

Occupational Health and Safety Risk Management in Ontario

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Introduction

The Ministry of Labour of the Canadian province of Ontario has revolutionized the way that Labor Inspectorates collect, analyze, and most importantly, utilize data from businesses. Over the past ten years, the Ministry has established a system known as “risk-based enforcement” which analyzes injury, workers’ compensation, and disability data to rank industries and firms within industries on a continuum of risk. The Ministry then prioritizes inspections for the year using this risk assessment, continually updating their data to better protect Canadian workers. While the Ontario system is fairly elaborate, a similar system can be implemented in Armenia to help target inspections and allow the Labor Inspectorate to best utilize its scarce resources.

The Ontario Health and Safety System

The Ontario Health and Safety System has four parts, each of which plays a distinct and important role in the protection of workers in the province:

1. the Ministry of Labor (MOL);
2. the Workplace Safety and Insurance Board (WSIB);
3. the Safe Workplace Associations (SWA); and
4. the Institute for Work and Health (IWH).

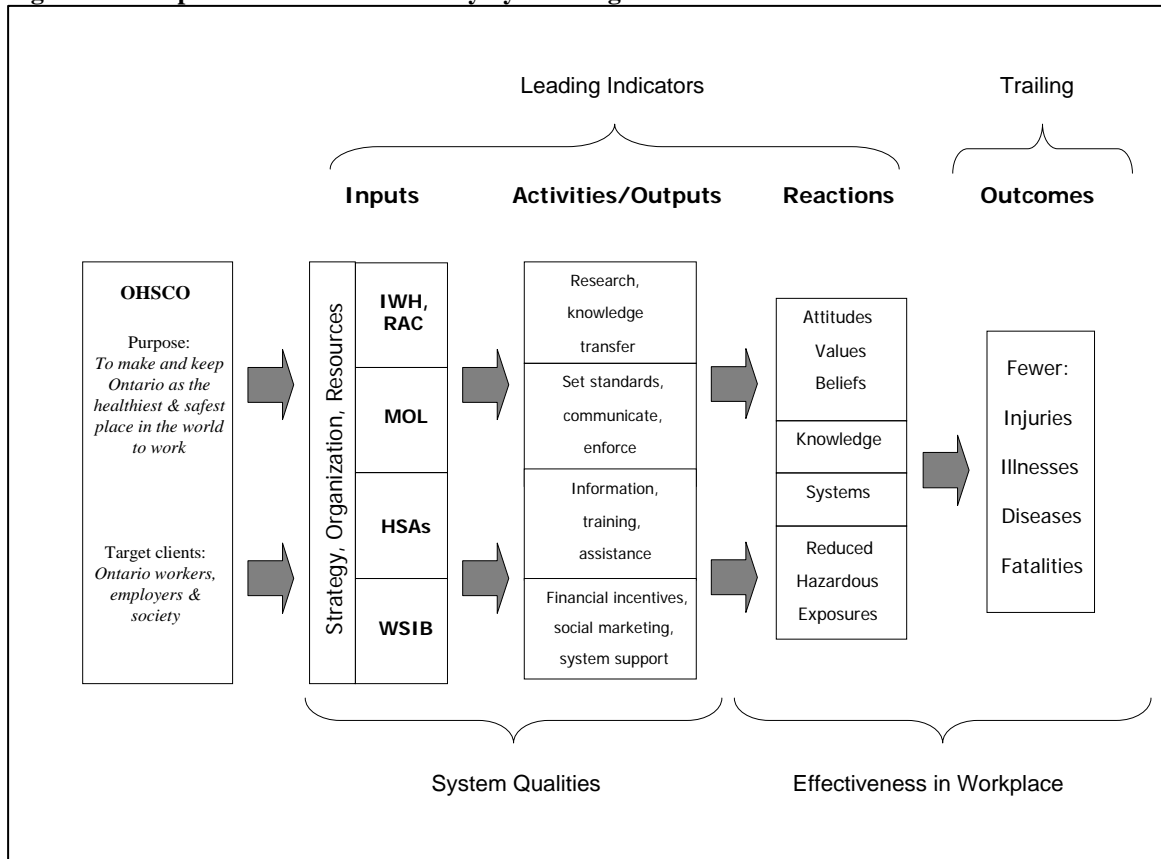
The MOL is the main governmental agency in Ontario dealing with safety, and it sets, communicates, and enforces standards to protect workers from injury. The WSIB, a quasi-independent agency of the MOL (whose CEO reports to the Minister of Labour), provides insurance services to employers, as well as setting premiums, adjudicating worker’s claims for injuries, paying injured workers for lost wages, and managing their health care and rehabilitation and vocational re-training. SWAs are organizations of private sector employers that provide training and consultation services to their members, while the IWH is a non-profit organization that researches health and safety questions and transfers knowledge to employers and the other parts of the OHS system. Strategic planning and coordination among these various agencies and organizations is accomplished through the Occupational Health and Safety Council of Ontario (OSHCO) which has members from the WSIB, MOL, each SWA, and the IWH.

