High performance work systems and firm performance

Benefits of employee involvement, skill training, and other high performance work practices tend to be greater when new methods are adopted as part of a consistent whole, rather than in isolation

Jeffrey Kling

In today's competitive world economy, the strength of U.S. firms is increasingly dependent upon product quality and rapid adaptation to changing conditions. To survive in this environment, firms may choose to rely upon the creativity, ingenuity, and problem-solving abilities of their workers. To do so, they attempt to provide workers with the information, skills, incentives, and responsibility to make decisions essential for innovation, quality improvement, and rapid response to change. Firms taking this approach often are referred to as "high performance work organizations."

By way of example, take the case of delivery truckdrivers. Drivers can be assigned loads and routes by a supervisor. Alternatively, they can be made responsible for scheduling their own routes and for making changes. They can use their knowledge of customers and routes to inform existing customers of new services, acting as assistant sales representatives. They can participate in problem-solving groups to identify bottlenecks in processes, such as the morning's sorting of packages, that slow delivery. Installing communications equipment in trucks can facilitate teamwork to allow balancing of routes between couriers with unexpectedly large shipments and those with lighter loads, without the intervention of a supervisor. These work practices have been used by Federal Express couriers, and both the company and the workers appear to have benefited from converting ordinary driving responsibilities into jobs that require higher skills.[1]

While this example helps illustrate the types of work practices firms may adopt, the anecdotal experiences of a few firms are unlikely to be representative. The goal of this literature review is to ascertain whether high performance work practices are more generally associated with better firm performance.

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Scope of the study

Many firms have implemented at least some high performance work practices.[2] In a nationally representative sample of 700 private sector establishments, 37 percent had a majority of frontline workers engaged in two or more high performance work practices.[3] Firms themselves largely look upon high performance practices as having been successful. Among *Fortune 1000* companies using at least one practice that increased the responsibility of employees in the business process, 60 percent reported that these practices increased productivity and 70 percent reported that they improved quality.[4]

Many company initiatives, however, are piecemeal rather than systemic. The existing evidence suggests that it is the use of comprehensive systems of work practices in firms that is most closely associated with stronger firm performance.

This review of the effects of high performance work practices focuses on studies that use quantitative measures of productivity, quality, and financial performance that are comparable across firms. Many of these measures can be assessed at the plant or work group level, which allows detailed analysis of effects from changes in work practices. The review consists of two basic parts. First, it examines the effects on labor productivity of three specific practices—training, compensation linked to firm or worker performance, and employee involvement in decisionmaking. Second, it examines high performance systems in which such practices are implemented together.

The review is limited to certain work practices. Some are not addressed due to the paucity of existing research; accordingly, the performance effects of family-oriented work practices, the provision of healthy and safe workplaces, and greater emphasis on employment security are not examined. The important role of technology in promoting high performance workplaces also is beyond the scope of this article.

The studies reviewed here demonstrate correlations between work practices and firm performance. The results are therefore suggestive, but do not prove causality. Some studies compare firms that already use high performance work practices and those that do not. Others examine changes in firm performance after introduction of new practices in comparison to firms that do not implement new practices. Studies included in other review articles cited herein were not summarized individually, to avoid "double-counting."

Exhibit 1 summarizes the array of surveys and systematic studies that already has been conducted on the effects of high performance work practices. For all three specific work practices examined, the evidence suggests a positive relationship between their usage and productivity, and these positive effects appear to be mutually reinforcing. Moreover, the impact on productivity of systems of interrelated practices appears to be greater than the sum of independent impacts when each component is implemented in isolation.

Work practices

Skill training. Companies faced with rapidly changing market conditions may rely on workers to anticipate possible problems, eliminate bottlenecks, avoid production shutdowns, develop new products, and ensure quality. These firms might also make use of group meetings, in which workers who have been assisted to develop strong social and communications skills contribute effectively to decisionmaking and implement improvements. Emphasis on quality and prevention of mistakes requires employees with a broader understanding of the production process and of the information technology used to monitor it. In short, this type of production process underscores the importance of training that provides general problem-solving skills.

