Scientific and Technical Production

Five-Year PLAN 2013 2017

FOREWORD

It is with pride but above all great confidence in the future that I release the 2013-2017 Five-Year Scientific and Technical Production Plan of the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST). Numerous consultations with our partners in the work and research communities were required to ensure that it addressed real needs and emerging issues.

Coordinated by the Institute's Scientific Division with support from the Research and Expertise Division, this plan draws inspiration from many sources. It is built on solid foundations: specifically, the concerns and priorities identified by our main partners in Québec's prevention network. Employer and union representatives, together with the members of the scientific and technical community who sit on our Scientific Advisory Board, all did their part to make sure that its content accurately reflects the needs and research priorities of Québec workplaces.

This Five-Year Plan also takes into account the findings of the independent international committee that evaluated the IRSST and its output in 2011. In addition, it meshes perfectly with the philosophy set forth in Québec's *Government Sustainable Development Strategy*. As a clear signal of the Institute's voluntary commitment in this regard, its next sustainable development action plan will also cover the years 2013–2017.

Such plans can be adjusted endlessly to contain a little more of this or a little less of that. But all the individuals who contributed to these plans—and I offer them my sincerest thanks—know that the plans are on track and that their implementation will promote advances in the knowledge essential to preventing work-related accidents and occupational diseases and rehabilitating injured workers. This plan constitutes the road map we will follow over the next five years to accomplish our mission.

Marie Larue
President and CEO

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ACRONYMS AND INITIALISMS USED

Acfas	Association francophone pour le savoir
ADRIQ	Association pour le développement de la recherche et de l'innovation du Québec
AIHA	American Industrial Hygiene Association
ANR	Agence nationale de la recherche (France)
ANSES	Agence française de sécurité sanitaire de l'environnement et du travail
ASTM	American Society for Testing and Materials
BAuA	Federal Institute for Occupational Safety and Health (Germany)
BGIA (now IFA)	Institute for Occupational Safety and Health of the German Social Accident Insurance umbrella association
CANMET	Canada Centre for Mineral and Energy Technology
CBHP	Chemical and Biological Hazard Prevention
CIHR	Canadian Institutes of Health Research
CIS	International Occupational Safety and Health Information Centre
CLAS	Calibration Laboratory Assessment Service
$(CM)^2$	Center for Characterization and Microscopy of Materials
CPMT	Commission des partenaires pour le marché du travail (Québec)
CSA	Canadian Standards Association
CSST	Commission de la santé et de la sécurité du travail du Québec
CTT	Centre de technologie textile (Saint-Hyacinthe, Québec)
DDCR	Dépôt de données central et régional (CSST, Québec)
EMPs	Elongated mineral particles
DGUV	German Social Accident Insurance
EQCOTESST	Québec Survey on Working and Employment Conditions and Occupational Health and Safety
ETS	École de technologie supérieure (Université du Québec)
FIOH	Finnish Institute of Occupational Health
FRQNT	Fonds de recherche du Québec – Nature and Technology
FRQS	Fonds de recherche du Québec – Health
FRQSC	Fonds de recherche du Québec – Society and Culture
FTE	Full-time equivalent
GC	Gas chromatography
GC/MS	Gas chromatography/mass spectrometry
HPLC/MS	High-Performance Liquid Chromatography/Mass Spectrometry
HSE	Health and Safety Executive (United Kingdom)
HSL	Health and Safety Laboratory (United Kingdom)
HVAC	Heating, ventilation and air conditioning
ICAR	Shared infrastructure for acoustics research
ICP-MS	Inductively coupled plasma mass spectroscopy
IFA (formerly BGIA)	Institute for Occupational Safety and Health of the German Social Accident Insurance umbrella association
ILO	International Labour Office

INRS	Institut national de recherche et de sécurité pour la prévention des accidents du travail et des maladies professionnelles (France)
INSPQ	Institut national de santé publique du Québec
IOM	Institute of Occupational Medicine (United Kingdom)
IRI	Income replacement indemnity
IRSST	Institut de recherche Robert-Sauvé en santé et en sécurité du travail
ISO	International Organization for Standardization
ISQ	Institut de la statistique du Québec
ISSA	International Social Security Association
IWH	Institute for Work & Health (Ontario, Canada)
KT	Knowledge transfer
LIMS	Laboratory Information Management System
MPRP	Mechanical and Physical Risk Prevention
MSDs	Musculoskeletal disorders
MSSS	Ministère de la santé et des services sociaux (Québec)
NE^3LS	Knowledge Network on the Ethical, Environmental, Economic, Legal and Social issues regarding Nanotechnology development
NIOSH	National Institute for Occupational Safety and Health (United States)
NP	Nanoparticles
NRCC	National Research Council Canada
OHS	Occupational health and safety
OSHA	Occupational Safety and Health Administration (United States)
PCR	Polymerase chain reaction
PDF	Portable Document Format
REM	Réseau d'échange sur la manutention
REPAR	Réseau provincial de recherche en adaptation-réadaptation (Québec)
RPDs	Respiratory protective devices
RRSSTQ	Réseau de recherche en santé et en sécurité du travail du Québec
RTW	Return to work
SIAS	Safety of industrial automated systems
TLI	Accepted time-loss injury
UPA	Union des producteurs agricoles
UQAM	Université du Québec à Montréal
WHO	World Health Organization
WSBC	Worksafe British Columbia
WSIB	Workplace Safety and Insurance Board (Ontario, Canada)

1. INTRODUCTION

In the current context of a dramatically changing work world coupled with growing concern for sustainable development and at the very time when Québec is embarking on a major development project with its *Plan Nord,* this five-year research plan charts the course the Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) will follow over the next five years. With a 30-year track record in research and based on the recommendations made in 2011 by an independent international committee mandated to evaluate the Institute, the IRSST seeks, through this plan, to ensure its optimal development in order to meet the needs expressed by its clientele while remaining attentive to emerging issues.

The 2013–2017 five-year plan is the result of an extensive consultation process involving representatives of the CSST, joint sector-based associations, employer and worker associations, and researchers themselves, who keep abreast of evolving occupational health and safety (OHS) knowledge and trends. Statistically, a downward trend has been observed in the number of compensated work-related injuries in the past few years while the labour force continues to grow. The average duration of compensation has also continued to lengthen, suggesting greater severity in the injuries sustained. Regarding fatalities, the number of deaths resulting from traumatic accidents has tended to decline in recent years. Conversely, an upward trend has been witnessed in the number of cases involving occupational diseases, which now cause more deaths than do industrial accidents. In terms of rehabilitation, less than 10% of all injuries still account for nearly 60% of the costs.

In addition to taking into account the statistical profile of compensated occupational injuries and deaths, the five-year plan looks at the work undertaken by the IRSST at the time of its previous plans and continuing today. To fully carry out its mission, the Institute must also work with an eye to the future by anticipating today the future risks that may come with new technologies, organizational and environmental changes, and new substances, among other things. The 2013–2017 five-year plan was drafted with all these factors in mind.

The 2011 institutional evaluation brought to light a number of challenges the IRSST will have to face in the years ahead. While recognizing the IRSST's "unique" contribution to the health and well-being of Québec workers, the independent international committee concluded that the Institute would have to do everything possible to groom the next generation of researchers, both internal and external, to ensure a critical mass in preparation for the retirements expected in the short and medium terms. It also indicated the need to step up efforts to render research results available to workplaces and the scientific community as quickly as possible. Concerned about the need for clearer lines of authority, the committee further recommended that the organizational structure and the composition of the research fields be revised to ensure a critical mass of researchers in each field.

Based on the findings that emerged from the institutional evaluation, the IRSST has identified the main challenges it will face during the 2013–2017 cycle. They are:

- ensuring the viability of its research fields at a time of limited resources compounded by the retirement of OHS researchers and specialists;
- delivering the results of research activities to its various clienteles diligently and efficiently;
- increasing the uptake and application of research results by workplaces and the scientific community;
- remaining attractive and competitive as a key OHS research organization and maintaining local, national, and international recognition of its scientific leadership;
- ensuring an ongoing offer of diversified laboratory services adapted to the new realities of the work world.

These challenges are related to the main orientations that will guide and shape the IRSST's actions until 2017. Through this five-year plan, the IRSST thus seeks to:

- adopt a structure and a research program that will enable it to fully accomplish its mission;
- ensure the availability of a critical mass of internal and external researchers to address the priority needs identified for its research fields;
- subscribe to approaches and processes that will enhance the Institute's efficiency in terms of project planning and management;
- increase its visibility in the public space and step up its efforts to disseminate results;
- develop avant-garde strategies for transferring research results and promoting their uptake by the stakeholders involved;
- diversify its research partnerships to increase its competitive edge;
- adapt its laboratories' service offer to the needs expressed, while maintaining the highest quality standards.

The following sections describe the details related to each of these main orientations, which form the foundation for the 2013–2017 five-year plan.

2. DESCRIPTION OF THE RESEARCH FIELDS, PROGRAMS, AND PLANNING TOOLS

A new organizational model was put in place in early 2012 in accordance with one of the recommendations emerging from the 2011 institutional evaluation. Accordingly, this five-year plan proposes reducing the number of research fields from seven to four. Three of the newly defined fields focus on OHS problem prevention, while the fourth concentrates on occupational rehabilitation. In this new configuration, two of the previous fields ("Chemical Substances and Biological Agents" and "Occupational Rehabilitation") remain virtually unchanged. Two of the new fields were created by merging prior fields that covered converging disciplinary areas. The goals and research orientations were revised to fit each of the new fields, specify the priority areas for development, and delineate their scope of action. The four proposed research fields are:

- Chemical and Biological Hazard Prevention: formerly known as "Chemical Substances and Biological Agents," to which a respiratory protection component was added;
- Mechanical and Physical Risk Prevention: obtained by merging the "Noise and Vibration," "Protective Equipment," and "Safety of Industrial Tools, Machines, and Processes" fields;
- Sustainable Prevention and Work Environment: obtained by merging the "Work Context and OHS" and "Musculoskeletal Disorders" fields;
- Occupational Rehabilitation: remains essentially the same.

Research will be developed within these four priority fields over the 2013–2017 five-year cycle. The following sections describe each of the fields in terms of their goals, research orientations, thematic programs and research themes, and those to be developed. The priority issues for each field are put into perspective based on statistical data for compensated work-related injuries and deaths, research mapping, and scientific monitoring and surveillance. A descriptive, summary fact sheet is presented in Appendix 1 for each research field. This section ends with a presentation of the scientific monitoring, statistical surveillance, and outreach activities and events anticipated by the IRSST to ensure optimal research planning within its various fields.

2.1 Chemical and Biological Hazard Prevention (CBHP)

Context

Every year, many Québec workers develop occupational diseases related to overexposure to chemical substances (e.g. beryllium, silica, styrene, wood dust, and asbestos) or biological agents (e.g. bacteria, fungi, and moulds) in many different work environments. This situation could often be prevented through improved knowledge of the agents involved and the related health risks, and through greater awareness of these hazards.

The development and implementation of effective primary prevention measures remains the best option. In many cases, approaches adapted to the treatment and rehabilitation of workers who have developed such health problems also prove necessary.

Goals

The goals of the Chemical and Biological Hazard Prevention (CBHP) research field are to help prevent occupational diseases and their adverse effects on health and to improve and sustain the health and well-being of workers exposed to chemical and biological agents, through the development of new knowledge or use of existing knowledge.

The often multi- and interdisciplinary research conducted in this field focuses mainly on primary prevention and the development of adapted tools for use in enterprises. The IRSST responds to the needs identified by the CSST, its partners, and Québec workplaces. The transfer and dissemination of information are strongly advocated.

Research orientations

The studies and activities conducted in the CBHP field revolve around three major orientations:

- the development of strategies and methods for evaluating exposure and estimating health risks, using toxicological and epidemiological approaches among others;
- the development and validation of technologies and tools designed to reduce and control exposure;
- the development of methods for sampling and analyzing chemical substances and biological agents.

2.1.1 Putting the field's priority issues into perspective based on statistical data

During the 2005–2007 period, chemical products and compounds[1] caused slightly more than 1,500 CSST-accepted injuries a year on average, including approximately 350 injuries attributable to occupational diseases. During the same period, biological agents caused an average of 1,360 CSST-accepted injuries a year, including 80 cases of occupational diseases. In addition, the proportion of all CSST-accepted injuries related to biological agents, while still small, more than quadrupled between 2000 and 2008.

During the same period, 10% of the accepted occupational diseases, excluding musculoskeletal disorders (MSDs), were caused by chemical products and compounds (8%) or biological agents (2%). Of these, 36% resulted in time-loss injuries

[1] The definition used includes radiant metals, non-metallic minerals, dusts, and particles, in addition to chemical products and compounds.

compensated for an average of 395 days, that is, three months longer than for all diseases other than MSDs.

Six CSST-accepted occupational diseases caused by chemical products and compounds were associated with more than 25 cases annually and represented 86% of all cases. These diseases were, in decreasing order of numbers of cases: asbestosis, mesothelioma, contact dermatitis, other eczemas, malignant tumours (cancer), silicosis, and asthma.

Moreover, between 2005 and 2011, an average of 117 deaths occurred annually due to occupational diseases caused by exposure to harmful substances or environments. Of these, 81% were related to asbestos, 11% to silica, and 8% to other substances (e.g. aromatic hydrocarbons, metallic particles, dusts, powders, or fumes). It is important to underscore the upward trend in deaths attributable to occupational diseases (136 in 2011) observed over the past five years relative to the preceding five years, while the reverse trend is observed in deaths attributable to accidents.

2.1.2 Putting the field's priority issues into perspective based on research mapping and scientific monitoring and surveillance

The 2009–2011 Three-Year Plan defined ten active research programs and themes for the Chemical and Biological Hazard Prevention (CBHP) field, formerly the Chemical Substances and Biological Agents field: (i) Substitution of solvents; (ii) Study of environmental and physiological factors that may contribute to biological variability; (iii) Monitoring and control of beryllium exposure; (iv) Bioaerosols; (v) Environment and agriculture workers; (vi) Ventilation; (vii) Toxicological interactions; (viii) Nanotechnologies (nanoparticles and nanotoxicology); (ix) Asbestos; and (x) Occupational asthma. Two new programs were also supposed to be developed, specifically, one on silica and the other on industrial hygiene sampling methods and strategies.

An overview of international research conducted from 2008 to 2010 was prepared to put the priority issues addressed by the 2009–2011 Three-Year Plan into perspective and position the IRSST relative to other, similar organizations. Seven organizations were retained for this purpose based on their influence on OHS research and their international reputation: the National Institute for Occupational Safety and Health (NIOSH) in the United States, the Health and Safety Executive (HSE) in the United Kingdom, the Institut national de recherche et de sécurité pour la prevention des accidents du travail et des maladies professionnelles (INRS) in France, the Institute for Occupational Safety and Health (IFA) in Germany, WorkSafeBC (WSBC) in British Columbia, Canada, the Workplace Safety and Insurance Board (WSIB) in Ontario, Canada, and the IRSST in Québec.

Seven hundred eighty-seven (787) studies on chemical and biological contaminants were documented. This exercise, which disregarded the number of researchers working in the establishments, revealed that most of the studies were conducted by NIOSH (361

projects, or 46% of the total number) while the IRSST was responsible for approximately 10%. The proportions for the other organizations were as follows: 16% for the HSE, 13% for IFA, 11% for the INRS, 3% for the WSBC, and 1% for the WSIB.

Of the different research themes, those concerning nanotechnologies, silica, asbestos, and beryllium ranked among those most studied by the various organizations. Regarding health problems, occupational cancers and occupational asthma were found to garner the most attention. The relevance of the IRSST's choices of research themes were thus confirmed by those of the other organizations studied, particularly when it came to themes relating to asbestos, nanotechnologies, ventilation, bioaerosols, and exposure to chemical and biological contaminants in the agricultural sector.

2.1.3 Current and future programs and themes

The institutional restructuring, combined with in-depth reflection and consultation on the orientations of the new CBHP research field, led to the establishment of 11 programs or themes in the 2013–2017 Five-Year Plan: Exposure science[2]; Ventilation and air quality; Asbestos and other elongated mineral particles; Microorganisms in the workplace; Nanoparticles; Silica; Asthma and obstructive respiratory diseases in the workplace; Chemical and biological contaminants in agricultural environments; Occupational cancers; Chemical and biological hazards related to green jobs; and Respiratory protection.

The following paragraphs describe these programs or themes under three main categories: (a) current thematic programs; (b) current themes; (c) thematic programs to be developed.

2.1.3.1 Current thematic programs

2.1.3.1.1 Exposure science

Aims

The aims of this thematic program are to consolidate and advance knowledge pertaining to the characterization of occupational exposure, using approaches such as modelling and exposure estimation for predictive and risk analysis purposes. The studies conducted concern sampling strategies (primarily regarding inhalation and dermal exposure) and data interpretation (dusts in the ambient air, in the oronasal region, and on the dermis; deposited dusts; exposure biomarkers in the blood and urine); metrology; and the effective use of existing data for epidemiological, monitoring, and surveillance purposes.

[2] Exposure science studies the link between the presence of toxic substances in the environment and the occurrence of damage or harm.

Progress report

While this thematic program was officially announced in the 2009–2011 Three-Year Plan under the name “Industrial hygiene sampling methods and strategies” and proposed in 2011, the IRSST has been actively involved in this field for many years. The Institute’s achievements in this regard include the *Guide de surveillance biologique* (biological monitoring guide) and the Sampling Guide for Air Contaminants. Two research activities related to this new thematic program are ongoing. The first involves a producing a knowledge review of both thermal stress impact on the toxicokinetics of chemical substances and biological monitoring data. The second activity involves developing the best method for standardizing measures of urinary concentrations in grab samples in order to increase the reliability of biological monitoring tests conducted to measure occupational exposure.

Developments anticipated during the cycle

The strategy used to estimate chemical risk traditionally involved evaluating worker exposure by means of *in situ* measurements and comparing them to reference values or permissible exposure limits (PELs). Such an approach is demanding in terms of human, physical, and financial resources as it requires a large number of measurements and sound statistical analysis. While it remains the approach envisaged for evaluating risks and orienting preventive actions, research efforts in the exposure science program during the 2013–2017 five-year cycle will seek more specifically to target the risk situations where more in-depth investigations may be required. It is therefore expected that several studies will be put forward, including the following: evaluation of exposure to crystalline silica in construction by modelling data from an occupational exposure database; validation of a meta-analytical method for documenting occupational exposure from data in the scientific literature; utilization of the measurement data on occupational exposure to chemical substances collected by teams in Québec’s public occupational health network; development of a job-exposure matrix using coded data collected during various Montreal studies on occupational cancer; and validation of estimates of Québec workers’ exposure to known carcinogenic substances. As mentioned earlier, several of these studies are directly linked to other research programs or themes associated with this field, including those on silica and occupational cancers.

