innovations, including improvised actions, seemed to pre-date this more explicit effort.

Our observation of these competencies still leaves ample room for additional biases and dangers in generating and harvesting improvisation (Miner, Moorman, and Bassoff, 1997). Our research strategy revealed evidence of their existence, but we could not assess whether the competencies were sufficient to overcome fragmentation, for example, or to maximize improvisations' full benefits for these firms.

DISCUSSION AND CONCLUSION

Extensions and Contrasts with Existing Improvisation Literature

Organizational improvisation. Much theory and research on improvisation has focused on individuals and small groups, but, consistent with work in other fields, our study highlights organizational improvisation. While our field observations suggested that individual improvisation was often part of team- or organization-level improvisation, other processes were collective, as when the entire group devised a product change that no single individual had designed. These findings parallel other research demonstrating that a collective can design a new action pattern without advance planning and even without members' awareness of the pattern as they execute it (Hutchins, 1991). Furthermore, the distinct competencies in improvisation did not appear to reside in specific individuals; rather, they flowed from broader organizational routines, cultures, and collective capabilities. These factors also imply that improvisational action can occur and be studied at any level of analysis, including strategic improvisation by an entire firm.

Previous work tends to report on one specific form of improvisation, but our observations indicated at least three types of improvisational productions (behaviors, artifacts, and interpretations), as well as varied instrumental referents, such as problems, temporal gaps, and opportunities that both focus and constrain improvisational action. This variety stimulated us to consider several basic aspects of improvisation as a construct and activity. Future research can fruitfully consider the implications of different improvisational forms and referents for organizational performance.

The value of improvisation. Hatch (1997a) has suggested that organizational researchers may fall prey to romanticizing improvisation's likely value for organizations or the difficulty of generating high-quality improvisation. Our observations supported this concern, but they also advance our understanding because they make explicit several specific, distinct

ways that improvisation can both bear fruit and raise dangers for organizations. The observations suggest that future researchers should not expect a single benefit from improvisation; instead, we should anticipate and examine such disparate valued outcomes as temporary action patches, troubleshooting, the successful use of serendipitous opportunities, and even aesthetic creations.

Our findings also imply that the improvisational context should influence the trade-offs between benefits and dangers. They are consistent with the intuition that the degree of underlying interaction in the system, sometimes termed epistasis (Kauffman, 1996; Levinthal, 1997) or complementarity (Milgrom and Roberts, 1990), will moderate improvisation's impact in two ways. First, in highly interactive systems, individual improvisational actions have a greater chance of causing inconsistency and coordination problems than they would in a modularized system. Although this is easy to see in the case of product features, the same logic applies to interactions among behavioral routines, interpretations, or whole strategies. Second, improvisational activity often precludes systematic variation in several different causal factors, so it is less likely to produce good knowledge about interaction effects themselves (Kauffman, 1996). Aggressive investigation of how this and other contextual factors may influence or bias the value of improvisational learning seems especially promising for further work (Miner, Moorman, and Bassoff, 1997).

In contrast to Moorman and Miner's (1998b) prior predictions, we did not find that these firms had developed general improvisational competencies; rather, they had developed improvisational competencies in very specific areas. This finding may be partially explained by Schön's (1983) claim that the medium of interaction (e.g., an architect's sketch pad, the relation between a patient and therapist, or the materials used by FastTrack engineers) has a crucial impact, such that competencies are rooted in a specific domain. Although Schön had in mind improvisation by individual professionals, our findings suggest that the specific medium of organizational interaction might similarly shape and bind organizational improvisational competencies to particular areas of activity. This possibility underscores the potential value of research on how improvisation may help create and sustain distinct communities of practice in organizations (Brown and Duguid, 2001).

Defining improvisation. Our work also refines some prior definitions of improvisation while encouraging resistance to the inclusion of unnecessary additional features in its definition. Specifically, our emphasis on substantive rather than temporal convergence of planning and execution should help empirical researchers distinguish improvisation from rapid sequencing of distinct action steps, which Eisenhardt and Tabrizi (1995: 85) called a "compression strategy" when done deliberately to achieve rapid product development. As organizational memory and organizational processes become embedded in rapid electronic processing systems, this definitional refinement should help keep improvisational research

clearly distinct from research that investigates compressed stages.