One study described the effects of formal training programs in 155 manufacturing firms. Those that introduced a formal training program for some employees after 1983 experienced a 19 percent larger rise in productivity on average over the next 3 years than firms that did not introduce a training program. Businesses that were operating below their expected labor productivity levels in 1983 were more likely to adopt new employee training programs between 1983 and 1986. The use of formal training programs was associated with significantly larger increases in productivity growth, bringing these businesses up to the labor productivity levels of comparable businesses by 1986.[5]

Training is also associated with improved quality of output. A survey of 157 small manufacturing firms in Michigan (500 or fewer employees) recorded changes in training from 1987 to 1988 induced by provision of a State subsidy for training. Note that grants were provided on a "first-come, first-served basis," so recipients and nonrecipients (which applied for grants after program funding was exhausted) are likely to be otherwise comparable. Researchers found that increased formal training significantly reduced the rates at which products had to be scrapped. Their results suggest, for example, that doubling the training per employee from the initial average of 15 hours would result in a 7-percent reduction in scrap.[6]

A lower bound of the effect of training on productivity can be inferred from the higher wages of those who receive training, assuming that part of the revenue from any employee productivity gains is passed on as higher wages. Eight studies show that wage levels and wage growth increased by up to 12 percent for individuals who had participated in a formal employer-sponsored training program.[7]

Compensation policy. Pay and performance can be more directly linked to create incentives for workers to pursue the interests of the team and the organization. These incentives may increase worker effort and align workers more closely with the long-term interests of the firm—resulting in better communication, increased product quality, longer job tenure, and greater acceptance of technological change.

An extensive survey of the effects of profit sharing on productivity reviewed 26 econometric studies. A majority (57 percent) of the statistical tests in the econometric studies showed a significant positive correlation between profit sharing and productivity. The correlation held both when comparing profit sharing and non-profit sharing firms and when comparing productivity in a particular firm before and after it adopted profit sharing. Productivity was generally 3 to 5 percent higher in firms with profit sharing plans than in those without. Firms implementing profit sharing showed similar productivity gains after adoption.[8]

Gain sharing is another type of compensation system where pay corresponds more directly to worker performance than under conventional approaches. IMPROSHARE is a type of gain sharing in which workers are essentially paid bonuses equal to one-half of any increase in productivity. A study of the use of IMPROSHARE by 112 manufacturing firms showed that defect and downtime rates fell 23 percent each in the first year after the approach was introduced. In the median firm, the overall increase in productivity was more than 5 percent in the first 3 months, and totaled more than 15 percent by the third year. In comparison, productivity increased by an average of roughly 6 percent over 3 years in

