The Adoption of High-Involvement Work Practices

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This article provides a theoretical framework for understanding why high-involvement work practices are adopted more rapidly by some organizations than others. Drawing on evolutionary economics and innovation literature, we identify three key drivers: (1) the level of complementary human resource practices and technology; (2) performance achieved with previous practices; and (3) factors that alter the cost of introducing new practices. Empirical analyses of a unique longitudinal data set of forty-three automobile assembly plants worldwide provide support for hypotheses about complementary HR practices (but not complementary technologies) and partial support for hypotheses about past performance and factors that alter adoption costs.

THERE IS A STRIKING PARADOX in research on high-involvement work practices.[1] A growing body of literature establishes strong empirical links between such practices and improved economic performance, and

[1] In using the term "high-involvement" as a descriptor for new work practices, we depart from the convention of many recent writings on this topic that use the term "high-performance" instead We do so because we believe that to label new work practices "high-performance" can be misleading in the absence of clear empirical tests of their actual link to economic performance in a given situation

finds that these practices are most effective as part of a larger bundle or system that includes complementary human resource (HR) practices (MacDuffie, 1995a; Ichniowski and Kochan, 1995; Ichniowski, Shaw, and Prennushi, 1994; Huselid, 1995; Batt, 1995; Arthur, 1992). Thus, from the perspective of economic rationality, one should expect high-involvement work practices to be widely used. Yet many argue that imitation, learning, and diffusion of these practices have been slow and sporadic (Pfeffer, 1994; Osterman, 1994; Kochan and Osterman, 1994; Ichniowski and Shaw, 1995). The goal of this article is to understand why individual work practices (as well as "bundles" or systems of high-involvement work practices *and* complementary HR practices[2]) are adopted more rapidly by some establishments than others.

We develop a theoretical framework that draws on evolutionary economics, innovation, and strategy literature to identify three factors driving adoption: (1) the presence of complementary HR practices and technology; (2) low levels of economic performance achieved with current work practices; and (3) organizational characteristics and behaviors that reduce the cost of introducing new work practices. Longitudinal data from the international auto industry allow us to test several hypotheses about these factors.

We examine the adoption of high-involvement work practices by analyzing data gathered in two rounds of surveys (1989 and 1993–94) from forty-three automobile assembly plants located around the world (MacDuffie and Pil, 1996a). Although the use of such practices increased considerably over this five-year period, the rate of increase varied dramatically from plant to plant. Given the growing intensity of international competitive pressure in this industry and its impact on product markets and business strategies, the lack of more extensive adoption of high-involvement work practices warrants close investigation.

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[2] The precise definition of "high-involvement work practices" in this area of inquiry varies from researcher to researcher, as does the nomenclature for such practices. We emphasize structural aspects of the organization of work (e g , the use of work teams and other small group activities organized for production-related problem solving) and associated practices (e g , job rotation, the division of labor for quality responsibilities between team members and supervisors or quality control staff), consistent with MacDuffie, 1995a and Osterman, 1994 We thereby exclude from our definition certain human resource policies (e g , training, hiring practices) that other researchers (e g , Huselid, 1995, Ichniowski, Shaw, and Prennushi, 1994) have included in this category However, we consider these HR policies as complementary to "high-involvement work practices," as explained below, and thus relevant to explaining variation in the diffusion of such work practices This article's focus on the adoption of high-involvement work practices, thus defined, reflects our observation that changes in these work practices are more difficult to carry out than changes in the complementary set of HR policies because they are more intricately bound up with core business processes and coordination requirements of the organization

This article builds on past research that examines how high-involvement work practices, when combined with complementary HR practices and manufacturing policies, contribute to the achievement of productivity and quality outcomes, facilitate management of the complexity associated with high product variety, underpin shop-floor problem-solving processes, and affect workers and institutions of worker representation (MacDuffie and Krafcik, 1992; MacDuffie, 1995a, 1995b, 1996b; MacDuffie and Kochan, 1995; MacDuffie and Pil, 1996a; MacDuffie, Sethuraman, and Fisher, 1996; Pil, 1996). The bundle of high-involvement work practices identified in this previous work as a strong predictor of economic performance here becomes the dependent variable for a dynamic analysis of changes in the utilization of these practices over time. This is the first in a series of papers that use these unique longitudinal data to explore economic, technological, and institutional factors promoting both convergence and divergence in the diffusion of high-involvement work practices across country and company boundaries (MacDuffie, 1996a; MacDuffie and Pil, 1996a, 1996b; Pil and MacDuffie, 1996; Pil, 1996).

Facilitating and Constraining Factors for Change in Work Practices

A theoretical perspective on organizational change that can help explain the limited adoption of high-involvement work practices can be found in evolutionary economics (Aldrich 1979; Nelson and Winter, 1982). The evolutionary perspective suggests that organizations develop a set of organizational routines over time. These established patterns of operation are generally tacit and become ingrained in the collective knowledge of the organization. Organizational routines change infrequently and are subject to selection pressures. Only changes that result in positive change for the organization are retained.

Routines can change through trial-and-error experimentation and/or organizational search for superior ways of doing things. With a trial-and-error approach, organizations are "groping" their way toward superior routines (Lippman and Rumelt, 1982). This is often "a chaotic or probabilistic process not easily amenable to conscious attempts to increase its occurrence" (Mezias and Glynn, 1993, p. 79). While a search for superior routines reflects a more intentional and directed effort to achieve change, managers typically look only to familiar technologies and organizational practices—those that are, in Cyert and March's (1963) terminology, "in the neighborhood"—as solutions to problems. Given the chaotic nature of trial-and-error change, the "local" nature of searches for superior routines,

and the embeddedness of established routines in daily organizational activity, organizations are always subject to a certain level of inertia (Nelson and Winter, 1982).

The literature on innovation provides further insight into how organizational change takes place, distinguishing two different kinds of change— variously described as "evolutionary" versus "revolutionary" (Mezias and Glynn, 1993); "incremental" versus "radical" (Dewar and Dutton, 1986); or "frame bending" versus "frame breaking" (Tushman, Newman, and Romanelli, 1986). While the former terms describe minor modifications in existing technologies and organizational practices, the latter terms describe "fundamental changes in the activities of an organization and represent clear departures from existing practice" (Damanpour, 1991, p. 561). "Revolutionary," "radical," or "frame-breaking" change is much harder to undertake and occurs much less frequently than evolutionary change (March, 1991, Tushman and Nelson, 1990, Mezias and Glynn, 1993). Furthermore, radical change—particularly involving fundamental shifts in technology—can be "competence destroying" (Tushman and Anderson, 1986), in the sense that the presence of an older technology both hampers the introduction of new technology and reduces the benefit associated with its introduction. We will argue in this article that a fundamental organizational change, such as the adoption of high-involvement work practices, can also be competence destroying.

The notion of competence-destroying change has very significant implications for an organization's learning curve. Suppose an organization has placed great emphasis on a strong Tayloristic approach to work organization, where supervisors are assigned the role of (and trained to be) autocratic disciplinarians and employees are viewed as little more than expendable labor. Switching to a system in which work is organized around employee teams would entail not just introducing a new system, but destroying the experience the organization had with the old system. Whereas learning under incremental change would look like curve A in Figure 1a, learning under competence-destroying change would have a slope that is much less steep. Furthermore, because of costs associated with unlearning old practices and introducing new ones, initially the organization may perform worse with the new practices (curve B) than with the old ones (curve C), even if over the long term the new practices are superior.

