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2002, Vol. 45, No. 3, 546–564.

PRODUCT DEVELOPMENT TENSIONS: EXPLORING CONTRASTING STYLES OF PROJECT MANAGEMENT

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Successful product development requires managing tensions—coping with fluctuating contingencies to foster innovation and efficiency. To investigate this challenge, we explored the nature, dynamics, and impacts of contrasting project management styles. Our conceptual framework details emergent and planned styles. Following 80 projects over two-year periods, we find that these styles offer disparate but interwoven approaches to monitoring, evaluation, and control activities; use of these activities fluctuates over time; a paradoxical blend of styles enhances performance; and uncertainty moderates project management–performance relationships.

> Tensions cannot be eliminated because they are inherent in [product development] activities and help power the innovation process. (Dougherty, 1996: 430)

Product development is a potentially vital source of competitive advantage and organizational renewal, but success is often elusive. Product development projects spark conflicts between external demands and internal competencies, needs for spontaneity and for structure, desires for change and for stability (Dougherty, 1996; Jelinek & Schoonhoven, 1990). Project teams strive to develop technical knowledge and achieve commercial objectives by building innovative capacity. Yet success also requires efficient execution to keep projects on schedule and within budget.

For over 30 years, researchers have sought to discover the contingencies that impact product development performance. Recent reviews (e.g., Brown & Eisenhardt, 1995; Montoya-Weiss & Calontone, 1994) have catalogued studies of project factors (such as novelty and scope), organizational factors (like structure and team composition), and environmental factors (such as market potential), stressing their mixed results. This literature highlights the tensions surrounding product development: project managers must cope with multiple—and often conflicting and fluctuating—contingencies as they seek to foster innovation and efficiency. Yet critics also note the limitations of a contingency approach (e.g., Dougherty, 1996; Pennings, 1992). To make sense of seemingly conflicting findings, researchers need more encompassing theoretical frameworks. Such frameworks might enable insights into how managers adjust their behaviors and organizations to changing contingencies. From a practical standpoint, however, contingency studies need greater precision. By virtue of operating at high levels of analysis, research often lacks an action orientation and offers limited managerial guidance.

Quinn (1988) proposed an alternative approach that may foster simultaneously broad and detailed understandings of management. He claimed that researchers might extend contingency studies by examining more general managerial capabilities or styles. Management style denotes an underlying mode of thinking and behaving that in turn promotes a specific repertoire of actions that managers

Many thanks to Editor Tom Lee and three anonymous reviewers, as well as to Suzanne Masterson and Steve Wheelwright, for their insightful comments on earlier versions of this article.

This research is based on work supported by the National Science Foundation under Grant No. SES-8519415 and by the Center for Innovation Management Studies, Lehigh University, under Grant No. 429551-802. The authors thank the University of Cincinnati and Purdue University for their support.

draw upon in contexts of varying complexity and uncertainty. Historically, the research literature has polarized management styles, framing them in terms such as convergent/divergent thinking, transactional/transformational leadership, theory X/theory Y. Likewise, product development researchers often stress divergence between an emergent and a planned style. Some advocate an emergent, fluid style of management as a means to foster creativity and improvisation (e.g., Doughtery, 1992; Moorman & Miner, 1998). Others prescribe disciplined planning as a way to focus and speed project efforts (e.g., Wheelwright & Clark, 1992; Zirger & Maidique, 1990). Yet proponents of both styles also recognize the need for balance. Case studies richly depict the interplay of emergent and planned styles (e.g., Jelinek & Schoonhoven, 1990). Laufer's (1997) case collection, for example, illustrates how exceptional project managers are capable of moving iteratively between contrasting styles in response to contending demands.

To date, however, product development literature lacks clear conceptualizations and corresponding measures of project management styles. Indeed, Dougherty (1996) called for constructs that *capture the tensions of product development.* Prescriptions for emergent and planned styles may reflect these tensions. Rather than another normative model, researchers need measures that help assess disparate, but potentially complementary, ways of managing. She also argued that more effective constructs would *build from the activities of project management.* Identifying varied approaches to specific managerial activities would enhance research precision and relevance. Without such constructs, researchers and practitioners are left questioning the nature, dynamics, and impacts of project management styles: What are the characteristics of contrasting styles? Do managerial styles vary as a project progresses? And, does style matter, significantly affecting project performance? This study addresses these issues to contribute a fine-grained treatment of project management styles and their roles in product development.

VARIED PRESCRIPTIONS FOR PROJECT MANAGEMENT

> In our tough, dynamic, and demanding world, "either/or" approaches are no longer viable . . . today's challenges of fast change and uncertainty require "both/and" approaches to thinking and working. Success demands that project leaders adopt both an inward and outward orientation, develop both formal and informal procedures. (Ian Mitroff [Laufer, 1997: xi])

Increasingly, researchers claim that managing tensions is crucial to product development success. Jelinek and Schoonhoven's (1990) case studies depict how conflicts between stability and change require continuous interplay between preexisting plans and evolving understandings. Dougherty (1996) concurred, expanding the set of tensions to include freedom/responsibility, emergent/determined, outside/inside. Revisiting Burns and Stalker (1961), she theorized that organic approaches (for instance, fluid roles, team autonomy) foster employee commitment and creativity, and that mechanistic approaches (for instance, formal methods, centralized authority) keep projects on target and linked to wider organizational goals. Yet product development studies often appear polarized within divergent streams, which offer seemingly contradictory prescriptions (Benghozi, 1990; Brown & Eisenhardt, 1995). Broadly speaking, work in these two streams advocates either an emergent or a planned style of project management. An emergent style involves facilitating team members' creativity, flexibility, and improvisation, and a planned style provides managerial discipline and direction.

The emergent stream is attracting increased attention, tapping insights from eclectic studies of jazz, sports, firefighting, and theatre. Social construction and cognition theories help researchers depict processes of "sense making" and improvisation (e.g., Dougherty, 1992; Weick, 1998). Moorman and Miner (1998) explained that improvisation occurs as teams learn experientially, building knowledge as they work through uncertainty and experiment with diverse product designs. Yet researchers also call for balance, as planning and structure offer a frame within which creativity occurs. Comparing the need for routines within product development teams to the needs of jazz ensembles, Pasmore noted this: "The lesson for us . . . is that flexibility is always possible without control, but that random activity does not produce jazz; it produces noise" (1998: 563).

Proponents of a planned style, in contrast, stress disciplined problem solving. Illustrative studies highlight the value of extensive planning and calculated implementation (e.g., Zirger & Maidique, 1990) and the need to methodically expand organizational knowledge (e.g., Clark & Fujimoto, 1991). A practitioner orientation aids discovery of the "best practices" to guide the development process; formal reviews are an example. Many, however, also endorse balance or "subtle control," calling for managers to set explicit goals for autonomous teams (e.g., Wheelwright & Clark, 1992). Eisenhardt and Tabrizi (1995), for instance, used

notions from the emergent stream to theorize how planning methods (like setting frequent milestones and having powerful leaders) foster improvisation.

Rather than sharpening the focus of research efforts, work accumulating in these streams has led to increasingly diffuse conceptualizations of project management styles. Dougherty (1996) highlighted two particular concerns. First, she criticized existing constructs for failing to capture the tensions of product development. Case studies depict contrasting styles in rich but ambiguous terms, and survey research offers explicit but oversimplified either/or measures. For instance, cases often describe how managers who are performing well learn to accommodate tensions, moving back and forth between disparate styles to meet fluctuating demands (e.g., Jelinek & Schoonhoven, 1990; Laufer, 1997).

Most survey measures, however, position contrasting styles at the opposite ends of a single continuum, portraying them as mutually exclusive. McDonough and Barczak (1991), for example, investigated two styles of control. They asked, Is product development accelerated by an emergent, participative style, which offers teams considerable discretion, or by a more directive style, where managers oversee project details? Although results supported a more emergent style, it should be noted that they used a single measure of control to assess both styles. Shenhar and Dvir's (1996) survey study offered very different results. They conceptualized varied styles of control, communication, and evaluation and obtained results suggesting that the greater a project's scope and uncertainty, the more a planned style (that is, firm control, formal documentation, external reviews) enhanced performance. Yet their measures also placed the styles along simple continua. According to Quinn, more insightful conceptual frameworks would detail stylistic differences, but "move from a traditional, schismogenic, either/or approach to a both/and approach, thus making it possible for us to see management behavior in genuinely new ways" (1988: 85). Corresponding measures would assess each style separately, rendering it empirically possible for managers to go back and forth between contrasting styles of a behavior.

