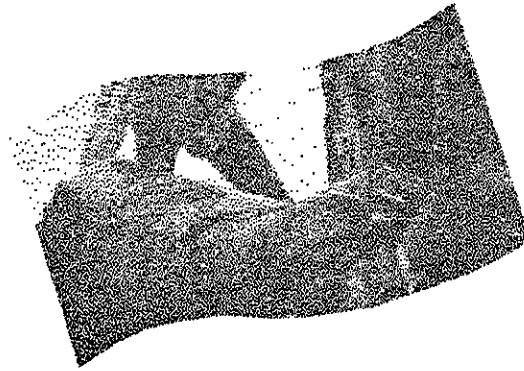


**Accident hazards associated
with domestic
waste collection**

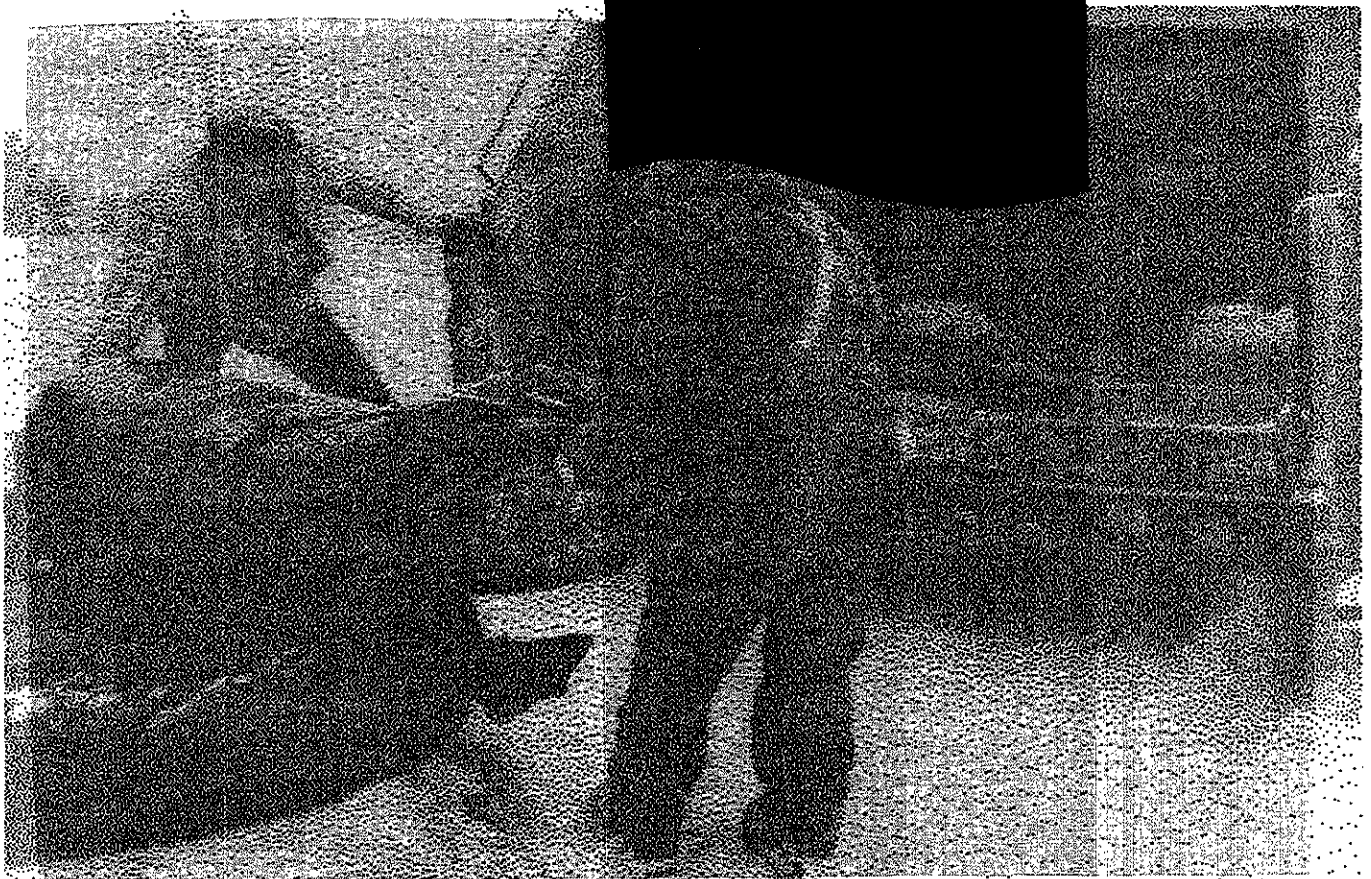


**ÉTUDES ET
RECHERCHES**

Madeline Bourdouxhe
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November 1993 RR-077

SUMMARY REPORT



IRSST
Institut de recherche
en santé et en sécurité
du travail du Québec

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The Institut de recherche en santé et en sécurité du travail du Québec (IRSST, Quebec Occupational Health and Safety Institute) is a scientific research agency committed to the identification and elimination at the source of occupational hazards, and the rehabilitation of workers who have suffered occupational injuries. With funding provided by the Commission pour la santé et la sécurité au travail du Québec (CSST, Quebec Occupational Health and Safety Commission), the IRSST conducts, funds and contracts research aimed at reducing the human and financial costs of occupational accidents and diseases.

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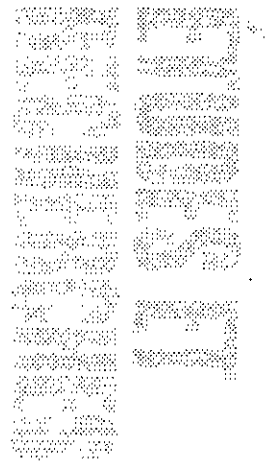
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Accident hazards associated with domestic waste collection



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SUMMARY REPORT

This study was financed by the IRSST. The conclusions and recommendations are those of the authors.

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We would like to express our special thanks to the Comité aviseur paritaire de la recherche (Joint Research Advisory Committee) and the groups they represent:

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PREFACE

This document is a summary of the detailed research report entitled "Étude des risques d'accidents dans la collecte des ordures ménagères" (Accident Hazards Associated with Domestic Waste Collection). The detailed report contains all the numerical and reference data that hands-on workers in the domestic waste collection or prevention sectors could possibly need, as well as workers' comments on hazards and their job, transcribed and put in appropriate perspective. Our scientific colleagues will find useful the complete description of our methodology and tools used to measure and analyse outcomes contained in the detailed report.

This summary report, on the other hand, is designed for a larger public, namely those wishing to further their understanding of the trade of garbage collector and obtain a rapid overview of accident hazards associated with it. The report contains an overview of the study's methodology, results, conclusions (with a discussion of the outlook in this area) and recommendations.

SUMMARY

What are the hazards faced by garbage collectors and garbage-truck drivers? As with any strenuous work requiring intense vigilance, garbage collection can be dangerous. Collecting garbage involves working on a dangerous machine that moves through traffic in all climatic conditions, performing work whose efficiency depends on work rate and rhythm. For all these reasons, accidents are common, although their precise nature depends on the specific trade (drivers, collectors, driver-collectors of side-loading trucks) and type of truck.

The scientific literature in this field is sparse and generally limited to a description of the injuries most frequently observed in collectors and drivers, and to accidents occurring during collection. The relative cardiac exertion associated with collection has been shown to depend on workload, itself dependent on the terrain and type of waste collected. Some studies have drawn up more or less complete inventories of potential physiological, mechanical and ergonomic hazards. Others contain recommendations concerning vehicles, protective equipment, and work practices and organization, with most reporting a decrease in the frequency and severity of accidents when these recommendations are implemented.

Unfortunately, the results of research conducted elsewhere are not directly applicable in Québec, due to

differences in context. In fact, each country, each province and sometimes even each municipality deploys its own combination of methods, equipment and vehicles to manage, plan and organize the collection of waste and recyclable material in its own fashion. The IRSST therefore undertook a research project on the collection of domestic waste in Québec by workers employed by municipalities and specialized companies. The project's immediate goal was to increase our understanding of hazards associated with workload, different types of trucks, work organization, different types of waste collection, and the work context climatic stresses, such as traffic, with the ultimate goal being accident prevention. The IRSST wishes to help workers and management resolve their most important safety problems, in a manner consistent with each group's specific needs. This project was conducted with the collaboration of municipalities, waste collection companies, and the joint health and safety sectoral associations for the sectors of Municipal Affairs and of Transportation and Warehousing.