Figure 1 describes the OHS system in Ontario and outlines how their activities work together to improve workplace health and safety.¹ Although each part affects all the underlying causes of injury and illness at work, the different parts of the system focus on the many different causes of injury and focus on specific areas of safety. The Ministry strives to improve compliance with

¹ Robson LS, Speers JC, Kusiak RA, Burns BB. Development of a performance measurement report for the Ontario Prevention System. Policy and Practice in Health and Safety 2007;5(1):3-18.

regulations, while the SWAs provide training and consulting to improve the level of knowledge of health and safety in the workplace and put in place systems in the workplace to identify and correct hazardous conditions. The WSIB provides financial incentives and penalties and promotional and advertising campaigns to help motivate the managers of businesses to reduce occupational injuries and illnesses, and the IWH helps improve our understanding of the nature and causes of workplace injuries and illnesses. The diagram in figure 1 was the basis for developing a framework for measuring the performance of the Occupational Health and Safety System.

Figure 1: Occupational Health and Safety System Logic Model



A Brief Description and History of the Ontario Ministry of Labour

The Ministry of Labour (MOL) is responsible for setting, communicating and enforcing standards for occupational health and safety and employment standards throughout the province of Ontario. Founded in 1919, the Ministry has four regional directors and about 20 district offices and about 28 district managers, with a main office located in Toronto. It operates two laboratories: one to test the strength of cables that lift cages in mines and the other measures the level of radiation in samples. Hygiene samples are collected for the Ministry hygienists by private sector suppliers and processed in laboratories operated by the private sector. Some engineering services are contracted out to the private sector.

The Ministry has three main areas of competency: health and safety, employment standards, and labour relations. The health and safety part of the ministry develops regulations to protect

workers, enforces the health and safety act and regulations and also revises the Occupational Health and Safety Act and the Workplace Safety and Insurance Act. Employment Standards enforces the Employment Standards Act and is involved in revising and updating the employment standards legislation. Labour relations focuses on settling workplace disputes under various employment-related statutes, assisting in the settlement of collective agreements and producing collective bargaining information. Supporting these divisions are two further units, the operations division (which oversees enforcement) and the policy and communications division (which oversees policy and regulations development). Both policy and operations staff are involved in making revisions to regulations and in developing new regulations.

Of the three areas covered by the Ministry, occupational safety and health is the newest: the OSH division was formed in the late 1970s by transferring the mine health and safety inspectors from the Ministry of Natural Resources and the Occupational Health Protection Branch from the Ministry of Health to the Ministry of Labour. The guiding regulation for the operations of the division is the Occupational Health and Safety Act (OSHA), which came into force around 1980 (and has been revised since that date – for example, in 2006, the OSHA was updated to include farming operations). Health and Safety Inspectors in the Ministry of Labour are empowered to enforce the OSHA and, very rarely, the Trades Qualification and Apprenticeship Act (TQAA).

Ontario's system is very different from Armenia (and indeed, other countries) where inspectors perform both employment and occupational safety functions. Employment standards are enforced by a separate set of inspectors within the MOL. The Employment Standards Act (ESA) regulates hours of work, the rate of pay, and holidays, but currently in Ontario legal interpretations prohibits information collected under one act, e.g. the ESA, being used to enforce any other act, e.g. OSHA. Some years ago, the Ministry of Labour took the lead in developing and implementing a plan that would remove the legal impediment to sharing information between Ministries for the purpose of enforcement. This led to the formation of the Inspection, Investigation, and Enforcement Secretariat. In the near future, non-compliance under one act can be shared with all other enforcement Ministries and could then trigger an inspection by another Ministry. For example, non-compliance with the Environmental Protection Act could lead to inspections for compliance with several other pieces of legislation.

Staffing

The Ministry has 465 health and safety inspectors for about 6 million workers. As Canada is a federal system, the provincial Ministry cannot enforce its Act and regulations in federally regulated businesses such as banks, international transportation companies, and businesses involved in the nuclear fuel cycle (these are regulated by federal agencies in Ottawa). Inspectors are specialized and grouped into 3 programs: mining, construction, and industrial. The number of inspectors in each program is allocated according to the risk of injury in each program rather than the number of workers in each program or the number of businesses in each program. The Ministry has professional staff that supports all programs and also inspects businesses. The professional staff consists of about 15 engineers, 15 hygienists, 5 ergonomists, 5 radiation protection officers, and 2 occupational health physicians.