2.1.3.1.2 Ventilation and air quality

Aims

The aims of this thematic program are to develop and validate methods for evaluating the efficiency of ventilation and local exhaust systems, and to study filtration and the aeraulic parameters of pollutant emission, dispersion, and capture. This program is closely linked to those on exposure science, nanoparticles, and microorganisms in the workplace. Links may also exist with themes studied in other research fields.

Progress report

Several projects have already been carried out under this program or are under way. The project on preventing poisoning in forage silos has been completed. A model was developed for calculating the ventilation time required to evacuate toxic and asphyxial gases from a silo when it is first opened after forage ensiling. This model will be used by the CSST and the Union des producteurs agricoles (UPA) and incorporated into a best practices guide for agricultural silos. A complementary activity is currently under way to adapt this theoretical model to the presence of toxic gases in silo chutes. The methods for collecting surface dusts in heating, ventilation, and air conditioning (HVAC) ducts and the cleaning initiation criteria studied during an IRSST laboratory activity were validated in the field. In addition, digital simulation methods for predicting effluent dispersion in the vicinity of buildings in urban environments are currently being explored. Several potential new projects are also being evaluated: one aimed at the characterization and control of exposure to silica dust emitted during dry and wet polishing operations in the granite and other quartz-containing-materials processing sector, and a second aimed at developing a risk analysis and classification tool for confined-space interventions.

Developments anticipated during the cycle

During the 2013–2017 five-year cycle, work will continue on identifying appropriate ventilation techniques for preventing chemical and biological hazards in confined spaces, as well as exposure to nanoparticles and fine and ultrafine particles. Theoretical and experimental modelling activities will be carried out to evaluate worker exposure to chemical and biological contaminants in light of ventilation parameters. A study aimed at characterizing the dispersion and control of dusts emitted during granite processing operations will be proposed. Exploratory work on digital simulation methods for evaluating ventilation efficiency and predicting contaminant dispersion will continue. Other anticipated topics of study are the characterization of ventilation system filters and respiratory protective devices (RPDs) and other filtering materials such as those in personal protective equipment designed to capture ultrafine and fine particles.

2.1.3.1.3 Asbestos and other elongated mineral particles

Aims

The focal points of this thematic program are industrial hygiene and exposure surveillance. More specifically, this involves the evaluation of respiratory protection programs and the effectiveness of containment measures where asbestos is present, the evaluation of exposure among machine maintenance personnel and construction workers during activities with materials containing vermiculite, the study of the effectiveness of exposure reduction measures, and the determination of exposure analysis and evaluation methods. This program also concerns medical surveillance, which falls under the auspices of the Institut national de santé publique du Québec (INSPQ).

Progress report

Most of the planned industrial hygiene objectives were attained during the preceding three-year cycle. The project on the relationship between the asbestos content of materials and its concentration in the air during dismantling work was completed, as was a research activity involving a synthesis of knowledge on the tremolite contained in talc. The IRSST also participated in work carried out by a group of experts on short and fine asbestos fibres, the results of which are available on the ANSES Web site. Another activity concerning the optimization of the transmission electron microscopy method of analyzing lung tissue samples will continue during the next cycle.

Developments anticipated during the cycle

Activities will be launched for the purpose of identifying and evaluating worker exposure to other elongated mineral particles (EMPs) found in certain ores. While the current study involving the optimization of the lung-tissue analysis method will be completed, a new project aimed at determining reference levels is expected to begin for the purpose of obtaining more accurate interpretations of results. Lastly, a project to develop a new approach for improved identification and quantification of asbestos fibres in the air and in bulk materials should be carried out. This project involves international collaborative efforts, notably with the National Institute for Occupational Safety and Health (NIOSH) of the United States.

2.1.3.1.4 Microorganisms in the workplace

Aims

A new thematic program on microorganisms in the workplace was proposed in 2012. It involves the continuation of work begun under the former “Bioaerosols” program, with an expanded scope to include all microbial problems. This program has three main aims: the development of state-of-the-art techniques for improving identification of microorganisms and their by-products, the diversification of sampling strategies, and the evaluation of their effects and early signs of these effects on worker health.

Progress report

A number of research activities are currently under way. These are the development of a method for detecting *Legionella pneumophilia*, the study of the mycological biomass in ventilation system ducts, the evaluation and control of exposure to bioaerosols during bronchoscopy operations, the choice of means of respiratory protection against bioaerosols through control banding, the study of occupational exposure to respiratory viruses in hospitals, and the evaluation of the role of Archaebacteria in lung inflammation in agricultural workers.

Developments anticipated during the cycle

The aforementioned research activities will be completed. Regarding methodology, two new research activities are planned: one involving the development of a method for analyzing subtilisin and its application for the purpose of evaluating exposure levels in a hospital, and the other, the development of a method for detecting mycotoxins using solid matrices. Metrology work will be initiated on the generation of quality-control samples to be used for analyzing spore traps. Research activities concerning the evaluation of worker exposure in green job sectors and wastewater treatment centres will be proposed. From the point of view of worker protection, there are plans for projects concerning the implementation and evaluation of ventilation models in bronchoscopy rooms, as well as the evaluation and control of exposure to bioaerosols in hospitals. Lastly, a project concerning evaluation of the risks of viral transmission in the air in intensive care units is planned. The IRSST further envisages promoting the creation of a research chair on bioaerosols and respiratory health to support the development of this research program and ensure the grooming of a new generation of researchers in this field.

2.1.3.2 Current research themes

2.1.3.2.1 Nanoparticles

Aims

In today's context where a growing number of Québec enterprises are developing new markets thanks to nanotechnologies, it is all the more important to support their development while fostering worker health and safety. The aim of this research theme is to promote the development of a variety of information tools and risk management support tools for use by establishments and workplaces that potentially expose Québec workers to nanoparticles (NPs). Emphasis is also placed on metrology and the characterization of NPs, the analysis of their aerodynamic behaviour, risk evaluation, and the study of means of exposure control.

Progress report

The research work conducted in this area has resulted in the development of a method for evaluating and characterizing nanoparticles in workplaces, the study of the aerodynamic behaviour of airborne nanoparticles, and the development of test benches for evaluating the effectiveness of respiratory protective devices (RPDs) and gloves against nanoparticles. A best practices guide and a guide on health effects and means of prevention were also produced. An ongoing study has identified more than 40 Québec enterprises that recently introduced NPs into their industrial processes. The aims are to complete the inventory of establishments in which workers handle NPs. Also, an agreement signed between these parties and the IRSST concerning the setting up of the NE^3LS network (Nanotechnology: ethical, economic, environmental, legal and social issues) in 2010 led to the funding of two studies in 2011. This collaboration will continue and the projects begun will be completed.

Developments anticipated during the cycle

Future work will involve evaluating nanoparticle exposure levels in various workplaces, improving a best practices guide on the efficient management of potential risks, and evaluating the performance of RPDs and ventilation system filters in connection with the ventilation program. Activities related to skin protection are expected to continue. New projects will be initiated under a new agreement with NanoQuébec: the first will evaluate exposure and potential risks, while the second will target means of controlling exposure with a specific focus on engineered nanoparticles produced for commercial purposes. Lastly, research on ultrafine dusts the size of NPs and specifically targeting exposure evaluation and control measures could be initiated over the next five years, given that analysis of the results obtained to date shows that the main causes of overexposure in Québec are related to dusts, a large proportion of which are nanometric in size.

2.1.3.2.2 Silica

Aims

The aims of this research theme are to identify the workers at the highest risk of exposure, evaluate their exposure, and develop preventive actions to control the health risks.

Progress report

The preceding three-year cycle saw the production of a relational database of crystalline silica exposure measurements in the construction industry. This database is being used in a current activity aimed at drawing up a detailed portrait of exposure profiles for each trade and task according to different parameters. In addition, a project involving the characterization of silica in the granite processing sector has been proposed. The specific objective of these projects is to identify the highest-risk jobs and trades in order to plan preventive actions and explore both the significant determinants of exposure and the effectiveness of means of controlling exposure.

Developments anticipated during the cycle

It is expected that complementary activities will be proposed in the years ahead in light of the results of the current studies, once they are completed. The rapidly expanding construction industry, particularly with the implementation of the *Plan Nord*, will require closer monitoring of exposure using enhanced means and more specialized knowledge. It is therefore deemed important to design a thematic program on silica, which will tackle the problems encountered not only in the construction sector but also in sectors where silica is omnipresent, such as the granite industry.

2.1.3.2.3 Asthma and obstructive respiratory diseases in the workplace

Aims

The aims of this research theme are to identify the causal agents and work situations most often associated with asthma and obstructive respiratory diseases. This theme addresses several needs relating to diagnostic methods, metrology and analyses, and the evaluation, control, and prevention of worker exposure to pollutants in targeted workplaces, as well as worker rehabilitation and reintegration into workplaces adapted to their condition.

Progress report

A research program proposed during the 2009–2011 cycle did not yield the anticipated results, given that several of the planned projects were refused. However, projects concerning the revision of the *Guide for the Safe Use of Isocyanates* and the development of a method for determining the concentration of crustacean proteins in the air and of a monograph on biological soaps (enzymes) used in industry were begun.

Developments anticipated during the cycle

The current projects will continue. The Institute's interest in maintaining a program on occupational asthma and obstructive respiratory diseases will be explored during the 2013–2017 five-year cycle. If such interest is confirmed, an update of the current program will be proposed.

2.1.3.2.4 Chemical and biological contaminants in agricultural environments

Aims

The aims of this research theme are to identify the agricultural workers at the highest risk of exposure to chemical and biological contaminants, evaluate their exposure, and estimate the potential health risks they face. Also, in connection with other programs, the activities carried out will characterize the biological and chemical environments in the agricultural industry and their effects on the respiratory system. Such knowledge is needed in order to adopt appropriate prevention and worker protection measures.

Progress report

While some studies were completed during the past few years, notably those concerning manure additives, liquid-solid manure separation, and air quality in veal calf farms, only one is currently under way. It is evaluating agricultural workers' exposure to pesticides in the pyrethrinoid family, which were introduced to meet sustainable agriculture requirements. Also noteworthy is a current study under the Ventilation and Air Quality program that is endeavouring to calculate the ventilation time required to ensure good air quality in forage silo chutes.

Developments anticipated during the cycle

The anticipated research activities should result in the identification of the sectors or agricultural activities that are critical from a perspective of health risk potential in order to subsequently develop a research program aimed at documenting exposure levels and determining the most appropriate prevention and protection measures. The IRSST's ongoing funding of the PHARE 2 project of the Canadian Centre for Health and Safety in Agriculture will help support the development of such a program.

2.1.3.3 New thematic programs to be developed

2.1.3.3.1 Occupational cancers

Aims

It is generally recognized that a number of factors play a role in the etiology of cancers and that it is difficult to accurately assess how much of that role is attributable to occupational factors. For industrialized countries, however, the data reported in the literature suggest that between 4.1 and 8.4% of cancers could be occupational in origin. A new thematic program on occupational cancers will therefore be proposed during this

new cycle. Its long-term objective will be to help lower the incidence rate of these cancers in Québec. It will be a transverse program, however, because it may involve several other thematic programs and themes such as those on silica and asbestos and other elongated mineral particles.

Progress report

One study was completed on mortality and the incidence of cancers in a large company in the non-ferrous metal smelting and refining industry. A first profile of Québec workers' exposure to carcinogens was also drawn up. Another activity aimed at roughly estimating the proportion of cancers attributable to work is also under way. Two literature reviews, one on the cancerogenicity of trichloroethylene and another on occupational cancers in shipyard workers, have been completed.

Developments anticipated during the cycle

Despite the fact that the Occupational Cancer program has not yet been developed, it would appear that research activities should focus on the following: better characterization of worker exposure to carcinogenic substances, notably those to which large proportions of workers (especially young workers) are exposed; improved understanding of the differences between male and female exposure; and the exploration of work practices and exposure control measures present in workplaces. The merits of launching a second phase of the study on cancers in the non-ferrous metal smelting and refining sector will also be explored.

2.1.3.3.2 Chemical and biological hazards related to green jobs

Jobs generated by efforts to "green" the economy are proliferating. Government incentives promoting sustainable development have contributed to the marketing of new technologies and the creation of jobs in the recycling, alternative energy source, transportation, natural resource management, and environmental protection sectors, to name but a few. The jobs created in these sectors are often called "green jobs" or "environmental jobs," and in 2010, were estimated to number over 155,000 in Québec. While they may be considered green, these jobs are not without their own occupational health and safety risks. In this context and given the results obtained in an IRSST-funded study, the relevance of a thematic research program that would draw up a profile of green jobs in Québec and assess the potential risks to worker health arising from exposure to chemical substances and biological agents will be evaluated. As the case may be, such a program may then be developed and proposed to the Institute. Its aim would be to support new research for the purpose of acquiring knowledge on the hazards and target populations and on possible means of control. One study already under way is attempting to characterize the OHS problems related to green jobs in Québec's photovoltaic industry and could contribute to the development of such a program.

2.1.3.3.3 Respiratory protection

This theme, which was previously treated under the Protective Equipment field, has now been integrated into the CBHP field. At present, a study aimed at optimizing Saturisk, a computer-based tool for calculating the service life of organic vapour cartridges, is expected to continue. Regarding the developments anticipated over this five-year cycle, useful activities that serve to support the *Regulation respecting occupational health and safety* (e.g. *Guide des appareils de protection respiratoire utilisés au Québec, guide pratique*) will continue. Further efforts will be made to identify the respiratory filters that work most effectively against nanoparticles. Discussions could be held on the choice of appropriate respiratory protection strategies in hospitals. Lastly, the relevance of preparing an overview of the respiratory protection situation regarding potential carcinogenic agents (diesel motor emissions) in certain occupational sectors will be evaluated. Close links can be anticipated between this theme and those involving nanoparticles, occupational cancers, microorganisms in the workplace, and ventilation and air quality.

2.2 Mechanical and Physical Risk Prevention (MPRP)

Context

Every year, many workers are victims of work-related accidents (some of them serious or even fatal) or contract occupational diseases stemming from exposure to numerous hazards posed by the machines they operate and their work environment. Preventive actions can be taken at the source, in the work environment, and with workers themselves to eliminate the risks, or, when measures cannot be put in place to eliminate or reduce risks at the source, by having workers use personal protective equipment. The OHS, scientific, and technological issues studied in this field concern machine-relate risks, mechanical risks, noise and vibration, heat stress, excavations, and falls from heights, on the same level, or due to slipping.

Goal

The researchers in this field focus specifically on the assessment and reduction of physical and mechanical risks that could jeopardize worker health and safety, taking into account workers' interaction with the machines around them and their work environment. The machines may be of the fixed or mobile industrial type or hand power tools. The main physical risks include noise, hand-arm and whole-body vibration, and heat stress. The mechanical risks include cuts, lacerations, needle punctures, crushing, contact with machines, falls from heights, falls on the same level, slips/trips, and trench cave-ins.

Their research efforts involve proposing methodological and metrological tools, simulations, and testing and evaluating methods to help those responsible in the workplace diagnose and assess risks more effectively. Efforts also focus on developing

support tools for selecting, enhancing, and designing prevention solutions, taking the human factor into account.

Research orientations

The research activities carried out in the MPRP field revolve around three major orientations:

- assessment of the mechanical and physical risks generated by machines or the work environment;
- reduction of mechanical and physical risks;
- taking the human factor into account in the evaluation and control of mechanical and physical risks.

2.2.1 Putting the field's priority issues into perspective based on statistical data

Work-related injuries associated with mechanical and physical risks represent a significant proportion of all injuries documented in the CSST's databases. Based on the five-year indicators applicable to the 2005–2007 period, accidents related to fixed machinery represent 5.3% (4,923) of all accidents involving time-loss injuries annually. The severity of injuries caused by machine-related accidents and the fact that machines are used in most activity sectors impelled the CSST to apply a "Sécurité des machines" (machine safety) action plan starting in March 2005. Moreover, this action plan was maintained in the CSST's 2010–2014 strategic plan. Affecting mostly manual labourers (85%) and young workers (ages 15 to 24), these types of accidents post a full-time equivalent (FTE) frequency rate among these workers that is twice as high as that for workers ages 45 and over. The most frequent traumatic injuries involve hands and fingers, and consist primarily of open wounds, bruises, and fractures. Upper extremity injuries represent approximately 20% of all injuries compensated by the CSST. Between 2006 and 2009, an average of 13 machine-related deaths occurred annually.

Of the other mechanical risks studied in this field, the entrapment of workers in the bottom of trenches due to wall cave-ins causes at least one or two deaths a year (44 deaths and 16 serious injuries occurred between 1974 and 2010), representing 1% of all work-accident fatalities. Wall cave-ins during work pose the most frequent and serious risk. Statistical data for the years 2000 to 2008 further indicate that falls from heights still constitute a major cause of work-related injuries (9.8% of work-related injuries compensated in relation to traumatic accidents, 5.6% of all compensated work-related injuries annually) and of deaths on the job (11 of the 68 accident-related deaths accepted in 2011). The relative numbers of falls on the same level and slips/trips without falling rose from 9.4% to 12.2% of all injuries accepted between 1998 and 2008. For the 2005 to 2007 period, these types of accidents ranked first among the most frequent type of accidents. During the same period, the most frequent injury sites associated with injuries caused by slips/trips without falling were the ankle (32.5%), back (20. 8%), and knee (15.8%), and these injuries predominantly (75.5%) involved

strains/sprains. The IRSST document entitled *Les coûts des lésions professionnelles par industrie au Québec (2005–2007)* (the costs of occupational injuries by industry in Québec, 2005–2007) indicates that strain/sprain injuries rank first in terms of total cost, representing $910 million a year (including human costs, loss of productivity, medical costs, and administrative and salary costs).

The data collected between 2001 and 2006 by the IRSST's Statistical Surveillance Group on CSST-accepted injuries attributable to exposure to mechanical stressors indicate that 19% of traumatic accidents resulted in cuts and lacerations. The majority (78%) of these accidents affected fingers and hands. Although the number of needle punctures and perforations was one-third the number of cuts, they accounted for 6.2% of the traumatic accidents. Injuries attributable to needles and syringes accounted for 2% (277 cases) of traumatic accidents caused by needle punctures and perforations. It is important to recognize, however, that a puncture caused by a syringe or needle containing potentially contaminated blood can have very serious consequences (e.g. blood-transmitted diseases such as hepatitis or HIV).

Lastly, regarding the physical risks associated with noise and vibration, the available data indicate that during the 2005 and 2008 period, the number of noise-related injuries rose from 2,211 in 2005 to 3,138 in 2008. Also, an IRSST study of the costs of work-related injuries showed that, taking into account all costs—direct, indirect and human—noise ranked first among all causal agents, with an average per-injury cost estimated at $154,406 a year. While the number of compensated time-loss injuries associated with vibration was much lower (fewer than 50 a year for both hand-arm and whole-body vibration), the average payouts in income replacement indemnities were generally much higher than the average cost of all injuries.