Some improvisation scholars have implied that its definition should include such constructs as the use of the improviser's rich prior background or memory as part of improvisation itself (e.g., Crossan and Sorrenti, 1997; Cunha, Cunha, and Kamoche, 1999). We suspect that several of these suggested additions arise because the writers, in developing their definitions, have focused on examples of successful improvisation carried out by skilled improvisers. Our field observations made clear that improvisation can also be unskilled and can cause harm. This convinces us that it is crucial to avoid delimiting improvisation in ways that restrict it to success if we are to build an empirical literature that can elucidate factors that moderate improvisation's impact. Some organizational learning research, for example, has suffered from a tendency to conceptualize learning as occurring only when it is accurate or useful. This has sometimes choked off research on the factors that influence when learning is and is not accurate or useful (Levinthal and March, 1993; March, 1998; Miner and Anderson, 1999). In this formative stage of the empirical literature on improvisation, we argue for the basic definition used in this study to leave open for future research questions of how it is correlated with other important activities.

In many cases, we observed improvisation emerge under time pressure to solve problems or address opportunities quickly. This is consistent with other work indicating that external time pressure, coupled with lack of relevant prior routines, may well be a common trigger for improvisation (Weick, 1996; Baker, Miner, and Eesley, 2001). We do not include it in our definition, however, because inactivity is always possible, and there were other triggers for improvisation even in our goal-oriented setting, such as the safety cover that FastTrack engineers just made up as they went along. The prediction that external time pressure will increase the odds of improvisation is an empirically testable prediction.

Having said that, we note that in this study we sought common patterns in improvisation in action, which leaves considerable room for further empirical work on the ways in which improvisation may vary. First, considering the novelty component in our definition, improvisation episodes may vary in two ways: in the overall proportion of activity that is innovative and in the degree to which the novel activities represent a departure from preexisting plans or routines, regardless of their proportion of the whole. For example, an episode might involve a large proportion of innovative activity, as when most parts of a new product are improvised, but still exhibit low radicality, as when the improvised new parts are similar to parts in prior products. Prior categorizations of improvisational intensity have often merged these qualities, although they may have different implications for the value and risk of improvisational activity.

Measuring improvisation. The emphasis on substantive convergence of design and implementation means that

Moorman and Miner's (1998b) suggestion that organizational researchers consider the length of time between plans and implementation as an indicator of improvisation is incomplete. Through computer-aided design, for example, a firm might be able to reduce the time between product design and production but not engage in improvisation, because the two processes remain distinct. This emphasis also points to the value of trying to measure the positive interaction that merges design and execution rather than viewing the absence of formal planning as a measure for improvisation.

Prolonged interaction with our sites also convinced us that improvisation can and should be studied using both qualitative and quantitative approaches. Our initial observations were driven by a qualitative analysis of meeting transcripts, interview notes, formal planning documents, and archival information. In a concurrent effort, we also developed formal paper-and-pencil tools to capture teams' impressions of many aspects of a very small sample of 100 narrow actions that occurred early in our observations. The informants' ratings of the incidents on a 7-point scale indicating the degree to which an action was extemporaneous was 4.52 (s.d. = 1.98). Our separate ratings as site observers of the same incidents was 4.01 (s.d. = 1.54) on a scale on which 7 indicated "high improvisation." This small, random sample was limited to within-project actions and therefore did not match the set of examples of improvisation we detected in our review of the transcripts and described in this paper. Nonetheless, the convergence of these ratings seems promising for both self-report measures and observational measures of organizational improvisation. Future work can clearly enhance their development.

Our observation that organizational improvisation can occur at different levels of analysis raises another crucial measurement issue. We noticed that we needed to pay close attention to the organizational level and time frame used as a frame of reference for judging whether improvisation had occurred. It was crucial, for example, to contrast scientist specials with FastTrack's original strategic plan, which included approved product families and specific lines within those families, all based on prior reflection about how the firm should deploy its attention and assets. Scientist specials meant that the overall strategic product development program was being modified as these products were created. Within the implementation of these scientist specials, there were varying degrees of concurrent product design and execution. Future research could investigate whether firms display a consistent tendency to improvise at many levels at once or whether they improvise at one level but not at another.

Further, our interaction with the data underscored that one must pay careful attention to the level and temporal pace of regular organizational planning and innovation as part of a reliable method to assess the occurrence of improvisation. This does not mean that assessment of improvisation is subjective and depends on any special viewpoint of the observer. It implies that a standard step in assessing improvisation should be to assess explicitly the level of organizational

design or planning involved. One heuristic is to consider what level of formal planning would be relevant to the activity at hand and then contrast the action to that level of formal design. We clearly saw that improvisation at different levels of action can be independent.

Extensions and Implications for Organizational Learning

Our findings extend the menu of distinct organizational learning processes by explicating improvisation as a special type of learning. This raises the issue of how improvisational learning contrasts with experimentation and trial-and-error learning, because all three can involve the creation of novel actions or knowledge. These contrasts suggest that improvisation represents a form of real-time, short-term learning that may or may not influence other learning processes. Second, improvisation is a double-edged sword that has the ability to enhance other learning processes and to detract from their value or operation. Finally, organizations appear to be able to develop competencies in generating and deploying improvisation in spite of its dangers, although these competencies may be localized.