The main objective of this research was to describe the work performed in, and the hazards associated with, a relatively unknown sector. Data on a wide variety of work situations throughout the province of Québec was collected from the accident files of the nine participating enterprises and during 300 hours of observation, interviews, and on-site video filming. A multidisciplinary, convergent strategy that drew on ergonomic, socio-graphic, statistical and work sociology methods was adopted. The results indicate that prevention activities would be profitably focused on the following factors: workload, variety and nature of objects handled, collection speed, traffic flow, mishaps and dangerous compensatory movements, potentially hazardous work strategies, truck characteristics (access to the cab and rear platform, height of the loading hopper), personal protective equipment, dispatching and allocation of collection routes, work-team training, schedules, workforce turnover and training, irregular workers (auxiliary collectors, jobbers), the nature of collection contracts, the behaviour of resident "waste generators" and its impact on collection, divergence of bylaws, vehicle purchasing and maintenance, and problems specific to recycling collectors (a new form of work for which few workers have been trained).

Further study and planning would help minimize the impact of several factors on the safety hazards associated with waste collection. Improvement of technical and organizational components would benefit everyone: if the equipment used reduced the manipulation of heavy or dangerous materials, work organized so that the collected material was more homogenous, the workforce better

trained and more stable, and job skills more easily acquired, waste collection would be cleaner, less arduous, cheaper over the long run, and safer.

GLOSSARY

Accident: Sudden and unanticipated event occurring during work and provoking an injury. In this report, consists of accidents reported by workers or described in enterprise records. Data on all accidents, regardless of whether or not they resulted in work absence, was recorded. Only accidents resulting in CSST-compensated work absences were selected for the primary analyses.

Accident hazard: Exposure to an object, set of circumstances, or dangerous event that could result in injury.

Collection point: Point at which a truck stops to collect a batch of waste. In 90% of cases, this involves movement of the truck; in the remaining cases (more common in urban zones), there is more than one collection point for each truck stop.

Front-end: Automatic front-end loading system for the emptying of commercial containers; rarely used in domestic waste collection.

Hazardous activities: Worker activities that could result in injury.

Helper: The most frequent term in the sector for collectors working on rear-loading trucks. A driver and his or her helper(s) constitute a work team.

Hopper: Cavity in the garbage truck into which workers deposit waste to be compacted. The position of the hopper defines the type of loading, i.e. rear- or side-loading.

Mishap or disturbance of normal activities: Event that disturbs the normal execution of a work activity, hampers fulfilment of an objective, and necessitates a compensatory activity.

Roll-off: Automatic loading system for very large commercial and industrial containers. Not used for the collection of domestic waste.

Route: Collection route, defined by contract. Often referred to as "the run."

Rural: Territory with a low population density and long collection route over country roads. Characterized by farms, villages and timberland.

Specific waste: Large, heavy, bulky items; "big pieces," "domestic monsters."

Suburb: Territory with a medium to high population density.

Trip: One full truckload. A route may require up to four trips.

Urban: Territory with a high population density; downtown core.

Work strategies: Activities designed to lighten the workload by reducing the time or effort required. Requires trade-offs in risks.

1. INTRODUCTION

Recently, the Québec press has reported extensively on waste collection. Reporters make dire predictions: consumers produce ever-increasing amounts of garbage, large landfills will soon be full, ecological concerns intensify, and although selective collection and recycling of waste might be a feasible solution, their implementation is slow and application uncertain. At no time, however, do these otherwise well-documented articles examine the nature of the actual job of waste collection in the current context. Despite this neglect and silence, these analyses are relevant and describe the issues at stake both now and in the future. The market for waste and recyclable material is profitable for those who can develop solid expertise. The principal players are already in place, and any study of the safety of waste collection in Québec and the effects of economic and technological change must take them into account.

1.1 SECTOR OVERVIEW AND RESEARCH OBJECTIVES

Besides the 250 workers employed by the five Québec municipalities that have their own waste collection boards, the private sector employs over 2 300 waste collectors and drivers in almost 350 companies. For over 30 years, the Association des entreprises de services en environnement du Québec (Québec Association of Environmental Services Enterprises) has represented the 20% of these private companies that account for 85% of both the volume of collected waste and the sector's dollar value. Depending on their size, waste-collection enterprises may perform residential, commercial and industrial collection, collect recyclable material, and operate landfills or sorting centres. Many enterprises rely, either wholly or partially, upon jobbers who rent or own trucks and are responsible for the collectors who work for them. Competition in the sector is high, as municipal contracts are awarded to the lowest bidder, and there is a regular annual turnover of enterprises (e.g. the appearance of 25 new enterprises in the Montréal area since 1989). The high competition also results in low domestic waste-collection rates—in fact, costs are at the same level as they were 10 years ago—and waste collection accounts for the lowest proportion of municipal taxes. However, as the 74 existing Québec landfills (60 municipal and 14 private) fill up, landfill costs rise, obliging municipalities to consider integrated

waste-management systems. All municipal workers are unionized. Unionization of private-sector workers began in the 1980s, and 20–30% of them are now unionized. Work schedules and wages in the large southwestern region of Québec have been mandated by the Décret sur l'enlèvement des déchets solides (Decree Concerning the Removal of Solid Wastes), administered since 1980 by the Comité paritaire des boueurs de la région de Montréal (Joint Collectors Committee for the Montréal Region). In the eastern section of the province, the relevant statute is the "waste collection" section of the Décret sur l'industrie du camionnage de la région de Québec (Decree Concerning the Trucking Industry in the Québec Region), administered by the Comité paritaire du camionnage de la région de Québec (Joint Trucking Committee for the Québec Region). The Abitibi, Drummondville-Victoriaville, and Trois-Rivières regions are in a unique judicial vacuum, as none of the above decrees apply to them. In these regions, working conditions depend on contractors' policies and direct negotiations with workers.

Several aspects of waste collection influence workload and hazards. Firstly, remuneration is on a flat-rate basis, that is, the territory specified by contract must be completely cleared of domestic waste on collection day. Since the volume of waste depends on residents' activities and varies from day to day and from season to season, the workload varies enormously. Secondly, workers are in direct contact with the objects and waste collected. This is quite different from the situation in the commercial and industrial waste-collection sectors, where containers are collected by either front-loading trucks equipped with automated forklifts, or by roll-off trucks. This means that workers in these sectors do not handle waste containers and are not in direct contact with waste. Working conditions for these collectors therefore more closely resemble those of domestic waste drivers, rather than domestic waste collectors.

Residential collection (also known as domestic collection) is, on the other hand, primarily manual, and workers continue to handle a wide variety of objects and containers of variable size, nature, and weight. A few suburban and rural municipalities have implemented semi-automated collection, involving the use of mobile domestic waste bins. However, most domestic waste continues to be collected manually, especially in cities. The principal characteristic of this job is thus significant physical exertion.

Compensation costs related to accidents in the waste-collection sector exceed \$2.5 million dollars annually. In 1989, the CSST assessment rates for private companies and municipalities were \$11.29 and \$2.38 per \$100 of eligible salaries, although the municipal rate is in fact that used for all municipal employees, of which collectors are only a small fraction. The most recent statistics (1986) indicate that waste collectors, grouped with workers in "other useful public services," have an average annual occupational injury rate of 41% and an average compensated absence of 24 days per injury. The daily absence rate, an integrated index of accident frequency and severity, is revealing: every day, 40 out of every 1 000 workers (4%) are absent because of an occupational accident or illness. Waste collection will inevitably change, intensify and become more complex as waste volume increases, landfill availability shrinks and recycling activities expand. It is therefore particularly appropriate at this point to scrutinize the spectrum of health and safety problems affecting waste collectors. By familiarizing ourselves with the occupational risks today, we can prevent them tomorrow.

At the request of the joint sectoral health and safety associations for the sectors of Transportation and Warehousing and of Municipal Affairs, and after confirming the existence of numerous, diverse and therefore costly hazards in this sector, the IRSST agreed to study the activities involved in domestic waste collection. Although workload, climactic conditions, scheduling and routing constraints, and vehicle layout are generally considered dangerous, no documentation of the hazards existed. CSST rates and official occupational-injury statistics give a glimpse of the seriousness and extent of accidents, but are incapable of explaining how and why accidents occur. A research project involving the rigorous observation of all operations and stressors associated with waste collection in private and municipal enterprises was clearly indicated.