2.2.2 Putting the field's priority issues into perspective based on research mapping and scientific monitoring and surveillance

To put into perspective the issues addressed in the three fields that were merged to create the MPRP field, international research mappings were done for the 2008–2010 period for the Noise and Vibration, Protective Equipment, and Safety of Industrial Tools, Machines, and Processes fields. Between eight and ten organizations were retained for this purpose, depending on the field. They included the National Institute for Occupational Safety and Health (NIOSH) in the United States, the Health and Safety Executive (HSE) in the United Kingdom, the Institut National de recherche et de sécurité (INRS) in France, Institute for Occupational Safety and Health (IFA, formerly BGIA) in Germany, WorkSafeBC (WSBC) in British Columbia, Canada, the Workplace Safety and Insurance Board (WSIB) in Ontario, Canada, the Finnish Institute of Occupational Health (FIOH), the German regulatory body known as the German Social Accident Insurance (DGUV), and the IRSST. A total of 148 projects were documented for the Noise and Vibration field, 171 for Protective Equipment, and 395 for Safety of Industrial Tools, Machines, and Processes.

Analysis of these mappings revealed that in terms of machine safety, the main research issues studied by the IRSST were also those of other research organizations, primarily with regard to risk assessment and reduction. The IRSST appeared to stand out, however, for the intensity of its research on the lockout problem. Moreover, studies on control system safety appeared more concentrated in certain research centres (e.g. IFA) and fewer in number than studies on the other themes.

The IRSST distinguished itself in the area of protective equipment by the importance of the studies it conducted on mechanical risk protection, particularly regarding hand injuries and risks associated with trench cave-ins. Respiratory protection ranked first among the issues addressed by all organizations, with the NIOSH apparently the most active in this area. Lastly, interest in the problem of falls from heights appears to be growing, with the number of projects documented during the 2008–2010 considerably higher than during the 2007–2009 period, for which mapping had previously been done.

Mapping of the Noise and Vibration field indicated that a larger number of projects were carried out on noise than on vibration (53% vs. 37%), with an even smaller proportion of research (9%) conducted on both issues. The research themes addressed by the different organizations overlap. The most frequent themes include means of noise reduction, characterization of exposure, vibrations emitted by hand power tools, and exposure to whole-body vibrations during the driving of motor vehicles.

2.2.3 Current and future programs and themes

Based on in-depth reflection and consultations about the orientations of the new MPRP research field, 13 programs or themes are proposed in the 2013–2017 Five-Year Plan. Several are thematic programs already under way and ongoing, but some have been renamed to better reflect the research topics involved.

The following paragraphs present the above programs in two main categories: (a) current thematic programs; and (b) thematic programs to be developed. It is proposed that eight current thematic programs continue and five new programs be defined over this new cycle.

2.2.3.1 Current thematic programs

2.2.3.1.1 Assessment of risks associated with machines

Aim

The aim of this program is to conduct studies that will provide enterprises with robust, reliable tools for assessing (analyzing and evaluating) the risks associated with machines. This step is prerequisite to identifying appropriate ways of reducing risks.

Progress report

First, the IRSST carried out a research activity in 2006 that yielded a compendium of knowledge on various tools for assessing risks associated with industrial machines. A second study involving the theoretical comparative analysis of selected machine-related risk assessment tools was subsequently carried out and completed in 2010. A new project involving practical experimentation with selected tools was authorized for 2012. To date, it is estimated that this program is 50% complete to date.

Developments anticipated during the cycle

It is expected that this program will be completed during the 2013–2017 five-year cycle, first by winding up the study involving practical experimentation with risk estimation tools and parameters applied to industrial machine safety. The findings of this study should lead to the proposal of robust, reliable configurations for risk estimation tools and the defining of informed criteria for assessing existing tools or developing specific new tools. It will be carried out in collaboration with a team from the Health and Safety Laboratory (HSL) of the United Kingdom. The last study to be proposed in this program will involve a comparative analysis of the various types of training associated with machine-related risk assessment. The researchers will compare several training courses and define the key factors ensuring more efficient and uniform uptake and use of machine-related risk assessment tools by workplaces.

2.2.3.1.2 Lockout

Aims

This program has several aims: to enhance understanding of the problems related to machine lockout, study the components of a lockout program and the conditions conducive to its application, evaluate its application in workplaces, and identify alternatives when the program cannot be applied.

Progress report

A study completed in 2008 enabled researchers to document and analyze various lockout programs and procedures. As a result, a feasibility study was done on the development of a lockout-procedure observation and follow-up tool; it was followed by another study on lockout procedures in the municipal affairs sector (document analysis and field observations). A technical fact sheet was produced to help enterprises verify the content of their lockout programs. Lastly, a study was launched in 2011 at the CSST’s request to evaluate safety during operations performed on machines in reduced risk conditions: reduced speed or reduced force. It is estimated that this program has been one-third completed.

Developments anticipated during the cycle

During this five-year cycle, the current research work under this thematic program is expected to continue, first with the completion of the study on operations performed on machines in reduced risk conditions: reduced speed or force. A new study will also be launched to observe and analyze the application of lockout procedures in various types of enterprises, including SMEs. Mining companies will be among those examined in this study, which seeks to understand the problems encountered and factors promoting the application of lockout procedures, and to document the types of lockout performed. Other studies will also be proposed, notably to document methods that could provide alternatives to lockout when it cannot be applied, to develop criteria and tools for selecting these alternative methods, and to study methods that could be used to prove that power has been turned off during lockout procedures.

2.2.3.1.3 Hand power tools

Aims

The work carried out within this transverse research program, which concerns both noise and vibration, is aimed at developing knowledge of the acoustic and vibratory performances of hand power tools, proposing ways of reducing these vibration and noise levels, and disseminating this information so that tool models with lower impact levels can be identified. More specifically, this means identifying the mechanisms whereby tools generate noise and vibrations in work situations, evaluating them on laboratory test benches that simulate working conditions, and clarifying dose-effect relationships for hand-arm vibrations.

Progress report

A first study led to the development of test benches for evaluating the noise and vibrations generated by the operation of hand power tools in automobile repair shops. A technical fact sheet was also produced to inform companies of the noise and vibration levels associated with various types of tools used in these workshops. Another study, conducted in collaboration with CANMET Mining and Mineral Sciences Laboratories (MMSL) of Natural Resources Canada, evaluated the noise and vibration generated by mining equipment. The noise and vibration generated by the main types of mining equipment were characterized through this work, in turn allowing the equipment requiring greater attention to be targeted and relevant information on the noise and vibration associated with them to be transferred to workers in the mining industry so as to raise their awareness of the problem and reduce their exposure. Studies were also undertaken to more accurately estimate the risks arising from exposure to hand-arm vibrations during operation of vibratory hand power tools, by integrating the impact of independent variables such as posture and coupling forces on vibration dose. This program is now 80% complete.

Developments anticipated during the cycle

It is anticipated that this thematic program will be completed during the 2013–2017 five-year cycle, first, by winding up the studies involving the characterization of exposure to hand-arm vibration, and second, by conducting a new study aimed at characterizing the vibrations associated with pneumatic nail guns. It appears that these tools are widely used in construction, mainly by carpenters, and that there is a need to identify the characteristics of the noise and vibrations they generate, as well as the tool models causing the least noise and vibration impact.

2.2.3.1.4 Acoustic barriers and noise control materials

Aims

Formerly named “Sound propagation in the workplace,” this program used to have two aims: (i) to more effectively control noise in the workplace, and (ii) to improve communication in noisy environments. Now under a new name, the program concentrates on the first aim and on the use of noise-abatement barriers and materials. The second aim is addressed in a new thematic program entitled “Audible alarm signals in the workplace,” which is presented in a later section of this document. More specifically, the program on acoustic barriers and noise control materials is aimed at developing reliable, user-friendly, transferable methods and tools that can be adopted by workplaces to help reduce worker exposure to noise. This can be achieved by developing tools to support both the design of noise-reduction solutions (for example, machine enclosures) and the evaluation of the acoustic performance of materials, while also evaluating and even designing new noise-abatement technologies based on the use of innovative barriers and materials.

Progress report

The activities related to this program have focused mainly on developing tools for calculating the acoustic dispersion of structures and on improving a tool to be used for the predictive calculation of acoustic performances of machine enclosures. The work on acoustic-dispersion calculation tools has led to the creation of an in-house bank of predictive calculation tools for reducing noise at source and during propagation. The aim of the activities on machine enclosures is to make a previously designed predictive calculation tool available, but for the time being, it is still at the prototype stage. A user-friendly graphic interface must be developed to make this support tool for designing machine enclosures available to potential users. Also, a study has been initiated to compare this tool to one developed by the INRS in France in order to prevent effort duplication and combine the strengths of both tools. It is estimated that less than one-quarter of this program has been carried out to date.

Developments anticipated during the cycle

During this new cycle, work will be ongoing to consolidate and enhance the bank of predictive calculation tools available at the IRSST (support tool for the design of machine enclosures, tools for calculating the acoustic dispersion of structures), to finalize the comparative study of the IRSST and INRS tools, and to make the support tool for the design of machine enclosures available. The steps initiated by the Université de Sherbrooke to create a “Chair on acoustic ecodesign” should be concluded. If they bear fruit, this Chair, for which the IRSST will act as a partner, will pave the way to launching joint projects focusing on the evaluation and optimization of the acoustic performances of new recycling materials in a sustainable development context.

2.2.3.1.5 Evaluation and modelling of personal hearing protectors

Aims

The aim of this program, which until now has been called “Hearing protection,” is to explore methods for evaluating the real protection offered by hearing protectors in workplaces and to develop support tools for designing efficient and more comfortable hearing protectors (personalized protection).

Progress report

The study involving measurement of the effective attenuation offered by hearing protectors in the workplace was completed and shed light on several important points. First, it showed that the measurement system developed was well adapted and effective in measuring the performance of hearing protectors over long periods of time in the workplace. Also, the results clearly indicated that the real protection obtained can vary significantly during a work shift and even from one worker to another. They further revealed that the real protection obtained often falls well below the protection level posted. Despite the success of the approach, some of the approximations used will have to be validated in greater detail to yield more robust estimates, notably for earmuffs. The simultaneous study involving the modelling of protectors, which was then at the feasibility stage, showed (at least in the laboratory) the potential of the finite element method for predicting hearing protector performance. Such studies open the doorway to more in-depth projects that may lead to robust models usable for designing more efficient and comfortable hearing protectors. To this end, broader studies began in 2010 with a focus on modelling earmuffs and earplugs, this time taking different complexities into account, mainly, the shape of the auditory canal and the head, the effect of the skin, and discomfort parameters such as the effect of earmuff headband force or the occlusion effect of ear plugs. In addition, an experimental study is now looking at the approximations used in the previous study and developing a test for characterizing and quantifying the occlusion effect. It is estimated that of the planned program, half of the portion concerning the evaluation of the effectiveness of hearing

protectors has been completed, while the portion concerning the design of these protectors is only just beginning.

Developments anticipated during the cycle

During this next cycle, work on the development of tools and methods for better evaluating workers' personalized hearing protection will continue, mainly to validate some of the approximations used in the activities carried out to date, particularly for earmuffs. There are also plans to explore hearing aids and the effect of hearing protectors on the location of alarms. The work involving the modelling of hearing protectors will also continue to support the design of more effective and comfortable protectors. These activities, conducted in partnership with the Université du Québec's École de technologie supérieure and involving numerous researchers and graduate students, will run for a few more years and will benefit from the ICAR laboratory, inaugurated in 2011. Also in connection with a current study on time-domain analysis methods, work may conceivably be done to design tools for modelling the effectiveness of hearing protectors for impulse noises, especially high-level noises.

2.2.3.1.6 Shoring and shielding systems

Aims

This program focuses on providing preventionists with tools to help them choose appropriate means of protection against trench cave-ins, taking into account both soil type and conditions and water table conditions. It is also intended to support the work of the review committee for the Québec Safety Code for the Construction Industry.

Progress report

To date, an inventory of shoring and shielding systems for excavations and trenches has been produced, and the stand-off distance at the top of trenches for excavations in municipal environments has been investigated. Further work has begun to produce a tool to help municipalities find or adapt an existing commercial shoring system that meets their needs. At present, the tool is available in paper format only and needs to be converted into a computer-based tool. This program is at the midway point.

Developments anticipated during the cycle

A proposal will be made to continue the research aimed at providing users with a tool that will guide them in selecting a shoring system better adapted to the requirements of excavation work, while drawing on the inventory of systems documented. Research will also continue in support of the efforts of the review committee for the Québec *Safety Code for the Construction Industry,* notably by exploring the possibility of establishing safe angles for trench excavation in light of soil types and water table conditions. The development of shoring-system classification indices will also be considered in order to provide clearer guidelines for excavation work.

2.2.3.1.7 Resistance of protective gloves and clothing to mechanical and physical hazards

Aims

The aim of this thematic program, formerly known as “Protective gloves and clothing,” is to evaluate the resistance of protective gloves and clothing to mechanical hazards (e.g. cuts, lacerations, tears, and adherence) while incorporating aspects related to human factors. The work will involve developing knowledge of the behaviour of materials in the presence of different types of hazards and of the impact of equipment use on physiological functions, motricity, and comfort. This in turn will make it possible to design tools for selecting protective gloves and clothing, develop test methods, establish equipment selection criteria, and contribute to the development of standards and more efficient products.

Progress report

Previously, this thematic program had four distinct parts (i) resistance to mechanical hazards, (ii) resistance to chemical hazards, (iii) resistance to nanoparticles, and (iv) human factors. Part (ii) of the program has ended, while part (iii) is now attached to the Nanoparticles program (see section 2.4.2.1). Parts (i) and (iv) are still attached to this program.

During the preceding cycle, the main work under this thematic program concerned protective gloves. It was not possible to devote special attention to other types of protective clothing. The work carried out to date has led to the development of test methods for characterizing glove resistance to cuts and needlepricks, which have been the subject of standards. Work also continued on characterizing the cut, perforation, and tear resistance of new gloves, and has led to the production of a computerized selection guide that was posted online in 2010. A preliminary study was conducted to explore the impact of industrial contaminants on glove resistance to mechanical hazards. The work on protective glove adherence resulted in the development of a characterization method. The part of the research program concerning glove resistance to mechanical hazards is now winding up. Another project on glove resistance to multiple mechanical hazards (cuts and perforations) and a study on the mechanical resistance of contaminated gloves were launched in 2011. Once these studies are completed, the *Protective Gloves Selection Guide* and Web site will be updated to complete this part of the program.

Developments anticipated during the cycle

The studies begun in 2011 on multiple mechanical hazards and the mechanical resistance of contaminated gloves should be completed and the *Protective Gloves Selection Guide* and Web site updated. Regarding the human factors part of the program, discussions were launched by the IRSST with a view to gaining access to a Université du Québec à Montréal (UQÀM) laboratory that includes a climate chamber. If an agreement is signed, research could begin on the physiological effects of wearing

protective clothing. During this new cycle, the emphasis is expected to be on evaluating protective clothing in terms of human factors, notably regarding thermophysiological comfort and mobility.

2.2.3.1.8 Protection against falls from heights

Aims

The aim of this program is to develop and apply test methods for identifying the personal protective equipment (lanyards, safety harnesses, belts, anchor points) and collective protective equipment (guardrails, horizontal lifelines) that are best adapted to different work environments, taking human factors into account. It also seeks to provide a basis for designing new products and defining selection criteria and to support the development of standards.

Progress report

As anticipated, the preceding cycle saw the completion of the project evaluating the anchoring systems for the three guardrail models most used by roofers. The results showed that the three types of guardrails and their anchoring systems comply with Québec's *Safety Code for the Construction Industry.* A knowledge transfer activity was initiated in 2011 to produce a prevention fact sheet on guardrail anchoring systems on flat roofs for roofers. Also in 2011, a study was initiated on the aging, degradation, and service life of fall protection equipment, and lifelines in particular. However, it was not possible to start work on components other than lifelines or on ways of taking human factors into account. The same applies to the work aimed at evaluating guardrail performance, which would require, as had been proposed, considering laboratory evaluation methods that incorporate conditions more representative of those in workplaces (modelling of the worker/guardrail top plate impact). It is estimated that only one-third of this thematic program has been carried out.

Developments anticipated during the cycle

During this next cycle, the current work on lifeline degradation and aging is expected to continue with its scope broadened to include straps and safety harnesses. Further aims of these projects are to establish service life (loss of mechanical performances) and to take into account both human factors (such as comfort and ergonomics) and constraints arising from the need to support heavier body masses than those allowed by currently used equipment. Particular attention will also be paid to evaluating the resistance of (personal or collective) protective equipment to falls from heights, mainly by modelling the dynamic behaviour of guardrails (simulating the shock sustained by a person hitting a guardrail).

Moreover, since a large proportion of work fatalities stem from the fact that workers do not wear their harnesses or are not attached, projects aimed at evaluating the reasons why fall-arrest safety harnesses are not worn and identifying solutions that will increase

the proportion of workers who do wear and attach their harnesses are expected to be carried out.

2.2.3.2 New thematic programs to be developed

2.2.3.2.1 Slips and falls on outdoor surfaces

During the preceding cycle, a preliminary study was conducted on the causes and risk factors involved in slips and falls by police officers and school crossing guards. It is expected that further to this work, a research program will be proposed on the issue of slips and falls, mainly from the perspective of protective equipment. This program will be based on the results of the previous project, but will focus mainly on (i) the study of the body's biomechanical response and motor control on icy and snowy surfaces, (ii) the evaluation and development of appropriate non-slip soles or footwear, and (iii) training.

2.2.3.2.2 Safety of machine maintenance operations

Formerly called "Maintenance," this program encompasses the various facets of maintenance-related safety issues, which differ from the issues that arise during machine operation. The same applies to safety issues associated with preventive maintenance operations, which are planned, and corrective measures, which are less planned. The aims of this thematic program will need to be reclarified and redefined during this new cycle. First, a distinction will be proposed between machine accidents related to maintenance operations and those associated with machine use for production purposes. Then, in light of the results obtained, a study of maintenance interventions may be put forward for the purposes of identifying the determinants that influence safety during these interventions and proposing tools for managing problems.

2.2.3.2.3 Evaluation and selection of suspension seats

In this thematic program, which forms part of the research on exposure to whole-body vibrations, the focus is on the selection and evaluation of suspension seats. The aim of this research is to produce tools that will assist in the selection of the seats best adapted for reducing exposure to whole-body vibrations in various categories of vehicles. Given that the vibratory environment present in many categories of vehicles consists of vibrations emanating simultaneously from several directions, a proposal will be put forward to continue developing this research component, taking multi-axis vibrations into account. Particular efforts will be made to factor in the biodynamic behaviour of the individuals sitting on the seats and to develop exposure evaluation methods and tools to assist in the design of seats adapted to the vibratory environment of the vehicles for which they are intended.