Table 1: Comparing allocation of inspectors and fatal injuries

Program	Inspectors (%)		Deaths per year (%)		Workers in thousands (%)	
Mining	25	6%	3	4%	20	0%
Construction	150	35%	25	36%	450	8%
Industrial	250	59%	42	60%	5,500	92%
Total	425	100%	70	100%	5,970	100%

Planning Inspections and Risk Categories

Ministry inspectors respond immediately to investigate deaths and serious injuries to workers. Serious injuries are defined by a regulation and they consist of amputations or fractures to limbs, loss of consciousness, serious burns, and substantial loss of blood or injuries that place life in jeopardy. Ministry inspectors also investigate when the workplace parties cannot resolve a worker's refusal to do work that he considers to be unsafe. Certain occupations, such as police officers, firemen, etc. do not have the right to refuse unsafe work. Ministry inspectors also investigate complaints about workplace conditions but they do not respond to them immediately. This type of reactive work, defined as inspections based upon need or emergency, represent about one third of inspectors' work load; planned inspections represent another third, with the remaining one third of their workload at the discretion of the inspector.

Moving Towards Risk-Based Enforcement

About 80,000 lost-time injuries occur each year in Ontario, with WSIB actuaries reporting that the projected total cost of a single lost-time injury was about \$20,000,² with the total projected compensation cost of these injuries about \$1.6 billion. The average cost of a no-lost-time injury costs about \$300, with about 180,000 occurring each year for a total cost of about \$54 million.

Faced with these figures, in 1995, the Ministry set a performance goal of reducing the injury rate of Ontario by 30% so that by 2000, the injury rate would be 1.7 per 100 workers per year. The Ministry's annual work plan at that time would specify the number of field visits to be done by inspectors and the number of inspections that would be done in each sector. However, more attention was paid to doing the planned number of inspections and little attention was paid to making sure that the inspections were done in each sector as planned. It appeared that the work-planning was not effective in reducing the injury rate.

In 2003, a new performance target of reducing the lost-time injury rate by 20% by 2007 was set. (The method of calculating the lost-time injury rate was changed to better reflect the number of workers who were insured or covered by the WSIB.) Based upon past experience, a new strategy was developed to ensure that the performance target was met. The previous work plan did not specify the businesses that would be inspected; that decision was left up to the inspector. In the new plan, the inspectors would be required to inspect 6,000 businesses that had higher than average injury rates. Selecting these businesses became the key goal of the Ministry.

² All dollar amounts are in Canadian dollars, roughly equivalent to \$1 US.

The Ministry developed three main risk categories for planned inspections.³ The high risk group of businesses was determined by an analysis of the injury data collected by the Workplace Safety and Insurance Board, a model that will be detailed below. The next, lower level of risk, priority businesses, was also determined by an analysis of injury data collected by the Workplace Safety and Insurance Board. The Safe Workplace Associations took their planned work from this group of businesses. The priority businesses that were not assigned to a SWA, were assigned for planned inspection by MOL inspectors but at a less intense rate than the high risk group. Priority businesses that declined the offer of assistance from their SWA were referred (called priority referral businesses) to the MOL for a planned inspection. Another group of businesses was developed by field staff using local knowledge or were local initiatives; e.g. planned inspections for all logging operations during a two year period.

The Model for Risk Ranking

A consultant had been hired some years earlier to assist the Ministry to make better use of WSIB injury data to plan inspection activity. The WSIB is the prime source for data concerning workplace injuries in Ontario, as it insures about 220,000 businesses and is responsible for paying out claims relating to work injuries. At the behest of the consultant, the Ministry went to the WSIB to secure data such as lists of injured workers, their place of employ, and the locations of their businesses, linked to the names of the businesses to identify where employees worked at the time of their accident. The list of lost-time injuries included such crucial data as:

- Age, gender, occupation, date hired, date injured, and language spoken by the injured worker,
- Nature and source of injury, injured part of body, and type of accident,
- Days off work and costs incurred to replace lost wages, health care, rehabilitation, and re-training.

The WSIB data was then used to compare the costs and frequencies of injuries in firms in the same sector. In order to perform this analysis, the MOL required specific data from the WSIB:

- Costs of injuries, injury by injury, for each company for a period of time (commonly from 3 to 5 years).
- Number of workers (hours worked), year by year, over the past few years (also 3 to 5 years).