1.2 LITERATURE REVIEW

The literature consulted prior to starting the project revealed the existence of a number of studies of waste collection (a full bibliography is available in the detailed report). This abundant literature contained almost no data on the actual work performed by collectors in Québec, however. Of all the studies consulted,

Toulouse's (1983) was by far the best documented. In that study, data was collected over a three-month observation and interview period was complemented by statistical analysis and analysis of serious accidents. The result was a comprehensive overview of waste collection and its associated hazards. The study's recommendations—unfortunately inapplicable in the present technological and organizational context—addressed issues related to equipment, the composition of the workforce, and work organization, and took into account constraints faced by employers and several other practical considerations, including the resistance to change among collectors and administrators.

1.3 OBJECTIVES

It is not coincidental that the most complete and valuable studies relied upon fieldwork, in the form of prolonged and intensive observation of waste collectors, and interviews with collectors about the reasons and logic underlying their work activities. The results of the literature review reinforced our initial resolve to rely upon anthropological and sociographical methods, supported by accident statistics and traditional ergonomic tools. We believe that the elimination of risks associated with waste collection depends on a detailed appreciation of the work itself. Prolonged observation is the only way to acquire such knowledge, and in-depth interviews provide insights into organizational constraints from the point of view of the workers and employers who must cope with them daily.

1.4 HYPOTHESES

We undertook this project with a number of research hypotheses, supported by the literature review and our knowledge of the principal safety preoccupations of workers and management in this sector. The following principles guided the development of our research strategy:

- a) Workload and hazards are a function of:
 - the type of equipment: rear- or side-loading trucks, presence or absence of mobile domestic bins
 - trade: drivers and collectors for rear-loading trucks, driver-collectors for side-loading ones
 - type of enterprise: municipal or private
 - residential sector: urban, suburban, or rural

- season, defined by both climatic conditions and the behaviour of residents: spring cleaning, moving, renovations and grass cuttings during the summer, leaf collection in the autumn.
- b) There are significant differences between the job's formal definition (bylaws, formal organization and management of collection), and the work actually performed in the face of constraints faced by both workers and management.

In addition to these general hypotheses, the following specific questions were addressed:

- Is there a relationship between waste collection with side-loading trucks and the development of shoulder and back problems?
- Does the nature, strength and precision of the contract between municipalities and collection services influence the behaviour of residents (i.e. electors), and if so, do these behavioral modifications affect workload and hazards?
- Is waste collection truly a trade? Is it worthwhile for specialized waste-collection enterprises to maintain trained and experienced workforces, or is anyone capable of performing this type of work?

2. METHODOLOGY

2.1 A MULTIDISCIPLINARY APPROACH

Our objective—to understand waste-collection work and use this information to characterize accident hazards associated with it—was best served by a multidisciplinary approach. Multidisciplinarity, i.e. the use of different viewpoints, tools, types of data, and analytical methods, was the only appropriate methodology to explore the complexities of this very diverse sector. All four researchers approached the study with the same goal: to completely understand all aspects of waste collection and assess the risks associated with this work.

Several hypotheses were scrutinized, using methods drawn from ethnography, industrial engineering, sociology, statistics, physiology and ergonomics. For some safety problems, there was a noticeable convergence of results from clinical analysis of work situations (hazards observed, quantified and filmed in the field), ergonomic evaluation of workload, vehicle evaluations, the workers' own description of the hazards, statistical analysis of enterprise data on accidents, and analysis of the organization of waste collection.

2.2 PROLONGED FIELD STUDIES

The effectiveness of research strategy adopted depends on the confidence informants have in the observers. In order to obtain high-quality data and information, it was essential that informants knew and accepted the researchers—not everyone wants to work while being followed by a van containing three researchers who film, take notes, measure trucks, weigh trash cans and ask questions. Similarly, management also had to trust the researchers before they would release valuable data on production and management practices, particularly when public and media preoccupation with the environment have placed waste collection enterprises in the limelight. Our prolonged presence in the field helped establish the necessary confidence. In most enterprises, collection of all the necessary data took an entire week (see section 2.4 for details of data collection), and we quickly realized that this lengthy stay increased our chances of collecting high-quality data. We therefore decided to follow workers from their arrival at the depot at five o'clock in the morning to their return, often 12 hours later, along sidewalks and down alleys, on the road, in the garages, at snack bars and at landfills and incinerators. This turned out to be a profitable decision, and allowed us to collect much data on inter- and intra-team variations in work strategy and the effect of collection territory on these strategies. We were able to observe modifications of work strategy adopted by collectors faced with constraints such as rush-hour traffic, high waste density in a territory, simultaneous collection in neighbouring areas, equipment failure and climatic conditions.

2.3 SAMPLING: ACCOUNTING FOR THE WIDE VARIETY OF WORK SITUATIONS

Conventional statistical sampling was considered inappropriate for a study such as this, which focused on detailed description rather than the search for explanations. In any case, there are no statistical methods that would have allowed us to constitute a suitable proportional sample. An empirical sample was therefore taken following preliminary investigations and consultation with the two joint health and safety committees involved. Nine enterprises, representing a wide range of work situations, were asked to participate in the study. All nine enterprises are interested in health and safety research. Although selection on a voluntary basis may introduce biases whose nature and extent are unmeasurable (it was suggested, for instance, that these enterprises may represent "the cream of the crop" from the point of view of management practices), it was unavoidable, as the quantity and quality of data collected in the field depended on the availability of workers and management and their motivation to explain their work to us.

Our preliminary investigations led us to believe that work stressors varied as a function of season, schedule, clientele, territory, type of collection, type of truck, type of employer and degree of unionization. After selecting enterprises on the basis of the last two criteria, collection routes which represented **all of the following work situations** were selected:

- Enterprises: municipalities and private-sector enterprises
- Unionization: unionized and non-unionized enterprises
- Seasons: all
- Days of the week: Monday to Friday
- Shifts: day and night
- Clientele and territories: urban, suburban and rural
- Collection: traditional residential collection (bulk household waste), and three recycling routes
- Trucks: rear- and side-loading trucks, with and without mobile domestic bins

The limitations of the sampling method are those of every exploratory study: there can be no absolute guarantee that the variables listed above are the only determinants of occupational injuries. For example, a variable not accounted for by the study design—subcontracting by jobbers—was accorded more

attention as the study progressed, as field observations clearly indicated the increasing prevalence of this practice and the fact that this increase is a recent phenomenon.

Finally, it is important to remember that our principal objective was to analyse hazardous work situations, rather than perform case studies of enterprises. This is particularly relevant to the interpretation of the data on work organization, where the limitations of the sampling method are most evident, as most of the data was collected during 29 collection trips.

2.4 DATA COLLECTION AND ANALYSIS

Observations were made during 29 collection trips in 9 enterprises located in 2 municipalities. This corresponded to the observation of 55 workers over 300 hours and 2 800 km, every day of the week, in all seasons, during day and night shifts, in urban, suburban and rural territories. Rear- and side-loading trucks, and manual and semi-automated collection (using small mobile domestic bins) were observed and compared. A few recycling collection trips were also observed. Over 60 video sequences of 20 minutes duration were filmed in order to obtain detailed information on workload and its variation. A portrait of the most frequent types of accidents was drawn up, based on multivariate analysis of the 9 enterprises' accident reports for 1989–1990 (755 accidents, of which 487 resulted in work absences). Indices based on the number of accidents expressed in terms of production data (number of workers, number of hours worked and tonnage collected) provide measures of the frequency of occupational injury, while the length of work absence provides a measure of the severity of injury. In all, 79 workers were interviewed: 31 workers agreed to participate in semi-directed, in-depth interviews on work hazards, 28 workers completed a brief questionnaire on the main safety aspects of waste collection, and 20 workers completed the questionnaire and agreed to be interviewed. Management agreed to provide information on the organization of waste collection and discuss safety-management practices.