As described, both companies we studied had extremely well-developed routines for knowledge discovery through experimentation. Because learning was the specific goal of experimentation, transcripts revealed that outcomes were often carefully observed and recorded. The focus on intentional learning also encouraged reflection on potential meanings of different outcomes (FT 4/17/95, FT 5/15/95); in some cases, those involved noticed no differences between conditions. In contrast, as we noted earlier, the goal of improvisation was not learning per se. Rather, improvisation arose as the firms struggled to deal with surprises. The intense attention to one specific context and the often implicit rule of ending the improvisation when a problem was solved or an unexpected opportunity was exploited meant that improvisational learning was far more likely to produce context-dependent knowledge. Moreover, improvisational learning could not be used to test interaction effects in the way that experimentation could. Finally, because the goal was not learning, knowledge outcomes were often not recorded or preserved for retention or transmission in the organization.

On the one hand, improvisation not only contrasted sharply with but, in some cases, seemed to drive out experimental learning, making the balance between them an important issue—given their different value to organizations—that has been understudied. Improvisational learning episodes did not necessarily drive out trial-and-error learning, however, but, in fact, sometimes served as trials for such learning. The sequence in which an improvisational activity was repeated after the organization registered its outcome amounts to trial-and-error learning in the end. We suspect this not uncommon sequence accounts, in part, for some of the conceptual and empirical confusion between improvisation and trial-and-error learning. Both trial-and-error learning and improvisational-learning processes were grounded in a specific context, involved actions with real consequences, and initially lacked the off-line quality of experimental learning.

On the other hand, repeated improvisational learning without trial-and-error learning can create "opportunity traps" that produce unintended drift or fragmentation over time. Within an individual project, improvised improvements of specific features can have an aggregate impact by the end of the process such that the product no longer matches the original market niche. At the level of whole new products, unchecked improvisational activity can generate excessive numbers of inconsistent products over time, a standard dilemma in the strategic management of product development (Burgelman, Maidique, and Wheelwright, 1996). More broadly, then, our observations imply that improvisational learning that exploits unanticipated opportunities may generate a chain of opportunistic actions, each of which appears to embody adaptive learning or benign opportunism (Miner, 1987) at the time. When taken together, however, the actions eventually can produce de facto strategies that are not adaptive for the entire organization.

Finally, as noted above, because of their nonsystematic nature and one-at-a-time contrasts, both improvisational and trial-and-error learning are especially likely to produce disappointing learning when there are strong interaction effects (i.e., complementarities or epistasis) in the learning context.

Considerable prior research has argued that preexisting memory influences the execution and quality of improvisation, as we noted in our introduction (Berliner, 1994; Pressing, 1984; Hatch, 1997a). Our study completes the loop by exploring ways in which improvisation can in turn influence memory, thereby contributing to theories of organizational memory (Walsh, 1995). The observations point to no single inevitable way in which improvisation affects organizational memory, however, but highlight instead a variety of possibilities. This invites further work on when and how such improvisation-induced changes in long-term memory occur.

Study Limitations

This study remains exploratory, in part because we limited our observations to two firms in order to get sufficient details to observe improvisation directly over nontrivial lengths of time. By finding common themes between a consumer firm and a scientific-product firm, we believe some generality was gained, but clearly it would be helpful to examine improvisation in a range of firms.

We also focused on improvisation specifically within product development, although prior work has also described improvisation (although not necessarily using this term) in production (Stoner, Tice, and Ashton, 1989), job creation (Miner, 1987, 1989), crisis response (Hutchins, 1991; Preston, 1991), organizational technological change (Barley, 1986), and even military activities (Metcalf, 1986). It might be that improvisation is more likely within product development than within other organizational activities, although it is not clear that such a frequency bias would alter the potential for varied types and impacts of improvisational learning.

Our focus on varieties rather than degrees of innovation in improvisation, along with the fact that both firms had highly

formalized product development procedures, reduces concern that the study's setting overdramatizes improvisation's presence. Nonetheless, close observation of improvisation in other organizational activities could extend and, perhaps, even challenge the types of improvisation we observed.

Neither firm we studied was an artistic or high-technology firm, reducing the chances that the links to learning represented idiosyncratic patterns for unusual firms. Both firms represented thriving, actively adaptive firms, however, which may have enhanced their chances of developing competencies at improvisation. Given our inductive approach, future research should engage in careful testing of our concepts and relationships in a generalizable sample of firms.