An intense analysis was then done within the Ministry on this data to select firms from each sector (industries) for planned inspections (examples of sectors are gold mining, retail, and low-rise residential construction). The intent of this analysis was to compare businesses doing the same kind of work and to select businesses with injury records that were significantly poorer than average for businesses doing the same kind of work; in short, to identify the highest risk firms in each industry.

³ http://www.labour.gov.on.ca/english/hs/highrisk_1.html (as of Dec 4, 2007)

The MOL's procedures call for coding of the nature and source of the injury, the injured part of the body, and the type of accident about 6 months after the injury occurred; coding this information is one of the final steps in dealing with the claim. Given this lag, it made more sense in developing a risk ranking to use the **costs** of the claim for a particular injury, rather than descriptions of the injury and/or the circumstances surrounding the injury, to determine a firm's risk rank. A small problem in using this criteria was that the total cost of a claim could take some time to determine; the most expensive injuries involve paying lost-time costs and medical care costs for many years. However, more expensive claims can be identified after a relatively short time, as most workers with a lost-time injury return to work quickly, within a few days, so their claims would be less expensive after only one year than the claims which accumulated costs for longer periods. After a period of years, the most expensive claims can cost over \$1 million while the less expensive claims cost a few hundred dollars.

Armed with these criteria, a model was developed to select a risk ranking following a simple pattern. Suppose you are doing the risk assessment at the end of one year in order to plan for next year and the data for the current year is reasonably complete. For firm j in sector s , the number of injuries this year is n_{js1} , number of injuries last year ago is n_{js2} and number of injuries 2 years ago is n_{js3} and $n_{js}=n_{js1}+n_{js2}+n_{js3}$ is the total number of injuries over the past three years.

For firm j in sector s , the i^{th} injury that occurred this year has now accumulated costs of c_{ijs1} and the i^{th} injury that occurred in the previous year has accumulated costs of c_{ijs2} and the i^{th} injury that occurred 3 years ago has accumulated costs of c_{ijs3} .

Firm j in sector s has w_{js1} workers this year, w_{js2} workers 1 year ago and w_{js3} workers 2 years ago and $w_{js}=w_{js1}+w_{js2}+w_{js3}$ is the total number of worker-years (or hours worked) over the past three years.

With this data, the weighted accumulated costs for firm j in sector s are thus:

$$c_{js} = \sum_1 c_{ijs1} * w_1 + \sum_2 c_{ijs2} * w_2 + \sum_3 c_{ijs3} * w_3$$

(\sum_1 is the sum over the n_{js1} injuries that happened this year, \sum_2 sum over the n_{js2} injuries that happened 1 year ago, and \sum_3 sum over the n_{js3} injuries that happened 2 years ago)

The weights themselves are determined by the MOL, and reflect a focus on recent injuries and appropriate discounting of injuries that happened 1 and 2 years ago. This near-term bias translates to weights of $w_1=10$, $w_2=1$ and $w_3=0.1$.

The total weighted costs for the n_s firms in sector s is

$$C_s = C_{1s} + \dots + C_{n_s s}$$

The total number of worker-years in the sector s over the past 3 years is

$$W_s = \sum (w_{js1} + w_{js2} + w_{js3})$$

where the sum is across all the businesses in sector s .

The average weighted cost per worker per year in sector s is

$$c_s/w_s$$

Variance in costs for firm j in sector s

$$v_{js} = c_{sj} - c_s/w_s * w_{js}$$

V_{js} compares the business's weighted costs with the weighted costs that would have happened if it had the average cost per worker for that sector.

The problem is to pick the businesses with the costs of injuries that are higher than average and where the inspector can be most effective in preventing injuries.

The cost variance formula can also be expressed as:

$$v_{js} = ((c_{sj}/n_{js})(n_{js}/w_{js}) - c_s/w_s)w_{js}$$

The total weighted costs in firm j are the product of the injury rate averaged over three years and the average weighted costs of injuries in the firm. The objective is to pick businesses for planned inspections where the cost variance is high, because both the injury rate and the average cost per injury are as large as possible. Inspectors need to avoid inspecting businesses which have slightly higher than average injury rates and injury costs but have large cost variances due to having a large number of workers; this is because businesses that have injury rates slightly above average will find it difficult to improve as compared to businesses that have very high injury rates. Firms which have high cost injuries are also more likely to have more serious injuries that could be prevented.