Dougherty's (1996) second concern is reflected in calls for more activity-based constructs (e.g., Pennings, 1992; Shenhar & Dvir, 1996). Jelinek and Schoonhoven (1990) criticized the lack of conceptual development around key managerial activities. Most studies analyze a narrow range of activities or depict broad product development strategies. The result is a limited understanding of what firms actually do to manage projects and how different styles affect performance. Building constructs from the activities of project management would enable a more thorough treatment of the "processes, dynamics, and events underlying this kind of innovation" (Dougherty, 1996: 424).

Practitioner-oriented texts, in particular, often stress the importance of three activities: project monitoring, evaluation, and control. Unlike environmental contingencies (like market fluctuations and competitive intensity), these activities denote elements of product development over which managers have some influence—and pose a largely untapped area of study (Rosenau & Moran, 1993). In addition, these managerial activities are ubiquitous, impacting project execution from idea generation and product design through production and product launch (Wheelwright & Clark, 1992). Yet managers' approaches to each activity may vary depending on whether they apply an emergent or a planned style exclusively or move between these styles.

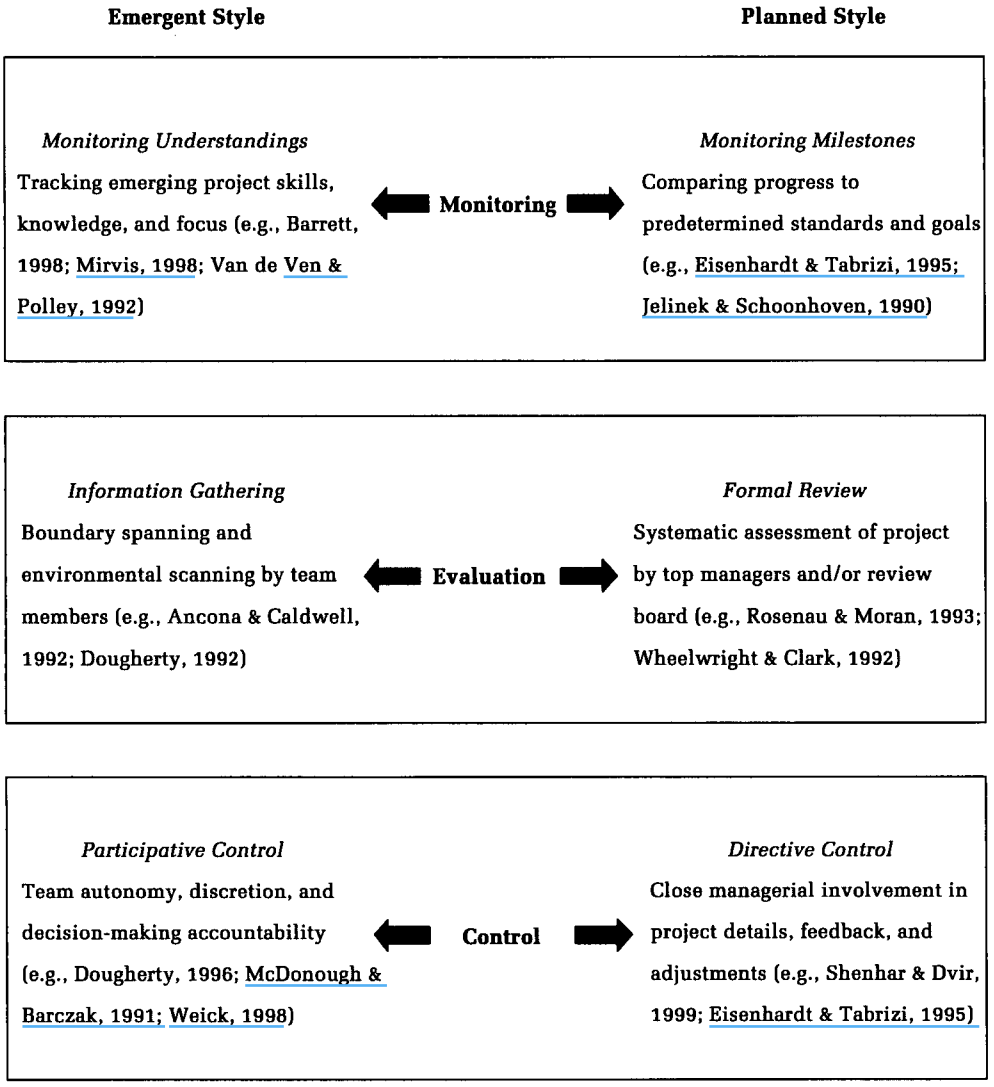
Styles of Approaches to Project Management Activities

> At the same time the firms we studied must stress innovation, they also require great precision and predictability to enable them to master complex design and production details. The implications of this dilemma must be worked out in management style. (Jelinek & Schoonhoven, 1990: 56)

To elaborate the natures of emergent and planned styles, we propose a conceptual framework that juxtaposes the respective approaches they entail to project monitoring, evaluation, and control. Figure 1 summarizes each activity set. As noted previously, proponents of both styles have called for balance but emphasized contrasting approaches. Building from the literature, we purposefully polarize these styles to accentuate their differences and similarities and to facilitate subsequent operational definition.

Emergent and planned styles reflect varied managerial assumptions and goals. Advocates of an emergent style view product development as inherently ambiguous (Dougherty, 1996). In this light, project managers seek to facilitate team members' improvisation and experiential learning, helping innovation emerge from the bottom up. Barrett (1998) explained that, whether a team is engaged in theatre or in product development, a fluid and spontaneous approach to management sparks creativity. As teams discover new opportunities and challenges, managers may encourage members to monitor their evolving understandings, gather information from diverse sources, and/or experiment with new designs as needed. Hence,

FIGURE 1
Contrasting Styles of Project Management



monitoring, evaluation, and control are loosely coupled activities.

In comparison, proponents of a planned style presume that product development is more predictable and rational, best managed as a top-down process. Successful senior executives and project managers provide discipline and structure, striving to direct team efforts and link project and organizational goals (Wheelwright & Clark, 1992). From this perspective, monitoring, evaluation, and control activities appear tightly coupled, interwoven within a systematic cycle. Milestones help a team methodically track a project; formal reviews enable critical assessments that inform major decisions (for instance, continue/terminate project; resource allocation); and directive control allows managers to adjust project resources and objectives as necessary (Rosenau & Moran, 1993).

Juxtaposing emergent and planned styles of monitoring, evaluation, and control accentuates the disparate, but potentially complementary, approaches to managing they imply. Monitoring activities track projects in progress. In applications of an emergent style, monitoring understandings gauges progress in terms of team members' experiential learning—that is, how their project focus, knowledge, and skills are developing as they interact with others and with the product itself (Van de Ven & Polley, 1992). Barrett (1998) theorized that, in innovation processes, sense making is often retrospective, occurring through and after action. Monitoring understandings aids retrospective sense making by helping team members comprehend how work is unfolding across varied actors and by fostering a greater mindfulness of others' expertise. Teams "are able to innovate and

elaborate on ideas with the assurance that they are oriented to a commonplace" (Barrett, 1998: 612). Monitoring understandings also helps team members translate their experiences into "superordinate goals, or a shared vision, and in interpersonal relations, into efforts to build empathy and mutual understanding" (Mirvis, 1998: 59).

In contrast, a planned style promotes *monitoring explicit milestones.* According to Jelinek and Schoonhoven (1990), milestones ideally convert a project strategy into analyzable technical, budgetary, and time-related objectives. Interim goals, schedules, and tests offer managers clear indications of a project's progress and a common frame of reference, but also serve as guides for team members (Eisenhardt & Tabrizi, 1995; Wheelwright & Clark, 1992). Such predetermined standards may aid team coordination and ensure that projects do not absorb unnecessary resources.

