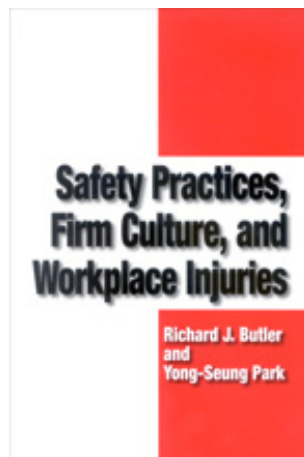**W.E. UPJOHN INSTITUTE**
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Human Resource Management and Safety: Technical Efficiency and Economic Incentives

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Human Resource Management and Safety

Technical Efficiency and Economic Incentives

More U.S. workers die each year on the job than were killed in the U.S. military cumulatively from 1998 through November 2004, even after including self-inflicted and accidental military deaths (DIOR 2005). In 2001, there were 8,786 job-related fatal injuries (5,900 not counting the fatalities caused by the terrorist attacks of September 11), or about 3.7 fatal injuries per 100,000 workers. Workers made 2.1 million trips to the emergency room for injuries sustained from accidents at work (Centers for Disease Control and Prevention 2004). Workers' compensation insurance, which covers all medical expenses and part of lost wages associated with injuries, cost employers $63.9 billion in 2001 (Williams, Reno, and Burton 2003). The indirect costs of accidents—lost wages, damage to equipment, and training and rehabilitation expenses—were several times this amount.

Human resource management (HRM) is usually viewed as an auxiliary function in a firm, contributing nothing to that firm's output—a cost tolerated because payroll, benefits, and certain types of human resource activity must be organized before the real job of production can be undertaken. But HRM practices can affect accident costs in three ways. Two of the three pertain to the real or intrinsic risk in the workplace. "Real" risk is the level of physical danger of accidental injury or occupational disease that comes from workers producing output. As men interact with machines, both men and machines cause accidents. Accidents can be reduced by modifying either part of the interaction: 1) by increasing workers' incentives to be careful, or 2) by modifying the workplace environment to employ processes, procedures, equipment, and ergonomics that reduce on-the-job injuries. In addition, HRM policy can reduce accident costs by lessening workers' incentives to file false or inflated accident claims for any given level of real risk.

Most models of firm behavior ignore HRM, assuming management simply chooses labor and capital to maximize firms' profits. As the product price, the wage rate, or the rental cost of machinery changes, so do the optimal production of widgets and the optimal configuration of inputs. In these traditional models, labor is passive with respect to the production process in two ways: labor does nothing to improve the technical efficiency of the firm, and labor always acts in the firm's best interest, regardless of labor's own incentives. Management is assumed to know everything the workers know.

THE IMBALANCE CREATED BY ASYMMETRIC INFORMATION

But the traditional model is seriously flawed, as there is ample evidence that workers are not passive. What workers know about their own behavior or about the firm's technology may profoundly affect profitability. Costs may also rise because of excessive consumption of fringe benefits by employees when legitimate claims are difficult to distinguish from questionable claims. Or management may ignorantly be providing inferior plant design or unsafe production processes—resource misallocation that could be improved with labor's help. Such asymmetric information, where employees know something that it is difficult or costly for management to know, can yield costs that are unnecessarily high.

The collapse of the Enron Corporation is an example of how important asymmetric information can be, though the information asymmetry there was largely between management and shareholders. Enron managers and accountants deceived shareholders into believing the company was in much better financial shape than it actually was, having information about company debt and revenue that the general public did not have. This asymmetry of information was exploited by management, inflating company stock value beyond its actual worth in order to increase management income and maintain management control.

While asymmetric information problems between management and shareholders, such as happened at Enron, are a spectacular type of asymmetric information problem, such problems also exist between management and company employees. In most jobs it is impractical to

monitor all employee behavior. So employees know more about their work effort and level of care than managers do. Where such asymmetric information exists, questions arise: Are employees working as hard as they have agreed to work under the employment contract? Are the employees treating company property with the same respect and due care with which they would treat their own property, so that there is no thievery, vandalism, or misuse of company equipment? Are the employees being as safe as prudently possible? Are the employees only using sick days when they need to use them? Are the employees only filing lost-work insurance claims for legitimate, on-the-job injuries? These are all areas where asymmetric information can drive a wedge between what management expects and what employees deliver.