The data collected constitutes a unique database that includes information on almost all the work situations and hazards encountered during waste collection. Data is available on:

- Nine participating enterprises: organization of collection, management of the workforce and vehicle fleet, safety management (45 variables);
 - 29 routes observed, including 3 recycling routes (49 variables): To complete these 29 routes, workers had to perform 61 trips (see glossary for these terms). During these 29 routes, notes were taken on all the waste collected by workers and all significant events. Data is thus available on:
 - the weight handled
 - the distances covered by the trucks and walked by workers
 - duration of collection, rest, meal, travelling, spill times, and so on
 - objects collected
 - mishaps and disruptions of normal work activity (see glossary for terms)
 - hazardous activities and work strategies (see glossary for terms)
 - 63 video sequences of 20 minutes duration each, totalling 21 hours of visual information, coded and entered into the database. This information complements the data collected by conventional methods during observation of the 29 routes. The films were used primarily to count objects which we were unable to count with the naked eye in real time during collection (e.g. small and large bags of garbage), and movements that were sometimes imperceptible to the naked eye (e.g. frequency of bending and twisting of the trunk, frequency of tosses);
 - Characteristics of the 55 workers observed at work and interviewed on site (33 variables);
 - 32 garbage trucks followed, measured and evaluated (46 variables);
 - 755 accidents occurring in 1989 and 1990 for which accident reports or accident declaration forms were collected in the 9 participating enterprises (33 variables);
 - Data necessary for the calculation of the frequency and severity of accidents: production and accident data from the nine participating enterprises (number of accidents, workers and hours worked, broken down by trade; number of vehicles; annual waste tonnage collected);
 - 10.5 hours of semi-directed interviews of workers — recorded, transcribed and thematically coded — used for content analysis. Content analysis of the workers' statements revealed the way they perceive certain work realities, particularly those affecting safety. This important data sheds light on workers' motivation for their actions, organization of their work, and attitude and behaviour with regard to safety. Subjects broached in the interviews concerned hazards associated with different types of waste, containers, work environment and vehicles, as well as health and safety training, safety equipment, the most common type of accidents, and safe work practices. Content analysis provided information on:
 - workers' knowledge of hazards,
 - workers' perception of the role of work experience in waste collection.
- Although this data covers a wide range of collection situations, it should be recalled that it does not cover the entire range of enterprises that may exist in the province.
- The data collected was analysed to determine **workload** and **accident hazards** associated with domestic waste collection.
- ## 2.5 THE BASIS OF COMPARISON: DEVELOPMENT OF NOVEL INDICATORS
- Whenever possible, data on accidents, workload and risk factors was analyzed and compared on the basis of:
- a) the type of loading (rear versus side, and the presence or absence of mobile waste bins);
 - b) the three trades involved: collectors, drivers of rear-loaders and driver-collectors of side-loaders;
 - c) collection sector: urban, suburban or rural;
 - d) type of enterprise: municipal or private-sector;
 - e) the two enterprises undergoing expansion and employing a young and relatively inexperienced workforce (with a high turnover rate) were compared to the other, more stable, enterprises.

Comparisons for the purpose of analysing accidents and workload were facilitated by the use of the following four indicators developed specifically for this study:

- mean trip-weight accident incidence: number of accidents resulting in work absence per 1 000 trips of a truck transporting 10 tonnes;
- collection sector density: number of kilograms of waste per kilometre of collection territory;
- collection speed: number of kilometres of territory covered per hour of collection;
- collection rate: number of tonnes of waste handled by a worker per hour of work.

3. RESULTS

A significant volume of non-recyclable and non-recoverable domestic waste will continue to be collected by existing collection techniques during the implementation of integrated waste-management systems, regardless of the extent of recycling activities in the collection sector and resident's reductions in waste generation. Workers performing waste collection, transport and unloading operations are exposed to certain hazards, however. Our results indicate that these hazards are primarily related to high workloads, and that the manner in which work is organized may sometimes increase the baseline risk. Experienced and well-trained workers—i.e. those who view waste collection as a true trade—develop practical expertise in controlling energy expenditure and anticipating hazards that allows them to work efficiently despite the arduousness of their tasks. The fact that none of the trucks evaluated in this study had an ideal design is an example of the constraints with which workers must cope. The following sections describe the hazards waste collectors and truck drivers face in the course of their jobs.

3.1 SOURCES OF HAZARDS

Analysis of field observations and measurements, interviews with management and workers, and analysis of video sequences resulted in the identification of several sources of hazards.

3.1.1 Workload is an important factor. On average, waste collectors handle 16 000 kg spread out over 500 collection points every day, equivalent to a collection density of 550 kg/km. Collection takes almost 6 hours, equivalent to 2.4 tonnes/hour, and involves walking 11 km during a total work day of 9 hours. Collection speed averages 4.6 km/h, over a territory of almost 30 km of sidewalks, streets and lanes. Rest periods are limited to a few minutes precariously balanced on the rear platform, or, in the case of driver-collectors of side-loading trucks, at the wheel. This demanding workload is exacerbated by such factors as the frequency of truck dismounts and mounts, the distance covered, travel modes, the static effort required to maintain one's balance on the rear platform, the frequency of handling operations per unit time, the variety of postures required (bending movements), the frequency of tosses and twisting movements of the trunk, and the high collection rate per unit time in some sectors. The fact that the AFNOR's adapted weight standard for manual handling was exceeded in 23% of observed trips is eloquent illustration of the impact of these factors. When workers' capacities, established on the basis of our observations (3.0 tonnes/hour for rear-loading trucks, and 1.9 tonnes/hour for side-loading ones), are taken into account, the frequency with which the AFNOR standard is exceeded rises to 37%.

3.1.2 The diversity and nature of objects handled causes serious problems. Manipulation of objects and containers of variable weight and volume interrupts the smooth flow of operations and breaks work rhythms. Objects in this category, often hidden by residents, include heavy, large, or bulky objects, sharp or pointed objects, and hazardous materials. The most frequently encountered objects are:

- glass, window panes, fluorescent tubing
- dangerous and toxic products (battery acid, cans of solvent or paint, aerosol containers, gas cylinders, motor oil)
- construction waste, dust, plaster, sawdust, hearth cinders
- pieces of wood with nails in them
- syringes, medical waste
- garden waste, grass, rocks, earth
- furniture, electrical appliances, "domestic monsters"
- pre-compacted waste (in apartment buildings): hypercompact "sausage bags"

- excessive numbers of small containers from small businesses and restaurants
 - large amounts of vegetable and animal waste in rural sectors
 - new, extra-large bags
 - prohibited containers (no handles, excessive weight, 45-gallon oil drums, thin-necked drums, garbage cans without covers)
 - small, apparently light bags that are in fact heavy;
 - excessive numbers of small bags
 - paper bags and boxes that rip
 - all waste that is hidden because of its excessive weight or toxicity, or that surprises unprepared workers
 - commercial containers that must be emptied with a jury-rigged system, which is often inappropriate and dangerous
- a distance of 15 km during 6.6 hours of collection
 - a waste density of 854 kg/km
 - a collection rate of 3.4 tonnes/hour
 - a minimum effort to stay on the rear platform of 13 kg
 - **and especially: almost 1 500/hour situations that could result in accidents or increase workload, including:**
 - 53 mounts and dismounts from the truck's rear platform
 - 38 short runs
 - 482 bending movements
 - 203 tosses
 - 159 twisting movements
 - 277 potentially hazardous actions (including 255 work strategies aimed at reducing workload by saving time or effort)
 - 285 instances of increased workload, including 11 mishap-recovery activities, and 274 dangerous or heavy objects or containers

In passing, workers have great praise for traditional green garbage bags and mobile domestic bins, which help standardize collection and control work rhythm and effort.

3.1.3 Climatic conditions and the nature of objects transported (wet paper bags and poor-quality green garbage bags that rip and scatter their contents over the sidewalk, frozen garbage cans, domestic bins stuck in snow banks), **the need to rush, traffic problems, parked cars, and crowded streets** all can cause **mishaps and dangerous recovery manoeuvres**. In an attempt to reduce their workload and maintain a high but constant work rhythm in the face of these constraints, workers often attempt to save time or effort by adopting **work strategies** that may be hazardous. The most commonly observed strategies included kicking bags or cardboard boxes towards the truck, zigzagging across the road to collect from both sides of the street, grabbing bags while the truck is in motion, carrying bags under the arm or against the body, using the thigh to help load bags and garbage cans, hand-picking of waste scattered on the ground, and manual compaction (pushing garbage overflowing the hopper with the hands when the compacting system is incapable of processing the load rapidly enough).

As an example, the following average values were observed for suburban collection with a rear-loading truck:

Collection with side-loading trucks or small mobile domestic bins, by reducing the manipulation of heavy or dangerous objects, reduces the hourly frequency of situations that could result in accidents or an increase in workload.