2.2.3.2.4 Audible alarm signals in the workplace

This thematic program derived from the split of the thematic program on sound propagation in the workplace into two parts. It concentrates on communication in noisy environments from the perspective of audible alarm signals. During the preceding cycle,

researchers evaluated a new alarm technology based on the use of white noise and compared this technology to traditional tonal alarms. Various aspects of sound propagation behind vehicles were investigated and alarm-signal perception experiments conducted. The results showed that the use of white noise creates a much more homogenous acoustic field behind vehicles and makes it easier for workers to locate the alarm spatially. However, the results also shed light on certain aspects still requiring closer study, such as the effect of hearing protectors on various measurements of acoustic perception during the use of either tonal or broadband alarms. For the 2013–2017 cycle, a new program will be proposed on broadband alarms and varying-intensity alarms (as well as a combination of the two) to study their effectiveness in the workplace in terms of sound propagation, spatial location, loudness, and perception (perception thresholds and feelings of urgency), but also in terms of their implementation in the workplace.

2.2.3.2.5 Control systems and automation

The aim of this program is to specify the roles and limitations of control systems, identify the technical means to be applied to improve safety in connection with their use, and pay particular attention to design practices for safe control systems. During the preceding cycle, a knowledge transfer activity led to the production of a safety evaluation checklist for plastic injection presses. A study was also conducted to test the effectiveness of the safety control systems on plastic injection presses with peripheral equipment such as robots and conveyors. While this program has yet to be defined, it is expected to focus on the application and user-friendliness of standards designed to ensure control system safety and on the technologies intended to ensure the safety of people in the vicinity of mobile machines or robots.

2.3 Sustainable Prevention and Work Environment (SPWE)

Context

Both workers and enterprises are faced with having to evolve in a dramatically changing work world. Many organizational, demographic, and technological changes are taking place within enterprises and exerting pressure, sometimes positive sometimes negative, on the health and safety of the labour force.

Whether it is changing markets, the shifting of jobs from a manufacturing sector to the service sector, or the introduction of new technologies, all such factors can influence occupational health and safety. Due to their multifactorial nature, these factors necessitate a broader view of work activities and the work environment, including an understanding of their effects on occupational health and safety. Where potentially negative effects are perceived, these factors require a search for means of intervention that will prevent them.

Goals

While the emphasis is still on the sustainable prevention of OHS problems involving primarily musculoskeletal disorders (MSDs), this field also helps further understanding of the positive and negative impacts of organizational, demographic, and technological changes on OHS. In connection with the OHS issues that may be identified, another goal of this field is to identify possible solutions that could help increase the positive and reduce the negative impacts of these changes.

In this context and given that the research topics may touch on multifactorial elements, making it difficult to clearly differentiate personal from occupational aspects, the joint support of both employer and worker representatives will be required. The multifactorial nature of the issues is such that the problems and solutions may sometimes be associated with personal factors and at other times with occupational factors, or even with a combination of both. These issues must therefore be analyzed from a broad perspective, that is, by looking at both personal and occupational aspects proportionally. In cases where the context extends beyond occupational health and safety strictly speaking, a search for co-funding should be envisaged.

Given the highly complex process involved, such preventive actions must not overlook the overall context in which enterprises operate. The development of ergonomic intervention practices constitutes an important goal of this field, as does the development and application of measurement methods and evaluation tools by means such as biomechanical measurements and modelling, questionnaires, and surveys.

During results dissemination, the results will have to be contextualized by explaining that they must be interpreted from a broader perspective encompassing the results of all studies conducted under a given theme or program.

Research orientations

The research activities conducted under the Sustainable Prevention and Work Environment field revolve around three major orientations:

- analysis of the impacts of organizational, demographic, and technological changes within enterprises on occupational health and safety;
- development and application of measurement methods and evaluation tools (measurement of exposures and risk and protection factors, activity analyses, surveys, and data collection tools);
- interventions pertinent to, and management of, OHS problems (e.g. OHS management in small enterprises, OHS management tools).

2.3.1 Putting the field's priority issues into perspective based on statistical data

The SPWE field places considerable importance on the prevention of musculoskeletal disorders (MSDs). This unavoidable issue was also targeted as a priority in the CSST's 2010–2014 strategic plan with the aim of reducing the number of such injuries in workplaces. From 2005 to 2007, there were slightly more than 92,000 compensated time-loss injuries (TLIs) annually; of these, 37%, or just over 34,000, involved MSDs. During that same period, slightly more than 8 million days were compensated, with 38% of them (3.1 million days) attributable to MSDs. The average duration of compensation for these MDSs was 90 days, compared to 74.1 days for traumatic accidents. Nor must the human costs (which are difficult to put a number on) associated with these injuries be underestimated.

Demographically, from 2005 to 2007, of the roughly 2.7 million remunerated FTE workers, nearly 10% were between 15 and 24 years of age. The average annual number of injuries for this age group was approximately 13,000, representing 14% of all compensated time-loss injuries. The frequency rate of time-loss injuries (TLIs) among FTE young workers (5.1%) was 48% higher than that for all remunerated FTE workers (3.4%); however, the average duration of compensation was two times shorter than that recorded for the entire labour force (43 days compared to 88 days). It therefore appears that it is injury severity rather than risk that differentiates young workers from older workers. Decreasing the number of injuries in young workers ages 24 and under is also one of the priorities of the CSST's 2010–2014 strategic plan.

The average annual number of TLIs among workers ages 55 and over during the 2005 to 2007 period was 10,437, representing 11.3% of all injuries. The average duration of benefit payments for this group was 135.1 days, which is considerably higher than the average duration of benefit payments recorded for the entire Québec labour force (88 days). The median duration of compensation for workers ages 55 and over was 20 days compared to 14 days for all workers. Moreover, the frequency/severity rate of TLIs was 3.9 days/FTE workers ages 55 or over compared to 3.0 days/FTE workers in all age groups.

In the current socioeconomic context, experts anticipate a trend toward aging workers staying in the labour force. Based on demographic changes in Québec, it is estimated that the population between ages 15 and 64, which still makes up the core of the labour force, will stop growing and even start shrinking as of 2013 (Grenier, 2009). It thus appears that workers ages 65 and over will continue contributing. It is in fact estimated that between 2014 and 2018, 40% of the growth in the labour force will be attributable to the fact that persons ages 65 and over will continue to work or return to work (Grenier, 2009). In the years ahead, we will therefore need to look at knowledge transmission and training with a view to keeping aging workers healthy.

Structurally, small enterprises of 50 workers or fewer[3] are at the heart of the Canadian and Québec economies. According to Statistics Canada, in 2010, 34% of jobs in Québec and 31% of those in Canada[4] were in small enterprises. Small enterprises constituted 95% of employer establishments in both Québec and Canada in 2009[5]. Based on figures compiled in the Québec Survey on Working and Employment Conditions and Occupational Health and Safety, 45.3% of the labour force (including management, salaried employees, and self-employed workers) is employed by small enterprises employing 50 or fewer workers. Small enterprises are also the biggest contributors to employment growth in Canada[6.]

Based on the annual indicators applicable to the 2004–2006 period, the average annual number of TLIs was 94,550, of which slightly more than one-third occurred in small enterprises. The average duration of benefit payments was 81% longer in small enterprises than in medium-sized and large enterprises (116 days versus 64 days). However, when the average durations of benefit payments are standardized by industrial structure, the gap between durations applicable to small enterprises and those applicable to medium-sized and large enterprises appears to be more in the order of 67% (Duguay *et al.,* 2012).

For all industries covered by the annual indicator study (applicable to the 2004–2006 period), the frequency/duration ratio of injuries is twice as high in small enterprises as in medium-sized and large enterprises. This means that for a given payroll, the income replacement indemnity (IRI) payouts are twice as high in small enterprises as in medium-sized and large enterprises. However, after controlling for industrial structure, the IRI payments for small enterprises are 58% higher than for medium-sized and large enterprises for an identical payroll (Duguay *et al.,* 2012). Special attention will therefore need to be paid to small enterprises in sustainable prevention research efforts.

2.3.2 Putting the field's priority issues into perspective based on research mapping and scientific monitoring and surveillance

An overview of the international research conducted during the 2008–2010 period was produced to put into perspective the priority issues examined under the former "Work Context and OHS" and "Musculoskeletal Disorders" fields (from which the current field derived). Depending on the field, between eight and nine organizations were retained. They included the National Institute for Occupational Safety and Health (NIOSH) of the United States, the Health and Safety Executive (HSE) in the United Kingdom, the Institut National de recherche et de sécurité (INRS) in France, the BAuA in Germany,

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3 While the definition of a small enterprise can vary from country to country and depending on the enterprise sizes taken into account, this definition enjoys a fairly broad consensus (Walters, 2001; Eakin *et al.*, 2000).

4 Statistics Canada, Employment by enterprise size, by province and territory, Canada, Québec. http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/labr77a-eng.htm;

5 Industry Canada (2010), Employer Establishments by Firm Size (Number of Employees) in the Provinces and Territories, June 2009. http://www.ic.gc.ca/eic/site/061.nsf/eng/rd02445.html.

6 Industry Canada (2010), Distribution of All Firms based on Average Annual Employment Growth, by Firm Size, 2001–2006. http://www.ic.gc.ca/eic/site/061.nsf/eng/rd02448.html (Figure 4).

WorkSafeBC (WSBC) in British Columbia, Canada, the Workplace Safety and Insurance Board (WSIB) and the Institute for Work and Health (IWH) in Ontario, Canada, Liberty Mutual in the United States, and the IRSST. A total of 238 projects were documented for the MSD field and 740 projects for the Work Context and OHS field.

Analysis of these research mappings revealed that in terms of number of projects documented, the NIOSH headed the list in both fields, with over one-third of the total numbers of projects. For MSDs, the IRSST ranked third with 13% of the projects, and fifth for number of projects related to the Work Context and OHs field, accounting for 6% of the total number. The IRSST stood out as covering a wide range of topics. On the MSD issue, it placed research priority on evaluating physical risk factors and developing biomechanical measurement instruments, thus resembling the profiles of the NIOSH and the BAuA. While the IRSST was concerned with a number of activity sectors and occupations, it concentrated primarily on material handling tasks and the back as an injury site. It also made a major contribution regarding evaluation, ergonomic intervention, and training. It was similar to the NIOSH in terms of its knowledge transfer activities, which focused more on producing guides or information than on developing tools for OHS professionals. It also appears that the IRSST was one of the only organizations to show particular interest in the sustainability of modes of prevention, either though continuous improvement or sustainable prevention.

More than 50% of the projects in the Work Context and OHS field concerned the effects of work on OHS and prevention management. A large portion of the research focused on questions related to age (young and aging workers), target sectors and groups, and changes under way in the work world. The IRSST occupied a key position in terms of research on age-related issues. Regarding changes in the work world, analysis of the research mappings revealed that issues such as organizational strategies, work schedules, and precarious work were also focuses of research for which the IRSST would appear to be well-positioned compared to other OHS research organizations.

2.3.3 Current and future programs and themes

The following sections describe the research programs divided into three main categories: (a) current thematic programs; (b) current research themes; (c) thematic programs to be developed. It is proposed that the development of three current thematic programs continue and that other projects in this field be grouped under four research themes. It is further proposed that five new thematic programs be defined over the 2013–2017 five-year cycle.

2.3.3.1 Current thematic programs

2.3.3.1.1 Material handling principles

Aims

Based on Statistics Canada data, in 2008, there were 36,650 people whose job title was “material handler” (all occupations: Trades, transport and equipment operators and related occupations), of whom 89% were male (32,695) and 11% were female (3,955). According to the Québec Survey on Working and Employment Conditions and Occupational Health and Safety (EQCOTESST), 42.9% of workers reported performing material handling tasks either from time to time (26.7%) or often/all the time (16.2%). The CSST’s statistics (Allaire and Ricard, 2007) indicated that it was the occupation that produces the largest number of spinal disorders.

The program on material handling principles focuses on training, but regards training simply as a gateway to encouraging both prevention and actions aimed at changing determinants in the work situation such as equipment, set-up, and work organization. It seeks to develop a new approach better adapted to work realities, to train professionals and trainers, and to do follow-up of the training they subsequently give in the workplace so that adjustments can be made as needed.

Progress report

This program is approximately 60% complete. The laboratory study comparing expert and novice material handlers was finished and the foundations of and procedures for applying the new training program were developed. A handling-context analysis grid was developed to accompany the training program and will be finalized during this next cycle in a knowledge transfer activity. A field study was conducted of the problems encountered in a population of day workers in a large municipality.

Numerous knowledge transfer activities associated with this program were carried out and will continue. The Réseau d’échanges en manutention (REM) was also active, organizing four breakfast seminars and producing four information newsletters. A Web site devoted to material handling was created and a symposium on the topic was held in November 2010.

In this same field, new laboratory studies were launched to enhance understanding of the work methods used by female and obese material handlers.

Developments anticipated during the cycle

The current work will be completed. A new, large-scale study will be carried out; it will involve training a group of professionals/trainers in the use of a new approach and conducting follow-up of a sample of the training sessions given in the workplace. This study should make it possible to identify the determining factors in the professionals/trainers’ assimilation and transfer of this new training approach and in the

receptiveness of the workplaces where it will be used, and to adapt the proposed training based on the results obtained. Subsequently, a project with a biomechanical focus will be carried out to determine the most appropriate measurement methods for assessing the effects of the training. Lastly, an extensive project aimed at implementing and evaluating the impacts of the training will be proposed. It will bring the program on material handling principles to completion, while other projects on this issue that are not focused on training may be carried out.

2.3.3.1.2 MSDs in emergency call centres

Aims

While problems related to the work of 911 emergency call centre agents readily come to mind, we cannot obtain data on CSST-compensated injuries for this population because it merges into a vast pool of white-collar workers. The first study conducted under this program therefore explored this population's musculoskeletal and psychological health. The aim of the program is to document and improve understanding of the problems experienced by emergency call centre agents in order to develop and implement concrete solutions that will prevent the risk of the onset of musculoskeletal and psychological health disorders.

Progress report

This program is approximately 80% complete. The first two studies are finished. The first was a monitoring study that documented the extent of musculoskeletal and psychological health problems among these agents and provided information about their work. The second study was multidisciplinary in nature and concerned the determinants giving rise to MSD and psychological health risks. The results provide a better understanding of the stresses experienced by call centre agents and point to a subsequent study on possible solutions. A knowledge transfer activity was initiated for the purpose of producing a video publicizing the work reality experienced by this population.

Developments anticipated during the cycle

Efforts will be made to maximize the transfer and application of the research results, mainly through the production of the video and implementation of knowledge transfer strategies. The activities under this program will be completed with a view to providing call centre agents with tools to support them in their task of taking and dispatching difficult emergency calls, and ultimately to reduce the risk of the onset of musculoskeletal and psychological health disorders.

2.3.3.1.3 MSDs related to office automation

Aims

MSDs were initially associated mainly with sizable biomechanical loads (e.g. heavy load handling, excessive exertion). However, more recent studies have shown that they are also associated with tasks requiring the handling of small biomechanical loads but involving sedentary work with a sometimes-heavy mental workload (Holte *et al.,* 2002; Lundberg *et al.*, 1994).

The prevalence of MSDs in populations of computer workers remains problematic, and prolonged computer work is associated with musculoskeletal symptoms, particularly involving the neck and forearms (Andersen *et al.*, 2008; Côté *et al.,* 2008; Gerr *et al.*, 2006; Griffiths *et al.,* 2007; Ljmker *et al.,* 2007; Wahlstrom 2005). The ever-growing use of computers in both the workplace and leisure activities suggests that this problem will take on significant proportions, hence the urgency of addressing this phenomenon. For example, in Québec, 30% of workers reported using computers at work in 1989 versus 50% in 2000 (Poussart, 2002). And more recent data (Vézina *et al.,* 2011) indicate that close to 20% of workers spend 31 or more hours a week on the computer in their main job.

The aims of this program, launched in 2011, are to improve understanding of the factors that have an impact on the onset of MSDs in workers who perform computer work and to update the best prevention practices to be applied in this context. The ultimate aim is to produce a best practices guide for the prevention of computer-related problems in collaboration with partners, professionals in the prevention network, and stakeholders in the workplace, and eventually to implement and evaluate this best practices guide in the workplace. While these practices will have been developed for computer work, it may be worthwhile to investigate the possibility that some of the results related to this program are applicable to other work situations involving prolonged static postures.

Progress report

This program is in its very early stages. A first biomechanical laboratory study is currently in the acceptance phase. The most widely approved hypothesis to explain the risks of the onset of MSDs associated with computer work is the sustained activation of the same muscle fibres. To reduce the risk, a means must be found to break this unchanging activation mechanism. The laboratory study will explore the characteristics that rest breaks should have to allow for variation in muscle fibre activation. At a later stage, a proposal will be made to explore realistic ways of integrating these breaks into a workplace. In addition, a proposal has already been made for a major activity aimed at preparing a profile of primary and secondary office-automation-related prevention practices used by OHS professionals and in workplaces in Québec. This study should make it possible to describe Québec practices, identify the most promising prevention

approaches, identify the difficulties encountered and success factors, describe the feasibility of the various approaches, and lastly, identify needs.

Developments anticipated during the cycle

The laboratory study and the study documenting prevention practices will be completed. Based on the information collected during the latter study, case studies on prevention activities may then be carried out. Another study concerning 911 emergency call centres (a study that could be linked to the program on MSDs and emergency call centres) will be proposed to explore possible interventions for influencing the psychosocial factors associated with computer work in situations involving high psychological demands.

On the basis of these different studies and drawing on the literature, a good practices guide will be designed, with input from professionals, the workplace stakeholders who participated in the studies, experts, and ergonomists. At the end of this five-year cycle, the program could be completed by implementing and evaluating this good practices guide.

2.3.3.2 Current research themes

The themes covered in this section concern research areas in which the IRSST has become involved in recent years even though they have not been included in specific programs. These areas are described more specifically here as research themes.

2.3.3.2.1 Development and application of measurement methods and evaluation tools

Aims

The work related to this theme involves developing ambulatory methods for evaluating back and postural constraints in order to measure worker exposure to ergonomic risks in the workplace.

Progress report

After several years of development, the posture dosimeter is now operational and being used in a field study to analyze the work of paramedics. Activities continue with the Institute for Occupational Safety and Health (IFA, formerly BGIA) of the German Social Accident Insurance umbrella association, for the purpose of developing an instrument for evaluating lumbar load in a number of work situations.

Developments anticipated during the cycle

The posture dosimeter is likely to be used more extensively in the field, not only to evaluate worker exposure but also to assess the effectiveness of certain substantial

changes in work by means of “before/after” measurements. A major project currently under way and aimed at developing a dosimeter that can evaluate internal changes will be finalized. Depending on the results obtained, it might then be conceivable to design a dosimeter for evaluating constraints on the lower limbs.

2.3.3.2.2 Interventions in the workplace

Aims

The studies conducted under this theme seek to analyze the intervention process used to prevent MSDs and other OHS problems, identify and apply optimal approaches, and assess their impacts.

