Creating a Safe and Healthy Workplace

A Guide to Occupational Health and Safety for Entrepreneurs, Owners and Managers

International Commission on Occupational Health

Scientific Committee on Occupational Health and Development

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Prepared by:

Brandi Karasiewicz Alford, MPH
Shannon Lynch, MPH
Ida Rosenblum, MPH
Craig Kullmann, MPH

Edited by Tee L. Guidotti, MD, MPH
Assisted by Tayseer El-Faki Mustafa, MD

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Address queries to icoh@inail.it.

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INTRODUCTION

This short book is for owners and managers of business enterprises, especially in the developing world, to help you identify, reduce, and eliminate hazards in the workplace. This guide also serves as a tool to promote a health and safety-oriented culture of cooperation among workers, managers, entrepreneurs, and governmental authorities. Working together, we can make a safer and healthier workplace.

The fact that you are reading this is good news for the workers in your business. It shows that you are concerned. Knowledgeable owners and managers know that injuries and illness that happen at work can be tragedies for the workers and their families, create conflict and hard feelings among workers, slow down production, and increase costs. These bad things may even happen to our personal friends and family. The best way to keep workers safe and healthy and to keep the business running well without injuries and unnecessary risk is to take a good hard look at how to make it safer.

Enterprises (in any kind of business) in developing countries and rapidly expanding economies, especially, face many challenges when it comes to protecting worker health and safety. One of the biggest challenges is finding useful information. This guide is designed to be a start in finding what you need. Business in developing countries and enterprises also have to deal with many hazards that are the result of rapid growth, old equipment, lack of education, and a holdover from how things were done in the past.

This short guide cannot cover all hazards that workers face, but it is a beginning. It will address the most common ones in small- and medium-sized enterprises. It is only a general introduction, although we hope that it will help you think through problems and will lead you to useful solution. It is intended to fill the gap between general information, that is intended to encourage worker health protection but provides little detail, and the professional literature of occupational health, which can be very complicated and technical. Many problems require more information than we can present in this short book. Additional resources in English are listed in Chapter 10 to help you find the answers you need.

In addition to what is in this book, you need to know what laws and regulations apply to your business. Owners and managers have a primary responsibility to follow the laws of their country. Beyond that, however, every business and all workers can get more out of good health and safety practice if owners and managers are not just satisfied with just following the law. We should try to be the best that we can be because, over time and when the business is good, healthy and safe workplaces avoid serious accidents, stay in business longer, keep their best workers, and run more efficiently.

It may be difficult to see the benefits of investing in worker health and safety at the same time that enterprises and countries are trying to grow and develop an economic base. Although this guide discusses the specifics of job related hazards, it is also intended to have a larger impact on the social and economic well-being of the enterprise and the country. There should not be much doubt that a healthy, motivated, and contented workforce will be more productive than one that is not. Therefore, an investment in the workforce is an investment in the future of the enterprise and the social fabric of any country.

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Chapter 1
PROTECTING YOUR WORKERS

Your workers keep you in business. As a manager you may keep the business going, and as an owner or investor you may supply the money it needs, but it is the workers who do the jobs that need to be done in your business and who therefore create the wealth in a successful business. To keep doing this without interruption, to do it with dedication, and to do it with full attention to the work they are doing, workers should be confident that they will not be injured or made sick at work. Their health matters to them just as yours does to you. An injury that keeps a worker off the job can set back the workers' entire family. It also matters to you, the manager or owner, both as a caring person and as a business leader.

A reputation for caring about your workers and seeking to treat them right brings honor to an employer. A reputation for not caring about workers and allowing injuries to happen can make people dislike owners and can make it hard to attract and keep the best workers. It is also good management because an injury causes delays, slows production, and raises expenses in the business.

Workers can only do so much to protect themselves. They may know how to do their own job but when they come to you they are usually not already trained in how to work safely and how to protect their own health. They also come with their personal attitudes, different for each person. Sometimes a worker knows the risks and wants to work carefully. Sometimes, a worker thinks that no serious injury will ever happen to him and that manly men do not protect themselves because they are tough. (Unfortunately, the accidents these people cause often injure someone working around them, not the person who caused it.) Most often, he or she simply does not know how to work safely and wants to do the job quickly and to produce more, especially if they are being paid by the piece. Often workers take shortcuts or do things that are unsafe because they think it will save time and they want to get the job done. Sometimes, they feel pressure from supervisors to produce more and more and to work unsafely to do this.

Most of the time, workers get away with taking shortcuts and nothing happens, so after a while this becomes their normal approach to work. They keep doings things that way. But then really bad things can happen, usually when nobody expects it, and there may be an injury and someone gets hurt and sometimes dies.

It is the responsibility of the owner and manager to make the workplace safe and healthy, to show workers that you expect them to work safely, and to create a work situation where everyone feels that they can work safely without pressure on them. It is not acceptable to put all the responsibility on the worker. We must all protect the health of workers.

This chapter talks about how to create a safe workplace that will help keep your workers healthy and out of harm's way. Some of these ideas may not apply to your particular factory, shop, or other workplace, depending on the type of business you are in but most of the ideas probably can be used your business. You will read many things here that you already know and some that you may never have considered.

You must start by learning the laws and regulations in your own country to be sure that you are following them in your business. Over and above these regulations, you will want to keep your eyes open for a better way to do things, for example by asking questions about a business similar to yours that gets better results in health and safety, by reading about the best practices in your industry, and by going onto the internet to get good

information from authoritative sources (see the final chapter of this book).

Training Your Workers

The more your workers know about health, safety, and hazards, the more they can protect themselves from harm and improve their own health. Worker training and education can prevent bad things from happening in the first place. All work-related (occupational) injuries and illnesses can be prevented.

Training is absolutely necessary so that workers can learn how to do the job correctly and safely. Training only once is not enough – the training has to be repeated, with different and practical examples, from time to time and each worker must demonstrate that he or she understands the message. The reason for the training must be understood, its importance must be emphasized, and the reasons for it must be made clear. The worker must know why he or she is doing something in a certain way to be safe as well as how to do it. With proper training comes understanding and then comes individual commitment and acceptance by more and more workers, so that safe work practices become normal in the workplace. When this level is reached in the workplace, it means workers looking out for each other and correcting mistakes, rising morale, and fewer injuries. Training workers about their rights and responsibilities as employees at the same time will give them the confidence to solve problems and may convince them that their employer is serious about protecting their health.

The main purpose of training your workers is to make them aware of potential hazards where they work. A second reason is to make them understand that work can be done safely. Training gives workers the knowledge and skills they need to perform the job with the least possible risk to their health and safety. A training program should include basic information on job skills and help workers to recognize and control hazards present in their own workplace. Workers should also receive training in employee rights and responsibilities, how to deal with emergencies, safe use of equipment, how to use personal protective equipment, and the safe use, handling, and transportation of hazardous materials. Even after initial training and education when the job begins, training should be repeated from time to time (at least every year) to keep workers up to date on these hazards and to remind them what they are working with and how to protect themselves and their families.

Medical Care and the Workplace

Medical Medical care should start with evaluating workers who are being considered for particularly demanding jobs or jobs that involve the safety of others. Medical examination ensures their capacity to do the job safely, protects the safety of people who may depend on them, determines their current state of health so that changes can be identified later, and determines if they have a medical problem that the work may make worse.

Good medical care (which is often hard to find) can help prevent harmful effects that may occur after an accident or exposure to a harmful substance but by then the damage is already done. That is why most of this small book has to do with prevention instead of medical care for injuries.

Having workers examined every year by a physician or nurse and having laboratory tests done is a good thing for their health but alone it is unreliable to find illnesses that come out of workplace exposures. It also does nothing to prevent accidents. Still, it is one way to protect workers, to keep a situation from getting worse, and to ensure that your protective measures are working. That is why it is required by law in many countries. If the doctor or nurse knows about "occupational diseases" they can look for them and advise you on what tests are needed. If the doctor or nurse does not have this specialized knowledge, please encourage them to get it and help them if you can.

There are certain specific tests that can be done to check workers for dangerous effects of exposure to chemicals. The most commonly available are blood tests for lead and for a certain type of pesticide (organophosphates). When tests are done from time to time (say, once a year) to check on whether workers are still healthy or are showing signs of a work-related disease, it is called "medical monitoring" (or "surveillance").

Most other tests require the doctor or nurse to know a lot more about occupational diseases. For example, the chest x-ray is a basic test available in hospitals and clinics. But interpretation of the chest

x-ray, for example being able to tell tuberculosis or cancer from occupational lung disease like asbestos (a serious lung disease caused by all forms of asbestos) or silicosis (another serious disease caused by rock or sand dust) requires that the doctor know what he or she is looking at.

The World Health Organization is pushing hard to make basic occupational health services available through the primary health care system in all countries. However, not many doctors and nurses know a lot about these things. If you are in a position to help your workers get medical care, consider asking the doctors in your community how much experience they have had with chemicals, work-related diseases, and how to prevent disability after injury. Then ask them questions about lead and asbestos (two of the most common and most important workplace hazards), after you have read about them in this book and see if they know as much as you do. That way you can decide for yourself who is the better doctor to watch over your workers. Having a doctor who knows these things is worth a little extra in the fees you pay because the results will be much better and there will be fewer expensive mistakes.

What to Do If an Exposure Is Causing an Illness

If medical monitoring proves that your employees are overexposed to a certain chemical, such as lead or a solvent, you should tell the employees. Most workers will understand if there has been a hazard that is newly discovered, but they could get angry if they think that information on their health has been held back from them. It is important to have open communication with your workers and ask them to help propose solutions. Nobody knows better how a job is actually done than the person doing the job. Workers often have good ideas on how to correct problems, but too often supervisors do not ask them.

When presenting the problem to the employees you should suggest ways you will fix the problem, and ask for their opinion on whether it will work. To fix the problem, you must locate the source of the exposure hazard and determine how big a risk it is. (This is covered in Chapter 8.) Once you locate the source and evaluate the problem, you can use the methods described in Chapter 6 and 9 to fix the problem, but you cannot fix a problem unless you know what it is. In cases in which the main problem cannot be solved, you can provide your employees with proper protective equipment. Sometimes you need professional help to solve the problem, but this book tries to help you and your managers and supervisors solve as many problems as you can by yourself.

Finding Problems and Improving Over Time

The experts in what it is like to do a job are the workers already doing that job. They are the first place to start when you investigate a problem or identify problems that can be improved. Unless they have done the jobs themselves many times, even supervisors who are directly responsible for the workers cannot know exactly what it is like to do what they do, and even then the workplace may have changed since they did the job. Workers often start doing things their own way and supervisors may not see the change. Someone who sits in an office may be an excellent manager but management skills cannot prepare a person for knowing what life is like all day in the workplace, and over time all workplaces change.

Workers can be asked directly when their knowledge is needed but it often works better to have a committee of a few workers. This committee, together with supervisors, should meet from time to time to talk about how things are going and what needs to be done to improve safety and health. That way, the workers can tell you through the committee when things are changing before a problem results in injury or can use their experience to propose solutions. Sometimes supervisors do not like these committees because they seem to bypass the supervisor's authority. However, they work much better than only relying on the supervisor. Supervisors sometimes filter messages to management depending on what he (or she) expects or thinks management wants to hear and even the best supervisors often do not always see small changes in how workers are performing their jobs and the shortcuts they take. The best supervisors are willing to work with these committees because everyone benefits. These committees should report directly to the senior manager and the owner, both. These committees are most effective when the owner or senior manager actively participates.

It also helps to have one senior, respected worker or one supervisor put in charge of watching over safe and healthy for the whole workplace. That person can learn more about safety, can get to know all the problem areas, and can be a champion for safe work practices. However, whoever does this job needs protection and strong support from the owners and managers. If they suggest changes that cost some money or that change the way things are done in the workplace, their recommendations may be unpopular and may be resisted by supervisors. Their jobs need to be protected in order to allow them to speak the truth and say what is required.

Your Business is Special

Every business, every industry, and every occupation has its own hazards and problems. But that does not mean that they are all completely different. We can all learn a lot from observing other workplaces, other industries, and other occupations. We can learn general principles that you can apply to our own business after a little thinking. As you read this guide, consider what applies to your business and your workers but also what are the principles of worker protection.

As an example, consider the construction industry. Construction work is done everywhere in the world and much of it is done the same way. Construction involves workers in different trades (occupations) who work together. Some of them share hazards and others have different hazards on the job.

Box 1.1 describes hazards in construction. Which of these hazards apply to your business? Can your business learn something useful and practical about safety and health protection from the construction business? Can you learn something useful and practical about safety and health protection from another, different industry?

Figure 1.1. *Workers in the construction trades face many hazards. The industry has a high rate of injuries and even deaths. The man on the right is making things even worse by smoking on the job, which is against the rules. Smoking is a serious fire hazard on the job and makes his health risk even worse. (Photograph ©dreamstime.)*

Box 1.1.
The Construction Industry:
An Example of Hazards in a Small- or Medium-sized Enterprise.

In most countries, the construction industry operates through contractors, who hire workers in specific trades on a job-by-job basis: electricians, plasterers, carpenters, bricklayers, plumbers, sheet metal workers, and painters. This short-term employment pattern leads to poor supervision of trades workers and a high turnover of employees. (Figure 1.1.)

Construction workers are exposed to a wide range of hazards. They are also exposed to mechanical hazards (ladders, scaffolds, unprotected edges and openings in platforms and floors, exposed electrical wiring, scrap, and debris). Falls from heights, falling objects, and overexertion are the most common incidents that occur among construction workers and cause the greatest numbers of lost-time days. Guards, railings, safety harnesses, and personal protection (hardhats and steel-toed boots) should be standard practice to prevent such risks. Safety hazards will be talked about in Chapter 2. Fires can also break out at building sites.

Many different types of craftsmen work on construction sites. Many of them, especially carpenters and plumbers, experience ergonomic and physical risks due to the tools, work postures, and loads handled. Construction workers have many problems with muscles and joints. These problems will be talked about in Chapter 3.

As in all workplaces, construction workers may have stresses on the job that come from pressure to do the job too quickly, or problem relationships with the supervisors or coworkers. Workers in the construction trades are often very independent. They like to do things their own way and sometimes there are conflicts. Stress in the workplace will be discussed in Chapter 4.

Construction workers also work with some very hazardous chemicals, such as solvents and lead, and silica dust. Cancer has been a major problem in the past due to exposure to asbestos dust from insulation materials. The risk of cancer has been highest in workers handling asbestos insulation but is also increased in other workers who are exposed to asbestos on the job, such as sheet metal workers. Although asbestos has been banned in many countries, it remains a hazard, especially for workers who must remove it. Chemical and dust hazards will be talked about in Chapter 5.