Dougherty (1996) claimed that varied approaches to monitoring reflect conflicts between emergence and determination. If firms rely strictly on developing knowledge from the bottom up, projects may not build on one another. Likewise, if teams are forced to follow top-down plans, they might not explore novel scientific or commercial opportunities. Emergent and planned styles may help teams cope with these tensions, offering complementary means of tracking and spurring progress. Monitoring understandings gauges whether team members are developing new skills and a shared vision, whereas milestones guide these developments toward the firm's strategic objectives.

Hypothesis 1a. Monitoring understandings (a component of an emergent style) and milestones (as in a planned style) are distinct yet interrelated approaches to project monitoring.

Evaluation denotes the appraisal of a project's value (for instance, its fit with market demands and organizational competencies). Applying an emergent style, team members evaluate their project by *gathering information* from external sources. This is a potentially vital boundary-spanning activity. By interacting with those outside the project, teams may gauge organizational support and manage others' impressions of the project (Ancona & Caldwell, 1992). Depicting functional groups as "thought worlds," Dougherty (1992) claimed that insights from different functions might clarify how other organizational actors envision a project, often revealing unexpected interpretations. Information gathering also may spur improvisation. As Crossan explained, "The environment will teach you if you let it" (1998: 595). Scanning the environment for divergent views fosters a sense of more complicated alternatives, helping teams break out of existing mind-sets to see a project in new light.

A planned approach entails more systematic evaluation, or *formal review.* Wheelwright and Clark (1992) stressed the value of reviews conducted by senior executives, divisional review boards, or cross-functional groups. As gatekeepers, reviewers determine whether a project will contribute significantly to its firm's product portfolio, is ready for transfer from R&D to manufacturing, or should be terminated. Within the cycle of tightly coupled planning activities, monitoring milestones may inform such appraisals by triggering alarms that a project is off course or exposing the need to connect the project to wider organizational goals (Rosenau & Moran, 1993: 166). Formal reviews also offer teams feedback that may delineate their project's scope (Shenhar & Dvir, 1996).

These contrasting activities correspond to divergent/convergent tensions of product development. Teams must look outward to cull fresh insights and alternative interpretations. Yet projects must also remain focused and build from existing organizational competencies (Dougherty, 1996). In response, emergent and planned styles of evaluation may spur the iterations between divergent and convergent thinking that fuel innovation (Mirvis, 1998). Information gathering encourages team members to explore opposing views, whereas formal reviews contribute assessments that help managers meld a project with their firm's vision of product development.

Hypothesis 1b. Information gathering (reflecting an emergent style) and formal review (a planned style) are distinct yet interrelated approaches to project evaluation.

Control practices influence the locus of project decision making. An emergent style fosters a participative approach. Participative control offers teams the freedom to challenge existing ideas and solve problems regarding product design and their own tasks (McDonough & Barczak, 1991). According to Dougherty (1996), product development often requires greater commitment and task variety than other types of projects. Participative control may build trust and enable team members' roles to evolve over time. In addition, improvisation thrives as members "are authorized to paraphrase, embellish, and reassemble their prevailing routines extemporaneously . . . [when] they are encouraged to think while doing rather than being guided solely by plans" (Weick, 1998: 549).

A planned style promotes *directive control.* Project and senior managers seek to provide teams guidance and support. In their research, Shenhar

and Dvir observed this: "Managers were concerned with finishing the project on time, within budget, and according to the initial plan and design" (1996: 616). To meet these goals, they remained closely involved in project details. Others have proposed that directive control spurs action, allowing managers to offer feedback and adjust resources as needed (e.g., Eisenhardt & Tabrizi, 1995). This activity builds from the other planned approaches, as monitoring milestones and formal reviews help managers recognize when and where to intervene.

These control activities mirror tensions between freedom and structure—the need to encourage commitment and creativity and to ensure timely and appropriate action (Benghozi, 1990). Researchers suggest that "subtle control" is the blend of participative and directive control apparent in "heavyweight" teams, which provide members discretion and the support of a powerful leader (e.g., Wheelwright & Clark, 1992). As Dougherty further explained, "It is desirable that people feel free to generate ideas, create possible solutions to problems, and experiment with various courses of action. It is also desirable that people feel responsible to work toward common goals" (1996: 430).

Hypothesis 1c. Participative control (reflecting an emergent style) and directive control (a planned style) are distinct yet interrelated approaches to project control.

The Dynamics of Project Management Styles

Researchers have proposed that project management styles are dynamic, evolving to meet fluctuating demands (e.g., Ancona & Caldwell, 1992). Managers, for instance, may alter their approaches in response to new resource allocations, changes in market demand, progress by competitors on similar projects, or novel scientific discoveries (Van de Ven & Polley, 1992). Yet, if styles fluctuate, researchers must pay close attention to when they analyze project management. Studies using cross-sectional or retrospective data may provide only partial or even inaccurate views of relationships between project management and performance (McDonough & Barczak, 1991). In contrast, longitudinal data might reveal whether—or how—managers adjust their actions to contextual changes (Pennings, 1992).

Existing literature suggests that activity styles fluctuate in different ways. Emergent activities may be crucial when a team is entering the unknown (Barrett, 1998). Van de Ven and Polley (1992) argued that an emergent style is most prominent at the start of a project, when teams seek to cultivate new ideas. Then, as the product development process moves toward transforming ideas into an implemented reality, emphasis on experiential learning declines. Likewise, Katz (1982) found that information-gathering activities decreased during lengthy projects, potentially isolating team members and impeding their performance. In sum, efforts to foster improvisation may wane as a project shifts from idea generation to manufacturing and eventual product launch.

Hypothesis 2a. The use of emergent activities will decrease as projects progress.

A planned style is likely to be more stable, but its role may change over time—helping reduce uncertainty in the early stages, then pushing a project to completion. Initially, planned activities serve to clarify project details. Close managerial control and frequent monitoring are vital, because the earlier a product is conceptualized, the faster its development (Clark & Fujimoto, 1991). Planned approaches are also more prone to inertia (Van de Ven & Polley, 1992). Over time, these managerial activities evolve into reliable routines, such as the use of systematic milestones and formal reviews. According to Rosenau and Moran, "imitation, standards, and routine" lie at the core of planned monitoring and evaluation (1993: 66). Coupled with directive control, these activities provide a consistent course of action for project teams.

Hypothesis 2b. The use of planned activities will remain stable as projects progress.

Project Management–Performance Relationships

This section addresses our concluding question: Does style matter? Project performance is multifaceted, encompassing the need for innovation and efficiency. As Bowen and colleagues (1994) explained, a successful product development project reflow contributes technical knowledge that enhances both the product and future R&D efforts and produces a final product capable of attaining its projected market share. Simultaneously, projects must remain on time and within budget. Yet few studies have investigated the effects of project management styles on multiple facets of performance (Brown & Eisenhardt, 1995; Jelinek & Schoonhoven, 1990). Moreover, Doughtery (1996) claimed that new, activity-based constructs are needed to identify specific levers of performance. In response, we employed our conceptual framework to examine how contrasting managerial activities impact innovation and efficiency.

Relationships between project management and

performance may vary with managerial style. In particular, researchers have proposed a positive link between an emergent style and innovation. As Moorman and Miner (1998) noted, the primary goal of this approach is to facilitate improvisation. Emergent activities help teams build technical knowledge by exploring novel scientific concepts and help them to achieve their commercial objectives by experimenting with alternative product designs. Information gathering potentially fuels creativity as teams grapple with divergent insights provided by external departments (Dougherty, 1992), whereas participative control and monitoring understandings may foster the experiential learning of team members (Van de Ven & Polley, 1992).

Hypothesis 3a. An emergent style of managerial activities will be positively related to project innovation (building technical knowledge and achieving commercial objectives).

In contrast, a planned style may enhance project efficiency—its principle objective (Shenhar & Dvir, 1996). Managers seek to ensure that teams have sufficient support and remain targeted on project goals. According to Wheelwright and Clark (1992), schedule- and budget-based milestones keep teams aware of their scarce resources. Likewise, formal reviews guide decision making regarding resource allocation. Directive control also may define project boundaries, reducing the likelihood of wasteful explorations and costly errors (McDonough & Barczak, 1991). In sum, planning activities provide discipline that may motivate action and bolster efficiency.