Exhibit 1. Summary of the studies reviewed

Author/dates[1]	Work practices	Performance measure	Results
Bartel (1994) All industries	Training	Net sales per worker	Productivity up 19 percent over 3 years in firm with training.
Holzer and others (1993) Michigan manufacturing	Training	Scrap rate	Doubling training associated with 7 percent decrease in scrap.
Bishop (1994) Literature review	Training	Wage	Wages of trainees up 0 to 12 percent in eight studies.
Kruse (1993)	Profit sharing	Various	Profit sharing associated with 3- to 5-percent increase in productivity.
Kaufman 1992) Manufacturing	Gain sharing	Relative labor	IMPROSHARE associated with 15 percent increase in productivity over 3 years.
Cooke (1994) Michigan manufacturing	Profit sharing, gain sharing, teams	Value-added per employee	A 5- to 25-percent increase in value-added in establishments with incentive pay.
Levine and Tyson (1990) Literature review	Participation in decisionmaking	Various	Majority of studies found that participation positively correlated with productivity.
Macy and Izumi (1993) Meta-analysis	Various: job design, teamwork, training communication, others	Various	Changes in work practices associated with productivity improvements of up to 40 percent.
Kelly and Emison (1995) Metalworking and machinery	Decentralized responsibility, problem-solving teams	Machining time per unit output	Production time decrease with worker participation.
Ichniowski, Shaw and Prennushi (1994) Steel	Teams, incentives, training, communication, others	Uptime, prime yield	Lines with most progressive system of practices had 7 percent higher uptime.
Arthur (1994) Steel	Employee involvement, teams, others	Labor hours per ton	"Commitment" system had 12 percent higher productivity.
MacDuffie (1994) Automobiles	System: teams, training, job rotation, others	Standardized production time per vehicle	Work systems associated with significant increase in productivity.
Cutcher-Gershenfeld (1991) Components-manufacturing	System: problem-solving, worker autonomy, others	Labor hours per standardized task	Nontraditional work groups had 17 percent higher productivity.
Huselid (1994) All industries	System: employee, skills motivation, others	Sales per worker	System indexes associated with 16 percent greater productivity.
Ichniowski (1990) Manufacturing	System: job design, training, others	Sales per worker	System indexes associated with higher productivity.
Hendricks and Singhal (1994) All industries	Quality Award recipient	Daily stock price	Quality Award announcement coincides with 0.6-percent stock jump.
Easton and Jarrell (1994) All industries	System: training, teamwork, organizational structures, others	Stock price, accounting profit	Firms implementing system had 20 percent higher stock price after 6 years.

[1] See text footnotes for full study references.

the manufacturing industries of which the firms were part.[9]

The presence of either profit sharing or gain sharing was found to be associated with higher productivity in an analysis of 841 manufacturing establishments in five Michigan counties. After controlling for unionization, the analyst found the use of profit sharing or gain sharing to be positively associated with higher value-added per employee. The magnitude of these effects varied from an average increase of 5 percent to 25 percent, depending on whether the firm was unionized, or used work teams, or both.[10]

Workplace participation. Involving front-line workers in decisions can occur through worker participation in teams and through decentralization of responsibility. Within teams, job rotation and cross-training can reduce fatigue, help produce greater job satisfaction, and reduce absenteeism and turnover problems. Peer pressure can also push workers to be more productive. Decentralization can result in better decisions by involving more people who have direct understanding of the issues at hand and by eliciting greater commitment from participants.

A comprehensive survey of the existing research on the effects of workplace participation on productivity suggests that the effects are positive. Of the 29 studies reviewed, 14 indicated that workplace participation has a positive effect on productivity, only 2 indicated negative effects, and in the remainder the effects were inconclusive. The 29 studies reviewed included 8 case studies, 12 field experiments, and 9 econometric tests. Thirteen of the studies examined substantive participation in decisionmaking on the shopfloor. Three of these were econometric studies of which two analyzed American firms; one showed a positive relationship between participation of clerical and production workers and productivity, while the other showed ambiguous effects for autoworkers. The participation measures included the existence of quality circles, work teams, and works councils, as well as the numbers of workers participating in such groups. The reviewers concluded that introducing participation was more likely to produce a significant, long-lasting increase in productivity when it involved decisions that extended to the shop floor and when it involved substantive participation in decisionmaking by front-line workers. In contrast, consultative arrangements such as quality circles—which involve information sharing rather than decisionmaking—often had short-lived benefits. A wealth of ideas built up over time could be brought forth consultatively, but enthusiasm for these arrangements waned without worker participation in decisions.[11]

An analysis of field studies at individual companies undertaken between 1961 and 1991 focused on the relationship between productivity and 44 work practices in three main categories: structural (such as job design and teamwork arrangements), human resources (training, communications skills), and technological (computerization, robotics). Differences in average performance between experimental and control groups and "pre" and "post" evaluations of changes were analyzed for productivity, quality, and cost performance measures that were standardized across the field studies.