In order to try to meet all of these competing objectives, an overall risk rank was obtained. Each dimension of risk - average cost per injury, injuries per worker per year and the cost variance - were ranked using percentiles. So for business j in sector s, ranks are formed for each of the three dimensions of risk r_{js1} , r_{js2} and r_{js3} which represent the percentile scores for v_{js} , c_{sj}/n_{js} and n_{js}/w_{js} . The values of each rank range from 0 to 99 - the firm with the highest c_{sj}/n_{js} will have a rank of 99 as 99% of the firms in the sector will have smaller values of c_{sj}/n_{js} . Form an overall index for each firm in sector s

$$r_{js} = (1 + r_{js1}) * (1 + r_{js2}) * (1 + r_{js3})$$

The overall capacity for planned inspections will then determine how many businesses in each sector can be included in the planned inspections. If capacity for planned inspections is I businesses, the number of businesses with planned inspections in each sector s, I_s needs to be determined. One way of determining each I_s is to take a constant proportion of businesses from each sector; however, it is better to allocate planned inspections in proportion to the costs per injury in the sector relative to the overall cost per injury. This allocates more planned inspections in those sectors where injuries are more severe and more costly and fewer in those where injury costs are lower and severe injuries occur less frequently.

In the first year that the risk ranking approach was used, each component of risk was at the 90th percentile or higher. So that

$$r_{js1} \geq 90 \text{ and } r_{js2} \geq 90 \text{ and } r_{js3} \geq 90 \quad (1)$$

Also, instead of using the average cost per injury, the most costly injury was used the cost of injury dimension in the formula. This had the effect of increasing the focus on businesses with one or more very costly injuries.

The number of businesses that meet requirement (1) is determined by the data and it make take a few iterations of picking different cut-off points (e.g. using 85 for one dimension and 80 for another) to pick up the required number of businesses in each sector (especially if planned inspections are allocated in different proportions in each sector).

Other factors need to be considered. Small businesses tend to have fewer injuries, but their injury rates have larger random variations than larger businesses where injury rates are based upon larger numbers of injuries. To reduce the effect of random variation in small businesses, longer time spans could be used for small businesses and shorter time spans for businesses with many workers. So, for example, a Ministry may choose to consider injuries and their costs and workers over 5 years for small businesses and consider injuries and workers over the past 1.5 years for larger firms.

Another variation in this risk assessment is to look at the of the rank of cost per injury multiplied by the rank of injuries per worker and see if those two variables capture the same businesses or different ones as all a ranking of all three variables – cost per injury, injury per worker, and excess cost per business.

The experience in Ontario was that the firms that were selected for planned inspections had injury rates that were significantly higher than average by a factor of 4 to 5 initially. This approach captured a disproportionately large number of injuries that were serious and thus targeted the highest risk firms. For example, the Ministry did planned inspections in about 3% of businesses registered at the WSIB, which accounted for about 10% of workers but 25% of serious injuries, 25% of injuries to young workers (under 25 years old), and 25% of injuries to newly hired workers (on the job for less than 3 months when injured).

Performance Measurement and Outcomes

Tracking the effectiveness of these inspections was crucial to determining if a risk-based approach was actually preventing injuries in Ontario. In order to evaluate the new risk assessments, the MOL instituted a computer system to keep track of the inspectors' activities. This system captures data about the field visits that each inspector makes, including information such as:

- The date the field visit took place;
- Name of business inspected
- Amount of time spent on the inspection; and

- Amount of time spent preparing for the inspection and traveling to and from the business that is inspected.

Additionally, the system also captures data on any violations that were recorded, including the specific section of the act or regulation which the business contravened, the text of the order written by the inspector, the date when the order was issued, the date when compliance was expected to be achieved, and when it was actually achieved.⁴

Ministry inspectors are required to inspect high risk firms at least four times per year, once per quarter. In the past, an inspection was not likely to lead to a follow-up inspection. The intent of inspecting high risk businesses every 3 months was to make sure that employers and workers complied with orders to the standard required by the inspector. A field visit is the basic unit of work for inspector and takes about 2 hours to do, excluding travel time and preparation time. A field visit means that one inspector has met the workplace parties at their place of work on one day. Field visits that are done to accomplish a certain goal, e.g. conduct the quarterly high risk inspection, investigate a fatality are grouped together into cases. By spending more time in the workplace, the inspector will be able to find more hazardous conditions and improve compliance with the health and safety legislation.

Since the late 1970's, when the occupational health and safety was consolidated in the Ministry of Labour, the key outcome measures have indicated that workplace conditions have improved. Figure 2 shows the trend in the number of fatalities per 100,000 workers per year from 1976 to 2006; it has declined by more than 75%.

⁴ The Ministry classifies violations (orders) into broad categories. Some orders require the business to stop using a particular piece of equipment or process that poses a significant and possibly immediate potential harm to the worker; these are called stop work orders. Some orders can be complied with quickly when the inspector is doing the field visit; these are called forthwith orders. Others require the development of a plan of action to achieve compliance and are called plan orders. Orders that can be complied with in a specific period of time are called time specified orders. An example would be training workers or developing a health and safety program. The time to comply with other orders may be difficult to determine and these are called time unspecified orders.