If new practices are time dependent, that is, if returns to such practices are quite low in the short term and only grow over time, a similar learning pattern to that experienced with competence-destroying change is ob-

FIGURE 1a
Learning Curves under Evolutionary versus Competence-Destroying Change
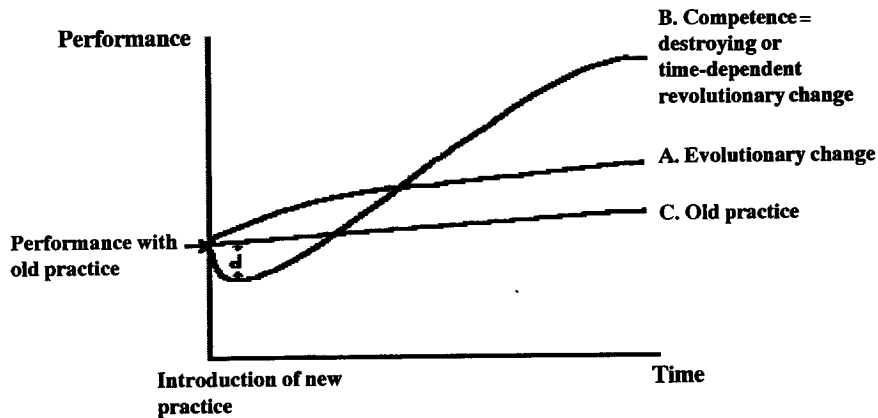

served. For example, if an organization makes significant investments over a long time period in employee involvement (EI) activities and training, the impact on worker commitment and skill—and hence on economic performance—will be larger than when efforts are concentrated in a very short time period. Furthermore, because these changes are not costless, the organization may perform worse (or at least no better) immediately after introducing the new practices relative to performance with the past practices.

Both competence-destroying change and time-dependent change can lead to "competency traps." These arise when favorable experience with an inferior routine leads an organization to accumulate more experience with it (Levinthal and March, 1981; Levitt and March, 1988). Given a negative differential between the current performance of existing routines and the initial performance of a new, potentially superior routine (shown by area "d" in Figure 1a), organizations may maintain the inferior routines with which they have had more favorable experience in the past. Thus superior practices that do not yield immediate results face a high risk of not being retained.

Although these arguments can be applied to the adoption of specific practices or routines, they have more profound implications for the adoption of bundles of practices. Given that organizations tend to approach change through trial-and-error attempts at problem solving and localized searches for superior routines, they will rarely attempt the comprehensive and simultaneous replacement of an entire bundle of existing practices.

FIGURE 1b
Performance Implications of Complementarities
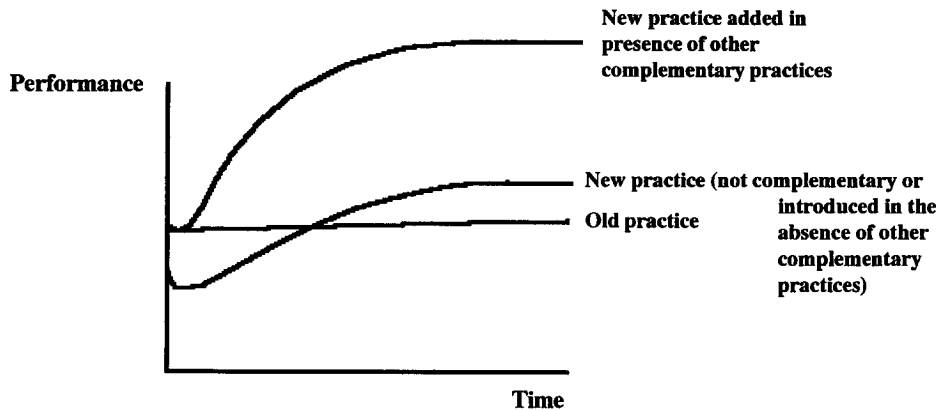
Instead, an organization may decide to implement one or two new practices and assess their impact before proceeding any further. Such behavior poses a problem because high-involvement HR practices and work systems are subject to complementarities (Milgrom and Roberts, 1995; Ichniowski and Shaw, 1995, MacDuffie, 1995a).

Practices are complementary when using them together results in greater performance than the sum of the performance resulting from using each practice separately. For example, when a high-involvement work practice is introduced in the presence of complementary HR practices and technologies, not only does the new work practice induce an incremental improvement in performance, but so do the complementary practices. However, if there are no complementary practices established, the only improvement in performance is due to the new work practice itself. Without the performance boost of complementary practices, the new practice may not be adopted, particularly if it represents competence-destroying change or only reveals its performance advantages over the long term. This is shown in Figure 1b. Figure 1b shows that, in addition to the presence of complementarities, the adoption of new work practices will depend on the performance achieved with past practices, as well as factors that alter the initial cost of implementing the new practices.

Hypotheses

The first hypothesis, drawing on the foregoing discussion, concerns the impact of complementary HR practices and/or technologies on the adop-

tion of high-involvement work practices.[3] Consider for a moment how HR practices might be complementary to new work practices. Careful hiring and selection procedures seek to identify new employees who are able and willing to support the new work practices. Extensive training, both on- and off-the-job, prepares production workers for new roles and responsibilities in shop-floor teams, for example, rotating jobs, revising work methods, taking over quality inspection and equipment setup tasks. Similarly, supervisors and engineers need to be trained in their new roles as coaches and advisors to quality circles and teams. Breaking down the status barriers between managers and production workers (e.g., a common parking lot and cafeteria, no neckties for managers) can facilitate management's shift to new roles while improving communication and worker commitment (MacDuffie, 1995a).

Incentive systems may also need to change to support new work practices. As more and more activities are carried out in teams (both on-line and off-line), it becomes increasingly difficult and costly to monitor the efforts of individual workers. A firm that makes compensation contingent on performance at the group or organizational level will have workers that are more likely to engage in mutual monitoring, and are more motivated to participate in activities that improve the organization's overall performance (Blinder, 1990; Levine and Tyson, 1990).

Another complement to high-involvement work practices is the presence of flexible automation (MacDuffie and Krafcik 1992, Parthasarthy and Sethi, 1993, MacDuffie and Pil 1996b).[4] Flexibly deployed workers

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[3] MacDuffie (1995a) also shows that low buffer levels are important and complementary to high-involvement work and HR practices We do not consider policies on buffers here because of a pattern observed in the second round data As in previous work (MacDuffie and Krafcik, 1992) that found companies would often introduce technological change without making corresponding changes in work organization, we found that many plants reduced their use of buffers between 1989 and 1993–94 without changing their work practices This suggests that changes in buffers can be made independent of changes in work practices, at least in the short term However, we did redo our analyses to include "use of buffers" as an independent variable In no equation was the 1989 level of buffers a significant predictor of change in work practices, and the coefficients in the remaining independent variables did not change appreciably

[4] It is certainly the case that flexible automation can also be part of a cost-minimization corporate strategy in which the primary goal of capital investment is the elimination of jobs and there are few incentives for management to invest in high-involvement work practices Indeed, this was the case in the early to mid-1980s, particularly in certain U S and European companies (e g , General Motors, Fiat) that sought to improve their competitiveness through investments in flexible automation that reduced their dependence on workforce skill and motivation However, by the late 1980s and early 1990s, many of these "technology-only" strategies had proven ineffective—particularly efforts to boost substantially the amount of automation in the labor-intensive assembly area Instead, companies appeared to be learning that flexible automation can be used in a very inflexible way *unless* implemented in the context of flexible work organization (e g., teams) and flexible workers (e g , highly

capable of effective problem solving are critical to achieving many of the strategic goals associated with flexible automation. When flexible automation is used to generate more product variety, workers must master a higher variety of more complex tasks in order to avoid productivity or quality penalties. Flexible automation facilitates rapid changeovers from one model to another, but effective changeovers require flexible workers who are accustomed to rotating jobs and modifying work methods (e.g., through their participation in work teams, problem-solving groups, and ongoing *kaizen*/continuous improvement efforts). Finally, flexible automation lends itself more readily to worker involvement in making incremental process changes, given that minor modifications in the software programs for robots may be carried out locally.