Some 131 North American longitudinal field studies of organizational changes affecting 15 or more employees were chosen from approximately 1,800 known field studies conducted between 1961 and 1991; 75 of these studies examined productivity. Results based on the 75 studies showed that changes in work practices were strongly related to increased productivity. In a selected sample of the field studies, the introduction of new practices was generally associated with a 30- to 40-percent improvement in performance.[12]

The effects of work organization on productivity in the use of machine tools has been studied extensively. An examination of computer controlled technology in more than 550 firms in 1991 revealed that machining time per unit of output decreased considerably when shopfloor workers wrote their own control programs; in other words, decentralization of work responsibilities was correlated with increased productivity. The results of this study suggested that if the percentage of workers who wrote their own programs increased from the current average of 40 percent to 60 percent, total production time would decrease by 10 percent or more, depending on plant type. The use of formal off-line problem-solving meeting by groups of workers also was associated with decreased machining time.[13]

Work systems

Specific work practices like those reviewed above may have limited or negligible impact unless they are elements of a coherent work system. For example, participation by workers in problem-solving committees may increase productivity if workers actively participate. Guarantees of job security may be necessary to induce workers to share the ideas that may lead to productivity improvements—and possible layoffs. Flexible assignment of workers to jobs might then be needed to make job security viable; assignment flexibility and long-term employment might then make training of workers more attractive to firms. Without incentives such as training or job security, workers may be underutilized. Yet the incentives will be ineffective without mechanisms such as flexible job assignment and worker participation in decisionmaking to make these mechanisms function correctly. Thus, a system of work practices designed with such complementarities in mind will likely result in greater improvements in firm performance.[14]

The study of specific industries allows assessment of firms that have the same available technology and produce essentially similar products, but differ in work practices. The

implementation of systems of high performance work has been most thoroughly studied in the steel, components manufacturing, and automobile industries.

Steel. A rich combination of workplace practice and productivity data has been collected for the steel industry. Concentrating on a single industry with a fairly homogeneous product (steel), analysts examined productivity by tracking monthly "uptime" on 35 comparable finishing lines in the United States, where uptime is the fraction of time the line is running as scheduled. Uptime is used as a measure of productivity because steelworkers influence output levels mainly through prevention of delays. Other key production parameters (such as width and gauge of steel, and the line speed) are determined by the technical specifications of the line and the specifications of customer orders. The authors of the study then examined the effects of a range of work practices on productivity differences between lines, and on differences after the introduction of a new practice on a given line.[15]

The authors used statistical techniques to identify four distinct human resource management systems. For example, production lines that adopted "System 1" used much more innovative practices than did "System 4" lines, while Systems 2 and 3 were gradations of these extremes. (See exhibit 2, panel A.) The presence of more innovative systems was associated with significantly higher productivity; the difference in uptime between System 1 lines (those most characterized by high performance work practices) and System 4 lines (those least characterized by such practices) was especially large even after including detailed controls for differences in machinery. System 1 had 7 percent more uptime than System 4. This difference was also apparent in the product quality, as measured by the total production that met the standards for designation as "prime" finished steel. System 1 had 13 percent more prime yield than System 4. These quantitative productivity and quality results were corroborated by field interviews at each of the lines.

Consistent with the results reviewed above on training, incentive pay, and work organization, this study found small positive productivity effects when comparing lines with specific policies to those without. The magnitude of the effect from any specific work practice, however, largely depended upon the presence of a systemic approach. Individual practices had little or no effect unless they were part of a larger set of complementary work practices.

Monthly data for each line were available for an average of about 5 years. Among lines where changes in work practices occurred, the movement towards high performance systems also seemed to raise productivity. At the same time, however, the introduction of any single practice without a change in the set of practices that defined the overall system had no effect on productivity.