HRM Practices Can Treat Asymmetric Information Problems

HRM practices are increasingly viewed as one way the firm can address asymmetric information problems. The hypothesized causal link between HRM practices and a reduction in asymmetric information problems has HRM changing profits: HRM programs provide workers with incentives to change their behavior by aligning their activities with management's profit objective. Without these incentives, profits are lower.

This model cannot be tested in its entirety; too many model components remain either unmeasured or unmeasurable. For example, asymmetric information is not public information; it is not measured. Profits and even costs are not uniformly reported for all companies, especially for small and medium-sized companies such as we have in our sample. However, there is one important category of cost—safety costs—which is measured in sufficient detail to use in testing our model. The test is simple: do alternative HRM practices affect employees' injury claims? Do some HRM practices help reduce injury-claim frequency? Do other HRM practices help reduce injury-claim severity? If they do reduce safety costs, is it because the HRM practices are improving technical efficiency or because HRM practices are reducing disability benefits consumption associated with asymmetric information?

In this book, we estimate how various HRM practices affect occupational safety: which HRM practices lower firms' workers' compensation costs and whether their impact comes through changes in technical

efficiency or through induced changes in workers' behavior. We present a model of safety outcomes in this chapter that illuminates the ways in which HRM might affect safety outcomes, and in the next chapter we use this model as a basis for reviewing the empirical research in this field. We present our own research findings in Chapters 3 and 4. In Chapter 5 we draw conclusions.

THE ACCIDENTS-OUTPUT TRADEOFF

Either improved technical efficiency or labor incentives will lower firms' overall safety costs, including outlays for machinery, compensating differentials for risk, and lost work time. Frequently we ignore the overall influence of safety. One long-recognized shortcoming of the simple classical model is that it fails to take into account that the firm produces not only output but accident claims with a given level of labor and capital inputs. That is to say, in real-world industrial processes, accidents are a natural by-product of production. Getting rid of all job accidents is often feasible only with very large reductions in output. Even white-collar workers occasionally bump their heads in their cubicles or get paper cuts that may become infected; wearing special headgear and thick mittens could prevent such accidents. We rarely wear headgear or mittens in the office because the reduction in productivity would outweigh any gains in safety. On the other hand, sometimes we can increase the level of output by ignoring prudent safety precautions—such as by taking off the safety guards from machinery or removing the guardrails along catwalks and stairs that inhibit the movement of materials—but accident costs resulting from ignoring basic safety practices generally outweigh the additional output that would be garnered by doing so. There is a tradeoff between accidents and output.[1]

Another shortcoming of the classical model, mentioned earlier, is that the human factors in the production process are not passive—employees may react to incentives, and employees may provide valuable information about the optimal organization of production. For example, when construction workers show management how a wall can be framed more safely and quickly by assembling it horizontally on the ground, rather than piecing it together vertically in the air, they provide valuable information on the technical efficiency of the process. Because workers

are assembling products every day and building techniques are constantly changing, opportunities for uncovering such technical efficiencies are abundant. When HRM practices lead to improved techniques of production, technical efficiency improves. Accident prevention costs, broadly defined, fall.

HRM Practices Can Also Treat Safety Behavior Problems

Likewise, variations in HRM practices may change worker safety behavior and the firm's safety costs. Consider the time path of injury benefits, shown in Figure 1.1, typical of workers' compensation laws in most states—including Minnesota, from which we draw our sample for this study.

Figure 1.1 Time Path of Injury Benefits
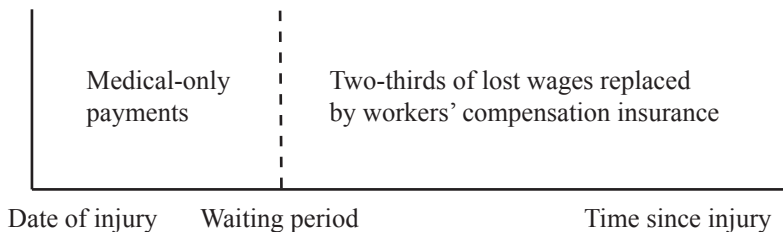
The first three days following the injury are known as the waiting period in workers' compensation. (It is three days in Minnesota; other common waiting periods are five and seven days.) During the waiting period, the injured worker receives no lost wage benefits, though all of the injury-related medical costs are covered by the firm's workers' compensation insurance policy. Hence, during the waiting period there are only payments for medical treatments. After the waiting period, two-thirds of the worker's lost wages are replaced by indemnity payments (payments for lost wages, in addition to the medical payments). Both the waiting period and the partial wage replacement are types of insurance cost sharing. Insurance contracts are structured so that whenever a worker is injured, he bears part of the wage-loss risk.