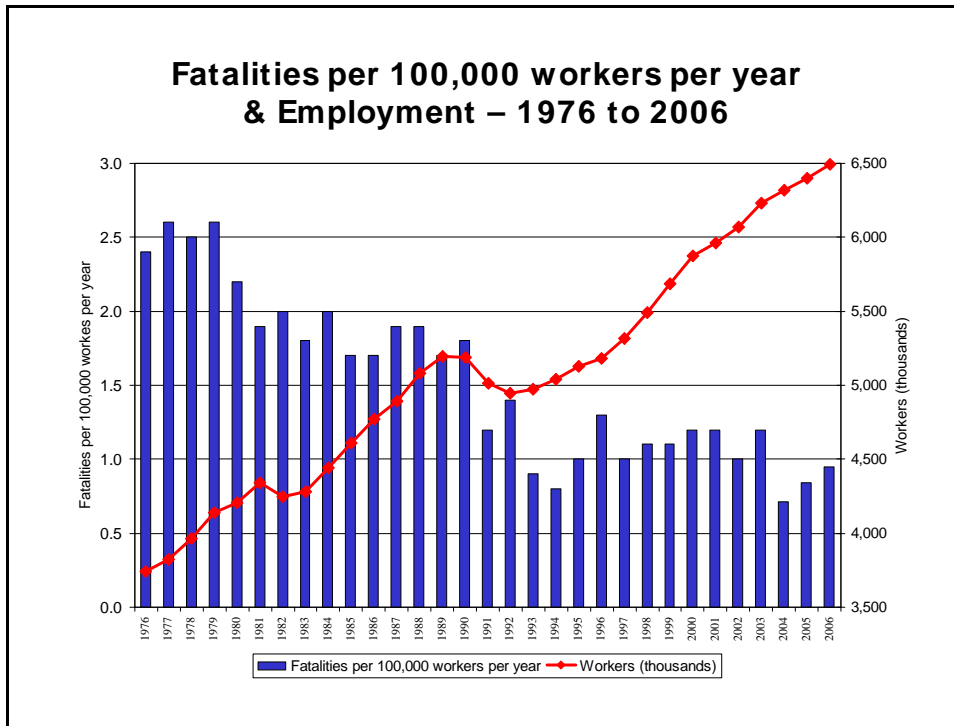


Figure 2: Long term trend in fatality rate in Ontario (excludes long latency occupational diseases)

Figure 3 shows the long term trend in the lost-time injury rate. It has also declined by more than 65% from 1976 to 2007. However, in the years from 1998 to 2000, the lost-time injury rate did not change and the rate of change in the lost-time injury rates in the years after 2000 was less than the rate of change in the late 1980's to the early 1990's. This rapid decline in the injury rate was probably due to the slowdown in economic activity in those years.