Hypothesis 3b. A planned style of managerial activities will be positively related to project efficiency (keeping projects on time and within budget).

Studies suggest that project uncertainty moderates project management–performance relationships (e.g., Eisenhardt & Tabrizi, 1995; Moorman & Miner, 1998; Shenhar & Dvir, 1996). Examining change in project uncertainty may extend this work and offer further insights into the dynamics of management styles. As Dougherty (1996) explained, fluctuations in uncertainty intensify product development tensions, straining managers' capacity to gauge critical contingencies and meet conflicting demands. Hence, varying uncertainty surrounding the technology and/or the commercialization of a developing product pose an exceptional test of managerial capabilities.

According to Pennings (1992), changes in uncertainty interact with managers' perceptions and actions. Exploring these interactions may enable a greater understanding of how managers cope with new opportunities and problems. For instance, technical uncertainty may increase when teams make dramatic scientific breakthroughs, and commercial uncertainty rises if teams recognize that their firm lacks the ability to take their design to market (for instance, it is inexperienced in manufacturing or selling that type of product). Coping with such variations demands greater managerial flexibility. The improvisation fostered by an emergent style may help teams work through heightened ambiguity. On the other hand, more structured, planned activities may offer a sense of order that reduces team members' anxieties.

Hypothesis 3c. Change in project uncertainty moderates project management–performance relationships.

METHODS

For this exploratory study, we sought an organization that would provide access to numerous and diverse projects. The chosen site was a U.S. firm in the chemical industry (over 26,000 employees, $4 billion in net sales, and $590 million in annual R&D investment). This firm competed in four lines of business, each with its own R&D division dedicated to developing a different type of product: agricultural chemicals (for instance, ear tags for farm animals), consumer products (such as a new elevator mechanism for a stick deodorant), industrial chemical intermediates (such as wet strength resins for paper), and pharmaceuticals (such as new formulations of over-the-counter vitamins and prescription antiarthritics). This site also enabled us to focus on R&D, a particularly tenuous phase of product development that requires considerable creativity and experimentation within clear time and budgetary constraints. The firm had strong competencies in manufacturing, but it was deeply concerned with improving the management of its R&D. Divisional managers, project managers, and team members generously contributed their time and energy to the study.

Within the research site, data were collected on a sample of 80 product development projects. Three criteria were used to select projects: (1) the project had to be judged by R&D personnel as promising, but presenting significant technical uncertainty; (2) the project had to have been authorized and assigned personnel and budgetary resources; and (3) the research had to have progressed beyond the basic level and be directed at a specific usage, but not necessarily associated with a defined product.

These criteria helped ensure that projects in the study had a reasonable probability of continuing for a significant period of time before completion or termination.

Because a limited number of projects were initiated across the four divisions in any single year, we used a staggered data collection strategy to build the sample. We examined 11 projects started in year 1 of the study, 39 projects initiated in year 2, and so on until a complete sample of 80 projects was obtained. This sample size provided sufficient, albeit limited, degrees of freedom for analysis and was feasible given the demands of our research design. Employing a multiple panel approach, we collected data in real time, following each project until it was completed or for a maximum of two years. The survey was first administered six months after a project had begun and was then given approximately every six months. At the end of the study (which spanned more than six years), 23 projects had been completed, 30 projects had been terminated, and 27 projects were still ongoing.

Project informants were selected through discussions with an R&D manager in each division, who served as a liaison between our research team and that division's project teams. Four criteria helped identify appropriate informants: (1) they needed to have been highly involved in project efforts at the time data were being collected; (2) they needed to hold a position that would allow them to knowledgeably answer the types of questions being posed; (3) when possible, independent informants were selected to reduce common method variance bias; and (4) where feasible, multiple informants were chosen to respond to questions about the project. Questionnaire packets for each respondent were distributed by the liaison and returned in sealed envelopes. Both phone calls and direct follow-up by the liaison were used to correct any problems (such as obviously missing data) and to request the return of questionnaires. This procedure yielded a 91 percent response rate.

Prior to each panel of data collection, the division liaisons reviewed the respondents to ensure that they continued to meet the criteria. If a respondent was no longer actively involved in a project, she or he was replaced. Members of the project team provided information about project management and uncertainty. The project leader and one independent source—typically, an upper-level R&D manager—provided information regarding performance. For the purposes of this article, we analyzed data collected at three points in time, including the first panel (time 1) and the last panel (time L, which was approximately 24 months after time 1), as well as the panel immediately preceding the last panel (time L − 1, approximately 18 months after start-up.

Measures

Questionnaires for this study were developed through a year-long joint effort of academic and firm R&D personnel. Factor analyses conducted on the resulting data aided development of the project management, performance, and uncertainty measures (Table 1, below, gives all items and factor loadings). To examine project management styles, we operationally defined six constructs that distinguish between emergent and planned approaches to monitoring, evaluation, and control. Confirmatory factor analyses (discussed in the Results section) served to test our proposed conceptual framework. We also sought to identify varied facets of project performance (building technical knowledge, achieving commercial objectives, and staying on time and within budget) and of project uncertainty (technical and commercial). As Hurley and colleagues (1997) suggested, exploratory methods were used in lieu of hypothesized models. Principal factor analyses with varimax rotation aided scale development. The four performance factors and two uncertainty factors were determined using several decision rules: theoretical rationales, eigenvalues greater than one, scree plots, and high factor loadings.

Project management styles. We sought to measure emergent and planned approaches to each activity. For project monitoring, an emergent style stresses *monitoring understandings.* Four items assessed the importance, in a given project, of team members' demonstrating an understanding of project objectives, technical knowledge, awareness of project details, and devoting sufficient time to the project. In contrast, a planned style calls for *monitoring milestones.* Four items gauged the importance, in a given project, of the project schedule, interim goals, and test results for tracking progress. Monitoring items were rated on a scale ranging from 1, "not very important," to 5, "very important."

The emergent style of project evaluation, or *information gathering,* encourages team members to seek ideas and feedback from people outside of the project. Our three-item measure assessed the degree to which teams received useful information from regulatory and marketing personnel on technical and commercial issues (1, "little useful information," 5, "much useful information"). For the planned style, *formal review* signifies systematic appraisals by senior managers. Three items mea-

TABLE 1
Results of Factor Analyses for Project Management, Performance, and Uncertainty Variables[a]

Analysis	1	2	3	4	5	6
Confirmatory factor analysis: Project management						
Monitoring understandings						
Clear understanding of technical objectives	.52					
Show current technical knowledge	.63					
Aware of all project details and work	.71					
Devote sufficient time to working on the project	.72					
Monitoring milestones						
Being on schedule		.83				
Being ahead of schedule		.61				
Producing "hard data" (for instance, test results)		.38				
Accomplishing specific interim project goals		.51				
Information gathering						
Technical/scientific information from regulatory personnel			.54			
Technical/scientific information from marketing personnel			.90			
Commercial information from marketing personnel			.70			
Formal review						
By corporate executives				.80		
By the MRPC (the firm's expert review board)				.79		
By development research personnel				.49		
Participative control						
Sufficient freedom in running your part of the project					.74	
Sufficient decision authority regarding resource allocation					.86	
Accountability for the success of your part of the project					.60	
Directive control						
Involvement by project/upper management in details, tightening schedules						.66
Feedback from project manager about how the project is progressing						.61
Involvement of project manager in altering resources, objectives, and schedules						.54
Exploratory factor analysis: Project performance						
Technical knowledge						
Probability of yielding a major breakthrough	**.83**	.07	−.13	−.12		
Extent yielded information suggesting new market areas	**.78**	.03	.04	.17		
Extent yielded information suggesting new product areas	**.78**	−.09	.07	.20		
Extent yielded valuable technical knowledge	**.72**	.17	−.20	.10		
Probability of yielding proprietary technical knowledge	**.67**	.17	−.18	−.08		
Probability of yielding an incremental advance	**.69**	.35	−.11	−.21		
Extent yielded information helpful to other ongoing projects	**.66**	−.03	.06	.18		
Commercial objectives						
Probability of getting product to market in timely fashion	.10	**.82**	.05	.41		
Probability of introduction in time to capture desired market share	.15	**.86**	.01	.31		
Probability of meeting commercial objectives	.10	**.88**	−.04	.10		
Probability of developing a product with reasonable manufacturing costs	.03	**.78**	−.06	.05		
On time						
Is project on time in terms of its projected schedule?	.09	.29	.08	**.84**		
How does progress compare to its projected schedule?	.10	.33	.09	**.84**		
Within budget						
Has this project been more costly than expected or overspent?	−.14	.02	**.88**	.05		
How do actual costs compare with estimated costs?	−.06	−.08	**.84**	.07		
Is this project within budget in terms of its projected costs?	−.03	.01	**.79**	.05		
Eigenvalue	4.83	3.13	2.13	1.08		
Percentage of variance explained	30.2	19.6	13.3	6.74		
Cumulative percentage of variance explained	30.2	49.8	63.1	69.8		