Progress report

A major book entitled *L’intervention en ergonomie* was published. In addition to serving as a training tool for ergonomists, this publication sheds light on the approaches used in ergonomic interventions and MSD prevention. Again with a view to preventing MSDs, a field study on the implementation of job rotation in an aeronautics plant was initiated. A review of the French-language literature on participatory ergonomic interventions aimed at MSD prevention was completed. It proposes a model and grid for formally depicting all dimensions of an intervention. This study followed a review of the relevant English-language literature on participatory ergonomic interventions carried out in collaboration with the Institute for Work & Health (IWH) in Toronto, Canada. As well, the now-completed pilot study involving follow-up of CSST-inspector interventions suggests that their interventions yield positive results. Lastly, research activities on the constraints related to working with tools in the automobile repair industry were completed, and knowledge transfer activities are now under way.

Developments anticipated during the cycle

During this next cycle, the book entitled *L’intervention en ergonomie* will be translated into English to reach a broader readership. A sequel to the study on job rotation in the aeronautic sector will be carried out to evaluate the sustainability of the changes introduced in the work and to estimate the costs and benefits. Efforts will be made to disseminate the approach used in this study and explore the possibility of applying it in other situations.

It is expected that an extensive study aimed at implementing and following up on interventions designed to improve palliative care nurses’ satisfaction and well-being will be launched. This will be the sequel to a first study that revealed the problems encountered by this worker population in hospital environments.

2.3.3.2.3 Transmission of job knowledge and prudent knowledge, and training

Aims

The entire theme of job and prudent knowledge transmission and training is closely linked to the aging of the active labour force and the integration of new workers, including those ages 15 to 24.

In developed economies such as Québec's, we are witnessing an aging of the active population and the early retirement of workers from the babyboomer generation (ISQ, 2004). These retirements of experienced workers create a need for new workers in enterprises, against a backdrop of anticipated shortages in certain trades (De Long, 2004). While retirements and the end of working lives have always been part of the reality faced by organizations, the current context points to problems with transition and continuity in corporate memory.

The aims of the work carried out under this theme are to study the organizational factors that foster job and prudent knowledge transmission from experienced to novice workers, ultimately to promote the retention of aging workers in the labour force. Special attention is also paid to incorporating OHS dimensions into training courses offered in enterprises or the vocational training network.

Progress report

A major project co-funded by the IRSST and the Commission des partenaires du marché du travail (CPMT) on the transmission of job and prudent knowledge in various sectors (home support services, film industry, institutional kitchens) was completed, and promotional and knowledge transfer activities must now be organized. Lastly, collaborative activities with French and Belgian researchers resulted in the production of an organizational practices guide promoting OHS in home support services and of a research report by the Agence nationale de recherche (ANR) in France on the intergenerational transmission of experience in hospitals.

Developments anticipated during the cycle

While focusing on the OHS issues facing managers, trainers, or teachers and learners (issues that differ from one job sector or study program to another), the research anticipated over this next cycle will concern mainly the development of professional skills in the context of training courses in enterprises or the vocational training network. Few data are available on these issues, which limits the support that can be lent to organizations in their OHS training and problem prevention activities.

2.3.3.2.4 Integration of OHS into the design phase

Aims

The integration of OHS right from the design phase represents an important issue in the context of primary prevention in the workplace. This research theme focuses specifically on this issue, whether during investment or design projects.

Progress report

A large-scale activity concerning the taking into account of the work activity in engineers' practices during major design projects came to an end. This study cast light on design engineers' practices and those of a client interacting with operational resources during the design of a plant, with a view to identifying the degree of importance placed on OHS considerations and the conditions promoting OHS.

Developments anticipated during the cycle

Continuing on from previous activities, it is anticipated that a look will be taken at the situation prevailing in small enterprises. This could involve exploring strategies for offering these enterprises better support in their efforts to take work situations into account in the design or transformation process and to take preventive action in this particular context.

2.3.3.3 New thematic programs to be developed

2.3.3.3.1 Young workers ages 15 to 19 and OHS

Aims

Of all the research projects conducted on the issue of young workers and OHS, few focus on workers ages 15 to 19. From 1976 to 2005, the activity rate of these young workers rose from 43.7% to 51.8%. Also, the proportion of young workers ages 15 to 19 who work and study at the same time has nearly doubled over the past 30 years. Data from the Dépôt de données central et régional (DDCR) of the Commission de la santé et de la sécurité du travail (CSST) reveal that 21,963 workers ages 18 or under were compensated during the 2000–2007 period. In terms of severity of work-related injuries, an average of 158 workers ages 18 or under sustained serious occupational injuries with permanent sequelae each year. This means that 5.8% of the injuries documented during this period occurred in this age group. Twelve deaths of workers ages 18 and under also occurred between 2000 and 2005.

In Québec, young workers enter the job market at younger and younger ages, and the participation of young students is on the rise (ISQ, 2007). In a recent survey of 3,500 young Québec secondary school students, more than 50% of the respondents confirmed that they held remunerated jobs during the 2007–2008 school year (Gaudreault *et al.,* 2009). Moreover, a substantial proportion of students spend more

than ten hours a week working at remunerated jobs (Marshall, 2007, Ledoux *et al.,* 2008; Gaudreault *et al.,* 2009; Roy, 2008).

During this next cycle, particular attention will be paid to workers between the ages of 15 and 19 in the context of a new program on young workers and OHS. As well, this cycle will see the completion of the current program and allow the data collected to be disseminated, mainly to young people who both work and study.

Developments anticipated during the cycle

The program under way on young workers and OHS will be completed and a new program with a focus on young workers ages 15 to 19 will be proposed. The current program will end by winding up the study launched in 2011 for the purpose of producing an inventory of young-worker integration programs and practices developed by enterprises and defining guidelines for the development of new-worker orientation and safe-integration programs. The new program may draw on the data collected in the *Québec Longitudinal Study of Child Development* of the Institut de la statistique du Québec (ISQ), in which the IRSST hopes to participate, and which will provide an overview of the OHS problems experienced by young people ages 15 to 19 in connection with their work.

2.3.3.3.2 Workforce and OHS management in mines

Aims

Over the 2005 to 2007 period, the mining sector employed an average of 14,360 remunerated FTE workers, including 12,756 remunerated workers. During the same period, 1,265 work-related injuries were accepted annually. This sector accounted for 13% of occupational diseases, exceeding the average of roughly 4% for all these diseases for all sectors. Again for the same period, 34 deaths were recorded over the three years, 65% of which were attributable to occupational diseases.

In the context of the major developments anticipated in the mining sector, notably in the context of the *Plan Nord*[7], a new program will be proposed as a continuation of the large-scale project already launched in this sector concerning the integration of new workers into the mining sector. The main aims of the program will be to facilitate the safe integration of new workers and to retain aging workers, as well as to take into account the main OHS challenges that will arise from the developments associated with the *Plan Nord.*

Developments anticipated during the cycle

The study aimed at understanding the mechanisms that promote safe integration of new workers will be completed, and a new research program will be proposed. It will focus on the new OHS challenges likely to be generated by the major developments

[7] The *Plan Nord* is the broad development plan (including mining, energy, and tourism) introduced in 2011 for northern Québec.

associated with the *Plan Nord*, such as the aboriginal work force, atypical work schedules, and work in remote regions. OHS training, safe learning conditions, as well as the work of OHS teams in a context of intense activity in the mining sector announced in the *Plan Nord,* will be some of the aspects warranting consideration in this program.

2.3.3.3.3 OHS in small enterprises

Aims

Research on OHS in small enterprises, which have fewer than 50 workers, has been on the rise for the past 15 years in Québec, and the IRSST has already funded a number of research projects on this topic. In consultation with representatives of the relevant associations, a new research program will be developed that will seek to draw up a profile of the main risks faced in small enterprises and to compare them with those in medium-sized and large enterprises, as well as to develop and pilot intervention models adapted to the small enterprise context.

Developments anticipated during the cycle

To support the program's development, a proposal will be made to use databases containing pertinent information in order to draw up the profile of the OHS issues faced in small enterprises compared to those in medium-sized and large enterprises. This is an absolute prerequisite to orienting the future activities of the new program. Projects could then be focused more specifically on the preventive actions to be taken by first targeting the economic activity sectors most active in promoting OHS actions in small enterprises. Depending on the needs expressed, these projects could ultimately lead to the development of intervention models adapted to small enterprise realities. Particular attention will be paid to prevention mutual groups so that their presence in small enterprises can be factored into the profile drawn up of the OHS situation in these small firms.

2.3.3.3.4 Biomechanical modelling

Aims

Biomechanical modelling is the only non-invasive approach for estimating loading on internal structures (e.g. intervertebral discs). Over the years, the IRSST has worked with its university partners to develop well-known expertise in the development and application of models for evaluating, among other things, loading on the spinal column and the shoulder structure. Such advances are required to estimate worker exposure in the workplace and evaluate the impact of prevention interventions.

Developments anticipated during the cycle

A new program will be proposed based on the results of the current modelling studies concerning the lumbar spine and shoulder. These latter studies are endeavouring to

validate certain basic hypotheses to obtain the most pertinent entry data for accurately evaluating the externally generated forces exerted on the back and shoulder. The work is expected to continue in order to generate simple equations that can be used by OHS professionals to calculate loadings in a variety of work situations using a minimum amount of entry data for the calculations.

2.3.3.3.5 Work-related road safety

Aims

In Québec, transportation accidents rank first among the causes of death in work-related accidents. It is therefore important to devote research efforts to thoroughly understanding the causative factors and targeting the actions that will prevent road accidents in connection with the driving of vehicles for work. In addition, recognizing the importance to be placed on this subject, a first thematic scholarship on road safety was launched by the IRSST in its 2013–2014 scholarship competition program.

Developments anticipated during the cycle

Based on the results of a recently completed study that identified the circumstances under which work-related road accidents occur, a proposal will be put forward for a new research program The program will be defined following consultations with key stakeholders, including representatives of Québec's road-safety research network with whom the IRSST has connections. The research themes to be considered include the development and application of methods for measuring and tools for evaluating the risks of road accidents, as well as the development of management processes and tools for preventing work-related road accidents.

2.4 Occupational Rehabilitation

Context

While the number of people in the labour force grew steadily from 2000 to 2008, the annual number of work-related time-loss injuries (TLIs) continued to decline. Conversely, the proportion of cases referred for rehabilitation rose yearly, increasing from 5% of all injuries in 2000 to 9% in 2008. The number of compensated rehabilitation days also continued to rise. Differences were observed according to economic activity sector, gender, age, and administrative region where the injuries were reported. It was clearly established that the duration of the compensation period increased with worker age and was longer among men, who accounted for two-thirds of the cases referred for rehabilitation. However, proportionally speaking, the rate of referral for rehabilitation was higher among women. From 2005 to 2007, 8% of the injuries involving referral for rehabilitation accounted for 58% of all income replacement indemnity payouts.

Goals

Occupational rehabilitation research helps to prevent or reduce the risks of prolonged disability in workers who sustain work-related injuries and to support both the CSST's service offer and clinical and workplace interventions. More specifically, it involves using evidence-based data to support the sustainable and safe return to work of workers with such injuries. This is achieved by studying (1) the various personal, organizational, administrative, and healthcare-system-related factors that facilitate or hinder the return-to-work process, and (2) methods of intervention for rehabilitating workers or reintegrating them into the labour force.

Research orientations

The research activities carried out under the Occupational Rehabilitation field revolve around four major orientations:

- development of tools for assessing the health of workers who have sustained work-related injuries and are at risk of disability;
- study of the personal, clinical, organizational, and administrative determinants of a return to work;
- development and implementation of rehabilitation and return-to-work interventions;
- development and implementation of tools designed for rehabilitation and return-to-work professionals.

2.4.1 Putting the field's priority issues into perspective based on statistical data

Of the 7,600 work-related injuries involving referral for **rehabilitation** annually from 2005 to 2007, the anatomical site in 30% of the cases was the **back**, representing an annual average of approximately 2,200 cases a year. Of all back injuries (with or without referral for rehabilitation), 19% were associated with traumatic accidents, 74% with MSDs, and 8% could not be classified.

Back injuries involving referral for rehabilitation represented 9% and 7% of the cases associated with traumatic accidents and MSDs respectively, 58% and 55% of the compensation days respectively, and 59% and 54% of the payouts respectively. Nearly three-quarters of the back-related time-loss injuries (TLIs) involving referral for rehabilitation concerned manual workers. Moreover, the FTE frequency-severity rate for these workers was considerably higher than for other workers, and workers ages 45 and older were generally overrepresented. The low back region accounted for 70% of the back injuries involving referral for rehabilitation. However, this proportion varied somewhat according to occupational category, gender, and age group.

Adding the occupational category dimension to the five main injury sites, it appears that manual workers sustained more hand and finger injuries involving referral for

rehabilitation, while workers with mixed functions sustained more back injuries[8]. Among non-manual workers, the proportion of cases involving referral for rehabilitation was higher for multiple injury sites.

Non-manual workers sustained slightly fewer sprains/strains and musculoskeletal disorders. Yet compared to other workers, they represented a much larger proportion of psychological disorder cases involving referral for rehabilitation. This type of injury represented a little more than 2% of all injuries involving referral for rehabilitation among manual workers.

Sprains/strains were the primary type of injury involving referral for rehabilitation, accounting for 78% of the cases and 74% of the payouts. These proportions varied slightly by sex, but negligibly by occupational category and age group. Excessive exertion (mainly when lifting) accounted for 49% of the cases referred for rehabilitation and 47% of the total indemnity payouts for back injuries.

Major variations existed between economic activity sectors and occupational groups. In workers ages 25 and older, the 15 occupational sub-groups with the largest number of injuries involving referral for rehabilitation accounted for between 55% and 61% of all cases, total payouts, and compensated days. The five most heavily represented sub-groups were, in order of importance: (1) material handlers, (2) road equipment operators, (3) other construction workers, (4) workers not classified elsewhere, and (5) specialized personnel, nurses, and other healthcare therapists and assistants. With the exception of other construction workers, specialized workers (metal products), and workers not classified elsewhere, more than 67% of the cases occurring in each of the high-injury-volume sub-groups were found within only one or two occupations.

2.4.2 Putting the field's priority issues into perspective based on research mapping and scientific monitoring and surveillance

For the Occupational Rehabilitation field, research mapping of the 2008–2010 period resulted in the documentation of 172 projects at ten research organizations, including the National Institute for Occupational Safety and Health (NIOSH) in the United States, the Health and Safety Executive (HSE) in the United Kingdom, the Institut National de recherche et de sécurité (INRS) in France, the Institute for Occupational Safety and Health (IFA, formerly BGIA) in Germany, WorkSafeBC (WSBC) in British Columbia, Canada, the Institute for Work and Health (IWH) in Ontario, Canada, the Workers Safety and Insurance Board (WSIB) also in Ontario, Liberty Mutual in the United States, the Finnish Institute for Occupational Health (FIOH), and the IRSST.

Analysis of these mappings revealed that the IRSST ranked third in terms of number of projects documented, with 19% of the research activities. Ontario's IWH ranked first, with 29% of the projects. The Canadian organizations alone accounted for 64% of the

[8] Occupations that require carrying out activities which are physically light and continuous, or intense and sporadic (e.g. nursing personnel, hair stylists, or technicians).

projects documented, thus illustrating the importance placed on this research niche. The most predominant research orientation was the determinants of disability and the return to work, which represented 43% of all the projects.

The mapping of occupational rehabilitation research made it possible to draw up a profile of the research conducted in this field and of the orientations and themes generating the largest number of projects. It also served to identify new issues. The subject of determinants related to workers' personal characteristics (e.g. perceptions and attitudes) was extensively developed during the years 2000 to 2010 and continues to be of great interest. However, increases in the numbers of certain projects indicate a shift in interest toward workplace-related determinants. While the investigation of personal factors remains predominant, the trend would suggest that an understanding of the social and interpersonal dimensions is increasingly a topic of study, e.g. work context, family, social networks, industrial relations, OHS management, and absence management in the workplace.

Regarding the development of intervention models and return-to-work support tools, the research results are still intended mainly for clinical settings even if an increase in the number of projects aimed at workplaces has been witnessed. However, this latter trend does not appear to reflect the concerns formulated in international forums such as the Musculoskeletal Disorders and Chronic Pain Conference held in Los Angeles in February 2011. At this conference, researchers and medical consultants from insurance companies enunciated a clear need for the development of practice guides. They lamented the excessively long delays between the publication of scientific data and their application in practice settings. In the research mapping done, insurers rarely appeared as a target of initiatives involving the development of RTW support tools, an issue reiterated at the Los Angeles Conference where these same stakeholders stressed the need to properly educate their partners (enterprises, third-party payers) to promote sound disability management.

The mapping of rehabilitation research also revealed the emergence of new themes such as that of workers in vulnerable situations. This category of workers is exposed to increased risks of work-related injuries and long-term disability. Gender (mainly women and OHS) is an issue that has been recognized for some time in the rehabilitation field. Also, for the past few years, the aging of the labour force and increase in immigrant workers and workers from ethnocultural minorities have been garnering growing attention in the rehabilitation field. With respect to the aging labour force, related themes also come up and are often defined in terms of comorbidity. For example, obesity and problems of excess weight are of concern to a growing number of stakeholders in the OHS field. They are also the leading factor in long-term disability in workers with gonarthrosis (osteoarthritis of the knee) and are generally found in the older segments of the active labour force. Similarly, regarding the theme of immigrant workers, the CSST considers that more than half of the compensation claims come from this group of workers, who face numerous work-related difficulties such as cultural and linguistic barriers, limited possibilities of occupational requalification, and precarious employment. A study commissioned by the Direction de la santé publique de Montréal in 2005

reported an increase of over 40% in intervention time for immigrant workers, and recommended, among other things, supporting the cultural adaptation of existing programs and documents and promoting the adaptation of screening tools to reflect migration realities. The CSST's 2010–2014 strategic plan in fact places particular emphasis on promoting sustainable prevention by targeting vulnerable immigrant workers in particular.

While certain groups are in vulnerable situations, their concentration in higher-risk sectors plays a major role in the prevalence and distribution of work-related injuries. This applies as much to immigrant and female workers as to the entire working population. For this reason, researchers are studying work contexts and specific sectors more frequently. Currently, the health and social services sector is the focus of increasing investigation. In the research mapping of the Occupational Rehabilitation field, the proportion of these types of projects rose from 4% for the 2002–2007 period to 8% for 2008–2010. Overall, rehabilitation projects concerning a specific sector rose from 12% to 22% between these periods. This reflects a need for improved understanding of workers' reality if we are to intervene more effectively on two fronts: early intervention and post-rehabilitation employment retention.

2.4.3 Current and future programs and themes

The following section presents the program for this field in two main categories: (a) current research themes, and (b) thematic programs to be developed. It is proposed that the current development of three themes continue and that a new thematic program be defined over this five-year cycle.

2.4.3.1 Current research themes

2.4.3.1.1 Risk of prolonged disability among workers

Aims

It is a recognized fact that a small proportion of workers who have sustained work-related injuries develops prolonged disability and accounts for the largest portion of compensation payouts. The focus of this research theme is the worker, and the aim is twofold: to define the predictors of prolonged disability in terms of days of work absence and to target the highest-risk groups. To achieve this aim and support a prompter return to work, it is essential both to improve knowledge of the main indicators and to develop prediction tools.