Another study examined productivity in 30 mini-mills, focusing on the average number of hours needed to produce a ton of steel. The mini-mills were characterized as employing either "control" human resource systems or "commitment" systems. The goal of control systems is reduction of direct labor costs through output-based incentives and compliance with specified procedures. Commitment systems relied on employee involvement in decisions and group problem solving to align individual and organizational goals. Accounting for differences in firm size and age, the commitment system was associated, on average, with 12 percent fewer labor hours per ton than the control system.[16]

Components manufacturing. A detailed study of a components manufacturing operation focused on the impact of industrial relations on productivity and quality in 25 work areas that performed fabrication, assembly, storage, and general services within a single plant.[17] The categorization of industrial relations within work groups ranged from traditional to nontraditional, as defined in exhibit 2, panel B.

Monthly data on each work area was recorded over 3 years. The performance differences between work areas with nontraditional relations and those with traditional relations were substantial. On average, nontraditional relations were associated with 75 percent fewer worker hours lost to scrap, 42 percent fewer defects per worker, and 17 percent higher labor productivity (defined as average labor hours per standardized task). Over the period studied, a shift towards nontraditional relations within a given work area resulted in significantly lower costs, less time lost to scrap, and higher productivity.

Automobiles. In the automobile industry, plants with better product quality and higher productivity use flexible production systems—relying heavily on multiskilled employees who are actively involved in quality control and problem solving. The Massachusetts Institute of Technology's International Motor Vehicle Program collected data on labor productivity (hours for assembly, taking into account vehicle complexity) from 62 plants representing 24 producers in 16 countries in order to examine the relationship between productivity and buffer use, work system, and human resource policies. The work systems and human resource policies consisted of the components shown in exhibit 2, panel C.

The use of innovative work systems and human resource policies was correlated with the lower usage of buffers (inventory and repair space), which makes problems more visible and thereby promotes problem solving. The combination of innovative work systems, human resource policies, and lower use of buffers was associated with a large and significant increase in labor productivity.[18] Quality (number of defects per vehicle) was also examined. Considered

Exhibit 2. Definitions used in research on work systems, selected studies

Study	System classification	
A. Steel industry	*System 1:*	*System 4:*
Problem-solving skills training	Common	Uncommon
Worker-management discussions	Frequent	Infrequent
Problem-solving teams used	Often	Seldom
Job classifications	Few	Many
Gain sharing compensation	Used	Not used
Selection procedures	Extensive	Minimal
Employment security	High	Low
B. Components manufacturing	*Nontraditional:*	*Traditional:*
Frequency of conflict	Low	High
Speed of conflict resolution	Quick	Slow
Number of problem-solving efforts initiated	Many	Few
Level of worker autonomy	Substantial	Minimal
Frequency of feedback	Frequent	Seldom
Frequency of worker-initiated changes in work design	Common	Rare
	System index components	
C. Automobile industry	*Work practice:*	*Measurement:*
Work system	Work teams	Percent involved
	Problem solving	Percent involved
	Job rotation	Scale
	Production workers monitor quality	Scale
Human resource policy	Recruitment and selective hiring	Scale
	Contingent compensation	Scale
	Labor management relations	Scale
	Orientation training	Number of weeks
	Ongoing training	Number of hours
D. Cross-industry survey		
Employee motivation	Performance appraisal	Percent covered
	Appraisal affects pay	Percent covered
	Merit or seniority promotion	Scale
	Applicants per job	Average
Employee skills and organizational structure	Incentive compensation	Percent with access
	Average training time	Average hours
	Job design analysis	Percent covered
	Information sharing	Percent involved
	Internal promotion	Percent of jobs filled from within
	Attitude surveys	Percent involved
	Labor-management participation	Percent involved
	Grievance procedure	Percent covered
	Employment test	Percent involved

separately, work systems and human resource policies were associated with higher quality; however, the interactions between the two factors and with use of buffers were mixed.