Implications for Other Literatures

New product development represents an important mechanism through which organizations adapt to their contexts and sometimes shape the settings in which they compete. Eisenhardt and Tabrizi (1995) argued that organizations can speed up product development by compressing distinct phases or by merging them in ways that include improvisational activity, although they did not directly observe improvisation itself. We did observe improvisation in the product development process and support their supposition that it occurs. Other observers have also noted improvisational processes within the technical development of products (Dougherty, 1990, 1992; Leonard-Barton, 1995), but our study provides additional insight into the question of how improvisation occurs and may even be institutionalized.[4] Although this juxtaposition of innovation and order is not new (Burns and Stalker, 1961; Nord and Tucker, 1987; Jelinek and Schoonhoven, 1990), much literature still tends to dichotomize the two (Tushman and Anderson, 1986; March, 1991). Therefore, by providing insight into how firms sometimes operate to harvest and retain improvisation and by describing some of the mechanisms by which firms generate improvisations, we have advanced the literature in this area. Further, our results add to and reinforce trade-offs between the advantages and disadvantages of improvisation in product development, creating an area ripe for empirical research.

Entrepreneurship. Improvisation also offers a very promising lens for investigating entrepreneurial processes. Many entrepreneurs do not formulate careful plans when starting their businesses but, instead, respond to sudden opportunities in ways that fit our definition of improvisation (Baker and Aldrich, 1994; Baker, 1995). Careful application of the improvisation framework may help illuminate key determinants of organizational founding and early growth processes. Skillful improvisation in making do with materials at hand, for example, may cause trouble for a new firm making the transition to appropriate strategic planning and implementation (Baker, Miner, and Eesley, 2001).

At the same time, the entrepreneurial context may benefit empirical research aimed at further developing theories of improvisation. If access can be gained, start-ups offer a more compact setting than do large, complex organizations for examining specific links between design and implementation

of both strategies and tactics (Aldrich, 1999). We also suspect that new firms will vary in their improvisational capabilities, making this a promising area for examining factors that enhance or detract from improvisation's potential value. Finally, close examination of founding processes may shed light on the origins of improvisation in existing large firms. In our field encounters, we tended to assume that the firms had developed their improvisational competencies over time. Empirical research on new organizations might reveal that the improvisational competencies we observed represent original competencies of firms that persisted as the firms matured, rather than new patterns the firms acquired over time.

Models of emergent change. Our study also helped us see that some apparent contradictions between planning and improvisation are illusory. Although it seemed counterintuitive, for example, our field encounters convinced us that organizations can plan to improvise, routinize processes to stimulate improvisation, and routinize the observation of their own improvisational activities, all without the actual content of the improvisation being planned in advance. Our findings have implications for literatures that emphasize the fusion of unplanned innovation and order. These include models that describe how emergent aggregate patterns arise from rational actions at a lower level of activity (e.g., Schelling, 1978; Arthur, 1987; Stein, 1989; Baum and Singh, 1994) and work that describes unintended outcomes and actions that occur at the same level of analysis (e.g., Follett, 1930; Alinsky, 1969; March and Olson, 1976). In contrast, the scientist special or improvised team behavior are not emergent outcomes of lower-level actions of which the improvisers are unaware. They are designed and enacted at the same level of analysis. They are also not an unintended outcome of other actions; they are the deliberate creation of a novel production. Emphasis on unplanned, novel, but orderly actions marks improvisation as a narrow yet important type of emergent order (Berger and Luckmann, 1967; Giddens, 1984; Feldman, 2000). Its most distinct feature is that the design unfolds during and is fundamentally shaped by the interaction of the designer and the immediate moment and materials.

Improvisation involves a genuine fusion of design and execution, of unplanned change and order, but it was not all-pervasive in these organizations. We noticed that a particular episode of improvisational activity was often nested within other, nonimprovisational activities. Teams tended to improvise in one domain, such as product features or team process, at a given point while following plans or prior routines in other areas. At SeeFoods, the team improvised a new focus group approach. The area of application was not new, but the process was. Likewise, we saw teams using well-established processes but improvising a new feature or product-related outcome, such as the ideation sessions at SeeFoods and the scientist specials at FastTrack.

Weick (1998: 551) has expressed concern with assertions that organizations can develop competencies in improvisation, suggesting that efforts to fuse routinization and improvisation may involve "lost precision" and reflect an effort to

embrace improvisation "without giving up the prior commitment to stability and order." We agree that careless research on improvisation could feed a pervasive thirst for predictability and functionalism by disguising the essentially creative aspects of improvisation. At the same time, our field observations opened the door to a vision of organizations that embraces both their crucial protean aspects and their widely observed inertial qualities. Improvisational episodes were common but often ephemeral. From time to time, their productions or collateral insights found their way into various parts of the organization's enduring memory; at other times, they did not. The careful delineation of improvisational episodes and tracing of their fates seems to us to offer a promising approach to probing longstanding puzzles in organizational learning and change.

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