Each of the construction trades also has its own problems and hazards for workers:

- Bricklayers experience hand, shoulder and arm injuries, and lower back pain from ergonomic risks, including manual handling of bricks or carrying bricks on platforms supported on the shoulder.
- Carpenters and cabinetmakers also experience exposure to wood dust, which can cause allergies and respiratory irritation.
- Electricians are exposed to high-current power leading to electrical burns and face the risk of electrocution due to contact with overhead power lines.
- Heavy equipment and crane operators are exposed to noise and whole-body vibration, leading to back pain.
- Insulation workers are exposed to small fibres of the insulation material, which can cause lung disease and cough. Asbestos is no longer used for insulation in most countries but insulation workers who used it in the past often got cancer from it.
- Painters are exposed to solvents and may be exposed to lead. Poisoning from these chemicals can occur in different situations. Solvent poisoning is more common in spray painting. Lead.poisoning is more common in countries that use lead paint in houses and in painters who use or remove lead paints in outdoor structures, such as bridges.
- Plumbers may be exposed to asbestos (from insulation) and lead from pipes.

- Roofers have a dangerous job because they work at height. Without fall protection (a harness that can be work to keep the worker from falling) they can fall to their death or have a serious injury.
- •Roof-laying (putting down an asphalt roof on a building) is a particularly dirty job, often performed under hot conditions, requiring the roofer to pick up and carry heavy rolls of felt and buckets of asphalt. Asphalt burns, fire, and exposure to polycyclic organic hydrocarbons (a family of chemicals that can cause skin changes and cancer) are big hazards on the job. Roofing workers also have an elevated risk of skin cancer.
- Asphalt paving workers are exposed to the same fumes as roofers and show elevated death rates from lung cancer and respiratory disorders.

One of the most important issues in construction safety is the hazard of trenches and excavations. Excavations can be very large, for example when buildings are being built. (Figure 1.2)

Trenches are smaller excavations. Trenches are dug using a backhoe or sometimes workers with shovels and picks; the sides of the trench are straight. If the trench is too deep, the sides can collapse, particularly when the soil is sandy, full of gravel, wet, or when clay soil dries out, cracks, and crumbles. Collapsed trenches can trap, bury or suffocate workers, with fatal results. Small disturbances, such as vibration from passing trucks, can precipitate the collapse of a trench or excavation. It is critical to shore up trenches with planks and timbers to keep them from collapsing. It is also critical to stabilize larger excavations, which is done by sloping the sides gradually so the soil does not start a slide, by cutting a series of benches or steps into the ground at a gradual angle, or by shoring up the sides to keep it from falling in.

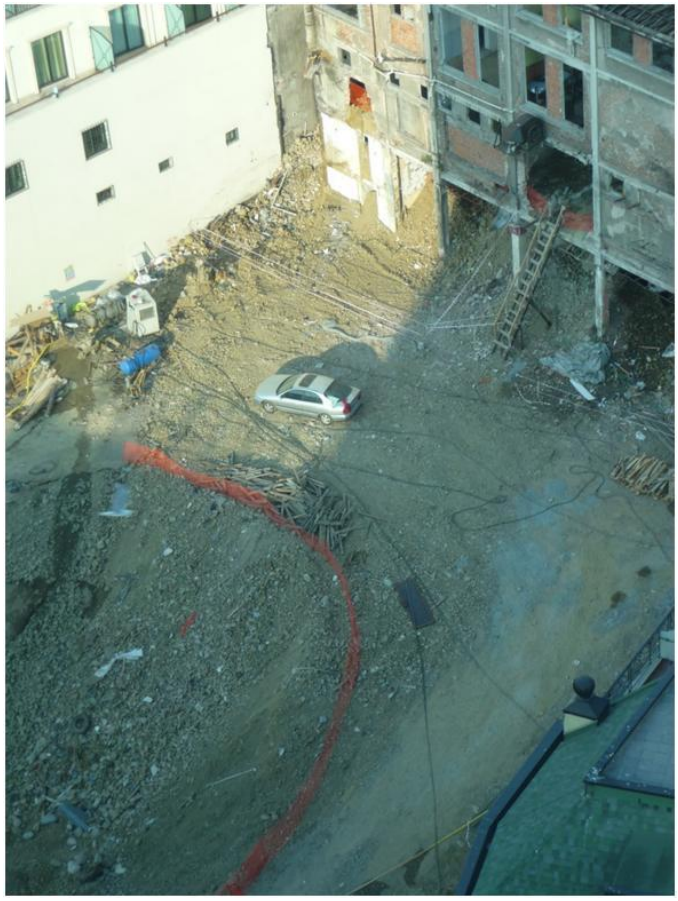


Figure 1.2. *An excavation in Turkey at a building site. Note that the sides of the excavation are too steep and have no shoring to keep the slope stable. Things are already sliding down into the excavation. The car may be next. Notice that the fence has been put in the wrong place – it should keep people and cars far away from the pit, not catch people and things that fall into it. (Photo by Tee L. Guidotti.)*

Chapter 2
SAFETY

"Safety" usually means protection from physical hazards. When an accident happens, production slows down and the worker usually cannot work, at least for a while. After a serious accident or death, the worker's family can be in danger because of loss of income and support. This chapter examines the most common safety problems likely to be faced by a small business.

Safety hazards cause accidents and the injuries that result can be serious. Safety hazards consist of things like sharp equipment, unsteady ladders, scaffolding that can fall down, ditches or trenches that can collapse and bury someone alive, water puddles on walkways where people can slip, poorly insulated or shorted electrical connections, poor lighting where workers cannot clearly see what they are doing, hot things that can burn, and confined spaces where poisonous gases can collect.

Safety hazards certainly exist in your workplace – they are everywhere and they are often very bad. Safety is partly a matter of seeing what is there. A responsible owner and manager will observe safety hazards and insist that they be corrected and that conditions are made safe. Many physical hazards can be controlled with simple safety measures and essential work practices such as cleanliness, proper equipment, and monitoring conditions to be sure that things are cleaned up and kept in order. Sometimes costs have to be cut due to slow business or low prices and at other times the business is good and production is going at full capacity. In both these extreme cases, there is a strong temptation to cut back on maintenance and safety to save money and time. This can be a serious mistake because it creates conditions where an accident is more likely to happen.

Walking Surfaces

The most common accident in the workplace is a fall. Walking surfaces should be safe to prevent workers from slipping, tripping, or falling. This includes aisles and passageways, and stairways, covers, and guardrails. Wherever people could fall, there should be handrails, protection from floor openings (such as holes in the floor), and well-secured ladders. Walking areas should be wide enough for people to pass one another easily, while carrying whatever they will be holding. An elevated floor or walking surface, like a ramp, scaffold, or balcony, should be strong enough to carry heavy loads, if that is how they will be used. If the walking surface is not strong, there should be signs that show the maximum weight that is safe to carry.

Common reasons for slips, trips, and falls include small objects on the floor, insufficient lighting, poor maintenance, improperly constructed stairs and platforms, uneven surfaces, inattention, running, and failure to use safety equipment and proper household procedures such as cleaning up spills.

Walkways, both inside and outside of buildings, should be clean and dry to prevent slips, trips, and falls. Stairways and ramps should always be kept dry, free of spills or objects people could trip on, and should have a good grasping surface on the rails and a rough walking surface that prevents slips. Keep floors clear of clutter and trip hazards. Common hazards on floors include buckled or torn carpet or mats and wires, such as phone lines or extension cords that extend across walking passages. Carpet should be smooth and bound on the edges, if possible, or nailed down tightly. Taping the carpet down is only a temporary solution, because when the tape peels back it can cause a person to trip. Mats should be as flush to the

floor as possible. These hazards can be found in offices as well as production areas.

Slippery surfaces are a big problem with many types of floors, especially if the floor gets wet. If you think slipperiness could be a problem at your place of employment, a simple slip test can be performed. This is done by pulling a heavy block by hand across the surface. The block can even be attached to a simple spring scale and you can measure the amount of resistance the floor surface gives when the block is pulled across it. If the block slides easily, the floor is much too slippery. Employees should be trained to clean up spills right away to prevent slipping.

Another factor is what is on the workers' feet. In most workplaces with tools, parts, nails or screws, and other objects that could end up on the floor or get dropped, workers need to have footwear that gives them a good grip on the surface and protection from injuring their feet. That means hard shoes and sometimes safety shoes, with steel toes and soles. Sandals and flip-flops should never be worn where there are such hazards.

Another hazard is walking where moving vehicles are passing. A very simple and effective safety precaution is to mark off areas on the floor where free moving vehicles like forklifts and employees carrying equipment and heavy loads will pass and where other workers and visitors should not walk. One way to do this is to paint yellow crossed lines in these areas and to post signs to warn of moving vehicles or people.

Training workers in safe working practices and promoting awareness should help prevent slips, trips and falls but training alone cannot be the only way of preventing slips, trips, and falls. These things may seem to be just common sense to the owner or manager, but when things get busy and people are working with their mind on other things, they take shortcuts and unexpected things can happen.

Guards and Rails

Platforms and overhead walkways need railings so that workers do not fall. It only takes a stumble or a moment's distraction for this to happen without a guard rail. A broken arm or leg can mean weeks off work and a head injury can sometimes mean disability for life.

Guardrails and covers also prevent workers from being injured by falling or from falling objects overhead. Guardrails should always be present where workers may be around vats, holes, manholes, ditches, the entrance to tanks, and anywhere else a person could fall in.

When the walkway is elevated above ground, railing should include "toeboards". A toeboard is a piece of railing at the bottom that prevents things such as tools, parts, and trash from falling over the edge of the platform and possibly injuring someone below. When the walkway is under an area where construction is taking place or tools are being used, put a roof on the walkway to protect workers from falling objects.

Ladders

Ladders are used every day but can be dangerous when they are not used correctly. Injuries can occur when a portable ladder is placed on uneven or unstable surfaces, when workers reach too far to one side and cause the ladder to move to the side, and when the ladder is not braced properly or is supported only by other workers. Serious injuries can happen from falls if workers select the wrong ladder for the job, rain, water or oil makes the rungs of the ladder slippery, they try to hold equipment and climb up or down the ladder without holding on with both hands, and when the ladder is placed wrong, or used incorrectly. Portable ladders should not be used if there is a safer alternative such as scaffolding, work platforms, or fixed ladders.

The ladder has to be tall enough for the job. Workers often stand too high on the ladder to keep their balance (the last two rungs are very dangerous places to stand) because they do not want to take the time to get a longer ladder, or they may place the legs of the ladder on bricks or drums in order to get higher, which is very dangerous.

The rungs of the ladder should be coated with or made of non-slippery surfaces. Ladders should be checked periodically for broken rungs, loose pieces, or cracks and should be clean and free of grease or other slippery materials.

A very important component of worker safety with ladders is the placement of the ladder. The top of the ladder should be well supported, so it does not slide or slip. The legs of the ladder should be placed on a solid, stable, non-slippery surface. The ladder should be placed so that there is a ratio of four to one for the height of the ladder to the point of support at the top divided by the distance back from the support. That is, for every meter (100 cm) vertical, there is about 25 cm (1/4 meter) horizontal out from the base of support, a ratio of 4 to 1 (height to distance back from where the ladder is supported at the top). If the ladder is resting on a support structure, there should be at least a meter, extending beyond the support, so that the workers can safely lift themselves up and get off. (See Figures 2.1 and 2.2).

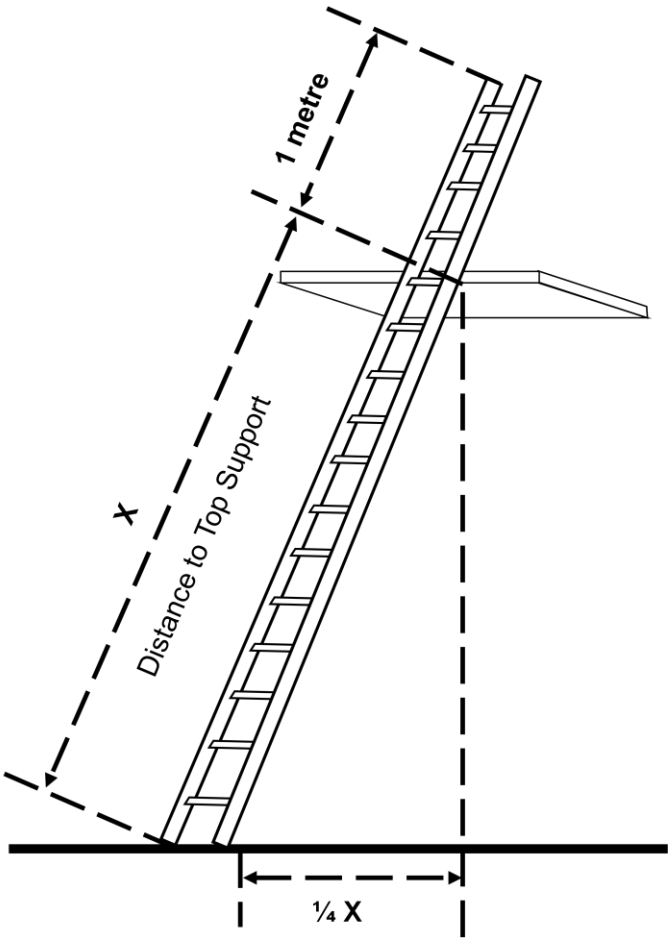


Figure 2.1. *This is how a ladder should be placed.*

How the worker uses the ladder is also important. Workers climbing up or down ladders should always face the ladder and hold on, and never climb down with their back to the ladder. Soles of the workers' shoes should be free of mud, grease and other slippery substances. Tools should be carried on a belt or hauled up using a line, in order to leave the hands free for grip during climbing.

Figure 2.2. *This worker is completely unprotected, up on an elevated platform without guard rails. The ladder is also too short and there is clutter on the walkway that could easily cause him to trip and fall to the concrete floor below. If he falls on his head from this height, the brain damage that could result could be permanently disabling.*
(Photo courtesy of Julietta Rodríguez-Guzman, Universidad El Bosque.)

Equipment and Electricity

The power equipment used in your workplace always has two types of hazards: the hazard of what powers the equipment and the hazard of what the equipment does.