3.1.4 Problems related to the use of public thoroughfares. The street is the collectors' workplace. This circumstance exposes them to additional hazards, related to:

- climatic conditions (in the winter: falls and slides, difficulty in collecting from snow banks, and cooling of muscles in intense cold; in the summer: dehydration);
- urban layout and the state of the roads;
- parked cars;
- competition with drivers in a hurry, pedestrians and cyclists;
- curious children, for whom collectors must be vigilant.

3.1.5 Vehicles. The trucks used in waste collection consist of the truck body (cab, chassis and drive-train) plus a compacting box containing the waste. Different enterprises opt for different combinations of truck body and box (loading position, model and capacity), and there is consequently a wide variety of vehicles on the road. In fact, 22 different body/box combinations were observed among the 32 vehicles followed during collection trips. Each combination was evaluated on the basis of 21 criteria and the workers' measurements. A tabular summary of this evaluation, indicating the proportion of vehicles satisfying anthropometric standards and reference values for each of the 21 criteria, is available in the detailed research report (chapter 5 and appendix 12).

In all the vehicles evaluated, it was difficult to access the cabs and rear platforms and maintain balance on the rear platforms, although the degree of difficulty varied from truck to truck. Excessively high or shallow steps and rear platforms are difficult to mount and render descents perilously similar to jumps. Hand-rails that are too high or too close to the truck body only worsen the situation. These conditions increase the frequency of falls and of collisions with structures adjacent to the rear platform. In addition, the upper edge of the hopper is very high, and shorter workers must expend additional energy lifting objects into it from the ground. In some cases, workers use their legs or thighs for support or additional power when loading the hopper. The difficulty of this task increases as the height of the hopper increases, as the work consists of repeated handling of heavy objects over a prolonged period.

The characteristics of side-loading trucks and the operations related to their loading result in specific repetitive movements likely to cause muscle and joint problems in the shoulder and upper back. Driver-collectors of side-loading trucks have an additional constraint, as they must cope with both the physical strain of collection and the mental strain of driving (complexity of manoeuvres required to minimize movements when carrying waste, and the responsibility for the vehicle that must be left in order to collect waste in the street). Several driver-collectors stated that as a result of always working alone, they developed, over the long run, a series of behaviours which they call the "Shu-pack syndrome," after the name of their truck: the only way they could communicate and cope with their isolation was to listen to snatches as of open-line radio programs (they dismount from their trucks an average of

13 times for every 10 minutes of collection), and to talk to themselves.

Rear-loading trucks have larger capacities and hopper dimensions, leading to excesses impossible with side-loading trucks. Because of these characteristics, and the high waste density in sectors where rear-loading trucks are usually used, situations that could lead to accidents are generally more common with this type of truck than with side-loading trucks.

3.1.6 Personal protective equipment, such as gloves and boots, is usually provided free of charge and in good condition. While the theoretical value of such equipment is beyond question, it may nevertheless prove inadequate in the field. In concrete terms, the equipment is inappropriate for the conditions under which collection is carried out. Boots, in particular, are incompatible with the short useful depth of rear platforms and the high work rhythm necessitated by the manner in which collection is organized. In this case, the solution consists of improved work organization (so as to permit a reduction of the work rhythm), rear platform design, and design and selection of footwear adapted to the specific needs of waste collection.

3.1.7 Some aspects of **work organization** increase workload and by extension, hazards. As previously mentioned, the main characteristic of waste collection is its flat-rate pay scale (all waste in a sector must be collected on collection day), and in common with most flat-rate situations, the main advantage to workers of this system is the ability to manage their work time and save time by adopting a rapid work rhythm as they see fit. This explains why attempts, based on safety considerations, to slow down the pace of work have been unsuccessful. Other elements related to work organization having an impact on occupational hazards include: route organization, dispatching and allocation; work-team training; schedules; employment criteria; training; personnel turnover; the nature of collection contracts; bylaws; and the existence of precarious job categories such as auxiliary collectors and jobbers.

Worker training upon hiring is inadequate and too short, and veterans' expertise is not exploited. Mentoring by more experienced workers is far from systematic. Collectors learn on the job, in the street, with no preparation. It is rare that new employees receive

information on work practices that would permit them to perform their job without wearing themselves out or injuring themselves.

Some work schedules exceed workers' capacities. Measures aimed at distributing workload more evenly (addition of a second collector or truck) are rarely applied, even on high-volume routes. In non-unionized enterprises, overtime is sometimes not paid, the argument being that flat-pay scales are based on annual averages. Over the long run, some workers nevertheless find themselves shortchanged by this pay structure. Data from interviews indicates that this state of affairs affects safety by inciting workers to adopt faster work rhythms: since overtime is not paid, workers adopt faster work rhythms on heavy collection days in order to finish their route within the allotted time.

Collection sector boundaries sometimes fail to adequately take workload into account. Sectors are sometimes redefined in order to balance workloads, but workers find these redefinitions disruptive (since knowledge of the collection route is a major determinant of efficiency and safety) and sometimes illogical.

Team cohesion is as important as knowledge and mastery of the collection route. Management of some enterprises have grasped this, and hesitate before modifying effective work teams, but this is not always the case. It would be desirable to always take worker preferences into consideration when forming work teams.

Enterprises undergoing expansion are faced with a workforce problem, since they must recruit relatively inexperienced personnel with a high turnover rate. These two factors, in conjunction with the precarious status of auxiliary collectors, militate against the acquisition of hands-on knowledge that would improve the safety of collection work. We observed that experienced workers, who view their job as a true trade, develop a wealth of insight into their collection routes. This, in turn, allows them to manage their energy expenditure, adopt a safer, more effective and productive work rhythm, and incur fewer injuries, despite their considerable workload. This adaptation is, however, only possible when workloads are within acceptable limits and workers are able to maintain work rhythms are well matched to them. Certain work-organization modes are more supportive than others of the acquisition of skills, experience and expertise serving all parties' interests. On the other hand, enterprises having undergone recent and extensive

expansion, and in that personnel turnover was high, appeared to have lost control of this important phenomenon. This may explain the high frequency of occupational accidents observed in these enterprises.

Both content analysis of interviews with workers and our observations of collection work revealed that whenever possible, workers use their acquired skills to avoid hazards. The importance of developing and maintaining work rhythms that are well matched to the variations in workload on a given day in a given sector cannot be overemphasized. Maintenance of rhythm is what allows collectors to remain at their jobs and perform their work as efficiently and safely as possible. Work organization influences work rhythm, however. Excessively heavy waste, non-standard containers, excessive numbers of small businesses and industries in supposedly residential sectors, and route changes all disrupt collectors' work rhythm. On the other hand, experience, i.e. knowledge of the route and of residents' seasonal habits, team stability, and familiarity with a vehicle's advantages and disadvantages (acquired through prolonged experience with the same vehicle), helps collectors maintain their rhythm.

Some hazards are beyond the control of collectors (as opposed to work rhythm, for example), and can only be controlled by the "art of the route"—management's organization of routes so as to allow collectors to manage their workload. This organization takes into account the route's total tonnage, density, length and idiosyncrasies. Workers also appreciate management taking their preferences into account when forming work teams, as communication is an essential determinant of safety and operational efficiency. Moreover, the collectors' safety is essentially in the hands of their drivers, and mutual confidence between the two team members is essential. At this juncture, it is perhaps useful to say a few words about drivers and emphasize the complexity of their task (counting heaps of waste, knowing where to stop to minimize loaded movements by the collector) and the necessity of training new or replacement drivers. Possession of a truck driver's license is no assurance of competency as a waste-collection driver.

In order to develop the expertise and experience that reduces risks, both collectors and drivers must not only keep their jobs long enough to learn their trade, but also be lucky enough to be trained by a veteran and maintain some continuity of collection routes and teammates.

Inadequate planning of collection routes sometimes leaves collectors feeling unnecessarily exposed to known and otherwise avoidable hazards. It would be desirable to consult experienced workers in this area.

Working conditions, particularly in non-unionized enterprises, have been affected by the increased number of enterprises in the sector and the intense competition for collection contracts. The range of working conditions described by interviewed workers was extreme, ranging from the worst conditions imaginable to more acceptable ones, from conditions that prematurely wear out workers to those promoting the recognition and appreciation of their acquired skills. These narratives reflect the evolution of a traditionally harsh occupation that has nevertheless largely succeeded in developing into a self-respecting, professional industry.