Thus the first hypothesis is:

> H1: Organizations will be more likely to adopt high-involvement work practices if they have already adopted complementary HR practices and/ or flexible automation.

This hypothesis leaves unspecified the way in which complementary HR practices and flexible automation influence the adoption of high-involvement work practices. It is possible that firms already using these complementary practices and technologies may discover through trial-and-error experimentation that high-involvement work practices are a good "fit" with these existing practices and yield performance gains in a relatively short period of time. However, firms may also examine what other firms are doing as they search for superior practices and discover the benefits that accrue from the complementarities among high-involvement work practices and the associated HR practices and flexible technologies.

From the perspective of the "new institutionalism" (DiMaggio and Powell, 1991), this latter approach—search through comparison with other firms—might lead to adoption of high-involvement work practices even among firms that are *not* using complementary practices or technologies. In other words, firms often copy what other successful firms are doing (what DiMaggio and Powell call "mimetic isomorphism") whether or not they can implement new practices in the context of other complementary practices. Thus the relationship between prior usage of complementary

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trained and accustomed to cross-utilization and ongoing problem solving) Thus from the late 1980s forward, we believe that the characterization of flexible automation as strategically complementary to flexible work practices is accurate for most U S., European, and Japanese companies

HR practices and technologies and the adoption of high-involvement work practices will have to be quite strong for hypothesis 1 to hold.

The second hypothesis considers whether or not the adoption of high-involvement work practices is more likely when organizations exhibit inferior performance. Cyert and March (1963) suggest that innovative change can be either the result of search for the application of underutilized resources or a reaction to adversity. There are conflicting perspectives on the impact of adversity, in terms of poor performance, on a firm's behavior. Some literature suggests that poorly performing organizations become increasingly committed to losing courses of action, that is, escalating commitment (e.g., Staw, 1976). Other literature suggests that poor performance is more likely to result in innovative change. Chandler (1962), for example, proposed that poor performance induced search for new behaviors within organizations. More recently, Bolton (1993) showed empirically for a sample of high-tech firms that those exhibiting substandard performance were more likely to alter how they conduct research than their better-performing counterparts.

The latter views are consistent with the evolutionary perspective on change outlined above. Under conditions of poor performance, the organization is already inclined to view current practices as suboptimal. Therefore, even though competence-destroying change may reduce the immediate benefit of new practices, the short-term differential between potential new practices and existing practices (area "d" in Figure 1a) is not as great. As a result, the cost of change relative to maintaining the status quo is less for poorly performing organizations, and change is more likely. The second hypothesis, therefore, is:

> H2: Organizations will be more likely to implement high-involvement work practices if they are exhibiting poor performance relative to competitors.

The third hypothesis considers organizational behaviors and characteristics that can alter the cost of introducing new work practices. One such cost results from the difficulty of unlearning the old way of doing things. The current way of doing things is accepted as the norm by those who work in the organization, and patterns of interaction, communication, and trust develop around these routines (McNeil and Thompson, 1971). Over time, routines develop into customs backed by moral claims on how things are to be done (Doeringer and Piore, 1971). For example, in a Taylorist work environment, workers have a clear understanding of what is expected of them, and they learn to work in accordance with those expectations. There

are seniority rules that are respected, clearly defined job roles, an understanding on the part of the workers of what behavior management wishes to elicit, and what will be given in return. When switching to a team-based environment, production workers and managers face great uncertainty. They have to learn new roles, new ways of interacting, and develop a new degree of trust in the new system and one another. The less experience employees have had with the current system, the easier the change may be, because their expectations about the work environment would be less fixed, and current routines would be less ingrained. This leads to the third hypothesis:

> H3: Organizations will be more likely to implement high-involvement work practices if their employees have less experience with existing practices.

The fourth hypothesis considers how trust (or the lack of trust) between employees and managers can affect the likelihood of adopting high-involvement work practices. Many researchers have emphasized that the successful implementation of high-involvement work practices requires mutual understanding that not only are employees committed to the organization they work for, but that the organization shows commitment to them in return (Burack et al., 1994; Aoki, 1990; Kochan and Osterman, 1994). According to Bailey (1992) and Levine and Tyson (1990), long-term employment relations and job security are the most important factors establishing such reciprocal obligation.

When long-term job security is drawn into question through workforce reductions like layoffs, trust and commitment may disappear. Layoffs often break the implicit "psychological contract" between employees and the organization they work for—even for those employees who are not laid off (Brockner et al., 1987). The reduced levels of trust accompanying such a break increases the difficulty of successfully implementing high-involvement work practices and reduces the likelihood of near-term benefits (Kochan, Katz, and Mower, 1984). For example, it would be very difficult to implement a suggestion program focused on performance improvements when employees fear that such improvements might result in future job reductions. Thus the fourth hypothesis predicts that:

> H4: Organizations will be less likely to introduce high-involvement work practices if they have recently undertaken layoffs or other actions that reduce trust on the part of the workforce.

The fifth hypothesis considers organizational disruptions that can lower the cost of introducing high-involvement work practices. An organizational disruption can potentially "unfreeze" the existing way of doing things (Lewin, 1947; Schein, 1992) and thus represents a competence-destroying change in and of itself.[5] This reduces the penalty associated with trying a new way of doing things, relative to returning to the status quo. Such a disruption could take various forms that may vary by industry context. In the airline industry or telecommunications industry, for example, deregulation might constitute such a disruption. In the automobile industry, product market-related changes provide periodic disruptions. For example, opportunities are presented each time a new product (and the associated new process technology) is launched in a given factory to implement other changes in the organization and coordination of work as well. This leads to the fifth and final hypothesis:

> H5: Organizations will be more likely to introduce high-involvement work practices in the presence of changes that cause some "unfreezing" in the current way of doing things.

Sample and Methods

To test the hypotheses in the previous section, we draw upon data collected through the International Assembly Plant Study, carried out under the auspices of the International Motor Vehicle Program at MIT (MacDuffie and Krafcik, 1992; MacDuffie and Pil, 1995). These data were collected via plant-level surveys, first in 1989 (hereafter Round 1), and again in the fall of 1993 through the spring of 1994 (Round 2). In Round 1, 90 plants were contacted and 70 completed and usable responses were received from plants representing 24 companies in 17 different countries. In Round 2, 109 plants were contacted and 86 completed surveys were returned. Of these, 83 were usable, reflecting data from 21 different companies and 20 different countries. The response rate of 77 percent in Round 1 and 79 percent in Round 2 is extremely high, given the comprehensive nature of the survey. All the plants participating in Round 1 and forty-one of the plants participating in Round 2 of the study have been visited by a member of the research team in order to verify

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[5] The layoffs identified in hypothesis 2 are, arguably, an "unfreezing" event as well However, we choose to examine the effect of layoffs on adoption separately because they potentially affect the "psychological contract" in a way that the "unfreezing" events considered here (which offer opportunities to implement new practices because they force an interruption in ongoing activities) do not

data and provide feedback. Each participating plant also received a customized report showing their performance in relation to average values for plants by region.

The plants sampled in each round represent approximately one-half to two-thirds of the total assembly plant capacity worldwide. All told, this study represents the most comprehensive effort ever undertaken to gather longitudinal international data on new work practices and HR policies, the role of these practices in the overall production system, and their impact on economic performance.