Progress report

Significant advances were made regarding this theme during the 2009–2011 three-year cycle. Two main risk categories were studied: personal risks and risks related to the work environment. The study of personal risks covers both emotional and cognitive risk factors, physiological factors, and workers' sociodemographic characteristics.

In terms of personal factors, the relationship between the presence of depressive symptoms and disabilities in workers suffering from persistent pain was documented. More specific projects on the factors influencing the work reintegration of workers suffering from depression are under way and should allow for the design of return-to-work (RTW) support tools for workplaces. Another study focused on anxiety to show how it can be associated with an unfavourable RTW prognosis and even culminate in depression. The study of physiological factors made significant headway during this last cycle. For workers with persistent low back pain, it was shown that excessively heavy environmental demands can undermine the body's defence mechanisms and render it more vulnerable to the risk of prolonged disability following injury. Also, an early screening questionnaire for chronic disability related to low back pain was designed.

Shortly before the implementation of the 2009–2011 Three-Year Plan, an exploratory study on pain representations generated other projects that advanced the work on the determinants of disability. Inspired by these activities, researchers initiated a study on shared decision making (clinician and worker) and endeavoured to develop a program theory that would enrich existing approaches in terms of the therapeutic relationship. A postdoctoral study was conducted on gender- and sex-related determinants, and a new instrument specifically adapted to MSDs was designed to measure sickness perception. Little was done in terms of studying sociodemographic factors during the 2009–2011 cycle. However, a knowledge review concerning immigrant workers or workers from cultural minorities was conducted to extract the main risk factors associated with this growing contingent of the labour force. This theme is expected to be part of a proposal for a more in-depth program during the 2013–2017 five-year cycle.

Developments anticipated during the cycle

The development of a screening tool (clinical prediction rule) for identifying patients with non-acute low back pain who respond best to a lumbar stabilization exercise program will begin. The results of clinical examinations in a physiotherapy context will provide the main indicators. Along the same lines, a current study concerning the effects, on long-term disability, of an early screening program aimed at workers compensated for work-related low back pain will be completed. This screening process is based on psychosocial indicators and should provide CSST professionals with a useful reference point. Also, it is expected that the inventory of factors influencing the work reintegration of workers with psychological injuries will be updated through another study that is likely to end. A proposal will be made to initiate research that will improve understanding of disability risk factors, which can be personal, environmental, and systemic in nature, and of the interaction among them. Improved understanding of these complex interactions should be helpful in guiding rehabilitation approaches and promoting a prompter return to work.

2.4.3.1.2 Support for interventions in clinical settings

Aims

One of the aims of this theme is to improve interventions carried out in the healthcare system in order to ensure the most effective action possible. A second aim is to speed up the rehabilitation process so as to initiate occupational reintegration gradually or completely, while ensuring the safety of injured workers and better adaptation of services to their specific needs.

Progress report

Several tools for evaluating worker health were produced during the 2009–2011 cycle, including a practice guide on the evaluation of work-related capacities for workers with a physical impairment. This guide allows informed choices to be made, from among the many available tools, of the best approach to use in light of the goals, finally providing clinicians with guidelines to support them in their choices**.** A work disability diagnostic interview tool (WoDDI) was also produced for individuals on prolonged absence for mental health reasons.

Research projects on the development of physiological and biomechanical measurement tools yielded results. Work on the evaluation of low back pain is sufficiently advanced that it can be used in activities involving the evaluation of certain exercise programs. The development of radiological indices for the upper extremities was begun for purposes of evaluating the condition of the shoulders. Regarding the lower extremities, the topic of osteoarthritis of the knee is currently the focus of a knowledge review of the evaluation tools and interventions available to clinicians, being conducted in the context of the IRSST-REPAR/FRQS partnership. Another project stemming from this partnership got under way in 2012; its focus is shoulder injuries.

Developments anticipated during the cycle

Again in the context of the IRSST-REPAR/FRQS partnership, two knowledge reviews will be produced to shed light on the evaluation and intervention methods associated with specific joint problems. The first will concern workers with osteoarthritis of the knee, and the second, shoulder problems. Other injury sites may be targeted to launch other studies related to this partnership. Regarding shoulder injuries, radiological indices for predicting chronicity of problems related to this joint will also be produced.

A guide for evaluating the margin of manœuvre in a work situation will be developed as a tool adapted for clients with prolonged disability of musculoskeletal origin. Lastly, a program for shared decision making by occupational therapists and workers with a work disability attributable to a persistent musculoskeletal disorder will be developed and implemented.

2.4.3.1.3 Support for return-to-work interventions in the workplace

Aims

When workers are ready to begin a gradual or complete return to work, the various stakeholders in this process (e.g. insurer, clinical setting, and employer) must be involved in order to promote a safe, sustainable return. The aim of this theme is therefore to develop interventions and tools that will allow these various stakeholders to play their roles optimally. The CSST's 2010–2014 strategic plan also places particular emphasis on ways of assisting workers and supporting them in a prompt, sustainable return-to-work process.

Progress report

This theme is intended to address the lack of evaluation and intervention tools that would bridge the gap between interventions carried out in the healthcare system and work reintegration. Substantial progress was made during the 2009–2011 cycle regarding psychological health problems. Work was initiated on the interventions to be carried out with workers who have sustained post-traumatic stress and for the purpose of studying factors facilitating a return to work in workers suffering from depression. One research group has several accomplishments to its credit, including the production of a guide to return-to-work support practices following an absence due to a mental health problem; the design, implementation, and evaluation of an integrated program of practices for supporting a return to work; and a pilot project concerning a psychological health intervention that takes into account the organizational aspects of workplaces.

A literature review conducted during the last cycle revealed that companies' usual intervention strategies focus mainly on workers rather than on management or work organization practices. The coordination of efforts among stakeholders in the healthcare system (attending physician and other health professionals) and the workplace (e.g. immediate superior, employer, union, RTW coordinator) and the insurer (compensation agent, rehabilitation counsellor) is necessary to promote the return to work. The investigation of all these dimensions in interventions involving companies has only just begun. Clearly much work remains to be done in relation to this theme.

Developments anticipated during the cycle

Research activities will continue focussing on the return-to-work processes to put in place following a musculoskeletal injury or psychological health disorder at work. Moreover, one study will investigate the approaches taken by professionals involved in coordinating the return to work in companies, while another will look at the processes used by workplaces to ensure a safe and sustainable return to work of workers who have sustained an injury. A proposal will also be made for the design of an ergonomic workload-evaluation tool for stakeholders who coordinate the return to work in companies. Special attention will be paid to small and medium-sized enterprises to generate knowledge that will help them develop RTW practices adapted to their context.

These projects will be carried out in collaboration with the research chair in work rehabilitation.

Several current projects will be completed, including a study on the risk factors for depression as perceived by union representatives, another on the validation of a screening questionnaire for workers with a transient mental disorder, and a third exploring the adaptation of an individual-based rehabilitation approach to an organization-based prevention approach aimed at preserving psychological health in the workplace. Lastly, two intervention programs will be evaluated: one specific to post-traumatic stress and a second concerning psychological injuries in general.

2.4.3.2 New thematic program to be developed

2.4.3.2.1 Protection and support for workers in vulnerable situations

Aims

Workers in vulnerable situations are individuals who, based on their sociodemographic or occupational characteristics and the related work contexts, run a greater risk of occupational injury or prolonged disability. They include young people, aging workers, women, immigrant workers, and workers from ethnocultural minorities.

The aims of this research theme over the 2013–2017 five-year cycle is to gain a better understanding of these specific categories of workers and to evaluate their needs. Projects will be proposed to identify the occupational trajectories of certain categories of workers in vulnerable situations; to improve understanding of the specific work contexts that expose them to situations of greater vulnerability; and to help design return-to-work support tools that target specific needs, from the prevention of disabilities to the promotion of rehabilitation and the return to work following a prolonged absence. Inasmuch as the evaluation allows for it, studies will be proposed for the purpose of investigating the variables associated with gender/sex, age, and immigrant workers, or workers from ethnocultural minorities. In addition, a partnership project with the Canadian Institutes of Health Research (CIHR) could lead to the creation of a research chair on the question of gender as it relates to OHS.

2.5 Research planning tools

2.5.1 Scientific monitoring by field

The process of organized scientific monitoring plays a key role in establishing the Institute’s research program. More specifically, scientific monitoring has four components: research field mapping, identifying emerging issues, producing knowledge reviews, and information monitoring.

Research field mapping consists of preparing, for each of the Institute’s priority fields, a profile of the research conducted in the main OHS research centres worldwide, by identifying the themes and subjects studied and drafting a list of researchers or

research groups associated with these centres as well as their main areas of expertise. The activities related to this component are expected to continue periodically over the 2013–2017 five-year cycle, given that the most recent mappings were updated in 2011 for each of the prevailing research fields at that time. The preceding sections on the research fields have referred to these mappings.

The identification of emerging issues pertinent to the Québec context involves two complementary processes: passive and active monitoring. Passive monitoring consists of documenting and analyzing the content of existing documents likely to touch on future issues (conference proceedings annual reports, and main publications of organizations active in OHS). Since the fall of 2009, active monitoring has involved the online posting of thematic blogs related to the Institute's research fields, using information obtained through daily monitoring of over 650 Web pages. These blogs will be maintained and adjusted to the new fields.

The production of status reports provides a snapshot at a given moment in time of the main issues related to a target OHS issue. This type of information serves as an extremely useful tool when a position has to be taken on the type of research to prioritize and the resources to be deployed to adequately address certain issues. Several status reports have already been produced for each of the research fields at the rate of one or two per field per year. This type of document will continue to be produced for each field. Depending on the scope and interest of certain status reports, the IRSST will assess the possibility of ensuring their dissemination to a broad public or even of producing an official publication.

Carried out with the Documentation Centre's assistance, information monitoring consists of identifying and redistributing information that might be useful to members of each research field. This operation is expected to be ongoing; to date it has taken the form of email messages providing hyperlinks to, for example, very recent publications or pertinent information from a Web site. Other means could be explored over this new cycle.

2.5.2 Statistical surveillance

Since 2006, an analysis-by-field approach has been added to the broader statistical surveillance of all compensated work-related injuries in Québec. Both approaches remain relevant for the 2013–2017 five-year cycle.

More specifically, the activities carried out by the Statistical Surveillance Group are intended to produce, develop, analyze, interpret, and disseminate statistical indicators for each of the fields in order to support the Institute's strategic orientations and research programs. Based primarily on data concerning compensated work-related injuries in Québec, the activities of the statistical surveillance analysts seek to identify the activity sectors, occupations, and populations at risk; to detect trends; to bring to light certain research issues related to the fields, and to provide statistical information on particular issues.

The activities of the Statistical Surveillance Group can be divided into three categories: comprehensive surveillance, surveillance by field, and statistical knowledge activities.

For more than 25 years, the IRSST has been conducting statistical studies (namely producing five-year indicators) aimed at measuring the frequency and severity of work-related injuries by industry and occupational category. These studies are intended to provide the backdrop for OHS indicators in Québec. After each census period, the Group therefore produces five-year indicators. As these indicators are relevant to defining research orientations, this activity will continue with the production of five-year indicators applicable to the 2010–2012 period.

While essential to the identification of industries and occupational categories with the highest injury frequency and severity rates, the five-year indicators do not, however, identify short-term changes and trends. During the 2009–2011 period, it was shown that annual indicators could be produced. Over the 2013–2017 five-year cycle, it is therefore planned to develop these indicators on a broader basis and to produce them for the research fields that have the necessary data available. These indicators will allow for faster detection of changes in terms of risk or severity of work-related injuries.

As a continuation of two studies conducted on the costs of work-related injuries, there are also plans to develop economic indicators that can then be analyzed for different worker groups or injury types.

The aim of statistical surveillance by field is to present statistical profiles of work-related injuries; to measure the risks, severity, and costs of these injuries; and to identify target groups and exposed populations for the fields where relevant indicators can be produced. Statistical surveillance activities by field will continue, with adaptations made to suit the new fields.

Over the 2013–2017 five-year cycle, the production of situational profiles should continue in light of the needs identified by the research fields. The statistical profiles produced using the five-year indicators applicable to the 2000–2002 period will be updated in light of the new five-year indicators applicable to 2005–2007. Profiles related to monitoring activities or specific problems could also be produced.

In terms of statistical knowledge, projects could be initiated to explore in greater depth certain factors (e.g. aging of the labour force) that are likely to have an impact on the frequency and severity of work-related injuries in order to gain a better understanding of the determinants. It is conceivable that data emerging from the EQCOTESST study published in 2011 could eventually be used to shed more light on certain risk factors and provide better guidelines for choosing preventive actions.

2.5.3 Scientific events and activities

Since 2006, a scientific activities and events program was launched in the different research fields to encourage scientific exchanges and collaborations, drive the research

program, and ensure the Institute’s scientific leadership. These events and activities took various forms, such as symposia, seminars, lectures, or informal meetings involving researchers and sometimes partners from the OHS network. Such events and activities can be extremely helpful for taking stock of specific subjects or themes, identifying research issues, fuelling the reflection process in order to define research projects and programs, and sharing research results or new approaches. It is anticipated that this program will continue in each of the fields over the 2013–2017 five-year cycle with at least one event held each year.

3. THE NEXT GENERATION OF RESEARCHERS

The IRSST's research development strategy relies on its own scientific resources and those available within universities and public or private research centres. Given the many retirements anticipated over the next few years, both internally and externally, ensuring the availability of a critical mass of researchers to meet the needs of the research fields has become a top-priority challenge. This observation concurs with one of the concerns stated in the 2011 institutional evaluation report. To address it, the IRSST plans to act on three fronts over the 2013–2017 five-year period: internal recruitment, consolidation of the pool of external researchers, and training of a new generation of young researchers.

3.1 Internal succession plan

The question of renewing its workforce is a pressing one for the IRSST, as many of its employees now have nearly 30 years of service. While the Institute succeeds year after year in filling routine positions for technical, professional, or office staff and foresees no particular problem in this regard, it is quite another matter when it comes to research positions. The Institute has recurrent problems when it comes to filling certain researcher positions, particularly in the Mechanical and Physical Risk Prevention and Chemical and Biological Hazard Prevention fields. This situation was deemed sufficiently critical that in the summer of 2009, a special committee was struck under the Scientific Advisory Board to address the succession issue. It became abundantly clear from the committee's work that the usual recruitment methods, while they had to be maintained, would be insufficient to meet all the anticipated needs. It was proposed that staffing programs be established in fields where the external supply of new researchers was scarce or nonexistent. Since 2010, thanks to a budget earmarked for internal human resource development, the Institute has therefore released from their routine tasks a number of employees with manifest aptitudes for and interest in graduate studies in certain target sectors to allow them to pursue a research career. As this approach has already begun bearing fruit, the Institute intends to continue along this path. Under these programs, three candidates who recently registered in doctoral programs are expected to complete their studies over the 2013–2017 five-year cycle in the fields of machine safety, chemistry, and industrial toxicology.

Another area of expertise experiencing particular recruitment difficulties is that of protective equipment. Given the IRSST's unsuccessful efforts in recruiting a researcher in this field, an alternative strategy is envisaged. The Institute will endeavour to interest a postdoctoral candidate to orient his or her work toward OHS by inviting the person to spend time at the Institute and offering job prospects at the end of his or her postdoctoral internship, either within the Institute itself or on university research teams.

Complementing the efforts made to sustainably strengthen the internal teams, a number of processes, mainly in the form of agreements with universities, provide access to valuable resources and expertise, making it possible to respond on an ad hoc basis to needs identified in the various research fields. The hosting of high-calibre researchers

from abroad who are on sabbatical or professional development leave constitutes a promising avenue to pursue. The Institute therefore plans to promote such arrangements during the 2013–2017 five-year cycle.

Lastly, the IRSST actively hosts and supervises trainees at all levels of studies. These trainees make a highly valued contribution in the fields for which new researchers are few and far between. The Institute intends to pursue its commitment in this regard, in view of the extremely positive results observed to date.

3.2 External succession plan

As a funding organization, the IRSST has an array of means (grant programs, research chairs, special competitions, contracts, and sponsorships) for encouraging external researchers to pursue work in the OHS field. Over the years, this has allowed it to play a key role in building and putting down firm roots for the growth of a large community of occupational health and safety researchers in Québec. However, the impacts of attrition have also been felt in recent years due in part to the retirement of many university researchers. The Institute hopes over the 2013–2017 five-year cycle to slow this erosion of resources by mobilizing a large number of researchers, mainly at universities, to conduct OHS research.

Grant programs remain the core of the IRSST's strategy. A vast promotional campaign aimed at publicizing these programs among both seasoned and novice researchers will therefore be developed and implemented (e.g. presentation tours at universities, advertisements in academic journals, promotional videos, and Web alerts). Nor does the Institute rule out the possibility of the occasional targeted canvassing of certain university establishments or of directly approaching certain researchers who have unique expertise likely to support the development of priority themes.

On the administrative level, the Institute is also aiming to simplify the process of filing and processing grant applications. The recent introduction of a streamlined version of the *Letter of intent* form considerably reduced the requirements formerly involved in filing a grant application with the IRSST. This change has already met with a very positive response from the scientific community. In addition, efforts to improve research project management (see details in section 4), currently being piloted with the Institute's internal researchers, should eventually be extended to external researchers and provide them with greater support during the research-proposal preparation phase. Lastly, the online posting of electronic forms, which is planned over the 2013–2017 five-year cycle, should facilitate the exchange of information and speed up file processing.

The creation of research chairs provides another means of stimulating external OHS research and of attracting new researchers. The Institute therefore intends to continue supporting current chairs, i.e. the Research Chair in Protective Materials and Equipment for Occupational Safety and Health at the ÉTS, the *Chaire en analyse des risques toxicologiques en santé humaine* (chair in human health toxicological risk assessment) at the Université de Montréal, the Chair in Occupational Health and Safety Management

at Université Laval, and the Chair in Work Rehabilitation at the Université de Sherbrooke. In addition, discussions are currently under way regarding possible support for two new chairs, one on bioaerosols and respiratory health at Université Laval and the other on ecoacoustics at the Université de Sherbrooke.

On another front, the IRSST recently accepted to join forces with the CIHR, with the summer 2012 announcement of the establishment of a five-year research chair program on gender, work, and health. These chairs will be awarded to experienced researchers through a national competition and the results publicized in early 2013. Not only will the awarding of one or more chairs to Québec researchers build researcher loyalty in the OHS field, but it will help position the IRSST as an influential player in research on the issue of gender in the field of occupational health and safety.

Furthermore, the Institute partnered with the Fonds de recherche du Québec (Nature and Technology, Health, Society and Culture) to support two networks: the Réseau de recherche en santé et en sécurité du travail du Québec (RRSSTQ) and the NE^{3}LS Knowledge Network on the Ethical, Environmental, Economic, Social, Legal, and Social Issues regarding Nanotechnology Development. These networks represent interinstitutional and interdisciplinary structures that allow researchers to group together around shared interests in efforts to strengthen research. It is conceivable that the activities of these two networks continue over the next few years and that other potential networks emerge.