Cross-industry surveys. The study of work practices and firm performance with the broadest sample is based on a 1992 survey of 855 publicly held firms from all major industries. This study created two indexes, "employee skills and organizational structures" and "employee motivation," that were based on the firm characteristics described in exhibit 2, panel D. Considered separately, each of these indexes was significantly correlated with higher sales per worker. Taken together, a one standard deviation increase in both indexes was associated with a 16-percent increase in productivity. These indexes also were positively related to financial performance measures such as the gross rate of return on assets and the ratio of stock market value to total assets.[19] Another wave of this survey in 1994 provides the opportunity to examines changes over time within 222 firms. The preliminary results appear consistent with those in the original cross-section, although measurement error of the human resource variables is exacerbated in this case because the

"signal to noise" ratio is much lower when examining changes over time, complicating interpretation of results.[20]

An earlier study with similar methodology examined 126 nonunion manufacturing firms. Those using a work system including flexible job design, formal employee training, merit-based promotions, and formal employee-management communication mechanisms were associated with substantially higher sales per worker than systems incorporating few or none of these practices.[21]

Event studies. An estimate of the impact of a system of work practices can be obtained from changes over time in the stock market valuation of the implementing firm relative to that of other comparable firms. However, the timing of the "event" of instituting a system of work practices is difficult to pin down. Several approaches have been tried; the two discussed below focus on total quality management, a broader concept of which work practices are a component, and the results should be interpreted with this in mind.

For one study, the event was defined as public announcement of the receipt of a major quality award such as the Baldrige National Quality Award. The announcement of the award reveals new information that a firm has successfully implemented certain business procedures. These procedures often include training, compensation policy, and employee involvement as well as more direct quality process criteria. Financial markets may have already known these procedures were in place, so market reaction to an award announcement is interpreted as a lower bound to the valuation of the work system and other new business procedures. For 91 firms, the average excess stock market return on the day of the award announcement was about 0.6 percent, with larger increases for small firms.[22]

Another method of defining the event specifies the year in which the innovations began. Focusing on quality management, analysts used interviews of firm executives to discern the timing and extent of innovation in training, teamwork, and organizational structures, in addition to quality concerns in production, supply, customer satisfaction, and engineering—based on Baldrige Award criteria. This process identified 108 firms that had successfully implemented these innovations. These firms were matched with "control portfolios" of three firms in the same industry with similar financial characteristics. The innovative firms outperformed the control firms over the 6 years subsequent to the initial implementation of the quality procedures, resulting in a cumulative excess increase in stock price of over 20 percent, a 3- to 4-percent annual increase over the period. The 44 most innovative firms also had better financial performance on accounting measures such as net income, operating income, and sales per employee.[23]

Conclusion

Taken together, the studies reviewed show that specific practices such as training, alternative pay systems, and employee involvement often are correlated with higher productivity. These and other practices are associated with even greater productivity improvements when implemented together in systems. Yet, the nature of the relationship between high performance work practices and productivity is not clear.

Four main questions remain unanswered. The first is one of incidence. How does the use of high performance work practices vary by industry or firm size? How has the use of such work practices changed over time? There is currently no nationally representative survey sample large enough provide answers.

The second question concerns timing: do changes in work practices precede changes in performance? The collection of repeated waves of data on work practices (either for within-industry or for cross-industry studies) would address this question, if the data could be linked to firm performance measures. Directed interviews and adminstrative records would likely be necessary if analysts are to distinguish true changes over time from measurement error. In addition to productivity, other firm outcomes—such as financial performance—are of interest and deserve more attention.

The third question involves causality: why do firms adopt new work practices? In addition to benefits such as productivity gains, the costs of implementing the practices must be assessed, as must their likelihood of success, to determine their risk. Examination of this question would naturally involve considering the competitive environment of the firm. High performance work practices may be greatly advantageous to firms in some markets (perhaps those manufacturing goods that are facing international competition from low-cost producers) and of limited use in others (such as firms supplying domestic services not facing the same type of competition). It appears that innovative work practices have long had the potential to decrease time from order to shipment in the apparel industry; however, only recent market pressure from retailers that places a premium on quick response from suppliers has made new work practices attractive to apparel assembly firms.[24] Indeed, understanding the role of work systems within the firm requires this type of contextual analysis, which is most tractable at the industry level.