There are forty-three plants that participated in both rounds of data collection. Of these, four are missing some data and were dropped for the purposes of the regression analyses, leaving a usable sample of thirty-nine plants. About 60 percent of the Round 1 sample participated in the Round 2 data collection; thirty-one plants participating in Round 1 are not in the matched sample. This change in the sample from Round 1 to Round 2 is due in part to six plant closings and the opening of nine new plants. The remaining differences between the two rounds are the result of changes in the composition of auto company participation in the Assembly Plant Study: some Round 1 companies declined to participate in Round 2 and some companies that had not participated in Round 1 joined the study. Each change in a company-level decision to participate in the survey generally involves several assembly plants.

Operationalization of Variables

Dependent variable. To investigate changes in the use of high-involvement work practices by our sample of assembly plants between 1989 and 1993–94, we utilize a composite index, referred to as the "Work Practices" index, that reflects five specific work practices: (1) shop-floor "on-line" work teams, (2) "off-line" employee involvement or problem-solving groups, (3) job rotation, (4) suggestion programs (number of suggestions, as well as percent implemented), and (5) the decentralization of quality efforts (the degree to which production workers take direct responsibility for quality-related activities). Appendix A contains the details of how each of these work practices is measured.

The Work Practices index is calculated by pooling the data across the two time periods (1989 and 1993–94), standardizing the data for each practice through a z-score transformation, and then additively combining the standardized scores[6] (see MacDuffie, 1995a for more details). In order

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[6] The Cronbach's standardized alpha score for this index was 0 69 Principal components analysis found that all variables in this index loaded on one factor

to have an index value that is easier to interpret, we apply a linear transformation to the sum of the z-scores, such that the plant with the lowest level of these high-involvement work practices has a score of zero and the plant with the highest level has a score of one hundred. The distribution of the variable is unaffected by this transformation. Because we pool the data before these transformations, a specific bundle of practices will yield the same index score in either 1989 or 1993–94.

Independent variables. The first independent variable is an index of HR practices that are thought to be complementary to high-involvement work practices. The complementary HR practices included in this index are: criteria used for selection and hiring of production workers; extent of contingent compensation; training (both on- and off-the-job) for new and experienced employees; and the extent of status differentiation between production workers and managers. The specific measurement of each HR practice can be found in Appendix A, and specific arguments about why these practices are particularly complementary to the new work practices measured for this study can be found in MacDuffie (1995a). This "HR Policies" index was created the same way as the Work Systems index— pooling data across both rounds, standardizing the data and summing across the practices, and then applying a linear transformation to get a zero to one hundred scale, where zero indicates the plant with the fewest and one hundred the plant with the most of these complementary HR practices.[7]

A second independent variable is flexible automation, operationalized as the number of robots in the plants, weighted by number of employees, where robots are defined as programmable equipment with three or more axes of motion.

A third set of independent variables includes two measures of plant-level performance: log productivity and log quality. The productivity measure follows a methodology developed by Krafcik (1988) to measure the number of labor hours required to produce a standardized vehicle. By adjusting for the type of vehicle produced, the level of vertical integration of the plant, and working time differences across plants, the resultant measure is comparable across all assembly plants. The quality measure is based upon the number of defects per one hundred vehicles. This figure is based on annual surveys of new car owners by J. D. Power and Associates. The J. D. Power data are adjusted to include only defects directly attributable to the assembly plant (MacDuffie and Pil, 1995; Krafcik, 1988). J. D. Power data

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[7] The Cronbach's standardized alpha score for this index was 0 59 Principal components analysis found that all variables in this index loaded on one factor

are only available for vehicles sold in the United States and thus are missing for seven of the plants in our matched sample. As a result, those regressions that include quality as an independent variable are limited to thirty-two plants. For both productivity and quality, higher values indicate poorer performance (i.e., more labor hours or more defects per vehicle).

Employee job tenure is the fourth independent variable. Given that the more traditional "job control" work practices associated with mass production plants have been dominant for most of this century (Katz, 1985; Womack, Jones, and Roos, 1990), the most direct proxy of how much experience employees (both workers and managers) have with those practices is their tenure level. We measure both production worker tenure and average tenure levels of the five top managers in the plant (plant manager, head of finance, head of engineering, head of human resources, and head of material services).

Company actions that reduce employee trust constitute the fifth set of independent variables. We asked plants about the layoff of production workers, the layoff of managerial employees, and the use of early retirement incentives as means to reduce the workforce between 1989 and 1993–94—actions frequently undertaken in the downsizing of many automotive companies in recent years. We believe that early retirement incentives would be less likely to result in broken trust than actual layoffs, and thus unlike layoffs might *not* reduce the likelihood that new high-involvement work systems are implemented.

Finally, we identified two major types of disruptions in assembly plants that could result in "unfreezing" of the current way of doing things: major product changeovers and significant new additions to the plants. When plants introduce a new product, assembly lines are reorganized, layouts are changed, jobs are redefined; there is a general upheaval in the way things are done. We measure the percent of a plant's products (as a percent of output volume) that were introduced during the time period between 1989 and 1993–94. Significant new additions were measured as a dichotomous variable capturing whether or not a plant added a new assembly line between 1989 and 1993–94.

Specification

We use the 1993–94 (Round 2) Work Practices index score as the dependent variable, including the 1989 (Round 1) Work Practices index score as an independent variable. Also included as independent variables are the level of complementary HR practices in 1989 and the level of flexible automation in 1989; log productivity and log quality; the variables on

employee and managerial experience/tenure; the variables on layoffs and early retirements; and the variables on plant-level disruptions. Because of the extremely small sample size, we do not test any models including all of these variables. Instead, we first test an equation with only the 1989 level of Work Systems, HR Policies, and flexible automation on the right-hand side. Equations 2–5 add to these base variables each of the other blocks of variables (e.g., performance, experience/tenure, layoffs, disruptions) separately. For all the equations, the White (1980) test was unable to reject the null hypothesis that the error terms are homoskedastic.

Results

We begin by examining the change in the use of high-involvement work practices by the thirty-nine matched plants in our sample. Table 1 reveals an overall increase in the use of high-involvement work practices by these plants from Round 1 to Round 2. With the exception of decentralized

TABLE 1

CHANGE IN HIGH-INVOLVEMENT WORK PRACTICES AT MATCHED PLANTS
MEAN (STANDARD DEVIATION)

	Plants in 1989	Same plants in 1993/94	T-test
High-Involvement Work Practices Index	34 6	46 9	***
(0 = low and 100 = extensive use of high-involvement work practices)	(24 9)	(23 2)	
Individual Practices in High-Involvement Work Practices Index			
% of employees in work teams	15 7	46 3	**
	(29 1)	(39 3)	
% of employees in problem-solving groups (e g , quality circles, employee involvement groups)	28 9	48 8	***
	(37 6)	(38 7)	
Job rotation	3 0	3 2	*
(1 = none, 5 = within & across work groups and departments)	(1 2)	(1 2)	
Suggestions per employee	9 2	12 8	***
	(28 3)	(33 2)	
% of suggestions implemented	38 2	50 8	***
	(36 6)	(32 3)	
Responsibility for quality	1 6	1 7	——
(1 = production workers, 4 = specialists)	(1 2)	(1 3)	
n	43	43	

* = significant at 10 level ** = significant at 05 level, *** = significant at 01 level