What powers the equipment is usually electricity. Electricity has to be looked at as a hazard by itself. A frayed electrical cord, a plug that is not grounded, a short in the equipment, an outlet that is overloaded, all can result in electrocution of a worker. Electrical equipment needs to be inspected from time to time and sometimes cords need to be replaced. Circuits should never be overloaded because that causes fires, power outages, and electrocution hazard. (Figure 2.3)

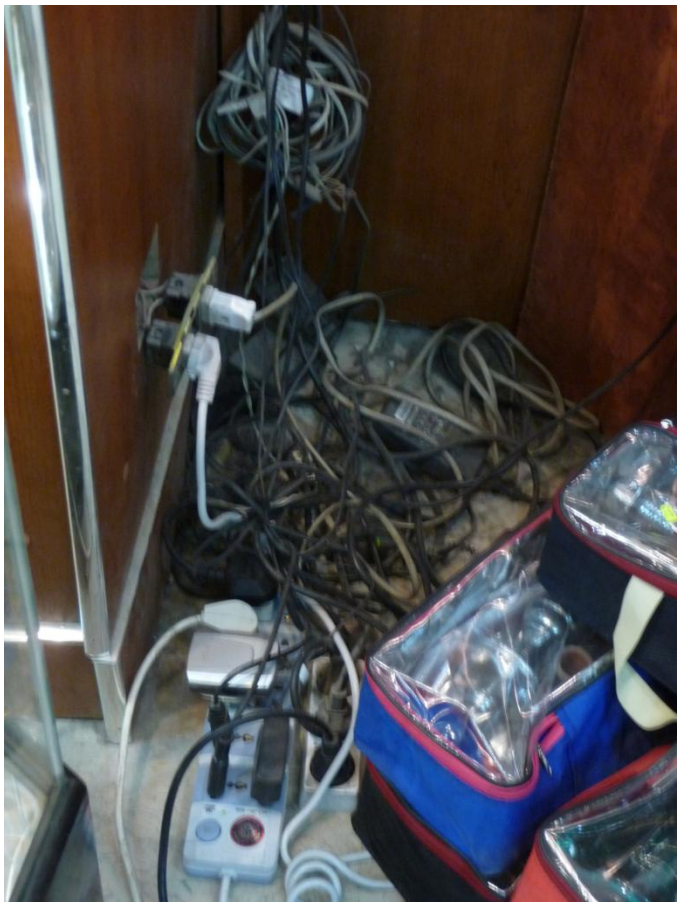


Figure 2.3. *Too many electrical plugs in too few outlets. These electrical cords and outlets at a store in Egypt are dangerously overloaded. The wall outlet is poorly wired. This situation is likely to cause a fire.*

What the equipment does is usually obvious if you pay attention. A drill can go through a hand and a power saw can take off a finger so fast the worker does not know it has happened until it is too late. Machines are much faster and more powerful than people, and so it is too dangerous just to depend on "being careful" to prevent accidents.

Both mechanical and power equipment can cause injuries and the more power the worse the injury that can be caused. When a person is using a handsaw, they can stop immediately if something is going wrong. Power equipment keeps on going and can injure the worker so quickly that he or she cannot react. A serious injury can result even when the worker is working carefully and paying attention.

Workers often like to express themselves through the clothes they wear and how they wear their hair, but there must be limits in the workplace for safety. Loose clothing or jewelry or long hair can get caught in a turning part. When a fan blade or a drill press or a roller or a lathe catches onto a sleeve or a necklace or a headscarf, it can pull tight in an instant and strangle or crush a person. Long hair can get caught and pulled so hard that it rips skin and hair off. Workers should wear clothing that will not get caught in the machinery and no loose jewelry, such as necklaces or chains around their neck. If they wear long hair it should be pulled back and bound for safety.

Equipment needs to be maintained and fixed when it is broken. A piece of equipment that is broken or badly repaired and is still operating is usually dangerous. It is not operating the way it should and that means that it is unpredictable or that safeguards are not likely to work either.

Equipment needs to be used properly, as the manufacturer made it. Good and modern equipment always comes with guards that keep the worker's fingers, hands, feet and body away from parts of the machine that cut, pinch, grab, crush, turn, and pull. Sometimes workers want to take them off because they think they can work faster without them. These guards should never be removed because they are there to protect the worker from injury.

The worker in Figure 2.4 is one second away from cutting his own finger off. There are also many other problems in his workplace, including fire hazards. This is typical. Workplaces that have one dangerous hazard almost always have several other serious hazards. The workplace in Figure 2.5 shows this even better. There are many hazards in this workplace, as well, showing that many hazards can always be found in the same poor workplace. They are there because of neglect, lack of awareness, or poor work practices.

Figure 2.4. *This worker is pushing a board into a table saw with his bare hands. See how close his arm is to the blade (on right). Also, you can see how dirty this workplace is by the dust on the lens of the camera. Workers here are breathing this dust all day. However, there is one good thing in this picture: the tubing on the left shows that there is a local exhaust system under the table that removes sawdust from under the saw. It is hard to know how effective the dust collection system is in this situation because there is so much dust around. (Photo courtesy of Seifeddin Ballal, University of Dammam.)*

Figure 2.5. *A cluttered, unsafe workplace. See the trip hazards on the floor, the unstable work surface (held down by bricks but supporting a hot iron), the long clamps against the wall that can fall down easily, poor lighting, several fire hazards, and dust everywhere (visible on lens of camera). (Photo courtesy of Seifeddin Ballal, University of Dammam.)*

Falling Objects

Falling objects can do a lot of damage. The higher they are dropped, the more damage they can do. Having a wrench drop on a worker's foot is not fun and if the worker is wearing sandals it can break their foot. When they land on a person's head, it can cause brain damage (being knocked out is a sign of brain damage) or even kill the worker. Workers need to wear hardhats in any workplace where objects could fall from overhead, even small ones. They need to wear hard shoes, preferably safety shoes or boots, around any workplace where there are parts, tools, or other objects that could be dropped.

Fire

Fires are responsible for more deaths than any other workplace emergencies. A small fire can get big fast and spread quickly. Even a small fire can kill or injure workers and a big fire can kill many people and shut down a business for good. Local governments have fire safety codes and businesses must follow their rules exactly. What to do in case of fire should also be the first issue in the company's emergency management plan. (See Chapter 6.)

Once a fire starts, the smoke it creates can be more dangerous than the fire itself and can make it difficult to see how to escape. The smoke itself can make a person sick and the carbon monoxide the fire produces can cause them to pass out. In a fire, the safest air is near the floor, so when smoke is heavy, a person should crawl, rather than walk, to safety.

Fires need fuel and oxygen to burn. One way to prevent fires is to remove trash regularly and keep the workplace clean. Oily rags and chemicals that can catch fire should be kept in closed metal cans. Flammable liquids like gasoline and alcohols are dangerous in the workplace and should be used carefully and in small quantities. Their fumes can catch fire and bring the fire back to where the fuel is. A common source of fires in laundries and industries that clean textiles is the lint trap and the ducts that carry hot air away from clothes dryers, because the lint can catch fire. Leaking gas lines and propane tank connections are also a major cause of fires in buildings used for business.

Fires also need an "ignition source", something that starts them burning. This can be a spark from a bad extension cord or a damaged outlet box or faulty machinery that has a short. Every electrical machine and every place where there is an open flame should be inspected at least monthly to be sure that it is working properly, properly grounded, and not a fire hazard. This includes stoves and extension cords. Fires can also be set off by a match or cigarette lighter, or a lit cigarette thrown into paper. That is why smoking should not be allowed in the workplace or near trash cans and there should be an ashtray or a can with sand in it at the entrance to all buildings. A hot surface and static electricity can also set off explosions.

An alarm system should be installed and workers should perform fire drills so they know what to do in case of emergency. All employees should know where the fire alarms are, how to operate them, and when to do so.

Escape from a fire should always be easy and there should always be a second, backup way out. Exits should be marked clearly and if the building is open to the public, easy-to-read floor plan maps showing the most direct escape routes should be posted where they are easy to see. Escape routes must be free of any obstruction and of clutter, including material that can catch and spread fire. There should always be at least two exits, so that if workers cannot get out one way they can go out the other. Never block a path that a person might have to take to escape a fire. Never, ever lock or chain the doors of a fire exit closed – people could die, as they already have in many incidents where this has happened.

As employees leave to evacuate, they should turn off machinery if there is time. After people leave the building. Employees should have a place to meet outside the building, at a safe distance away. Reaching this "assembly point" should be part of the fire drill.

In most business, a "fire suppression system" should be installed, particularly in restaurants, public places, and where open flames are present. These are usually sprinkler systems. These systems save lives and they also limit property damage. They can keep the fire from getting out of control before the fire department can come.

Fire extinguishers should be available wherever there is a fire risk and in corridors of every building. There are different kinds, so the right fire extinguisher should be chosen for the purpose and responsible workers need to be taught how to use them. They should also be kept up to date on service. Fire extinguishers should be used for small fires and not used when there is a risk of injury to the worker.

In places where fire departments may not come or may not be available, however, a company may have to rely on its own workers to fight fires. If that is so, they need to be properly trained and to practice frequently.

Special attention needs to be given to people with disabilities. If certain workers cannot get out of the building on their own, there should be someone assigned in advance to help them and a plan for getting them out if necessary. It is dangerous for one person to carry another person down a flight of stairs. (Fire departments have special chairs to help do this.) If a disabled person is in immediate danger and cannot evacuate, the disabled person should move to a safer area until help is available. Enclosed stairwells are usually much safer than corridors or rooms in the building. To help a blind person, a person trying to help should ask them to hold on to his or her arm as they exit together; the person helping should never grasp the arm of a blind person and pull them.

Explosion

Preventing explosions is much like preventing fires. Explosions can occur by accident or by attack, which may be on the property of the business itself but is more likely to be nearby. What to do in case of explosion should be included in the company's emergency management plan. (See Chapter 6.)

The most common explosions in industry are caused by leaking gas lines or equipment that uses gas. Many chemicals that fuel fires can also be explosive if they are set off all at once. Gasoline, for example, has the destructive power of dynamite when an entire can is ignited.

Explosions can also occur with dusts that burn easily, when dusts are suspended in air and are suddenly set on fire by an ignition source, a hot surface, or static electricity, which can build up when gasoline runs through a hose or solvents are poured or two non-conducting surfaces rub against each other. The smaller the dust particles and more concentrated the dust cloud, the more likely it is that the dust will explode. Common explosive dusts include lint, dry wood dust, coal dust, powdered sugar, animal feed dust, flour, plastic resin dust, and grain dust. However, some explosive dusts consist of metals that oxidize easily, even though the same metal would not burn in their usual bulk form, like iron, magnesium, aluminum, and titanium. Dust collectors reduce the risk of fire and explosion but they should be inspected regularly and kept well maintained. Faulty dust collectors are an important cause of dust explosions.

If there is any possibility of trouble, it is worth training employees for what to do if a bomb or an accidental explosion goes off nearby. An intentional explosion often draws people into the area where they can be hurt or killed by a second explosion timed to go off a few minutes later. Employees and visitors should stay in the building if the explosion went off outside and the building is safe. They should get as far away from windows facing the direction of the explosion as they can; flying glass from a second explosion can blind people.

If the explosion was inside the building, then employees and visitors should evacuate as for a fire, get as away from the building as possible while staying together, and if possible go to the assembly point and wait for further instructions. It is important to record the names of people who got out in order to determine who might be missing.

Confined Spaces

Any enclosed or partly enclosed space in a workplace that a worker must enter and work in and that cannot exit quickly is a confined space. Confined spaces are places where gases can build up or where there can be a fire that a worker cannot escape or where oxygen can be used up. Examples include tanks, wells, big pipes, between decks of a ship, in a deep ditch, inside a tunnel or shaft, down a manhole, inside a walk-in freezer, and in a bank vault, If a worker is inside the confined space, if anything goes wrong the situation can be so dangerous that it can cause death. Many things can go wrong in a confined space, such as too little oxygen to breathe, a build-up of poisonous gases, fires, falls or other injuries that keep the worker from being able to get out, heat or extreme cold, flooding, and becoming trapped. Confined spaces need to be locked and people need to be kept out until work is done. The work must follow a plan that is approved by the supervisor or at a higher level. (In large industries in most countries there is a standard operating procedure called "lock out/tag out" that is used for this situation.) That plan should include having a second worker on the outside watching them while they work, supplying air if needed, and testing for gases and adequate oxygen

before the worker goes in. Confined spaces have to be controlled, with people on the outside working together as a team with the worker on the inside, with lots of ventilation, and with testing to be sure that it is safe.

Heat

One of the most common and dangerous safety hazards is heat. Overheating can make people sick and can even kill a person. The heat can come from hot weather or from an industrial source such as a furnace. Heat stress, as it is called, is a severe problem in construction work (See Box 1.1), especially in tropical and desert climates. (See Table 8.1, which mentions location as a category of hazard.) The combination of heat and high humidity is particularly dangerous, because the humidity does not allow the human body to get rid of heat.

There are a few important rules for protecting workers from extreme heat:

- Allow and even encourage workers to slow down and to take rest periods more often. In the end, they will get as much work done as before.
- Provide clean water (just plain water is best) where workers can drink whenever they want and how much they need. Encourage them to drink a lot of water.
- Do not give workers salt tablets. It is unnecessary and can make people sick to their stomach.
- Provide shade in a safe place so that workers can cool down, especially during rest periods and if they feel sick, dizzy, or weak, or get a headache. This is called heat exhaustion. Workers who feel dizzy also sometimes faint but they should come around right away when they lie down. If the person does not wake up or if he vomits or acts confused, the condition is more serious, as in the next point.
- Educate supervisors that heat stress can kill people. A worker who vomits, acts confused, says he is not feeling hot or thirsty, gets a headache, has a convulsion, or loses consciousness and does not recover when they lie down is probably on his way to death from what is called heat stroke and needs emergency treatment and cooling down right away.

Workers build up tolerance for heat over time. People who are used to hot and humid climates can work in hotter weather that others can stand but everyone still has limits. Countries in the Arabian Gulf have set limits for outdoor workers during the summer: even workers who are used to the heat are not allowed to work during the middle of the day when temperatures are highest.

Other workers are much more vulnerable to heat stress. These include workers who are taking certain medicines, who have recently drunk alcohol, who are heavy, and who have certain illnesses. Even healthy people without these problems can get heat stroke and heat exhaustion.

Hot surfaces in the workplace can set off fires, as well as being a hazard for burns.

