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An economic evaluation of a participatory ergonomics process in an auto parts manufacturer

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ABSTRACT

Problem: We assess the costs and consequences of a participatory ergonomics process at a Canadian car parts manufacturer from the perspective of the firm. *Method:* Regression modeling was used with interrupted time series data to assess the impact of the process on several health measures. Consequences were kept in natural units for cost-effectiveness analysis, and translated into monetary units for cost-benefit analysis. *Results:* The duration of disability insurance claims and the number of denied workers' compensation claims was significantly reduced. The cost-effectiveness ratio is $12.06 per disability day averted. The net present value is $244,416 for a 23-month period with a benefit-to-cost ratio of 10.6, suggesting that the process was worth undertaking (monetary units in 2001 Canadian dollars). *Discussion:* Our findings emphasize the importance of considering a range of outcomes when evaluating an occupational health and safety intervention. *Impact on industry:* Participatory ergonomics process can be cost-effective for a firm.

1. Problem

A number of intervention studies support the effectiveness of participatory ergonomics interventions as a means of reducing exposure to biomechanical and psychosocial health risk factors (Jensen, 1997; St. Vincent, Chicoine, & Beaugrand, 1998; Wilson & Haines, 1997; Lanoie & Tavenas, 1996; Nagamachi, 1995). Participatory ergonomics interventions generally involve the development of ergonomics teams consisting of participants from both the management and worker groups within an organization. These teams seek ways to reduce workplace health risk exposures through redesign of processes, tools, and equipment. The team should include participants from various departments and various levels within the organization in order to ensure that those who have first-hand experience about the issues being investigated have a say in how to address them (Kuorinka, 1997), and that all stakeholders potentially influenced by a change are included in the decision making process.

Despite the large number of studies that describe the prerequisites and best practices for successful participatory ergonomics interventions, few such studies investigate the cost and consequences of participatory ergonomics (Rivilis et al., 2008; Tompa, Dolinschi, & de Oliveira, 2006). A recent systematic review of the workplace intervention literature identified five participatory ergonomics interventions in the manufacturing and warehousing sector that included some form of economic analyses (Tompa, Dolinschi, de Oliveira, & Irvin, 2007). Two studies had undertaken a full economic evaluation (Abrahamsson, 2000; Lanoie & Tavenas, 1996). Three began to broach such an analysis by costing out the benefits of the intervention (Halpern & Dawson, 1997; Moore & Garg, 1998; Ridyard & Hathaway, 2000). Other ergonomics intervention studies (not necessarily participatory) have considered the costs and consequences of such interventions in manufacturing (e.g., Lahiri, Gold, & Levenstein, 2005; Kemmlert, 1996). Oxenburgh, Marlow, and Oxenburgh (2004) also provide a series of illustrative examples of cost-benefit analyses of ergonomics interventions, several of which were in the manufacturing sector. As well, there are good examples of economic analyses of ergonomics interventions in other sectors, such as in the administrative and support sector (e.g., DeRango et al., 2003; Lahiri et al., 2005; Rempel et al., 2006); health care (e.g., Chhokar et al., 2005; Evanoff, Bohr, & Wolf, 1999); and retail (e.g., Banco, Lapidus, Monopoli, & Zavoski, 1997). Most studies undertaking economic analyses of ergonomics interventions find that they are worth undertaking from the firm perspective in that they result in positive net present values, benefit-to-cost ratios greater than 1, and/or relatively short pay-back periods.

The modest number of full economic evaluations in the occupational health and safety (OHS) literature is somewhat perplexing, given that one of the most common objectives of firms considering

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such interventions is to reduce the financial burden of work-related injuries and illness. Tompa et al. (2006) provide a number of insights into why this might be the case, such as: (a) the complexity of the policy arena of OHS and labor legislation, (b) the sometimes conflicting incentives and priorities of stakeholders, (c) the uneven distribution of the costs and consequences of interventions to avert work injuries, illnesses, and disability, and (d) the presence of multiple and sometimes overlapping programs for wage replacement and health care provision in cases of injury, illness, and disability. Other reasons include the difficulty in obtaining appropriate data, understanding the methodology of economic evaluation by the firm and its workers, and the amount of time required to do a scientifically sound study. These and other factors make it a challenge for OHS researchers to undertake economic analyses in this arena. Anecdotal evidence suggests that many economic evaluations of OHS interventions and business case analyses are undertaken, but they are not published. For example the ORC Worldwide model known as ROHSEI (Return on Health, Safety and Environmental Investments) has been used successfully for over a decade in a number of Fortune 200 organizations.