TABLE 2

Means and Standard Deviations for Regression Variables

Variable	Mean	Standard Deviation
High-Involvement Work Practices Index 1989	34 6	24 9
High-Involvement Work Practices Index 1993/94	47 6	22 8
Complementary Human Resource Index in 1989	42 0	21 9
Flexible Automation in 1989	13 2	12 6
Log Productivity	3 4	0 4
Log Quality	4 2	0 4
Production Worker Tenure	11 9	5 2
Managerial Tenure	10 0	6 1
Layoffs of Production Workers	42	0 50
Layoffs of Management	47	0 47
Early Retirement Incentives	58	0 58
Major Addition to Plant	.17	0 38
% of Plant's Output That Is New	66	0 42

quality control, which remains at about the same level, there was a significant increase in the use of all high-involvement work practices between 1989 and 1993–94. The most striking increases are in the use of on-line work teams and off-line problem-solving groups (e.g., Employee Involvement groups, quality circles). This table suggests that plants can and do increase their use of high-involvement work practices and that this is the prevailing trend worldwide. However, there remains large variance in the degree to which plants change. Although the average change in the work systems index was 12.3 (on a zero to one hundred scale), the standard deviation for the change was 22.2. Some plants undertook only minor change in their use of high-involvement work practices between 1989 and 1993–94, whereas other plants showed dramatic increases and still others showed modest decreases.

We now turn to testing the hypotheses outlined above to explain why some plants change their use of high-involvement work practices more than others. Tables 2 and 3 provide descriptive statistics and Table 4 shows OLS regression analyses.[8]

Hypothesis 1 suggested that organizations that utilize a greater number of complementary HR practices and/or technologies will be more likely to

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[8] We also ran these in the form of rank regressions to test for the potential problems associated with small sample regression The results are substantively the same as those reported here

TABLE 3

CORRELATION MATRIX

	Work 89	Work 93/94	HRM 89	Flex Auto 89	ln Productivity	ln Quality	PW Tenure	Manager Tenure	Layoffs	Mgr Layoffs	Retire	% New Output
Work 1989	1 0000											
Work 1993/94	5772**	1 0000										
Human Resource Management 1989	5496**	5303**	1 0000									
Flexible Automation 1989	.5440**	2769	6096**	1 0000								
Log Productivity 1989	-5551**	-1721	-3614*	-6554**	1 0000							
Log Quality 1989	-.5048**	-2998	-7098**	-4799**	2167	1 0000						
Production Worker Tenure	-0596	-.1184	-2515	0184	-2311	3327	1 0000					
Managerial Tenure	1039	3619*	1137	-0679	1382	0120	0008	1 0000				
Layoffs	-5824**	-4393**	-4538***	-3127	3014	6371**	1729	-0983	1 0000			
Management Layoff	-5409**	-3785*	-2814	-3424*	3176	5690**	-0557	1865	5549**	1 0000		
Retirement Incentives	-7091**	-4633**	-5364***	-3950*	3063	6693**	3402	0202	3714*	5737**	1 0000	
% New Model	3131	5168**	3857*	3450*	-2280	-1190	-2159	3001	-4727**	-2051	-1061	1 0000
Change in Plant	2401	2161	1677	0966	-1301	-1572	-2449	-1860	-2268	-2737	-3780*	1811

* = Significant LE 05, ** = significant LE 01 (two-tailed)

TABLE 4

UNDERSTANDING CHANGE IN USE OF HIGH-INVOLVEMENT WORK PRACTICES ($N = 39$, 1989 TO 1993/94)

Dependent Variable = High-Involvement Work Practices in 1993/94

Variable	Equation 1 B	SE	Equation 2[a] B	SE	Equation 3 B	SE	Equation 4 B	SE	Equation 5 B	SE
High-Involvement Work Practices, 1989	0.44***	0.15	0.43**	0.19	0.34**	0.15	0.37*	0.21	0.40***	0.14
Complementary HRM Index, 1989	0.41**	0.18	0.62**	0.23	0.31*	0.19	0.39*	0.23	0.32*	0.17
Flexible Automation, 1989	−0.36	0.32	−0.13	0.39	−0.05	0.33	−0.36	0.34	−0.47	0.30
Log Productivity, 1989			4.42	11.1						
Log Quality, 1989			16.92	11.4						
Production Worker Tenure					−0.13	0.63				
Managerial Tenure					1.50**	0.57				
Layoffs of Production Workers										
Major Addition to Plant							−5.24	8.43	2.1	7.45
% of Plant's Output That Is New									19.17**	7.16
Constant	19.3***	6.59	−77.4	74.6	9.61	12.2	26.03**	10.97	12.84*	6.57
F-statistic	8.43***		4.8***		5.7***		4.91***		7.37***	
Adjusted R^2	0.37		0.38		0.45		0.32		0.46	

Significance Levels * = .10, ** = .05, *** = .01

[a] Regressions including productivity and quality represent a reduced n of 32 because quality data are not available for any non-U.S. plants that do not export to the United States

adopt high-involvement work practices than those who have fewer or no complements. This is the "bundling" or complementarity argument, but unlike MacDuffie (1995a) which examines bundles in a cross-sectional sample, it is here applied to the dynamics of adoption of high-involvement work practices over time. Equation 1 assesses the impact of the 1989 level of complementary HR practices and flexible automation on the 1993–94 level of high-involvement work practices, controlling also for the level of high-involvement work practices in 1989. This equation, with an adjusted *r*-squared of 0.37, reveals that the Round 1 level of work practices and complementary HR practices are statistically significant predictors of the Round 2 level of work practices, that is, that plants are more likely to increase their use of high-involvement work practices when they have already implemented complementary HR practices, controlling for their initial level of work practices.

However, the 1989 level of flexible automation appears to have no significant impact on the use of high-involvement work practices in 1993/94, when controlling for the 1989 level of work practices and HR practices. It may be that the 1989 sample contained a mix of some "high-tech" plants with complementary work practices but also plants in which a high level of flexible automation is coupled with traditional work practices. In these latter plants, capital investment may have been intended primarily as a means to reduce labor costs and thus as an alternative strategy to investing in high-involvement work practices. If these "high-tech" plants with traditional work practices experienced poor performance because they were not able to gain full benefit from their capital investment, we would expect them to have a strong incentive to move toward high-involvement work practices. But if their performance was adequate (but not stellar), these would be precisely those plants most likely to face the *disincentives* to investing in high-involvement work practices highlighted in this article, given the potential short-term costs of such a change.

In equation 2, we test the hypothesis that the worst-performing plants will be those most likely to undertake change in their work systems. The positive coefficient for log quality suggests that plants with a greater number of defects per vehicle in 1989 are more likely to increase their use of high-involvement work practices by 1993/94. However, the coefficient is not quite statistically significant ($p = 0.15$). Furthermore, productivity levels in 1989 appear to have no predictive power with respect to 1993/94 usage of new work practices.[9]

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[9] We reran equation 2 dropping the 1989 level of quality, but the impact of the 1989 productivity level remained insignificant The same was true when only the impact of 1989 quality was considered

A potential cause for the lack of strong support for the performance hypothesis is the fact that in the Round 1 data, both performance measures are very highly correlated with the levels of complementary HR practices and work practices ($r = -0.66$ and -0.50 respectively for quality [defects per one hundred vehicles] and $r = -0.36$ and -0.56 respectively for productivity [hours per vehicle]). Furthermore, we are faced with a reduced sample size because quality data are not available for all plants, limiting the power of the analyses and increasing the likelihood of a Type 2 error. Nevertheless, it should be noted that even controlling for 1989 performance, the overall predictive power of the model is still high (with an adjusted R-squared of 0.38) and the effect of complementary HR practices remains stable.