Noise

The most common hazard in workplaces around the world is loud, continuous noise. Noise levels usually go up and down, depending on what is being done in the workplace. The average level noise is most important over time in affecting hearing. However, bursts of very loud noise, enough to make your ears hurt or cause a ringing in your ears, affects hearing too.

Noise causes loss of hearing (deafness) over time and this can be tragic. Unfortunately, by the time they are older many workers cannot hear what their children or grandchildren are saying, cannot hear music clearly, and confuse words when people tell them something, even when they strain to hear. Noise also makes it hard for workers to communicate in the moment and to warn each other of safety hazards in the workplace. Noise also has other effects, like raising blood pressure.

There are some simple tests to determine whether noise is too loud in a workplace:

- Test #1: If two adults with normal hearing stand one meter apart and talk in a normal voice, each should be able to hear and completely understand what the other one says. If either of them cannot hear the other clearly or cannot make out the words, then the background noise is too loud.

- Test #2: If a person with normal hearing suddenly cannot hear as well as usual when the noise stops, then the noise was too loud. This temporary reduction in hearing is a nerve reflex that the body uses to protect the ears from permanent injury. It usually lasts for several hours before hearing goes back to normal.
- Test #3: If a person with normal hearing suddenly experiences ringing in their ears when it stops that they did not have before, then the noise was too loud. A lot of people already have ringing in their ears and for them loud noise will make it worse and may make them dizzy.

Noise is used as an example of hazard control in Chapter 8. (See box 8.1.) Fortunately, there are many ways of controlling noise exposure that are inexpensive and effective. The general approaches are discussed in Chapter 6. The key to controlling noise is choose one or more approaches that fit the situation:

- Maintain equipment in good shape to prevent vibration and noise.
- Put noisy machinery on a material that absorb vibration, such as spring isolators or Neoprene® rubber pads.
- or fasten them tightly to solid surfaces (like a concrete floor) that do not transmit noise and vibration as easily.
- Separate the worker from the source of noise by a noise-absorbing barrier.
- Separate the worker from the source of noise by distance; move them as far away as is practical.
- Install sound-absorbing wall and ceiling coverings (usually in the form of ceiling tiles) to reduce reflected sound waves.
- Enclose the source of noise in a box or cover that absorbs the sound. (The enclose has to be almost complete to be effective.)
- Enclose the worker in a booth or room that is sound-proof, and so insulated from noise outside.
- Provide workers with personal hearing protection, as outlined in Chapter 6: earmuffs, earplugs. (Cotton does not work.)

Box 2.1.
Simple questions for safety.

You can begin to evaluate the safety of your workplace using the following questions. ("No" answers indicate that problems exist in the workplace.)

Layout and workplace design

- ☐ Are the work areas set-up so that moving equipment does not interfere with workers?
- ☐ Are the walkways wide and free of machines or operators of machines?
- ☐ Are aisles and doorways large enough to allow safe clearance of equipment, machinery and loads?
- ☐ Are areas marked on the floor and on signs at eye level where machines move and workers walk?
- ☐ Is the lighting sufficient so visibility of work surfaces and walkways is good?
- ☐ Are there floor loading guidelines posted and are they followed?
- ☐ Are signs that are important for safety written in the language or languages workers can read?

Equipment

- ☐ Is the equipment in good shape? Has it been maintained? Is it serviced regularly?
- ☐ Is the electrical power to the equipment safe (outlets not overloaded, wires in good condition, plugs grounded)?
- ☐ Are all guards and protections that came with the equipment still on it?
- ☐ Do workers use the equipment safely?

Floors and aisles

- ☐ Are the floors of the workplace kept clean and orderly and free of hazards?
- ☐ If the floor gets wet, are there drains to remove the water and rubber matting to prevent slipping?
- ☐ Are the floors nonskid/nonslippery?

Outdoor areas

- ☐ Are abrasive surfaces used where ice and snow cannot be removed or where surfaces remain wet?
- ☐ If gravel is used as a walkway, is it small and safe?
- ☐ Are outdoor spaces and pathways for walking or transportation free of debris?

Open areas

- ☐ Do rails and toeboards protect workers in open areas?
- ☐ Do stairs have handrails?
- ☐ If pits, ditches, or open vats exist, are there measures in place to prevent falling into them?
- ☐ Is there someone watching the floor hole if there is no cover for it and it is in use?

Ladders

- ☐ Are ladders free of broken or damaged rungs?
- ☐ Are the rungs of the ladder non-slip?
- ☐ Do workers place the ladder correctly (as described in the text)?

Confined Spaces

- ☐ Does the business have a "lock out/tag out" system to protect workers who are working in confined spaces?
- ☐ Is the air supply to workers inside a confined space protected and secure?
- ☐ Is there always a worker outside the confined space watching the worker inside and making sure that everything is all right?

Heat

- ☐ Is there shade at the workplace so that workers can cool off?
- ☐ Is there enough clean water that workers can drink all they need, anytime they want?
- ☐ Do workers take more breaks when the heat and humidity are worst?

Fire and Explosion

- ☐ Is there a fire suppression system (sprinkler system) in the building? Fire extinguishers?
- ☐ Are flammable liquids and oily rags kept in closed metal containers?
- ☐ Is the material that can burn (such as paper and wood) kept safely and the amount of it stored on site kept to a minimum?
- ☐ Are sources of ignition in the workplace inspected regularly and kept well maintained?
- ☐ Is there an evacuation plan? Are employees trained in it? Are they required to participate in regular fire drills?
- ☐ Are all exits and evacuation paths kept open, clear of obstruction, unblocked, and unlocked?
- ☐ Does your enterprise have a written policy on fire prevention and are workers trained?
- ☐ Does your company prohibit smoking in the workplace?
- ☐ Is the training repeated at least once a year with practice drills?
- ☐ Are chemicals that could catch fire far away from flames and sparks and operations like welding, and kept in closed containers?
- ☐ Are rags used to clean up grease, solvents, or gasoline kept in a tightly closed metal container?
- ☐ Are fire extinguishers available and in reach in the workplace? Do all employees know exactly how to use them?
- ☐ Are fire exits and escape routes from your company's workplaces always kept open, always kept unlocked, and always kept free of obstacles during working hours? Are all fire exists marked with a big, visible sign?
- ☐ Has the manager of your company talked with the current chief of the fire department or a qualified representative about what hazards are in the workplace, how firefighters can get in, and how your workplace is laid out?

Noise

- ☐ Is the workplace free of any source of continuous loud noise? If there is a source of loud noise, is it controlled to a low level? (Where is it located and what can be done to reduce the noise?)
- ☐ Can two workers with normal hearing hear what each other are saying without having to yell when they stand one meter apart?
- ☐ Is the workplace free of any source of repeated, sudden loud noise? If there is a source of sudden loud noise, is it controlled to a low level? (Where is it located and what can be done to reduce the noise?)
- ☐ Are workers provided with hearing protection? Do they use it?

Management

- ☐ Are new workers trained to do their job safely?
- ☐ Are current workers given regular training to make sure they know how to work safely and effectively?
- ☐ Is the workplace well maintained and kept clean?
- ☐ Are repairs made quickly and correctly by people who really know how to repair the equipment?
- ☐ Does your company have a procedure to be sure that every employee who drives a company vehicle (car, truck, forklift, and other) knows how to operate it safely, has a license to drive, and is a safe driver?

Chapter 3
EFFICIENT AND SAFE WORK

Workers are not machines. They have limits to their strength, come in different sizes and body measurements, cannot possibly function without ever making a mistake, can only work for a limited amount of time before they get tired, and can easily get hurt. That is why the workplace needs to be designed for people and their limitations. A properly designed workplace will make it possible for the worker to work more efficiently, more productively, and more safely.

The professional field that covers workplace design, safety, and efficiency is called ergonomics. Think of ergonomics as a science that fits the job and work environment to the worker. When the work fits the worker, the job is more efficient and safer. For example, when you buy a pair of shoes, you do not buy them too big or small because the cost is just a little less, you buy a pair that fits just right because it is worth it. A pair of shoes that are too small will give you blisters and sore feet before long, and you won't be able to walk comfortably. Your feet will hurt, you will not be able to walk far, and you will not be happy. A pair of shoes that is too big will fall off your feet. The same idea applies to equipment and workplaces.

Ergonomics is very similar. A workplace that is inefficient in design will make the worker inefficient and unproductive, and also tired. Injuries are more likely when the workplace is badly designed and the tools are not right. A worker that does not have the proper tools or work environment will also be stressed. A stressed worker will not be as efficient as a worker who is not stressed. This is not good for you, your company, the worker, or the worker's family. So when you think about ergonomics, remember: fit the job to the worker. (See Figure 3.1.)

Figure 3.1. *These workers are stacking unfinished bricks inside a kiln for firing. See how awkward it is to carry the bricks in one at a time. The workers use a cart on wheels to bring the bricks to the kiln area but the cart is too big to come closer. The man doing the stacking has to bend his head over to fit and needs to come out every few minutes to straighten his neck. These workers are also at risk for silicosis (see Chapter 5) because special bricks with a high silica content that can stand the heat, called "refractory" or "furnace" bricks are used in kilns or furnaces and repairing them is a dusty job. (Photo by Carlos Julio, supplied courtesy of Julietta Rodríguez-Guzman, Universidad El Bosque.)*

Your employees can perform their jobs better if the job fits their capabilities in these three categories:

- Physical Conditions
  - Speed of Work
  - Work Capacity
  - Workplace Design
- Environmental Conditions
  - Temperature
  - Noise
  - Humidity
  - Lighting
  - Access to drinking water
- Mental Conditions
  - Responsibility
  - Hours Worked
  - Rest Breaks

If one or more of these three conditions is poorly designed, the worker may not be very productive and is likely to be unhappy at work because of it. However, employers can help change the situation because managers have control over the job and the work environment. However, there are many very simple, low-cost improvements that you can do to help your employees perform their jobs better no matter what industry you are in. These include:

- Improve materials storage and handling (figure out more efficient ways of lifting, carrying, packaging, and transporting things)
- Improve work organization and schedules (figure out more efficient and comfortable ways to use workers' time)
- Improve environmental conditions (make the workplace safer and less physically stressful, so workers can concentrate on the job)
- Removal of hazards (a safer workplace is a more efficient workplace)
- Improve safe working procedures (if the process is made more simple, direct, and visible, it will usually be safer)
- Provide good resting quarters or facilities (cool, quiet, and away from noisy work)
- Improved workstation design and posture (workers should be able to sit or stand naturally and have everything they need to do a job within easy reach)
- Proper job training (workers should not only be told but asked to say in their own words what they have learned, to be sure they know it)

Many of the most severe ergonomic problems occur in "materials handling", when workers have to pick up, package, haul, and deliver goods, as shown in Figure 6.2. These problems are often easy to solve once they are examined.

Figure 3.2. *A man in East Africa pulls a handcart loaded with cement at a ceramics factory making sinks and toilets. Notice that his shoes are worn out, which makes pulling the cart even more difficult. (Photo courtesy of Suvi Lehtinen, Finnish Institute of Occupational Health.)*

How Do I Know What the Problems Are?

How do managers and supervisors without experience or training in ergonomics science know if there are problems with a job or the work environment? How do you assess the problem and determine how severe it is?

It is not difficult to solve most problems in ergonomics. There are many tools that are available to you. The easiest and most effective way to find out about problems is simply to ask the employee. Suggestions made by workers are a great way to find out which simple improvements that will lead to increased employee satisfaction and productivity.

A side benefit of listening to your employee is that it lets them know that their health and well-being are important to you and the company. Employees that perform stressful jobs may not always have a solution to their problem, but at least they can define the problem for you so that a solution can be found. Other tools in your ergonomics toolbox are:

- Directly observing your workers, their fatigue, and posture
- Keeping a record of complaints and injuries for different jobs
- Questionnaires
- Have a specialist (ergonomist) evaluate your company
- Trying the task yourself and seeing what the problems are.

The following are some examples of simple low cost improvements. These examples will help show how small improvements can make a big difference.

Box 3.1.
Case Study: Backbreaking Bags

A cement distributor bought 45-kilogram bags of cement from a production plant and sold them to hardware stores throughout the country. A large tractor-trailer flatbed truck was used for the deliveries. Each truck usually delivered about 600 bags on each route. That is approximately (45 kg/bag x 600 bags =) 27,000 kilograms that has to be moved from the truck into the hardware stores' storage units. There were three men (runners) that carried up to three bags (135 kg!) on their shoulders at one time from the truck to the storage units. There were two men standing on the truck loading the bags of cement on the runners' shoulders.

The men were asked if they experienced any problems with their jobs. They explained that they were on a tight time schedule and had no choice but to carry 2 to 3 bags on each trip from the truck. They all said that they experienced neck, shoulder, and back pain. In addition, while loading the bags on their shoulders, they got covered in cement dust, which irritated their skin. When they unloaded the bags off their shoulders, the bags often dropped at least 3 to 4 feet to the ground, causing the air to be filled with cement dust. Sometimes the bags broke, causing a loss for the company. All of them experienced irritation in their lungs and difficulty breathing at times.

The men considered this job to be terrible, nasty, and much too hard for what they were paid. They did not care much about broken bags and the loss to the company, because they thought the company did not care about them.

A simple, low cost, and low technology solution could be a hand truck (a rack on wheels, as illustrated in Figure 3.3) and a removable metal ramp that can be attached to the back of the truck. Delivering cement is a physically demanding job, but the strain on the body and chemical exposure to the skin and lungs can be greatly reduced. Loading and unloading the hand truck with bags of cement will still require lifting, but the impact on the neck, shoulders, back, and knees will be much less. The hand truck will eliminate the distance that the bags are dropped to the ground and reduce the amount of cement dust that is in the air. Workers are much less likely to drop the bags and so there will be less loss, which should pay for the hand truck easily. Simple training can also be done to show workers how to lift heavy objects properly with their legs and not their backs. This is a relatively low cost investment that can help workers move more bags of cement per person. Increased efficiency should also allow the workers to have more rest time between deliveries to recover and this will improve worker satisfaction and efficiency!

Figure 3.3. *A hand truck. (Photograph ©dreamstime.)*

The same principles used in Box 3.1 and Figure 3.2 also apply to warehouses, markets, shipping departments, and stores. Simple devices such as hand trucks and wheelbarrows protect the worker, reduce the number of injuries, save time, and greatly increase the amount that one worker can carry.

In this next example, the management in a manufacturing company worked together with their employees to make improvements. Working with your employees to improve the way they do their jobs is a great way to build trust and gain their respect.

Box 3.2.
Case Study: Just Raising Things Up Made A Big Difference.