Domestic waste collection possesses a technical specificity that is worthwhile to recall and that has a direct impact on workload and hazards: in domestic collection alone (as opposed to commercial and industrial collection) workers are in direct contact with the collected waste and are required to handle waste and containers. Mobile domestic bins are the first step in the semi-automation of collection, but municipalities, citizens and enterprises have not generally collaborated on the planning and integration of this type of collection.

3.1.8 The role of the myriad variations of **residents' behaviour** in the creation of additional hazards merits a study in itself. Prohibited or dangerous wastes skilfully hidden in regular waste, non-standard containers, excessively large or heavy waste, disagreements over collection times, and nonconformity with bylaws all increase the number of hazards—and the potential for conflicts between residents and collectors! Collectors are often reduced to the role of “garbage police,” educators and buffers between municipalities, enterprises and residents.

Waste collection is heavily influenced by the habits and behaviours of residents who generate the waste. This field study confirmed the existence of sector-specific habits that are resistant to change. Workers suggest that it is the municipalities' responsibility, however, to educate residents about hazardous waste and offer specialized collection services.

3.1.9 Hazards arising at landfills and incinerators, and those associated with recycling activities are significant. Enterprise records and CSST statistics indicate that accidents at incinerators and landfills are rare but serious. In our observation of collection routes, we observed several mishaps at the landfill and incinerator, where traffic density, the number of trucks and the speed with which the trucks unload all favour spills, ejection of hazardous waste, and collisions. Visibility at the incinerator is low, and collisions are frequent there as well. Workers were quite categorical about the frequency and nature of the hazards at these two sites.

Our observations of recycling activities indicate that this type of collection is not without its own problems: despite a low waste density and collection rates far below those of traditional collection (with the exception of the collection of leaves for composting), the hourly frequency of situations that could result in accidents is high. The fact that this is a new type of work for which few workers have been trained should be borne in mind.

We analysed inconveniences associated with the collection of small, blue rectangular recycling boxes and affecting workload, and consequently the risk of accidents or mishaps. In several cases, workers were obliged to perform dangerous activities such as mounting the truck's compaction box to get into the compartments and compact paper and cardboard with their feet. Several work strategies aimed at speeding up work rhythm were also observed, e.g. hand re-sorting of the material to be recycled, and removing objects from the blue recycling box and carrying them to the truck, rather than carrying the box to the truck. The frequency of mishaps and disruptions of normal work activity in this type of collection was particularly high: almost 4 mishaps per hour, i.e. 3, 5, and 10 times higher than the rate observed for an equivalent collection rate of conventional waste with rear-loading trucks, side-loading trucks, and side-loading trucks with domestic bins. These mishaps result in compensatory activities that are themselves dangerous. Our observations suggest that the number of mishaps could be related to the nature of the task itself, specifically the large number of fine manipulations during sorting operations at the various truck compartments. Collectors are more used to handling large objects and receive no training in sorting and separation. Another inconvenience of blue boxes is the absence of covers, which results in the accumulation of water in the boxes and the degradation of the boxes'

contents when it rains or snows. This, in turn, is responsible for many paper bags tearing and scattering their contents on the ground. Bending movements are less frequent than in conventional collection, but are deeper, since the low box height obliges workers to stoop considerably. Finally, unloading recycling trucks is also associated with problems.

3.2 A DANGEROUS TRADE: OCCUPATIONAL ACCIDENTS

Waste collection is a dangerous trade. If we accept that garbage trucks are similar to hydraulic presses, it follows that waste collection can be seen as a variant of working on an industrial press under conditions much more demanding than those encountered in factories: in waste collection, the machine travels through traffic in all seasons and workers must feed it by running behind it and tossing irregular objects of variable volume and weight, containing invisible and hazardous objects, into it. On average, collectors handle 2.4 tonnes of waste per hour. The efficiency of waste collection operations is entirely dependent on determinants of work rate and rhythm. The need to avoid rush-hour traffic and bridge lineups creates time pressures at collection points (an average of 500 collection points per 16 tonnes of waste per trip), and during transport. Speed is again of the essence during unloading at landfills and incinerators.

All in all, then, a dangerous trade. Statistics back up this impression. The average annual accident rate in this industry, for all types of enterprise, truck and trade, is almost 80 accidents for every 2 000 hours of collection. This is equivalent to 8 workers of every 10 suffering an injury at least once a year. Four accidents occur for every 1 000 10-tonne truckloads. On average, each accident results in 10 lost workdays, and accident compensation of \$820.

Indices of injury frequency and severity vary among enterprises, with higher rates observed in municipal enterprises. As described below, the three types of accidents entailing the longest work absences are concentrated among municipal workers. Several explanations of the higher incidence rate observed among municipal workers (74 accidents/100 workers versus 57/100 workers in private enterprises) have been advanced. Firstly, there are proportionally more collectors—i.e. workers who load rear-loading trucks, and who, as will be discussed presently, constitute the

trade at the highest risk of accidents—in municipal enterprises (57% versus 43% for municipal and private enterprises). Secondly, 80% of municipal trucks are rear-loaders, compared to 75% in private enterprises. Although rear-loading trucks are not more dangerous than side-loading trucks per se, their greater hopper capacity and the high collection density and rate that characterize the areas in which they are used contribute to the higher hourly incidence of situations that could result in accidents. Thirdly, municipal collection generally involves collection in urban areas with very high waste densities. Our analysis of workload indicates that a sector's waste density exerts a very strong influence on the average number of hazardous situations occurring per hour of observation. When other factors related to the urban milieu (e.g. traffic density and stress arising from competition for the use of public thoroughfares, especially during rush hour) are factored in, it is not surprising that accident risks are so high. Finally, the largest of the two municipal enterprises in our sample recently underwent significant expansion, and was obliged to hire inexperienced personnel. This resulted in a high turnover rate among its collectors and the creation of a special job category (auxiliary collectors), both of which militated against the formation of a stable, motivated, and experienced workforce. As we have noted, job experience is one of the prerequisites for the implementation of safe and productive work practices.

Differences in the frequency of accidents in municipal and private enterprises could also be due to differences in accident-reporting practices. Workers, management and individuals responsible for the Décret des boueurs (Collectors' Decree) all reported the existence of certain practices that are particularly prevalent in non-unionized enterprises. These informants pointed out that the CSST's high assessment rates, and the fact that the rates are "personalized," discourage complete accident reporting. Enterprises may adopt several strategies to reduce their costs, ranging from temporary reassignment (in which a collector injured as a result of an undeclared accident is reassigned to driving duties), to straightforward layoffs following accidents, and transfer of responsibilities and costs to jobbers, salary insurance policies, or the RAAQ (Automobile Insurance Board). Consultants hired by some private enterprises sometimes encourage their clients to systematically contest occupational accident claims that are hard to verify; for example, those related to back disorders. In municipal enterprises, in contrast, the situation favours the

complete reporting of all accidents, and even of mishaps—workers do not fear being penalized for declaring injuries or relapses, and injured workers receive additional compensation, equivalent to the difference between their salary and compensation received from the CSST, from their municipalities. In one of the municipalities included in this study, the fact that collectors were classified as occasional workers favoured recourse to the CSST rather than to salary-insurance policies by workers who had not completed their probation period.

The results of our analysis of the effect of occupation on accident frequency confirms our field observations and detailed analysis of workload. Collectors working on rear-loading trucks were at the highest risk and had an accident rate of 109 accidents per 100 workers having worked at least 2 000 hours annually. This is entirely foreseeable, of course, given the nature of the work: collectors have the highest workload and are the only ones of the three trades in prolonged contact with hazardous objects. The nature of the equipment is also a factor here, since rear-loading, but not side-loading, trucks allow the loading of objects exceeding weight and volume standards. Terrain also plays a role, since differences in the technical characteristics and hopper capacity of rear- and side-loading trucks lead to their being used in different types of sectors. Rear-loading trucks were the only trucks used to collect waste from sectors with the highest average waste density (kg/km) and hourly collection rate (tonnes/hour); these are also the sectors with the highest workload and incidence of hazardous situations. Finally, the two enterprises undergoing large-scale expansion—and incidentally, the two with the worst safety record—use rear-loading trucks exclusively and employ young and inexperienced collectors, both factors that contribute to the higher accident rate associated with rear-loading trucks. As these two enterprises are also the two largest in the study sample, the high accident frequency for their collectors biases the entire sample. However, even excluding this statistical artifact, it is clear that collectors are at the highest risk of accidents. This is not to say that drivers of rear-loading trucks and collector-drivers of side-loading trucks run no risks: their accident frequencies are 37 and 71 accidents per 100 drivers or driver-collectors working 2 000 hours annually.