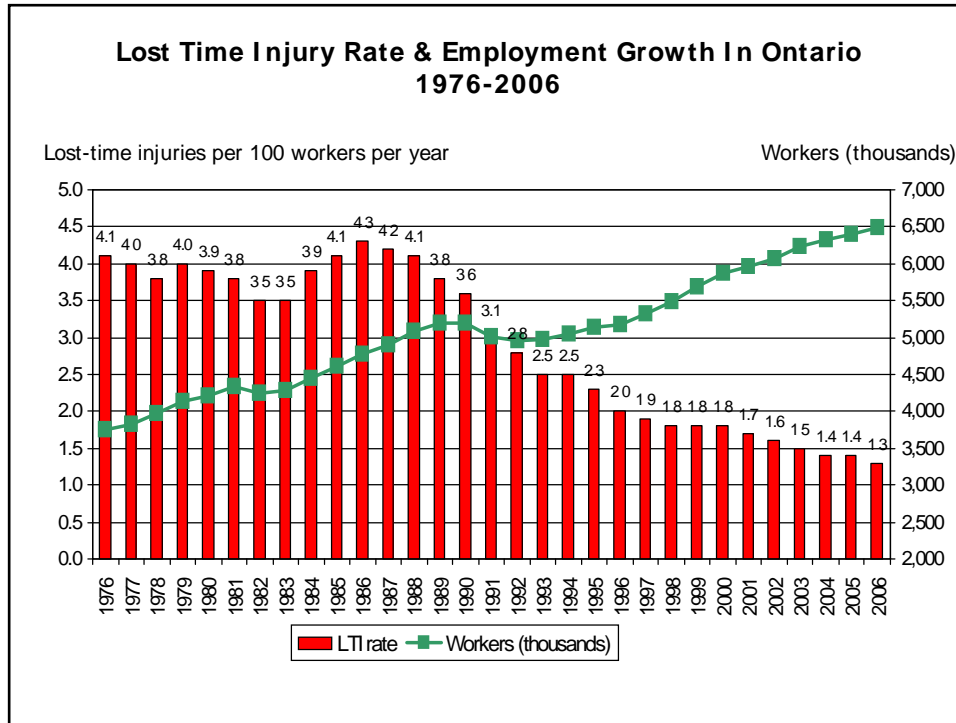


Figure 3: Long term trend in the LTI rate in Ontario

Early in 2003, the Institute for Work and Health completed a literature survey about the effectiveness of enforcement and financial incentives. The literature review concluded that enforcement was effective in the businesses where it was conducted and that there was little evidence that enforcement produced a general deterrent effect. The literature review could not find evidence that financial incentives and penalties led to a reduction in the injury rate.

The injury rates and the number of injuries in the high risk businesses were significantly above average. Improved compliance in the high risk businesses would not result in reductions in the number of injuries that would be sufficiently large to lead to the overall reduction in injury rates of 20% during a four year period. For this reason, the new strategy enlisted the SWA's to focus their attention on priority businesses, about 10,000 businesses with risk scores lower than those for high risk businesses.

The business case for risk-based enforcement also indicated that the costs avoided by reducing injury rates would amount to about \$300 million in the fourth year of the new strategy when the target for reducing the injury rate was to be achieved and in each successive year. Since the compensation board's costs represent about one third or less of the costs of workplace injuries, the reduction in the number of injuries would lead to overall cost savings of close to \$1 billion per year.

Figures 4 and 5 track the trend in the number of field visits and the number of orders issued by program for the time period 1995/6 to 2006/7. The number of inspectors in the MOL increased by about 200 during the period 2005/6 to 2006/7 from 265 to 465, a 75% increase, and field visits increased by a comparable amount (an increase of 80%). The enforcement data indicate

that the number of violations issued rose from about 80,000 in 2003/4 to just under 180,000 in 2006/7, an increase of more than 100%.

A detailed analysis of the inspector’s activities showed that 80% of high risk businesses were found to be non-compliant (i.e. issued one or more orders), a much higher rate than in past inspections, where only 50% of businesses were found to be non-compliant. Another analysis showed that, in the high risk businesses, the number of orders issued by an inspector increased in proportion to the injury rates – inspectors found more contraventions in businesses with higher injury rates. The high risk businesses were more likely than low risk businesses (low risk businesses were the businesses not included in any of the risk categories mentioned earlier) to be issued orders for training workers and to implement health and safety management systems. Serious hazards, those hazards that are often associated with fatalities and serious injuries, were found at the same rate in high risk and low risk businesses. These findings supported the importance of training and health and safety management systems in protecting workers. The analysis of inspectors’ activities also supported the strategy of focusing inspectors on businesses identified by the analysis of WSIB injury records. The new strategy made better use of the inspectors’ time.