Additionally, methods guidance to assist with addressing the complexity of issues in the OHS arena is still underdeveloped. Some methods guidance exists (e.g., Barefoot Economics, 2002; Mossink, 2002; Oxenburgh et al., 2004), and recently there have been substantive new efforts to advance the methods and tools. Most notable are a conference co-organized by the National Institute for Occupational Safety and Health and the World Health Organization that gathered members of the global OHS community to discuss methods and practice (Eijkemans & Fingerhut, 2005), and a methods text designed to lay the foundations for a systematic methodology of economic evaluation of OHS interventions (Tompa, Culyer, & Dolinschi, 2008). Other methods guidelines have also been developed, including the Strategy to Demonstrate the Value of Industrial Hygiene Strategy by the American Industrial Hygiene Association (www.ihvalue.org), and the Centers for Disease Control and Prevention's guidelines entitled *Framing an Economic Evaluation* (www.cdc.gov/owcd/eet/Framing3/Fixed/1.html).

In this study we report on the economic evaluation of a participatory ergonomics process[1] undertaken at one plant of a car parts manufacturer in central Ontario, Canada that employs approximately 175 workers including 125 hourly production workers. We undertake both cost-effectiveness and cost-benefit analyses from the perspective of the firm. We consider the implementation costs of the process (e.g., trainer, worker time in training, costs of the changes that were introduced) and the ongoing costs of the intervention (e.g., team meeting time). In terms of consequences, we consider measures of health and productivity proxied by data drawn from the plant's administrative sources.

2. Methods

2.1. Description of the ergonomics process

The objective of the participatory ergonomics process introduced to the worksite was to improve the musculoskeletal health of workers. The process followed the University of Waterloo Ergonomics Process and Program Blueprint (Wells, Norman, Frazer, & Laing, 2001). This Blueprint presents an approach to reducing the major risk factors contributing to the development of pain and injury in the workplace, focusing predominantly on the back and upper limbs. It is an iterative process based on two complimentary pathways: (1) a proactive pathway drawing on previous experience and ergonomics best practice during the design stage of equipment or processes; and (2) a reactive pathway consisting of six steps: (a) identifying opportunities for improvement, (b) assessing ergonomics risk factors and prioritizing jobs for improvement, (c) developing solutions, (d) implementing prototypes, (e) evaluating prototypes, and (f) adopting solutions.

The organization involved in the ergonomics process was a multinational company with headquarters based in Canada that manufactures foam parts for the automotive industry as components within vehicle interiors. Representatives from the corporate Health, Safety, and Environment department approached the plant management and labor union representatives about engaging in a participatory ergonomics process. A presentation was made to plant management and the union in order to gain support for, and commitment to, the ergonomics process by each of these stakeholder groups.

The process involved the formation of a steering committee and a worksite ergonomics change team. The steering committee consisted of individuals from the head office and the worksite, specifically: (a) a corporate Health, Safety and Environment department representative, (b) the plant manager, (c) a representative of the labor union, (d) a human resource management representative, and (e) the researchers involved in evaluating the process. The steering committee provided oversight of the initiative, ensured communications flowed between the plants and head office, and supported the process with appropriate resources. The group held meetings at approximately six-week intervals.

The ergonomics change team (ECT) consisted primarily of workers and management from the worksite. Specifically, it included a worker representative from each of the three shifts, the full-time plant union health and safety representative, a mechanical engineer, the production manager, two human resources representatives, the tooling supervisor, a corporate manager from the Health, Safety and Environment department, and two members of the research team. The group's mandate was to follow through with the steps identified in the Blueprint approach. The ECT and workers affected by the changes being considered were involved throughout the process. ECT activities were supported through a variety of communication channels, such as newsletter articles, bulletin board postings, a suggestion box, presentations at meetings, and feedback during prototype evaluation (Laing et al., 2005).

The research team provided training and assistance with the execution of the process for a period of 11 months, starting in May 2001. In the first month, the ECT received training from the research team in the form of a three-day course that covered anatomy, principles of ergonomics, physical and psychosocial risk factors for injuries, and tools to perform ergonomic assessments and analyses. More advanced training sessions were provided on an as needed basis. During the following 10 months, the ECT focused on identifying and implementing change projects. At the end of the 11-month period, the research team withdrew its involvement, at which point the process was meant to be self-sufficient.

The ECT identified and prioritized projects based on data of injury rates in different departments,[2] pain reports from questionnaires completed by workers, complaints and suggestions from workers, and production and quality issues. Typically, a maximum of three projects were addressed at any one time in order to ensure that efforts were not spread out too broadly. The research team was actively involved with assisting the ECT in identifying and developing projects during the 11-month intervention period. Each of the changes implemented by the ECT was evaluated by the research team. All workers within a department rotated through the jobs within their department, and so all were exposed to at least some of the ergonomic changes on a daily basis.[3]

[1] We make a distinction between the 'ergonomics process' and the 'ergonomics intervention.' The former refers to the entire initiative and its consequences, whereas the latter refers to the ergonomics changes implemented in a particular work setting. The ergonomics process encapsulates effects beyond simply physical exposures, such as changes in worker morale, and the industrial relations climate.

[2] Four departments existed in the plant, namely Components, Demould, Finishing, and Utility.

[3] Because workers from the utility department rotated through jobs based in each of the other three departments, they were not included in the change evaluation process.