TABLE 1
continued

Analysis	1	2	3	4	5	6
Exploratory factor analysis: Project uncertainty						
Technical uncertainty						
Adequacy of science and technology (S&T) used in this project	.32	**.62**				
Division's state of the art in this project's S&T	−.08	**.59**				
Recognition of technical objectives for this project	−.07	**.60**				
Team members' familiarity with the S&T used in the project	.15	**.62**				
Team members' actual experience with this project's S&T	.19	**.65**				
Definition of technical objectives for this project	.25	**.66**				
Predictability of progress of S&T knowledge development in division	.40	**.53**				
Whether a particular S&T strategy is being followed in this project	.29	**.57**				
Rate of progress of S&T knowledge development in division	−.17	**.61**				
Division's rate of entry into this project's S&T area	.27	**.41**				
Commercial uncertainty						
Firm experience with manufacturing the product	**.75**	.05				
Firm experience with packaging the product	**.86**	.15				
Firm experience with advertising the product	**.89**	.11				
Firm experience with selling the product	**.88**	.11				
Firm experience with distributing the product	**.87**	.11				
Eigenvalue	5.26	2.49				
Percentage of variance explained	35.1	16.6				
Cumulative percentage of variance explained	35.1	51.6				

[a] Bold type indicates the factor loadings are significant at $p < .01$.

sured the extent to which corporate executives, an expert review board, and divisional development research personnel reviewed the project (1, "never evaluate," 5, "often evaluate").

Participative control denotes the emergent style of control, whereby managers offer teams considerable autonomy. Three items measured the extent to which team members felt they had decision-making authority and accountability (1, "not at all," 5, "a great deal"). The planned counterpart, *directive control,* signifies close supervision. Three items gauged whether management was becoming more involved in project details (for instance, altering the budget and priorities) and providing feedback and technical and commercial information (1, "never," 5, "often").

Project performance. We measured project performance using the averaged judgments of the project manager and his or her department head. Perceptual measures of performance were used to reflect expectations rather than final outcomes. Use of these measures enabled us to gauge perceptions of project performance during each panel of data collection and to assess performance regardless of whether or not the project was completed by the end of the two years.

To tap the multifaceted nature of performance, we studied project innovation and efficiency. The resulting measures are similar to those used in survey research (e.g., Souder, Sherman, & Davies-Cooper, 1998) and to conceptualizations posed by case studies (e.g., Bowen, Clark, Holloway, & Wheelwright, 1994). Two measures addressed alternate dimensions of innovation. Answering these questions required respondents to assign probabilities between 0 and 100 percent. A seven-item *technical knowledge* measure gauged the probability that a project would yield valuable technical knowledge, suggest new markets, promise a major breakthrough or an incremental advance, and help in ongoing projects. Four items assessed the probability that the project would meet its *commercial objectives*—that is, develop a product with reasonable manufacturing costs that could gain its projected market share.

We also employed two measures of project efficiency. The measure *within budget* consisted of three items that assessed the extent to which a project was progressing within projected cost levels (1, "way under budget," 5, "way over budget"). A two-item measure labeled *on time* gauged whether the project was meeting its schedule (1, "way behind schedule," 5, "way ahead of schedule").

Project uncertainty. We examined technical and commercial forms of project uncertainty. As in measures used in recent studies (e.g., Green, Gavin, & Aiman-Smith, 1995; Souder et al., 1998), both forms were deemed a function of familiarity. For technical uncertainty, we reverse-coded ten items indicating the degree to which team members were

familiar with the science and technology used in a project and the division's level of expertise in this area. For commercial uncertainty, five items, also reverse-coded, assessed a firm's experience commercializing (manufacturing, packaging, advertising, selling, and distributing) products like the developing product.

Our plan for assessing change in uncertainty was to assign projects to conditions of decreasing and increasing uncertainty on the basis of their scores at times 1, L − 1, and L. Repeated-measures analyses, however, indicated that, although technical uncertainty did change over time ($F_{2, 76} = 5.67$, $p < .01$), commercial uncertainty remained stable ($F_{2, 76} = 0.09$, $p < .91$). Considering these findings, and the absence of a compelling rationale for choosing one form of uncertainty over another, we created two separate measures. For *change in technical uncertainty,* we followed our initial plan, creating median splits based on a project's scores at each panel. Projects with decreasing technical uncertainty were coded as − 1 ($n = 26$); projects with unchanging uncertainty were coded as 0 ($n = 27$); projects facing rising uncertainty were coded as 1 ($n = 26$). For *magnitude of commercial uncertainty,* we again developed three categories. Yet given the greater stability of this variable, categories signify low, unchanging (− 1, $n = 28$); varied or changing (0, $n = 17$); and high, unchanging (1, $n = 33$) commercial uncertainty. Assessing both the change in uncertainty and the magnitude of uncertainty has a long history in organization studies (e.g., Duncan, 1972; Perrow, 1967).

RESULTS

Hypotheses 1a–1c concern the convergent and discriminant validity of the measurement scheme—developed in accordance with our conceptual framework (Figure 1). To test these hypotheses, we employed confirmatory factor analysis (CFA) using EQS (Bentler, 1995). For purposes of construct development, we used the responses of the 213 project team members who participated in at least one panel of data collection. We estimated a CFA on the 20 items measuring project management styles. The model included six factors representing emergent and planned styles of monitoring, evaluation, and control. Each item was allowed to load only on the factor for which it was a proposed indicator, and no correlations were permitted in the error structure. Factors were allowed to covary *within* managerial activities (for example, participative and directive control were allowed to covary), because we proposed emergent and planned styles as offering interrelated approaches to each activity. Consistent with our conceptual framework, the three planned activities were allowed to covary, reflecting their tight coupling. Results indicate that this six-factor model was a good fit to the data ($\chi^2 = 267.21$, $df = 164$, goodness-of-fit index [GFI] = .89, comparative fit index [CFI] = .90, root-mean-square error of approximation [RMSEA] = .055). Item loadings were as proposed and significant ($p < .01$). Factor covariations were also significant ($p < .01$). Table 1 gives results.

To test whether emergent and planned styles of each activity were distinct, we compared this model to a nested alternative. Following Bentler (1995), we developed a nested model by adding meaningful constraints to our original model. Specifically, we set the covariations between activities equal to one. These constraints signify that contrasting approaches comprise a single construct—for instance, that participative and directive control are two ends of the same continuum—as some researchers have suggested (e.g., McDonough & Barczak, 1991). We conducted a CFA to assess the model ($\chi^2 = 472.74$, $df = 167$, GFI = .84, CFI = .71, RMSEA = .093). A chi-square difference test showed that the fit of the nested model was significantly worse than that of our original six-factor model ($\Delta\chi^2 = 205.56$, $df = 3$, $p < .001$). In sum, our CFA results supported Hypotheses 1a–1c: emergent and planned styles offer distinct, yet interrelated, approaches to project monitoring, evaluation, and control.