A relatively small company produced and sold replacement parts for different types of old cars. The company employed 155 workers, and produced many different parts, which varied in size and weight. The manufacturing plant was small and cramped, because the production process and storage areas were in the same building. In an effort to increase efficiency and productivity, managers had the supervisors conduct a survey of the plant's employees. They asked the employees to identify problems that they experienced with their jobs. Their survey showed that employees had the most problems with:

- lifting and lowering heavy objects
- poor workstation design
- poor delivery route organization within the plant

Employees indicated that they had to squat or bend for long periods of time to perform their jobs. They said that they would prefer to sit at a higher level, on a worktable. Also, there was no delivery system in the plant, so the workers transported the parts themselves to the different areas and were always getting in each other's way. They suggested that delivery routes be marked out on the floor.

The supervisors seriously considered the employee's problems and evaluated the organization of the plant, work areas, and delivery routes. They determined that pushcarts with metal baskets would eliminate some of the heavy lifting and lowering being done by the employees.

They also looked at workstation design. They built tables that were high enough off the ground that would allow the worker to either stand or sit while performing the job. This eliminated the unnecessary bending and greatly increased worker satisfaction.

Last of all, management decided to design better routes for the transport of the parts from one area to another. They painted the new routes in yellow on the floor to show the employees where they should go. As the process got more and more efficient, they were able to employ a few more workers just to make deliveries from one area to another and their plant became even more efficient.

In this example, worker input was very important. It improved the overall process and efficiency of the plant's production, and created better working conditions.

This last example uses knowledge about the environmental, physical, and mental loads that were mentioned at the beginning of this chapter.

Box 3.3.
Case Study: Case Study: Reorganizing the Work for Efficiency and Safety.

A small factory produced oxygen to fill tanks that were sold to hospitals. The company operated on a 24-hour schedule. The work was broken up into three 8-hour shifts: 6 a.m. to 2 p.m., 2 p.m. to 10 p.m., and 10 p.m. to 6 a.m. Each shift includes a 30-minute break. The main hazards in this company were accidental explosions due to pressurized oxygen and body stress due to heavy lifting of the oxygen tanks (one tank weighs 55 kg.)

A specialist was hired to look at the workers schedules and productivity. They also investigated environmental and workstation problems such as: temperature, lighting, rest areas, and workstation design. The investigator observed workers during all three shifts and asked them questions about their jobs. The investigator determined that the night shift workers felt the most tired and even observed an employee that controlled oxygen production falling asleep. In general, the night shift filled fewer oxygen tanks compared to the morning and afternoon shifts. The night shift also reported more accidents compared to the other shifts. The investigator and the management realized that this was a serious problem because high-pressure oxygen is very dangerous. All of the shifts reported that the lighting in the plant made it difficult to see and strained their eyes.

The investigator met with the management and the workers to show them the results of the analysis. Table 3.1 shows the areas for improvements and the changes made by the company.

Table 3.1. Changes Made by the Company for Worker Protection.

Areas for improvements	Changes made by company
Improve material handling	• Multi-level carts to carry oxygen tanks
Improve safety of work	• Installed safety valves on machines that fill oxygen tanks • Location to put tools when not in use • Proper machine guards • Machine operating instructions translated to the native language of the workers (In many workplaces this should include using pictures instead of words to get the message across.)
Working environment	• Increased light • Provided comfortable rest area
Improved organization of shifts	• Eliminated night shift and kept the morning and afternoon shifts

The changes the company made worked well. Production did not drop by eliminating the night shift and the employees benefited from improved working conditions.

Lighting

Lighting should be adequate for visibility, efficiency, productivity, and safety. Poor lighting in the workplace can cause blurred vision, fatigue, eyestrain, neck and back pain, and headaches. Inadequate lighting makes work unsafe and usually results in poor work performance.

How much light is needed depends on the specific tasks. Finer and more detailed work need brighter lighting. Proper lighting allows employees to work without straining their eyes. It allows employees to be more aware of hazards, hazardous operations, and equipment, makes work more productive, and could prevent costly mistakes or accidents.

Lighting of adjustable intensity should be included for older workers or those with visual problems. Using only overhead lighting can cause visual problems such as shadows, that may hide hazards such as sharp edges or make work difficult. Task lighting can be used when general lighting is not enough. Employees should be trained to check lighting at the same time that they do a maintenance check or tool set-up. Employees should know how to get the proper lighting for their specific job and what to adjust, if applicable. Lights should be cleaned and maintained often. Burnt out light bulbs should be replaced immediately or a schedule should be created for bulb replacement in large areas at one time.

Modern light sources, such as spiral fluorescent bulbs like the one shown in Figure 3.4, are much more efficient than old-style light bulbs. Halogen lights save energy, last longer, and do not drop in intensity the way older light bulbs did, but they are also much hotter and can burn fingers severely.

This case study shows that solutions to lighting do not have to be expensive.

Figure 3.4. *Modern light sources cost more but are much more energy efficient and last much longer than old-style light bulbs.*
(Photograph ©dreamstime.)

Box 3.4.
Case Study: Case Study: A Cheap Lighting Solution.

In a poor part of a city, a family living in a hut with a metal roof was trying to earn some money by doing piecework at home. They often worked outdoors because the light in their shack was so dim they could not easily see and they could not afford to spend money on extra lights. This meant that they could not work if it was raining.

A non-governmental organization had a solution for them. They got a plastic water bottle that was made from clear plastic. They filled it with water and put in a little bleach so the water would stay clear. They went to a local metal smith and had him make a patch for the metal roof out of sheet metal, with a hole in the middle exactly the diameter of the bottle and metal flaps sticking up around the hole. They put the bottle into the hole, right in the middle of the bottle, and held it in place by the flaps and wire, and wrapped it with plastic and waterproof glue to seal it. Then they put the patch into their roof with the top of the water bottle sticking up and the bottom half inside their shack.

Now, during daylight, the bottle picks up the light outside and brings it into the shack. It is like having a new light bulb in the ceiling.

Chapter 4
STRESS

Stress is what people feel when they are faced with something they are not sure they can handle. Stress is not just about emotion. It also affects the body and the ability to work. Good stress happens when people feel challenged and stretched to do their best. Bad stress happens when people feel overwhelmed, exhausted, and defeated. Bad stress can occur at work, at home, and in all parts of daily life but bad stress coming from work is the subject of this chapter.

There will always be some amount of stress in the workplace. After all, business is not easy. However, the key to managing the bad effects of stress is to reduce it to a level that your employees can handle. Too much stress will cause problems for workers and for the enterprise.

Harmful stress occurs when a person is unable to deal with the problems of daily life. It is something that everyone encounters every day to some degree but if there is too much stress on the job it starts to affect workers badly, spreads to other workers, and the entire company suffers too. As the owner, manager, or supervisor, you have control over how stressful a job has to be. If you find yourself constantly replacing skilled or unskilled workers who do a certain job, this suggests a problem in that workplace.

Stress is not just caused from too much work and too little time to finish it, although that can be a factor. It is also caused when a worker feels that he or she has no control over what they are doing, that the assignments in the job are unfair, and that the worker has to put too much effort into the job for what he or she is getting out of it, both in pay and satisfaction. Much stress is also caused by poor personal relations at work, both from supervisors who are insensitive to workers and do not know how to manage them effectively, and also from the worker's own co-workers.

Figure 4.1. *Much stress in the workplace comes from problem relationships and this can severely harm the business. (Photograph ©dreamstime.)*

Some employers think that stress is a good thing, because it keeps their workers motivated and highly productive. It is true that a certain medium-low level of stress helps motivate people to get things done. However, too much stress over a period of time can be harmful to health and overall well-being. When a worker first starts out, he or she may be motivated by stress, but after a while, too much stress will wear workers down and they will actually be less productive. Time constraints, unrealistic production schedules, physical loads on the body, a poor and dangerous working environment, bullying co-workers or supervisors, long hours worked, and unfulfilling jobs, and much more, cause a lot of stress among workers.

Unrelieved stress can cause both major and minor health problems. These include heart disease, upset stomach, ulcer, depression, and sleep problems, and can seriously interfere with other conditions such as diabetes.

When workers are not able to manage their stress anymore, they may look for any way available to ease it. They may take shortcuts that are unsafe in order to produce more or to get ahead of the schedule. They may fight or argue. Consuming alcohol, smoking tobacco, or using drugs are bad ways that some people use to deal with too much stress in their life. Poor habits along with the health problems from stress can lead to decreased productivity, increased number of accidents, and days off work. When employees miss work, it can put more stress on their fellow workers and decrease the efficiency of the company to get the job done.

The best ways to combat stress in the workplace are these:

- Make workers feel that the work they do is important and that their effort is appreciated.
- Make sure that supervisors are fair and are not playing favourites with workers.
- Keep the workplace safe so that workers know that they will not be injured or made sick by their work.
- Keep the pace of the work realistic, within the ability of workers to do the required work without taking dangerous shortcuts or becoming exhausted.
- Organize the work so that things do not come to a stop when one person can't keep up or has to be out for a day or two, and so that other workers are not overloaded when this happens.
- Distribute or alternate workload among workers as fairly as possible (physical lifting, repetitive labor).

These are just a few examples of what can be done to relieve your employee's stress. Other important issues are discussed below.

Figure 4.2. *Workers feel a lot of stress when they are expected to solve a client or customer's problem but do not have authority or enough control over the situation to do it. Then they feel that their only purpose is to listen to complaints and to take abuse from dissatisfied customers.*
(Photograph ©dreamstime.)

Working Life

If people do not get a reward or good feeling from their job, they need to get it from being appreciated by their boss and co-workers. This is easy to do, but only if the supervisor can talk to workers as people and not as subordinates that they can order around. A good supervisor will:

- Be a "people" leader, making every worker feel part of the team, in addition to managing the business.
- Make workers feel like they are valued.
- Provide workers opportunities for training.
- Reward workers for good performance.
- Provide workers opportunities to advance in the company.

- Allow workers to participate in making decisions.
- Allow sufficient breaks and socializing.
- Give workers meaningful work, not just something to do (a particular problem with injured workers).
- Provide an outlet for exercise (football, tai chi, stretching).

There are many jobs that are not fulfilling, but someone has to do them. People can put up with a lot more if they feel that their manager cares and appreciates what they are doing.

Conflict and Violence

Sometimes workers are afraid of other workers, or of their supervisor. The fear of violence is a source of stress that cannot be tolerated under any circumstances.

Conflict is unavoidable when people are brought together and it is not always or entirely negative if it reveals problems or deeper issues. However, when conflict is not settled by reason or negotiation or a fair process, some people will resort to violence. Violence can be physical and non-physical.

Think of physical violence as using force to cause harm to someone else. Examples are: beating, kicking, slapping, pushing, pinching, and sexual assault. Physical violence tends to be done away from other people and in places where management cannot see what is going on. The people who become violent usually have done it before and are usually not good at handling problems in other ways. That is why strict rules have to be set down and training alone is usually not enough for them. Usually the people who act this way claim it was just a joke or that they were only teasing another worker. Do not believe them.

Non-physical violence is using power to dominate or oppress someone or threatening to use force that can result in harm to another person. Examples are: threatening, harassment, constant teasing, hazing, bullying, and verbal abuse. Threats should be taken seriously in the workplace. They may indicate that the person making the threat is capable of violence that can result in serious injury. Harassment and teasing are sometimes explained away as a joke, "just having a little fun" or accepted as if they were not serious behavior. In fact, harassment and teasing are ways of forcing another person to submit to another person against their will. They cause anger and resentment and are very bad for personal relations at work. Harassment and teasing can be just one person on another but often they along with people ganging up on someone weaker. Hazing is a form of bullying and teasing in which workers make life miserable for a new hire as a way of forcing him or her to accept lower status to the people who have been there longer. It can take many forms, such as freezing new workers out of lunchtime or social activities, sending them on meaningless errands, lying to them about how the workplace works, being rude to them, making them look incompetent to bosses, or putting them in situations where they cannot do anything right. Sometimes, especially in the military and in tough jobs, where new hires are expected to "take it and be a man", hazing involves actual physical abuse, such as beatings. Bullying is when a person or group (basically, a gang) repeatedly threatens a worker or tries to interfere with how they are doing their work. Bullying and hazing sometimes happen when workers are trying to slow down a highly motivated new worker to keep him or her from making the others look bad. This kind of behavior hurts people and is never just a joke.

Physical and non-physical violence both create a second power structure in the workplace in which the bully is more important than the managers and supervisors. It always damages the workplace.

Women are often the targets of violence, both physical and non-physical. Sexual harassment can take many forms, from unwanted comments that make a woman feel uncomfortable all the way to unsafe acts of physical violence and evil, like rape. Sometimes men and boys are treated the same way. The people who do these things (almost always men for physical violence, both men and women for non-physical violence) think they can get away with it because nobody cares or wants to stop them.

The employer should make a workplace policy that says that violence of any form (physical and non-physical, in all the forms described above) will not be allowed and that threats will always be taken seriously. Workplace violence is a serious issue. Enforcement of this policy will let your employees

know that you care about their safety and well-being. A policy should include:

- A statement that physical violence, threatening, harassment, constant teasing, hazing, bullying, and verbal abuse will not be tolerated
- A commitment to fire or reassign workers who violate this policy (expect that they will deny everything), not the victim
- Protection against retaliation ("revenge harassment") for workers who report abuse
- Monitoring for signs of conflict, rivalry, or when one worker is becoming isolated from his or her co-workers.

It is important to make sure that all employees are aware of the policy and that it is enforced. It is much harder for a bully to act when everyone knows that management will not stand by and when other people can see what is going on.

Box 4.1.
Checklist of Simple Measures to Manage Stress in the Workplace.

("No" answers indicate problems.)

Working Conditions:

- ☐ Are workers treated fairly and without discrimination?
- ☐ Are workers able to have some control over their work and do they have ways to adjust and balance their workload when things are busy?
- ☐ Can workers keep up with the pace of work?
- ☐ If needed, have steps been taken to install extra lighting in the workplace to make work easier?
- ☐ If needed, have steps been taken to remove barriers that make it difficult to see what is happening?
- ☐ Are employees allowed and encouraged to work in pairs for safety?