THE PERILS OF MORAL HAZARD

Cost sharing, such as waiting periods and partial wage replacement, mitigates incentive problems under asymmetric information. Behavioral changes resulting from incentives generated by disability and health insurance coverage are known as *moral hazard*. In other words, moral hazard exists when workers (or firms or health care providers) change behavior for personal gain under an insurance contract.

There are many actions an insured worker or health care provider can take that affect the size or the probability of a loss.[2] With respect to injuries that are temporarily disabling, for example, an insurance contract may specify that the only disabilities covered are those arising from injuries sustained while on the job. Hence, a worker may claim a given condition arose from a job injury and may seek temporary total disability benefits because his real health condition does not qualify under the contract. Or, the worker may have a recurring health condition, such as lower back pain, which in the absence of insurance he simply tolerates, since treatment would impose personal costs. When insured, however, he may choose not to work and incur health service costs and draw disability benefits since others are paying the benefits. An extreme case of behavioral change might be overt fraud in which a worker—facing a pending layoff—claims injury benefits when no injury or health condition was incurred, either on or off the job.

Insurance contracts recognize that moral hazard is costly. If insurers or firms had full information about all workplace injuries, they could reimburse workers for all lost wages until those workers returned to work. Under full information, the firm would know what injuries were work-related and the firm would know exactly when the worker was able to return to work. But firms don't usually have such information. Monitoring the behavior of all participants in an insurance contract is costly, and the costs of such monitoring generally exceed the benefits. The workers know this, and since they have considerable latitude in changing their behavior to enhance their short-run well-being, they sometimes behave differently than they would in the absence of insurance payments. Therefore, the root of the moral hazard problem is an information asymmetry between workers and firms—workers know more about their own health status, as well as their preference for lei-

sure over work (hence their willingness to feign injury if it results in paid leisure time), than firms know.

Workers' compensation insurance recognizes the complex incentives generated by disability coverage and alters the benefits contract so workers bear some of the costs of the injury themselves. They get no lost-wage pay during the waiting period and only partial reimbursement thereafter. These cost-sharing arrangements exist to induce workers to take an appropriate amount of care on the work site and only the necessary time off work. HRM practices can affect those incentives.

An Illustrative Model of Three Cases of Worker Reimbursement

Consider a small construction company (Table 1.1A,B,C). Initially assume the firm's policy is to allow sick-day pay to reimburse workers for lost wages during the waiting period. We will call this the usual case. We also assume a simple fixed input-output process (a Leontief technology) that requires five laborers to construct a building.[3] Only construction workers actually build; the foremen supervise workers and help replace the labor services of injured construction workers. We assume the rate of building depends only on the number of construction laborers, but the rate of concomitant accidents varies with the degree of care exercised by the workers and the supervising foremen.

Since output is fixed, the firm's economic problem is to minimize the sum of labor costs and safety costs. In this example, each foreman is paid $100,000 and each construction laborer is paid $40,000. Each accident costs $30,000 in terms of replacement labor and capital costs. These are the only costs associated with on-the-job accidents. Initially, suppose a workers' compensation system is in place that only pays some of the lost wages after the waiting period, though the firm's HRM practices allow workers to use their sick-day benefits to replace their lost wages for the first three days following an injury. Hence, injured workers bear some costs of workplace injuries, though not any costs associated with the waiting period.

Table 1.1A is the usual case, before any changes in standard HRM practices are implemented. Our assumed Leontief technology is such that with the number of laborers fixed, the output is fixed, and there is no substitution between foremen and laborers in building production. While adding more foremen doesn't increase the number of buildings,

Table 1.1A Usual Case: Partial Wage Replacement after the Waiting Period

Number of foremen	Number of laborers	Accidents	Wage/salary costs ($)	Accident costs ($)	Total costs ($)
1	5	8	300,000	240,000	540,000
2	5	4	400,000	120,000	520,000[a]
3	5	1	500,000	30,000	530,000
5	5	0	700,000	0	700,000

[a] Optimal cost-benefit level.

it does lower the number of accidents. Foremen monitor the safety content of work, and with more foremen present, safety costs fall, although at a diminishing rate. Since output is fixed, the firm maximizes its profits by minimizing the costs.