3.3 Training of new researchers

The Institute plays an important role in training new researchers and developing their interest in OHS research. Its Graduate Studies Scholarship program gives over 30 master's, doctoral, and postdoctoral students annually an opportunity to improve their knowledge in this field. The scholarships will therefore be maintained, including the thematic scholarships offered to applicants investigating problems related specifically to mechanical risks (e.g. cuts, lacerations, needle punctures, crushing, contact with machines, falls from heights and due to slipping, and trench cave-ins).

The Graduate Studies Scholarship program is not the only means of supporting the training of future researchers. At the Institute, this support is also offered through a variety of practices such as hosting trainees, integrating students into scientific activities, and supervising master's or doctoral work by internal researchers who have associate professor status in a university department. These efforts will continue.

In a survey of external research collaborators conducted as part of the 2011 institutional evaluation, over 90% of the respondents unequivocally lauded the IRSST's exceptional contribution to the training of the next generation of OHS researchers in Québec.

Yet despite this success, the Institute is not satisfied with the status quo. Rather, it considers that additional efforts are needed over the 2013–2017 five-year cycle to ensure that OHS training translates concretely into OHS research careers. One of the

initiatives envisaged to facilitate this transition of young graduates to enriching careers would be the establishment of a special program for young researchers. The aim will be to facilitate, by different means such as start-up funds or the easing of grant access requirements, the funding of new research projects submitted by young, not-yet-established researchers. A reflection process will be initiated early in the cycle to define more specifically the parameters to be prioritized for this type of program.

Along the same lines, discussions began early in the year with the Chief Scientist of Québec to explore how the IRSST and the Fonds de recherche du Québec, which shares a common concern for the succession, could join forces and optimize their efforts to renew the researcher pool. A few avenues have been explored to date, including setting up a joint program for junior research scholars. The IRSST sees this as an ideal opportunity for attracting and building the loyalty of high-calibre applicants in certain areas of expertise for which current resources still appear to be extremely limited. As the discussions with the Chief Scientist are in the very early stages, they are expected to continue over the 2013–2017 five-year cycle in order to establish a partnership allowing for the implementation of such a program.

4. PROJECT MANAGEMENT

An internal audit at the IRSST in 2009 brought to light problems in terms of meeting deadlines during the execution of research projects. Despite periodic reminders to researchers, there was a significant time gap between the date of receipt of the final research reports and their publication dates compared to the schedule established when the research protocols and designs were accepted. Given the importance placed by the IRSST on ensuring that workplaces are parties to the studies launched, it is vital to ensure that these studies address the needs expressed as effectively as possible and within the shortest timeframes. In fact, the IRSST's added value is not measured solely in terms of its contribution to the advancement of knowledge, but also its ability to effectively produce and transfer knowledge in a manner that promotes its uptake and use by the workplaces concerned. This implies that the activities and projects have been designed, planned, and carried out with maximum efficiency, foresight, and impact. A process aimed at improved research project management was therefore initiated at the IRSST in 2011 and should be fully implemented during the 2013–2017 five-year cycle.

The project-management improvement process is now underway to increase both the scientific merit and organizational efficiency of research activities. It is built around three phases: project "emergence," planning, and execution. The process involves implementing a system of *portes* (progress milestones), which constitute key times for conducting assessments both before and after a project and for deciding what adjustments are needed and what opportunities should be grabbed. Project "emergence" involves initial reflection on and clear identification of the issues and needs faced and knowledge transfer products required, all with the input of the workplaces concerned. Planning involves deploying the activity tree (work breakdown structure) related to the project in order to optimize the quality/time/resource triad. The main dimensions to be tracked throughout the project are identified at this stage, which leads to the submission of a research proposal or protocol. Lastly, execution includes all steps leading to the production of deliverables, including the identification of problems and solutions, follow-up at the various milestones, and post-project evaluation (project post-mortem).

To date, the IRSST's researchers have received training on research project management and participated in pilot experiments exploring the feasibility and acceptability of the "progress milestones" process. This was done for various projects at different stages, from pre-project planning, to start-up, completion, and post-project evaluation. Given the conclusive nature of the pilot experiments, it is anticipated that this exploration phase will be followed by a trial implementation phase, which would constitute a transitional system. In turn, this should lead to implementation of a permanent system for internal researchers in early 2013. Over the 2013–2017 five-year cycle, the IRSST therefore plans to introduce project management practices combining scientific quality with organizational efficiency. This project management process will essentially be centred on the following aspects:

- Implementation of a follow-up system called progress milestones, which comprises planned steps for reviewing accomplishments, identifying problems, planning subsequent steps, and making necessary adjustments. This follow-up will cover all phases of a project from its emergence to filing of deliverables. It will first be implemented for internal projects and joint internal/external projects. It will then be adapted for extension to projects for which the principal investigator is an external resource;
- Establishing a scorecard designed to allow for more efficient follow-up of the progress of the IRSST's entire project portfolio;
- Evaluation of the impacts of the project management process on the quality/time/resource triad.

Prior to formal implementation, the parameters applicable to the different types of milestones must be defined: pre-project planning milestone, start-up milestone, progress milestone, special milestone, and post-project evaluation milestone. It will also be necessary to recruit and train external facilitators to lead the progress milestones meetings. The system is expected to be fully operational by the end of 2014 for all research projects funded by the IRSST. Its real impact on research-project execution times and compliance with schedules may then be evaluated.

5. VISIBILITY AND INFORMATION DISSEMINATION

5.1 Institutional visibility

The IRSST's Communications and Knowledge Transfer Division plans and manages activities focused on promoting and transferring the Institute's new knowledge, information, products and methods. In terms of information dissemination, whether by publishing its online information newsletter, launching various products on the Institute's Web site, contributing to *Prévention au travail* magazine, participating in the organization of scientific events, or assuring its presence in the social networks, this team ensures visibility for the organization, its staff, and its products.

5.1.1 The IRSST's Web sites

From 2006 to 2011, the number of visitors to the IRSST's Web site more than tripled. This traffic, which does not take into account visits to the other IRSST-managed websites, also reflects the very marked increase in the number of PDF document downloads from the Web site. Only documents downloaded in their entirety are counted, in the context of the IRSST's free-download policy concerning research documents.

The IRSST's Web site is its main vehicle for promoting its work, products, and personnel. A major revamping of this Web site that began in the preceding three-year cycle should culminate during this new cycle with the launching of a totally upgraded, more attractive, user-friendly, and high-performance version. The new site will present the new organizational structure and research fields, and provide information on some of the original achievements arising from the Institute's scientific monitoring and statistical surveillance activities.

The new site will differ from its predecessor with its modern, high-performance search engine, better integration of the social web and a new Web site architecture based on the organization's research priorities and clienteles.

5.1.2 InfoIRSST electronic newsletter

The *InfoIRSST* electronic newsletter publicizes news about the Institute's activities and laboratories, new research projects, and latest publications. During the preceding three-year cycle, the number of subscribers grew continuously, reaching 18,178 in 2011. It is anticipated that over the 2013–2017 cycle, the newsletter will continue to be produced and promotional campaigns targeting other clients will be launched to increase the visibility of the Institute, its personnel, and their work in the public eye.

5.1.3 Prévention au travail magazine

A joint publication of the IRSST and the CSST, *Prévention au travail* magazine is designed to encourage prevention management and initiatives in all workplaces by

offering practical solutions and presenting research results. The magazine is issued four times a year, and had a print run of 26,000 in 2011.

This magazine is also available in electronic format. Its Web site provides information supplements to the print articles. In 2011, over 30,000 visits were recorded to pages on the IRSST's work and a comparable number of article downloads concerning the IRSST's activities and research results.

A 2011 survey of *Prévention au travail* subscribers confirmed that the vast majority (90%) appreciated the form and content and regarded the magazine as useful in their workplace. Over half of them use it for training purposes or make it available in a common space within their company. Based on the results obtained, the magazine graphics have since been upgraded and its content adapted. The two co-editors—the IRSST and the CSST—each have a Web site for the magazine. During the 2013–2017 five-year cycle, they will merge these sites. An information letter related to *Prévention au travail* will also be produced.

5.1.4 The IRSST's thematic Web sites

To meet the needs voiced by its partners and workplaces, the IRSST deemed it pertinent to design thematic Web sites with the help of contributors. These initiatives allow for the transfer of the IRSST's research results, notably in the following three areas:

- Manual material handling (http://www.irsst.qc.ca/manutention)
- Protective gloves (http://www.irsst.qc.ca/gants/fr/index.html)
- Substitution of solvents (http://www.irsst.qc.ca/solub/)

Launched at the end of 2008, the ***Manutention manuelle*** Web site (in French only) offers quick access to the most pertinent and recent data on manual material handling and on ways to prevent back injuries. More than 60,000 visitors visited this site during the last two years.

The ***Protective Gloves Selection Guide*** Web site comprises an interactive selection tool. It provides the information necessary to help individuals and those in charge of OHS to identify appropriate protective gloves for their needs. In 2011, this site had more than 3,000 visitors.

The ***SOLUB*** (in French only) Web site was launched at the end of 2011 to support professionals who are undertaking a systematic approach to finding substitutes for solvents in the workplace. This approach takes into account the technical, financial, health- and safety-related, environmental, human, and organizational issues facing workplaces. It was visited by more than 10,000 people.

These three Web sites will be maintained over the 2013–2017 five-year cycle and their content adapted in light of results emerging from any new studies carried out.

5.1.5 The social networks

The Communications and Knowledge Transfer Division also ensures the Institute's visibility in the social media. The IRSST's Twitter account was followed by 627 subscribers in 2011; more than 700 individuals liked its French and English Facebook pages; nearly 400 people visited its LinkedIn page, and more than 12,000 people viewed one or another of the Institute's 63 videos on its YouTube page. The Institute's presence on these networks allows a younger clientele to be reached and targeted in light of their particular OHS research interests. The IRSST will maintain its presence on these networks over the 2013–2017 cycle.

5.1.6 Mentions of the IRSST in media reviews

The media reviews produced by the Communications and Knowledge Transfer Division over the 2005–2011 period led to the compilation of more than 2,000 pages of magazine, journal, newsletter, and Web site articles that mentioned the IRSST's work and personnel. A promotional activity was carried out in 2007 with the media and Web sites interested in occupational health and safety in Québec, the rest of Canada, and abroad; they numbered over 700. New promotional activities are anticipated over the next few years to ensure visibility and broader recognition of the Institute's work.

5.1.7 Information monitoring blogs

In 2009, a scientific monitoring tool was put in place in the form of a blog for each of the research fields, for OHS statistics, and for OHS in general. By means of these blogs, the IRSST provides access to scientific information obtained from the daily monitoring of over 650 Web pages dealing with occupational health and safety (OHS), as well as information collected by its personnel during discussions, workshops, forums, colloquia, conferences, or any other events touching on the major OHS research issues. The monitoring blogs address all publics, but particularly the scientific community and OHS professionals and practitioners.

The number of visits to the blogs since the end of January 2010 indicates very significant traffic. Over 60,000 unique consultations took place, that is, 60,000 visits involving one or more page views. A user satisfaction survey was conducted in October 2010 of people who had subscribed to the blog alerts. It revealed a very high satisfaction level, suggesting that this initiative should be continued over the 2013–2017 five-year cycle.

5.1.8 IRSST.TV

In June 2011, the IRSST added videos to its vast array of communication means. Internet users can tune in to IRSST.TV, the section of the Web site that offers content exclusively on video. With passing time, this new section was enriched with an interesting program of recordings of researcher lectures, symposia on various topics related to occupational health and safety, and short takes in the form of reports on the

Institute's participation in various events. Today, IRSST.TV features more than 80 titles, with over 7,000 views tabulated during 2011.

5.1.9 Institutional awards and prizes

To contribute to the development of the next generation of OHS researchers and ensure greater visibility for the IRSST among the members of Québec's research community, a *Prix Acfas – IRSST – Santé et sécurité du travail* was created. Two $5,000 awards, one for a master's student, the other for a doctoral student, will be handed out annually at the annual Acfas (Association francophone pour le savoir) gala, starting in the fall of 2013. These awards are intended to officially recognize students' academic excellence and the quality of their research, which must focus exclusively on occupational health and safety questions. It is also hoped that they will encourage the award winners to pursue a research career.

Moreover, a *Prix Innovation – SST* was created by the IRSST in 2010 to offer formal recognition to a company or organization that innovates in work-related injury and occupational disease prevention. This award is given annually by the Institute at the gala of the Association pour le développement de la recherche et de l'innovation au Québec (ADRIQ).

5.2 Dissemination of research results

5.2.1 Research reports

For the most part, research reports constitute the deliverables from IRSST-funded research projects and are generally published by the Institute after undergoing scientific peer review. These reports pass on the research results to the various clienteles (e.g. OHS practitioners, researchers) likely to be interested in or benefit from them.

After declining in 2009, the number of reports published annually by the IRSST has been trending upward in the past two years, with 55 reports published in 2011, including seven English translations. The number of complete document downloads soared, as indicated earlier in section 5.1.1. Efforts will therefore be made over the 2013–2017 five-year cycle to further increase the number of downloads. A committee responsible for studying the types of deliverables associated with the research projects will submit its report, in turn allowing for a decision regarding the form that research reports should take over the next few years.

The IRSST plans to step up its efforts to translate documents in order to meet the needs of its English-speaking clientele. The IRSST added the translations of 28 research report summaries to the seven report translations posted on its Web site in 2011. Currently, around 100 institutional publications are available in English on the IRSST's Web site, a number that is expected to grow in the years ahead. The proportion of reports translated into English has held steady at approximately 18% over the past two years.

5.2.2 Scientific publications

Over the 2009–2011 period, the number of scientific publications in peer-reviewed journals and conference proceedings increased over the preceding period for both the IRSST'S research collaborators and its personnel. In 2011, 53 articles were published in peer-reviewed journals and 70 in peer-reviewed conference proceedings. These publications, in addition to contributing to the sharing and advancing of OHS knowledge, allow researchers to assess themselves relative to their peers and to reinforce their own reputation and that of the Institute. The efforts made to increase the number of scientific publications in peer-reviewed journals, particularly for IRSST personnel, will be intensified over the 2013–2017 five-year cycle.

5.2.3 Papers delivered at scientific events

Scientific conferences provide opportunities for disseminating knowledge and forging links with other researchers while taking stock of the current status of knowledge and identifying research needs. Each year, IRSST personnel participate in large-scale scientific conferences to present the results of IRSST-funded research projects. The number of papers delivered at conferences varies from year to year, but generally exceeds 50 for presentations related to current studies. In 2011, 53 papers were given by IRSST personnel or IRSST-funded researchers at scientific conferences or events. During the 2013–2017 five-year cycle, the Institute will continue to ensure its presence at the main large-scale events to present its research results.

5.2.4 Outreach activities

As well as contributing to the advancement of scientific knowledge and to the work done by the technical committees, the IRSST's personnel and their external collaborators participate in many outreach activities organized mainly for partners in Québec's OHS network but also elsewhere. These activities provide opportunities for presenting the evidence-based data emerging from research in simplified form, whether by means of simplified articles or guest speakers at events.

From 2006 to 2010, the IRSST's personnel and collaborators took part in over 200 outreach activities, most of which (177) were part of events such as conferences, forums, colloquia, or training courses. The person responsible (first author) for more than two-thirds of the papers was an IRSST staff member.

It would not be surprising if we were to witness an increase in this type of contribution over the next few years, given the priority the IRSST places on knowledge transfer.

6. RESULTS TRANSFER AND UPTAKE

The IRSST promotes the development of new knowledge in the various priority research fields in occupational health and safety through the research work it funds and carries out. An organizational priority for the IRSST since 2006, knowledge transfer is essential if workplaces are to appropriate the results of this research to obtain a genuine impact on worker health and safety. The attainment of this objective depends on a wealth of knowledge, state-of-the-art expertise, a solid network of collaborators and intermediaries, and the creation of a team dedicated solely to these questions.

Yet despite this organizational commitment, the transfer of evidence-based knowledge remains a major challenge. OHS stakeholders have access to an abundant source of information in which the IRSST has to effectively position its own scientific production. In addition, the uptake and use of the related knowledge requires that it be relayed to the target publics using strategies adapted to their specific needs and contexts.

During its first 25 years of operation, the IRSST placed great importance on disseminating results when research projects were completed. To do so, it successfully forged special ties with the front-line OHS stakeholders who relay new information to workplaces. However, it became evident that by involving the workplaces concerned right from the research start-up phase, the latter would be better equipped to appropriate (take ownership of) the results directly and promote the use of the knowledge produced in order to induce all stakeholders to take responsibility for creating healthier, safer workplaces.

The Communications and Knowledge Transfer Division therefore relies on a framework of practice designed to consolidate, update, and broaden KT practices by focusing on an integrated research and knowledge transfer approach. Based on enriching, frequent, and continuous interactions between researchers and the workplaces concerned by the research projects right from the project development phase, this approach requires the building and maintenance of networks assembling all OHS stakeholders: researchers, prevention organizations and associations, employer and worker associations, and workplaces. This dynamic upholds the equal representation principle that characterizes OHS activities in Québec.

Knowledge transfer advisers are those responsible for knowledge transfer within the IRSST and play different roles depending on the phases of the research and KT cycle. They use their strengths and skills on the strategic, relational, and pedagogical levels, notably to help reconcile the interests and imperatives of the research community with those of all parties involved. The team helps analyze partners' needs and transpose them into research intentions. It supports researchers regarding all aspects related to knowledge transfer throughout the research process, beginning with the preparation of grant applications. It also supports them in their relations with workplace partners. Lastly, these advisors work with each of the partners to identify the most appropriate dissemination/transfer strategies in light of their particular characteristics and issues, as well as to ensure implementation of strategies and evaluation of spinoffs.

Judging from the consultations held with various clienteles, this type of assistance appears to be much appreciated by internal research personnel, external researchers, and OHS network partners. Interestingly, a large majority of external researchers contacted by survey appreciated the IRSST's support and considered it a distinctive attribute worth preserving. The Institute's social partners underscored the significant progress made by the IRSST in terms of results promotion and transfer. They feel well served by the knowledge transfer advisors and see the close researcher/partner approach currently favoured by the Institute as ensuring that the research results are usable in the field.

Collaborators and partners are thus vital to the implementation of research projects. Drawing on their in-depth knowledge of the workplaces, OHS issues, and current challenges, the leaders of the different research fields at the IRSST are able to develop a fine-tuned research program. Moreover, in keeping with the spirit of the framework of practice, work meetings are held first to ensure that the projects are solidly grounded. The resulting formation of follow-up committees has proven to be the most appropriate mechanism to date for allowing our various partners to discuss their needs, provide input based on their expertise, and implement appropriate knowledge transfer strategies.

More than 100 current projects are supported by a follow-up committee established from an inventory of over 185 organizations operating in all spheres. The pooling of experiential knowledge and scientific knowledge and the collaborative ties thus created help optimize the concrete spinoffs of research and the resulting evidence-based data. The leadership and participation of all these collaborators and partners contributes significantly to the IRSST's advances in research.