Conflict and Violence:

- ☐ Has the enterprise adopted a policy against abuse of workers?
- ☐ Does management encourage employees to settle disputes or arguments peacefully?
- ☐ Does management record all incidents and threats that come to its attention?
- ☐ Does management encourage employees to report incidents of violence?
- ☐ Does management investigate all incidents and threats?
- ☐ Does management make corrective actions when they are required, including firing a worker who commits an act of violence?
- ☐ Do supervisors talk about abuse openly and before there is a reason too?
- ☐ Do workers know who to notify if they witness an act of violence or are themselves a victim of violence or harassment?
- ☐ Do workers report the incident to management immediately?
- ☐ Are workers required by their job to go to areas where they feel unsafe?
- ☐ Are employees required to travel alone in places that may be dangerous?
- ☐ Are employees required to carry large amounts of cash when travelling?
- ☐ Is there a risk of violent conflict with customers or clients of the business?
- ☐ Are employees working alone in an isolated location, in an unlighted area at night, or at a time of day when violence is more likely to occur?

Chapter 5
DUST AND CHEMICAL HAZARDS

Sometimes, dusts and chemicals in the workplace can make your workers sick. If you make a chemical product, then it is possible that your product could also make someone sick if you do not take precautions.

You need to find out how dangerous a chemical substance that is used in your business may be. Your tool for this is the "safety data sheet" (SDS) and the product label that comes to you from the manufacturer. These labels are required by international regulations and most country's laws require the manufacturer to provide basic information on what is in the chemical product, how toxic (potentially poisonous or not) they are, what is the basic protection required for workers to use them, and what the allowable occupational (work-related) exposure level is, which is a guide to knowing how toxic (poisonous) it is compared to other chemicals. (We talk more about this in Chapter 9.) We are using simplified words in this chapter from what an expert might use. In Chapter 10 we talk about words used to describe hazards and their meaning.

First, what is a "chemical"? All of the exposure listed in this chapter should be considered chemicals in the technical sense. For examples, solvents are considered chemicals. A chemist will tell you that a chemical is any substance and any of the parts that make it up, from an element to a complicated molecule, like a drug or a pesticide. A chemical can be a gas, a liquid, or a solid. That is the true technical definition. However, most people use the word chemical to mean substances that are made or that are extracted (for example, from plants or minerals) and are usually liquid or gas. We will use the word "chemical" to mean any liquids and gases that are part of the product, process, waste, contamination (a contaminant is a chemical or dust that does not belong there), and clean-up that you do in your business.

We will use the word "dust" in its regular meaning, little particles of solid matter in air. The dust we are concerned with here is not so much plain dirt or the kind of dust in a house but dust that comes off of a work process or that has contaminants in it. In particular, we are talking about fine dust, where the particles are small and can be breathed into the lungs very easily. Dust particles this small cannot be seen with the eye but they do the most damage. (In Chapter 2, two figures showed examples of dusty workplaces: Figure 2.4, where there was a dust removal system visible, and Figure 2.5.)

An "exposure" is when a person comes into contact with a hazard like a chemical. Everyone is exposed to chemicals that are being used in the workplace but usually the amount of exposure is small. When it is higher than what is allowed by worker health standards or high enough to make someone sick, we call this "over-exposure." In Chapter 6 and Chapter 9 we will talk about how to prevent over-exposure in order to keep workers healthy.

Work over-exposures can either directly cause disease or indirectly contribute to the development of a disease. For example, silica (rock) dust exposure over a prolonged period of time can directly cause a serious lung disease called silicosis but it also indirectly makes workers who are affected by it more likely to get tuberculosis.

This chapter was designed to introduce you to common workplace exposures and occupational (work-related) diseases. Knowing what over-exposures could make your workers sick will help prevent unnecessary illness and will help you keep your workplace healthy. See Checklist 5.1, at the end of this chapter.

Figure 5.1. *This worker is shoveling asbestos onto a cart. This is extremely dangerous and this worker has a high risk of dying from either lung disease or cancer as a result of this job. The dust mask he is wearing is not enough protection. He should be using a respirator that is designed for dangerous dusts and the material should be sprayed with water to keep dust levels down but, most importantly, asbestos should not be used at all, ever.*
(Photo by Fernanda Giannasi, supplied courtesy of René Mendes, Federal University of Minas Gerais – retired, Brazil.)

Chemical Hazards

This section is to help you identify and understand common workplace chemical hazards and the more common diseases they may cause. (It is even hard for medical doctors to know all the diseases they could cause.)

Workers who are exposed to chemicals or dusts than can be carried home one their clothes, on their skin, or in their hair should have a place to wash and change clothes before going home. This prevents exposure of their family. Wives and children of workers have shown serious illnesses from exposure to lead and asbestos when husbands who worked with these substances brought them home.

There are some general principles that apply to many chemicals and dusts.

- Many chemicals (but not all) stay in the body for a long time.
- Chemicals that are toxic (poisonous to some degree) can cause illness right away (acute poisoning) or slowly over time (chronic poisoning), depending on the chemical. Most (but not all) work-related diseases are chronic, developing over time.
- Chemicals that react strongly with other chemicals can also cause injuries. They can make people sick but they can also cause burns (acids and alkali), explode, eat away at skin, or cause damage to the eyes.
- Chemicals usually (but not always) affect everyone who is exposed to them in the same way. Sometimes a person who is different in some way will react in a different way than usual - we call them "susceptible". The most common susceptible people are children, pregnant women (for injury to the unborn child), and people who already have poor health for other reasons. The most common health problem that makes a person susceptible to dust and chemicals in the air is asthma. Susceptible people are affected by dust and chemicals earlier or at lower levels than other people, but everybody can be affected by dust and chemicals at some level.
- For most chemical exposures that can be toxic, the higher the exposure and the more the chemical there is the worse the poisoning it causes. However, this is not true for allergy. If someone becomes allergic to a chemical and has a bad reaction (like a severe skin rash or asthma due to allergy to it), they usually cannot stand to be around any of it.

Occupational chemical exposures can be divided into 5 common practical categories (these are not the way chemists would classify them):

- metals
- solvents
- process or production chemicals
- gases/inhalants
- minerals.

Under each of the five categories, there are specific examples of common occupational exposures and the diseases they cause. You should know, however, that there are many other problems that can occur.

Metals:
Metals are strong and are good conductors of heat and electricity. They can be used alone, combined with other metals (as "alloys"), as elements in chemical compounds, or as additives or contaminants mixed with other chemicals. Metals

are used in the construction, automotive, aerospace, electronics, glass, mining, smelting, welding and other manufacturing industries. Metals are also found as additives in paint and plastics. They also can be dissolved in liquids and may cause problems because of their chemical nature.

People can become sick by inhaling dusts or fumes containing metals and metal-containing compounds. Metal exposure also can occur by eating and drinking substances containing metals. The most common and one of the most dangerous metal hazards is lead. Most common metals (such as aluminum, copper, iron, and zinc) do not cause poisoning the way they are normally used, but sometimes they can. For example, zinc is not usually a cause of poisoning, but when a welder tries to weld galvanized iron (which is coated with zinc) it can cause a very uncomfortable poisoning that feels like influenza and lasts about two days before going away.

Arsenic: Arsenic is used for hardening lead in battery grids, bearings, and cable sheaths. Arsenic compounds are also used as pigments in glass and as preservatives in tanning. It was once commonly used in pesticides. Workers can be exposed to arsenic in making semiconductors and in smelting operations for copper and zinc. Arsenic at high levels can cause severe liver disease, nerve diseases of the type called "peripheral neuropathy", heart disease, skin cancer, bladder cancer, lung cancer, and a rare type of cancer that occurs in the liver (angiosarcoma). Peripheral neuropathy is a type of disease affecting long nerves that causes tingling sensations, loss of sensation, and muscle weakness that can significantly disable a person from performing tasks. Arsenic is also often a problem in water from wells that tap into arsenic-containing rock in many parts of the world.

Beryllium: Beryllium is a toxic (poisonous, but over a long period of time) and allergy-producing metal that is used in the aerospace, nuclear, electronics and beryllium mining industries. Workers are exposed to beryllium by inhaling beryllium dust, especially air containing beryllium oxide. The smaller the particles of beryllium in the air, the more toxic (poisonous) and allergy-producing the beryllium is. The allergy that beryllium causes is unusual and shows up as a serious disease of the lung and liver and also as lung cancer.

Cadmium: Cadmium is a soft, silver-white metal that is the by-product of the welding, smelting and refining of zinc, lead, and copper ores. Cadmium can be found in automotive parts, aircrafts, marine equipment, industrial machinery, jewelry, solder, rubber, inks, plastics, paints, textiles, ceramics and rechargeable household products. Workers are exposed by inhaling the cadmium and cadmium oxide fumes to cadmium during smelting and during the manufacturing of the products listed above. Exposure to cadmium dust and fumes at higher levels can cause kidney failure, severe lung shock, anemia, emphysema (although a different type than what is caused by smoking), and lung cancer.

Chromium: Chromium is a hard, brittle gray metal but a thin layer of it deposited on another metal is shiny and silvery. A thin layer of it protects steel from corrosion and that is why it is used for plating and is added to iron and carbon to make stainless steel. Chromium can be found in automotive parts, household appliance, tools, paints, pigments, dyes textiles, rubber, inks, and machinery. It is also present in cement. Workers outside of mining are exposed to chromium in the production of stainless steel by inhaling fumes. Workers may also be exposed by the use of chemical containing chromium in the paint, textile, leather, glass, and rubber industries. As a metal, chromium is safe except that dust and tiny bits of it in cement can cause allergies. Only one type of chromium chemical is toxic, "hexavalent" chromium, which is used mainly in electroplating. Hexavalent chromium causes lung cancer, and is also associated with nasal cancer, pancreatic cancer and stomach cancer, as well as bronchitis and asthma.

Lead: Lead is one of the most common and seriously dangerous dust and chemical hazards. Lead is a very heavy, dark-gray metal found in many places in industry and in the environment. The primary uses of lead are in storage batteries, alloys, pipes, smelters, cable sheathing, electrical solder, and as an additive in paints, and plastics. Lead paint is especially dangerous and has been banned in many countries because it can cause brain damage in children who want to eat flakes of it because it tastes sweet. Lead may also be found in cosmetics, munitions, leaded glassware, and jewelry. In some parts of the world, it can even be found in some traditional medicines, which are heavily used but very dangerous. Workers are

exposed to lead mainly through inhalation and ingestion of lead dust. Lead is particularly harmful because it damages nerves and can remain in the body for a very long time. Short-term and long-term exposure to lead causes lead poisoning, which can be acute (coming on quickly) or chronic (lasting a long time). Acute lead poisoning causes cramping, stomach pain, constipation, and colic. Chronic lead poisoning leads to memory problems, nerve disorders, anemia, sex problems in men, and kidney failure. Lead is also a serious risk for children, who can be exposed when their father (or mother) brings lead home from work as contamination on their clothes. Any parent who works with lead must change out of their work clothes before they spend time with their children. There is a test for lead in the blood. In many countries this test has to be given every year to workers who are exposed to lead. It has to be done by a laboratory that knows how to do it accurately and how to collect the blood, because it is easy to contaminate a sample with lead. (The old tests using urine are not good enough anymore.)

Mercury: Mercury is the only metal that is a liquid at room temperature and is shiny silver in color. Enough of it evaporates into a gas to make it a serious inhalation hazard. Mercury is found in thermometers, barometers, tubes, batteries, certain types of electrical switches, and electrical/medical devices. Mercury is also used in plating, jewelry, tanning, and dentistry. The largest use of mercury is in the industrial production of chlorine and sodium hydroxide. Mercury is heavily used in small-scale gold mining, where it has poisoned people and also caused serious damage to streams and rivers. Inhalation is the primary route of uptake for people. Mercury can also be absorbed when it is ingested. Mercury can cause shaky hands and nerve problems, kidney failure, mental disorders, sex problems in men, disorders in females, and eye problems. Mercury is extremely dangerous to the unborn child during pregnancy. Clothing contaminated with mercury and brought home by workers could be a source of mercury poisoning for family members, and so the same precautions should be taken as for lead.

Nickel: Nickel is a hard, silver-white, magnetic metal. Nickel is used in the production of stainless steel, and in electroplating. Workers can be exposed to nickel through skin contact and through their respiratory tract. Exposure to nickel can occur during mining, smelting, milling, roasting, sintering, and refining operations. Nickel metal exposure can cause allergy, which can be skin rashes or asthma. Skin allergy can happen just from skin contact with nickel metal. Nickel subsulfide, which is found mostly in smelting operations, can cause lung cancer, and probably other cancers but nickel metal does not.

Production and Process Chemicals:

Production and process chemicals are substances that are used to produce a desired effect: to make something (like plastics), to change the properties of something (for example a dye to give something color), or to do something (such as lubricants or cleaners). They will just be called “chemicals” from here on in this section.

Thousands of chemicals are used in the workplace. Chemicals used or produced in the workplace may be released into the air as gases, vapors, mists, dusts or fumes. Workers can be exposed to chemicals through eating/drinking chemicals, breathing in the chemical as a gas, breathing it in as a dust or carried on dust particles, and through skin contact. Overexposure to chemicals can cause damaging health effects. Below is a list of some common chemicals that are hazardous to the workplace. Please keep in mind that this is not a complete list. There are many more.

Polychlorinated organic compounds: These include polychlorinated biphenyls (PCBs), dioxins, solvents that have chlorine atoms (discussed under “Solvents”), many pesticides (the “organochlorine” type), and a lot of other chemicals. PCBs are chemicals that are no longer produced because they cannot be disposed of easily and are toxic to people and the environment. Workers can be exposed to PCBs from leaking transformers and from electrical fires occurring in PCB transformers during storage, shipment, or maintenance. There should be no PCBs anymore but sometimes they are found in old storage areas or in old electrical transformers, where they were heavily used in the past. A related type of chemical known as the “dioxins” are byproducts of the plastic, pesticide, and paper industries. The problem with this class of chemical is that these chemicals tend to stay in the body for long periods and many have toxic effects. Some cause cancer. That is why it is always better to substitute another

chemical to do the same job if it works about the same.