The tradeoff in Table 1.1A is simple: more foremen reduce accident costs but increase wage costs. The firm's optimal allocation rule will be to add foremen until the marginal cost of the additional foremen (in terms of the increase in wage costs) is greater than the marginal benefit of the additional foremen (in terms of the reduction in safety costs). In Table 1.1A, the cost-minimizing level of output is produced by going with two foremen. Going from one foreman to two increases the wage costs by $100,000 while it reduces the number of accidents from eight to four, saving $120,000 in accident costs. However, going from two foremen to three increases overall costs: wage costs rise by $100,000 while accident costs only fall by $90,000.

Even though the firm could construct its buildings without any accidents by hiring five foremen, it does not choose to do so. The additional costs (in terms of foremen's wages) do not justify the additional gains from producing with no injuries. It is not optimal to reduce the injuries to zero. Indeed, in each of the three cases we examine in Table 1.1, it is cheaper to allow some injuries than it is to do away with all injuries.

HRM Practices Can Worsen Incentive or Moral Hazard Problems

Suppose that we change HRM policy, but in a way that provides fewer incentives for workers to take care. Specifically, suppose that the new HRM policy guarantees that all lost wages due to an injury will be reimbursed, not just those of the initial waiting period, without time

limitation or a financial cap to the total benefits received: the company makes up any difference between the employees' wages and workers' compensation benefits through a wage continuation policy that guarantees that 100 percent of the worker's nominal wage will be replaced. With their pay as high on a workers' compensation claim as it is on the job, 1) workers could take more risks on the job than they formerly did when they bore some of the wage costs of an accident, changing their real safety behavior, or 2) workers might simply report more accidents than they formerly did, given the same level of risk. The former is called risk-bearing moral hazard; the latter, claims-reporting moral hazard (Butler and Worrall 1991). As the workers' insurance coverage under the new HRM policy expands, moral hazard potential increases and the number of reported claims rises.

An example of this rise in injury rates, holding the level of monitoring constant, is given in Table 1.1B. While the output remains constant at the same level it did in Table 1.1A, the accidents double for each combination of laborers and foremen. With one foreman and five laborers, the number of reported accidents goes from eight with normal care to 16 when laborers take less care because of moral hazard response. As the number of reported injuries doubles, the value of additional foremen increases. In Table 1.1A, going from one to two foremen decreases accident costs by $120,000; in Table 1.1B, going from one to two foremen decreases accident costs by $240,000. Because the marginal cost of foremen stays constant, the increased marginal benefit of additional foremen increases the firm's demand for their monitoring activity, and the optimal number of foremen rises. In Table 1.1B the potential for moral hazard behavior has increased, and the optimal number of foremen has risen from two to three.

Finally, as a direct result of the increase in the moral hazard under the new HRM policy reflected in Table 1.1B, there are more claims, so safety costs are higher for every combination of input (except for where there are five foremen; here the costs remain zero).

HRM Practices Can Also Improve Incentive or Moral Hazard Problems

Suppose that instead of "topping off" disability benefits so there were no wages lost when workers were injured, the firm adopted a

Table 1.1B Moral Hazard Response: Full Wage Replacement Benefits Lower Workers' Incentive to Take Care

Number of foremen	Number of laborers	Accidents	Wage/salary costs ($)	Accident costs ($)	Total costs ($)
1	5	16	300,000	480,000	780,000
2	5	8	400,000	240,000	640,000
3	5	2	500,000	60,000	560,000[a]
5	5	0	700,000	0	700,000

[a] Optimal cost-benefit level.

policy that moved in a different direction: it adopted the HRM practices of Table 1.1A with respect to disability benefits (only two-thirds of the wage is replaced following an injury), but now it has added a profit-sharing plan in which it distributes 10 percent of the company's profits to workers. Especially for a small company where workers can more readily monitor each other and apply peer pressure (so there is less likely to be a free rider response that mitigates the financial incentives), this is likely to align employees' incentives with management's profit-maximizing efforts.[4] We may suppose employees respond to such profit-sharing incentives by being more careful on the job or simply by filing fewer claims than in Tables 1.1A and 1.1B.