During the 2009–2011 three-year cycle, some 20 knowledge promotion and transfer activities were initiated and 26 were completed, including some begun during the preceding three-year cycle. Based on an assessment of the Knowledge Transfer and Partner Relations Department's achievements, there is a clear need to broaden the range of strategies used to promote interaction and exchange with users of research results.

Interaction with users of the evidence-based data emerging from research projects in the Occupational Rehabilitation field poses particular challenges, however, which the Institute hopes to meet in the next few years. In fact, among users of new knowledge, it is practitioners and professionals from the healthcare community who are of particular interest to the Occupational Rehabilitation field. These include occupational therapists, physiotherapists, front-line general practitioners, and medical specialists. To ensure that the evidence-based data emerging from research influences and enriches practitioners' practices, it is proposed that over the 2013–2017 five-year cycle, the most efficient strategies and practices adapted to the settings concerned be identified and implemented, notably through knowledge brokering. The IRSST will thus promote the use of evidence-based data in clinical settings. The most productive knowledge brokering practices used in the past few years in health research will be identified and integrated into existing practices at the IRSST.

The 2008 implementation of an exchange network in the material handling field allowed the IRSST to strengthen its ties with the various practitioners and professionals interested in this theme, thanks to the various exchange strategies used. The network provides a means of exchange similar to a community of practice, and its positive spinoffs encourage a broader-based reflection on the best exchange and communication strategies to be used to increase the dissemination and uptake of research findings by the IRSST's various clienteles. Given the many OHS issues that need to be addressed through thematic programs, it may be relevant over the 2013–2017 five-year cycle to promote the creation of larger communities of practice that bring together participants motivated by a desire and need to share problems, experiences, models, tools, and best intervention practices. The literature reports a number of potential benefits for participants, including both organizations (productivity gains, innovation) and members (development of knowledge, access to other resources, reduced isolation). More specifically, for the IRSST and participating members, the creation of such communities could foster (1) researchers' access to participants' tacit knowledge, allowing them to identify new research topics in terms of either problems to investigate or solutions to test; (2) access to more closely targeted practitioners and practice settings in light of the study objectives, and (3) practitioners' access to the knowledge and expertise developed by the IRSST's researchers and professionals, thereby improving their knowledge and practices.

7. DIVERSIFICATION OF PARTNERSHIPS

In Québec, the IRSST remains the only scientific research organization devoted exclusively to OHS. Its uniqueness also stems from the fact that it is both a research centre and funding organization. To fulfil its mandate, the Institute focuses on its own scientific resources, but also calls upon a network of external collaborators from the research community, including:

- an external network of researchers and experts in various disciplines who come from universities, research centres, and private firms;
- provincial and federal funding agencies;
- public, university, and private research centres involved in related activities;
- the main OHS research centres worldwide; and
- many national and international committees, particularly those involved in standardization.

The collaborative approach favoured by the IRSST strengthens the pool of OHS researchers, provides access to a wealth of knowledge and expertise for each of its research fields, contributes to the training of highly qualified personnel, and maximizes the spinoffs for workplaces.

7.1 Collaborative agreements

Over and above its own grant programs, the IRSST maintains alliances with provincial and federal funding agencies in order to develop particular sectors of OHS research. As mentioned in section 3.2 and by way of example, the Institute partnered with the Fonds de recherche québécois (FRQS, FRQNT, FRQSC) to support two networks: the Réseau de recherche en santé et en sécurité du travail du Québec (RRSSTQ), whose mandate was renewed in 2009 for four years, and the NE^{3}LS (ethical, environmental, economic, legal, and social aspects of nanotechnologies), for which funding began in 2010. Networks such as these enrich teaching, research, and knowledge transfer. It is therefore important that efforts continue over the 2013–2017 five-year cycle to maintain and diversify partnerships by creating new initiatives with provincial and federal funding organizations. The IRSST's partnership with the CIHR mentioned in section 3.2 illustrates this type of initiative, which will allow for the creation of a five-year research-chair program on gender, work, and health.

Occasionally the IRSST joins forces with agencies that are not directly involved but are interested in the OHS field. Thus, a new agreement signed in 2009 with REPAR/FRQS (Réseau provincial de recherche en adaptation-réadaptation of the Fonds de recherche du Québec – Health) led to the launch of a new funding program encouraging the production of knowledge reviews on the topics of clinical evaluation, rehabilitation, and the return to work of workers with a work-related injury. Another agreement, currently under discussion with the Institut de la statistique du Québec, could lead to the creation of a database for use in the context of new studies to be conducted mainly in relation to OHS and young people.

In addition to the ties cultivated with many Québec collaborators, enriching partnerships have been established over the years with OHS research centres elsewhere in the world. Such partnerships are expected to continue in the years ahead. Examples include a specific agreement on machine safety signed in 2009 with the INRS in France, and more recently, the 2012 renewal of an agreement with the Health & Safety Laboratory (HSL) in the United Kingdom. Here at home, the signing of a new partnership agreement with École Polytechnique de Montréal in 2010, the J. Armand Bombardier and Pratt & Whitney Canada Research Chair in Work Rehabilitation of the Université de Sherbrooke in 2011, and the renewal of the ÉTS-IRSST-CTT Research Chair in Protective Materials and Equipment for Occupational Safety and Health in 2010 should help ensure the maintenance of, if not increase in, research capacity in these areas. Other partnership avenues could be explored over the 2013–2017 five-year cycle.

7.2 Research chairs

The Institute has been associated with university research chairs for nearly 20 years. As mentioned in section 3.2, such chairs help create solid poles of expertise on certain priority OHS themes, as well as providing efficient platforms for training highly qualified personnel. The Institute's support for research chairs takes different forms and usually involves other partners.

Some of the IRSST-supported research chairs have already been mentioned, including the ÉTS-IRSST-CTT Research Chair in Protective Materials and Equipment for Occupational Safety and Health and the J. Armand Bombardier and Pratt & Whitney Canada Research Chair in Work Rehabilitation of the Université de Sherbrooke. Support for these chairs is governed by a partnership agreement between the IRSST and the organizations concerned. Other chairs, notably the *Chaire en analyse des risques toxicologiques en santé humaine* at the Université de Montréal and the Chair in Occupational Health and Safety Management at Université Laval, receive the IRSST's support through the funding of studies that can be linked to its programs. Such initiatives are expected to continue.

Lastly, other research chair projects currently under study could be created during the 2013–2017 five-year cycle; these have already been mentioned in section 3.2 and include a research chair on gender, work, and health, a chair on aerosols and respiratory health at Université Laval, and one on ecoacoustics at the Université de Sherbrooke.

7.3 Scientific recognition

The IRSST is well known for the calibre and originality of its research achievements. This scientific recognition constitutes a major asset in the strategic networking process and the Institute's international appeal.

Whether participating in the work of associations or organizations such as the Sheffield Group, which brings together the heads of leading OHS research institutes from around the globe, sitting on standardization committees, or helping organize large-scale scientific events, the IRSST makes its presence and influence felt in the forums where it is important to promote its research findings, both at home and abroad. Such actions allow the Institute to establish itself as a vital OHS research organization.

7.3.1 Involvement in colloquia

Since 2006, the IRSST has held an annual institutional colloquium that convenes members of the Québec research community to discuss transdisciplinary research themes or issues. It provides an opportunity for the Institute to showcase its leadership to the research community and debate the main research issues in OHS. This annual colloquium will continue to be held over the 2013–2017 five-year cycle, and there are plans to explore how these colloquia could also be used to promote and transfer the results of the research projects it funds.

To optimize its leadership, event-organizing, and research coordination role, the Institute is also active in organizing large-scale scientific events, by hosting and supporting national and international conferences and sitting on the scientific committees associated with events held elsewhere. In the fall of 2010, the IRSST organized the International Conference on the Safety of Industrial Automated Systems (SIAS) and hosted the Sheffield Group. It also hosted ISO TC 199 Technical Committee on Safety of Machinery and the ISSA International Section for Research on Prevention seminar held in conjunction with the meeting of the Sheffield Group. It participated in the scientific committee responsible for organizing the first colloquium of the NE^3LS network, held in the fall of 2012. Depending on the opportunities that arise over the 2013–2017 five-year cycle, the IRSST plans to continue its involvement in organizing large-scale scientific events that will ensure recognition of its research leadership, while enhancing its outreach on the local, national, and international stages.

7.3.2 Participation in prestigious committees

The IRSST’s strategic presence on the national and international stages is also ensured by its personnel’s ongoing participation in expert committees and standardization committees.

The Institute belongs to the International Labour Office’s (ILO) network of International Occupational Safety and Health Information (CIS) centres. This international recognition confirms the IRSST’s presence and influence in the worldwide preventionist community for the past 30 years. By becoming a CIS Collaborating Centre, the IRSST is able to make the scientific knowledge it produces more broadly accessible to all those wishing to support their preventive actions with evidence-based data.

Several members of the IRSST’s staff take part in the work of the Agence nationale de sécurité sanitaire, de l'alimentation, de l'environnement et du travail (ANSES) in France.

An agreement signed with this organization in 2011 provided for bilateral collaborative undertakings in terms of OHS research activities and expertise. These collaborative efforts are expected to continue over the 2013–2017 five-year cycle, mainly by ensuring IRSST personnel's participation in the work of ANSES' committees of experts.

Lastly, the personnel's participation in some 15 national and international standardization committees (e.g. ISO, ASTM, and ACNOR) should continue over the 2013–2017 period, and in committees of the CSST and its network, including regulatory committees.

7.3.3 WHO Collaborating Centre

In 2008, the IRSST began procedures with the World Health Organization (WHO) to become a collaborating centre in the Network of Collaborating Centres on Occupational Health. Obtaining the status of collaborating centre not only serves as recognition of the calibre of an organization's work, but also gives it a prominent role to play and allows for interaction with an entire network of organizations and researchers with similar interests. The process of designating the IRSST a WHO Collaborating Centre is currently under way and should culminate during the 2013–2017 cycle. Earning such official recognition would provide the Institute with yet another means of gaining visibility for its scientific leadership on the international stage while benefiting all WHO member countries.

7.3.4 Institutional evaluation

Given the IRSST's decision to conduct a recurrent institutional evaluation, the next evaluation should be carried out in 2016, which is five years after the previous evaluation in 2011. Such evaluations are essential in order to assess the Institute's performance with respect to its mission, evaluate progress since the last evaluation, make strategic choices, and remain at the forefront of research. They also provide a unique opportunity for having an independent international committee assess the Institute's achievements and scientific leadership.

8. LABORATORY SERVICES AND EXPERTISE

The CSST and the IRSST signed a service agreement whereby the Institute provides the Commission and its network with the laboratory services needed for the application of prevention activities prescribed by the government's occupational health and safety plan.

Not only does the Laboratory Division respond to requests for analyses from the CSST and all occupational health and safety professionals, but it also contributes to research.

8.1 Accreditations and certifications

Accreditations and certifications serve as a guarantee of the quality, integrity, and recognition of the IRSST's work. The Institute's laboratories hold national and international accreditations and certificates from the American Industrial Hygiene Association (AIHA), the Calibration Laboratory Assessment Service (CLAS) of Canada's National Research Council (NRC), and the Occupational Safety and Health Administration (OSHA) in the United States. The Institute's Laboratory Division is the only holder of certain certifications in Canada, and ranks among the Canadian leaders in the field of testing.

The IRSST's laboratory accreditations with the American Industrial Hygiene Association (AIHA) and the Calibration Laboratory Assessment Service (CLAS) of Canada's National Research Council were renewed during the preceding three-year cycle. In addition, new services were offered in these two accreditation sectors (spore traps in microbiology, the multi-solvent GC-MS (gas chromatography and mass spectrometry) quantification method, and determination of beryllium oxide). In terms of quality assurance, the steps involved in applying for ISO 17043 accreditation as a proficiency testing provider began in 2011 and will continue over the 2013–2017 five-year period. This new accreditation will be useful in supporting the development of quality-control tests for asbestos and isocyanates. Similarly, steps to ensure that current accreditations are maintained will continue over this five-year cycle.

8.2 Analyses and activities for the OHS network

During the 2009–2011 period, the number of analyses performed annually by the IRSST's Laboratory Division averaged 65,419, representing a slight drop of roughly 2,500 analyses compared to the preceding period.

In addition, the annual number of hours devoted to calibrating, repairing, and maintaining direct measurement and sampling instruments stood at 7,749, representing an increase of approximately 10% over the preceding period (2006–2008). This increase was associated with the execution of an instrument replacement plan and the deployment of the new ISO-prescribed calibration methods. All requests for calibration and conformity assessment are processed, and for the most part, come from partners in the prevention-inspection network. The 2012 introduction of a new Laboratory

Information Management System (LIMS) should facilitate equipment loan services by means of electronic transactions.

At the last consultation held with the Laboratory Division in the spring of 2010, more than 75% of the respondents expressed maximum or high levels of satisfaction with the turnaround time for receiving analysis results and with the various pieces of apparatus and equipment calibrated. In over 90% of the cases, the quality of the service received, work performed, and analysis report (presentation and intelligibility) were rated as highly satisfactory.

The IRSST's laboratories prioritize service to the professionals in Québec's occupational health and safety network when it comes to environmental, microbiological, and toxicological analyses. However, this does not prevent them from scouting for new clienteles. Since 2006, services offered to clients outside the network have been a source of additional revenues that are spent on hiring personnel and purchasing new instruments used in routine activities. Moreover, part of these revenues went toward launching and maintaining the Quality Control Program for Fibre Counting.

Since 2011, the IRSST's laboratories have been busy implementing a new Laboratory Information Management System (LIMS) to ensure analysis follow-up. The deployment of the new LIMS in 2012 will allow all partners to submit their samples and receive their analysis results via the Internet. The new system will also boost productivity and reduce the time taken to produce analysis results. It will facilitate certain equipment loan services by means of electronic transactions. From this dual perspective of productivity gains and improved customer service, it is anticipated that over the 2013–2017 five-year period, an in-depth review of the toxicological analysis protocols will begin, as well as the upgrading of the equipment needed to carry out these analyses.

Moreover, following implementation of the electronic microscopy service for lung tissue analysis, a new request to develop an analytical method using this technology was made for characterizing and quantifying asbestos fibres in materials. The creation of this service will both promote the development of new expertise in the IRSST's laboratories and provide the opportunity for forging new ties with the Université de Montréal's Center for Characterization and Microscopy of Materials $(CM)^2$.

8.3 Development and validation of analytical methods

8.3.1 Development of new methods

One of the roles of the IRSST's laboratories is to ensure the development and validation of new analytical and instrument-calibration methods. The process of setting development priorities is influenced by a variety of factors. The revamping of Québec's *Regulation respecting occupational health and safety* (ROHS) was reflected in an adjustment of the IRSST's analytical processes to include more adequate coverage of the new standards. The introduction of new substances in these same revisions made it necessary to develop new methods quickly. The need to revise and develop new

methods was also influenced by discussions held by the various ISO and ASTM committees. During the development of all analytical methods, close attention is paid to obtaining irrefutable quality results and optimizing productivity.

Since 2009, some of the new methods developed by the IRSST's laboratories have thus allowed it to add new services. These new methods include:

- the determination of multiple metals in the air by ICP-MS;
- the determination of nitrosamines;
- the evaluation of inhalable dusts through use of the IOM sampler;
- the determination of organic volatile compounds in the air by GC/MS.

During the 2013–2017 five-year cycle, five current projects should lead to analytical developments for exploring new services: the development of a polymerase chain reaction (PCR) method for detecting *Legionella* bacteria, as well as methods for the determination of nitrosamines by HPLC-MS, of specific proteins, of breathable compressed air by GC, and of quartz in process samples using the Reitveld technique.

8.3.2 New analyses related to new methods

The introduction of new methods in the IRSST's service offer impacts more than 50% of the laboratories' analytical production. A new contract with the CSST for electron microscopy services will also be implemented, broadening the service offer to include the electrical calibration of sound level meters.

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APPENDIX 1

Descriptive fact sheets on the research fields

Chemical and Biological Hazard Prevention (CBHP)

RESEARCH ORIENTATIONS

Development of strategies and methods for evaluating exposure and estimating health risks using toxicological and epidemiological approaches, among others;

Development and validation of technologies and tools designed to reduce and control exposure;

Development of methods for sampling and analyzing chemical substances and biological agents.

Current thematic programs

- Exposure science
- Ventilation and air quality
- Asbestos and other elongated mineral particles
- Microorganisms in the workplace

Current research themes

- Nanoparticles
- Silica
- Asthma and obstructive respiratory diseases in the workplace
- Chemical and biological contaminants in agricultural environments

New thematic programs to be developed

- Occupational cancers
- Chemical and biological hazards related to green jobs
- Respiratory protection

Mechanical and Physical Risk Prevention (MPRP)

RESEARCH ORIENTATIONS

Assessment of the mechanical and physical risks generated by machines or the work environment;

Reduction of mechanical and physical risks;

Takingi the human factor into account in the evaluation and control of mechanical and physical risks.

Current thematic programs

- Assessment of risks associated with machines
- Lockout
- Hand power tools
- Acoustic barriers and materials for noise control
- Evaluation and modelling of hearing protection devices
- Shoring and shielding systems
- Resistance of protective gloves and clothing to mechanical and physical stressors
- Protection against falls from heights

New thematic programs to be developed

- Falls and slips on outdoor surfaces
- Safety of machine maintenance operations
- Evaluation and selection of suspension seats
- Audible alarm signals in the workplace
- Control systems and automation

Sustainable Prevention and Work Environment (SPWE)

RESEARCH ORIENTATIONS

Analysis of OHS problems and assessment of risks in relation to social, organizational, and demographic aspects, and technological changes;

Development and application of measurement methods and evaluation tools (measurement of exposures and risk and protection factors, activity analyses, surveys, and data collection tools;

Interventions pertinent to, and management of, OHS problems (OHS management in small enterprises, knowledge transfer and training, OHS management steps and tools, adjustment of work situations).

Current thematic programs

- Material handling principles
- MSDs in emergency call centres
- MSDs related to office automation

Current research themes

- Development and application of measurement methods and evaluation tools
- Interventions in the workplace
- Transmission of job knowledge and prudent knowledge, and training
- Integration of OHS into the design phase

New thematic programs to be developed

- Young workers ages 15-19 and OHS
- Workforce and OHS management in mines
- OHS in small enterprises
- Biomechanical modelling
- Work-related road safety

Occupational Rehabilitation

RESEARCH ORIENTATIONS

- Development of tools for assessing the health of workers who have sustained work-related injuries and are at risk of disability;
- Study of the personal, clinical, organizational, and administrative determinants of a return to work;
- Development and implementation of rehabilitation and return-to-work interventions;
- Development and implementation of strategies designed for rehabilitation and return-to-work professionals.

Current research themes

- Risk of prolonged disability among workers
- Support for interventions in clinical settings
- Support for return-to-work interventions in the workplace

New thematic programs to be developed

- Protection of and support for workers in vulnerable situations