Polycyclic Aromatic Hydrocarbons (PAHs): PAH's are mostly contaminants and products of combustion (they are formed when materials are burned). The most common examples of PAHs include anthracene, benzopyrene, bitumens, carbon black, coal tar products, and naphthalene. Anthracene is used to make dyes, fibers, and plastics. Benzpyrene is not used as a chemical itself but it is often studied because it goes together with other PAHs and is easy to measure; so when a chemist measures benzpyrene in a mixture, it is a good guide to how much total PAH there is. Bitumens are used in road-paving, roofing, and asphalt products. Carbon black is used as a pigment for rubber tires and in the toner in copy machines. Coal tar is used for plastics, solvents, dyes, drugs, and water-proofing substances. Naphthalene is used to make insecticides. Exposure to PAH's occur from inhalation, skin contact, and ingestion (this form of exposure is rare) in many jobs: firefighters, oilfield workers, meat smokehouse workers, printing press operators, rubber workers, paint workers, roofers, pipe coaters, chimney sweepers, steel workers, brick layers, truck drivers, underground miners, and railroad workers, as well as any worker who comes into contact with smoke or burned material or any type of combustion product. PAHs can cause skin rash. Some of the PAHs can cause cancer: lung cancer, skin cancers, bladder cancer, and probably others. PAHs are among the most dangerous carcinogens in cigarette smoke. A worker who smokes and is also exposed to PAHs in the workplace is getting a double burden.

Pesticides: Pesticides are chemicals that are applied to crops in the form of sprays, dusts, and aerosols to protect crops from insects, rats, snails, and fungus. There are many types of pesticides. Some examples are organophosphates (such as parathion, one of the most dangerous pesticides in common use), pyrethroids, and organochlorines, which are not used much anymore because they harm the environment. Most contact occurs in agriculture. Workers are exposed to pesticides by inhalation, ingestion, and especially through skin contact. Pesticides, particularly the organophosphates, cause a variety of symptoms and illnesses including nausea, headache, vomiting, muscle weakness, and respiratory and skin problems. There is a test for the effects of organophosphate pesticides but it has to be interpreted by someone with experience and against an earlier baseline level (which is why medical monitoring is important, as discussed in Chapter 1). Some pesticides, mostly of the organochlorine type, cause reproductive effects, and possibly human cancer. Pyrethroids are replacing many of these pesticides because they are generally much safer but even so pyrethroids can cause allergic reactions, body nerve problems (usually short-term), and a feeling of being sick, at high exposure levels.

Figure 5.2. *A worker in East Africa sprays pesticide on crops. Some of it will get on his skin and he will also inhale some of it. (Photo courtesy of Suvi Lehtinen, Finnish Institute of Occupational Health.)*

Solvents:

A solvent is a chemical substance, usually a liquid, that dissolves something else, and so can be used for extracting or diluting, dissolving, or removing other substances. For instance, water is a solvent and it can dissolve salt. Solvents often provide the right conditions for chemical reactions so that a product can be manufactured. Most industrial solvents are organic chemicals. Organic chemicals are chemicals that contain carbon. Workers are primarily exposed to organic solvents by inhaling airborne solvents and through direct skin contact with the solvent. The one solvent that is also commonly ingested is ethanol (grain alcohol, the type found in liquor), and many of the effects of exposure to solvents are just like the problems found with drinking too much alcohol. Workers who work in spray painting, or the plastic, printing, graphics, metal, and dry-cleaning industries, and who make or use adhesives, lacquers, and paints are most likely to be exposed to high concentrations of

solvents and to suffer adverse health effects. At high concentrations, usually in a confined space, almost all solvents cause people to become slow and can even can knock them out. They also dry out the skin. Some solvents are very dangerous (like carbon tetrachloride) and others are not. Most of them are safe at low exposure levels. A few really bad ones, like benzene, are dangerous even at low levels. Some are toxic to the liver and kidneys. Some can cause cancer.

It is always best to use the safest solvent that works. Solvents are divided into the following categories based on the solvent's chemical structure. Below is a list of common organic solvents by category. There are many others.

Aliphatic hydrocarbons. Aliphatic hydrocarbons are simple hydrocarbons (chemicals made of only carbon and hydrogen) usually derived from petroleum. Workers are mostly exposed by inhaling aliphatic hydrocarbons. Alkanes are the simplest type and are found in gasoline. Most alkanes are not very toxic, but inhaling a lot of gasoline at high levels for long periods of time (much more than you would expect in a gasoline station or refinery – we mean the kind of exposure that occurs in a confined space or that is intentional) can cause brain damage. The alkane with six carbons is called hexane. Hexane is used in glues, rubbers, inks, etc. One type of alkane, called n-hexane, is known for being very dangerous, causing very severe, crippling body nerve disease (peripheral neuropathy). It should never be used, ever.

Aromatic hydrocarbons. An aromatic hydrocarbon is a more complicated molecule of carbon and hydrogen, also usually derived from petroleum but also formed by burning (combustion) organic (carbon-containing) matter. Workers are exposed to aromatic hydrocarbons through inhalation and skin exposure. Examples of aromatic hydrocarbons include: benzene, ethylbenzene (which is very different), toluene, and xylene (methylbenzene). They often go together. Benzene is by far the most dangerous. It is still used in manufacturing in some places and in laboratories for extracting chemicals but most companies try not to use it, ever, because it causes a form of blood cancer (leukemia). Toluene and xylene are two of the most widely used industrial solvents, particularly when making paint, adhesives, and pesticides. Toluene can cause brain damage at high exposure levels. Xylene is irritating and makes people cough. Ethylbenzene is a common contaminant of benzene and xylene. Fortunately, ethylbenzene is not highly toxic even though it looks a lot like benzene, but it can affect the liver at high concentrations.

Halogenated hydrocarbons. Halogenated hydrocarbons are carbon-hydrogen compounds with chlorine atoms attached. (There are also halogenated hydrocarbons with bromine or fluorine attached but they are not common in the workplace.) Halogenated hydrocarbons are the most dangerous group of organic solvents overall. They are used as dry-cleaning solvents, degreasers, and anesthetics. At high levels of exposure, a halogenated hydrocarbon might cause kidney disease, liver disease, or cancer, as well as spontaneous abortion (loss of the unborn during pregnancy). However, the threat is different for each solvent. Carbon tetrachloride and chloroform can cause significant liver and kidney disease. Some halogenated hydrocarbons can also cause brain and nerve injury. Perchloroethylene is in common use in dry cleaning and is considered relatively safe but it still should be treated carefully because at high levels it may carry a risk of cancer and birth defects.

Alcohols and phenols. Alcohols and phenols (aromatic compounds with an alcohol part) cause similar illnesses and some of their effects resemble the effects of ethyl alcohol in alcoholic beverages. Ethanol ("grain alcohol") is present in liquor, of course, so it is not surprising that the effects of other alcohols on the body are just like being drunk or hung over from alcohol abuse, like disorientation, slurred speech, etc. Alcohols are used as cleaning agents, thinners, and diluents. They are used in paints, pesticides, and pharmaceuticals. Examples of alcohols are methanol (the most toxic), ethanol, and propanol. The most commonly used and most toxic alcohol in industry is methanol (methyl alcohol or "wood alcohol"), which is used for removing ice and preventing water from freezing, in chemistry laboratories, and to produce formaldehyde. It is sometimes sold as illegally to drink when ethanol is not available, and this has been the cause of great tragedy. Methanol can also be inhaled from fumes in the air. Methanol is very dangerous because it can cause blindness. Most employers stay away from using methanol and ethanol and when they are used in the workplace it

is usually only in very small quantities. Glycols and glycol ethers. Glycols are hydrocarbons with more than one alcohol group on them. Glycol ethers consist of a carbon backbone to which side chains are attached by an oxygen bond. Glycols are not a major industrial hazard, but glycol derivatives, like glycol ethers, are a hazard. Glycol ethers are widely used solvents. They are found in paints, lacquers, enamels, inks, dyes, as cleaning agents and in antifreeze. Workers can be exposed to glycol ethers through skin contact and through inhalation when spraying or heating the liquids containing glycol ethers, for example when de-icing airplanes in cold climates. Glycol ethers may cause brain damage at high exposure levels. Glycol ethers may also cause anemia (low blood), skin rash, and harmful effects on reproductive organs.

Ketones. Ketones are used in surface coatings, dyes, inks, etc. One common ketone is acetone, which is found in cleaning supplies. Acetone is safe when used in a well-ventilated area but can catch fire easily. The most toxic ketone is methyl-n-butyl ketone (MBK), which causes a very serious body nerve disease (peripheral neuropathy) just like n-hexane, so nobody uses it and it is not produced in industry anymore. Methyl-ethyl-ketone (MEK) is just as effective and does not cause the same problem by itself. Generally, ketones have a strong odor and cause symptoms like headache and nausea which serve as a warning to workers that they are being exposed and keeps them from being overexposed.

Gases/Inhalants:

Gases or inhalants are chemicals that are released into the air. They may cause injury to the lungs and respiratory tract or they may pass into the body and cause internal injury.

Carbon monoxide. Carbon monoxide is most often a product of fuel burning that goes wrong because there is not enough oxygen to allow complete combustion. Sources of carbon monoxide include non-electric forklifts, gas-powered compressors and generators, and heating sources. Workers most often exposed to carbon monoxide include firefighters, petroleum refinery workers, traffic garage workers, furnace workers, or anyone working in a place, or even in a home, where the heating unit has malfunctioned. Carbon monoxide can cause headache, nausea, confusion at first, progressing to seizures, coma, brain injury/damage and tremors, and eventually death. It is the most common toxic gas on the job, as well as being a big cause of poisoning deaths in people's homes because of poorly vented fires.

Cyanide. Hydrogen cyanide is a colorless, odorless gas that is highly poisonous. Exposure to hydrogen cyanide occurs mainly by inhalation and sometimes by ingestion. Cyanide is used in metal plating, metal extraction, fumigants, furnaces, photography, metal hardening, and pharmaceuticals. Workers in metal and chemical manufacturing in processes that use cyanide, who process the cassava plant, and who fight fires are most at risk. Hydrogen cyanide can cause lung injury, brain damage, dizziness, fainting, and death.

Ozone. Ozone is a gas consisting of three oxygen atoms. It is highly irritating and is often found in electrical work, certain types of welding, and air pollution. Ozone can cause lung problems and asthma.

Minerals:

Minerals are naturally-occurring substances, often with a crystal structure. Inhalation of mineral dust can cause damage to the lung, leading to a group of conditions known as "pneumoconiosis" (a Greek-derived word for "dust diseases of the lung"). The three main types of pneumoconiosis are coal-workers pneumoconiosis, asbestosis and silicosis.

Coal dust. Coal workers' pneumoconiosis (CWP), also called "black lung", is caused by overexposure of coal dust. Coal miners who work underground and drillers are at the highest risk. Exposure to coal dust can also cause chronic bronchitis and coughing. Bronchitis is lung disease that makes the bigger airways (air tubes) of the lungs irritated and inflamed. When this goes on at high levels and for a long time, CWP can become a serious, irreversible lung disease. At high levels in mines, coal dust can also explode.

Asbestos. Asbestos is a mineral with long fibers that are heat resistant, strong, that separate easily, and are flexible enough to be spun and woven. Because of these characteristics, asbestos has been used for a wide range of manufactured goods, mostly in cement pipe (to reinforce the material), building materials (roofing shingles, ceiling and floor tiles), friction products (automobile clutch, brake, and

transmission parts), heat-resistant fabrics, packaging, gaskets, and coatings. Exposure to asbestos occurs by breathing asbestos dust-contaminated air. Workers most at risk for asbestos exposure are asbestos miners, textile workers, miller, cement workers, railroad repair workers, plumbers, pipe fitters, and maintenance workers. Asbestos has serious effects on the lungs besides the pneumoconiosis it causes, which is called asbestosis. Asbestosis has a picture on the chest x-ray that is characteristic and usually easy to identify. Asbestosis takes a long time to develop but once it does, it can kill workers if it is severe. Asbestos also causes lung cancer (in workers who do not smoke and even more in workers who do smoke) and another cancer called mesothelioma, which is a cancer of the lining in the chest around the lung. Asbestos also probably causes other cancers. There are different types of asbestos but all types cause lung injury and cancer, including chrysotile (which has been falsely marketed as safe). Many countries around the world have banned asbestos completely, because it is just too dangerous to use and because there are substitutes that are much safer.

Silica. Silica is the major mineral in most rocks and in sand, mostly in the form of a natural crystal called quartz. Silica dust is made when rock is cut, drilled, or crushed. Exposure is heaviest in ceramics production, mining, quarrying, tunneling, stone cutting, rock crushing operations, refractory furnace-brick repair (see Figure 3.1), abrasives manufacturing, and sandblasting. Because sand is almost pure silica, glass workers and sand-blasters can have intense exposure to silica dust. Some countries have made sandblasting with sand illegal. Intense exposure to silica may result in disease in a year or less, but it usually takes at least 10 or 15 years of exposure before symptoms develop, so workers may continue to be exposed for many years before they feel that they have a problem. Silica exposure causes silicosis, which is the pneumoconiosis associated with silica, and can be a crippling lung disease. Silica also can cause certain types of arthritis and other diseases, and lung cancer. People with silicosis also get tuberculosis much more easily than other people and when they do get it, it is then very hard to treat.

Organic dusts. This is a general term for dusts like cotton dust, grain dust, powdered sugar, and other sources other than minerals. Some of these dusts can cause asthma and serious lung diseases, like cotton dust and grain dust. Some of them can explode when there is fire, like sugar dust, grain dust, or coal dust.

Figure 5.3. *This worker is feeding asbestos into a chute where it will go to a vat to be mixed with cement. This is very dangerous work and puts the worker at risk of death from cancer or lung disease. The dust mask he is using is not effective against asbestos dust, so he and his supervisors only think that he is being protected when really he is not. Asbestos should never be used, ever. (Photo by Fernanda Giannasi, supplied with permission courtesy of René Mendes, Federal University of Minas Gerais – retired, Brazil.)*

Box 5.1.
Checklist for workplace exposures to chemicals and dusts.

("No" answers indicate problems.)

- ☐ When you use chemicals, solvents, pesticides, etc. in your business, are the workers protected?
- ☐ Is there any equipment giving off gases or fumes?
- ☐ Does anything your workers do in the workplace give off a lot of dust? ("A lot" means that you can see it.)
- ☐ Does the equipment where this happens have its own exhaust ventilation?
- ☐ Does the exhaust push air to the outside of the building and away from people (good)? (Or into the halls (bad) or air conditioning system (bad)?)

Chapter 6

HOW TO CONTROL UNSAFE CONDITIONS IN YOUR WORKPLACE

There are many specific ways of controlling hazards but they all fall into just a few easy categories. Some are more effective than others. Figure 6.1 shows the categories of controls for changing unsafe work environments or exposures. The most effective are elimination, substitution, and engineering controls because in these three approaches the change is more permanent and long lasting. Engineering controls can sometimes be costly but often are simple and cheap. The least effective approach is personal protective equipment, which depends too much on availability and on the worker or his or her supervisor knowing exactly how to wear it, how to maintain it, and which type to choose. However, any of these measures of control is better than none. In the following sections, the different types of controls will be addressed as well as the relevant issues and considerations for each. Figure 6.1 shows each of the measures and how they compare with one another.