In Table 1.1C, the input combinations are the same as those in Tables 1.1A and 1.1B, but there are fewer accidents that result at each level of input: Table 1.1C input combinations now have only half the accident rates of Table 1.1A, and only one-fourth the accident rates of Table 1.1B. Total costs are naturally lower for each combination of inputs, and marginal benefits of monitoring are lowered as well. Going from one foreman to two reduces accident costs by only $60,000, but it costs $100,000 in additional salary to obtain this reduction: the marginal benefits from safety monitoring have fallen, but the marginal costs stayed the same. Hence, less monitoring is optimal and only one foreman will be hired to work with the five laborers. If we assume that company revenue is $520,000, this implies profit sharing of $10,000 with one foreman (10 percent of profits = [$520,000 − $420,000] × 0.1), $6,000 with two foremen, and $500 with three foremen. This minimizes total costs at $420,000, given the new worker incentives induced by the HRM changes. Indeed, in the absence of profit sharing, the firm

would revert to Table 1.1A outcomes and total costs would increase by $90,000 (accounting for the profit-sharing payout).

HRM Practices Can Improve or Worsen Technical Efficacy

While the examples in Table 1.1 focused on workers' incentives (through risk-bearing and claims-reporting moral hazard) as HRM practices changed, those tables could just as well have represented changes in production efficiency (through physical ergonomic changes) induced by changes in HRM practices. If a change in HRM practices discouraged communications between worker and firm, it could worsen technical efficiency, and the results could be those pictured in Table 1.1B. For example, if HRM practices included safety standards that didn't improve safety but limited productivity—say, wearing thin, slippery silk gloves when handling power equipment in an effort to reduce carpal tunnel syndrome—then the change in HRM practices could conceivably increase accident costs. On the other hand, if the implementation of new HRM practices improves communications between the worker and the firm in a way that results in fewer accidents for each level of output, then costs would tend to change as they did in Table 1.1C. Assembling some components on the ground and then hauling them into place might be one such improvement. Changes in assembly sequencing, tool usage, and even product design might be other such improvements.

Table 1.1C Profit Sharing Initiated: Incentive Rises to Behave So as to Maximize Profits

Number of foremen	Number of laborers	Accidents	Wage/salary costs ($)	Accident costs ($)	Total costs before profit sharing ($)
1	5	4	300,000	120,000	420,000[a]
2	5	2	400,000	60,000	460,000
3	5	0.5[b]	500,000	15,000	515,000
5	5	0	700,000	0	700,000

[a] Optimal cost-benefit level. Assuming total revenue is $520,000, total costs including profit sharing are $430,000, $466,000, $515,500, and $700,000, depending on number of foremen.

[b] Represents one accident every other period.

The discussion of Table 1.1 illustrates the issues addressed in this book: the extent to which changes in HRM practices change accident costs, which HRM practices are most effective, and whether those result in moral hazard changes or changes in technical efficiency. In a world of perfect certainty and full information, the firm would always adopt those HRM practices that were optimal, producing the best combination of technical efficiency and economic incentives. So any expansion of a practice, or adoption of a new practice, would result in lower accident costs, given that output was held constant. But the optimal combination might not always be obvious to firms because of informational asymmetries, contract restrictions, poor management incentives, or inept bureaucratic procedures. In this study, we address these issues using a sample of Minnesota firms. We chose firms from that state because we have extensive data on their workers' compensation costs as well as their HRM practices. Using this sample, we hope to estimate not only which HRM practices are most cost-effective, but also whether they reduce costs through a reduction in moral hazard or an increase in technical efficiency.

Notes

1. See Walter Oi (1974) for an extensive analysis of this tradeoff.
2. See Butler, Gardner, and Gardner (1997) for empirical examples and citations to the empirical safety literature.
3. Wassily Leontief, a Nobel laureate in economics, pioneered the use of production functions where the ratios of inputs to outputs were fixed so there was no substitution between inputs. This type of production has been used extensively in short-term business forecasting and production planning.
4. The free rider problem arises when one worker does not incur the costs of taking care, thinking that all other workers will take care instead. Thus he is a "free rider" in that he doesn't incur the costs but plans to enjoy the benefits (the extra profits) generated when others take care.