Examining the dynamics and impacts of management styles required moving to the project level of analysis. Because responses reflect the judgments of multiple informants, we assessed interrater agreement (r_{wg}). Using Glick's (1985) heuristic of .6, the median r_{wg} values for our measures (which range from .75 to .98) supported aggregation of the measures. We developed scales using the average of the respondents' judgments. In light of the sample size and the need to do multivariate analyses, we replaced missing data with means at the item level. Examination of means, standard deviations, and correlations before and after replacement revealed only minor differences. We used responses collected at time L − 1 and time L to conduct multiple regression analyses. Table 2 provides complete descriptive statistics and correlational information from both data panels.

Repeated-measures analyses helped assess whether managerial activities fluctuate. We compared the project management data generated during time 1 (the first data panel) with the data generated at time L − 1 and time L. Analyses offered mixed support for our hypotheses, highlighting the dynamic nature of management styles. Hypothesis

TABLE 2
Descriptive Statistics and Correlations[a, b]

Variable	Time 1 Mean	Time 1 s.d.	Time L − 1 Mean	Time L − 1 s.d.	Time L Mean	Time L s.d	r_{wg}	1	2	3	4	5	6	7	8	9	10	11	12
1. Monitoring understandings	3.91	0.54	3.88	0.54	3.59	0.80	.82	**.74**	.46	.25	.21	.04	.27	−.13	.01	.32	.06	−.09	−.27
2. Monitoring milestones	3.88	0.57	3.82	0.57	3.59	0.83	.83	.41	**.69**	.43	.54	.10	.46	−.06	−.07	.37	.22	.13	−.32
3. Information gathering	2.70	0.70	2.61	0.70	2.45	0.83	.75	.16	.51	**.74**	.54	.03	.46	−.07	.02	.15	.18	.05	−.31
4. Formal review	2.84	0.78	2.84	0.78	2.64	0.84	.89	.20	.50	.55	**.73**	−.06	.38	.10	−.15	.29	.15	−.02	−.48
5. Participative control	3.83	0.73	3.80	0.73	3.79	0.69	.84	.14	.12	.11	−.11	**.77**	.01	−.22	−.26	−.14	.30	.34	−.10
6. Directive control	3.44	0.52	3.20	0.52	2.90	0.79	.77	.26	.52	.47	.46	.04	**.63**	−.04	−.12	.37	.14	.05	−.34
7. Change in technical uncertainty	n.a.[c]							−.27	−.10	−.05	.00	−.23	−.06	**n.a.**	−.32	.01	−.06	−.09	.03
8. Magnitude of commercial uncertainty								.03	.03	.01	−.10	.34	.03	−.32	**n.a.**	−.24	.34	.26	.29
9. Technical knowledge	21.48	10.59	21.48	10.59	20.61	11.48	.95	.00	.09	.13	.40	−.09	.28	.08	−.32	**.82**	.03	−.01	−.31
10. Commercial objectives	61.91	22.48	61.91	22.48	60.29	23.66	.98	−.05	.27	.40	.25	.25	.22	−.03	.38	.08	**.90**	.61	.01
11. On time	2.85	0.84	2.85	0.84	2.72	1.01	.76	.18	.19	.13	.03	.31	.34	−.11	.27	.12	.53	**.75**	.17
12. Within budget	2.73	0.54	2.73	0.54	2.62	0.61	.81	−.20	−.13	−.11	−.26	−.07	−.04	−.02	−.03	.01	.06	.12	**.75**
1. Monitoring understandings								.31											
2. Monitoring milestones								.14	.23										
3. Information gathering								.04	.20	.48									
4. Formal review								.10	.20	.30	.44								
5. Participative control								.13	.21	−.04	.03	.55							
6. Directive control								−.02	.11	.17	.18	−.10	.20						
9. Technical knowledge								−.04	−.11	−.07	.18	−.17	.12			.63			
10. Commercial objectives								−.05	.18	.24	.27	.27	.07			−.12	.58		
11. On time								−.02	.08	.15	.13	.33	.02			−.07	.46	.51	
12. Within budget								−.14	−.27	−.11	−.38	−.03	−.17			−.36	.02	.07	.30

[a] Cronbach's alphas are on the diagonal, in bold. Correlations below the diagonal are from measures at time L − 1 (approximately 18 months into the project). Correlations above the diagonal are from measures at time L (approximately 24 months into the project). The lower matrix includes lagged correlations (between time L − 1 and time L) for each variable.

[b] $n = 79$. For correlations above .28, $p < .01$; for correlations above .21, $p < .05$.

[c] Categories reflect uncertainty scores from time 1 through time L.

2a posits that the use of emergent activities declines as a project progresses. In support, we found that managers encouraged less monitoring of understandings ($F_{2, 76} = 5.37$, $p < .01$) and information gathering ($F = 3.29$, $p < .04$) over time, but the use of participative control remained relatively constant ($F = 0.17$, $p < .84$). In Hypothesis 2b, we propose that the three planning activities are more stable. In each case, however, decreasing use was reported. Emphasis on monitoring milestones ($F = 4.54$, $p < .01$) and directive control ($F = 15.44$, $p < .001$) declined in all three time periods. Formal reviews decreased significantly only during the last six months of data collection (time L − 1 to L; $F = 4.14$, $p < .04$).

To examine relationships between project management and performance, we used multiple regression analyses. Table 3 gives these results. Given the dynamic nature of management styles, analyses were conducted twice, at times L − 1 and L. We also tested a more stringent, lagged model (L − 1 → L) to assess whether managerial activities at time L − 1 were predictive of performance at time L. We propose that emergent activities positively impact project innovation (Hypothesis 3a), whereas planned activities enhance efficiency (Hypothesis 3b). However, we included all six activities in each equation to explore the possibility of more intricate tensions between the styles.

Results offered mixed support for Hypothesis 3a. Contrary to our expectations, only planned activities significantly impacted the building of technical knowledge. Formal review and directive control were positively related to technical knowledge, and monitoring milestones was negatively related in the lagged model. The relationship between project management styles and commercial objectives was more in line with prediction. In particular, participative control had a positive effect across all three models, and information gathering was beneficial at time L − 1. Interestingly, formal review, a planned activity, positively impacted commercial objectives in the lagged model.

We also found mixed support for Hypothesis 3b. As predicted, a planned approach helped projects remain on schedule. Directive control was positively related to on-time performance at time L − 1. Yet surprisingly, participative control—the emergent counterpart—appeared to speed product development in all three models. The results of tests of within-budget performance were contrary to our hypothesis. Formal review, the planned approach to evaluation, was significantly but negatively related to within-budget performance both at time L and in the lagged model.

To examine the impact of uncertainty on project management–performance relationships, we first conducted moderated regression analysis (MRA; Aiken & West, 1991). Because the uncertainty categories reflect measurements from time 1 through L, we tested interaction effects at time L. Conducting a total of eight MRAs, we regressed each performance indicator on change in technical uncertainty *or* on magnitude of commercial uncertainty,

TABLE 3
Results of Multiple Regression Analyses: Project Management–Performance Relationships at Different Points in Time

Variable	Technical Knowledge			Commercial Objectives			On Time			Within Budget		
	Time L − 1	Time L	Time L − 1 → L	Time L − 1	Time L	Time L − 1 → L	Time L − 1	Time L	Time L − 1 → L	Time L − 1	Time L	Time L − 1 → L
R^2	0.22	0.20	0.14	0.25	0.14	0.20	0.22	0.16	0.15	0.11	0.30	0.18
Adjusted R^2	0.15	0.20	0.07	0.18	0.07	0.13	0.15	0.09	0.08	0.04	0.24	0.11
F	3.34*	4.11*	1.98†	3.86	1.92	2.98	3.34	2.24	2.14	1.50	4.97**	2.64*
P	0.00	0.00	0.08	0.00	0.08	0.01	0.01	0.05	0.06	0.19	0.00	0.03
Monitoring understandings	−0.07	0.18	−0.01	−0.20†	−0.06	−0.17	0.07	−0.20	−0.09	−0.18	−0.17	−0.02
Monitoring milestones	−0.17	0.17	−0.26†	0.13	0.14	0.09	0.01	0.21	−0.02	0.03	0.07	−0.16
Information gathering	−0.14	−0.17	−0.21	0.29*	0.09	0.09	−0.03	0.05	0.07	0.03	0.02	0.21
Formal review	0.47***	0.13	0.32*	0.11	0.04	0.31*	−0.11	−0.11	0.20	−0.32	−0.44**	−0.43**
Participatory control	0.00	−0.16	−0.08	0.24*	0.29**	0.30**	0.28**	0.32**	0.36**	−0.09	−0.12	−0.08
Directive control	0.24†	0.26*	0.21	0.02	0.03	−0.13	0.37**	0.03	−0.09	0.13	−0.16	0.02

† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$

on the six managerial activities, and on the set of six interactions (each activity by technical/commercial uncertainty). Four models, shown in Table 4, offered support for Hypothesis 3c. Models including technical uncertainty were significant for both technical knowledge and within-budget performance. Commercial uncertainty, in contrast, moderated the relationships between the managerial activities and commercial objectives and on-time performance. Interestingly, interaction effects were most pronounced for planned activities. For instance, monitoring milestones displayed significant interaction effects in all four models, suggesting that the influence of this activity is affected by both the change in technical uncertainty and the magnitude of commercial uncertainty.