The final question concerns generalizability: how should research results be interpreted by other firms? Studies of specific industries offer the most comparable measures of firm performance. Additional industry studies, particularly outside the manufacturing sector, would provide a broader base of knowledge. Yet these studies must be supplemented by cross-industry research to assess different sectors in a comparative framework. □

Footnotes

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[1] Commission on the Skills of the American Workforce, *America's Choice: High Skills or Low Wages!* (Rochester, NY, National Center on Education and the Economy, 1991), Supporting Works, Vol.II, pp. 243–45.

[2] A review of various surveys of work practice incidence showed that many firms have implemented at least a few innovative work practices, but that these practices typically cover a small fraction of a firm's work force and that no particular practices predominate. See Eileen Appelbaum and Rosemary Batt, *The New American Workplace: Transformation of Work Systems in the United States* (Ithaca, NY, ILR press, 1994).

[3] Paul Osterman, "How Common is Workplace Transformation and Can We Explain Who Adopts It?" *Industrial and Labor Relations Review*, January 1994, pp. 173–88. The survey had a response rate of 66 percent and was limited to establishments with 50 or more employees (which employ more than half of all workers). An establishment could be a headquarters or a division of a company. Practices examined were teams, job rotation, Total Quality Management, and Quality Circles.

[4] Edward Lawler and others, *Employee Involvement and Total Quality Management* (San Francisco, Jossey-Bass, 1992). This survey had a 31-percent response rate. Employee involvement consisted of survey feedback, job enrichment or redesign, Quality Circles or other participation groups, Quality of Work Life committees, mini-enterprise units, or self-managing work teams. Note that evaluations were often reported by executives who made the decisions to implement these work practices.

[5] Ann Bartel, "Productivity Gains from the Implementation of Employee Training Programs," *Industrial Relations*, October 1994, pp. 441–25. Productivity is defined as net sales per worker. Controls for the industry average cost of purchased materials were included to approximate value-added. Data are from the 1986 Columbia Business Unit Survey; respondents represent about 2 percent of the original sample. Note that implementation of other policies such as job design, performance appraisal, and employee involvement were found to have no significant relationship with productivity.

[6] Harry Holzer and others, "Are Training Subsidies for Firms Effective? The Michigan Experience," *Industrial and Labor Relations Review*, July 1993, pp. 625–36. The response rate to this survey was 32 percent.

[7] John Bishop, "The Incidence of and Payoff to Employer Training," Working Paper 94–7 (Ithaca, NY, Cornell University, July 1994).

[8] Douglas Kruse, *Profit Sharing: Does It Make a Difference?* (Kalamazoo, MI, Upjohn Institute, 1993). Of the 26 studies, 9 examine U.S. firms; 5 of these have sample sizes of less than 200, while the remaining 4 have sample sizes that range from 495 to 2,976. In a sample of 250 firms, Kruse found that firms which implemented other personnel policies at the same time as profit sharing had greater productivity increases than those that did not; the effect of profit sharing, however, was dampened after these other policies were accounted for.

[9] Roger T. Kaufman, "The Effects of IMPROSHARE on Productivity," *Industrial and Labor Relations Review*, January 1992, pp. 311–22. The response rate to this survey was 44 percent.. Note that firms were not observed before implementation of IMPROSHARE; these firms may have had high (or low) productivity before implementation. The baseline of average productivity in manufacturing was not weighted to reflect the industrial composition of IMPROSHARE firms.

[10] William Cooke, "Employee Participation, Group-based Incentives, and Company Performance: A Union-Nonunion Comparison," *Industrial and Labor Relations Review*, July 1994, pp. 595–609. Value-added is defined as sales minus costs of materials, parts, and services. Respondents represent about one-quarter of the original sample. Note that in firms using profit sharing or gain sharing, the use of work teams had an ambiguous association with productivity. The use of teams alone was associated with much higher value-added in unionized firms, but with only slightly higher value-added in nonunion firms.