In equation 3, we test the hypothesis about the impact of employee experience levels on the adoption of new work practices. Contrary to our expectations, higher tenure levels did not decrease the likelihood that high-involvement work practices would be adopted. Indeed, higher levels of managerial tenure had a positive and statistically significant association with greater increases in the use of high-involvement work practices, while the coefficient for production worker tenure is very close to zero.[10]

One possible explanation is that the introduction of high-involvement work practices requires significant cooperation, trust, and coordination among different functional groups in each plant, which will more likely be present if the managers of those groups have greater experience working together. Although we had hypothesized that longer tenure for managers and production workers might be associated with more ingrained attitudes and less exposure to new points of view, it is possible that the intense competitive environment in the auto industry in recent years has provided a sufficient "shock" to motivate even long-time managers and employees to be open to changes in work practices.

The hypothesis about company actions that reduce employee trust is tested in equation 4. Although we report only the equation with production worker layoffs, we tested production worker layoffs, management layoffs, and early retirement programs, individually as well as in a group.

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[10] We also investigated another characteristic of the workforce—wage levels—as a potential determinant of the implementation of new work practices using a dummy variable for plants in low-wage countries (Mexico, Brazil, Korea, and Taiwan) (All other plants were located in the United States, Canada, Western Europe, Australia, or Japan) This variable had a positive coefficient but was not statistically significant ($t = 1 4$) Nevertheless, the positive coefficient contradicts the expectation that a "low-wage" strategy relying on traditional work practices might be dominant in these countries This fits with our observation that plants in these countries often face constraints on capital investment and have, instead, sought to improve their performance by implementing the new work practices, HR policies, and manufacturing systems associated with "lean production "

None had an impact on the likelihood that high-involvement work prac-
tices would be adopted. This may reflect the dual nature of layoffs and
other downsizing actions—what at General Motors are often called "sig-
nificant emotional events." Such actions can certainly do damage to em-
ployee trust and loyalty and create strong resistance (or even paralysis) in
response to organizational change efforts. But they may also have an
"unfreezing" effect (similar to product-related disruptions) that facilitates
change. Given that both of these effects may be present in the sample, they
may cancel each other out in the regression analyses.

The inclusion of these variables serves to reduce the coefficients and
significance levels for other variables in the equation. We believe this is due
to the extremely high correlation between levels of work practices in 1989
and downsizing activity (correlations range from .54 to .70). This suggests
that plants that had few high-involvement work practices in 1989 were also
those most likely to undertake downsizing by 1993/94. This is consistent with
the "bundling" idea—that past support for high-involvement work practices
would be linked to a visible commitment to avoiding layoffs—but it also fits
with the observation that many plants with traditional work practices in 1989
suffered from inferior economic performance.[11]

The final hypothesis suggested that disruptions resulting in an "un-
freezing" of the current way of doing things would make change easier and
therefore the introduction of high-involvement work practices more likely.
The results of equation 5 support this claim. New model introductions and
plant expansions are more likely to be viewed as "opportunities" for mak-
ing other changes than the layoffs (assessed in the second hypothesis),
which are more likely to be viewed as a "threat." But the analysis reveals
that only new model introductions prompt more extensive adoption of new
work practices. New plant additions did not appear to have a significant
impact on whether firms changed their work practices. Of note during this
period, however, is that practically all of the plants that added new assem-
bly lines were relatively new (e.g., Japanese transplants), and already had
high levels of high-involvement work practices before their expansions.[12]

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[11] There is the possibility that since layoffs often accompany poor performance, the effect of poor
performance on the adoption of high-involvement work practices is offsetting the effects of layoffs To
control for this, we reran equation 2 including layoffs Poor quality became a significant predictor of
change in work practices at the 10 percent level, while layoffs predicted a reduced likelihood of change
($p = 11$)

[12] In other analyses, we have examined subsamples of nine new plants ("births") that started
operations in the last ten years and six closed plants ("deaths") that shut down between Round 1 and
Round 2 Almost none of these plants are in the matched sample that provides the basis for the
analyses in this paper, so these results are not featured prominently here Other researchers (e g ,
Ichniowski and Shaw, 1995) have found that "greenfield" plants are more likely to implement new

Change in Complementary Practices

Although it is important to understand the impact of levels of complementary practices on the adoption of new work practices, *changes* in the levels of complementary practices can also have an impact on adoption patterns for high-involvement work systems. However, choices about work, HR, and automation, to some extent, may be made simultaneously. If so, we would expect that over time, the correlations between work practices, HR practices, and flexible automation would become stronger over time.

Looking at Table 5, we see that while the correlation between flexible automation and high-involvement work practices has grown larger and more statistically significant over time, the correlation between HR practices and automation is significantly reduced. Based on our fieldwork, we believe this is due in part to the decision by plants in newly industrialized countries to boost their investments in new HR practices significantly between 1989 and 1993/94, but not their use of robotics. We suspect that the increase in training, performance-based pay, the elimination of status barriers, and more selective recruitment and hiring practices that we observe in these plants reflect the corporate parent's assessment that such investments will cost less than extensive capital investments, where the latter are difficult to justify in locations that have both low production volume and low wages.

To understand further the issue of simultaneity in the choices firms make, we jointly estimate the adoption of work practices, HR practices, and flexible automation (Table 6). We find that although levels of work practices in 1989 help predict the level of automation in 1993/94, they do not predict the level of HR practices in 1993/94. Similarly, although HR practices in 1989 help predict work practices in 1993/94, they have no impact on the adoption of flexible automation. The 1989 level of robotics appears to have no impact on the adoption of either HR or work practices. Furthermore, although a Wilks' test cannot reject the null hypothesis that the impact of 1989 levels of HR and work practices is the same for the

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work practices Briefly, we find that the new plants in the Round 2 sample have higher levels of high-involvement work practices, on average, than the entire Round 2 sample but that these differences are not statistically significant Furthermore, while the closure of older plants with poor performance and traditional work practices should, over time, boost the average level of new work practices in the overall population of plants, we found that the work practices at "closed" plants were more traditional than the entire 1989 sample but that again these differences were not statistically significant These results bear further investigation, particularly since small sample sizes for the new and closed plants may affect the significance level of the *t*-tests

TABLE 5

CHANGE IN CORRELATIONS OVER TIME

	High-Involvement Work 1989	Complementary HRM, 1989
High-Involvement Work, 1989	1 0000	
Complementary HRM, 1989	5496*	1 0000
Flexible Automation, 1989	5440*	6096*
	High-Involvement Work, 1993/94	Complementary HRM, 1993/94
High-Involvement Work, 1993/94	1 0000	
Complementary HRM, 1993/94	4627*	1 0000
Flexible Automation, 1993/94	6152*	2069

* Significant at < 01 (two-tailed)

TABLE 6

JOINT ESTIMATION OF THE ADOPTION OF HIGH-INVOLVEMENT WORK PRACTICES,
COMPLEMENTARY HR PRACTICES, AND FLEXIBLE AUTOMATION
(STANDARD ERRORS IN PARENTHESES)

	Dependent Variables (1993/94 levels, n = 37)		
	High-Involvement Work	Complementary HR	Flexible Automation
Independent Variables			
High-Involvement Work, 1989	0.417***	−0 042	0 452***
	(0 152)	(0 147)	(0 134)
Complementary HR Practices, 1989	0 410**	0 430**	0 034
	(0 181)	(0 176)	(0 160)
Flexible Automation, 1989	−0 288	−0 296	0 788***
	(0 322)	(0 313)	(0 283)
Intercept	18 65***	39 23***	−0 217
	(6 60)	(6 42)	(5 798)
F-statistic	8 40***	2 16	17 60***
Adjusted R^2	0 38	0 08	0 57
Ho Is the effect of the independent variable equal to 0 across all dependent variables?			
F-test (based on Wilks' lambda)			
High-Involvement Work Practices, 1989	4 83***		
Complementary HR Practices, 1989	2 8*		
Flexible Automation, 1989	4 74***		
Ho Is the effect of the independent variable the same across all dependent variables?			
F-test (based on Wilks' lambda)			
High-Involvement Work Practices, 1989	0.00		
Complementary HR Practices, 1989	0.06		
Flexible Automation, 1989	4 21**		

* Significant at 10, ** significant at 05, *** significant at 01

adoption of work practices, HR practices, and flexible automation in 1993/ 94, the effect of flexible automation in 1989 is not the same across the three equations.