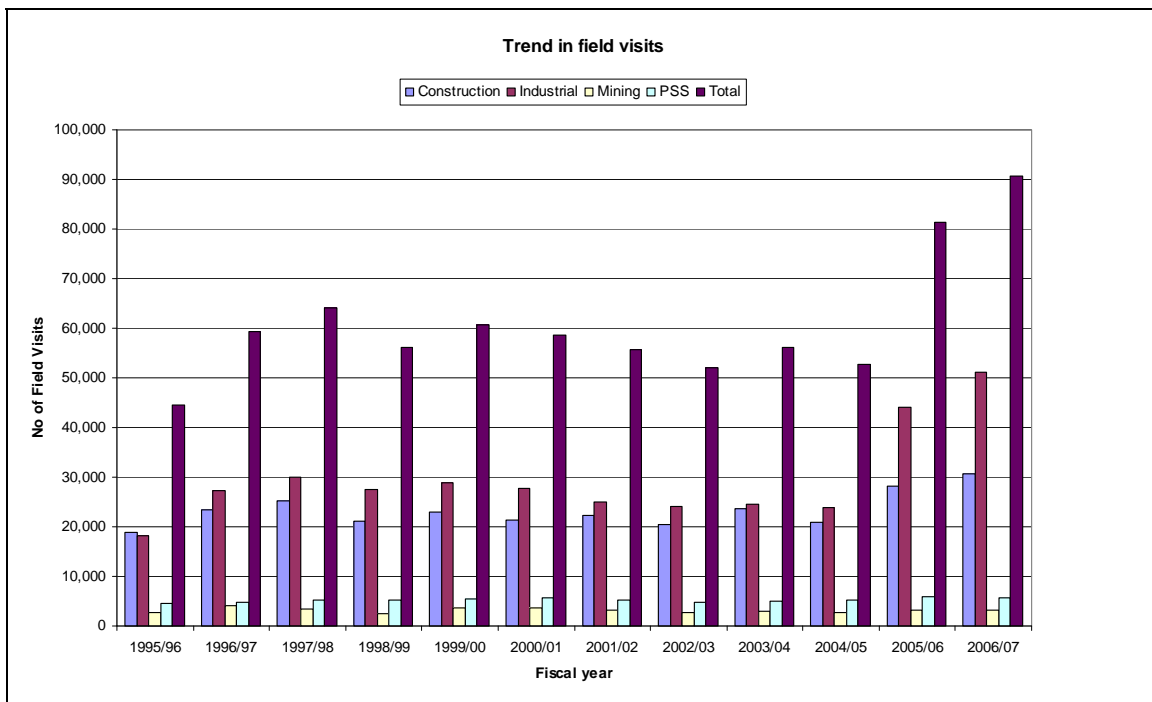


Figure 4: Trend in number of field visits by Ontario Ministry of Labour by program

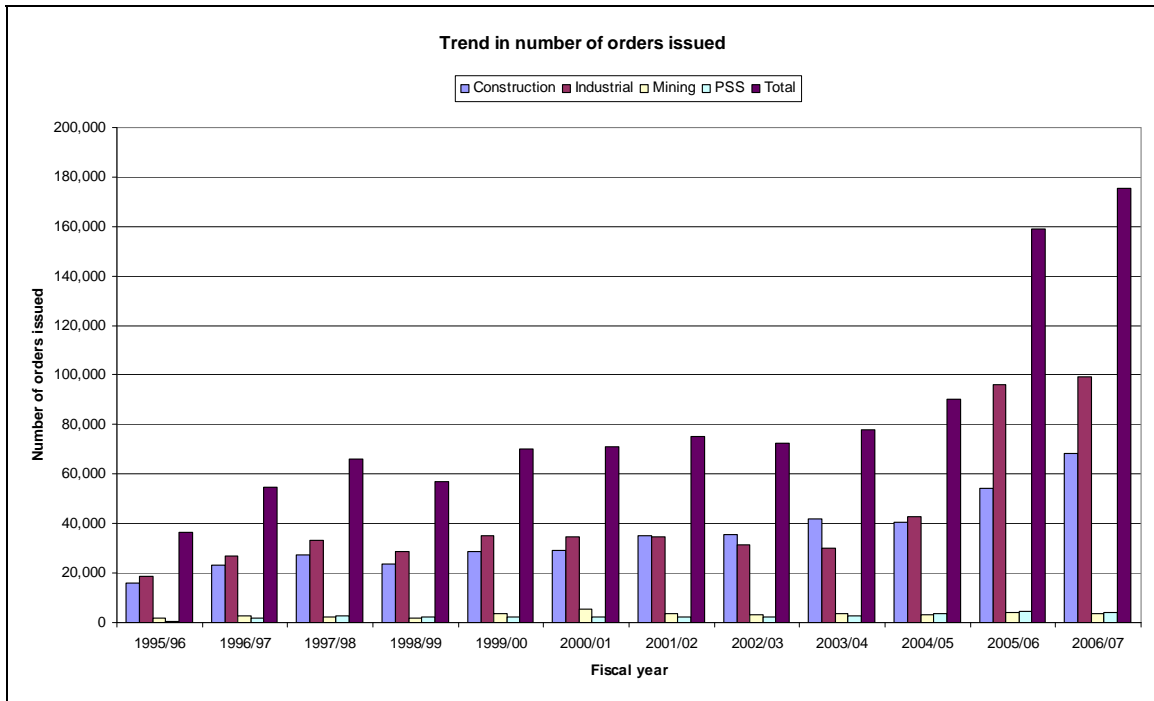


Figure 5: Trend in number of orders issued by Ontario Ministry of Labour by program

The lost-time injury rate has declined by about 18% in three years. The Ministry will easily achieve and probably exceed the planned reduction of 20% over a four year period. Most of the reduction in the lost-time injury rate occurred in year three of the program and 85% of that reduction occurred in the high risk and priority businesses. This suggests that risk based intervention has been successful and that there is some delay between improving compliance and realizing improved outcomes. This should be kept in mind when evaluating the impact of inspections and other interventions upon work injuries.



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