[11] David I. Levine and Laura D'Andrea Tyson, "Participation, Productivity, and the Firm's Environment," in Alan Blinder, ed., *Paying for Productivity* (Washington, The Brookings Institution, 1990), pp. 183–235.

[12] Barry Macy and Hiroaki Izumi, "Organizational Change, Design, and Work Innovation: A Meta-analysis of 131 North American Field Studies—1961–1991," in R. Woodman and W. Pasmore, eds., *Research in Organizational Change and Development* (JAI Press, 1993). Note that these cases do not represent a random sample of firms, and the criterion of publication may increase the likelihood that significant results would be reported. The authors argue that these cases are not subject to such a bias, because the high quality of the data available would allow publication of these studies regardless of the results.

[13] Maryellen Kelley and Grant Emison, "The Contributions of Alternative Forms of Work Organization and Employee Involvement to ManufacturingPerformance Under Different Technological Regimes," MIT Industrial Performance Center Working Paper 95-001WP, forthcoming in *Industrial Relations*. Analysis is conducted separately for branch plants and single-plant enterprises.

[14] Paul Milgrom and John Roberts, "Complementarities and Fit: Strategy, Structure, and Organizational Change," mimeo. (Stanford University, 1993).

[15] Casey Ichniowski, Kathryn Shaw, and Giovanna Prennushi, "Effects of Human Resource Management Practices on Productivity," mimeo. (Columbia University, June 1994).

[16] Jeffrey Arthur, "The Effects of Human Resource Systems on Manufacturing Performance and Turnover," *Academy of Management Journal*, forthcoming. The sample represents 30 of the 54 existing U.S. mini-mills in 1988. The productivity and quality data are from a survey of human resource executives.

[17] Joel Cutcher-Gershenfeld, "The Impact on Economic Performance of a Transformation in Workplace Relations," *Industrial and Labor Relations Review*, January 1991, pp. 241–60. This study observed the primary manufacturing facility of the Xerox corporation from 1984 to 1987.

[18] John Paul MacDuffie, "Human Resource Bundles and Manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry," *Industrial and Labor Relations Review*, January 1995.

[19] Mark Huselid, "The Impact of Human Resource Management Practices on Turnover and Productivity, and Corporate Financial Performance," mimeo. (Rutgers University, September 1994) and forthcoming in *Academy of Management Journal*. Respondents represent 25 percent of the original sample.

[20] Mark Huselid and Brian Becker, "The Strategic Impact of Human Resources: Evidence from a Panel Study," mimeo. (Rutgers University, December 1994). Note that the survey was mailed to 3,477 firms in 1992 and to 3,847 firms in 1994, so that the 222 firms in the panel represent about 6 percent of the original sample.

[21] Casey Ichniowski, "Human Resource Management Systems and the Performance of U.S. Manufacturing Businesses," NBER Working Paper No. 3449 (Cambridge, MA, National Bureau of Economic Research, September 1990). Respondents represent less than 2 percent of the original universe of more than 7,000 business lines that were surveyed

[22] Kevin Hendricks and Vinod Singhal, "Quality Awards and the Market Value of the Firm: An Empirical Investigation," mimeo. (Georgia Institute of Technology, October 1994) and forthcoming in *Management Science*.

[23] George Easton and Sherry Jarrell, "The Effects of Total Quality Management on Corporate Performance: An Empirical Investigation," mimeo. (Indiana University, December 1994).

[24] John Dunlop and David Weil, "The Diffusion of Human Resource Innovations: Lessons from the Apparel Industry," mimeo. (Boston University, December 1994) and forthcoming in *Industrial Relations*. For an indepth examination of six apparel plants, see Peter Berg and others, "The Performance Effects of Modular Production in the Apparel Industry," mimeo. (Washington, Economic Policy Institute, December 1994).