There may be some element of "regression to the mean" in these results. In the face of recessionary conditions that affected the entire automotive industry in the early 1990s (and lingered particularly long in Japan), many plants with high levels of high-involvement work practices in 1989 appear to have maintained the same or even slightly lower levels of these practices. This trend, combined with the boost in high-involvement work practices from plants with low levels of these practices in 1989, would weaken the statistical association between 1989 and 1993/94 levels.

Overall, these results suggest that, despite the "logic" of interdependence among high-involvement work practices, complementary HR practices, and flexible automation, the choices firms make about these practices do not necessarily happen simultaneously. Although the 1989 levels of high-involvement work practices and complementary HR practices have very similar effects on the 1993/94 level of work practices, the 1989 level of work practices has almost no relationship with the 1993/94 level of HR practices. So even though some plants are changing their HR practices independent of changes in work practices, the adoption of high-involvement work practices tends to follow the adoption of the complementary HR practices. This supports the idea that HR practices may be less difficult to adopt, given that they have less impact on how core tasks are organized. Yet once adopted, the HR practices appear to provide a strong incentive for firms to push further in the direction of high-involvement work practices. This analysis also suggests that the introduction of flexible automation does not necessarily exert a strong pull toward adopting flexible work practices but that flexible work practices do increase the likelihood that a plant will increase its reliance on flexible automation.

Discussion

In this article, we draw on theories of innovation and organizational change to explore various hypotheses related to the determinants of adoption for high-involvement work practices. Although previous empirical studies suggest that such practices can contribute significantly to economic performance (e.g., MacDuffie, 1995a; Ichniowski, Shaw, and Prennushi, 1994; Huselid, 1995), there are strong theoretical reasons (and considerable empirical evidence) to believe that the diffusion of such practices is slower and more sporadic than would be expected from the perspective of economic rationality (e.g., Pfeffer, 1994; Osterman, 1994; Ichniowski and Shaw,

1995). High-involvement work practices may represent "competence-destroying" change, which is difficult to implement, and may lead to worsened performance in the short term (and thus *not* an economically rational choice for individual managers held accountable for short-term results). These practices may also have a less favorable impact on performance if they are not given adequate time to develop. For both of these reasons, firms may be discouraged from making changes in work practices (particularly change involving "bundles" of interdependent practices rather than individual practices), or from continuing with change efforts beyond an initial trial period.

Given these impediments to change, we argue that there are three key factors at the plant or establishment level that drive the adoption of new work practices (and "bundles" of practices): (1) the level of complementary organizational practices and technologies that would increase the *bene-fit* from the new practices, (2) the performance levels the organization is achieving with its current practices, and (3) organizational characteristics or actions that alter the *cost* of introducing the new practices. We tested five hypotheses about the adoption of new work practices using two rounds of data (1989 and 1993–94) from the International Assembly Plant Study, focusing on a matched sample of forty-three automotive assembly plants.

Our empirical analyses indicated that there was an overall increase in the use of high-involvement work practices in automobile assembly plants around the world from Round 1 to Round 2, but with high variance in the degree to which existing plants changed their use of these practices. This variation results from the fact that some poor 1989 performers made major changes in work practices, while other plants made very few changes; similarly, among the better 1989 performers, some continued to increase their use of high-involvement work practices while others remained at the same level. In OLS regressions, we found that, as predicted, plants with HR practices that complement the use of high-involvement work practices were more likely to increase their use of those work practices. But the Round 1 level of flexible automation was *not* a significant predictor of the use of high-involvement work practices in the second round.

As noted above, this latter finding may be the result of different strategies for flexible automation that are reflected in the sample of Round 1 plants. Coupled with the joint estimation of effects from 1989 to 1993/94 for the three key variables (Work Systems, HRM Policies, and Flexible Automation), it provides a sketch of the dynamics of the relationship between new work practices and new technology during this period in the auto industry. Recall that the Round 1 level of work practices *was* a strong predictor of the Round 2 level of flexible automation but not the converse.

This suggests that either some "high-tech" plants in Round 1 did *not* increase their use of high-involvement work practices or that some "low-tech" plants in Round 1 *did* increase their use of such practices.

Our fieldwork suggests both are true. Round 1 plants that turned to technology investments as a means to improve their competitive position in the mid-1980s were also the plants least likely to turn to new work practices in the 1990s. In part this is the result of some underlying preconceptions regarding the role of labor in enhancing performance. On the other hand, many plants in newly industrialized countries are choosing to invest in high-involvement work practices *rather than* investing heavily in any type of new technology.

We found little support for the hypothesis that change in work practices was performance-driven. Although the coefficient for quality was positive and relatively large, indicating that plants whose 1989 quality was poor were more likely to implement new work practices, it was not quite statistically significant. Furthermore, productivity in 1989 had a much smaller coefficient (also positive) and was not a significant predictor of change in work practices. This supports other analyses (MacDuffie and Pil, 1995) that find that a subset of assembly plants in the Round 2 sample have been able to achieve impressive productivity results through top-down reengineering, without fundamental changes in work practices; however, the quality performance of these plants has not been very strong.

Despite this finding, it is worth noting that the coefficients for the performance variables were not negative, challenging the view that poor-performing plants would be *less* likely to make changes in work practices (due to such factors as escalating commitment to past, ineffective policies; lack of financial resources for change; adversarial labor relations; or incompetent management) than average performers. Furthermore, the predictive power of complementary HR practices remained stable when controlling for 1989 performance.

Finally, we investigated a series of factors that would alter the benefits and costs of introducing new practices. Our predictions for the impact of employee tenure and layoffs, with respect to both production workers and managers, were not borne out by the data. We speculate that, in the intensely competitive environment in the world auto industry over the past decade, there has been a strong external impetus for change that has overwhelmed differences between low-tenure and high-tenure workers and managers in terms of receptivity to new work practices. In this context, the benefits—particularly among members of the plant management team—of working together for longer periods of time, with respect to increased trust and cooperation, may come to the fore. We therefore do

not find support for the popular perception that older, more experienced managers and workers are more resistant to change in work practices than younger, newer employees.

With regard to layoffs, we note that downsizing actions can certainly damage the "psychological contract" between employees and the firm but that they may also provide additional impetus to efforts to change work practices. The story is further complicated by the fact that plants that have traditionally used few high-involvement work practices were also the plants that were most likely to undertake employee downsizing. (However, even when the implementation of new work practices is spurred forward in a climate of layoffs and downsizing, it remains to be investigated whether its impact on economic performance is as great as if this change occurred in a climate of trust and cooperation.) We did find strong evidence that plants that undergo a major disruption in their operations—creating a window of opportunity for various organizational changes—were more likely to adopt high-involvement work practices. What is particularly important about this finding is that some types of disruptions (e.g., model changes) occur naturally and periodically in an organization's life cycle, and as such provide perfect opportunities to undertake competence-destroying change in a way that minimizes the costs of the transition.