Next, we used split-sample analyses to detail the impact of managerial activities under varied conditions of uncertainty. Table 5 gives these results, which extended our previous regression analyses—in some cases by providing greater support for hypothesized project management–performance relationships, in others by elaborating our surprising findings. For example, as predicted, emergent activities significantly affected technical knowledge. The influence of these activities, however, fluctuated with changes in technical uncertainty. Under conditions of decreasing uncertainty, monitoring understandings facilitated technical learning, whereas participative control had a negative impact. When technical uncertainty was rising, information gathering proved detrimental. Planned activities, in contrast, consistently enhanced the probability that a project would build technical knowledge, even under conditions of rising technical uncertainty. This finding supports Devaux's (1999) paradoxical claim that planning is most vital when a situation is difficult to plan. When a project's science and technology is nebulous, formal reviews and directive control may provide teams with vital direction.

Split-sample analyses also supplemented previous findings regarding commercial objectives. Monitoring understandings continued to display an unexpected negative impact when commercial uncertainty was high. This emergent activity, how-

TABLE 4
Results of Moderated Regression Analyses: Project Management–Performance Relationships, Time L, as Moderated by Project Uncertainty

	Technical Knowledge[a]	Commercial Objectives[b]	On Time[b]	Within Budget[a]
R^2, base	.20	.14	.16	.30
$F_{6, 73}$	4.11	1.92	2.24	4.97
p	.00	.08	.05	.00
R^2, with interactions	.38	.36	.36	.38
$F_{13, 64}$	3.03	2.80	2.74	2.90
p	.00	.00	.00	.02
ΔR^2 after interactions	.19	.13	.16	.08
$F_{6, 64}$	3.26	2.27	2.77	1.55
p	.01	.05	.05	n.s.
Change in technical uncertainty	0.42**			0.05
Magnitude of commercial uncertainty		0.31**	0.19†	
Monitoring understandings	0.19	−0.03	−0.19	−0.09
Monitoring milestones	0.11	0.08	0.16	−0.01
Information gathering	−0.18	0.00	0.09	−0.03
Formal review	0.18	0.16	−0.03	−0.41**
Participatory control	0.07	0.27*	0.32**	−0.14
Directive control	0.33**	0.14	0.02	−0.10
Uncertainty × monitoring understandings	0.80	−0.21†	0.07	0.21
Uncertainty × monitoring milestones	−1.23*	0.37**	0.34*	−0.30*
Uncertainty × information gathering	0.00	−0.14	−0.21	−0.07
Uncertainty × formal review	1.01*	0.06	0.01	−0.09
Uncertainty × participatory control	−0.76	0.11	0.06	0.16
Uncertainty × directive control	−0.22	0.19	0.33*	−0.17

[a] Models including change in technical uncertainty were significant for both technical knowledge and within-budget performance.
[b] Models including magnitude of commercial uncertainty were significant for both commercial objectives and on-time performance.
† $p < .10$
* $p < .05$
** $p < .01$

TABLE 5
Results of Split-Sample Regression Analyses: Project Management–Performance Relationships under Varying Conditions of Uncertainty[a]

	Technical Knowledge[b]			Commercial Objectives[c]			On Time[c]			Within Budget[b]		
Variable	Decrease in Technical Uncertainty	No Change in Technical Uncertainty	Increase in Technical Uncertainty	Low Commercial Uncertainty	Changed Commercial Uncertainty	High Commercial Uncertainty	Low Commercial Uncertainty	Changed Commercial Uncertainty	High Commercial Uncertainty	Decrease in Technical Uncertainty	No Change in Technical Uncertainty	Increase in Technical Uncertainty
R^2	0.59	0.43	0.45	0.45	0.53	0.36	0.40	0.20	0.37	0.33	0.42	0.49
Adjusted R^2	0.43	0.27	0.28	0.29	0.25	0.21	0.22	−0.28	0.23	0.08	0.25	0.33
F	3.78	2.65	2.67	2.78	1.89	2.48	2.20	0.41	2.60	1.30	2.53	3.17
p	0.02	0.04	0.04	0.04	0.17	0.05	0.08	0.85	0.04	0.31	0.05	0.03
Monitoring understandings	0.38†	0.01	0.21	0.27	0.08	−0.21	−0.31	0.15	−0.13	0.11	−0.28	−0.14
Monitoring milestones	0.02	0.56**	0.48†	−0.26	−0.56	0.58*	0.11	−0.39	−0.63**	−0.38	0.33†	0.14
Information gathering	−0.13	−0.15	−0.46*	0.25	−0.64	−0.06	0.33	−0.33	−0.16	−0.15	0.03	0.03
Formal review	0.36†	−0.28	0.57*	0.31	0.22	0.10	−0.03	−0.06	0.02	−0.16	−0.36†	−0.66**
Participatory control	−0.40*	0.00	0.29	0.06	0.44	0.25†	0.31†	0.08	0.26†	0.04	−0.14	−0.35*
Directive control	0.26	0.34†	0.52*	0.39*	0.36	−0.13	0.38*	0.41	−0.39†	−0.03	−0.40*	0.05

[a] Figures in bold represent significant interactions identified in moderated regression analyses.
[b] For the decrease subsample, $n = 22$; for the no change subsample, $n = 27$; for the increase subsample, $n = 26$.
[c] For the low subsample, $n = 26$; for the changed subsample, $n = 16$; for the high subsample, $n = 33$.
† $p < .10$
* $p < .05$
** $p < .01$

ever, appeared beneficial under conditions of low uncertainty. Interestingly, the interaction effect was reversed for the planned approach to monitoring. Monitoring milestones had a positive impact when commercial uncertainty was high, but this activity reduced the likelihood of achieving commercial objectives when uncertainty was low. Control activities demonstrated a similar pattern. Participative control was advantageous under conditions of high uncertainty, and directive control had a positive impact when uncertainty was low.

Changes in uncertainty appeared to alter the impact of managerial activities on project efficiency. We proposed that planned activities speed product development. As in previous analyses, participative control unexpectedly and consistently fostered on-time performance. In the MRA, however, we found significant interaction effects for two planned activities. Examining the split-sample analyses suggests that monitoring milestones and directive control slowed the development process when commercial uncertainty was high. Yet under conditions of low uncertainty, these activities raised the likelihood that a project would stay on schedule.

Contrary to our predictions, formal review continued to show a significant and negative impact on within-budget performance. In addition, both forms of control displayed negative effects in the split-sample analyses. Participative control proved detrimental when uncertainty was rising, and directive control appeared inefficient under more stable conditions. We found, however, that one planned activity behaved more as predicted. Monitoring milestones increased the probability that a project would remain within budget when technical uncertainty was stable.