Having determined the number of accidents, let us now turn our attention to their nature and the circumstances under which they occur. The most common accidents appear to be:

- back or shoulder pain resulting from tossing or twisting movements during collection of bags (19% of accidents studied)
- back injuries resulting from excessive efforts while lifting objects (18%)
- ankle sprains resulting from falls or slips while dismounting from the truck or moving in its vicinity (18%)
- crushed hands, fingers, arms or knees resulting from being struck by containers or heavy objects, being caught between the vehicle and containers, or collisions with part of the vehicle or parked cars (18%)
- hand and thigh lacerations of variable depth caused by glass, nails, or syringes, occurring during hopper loading
- scrapes and bruises resulting from contact or collisions (5%)
- eye or respiratory-tract irritation caused by dust or splashes of liquids occurring during work near the hopper during compaction (5%)
- minor accidents of unknown cause (5%)

Collectors typically suffer hand and thigh lacerations, drivers typically suffer sprained ankles resulting from falls during cabin dismounts, and driver-collectors of side-loading trucks typically suffer shoulder and upper back pain resulting from tossing movements. The nature of the accidents also depends on the type of truck, although this can also be seen as a reflection of the specific trades associated with rear- and side-loading trucks. These differences are related to equipment design, the type of movements required, and the nature and density of waste collected in the sectors in which these two types of truck are used. Municipal and private enterprises do not report the same type of accidents, with shoulder and back pain resulting from tossing objects, back injuries resulting from excessive exertion, and falls during dismounting—the types of accident responsible for the longest work absences—characteristic of municipal enterprises. Private enterprises, on the other hand, report primarily hand, finger and knee crushes resulting from collision with or jamming by containers or vehicles, and hand and thigh lacerations caused by

sharp objects contained in bags. Private-sector enterprises also had the highest proportion of accidents whose circumstances are poorly or not documented on accident reports, with this being particularly true of jobbers and their helpers.

Finally, accidents resulting from excessive exertion while lifting heavy objects, crush injuries resulting from collisions or jamming, deep hand and thigh lacerations, and scrapes and bruises resulting from contact or collisions were typical of enterprises having undergone recent expansion. Enterprises with a stable or decreasing level of activity were characterized by accidents resulting in shoulder and back pain as a result of loading activities, and a high proportion of accidents whose circumstances are unknown.

4. CONCLUSION AND OUTLOOK

4.1 CONCLUSION

In conclusion, the safety of waste and recyclable material collection operations depends largely on workers' individual capacities (vigilance, aptitudes, motivation, stamina), experience and acquired skills—the last two of which are not recognized and valued in all enterprises. This state of affairs is a result of the current state of the collection system, i.e. the presence of high workloads, vehicle design flaws, and defective work organization and route planning, and is exacerbated by factors such as residents' failure to obey bylaws and municipalities' tolerance of these infractions. In practice, the safety and reliability of collection operations depends largely on the workers, who are sometimes unable to control the elements necessary to master their situation. After observing collectors at work, we are surprised that more accidents do not in fact occur.

Improvement of the technical and organisational elements of collection were relieve workers of a significant portion of the responsibility they currently bear for safety. If collection were organised so that waste and objects to be collected were more uniform, and equipment was introduced to reduce the handling of heavy, dangerous or bulky objects, collection work would be cleaner and less arduous.

Finally, the results of this study underscore the impact of work experience on safety. There is therefore a clear necessity, in both municipal and private enterprises, to recruit, train and retain stable, motivated and experienced workforces. There is an urgent need to train workers and value their role of interface between cities, enterprises and residents, a role they currently perform informally. Collectors should no longer be considered to perform a menial job or constitute a sort of "garbage police," but should be seen in their true light, that of tradesmen who render an essential, recognized and valued public service.

4.2 OUTLOOK

While it is all well and good to recommend that waste containers (garbage cans, conventional green bags, mobile domestic bins) be standardized over the short and medium term, it is difficult to be optimistic about the likelihood of this becoming reality: there will always be waste other than garbage cans, conventional green bags and domestic containers and bins, destined to sabotage attempts at reducing dangerous situations by standardizing containers.

The primary source of hazards in waste collection is the workload, but without disputing the effect of workload and collection modes (types of equipment, work and production organization, route planning) on safety, it is nevertheless true that a large fraction of the **hazards arise from the waste itself**. A prospective outlook focusing on operational safety and environmental protection calls for the reorganisation of collection on the basis of the type of waste, rather on the basis of the type of client (residential, commercial or industrial), as has always been practised. Recycling and truly integrated waste collection are solutions that are consistent with this principle. This reorganization requires sensitisation of citizens of municipalities, and the political will to enforce bylaws. It also demands that residents finally understand the true costs of waste collection. In any event, management on the basis of type of waste is inevitable: landfill sites are increasingly under scrutiny and are refusing certain types of waste, which must subsequently be sent to specialized treatment centres.

In the interim, the relationship between collectors and residents remains strained. Ideally, collectors should be taken at their true worth, namely a helpful group of workers. This is not the case however, and relationships

may become poisoned, in part because collectors are obliged to act as “garbage police” in the absence of integrated waste-management systems. In collectors’ opinions, their tolerance of prohibited waste and containers leads to abuses by residents. In common with some management representatives, workers described how work organization in the industry is affected by our mentality—as municipal clients—of getting rid of, rather than managing, waste. It is therefore easy to understand why problems persist despite the existence of bylaws concerning waste and containers. After observing relations between workers and citizens, citizens and complaints departments, and municipalities and enterprises, we question the relevance of approaches based solely on regulation and coercion. Individuals interviewed in the field suggested that municipalities assume the responsibility of sensitizing citizens to the risk of accidents associated with different types of waste and containers, especially since toxic substances responsible for these hazards may also represent environmental hazards. However, sensitization alone is inadequate: municipalities must also offer residents appropriate collection systems.

Workers and management in this sector invite all of us to reflect on the necessity of remembering worker safety when developing integrated waste-management systems.

5. RECOMMENDATIONS

The IRSST is a research agency, and the recommendations contained in its reports are therefore proposed solutions rather than regulatory statements. The goal of this study was to help the various parties involved in domestic waste collection identify and apply measures that would improve safety during collection, transportation and unloading operations.

The following recommendations reflect the consensus of the Comité avisier paritaire de la recherche (Joint Research Advisory Committee), composed of representatives of the following groups:

- Association des entrepreneurs de services en environnement du Québec (Québec Association of Environmental Services Contractors)
- Schaefer Group Ltd.
- Canadian Union of Public Employees
- Montreal Blue-collar Workers Union
- Steelworkers Union
- Teamsters Union, local 106
- the City of Montréal

The recommendations are presented under 10 thematic headings:

1. Management of health and safety
2. Training and hiring
3. Work organization, organization of collection, and workload
4. Vehicles
5. Special status of some workers
6. Collection contracts
7. Public management
8. Collaboration
9. Stability of the workforce
10. Research

1. Management of health and safety

1.1 Determine the most effective means of disseminating the results of the present research project to the joint health and safety associations for the Transportation and Warehousing and Municipal Affairs sectors, to the Union des municipalités (Municipalities’ Union), designers and vendors of collection equipment, and occupational health and safety consulting firms serving collection enterprises.

1.2 Sensitize management and workers to the results of the present research (information campaigns, posters, preparation of a video, training sessions for superintendents and foremen).

1.3 Develop accident-prevention programmes, based on workers’ knowledge of occupational hazards, which are better adapted to actual tasks.

1.4 In each enterprise, promote the creation of a place and time at which workers and management can discuss occupational health and safety problems such as accidents, personal protective equipment, and bylaws.

1.5 Encourage enterprises to collect information on all accidents that occur, even if the enterprises are not responsible for the actual reporting.

- Joint health and safety associations for the Transportation and Warehousing and Municipal Affairs sectors

1.6 Develop an analytical checklist that enterprises can use to collect information on accidents. At a minimum, the checklist should collect information on: nature of injuries; causal agents; nature of the accident; site; number of lost workdays; type of accident; circumstances of the accident; stressors; environmental, climatic and technical conditions; trade of the victim; and type of vehicle involved.