Other factors beyond those measured here can, we believe, also help explain the patterns of adoption of high-involvement work practices. We have identified such factors in qualitative analyses of what we have learned from interviews during our company and plant visits. For example, although individual plant performance may not be a strong predictor of change in work practices, we have found that *companies* that moved most rapidly to adopt new work practices from 1989 to 1993/94 typically shared many of the following: (1) they faced a serious competitiveness crisis in the late 1980s and early 1990s; (2) their senior managers (and, in some cases, senior union officials) perceived the source of the crisis as internal rather than external—the result of problems with organizing the production system according to traditional mass production principles—and validated this perception with benchmarking data evaluating competitors in various countries; (3) top managers (and union officials) reached the conclusion that lean production principles should be implemented; (4) the company had relatively little previous experience with work reforms; (5) company and plant-level managers and union officials held neutral or positive views about the value of work reforms as a means to improving performance; (6) the company found effective ways to cultivating organizational learning across internal functional or divisional boundaries; and (7) the company had access to some "learning model," that is, establishing some kind of

learning relationship (ranging from a joint venture to informal sharing of benchmarking data) with another company (not necessarily Japanese) already using these principles.[13]

Factors such as these help explain regional and company-level differences in the adoption of high-involvement work practices. (These are not highlighted in this article because the small sample size does not allow us to add regional or company dummies to the analysis.) These conditions were met for a number of European companies (as well as some New Entrant plants) that proved to be the most aggressive adopters of high-involvement work practices. There is also some indication that plants in any region producing high levels of product complexity, either as a function of manufacturing strategy or because the plant serves many export markets, are more likely to adopt both flexible automation and high-involvement work practices. In contrast, many plants in the United States and Canada retained relatively traditional work practices, for the following reasons: (1) management and union ambivalence about work reform that developed in response to earlier change efforts in the late 1970s and early 1980s; (2) competitive crises were not necessarily interpreted as having internal sources or as requiring a change in fundamental production principles; (3) organizational learning, with respect to innovations both inside and outside of the plant, was not always carried out effectively; and (4) the fact that most of these plants remained highly focused on building a single model at relatively high volume provided less incentive to become more flexible by changing work practices.

Taken as a whole, these analyses—both the quantitative analyses in this article and the related qualitative analyses—suggest that both the decision to adopt high-involvement work practices and the actual implementation of practices are affected by a complex mix of factors. Each factor potentially shifts the perceived costs and benefits of making a change in work practices, in terms of how time dependent or competence destroying it is. Each factor also affects the expectations for change from all the critical players—top management, top union officials, plant-level managers and union officials, and plant-level employees. Some combinations of factors, therefore, not only provide more economic incentives for change, in terms of quantifiable costs and benefits, but also provide a more persuasive and legitimate rationale for action than other combinations.

This article is one of the first to explore, both theoretically and empiri-

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[13] This list reflects our perception about the common characteristics of firms making the most changes in their use of high-involvement work practices and should not be interpreted as either a checklist of "must do's" or as the result of statistical analyses of the distribution of these characteristics

APPENDIX

OVERVIEW AND OPERATIONALIZATION OF VARIABLES

Variable Name	Description
High-Involvement Work Practices Index	Work structures and policies that govern shop-floor production activity and that foster worker involvement in decision making and problem solving. This is a composite index of the high-involvement work practices listed below. For each plant, scores on each practice were normalized across both time periods, summed, and then rescaled from 0 to 100 A low score indicates that a plant has few or no high-involvement work practices, and a high score indicates an extensive presence of work practices
Elements in High-Involvement Work Practices Index· Percent Employees in Teams	Percent of employees in on-line teams
Percent Employees in Involvement Groups	Percent of employees participating in some type of off-line problem-solving team (e g quality circles, employee involvement groups)
Job Rotation	Level of rotation at production worker level—1 = none, 2 = trained to do multiple skills but do not rotate, 3 = within teams, 4 = within teams and across teams in same department, 5 = within and across teams and across departments
Suggestions/Employee	Production-related suggestions per employee per year
Suggestions Implemented	Percent of suggestions implemented
Level at Which Quality Control Takes Place	The level within the organization at which four key quality control activities take place 1 = production worker level, 4 = specialists Tasks considered. inspection of incoming parts, work in progress, finished goods, and gathering SPC data
Complementary HRM Practices Index	Organization-wide HR policies that are complementary to high-involvement work practices Like the Work Practices index, this is a composite index including several HR practices For each plant, scores on each practice were normalized across both time periods, summed, and then rescaled from 0 to 100 A low score indicates a plant that has few or no complementary HR practices, and a high score indicates an extensive presence of complementary HR practices
Practices Included in Complementary HRM Practices Index	
Hiring Criteria	Criteria used to select production workers, first-line supervisors, and engineers This is a sum of various criteria, with a lower number indicating a greater emphasis on using previous experience in a similar job, and a higher number indicating willingness to learn new skills, and ability to work with others
New Training	Index of new training based on annual training hours of new production workers, supervisors, and engineers 1 = 0–40 hours of training for category receiving least amount of training 3 = 80+ hours.

APPENDIX Continued

Variable Name	Description
Experienced Training	Index of training for experienced employees based on annual training hours of experienced production workers, supervisors, and engineers $1 = 0$–20 hours of training for category receiving least amount of training, $2 = 20$–40 hours, $3 = 40$–60 hours, $4 = 60$–80 hours, and $5 = 80+$ hours
Contingent Compensation	Index of the level and scope of pay for performance 1 indicates no pay for performance 6 indicates pay for performance at the individual or group level, and for production workers, supervisors, engineers, and managers Intermediate values indicate some pay for performance for some of the employee groups
Status Differentials	This captures some of the surface indicators of status differences between managers and production workers One is added for each of the following practices—no ties for managers, a common cafeteria, a common parking lot, and a common uniform for all employees
Flexible Automation	This measure captures the degree to which flexible automation in the form of robotics is used in the plant It is the total sum of all robots in the body, paint, and assembly shops (programmable equipment capable of being reconfigured to alternate tasks—has at least 3 axes of motion) The number of robots is divided by the number of employees to yield the number of robots per employee, and is then rescaled from 0–100 where 100 represents the plant with the greatest number of robots/employee in 1989 and 1993/94
Log Productivity	Log of labor hours required to build a vehicle This figure is adjusted for level of vertical integration of the plant, product characteristics, and labor time differences across plants Higher labor hours per vehicle indicate lower productivity For additional information on this measure, see Krafcick (1988) and MacDuffie and Pil (1995)
Log Quality	Log of consumer-perceived quality, defined as defects per 100 vehicles, from J D Power J D Power Quality data are adjusted to reflect only defects originating directly in the assembly plant See MacDuffie and Pil (1995)
Production Worker Tenure	Average years all production workers have been working in the plant
Managerial Tenure	Average years 5 key top managers have been in the plant Plant manager, head of engineering, head of finance, head of human resources, and head of material services
Layoffs of Production Workers & Management, Early Retirement Incentives	1 if the plant undertook the measure between 1989 and 1994, and 0 otherwise
Major Addition to the Plant	1 if the plant added a new assembly line between 1989 and 1994
New Product Introduction	The percent of a plant's output that has been changed since 1988

cally, the determinants of adoption of high-involvement work practices in organizations. It underscores the value of a "systems" perspective that examines complementarities among variables related to work organization, human resource policies, and flexible technologies. Finally, it highlights the need for future research to consider adoption of high-involvement work systems from a dynamic rather than a static perspective.

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