DISCUSSION

This study is a response to calls for finer-grained constructs that capture the tensions and build from the activities of project management (e.g., Dougherty, 1996; Jelinek & Schoonhoven, 1990). Our conceptual framework juxtaposes emergent and planned styles to accentuate their differences. Yet, rather than depict these styles as mutually exclusive, we propose that each promotes a distinct, but potentially complementary, approach to project monitoring, evaluation, and control. The resulting constructs may help researchers and practitioners move beyond either/or thinking to examine the interplay between these varied styles. Tests suggest that the corresponding measures are reliable and valid, providing useful means of investigating complicated project management issues, such as how combinations of managerial activities affect team commitment and firm support for a project.

This exploratory study offers a basis for ongoing conceptual development. In particular, some items were customized for this research site. The information-gathering measure, for instance, gauged team interactions with marketing and regulatory personnel. Firm managers stressed that these external groups dealt with issues most problematic for their R&D efforts. Alternative sites might suggest other sources of pertinent information (such as suppliers, customers, quality assurance, or manufacturing). Tests on different samples also would further assess the validity, reliability, and factor analytic structure of this new instrument. Although our research focused on R&D, extended studies might examine the role of management styles across additional phases of product development (such as transfer from R&D to production to eventual product launch).

Project Management Dynamics

A notable strength of this research is its design. Survey studies of product development often examine a single cross-section of data, asking respondents, in hindsight, how a project was managed (Brown & Eisenhardt, 1995). In contrast, we collected data in real time, following 80 projects over a series of six-month intervals. Our analyses reveal the dynamism of managerial activities, as well as variations in uncertainty and project management and in the relationships between performance. These results demonstrate the need to purposefully incorporate time within future research. If innovation is marked by periods of stability and clarity and by bursts of creativity and ambiguity, then a key issue is how managers respond to such fluctuations (Dougherty, 1996). Retrospective studies may offer limited, or inaccurate, insights into the uses and effects of management styles.

Our findings indicate that, regardless of style, the use of most project management activities declines over time. The one exception was participative control, suggesting the unique nature of this emergent activity. The work of Van de Ven and Polley (1992) offers a possible explanation. In their longitudinal study, managers tended to retain, if not increase, team members' autonomy. These authors theorized that as a project progresses, its goals and potential for success will become clearer and teams will become increasingly focused and routine-oriented. As these changes occur, managers may feel more secure maintaining the current level of participative control. Extending this claim, we propose that managers also may reduce planned activ-

ities for fear that such intervention will impede progress.

Furthermore, despite declining usage, emergent and planned activities significantly impacted performance even 24 months into a project. This finding suggests that project management styles remain valuable, but their roles may change over time. Initially, emergent approaches may help teams work through the novelties of a project, whereas planned activities provide a sense of direction and order. Later in the process, more subtle managerial activities may serve a supporting role, helping teams to cope with varying levels of uncertainty and to push projects toward completion. Replicating this study in other sites would assess the generalizability of these findings and elaborate the changing role of management styles. By examining multiple data panels, our study contributes valuable, but partial, insights into the process by which managers adjust their activities to varying project conditions. More continuous longitudinal research might detail how and when managers engage in these activities, thus responding to Pennings's (1992) call for greater process understandings.

The Paradox in Project Management–Performance Relationships

This study explores the impact of contrasting management styles on multiple dimensions of performance. Our extensive regression analyses complicate existing understandings but also reveal an overarching paradox in project management–performance relationships. Results suggest that meeting tenuous demands for innovation and efficiency requires a blend of emergent and planned approaches. As Quinn (1988: 90) proposed, high performers may "transcend style," breaking away from a preferred mode of thinking and behaving to apply a more flexible and complicated repertoire of activities. Specifically, we find that successful product development may require managers (1) to use emergent and planned activities concurrently, (2) to go back and forth between styles as changes in project uncertainty occur, and (3) to make trade-offs between contending demands. We now briefly discuss these three managerial capabilities.

First, the ability to combine emergent and planned activities may improve certain facets of project performance. For example, both approaches to control helped teams use their time more efficiently, particularly under conditions of low commercial uncertainty. Like McDonough and Barczak (1991), we found that participative control sped product development. Providing teams with decision-making discretion and accountability may foster spontaneity, encouraging members to improvise and explore market opportunities as they arise. Yet under the same conditions, close managerial supervision also enhanced on-time performance. By examining participative and directive control as distinct activities, our study clarifies the frequent but ambiguous calls for subtle control: effective managers provide strong leadership to keep teams focused and on schedule, while empowering team members to foster motivation and creativity (e.g., Clark & Fujimoto, 1991; Wheelwright & Clark, 1992). As Jelinek and Schoonhoven proposed, accelerating innovation requires the sharing of control, because "discipline is exercised best in a freer process" (1990: 442).

Second, successful managers use iteration between styles in response to changes in project uncertainty. For instance, significant interaction effects suggest that monitoring milestones and understandings both enhance the likelihood that projects will meet their commercial objectives, but under different conditions. When commercial uncertainty is low, monitoring understandings is beneficial, possibly encouraging teams to step back, assess their work, and integrate their evolving know-how with existing organizational competencies (for instance, expertise marketing that type of product). In contrast, when an organization is unfamiliar with the developing product, monitoring milestones becomes vital. Some researchers have proposed that milestones offer a sense of structure, reducing team members' anxiety as they experiment with alternative designs (e.g., Eisenhardt & Tabrizi, 1995). Mirvis (1998), however, suggested that milestones play a very different role when uncertainty is high. Frequent milestones actually may stimulate anxiety, pushing team members to look ahead—previewing possible crises (like poor test results)—and to think through their potential responses.

The third paradoxical pattern exposes the possible need for trade-offs. Product development efforts demand both innovation and efficiency, but certain activities may foster one, while impeding the other. Formal review provides a case in point. Across varied conditions of uncertainty, this planned style of evaluation enhanced the likelihood that projects would build technical knowledge. At the same time, formal review activities consistently and negatively impacted within-budget performance. As Rosenau and Moran (1993: 166) proposed, frequent and systematic reviews may help top management stay informed, provide teams with valuable feedback, and adjust project resources as needed. Such evaluations, however, consume a tremendous amount of resources themselves. Hence, this activ-

ity may bolster innovation, but at the expense of budgetary efficiency.

In sum, our results support Dougherty's (1996: 433) claim that successful product development requires the capacity to manage tensions—not by sticking to the tried and true, but by applying different aggregates of action at different times. Yet our findings also accentuate the need for further research. Building on our conceptual framework, contingency studies might investigate complex interactions between project contexts (for instance, product novelty, team characteristics, environmental uncertainty) and management styles. Such work may help researchers comprehend how managers respond to numerous and fluctuating contingencies and offer practical insights into the conditions under which certain managerial activities become critical.

Furthermore, although we find that project management style matters, existing research demonstrates the importance of numerous product development methods (cf. Brown & Eisenhardt, 1995; Montoya-Weiss & Calatone, 1994; Wheelwright & Clark, 1992). A greater understanding of project management styles may extend this work. Emergent and planned styles offer internally consistent modes of thinking and behaving that help managers translate structural mechanisms and standardized engineering tools into action. For instance, future studies might assess how contrasting styles influence the use and effectiveness of such popular methods as concurrent engineering, cross-functional teams, or quality function deployment (QFD).

Concluding Note

As global competition intensifies and technological change accelerates, comprehending the challenges of product development is increasingly vital. This study explored the nature, dynamics, and impacts of contrasting management styles in diverse product development projects. We found that managers may be well served by developing a complicated and paradoxical repertoire of practices. Similarly, Mirvis praised the blending of approaches as "planned serendipity"; the notion is "that order arises out of chaos and that freedom produces control" (1998: 590). Managing tensions between loosely and tightly coupled activities, bottom-up and top-down processes, and flexibility and discipline may provide a key to high performance. We hope that, by capturing the tensions and building from activities of project management, this conceptual framework provides a potentially valuable foundation for future research. As Quinn explained:

> Just as organizations are usually not without tension, neither are managers. There are no clear maps for problem detection or solution. Many diverse kinds of behaviors are expected, and these are, at a minimum, distant, at a maximum, competing. [An insightful conceptual] framework allows for the dynamic tensions that can sometimes be at the heart of managerial life. It also allows for the fact that behaviors may change. A manager may engage in a set of behaviors reflecting one set of values at one point and in an entirely different set of values at another point. (1988: 88)

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