1.7 Enterprises should regularly analyse their accident statistics and base their prevention programmes on the results of this analysis.

2. Training and hiring

2.1 Ensure that new workers receive the necessary information about collection before beginning to work (short briefings on the most important subjects, e.g. the importance of good communication and hazards associated with use of the public thoroughfares).

2.2 Favour training of replacement workers (collectors and drivers).

2.3 Incorporate workers' knowledge and acquired skills into new training programmes describing safe work practices for each trade (drivers, collector-drivers and collectors).

2.4 Exploit veterans' expertise by favouring systematic learning through mentoring.

3. Work organization, organization of collection, and workload

3.1 Identify the conditions (e.g. double collection, days after holidays, peak periods of leaf and grass collection and moving periods) likely to result in collection routes exceeding a normal day's work and develop different ways to reduce this overload. These measures may include breaks, helpers for collectors, recovery times, agreements with municipalities concerning collection schedules and additional vehicles.

3.2 Take into account the increased risk associated with average collection rates above 3.0 tonnes/hour in rear-loading trucks and 1.9 tonnes/hour in side-loading trucks when establishing collection-territory boundaries. Ensure that workers are given this information.

3.3 Ensure, where appropriate, that the application of overtime clauses of the Décret des Boeurs (Collectors' Decree) and collective agreements favours the adoption of safer work rhythms by workers.

3.4 Implement various measures aimed at promoting team cohesion, since this is an important determinant of work rhythm and safety. For example, take workers' preferences into account when forming teams, hiring and calling up spare workers.

3.5 Implement various measures to promote and reinforce workforce stability, particularly as this affects collectors. For example, reserve auxiliary and temporary positions for collectors who are actually auxiliary, replacements or temporary, and grant regular status to collectors who have been employed full-time for a period agreed upon by the various parties.

3.6 Examine the possibility of harmonizing snow-removal and waste-collection schedules, so that collectors and driver-collectors do not have to spend their day climbing over snowbanks located between their trucks and objects and containers to be collected.

4. Vehicles

4.1 Establish contact with vehicle manufacturers (or their representatives) and promote the value of the present research's results as the basis for the design of more appropriate vehicles.

4.2 Organize trials of prototype vehicle layouts in real-life collection situations, taking into account the problems identified in the detailed vehicle evaluation, available upon request (chapter 5 and appendix 12 of the detailed research report).

4.3 Promote the use of mobile domestic bins in sectors where this is possible.

4.4 Increase signalling equipment on vehicles.

4.5 Provide spot lighting to illuminate areas adjacent to the truck while backing up during collection and at unloading sites.

4.6 Examine the feasibility of ensuring that hopper placement conforms to the reference criteria presented in the vehicle report, especially with regard to the height of the edge of the hopper.

4.7 Develop an easy-to-use mobile domestic bin transfer device that presents no mechanical hazards.

4.8 Promote the automatic loading of commercial containers with equipment similar to front-enders.

4.9 Equip rear-loading trucks with easy-to-use commercial-container transfer equipment that presents no mechanical hazards, where use of front-enders is not possible.

4.10 Install adapted seats for both collectors and drivers, in an attempt to reduce the risk of back injuries and safety hazards during trips.

5. Special status of some workers

5.1 In municipalities, define employment status so that workers who attain regular, full-time permanent status can remain collectors. This will promote the formation of a stable, motivated and experienced workforce. Ensure that workers applying to be collectors are aware of this.

5.2 Pay particular attention to the training and safety of auxiliary, occasional and temporary workers, as well as of workers on probation. We have observed that workers faced with an unfavourable context that does not view waste collection as a true trade run higher risks than experienced workers.

6. Collection contracts

6.1 Stakeholders in the sector (municipalities, enterprises, governments, worker representatives and citizens) should collaborate on the development of a simple and precise standard contract (schedule of conditions) stipulating parameters such as allowable weights and types of containers. It is particularly important that the authors of this standard contract foresee modalities to ensure the contract's enforcement.

6.2 Municipalities should no longer award collection contracts on the basis of the lowest bid. It would be useful to require enterprises to furnish minimal guarantees concerning the prevention of occupational hazards.

7. Public management

7.1 Employ publicity and information campaigns to promote citizens' respect and recognition of the essential public service performed by collection enterprises. Sensitize citizens to the increased risk of accidents resulting from prohibited behaviour (prohibited, dangerous and hidden waste). Explain that these hazards are associated with increased costs and that, in the final analysis, these hidden costs must be paid for by residents, in the form of that portion of collection enterprises' municipal bill accounted for by CSST dues.

7.2 Systematically identify, on tax bills, the portion of municipal taxes accounted for by waste management.

7.3 Calculate the portion of taxes accounted for waste management on the basis of the real cost of collection, transportation and treatment operations.

7.4 Maintain sidewalks and roads in good condition.

7.5 Urban planning: provide space for the deposition of waste at problematic points such as dead-ends, yards and crescents.

7.6 Eliminate piles of garbage: make use of containers mandatory and enforce bylaws regarding the days and hours at which waste may be put out.

7.7 Accelerate the implementation of collection programmes for toxic and dangerous products (such as paint, thinner, gas, battery acid, propane cylinders, chlorine, ink, cleaners and used oil).

7.8 Reaffirm workers' right and obligation to refuse to collect prohibited waste. Advise the public of alternate solutions.

7.9 In the medium term, organize collection on the basis of the type of waste. Progressively abandon collection based on the type of client (municipal-residential, commercial, industrial).

7.10 Systematize the collection of oversize waste and prohibit its regular collection. Advise the public. Organize two or three annual collection campaigns.

7.11 Oblige generators of large amounts of waste (such as restaurants, apartment complexes with pre-compacted waste, businesses and small industry) to use a commercial, automatic-loading container service.

7.12 Organize the collection of lawn clippings and leaves, or at least regulate the size of bags containing this waste. Prohibit mixing rocks and earth with this waste.

7.13 Standardize the weight (25 kg) and shape of acceptable containers. Refuse to collect waste from prohibited containers. Undertake concerted campaigns to sensitize citizens to applicable bylaws, and explain the logic of these bylaws from the point of view of safety.

7.14 Enforce bylaws prohibiting the use of small plastic bags. Alternatively, provide residents with community bins in which small bags can be deposited.

7.15 Standardize containers (mobile domestic bins) wherever possible, to reduce hazardous activities and mishaps resulting from tosses, twisting, bending and hazardous waste.

7.16 Eliminate bulk containers, e.g. wooden boxes.

7.17 Replace existing small commercial containers with front-end containers, or improve currently available models (volume, weight, wheels, ease of movement, area required for movement, coupling and unloading system).

8. Collaboration

8.1 Organize local and intermunicipal working meetings of representative employer associations (municipal and private), workers and municipal or regional decision-making bodies. These working sessions should address schedules of conditions, enforcement of bylaws, citizen education and management of complaints.

- efficiency (e.g. conformity to the schedule of conditions, conformity to schedules and clientele satisfaction)
- worker satisfaction
- management satisfaction

10.6 The impact of fully automated collection on occupational health and safety.

10.7 Workers' opinion of the most appropriate personal protective equipment (such as boots, clothes, reflective bands and gloves) for collection work.

9. Stability of the workforce

9.1 Create a working group composed of, among others, representatives of municipal and private enterprises and workers to study factors and measures likely to improve the stability of the workforce, especially as this concerns collectors. At the end of its term, the working group should issue a list of recommendations.

10. Research

The various stakeholders could agree to request the IRSST to pursue further research in areas that have not been completely documented by the present research. These include:

10.1 The impact of team cohesion on safety.

10.2 The impact of the implementation of subcontracting to jobbers on operational safety.

10.3 Comparison of the impact of flat-rate pay scales ("finish-go-home" system) versus hourly pay scales ("time worked is time paid"). A study of this kind would compare the advantages and disadvantages of these two ways of organizing schedules and salaries in the areas of:

- safety of collection, transportation and unloading operations
- profitability for the enterprise and the worker
- efficiency (conformity to the schedule of conditions, conformity to schedules, clientele satisfaction)
- worker satisfaction
- management satisfaction

10.4 Ergonomic design and/or correction of side-loading trucks, to reduce the frequency of twisting movements and tosses currently required.

10.5 The impact of the standardization of containers in a test sector on:

- workload
- operational safety
- operational costs and benefits