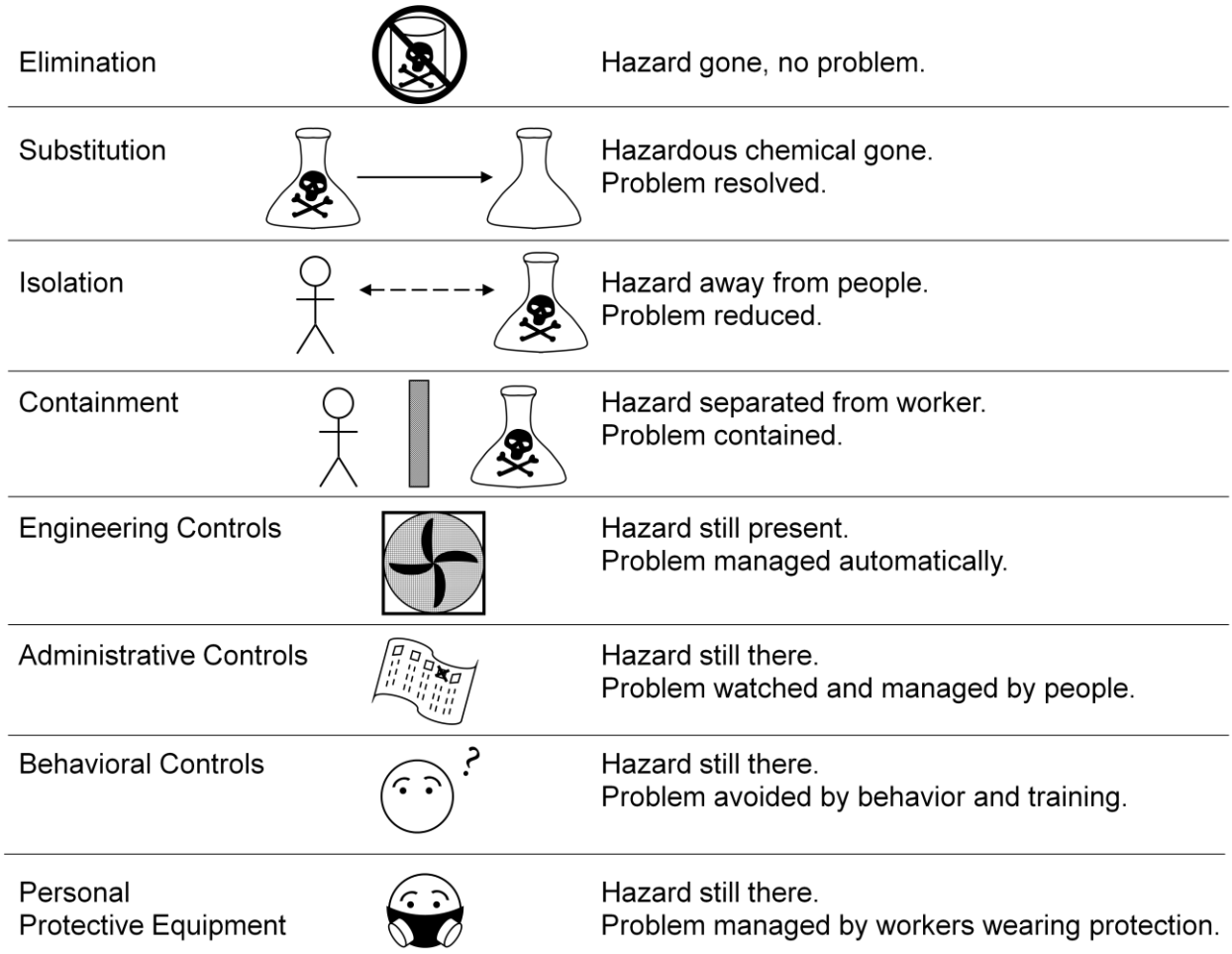


Figure 6.1. Measures to control exposure to hazards in the workplace.

Hazard Removal

Hazard removal is the elimination or substitution of hazards in the workplace. It is the best way to deal with hazards in the workplace if it can be done.

Elimination is best. If a hazard is unnecessary, or can be removed without causing problems, elimination is the best way to prevent problems. The elimination of hazards at their source is more effective than any other type of hazard control. For example, for many years people thought that dishes had to be washed in very hot water to be safe. The workers who did this were exposed to a risk of skin burns and skin rashes. Actually, wash water only has to be warm as long as soap is used. Workers do not have to be put at risk. Another example is asbestos. It should never be used, for anything.

Substitution is reducing the use of dangerous chemicals used in production or substituting less toxic materials for the materials with high toxicity. An example is the substitution of trichloroethane or dichloromethane (methylene chloride) for trichloroethylene or carbon tetrachloride as a solvent. They work just as well for almost anything and are much less dangerous. (Trichloromethane has its own problems but is still much safer that the first two.)

Even if it costs a little bit more to do the job (and it often does not), eliminating a dangerous chemical that is not needed saves in the long term by preventing serious problems. For example, sandblasting pipe and buildings with natural sand, which is almost pure silica, is very dangerous and requires effective protection to prevent a serious lung disease called silicosis, which takes years to develop but can cripple a worker for the rest of his life. Many countries (including Germany and the United Kingdom) do not allow sandblasting with sand. Fortunately, there are other abrasives that work very well and are not expensive, if you can find a supplier in your country. They include garnet or olivine (hard minerals that are safe), crushed nut shells, slag (waste mineral) from coal mining or foundries, crushed glass, glass beads, and steel grit (coarse particles). Even dry ice can be used for blasting, and it is particularly good for removing paint.

Separating Workers from the Hazard

Sometimes there is something dangerous about the process but you cannot do without it. Workers still have to be kept away from the hazard. Two options for separating the worker from the hazard are isolation and shielding.

Isolation works well if there is enough distance between the worker and the hazard. If a chemical is dangerous or there is a serious hazard from something like fire or explosion, there are still ways to separate workers from it so they do not come into contact with it. One way is to put the dangerous chemical or process at a distance away from where the workers are, so that if there is a problem, workers will not be affected. For example, once a kiln is fired up for making ceramics, it can release a lot of toxic gases and heat and some kilns have been known to explode. They should be kept as far away as possible from where the workers are.

Enclosure also works very well if the process or chemical has to be near the workers. Enclosure or containment means that the process or operation is put behind a barrier, or inside a protective cabinet, or tank, or other enclosure, and only opened when it is safe to do so. For example, equipment that makes a lot of noise can be put inside a box with soundproofing all around. Equipment that generates a lot of dust, like sandblasting (which can produce very dangerous silica dust which can kill), can be put into an enclosed cabinet when it is done on a small scale – the worker is outside and reaches in through gloves. A spray operation can be put into a cabinet, like a spray paint booth, to keep fumes and dusts from going everywhere and exposing workers. Chemicals can be kept inside pipes and tanks and pumped where they are needed instead of being open to the air. A machine like a grinder can be put behind a shield to protect the workers if something goes wrong (like a grinding wheel flying apart or chips flying off the wheel). Containment is common in manufacturing chemicals, for example. Chemical factories often make their products using pipes and tanks that are never open to the air, so that hazardous gases never escape and workers never come into contact with chemicals, except during maintenance and modifications.

Engineering Controls

Engineering controls change workplace design to reduce exposure or eliminate the exposure to toxins or hazards. There are many types of hazards that can be present in your workplace and many engineering controls to manage them. For example, adding ventilation is an option to reduce the concentration of airborne hazards. Engineering controls can include shielding methods from chemicals or preventing the generation of dangerous substances. (Some people consider enclosure and containment to be a type of engineering controls.)

Process Controls: Process controls are ways of designing the work, the flow of production, and the equipment to reduce the risk of something going wrong or that the worker will come into contact with the hazard. For example, when a product is spray painted, solvent chemicals go into the air. If paint is brushed on, there is much less chemical exposure. If paint cans are kept small and covered most of the time instead of using big open cans, there is not only less solvent chemical in the air but the paint lasts longer because it does not dry out.

An extremely important example of process control is wetting. Dry powders produce a lot of dust, which can be inhaled. Some dusts, particularly what comes from stones, sand, and ceramic production – called silica dust, are so dangerous that they can eventually cause a worker to die, usually years later. Silica dust is produced when rocks are crushed or stone is being drilled or cut or during sandblasting or in mining operations. When this is done dry, lots of dust is produced. The problem can be solved by continuously spraying water where the dust is produced. The dust level stays down and the workplace is much safer.

Engineering process controls also include guards that are put on equipment so that workers cannot get their fingers caught. They also include switches that turn machines off automatically when they are not being used and anything else that can be designed into the process to reduce the hazard.

Ventilation Systems: Ventilation is a particularly important form of engineering control.

Contaminated air is removed and diluted by ventilation systems, which are basically fans blowing air into the building or out of the building (exhaust). Ventilation systems can also control temperature, oxygen level, humidity, as well as the amount of dust or a chemical in the air.

Ventilation helps keep contaminants at levels that do not cause workers to have health problems and creates a more comfortable work environment. Sometimes it is enough to work out in the open, using the wind as natural ventilation. But most of the time workplaces are inside buildings and need mechanical ventilation.

There are two types of mechanical ventilation systems: “local exhaust” and “dilution ventilation”.

Local exhaust systems remove contaminated air from as close to the source as possible, draw it away with suction, clean it using the appropriate method depending on the hazard (filters are most common), and release the clean air outside the workplace (usually by a duct going outside to a vent). Local exhaust is the best method when the dust or chemical is dangerous but it comes from a small source. Sawdust from a table saw or fumes from welding on a workbench or an assembly line are examples of operations that can use local exhaust systems. (In Chapter 2, there was a local exhaust system visible in Figure 2.4.)

Dilution ventilation involves blowing fresh air into the workplace and letting air circulate and then get out. Air conditioning does this for buildings but factories with chemical or dust hazards in air should have special fans and duct systems to get much greater air circulation. Dilution ventilation works well for less hazardous substances and when the source is in many places, rather than in only one place. Dilution ventilation is less efficient than local exhaust at removing hazards.

Administrative Controls

Administrative controls are procedures and management policies that protect workers. For example, if workers are assigned to do dangerous work, such as working inside a tank (a confined space), on electric power cables, or digging trenches (ditches with steep walls), then they and their supervisor must get a permit from the manager. The

manager checks to be sure that they know and agree to follow safe working procedures: for example, to lock doors in an open position so that workers can escape if there is a problem, to lock power switches in the off position so that another worker will not accidentally electrocute them or start machinery that could hurt them, and to make sure that the walls of a trench are sloped enough and reinforced so that they will not cave in and bury a worker.

Administrative controls can also be used to limit the time a worker is exposed to a hazard. For example, construction workers can be limited to short periods of work during the hot summer months and supplied with cool water to prevent heat stroke (a disease that can kill). The number of hours in a day a worker is exposed to noise can be reduced if the noise gets louder. Maintenance, installation and start-up of new equipment, and high-risk operations can be done at times when few workers are in the workplace.

Another type of administrative controls is good work practices. This means keeping the workplace clean and free of trash (which can catch fire) and clutter (a safety hazard). Boxes and materials that are stacked neatly instead of just piled on top of one another are less likely to be knocked over or fall down, where they can be a hazard.

Providing a place where workers can eat and drink clean water away from the workplace also separates them from exposure to chemicals and dusts. There should be a clean place to store food, away from chemicals and dusts in the workplace.

Smoking is very dangerous in the workplace, as well as to the health of the person who smokes. Smoking in the workplace can cause fires and the smoke can combine with chemicals to be dangerous. There should be no smoking in the workplace. Workers should be encouraged to quit for their own health, of course. If workers have to smoke, then there should be smoking areas they can use outside the building and away from potential hazards. (You may have noticed the smoking worker in Figure 1.1.)

Another type of administrative control is to keep track of which workers are qualified to do what work. Keeping records of who was trained and how can pay off, especially in keeping track of who has been educated to work safely and who needs more training.

Personal Protective Equipment

Most experts think that personal protection is the least effective form of protection (others think that administrative controls are weaker). However, there are a lot of situations where it is the only practical means of protection.

Personal protective equipment (PPE) can consist of masks, gloves, aprons, and safety devices that workers use individually, if they are going to be exposed in some fashion to harmful substances, objects, environments or work practices. This is the least effective type of controls, but it can work well if done right. PPE is most useful when hazard and engineering controls are not practical or are unavailable. Figures 6.2, 6.3, and 6.4 shows some common types of personal protection equipment available.

Figure 6.2. *Types of personal protection equipment used in the workplace. Clockwise from bottom left: protective shoes or boots, gloves, eye protection, hearing protection (foam ear plugs), hard hat, respirator, apron (made of a chemical-resistant material).*

PPE puts a barrier against hazards right on the worker's body. Types of PPE include respiratory, eye and face, head, foot, and hand protection. See Table 6.1.

Table 6.1. Types of Personal Protection Equipment.

If the harmful substance or work environment affects the worker's…	The PPE you should wear is…
Lungs	Respirators (not just dust masks!)
Eyes	Goggles, safety glasses (regular glasses do not work!)
Ears	Ear plugs (foam or plastic insert), earmuffs
Head	Hard hat, helmet
Feet	Closed toed shoes, boots (sandals can be dangerous!)
Hands	Gloves

Many forms of PPE work very well to protect workers. However, all PPE requires that the worker use it, use it correctly, and use it all the time. Workers should receive the proper training and direction for using the PPE. They should be informed when the PPE should be worn, what form of PPE is necessary to wear, how it is properly worn, how to keep it clean (if the equipment is reusable), how to properly adjust it for correct fit, the limitations of the PPE in terms of protecting the worker's health, and how the PPE should be properly stored. For example, gloves are simple but there are still some things workers need to know about them, as mentioned below.

Figure 6.3. *Examples of basic personal protection equipment: hard hat, gloves, safety eyeglasses. (Photograph ©dreamstime.)*

Respiratory protection. Many hazards are carried by air and are breathed in by workers. These can be dust (which are particles in air) or chemicals that are in gas or vapor form. Effects on the body include eye irritation, skin absorption, and a change in the ability to smell things. Various odors, tastes, and irritations may be signs of respiratory contaminants, but are not reliable because they are not always present when there is contamination.

Dust masks are simple masks, usually made of paper or cotton, that cover the nose and mouth. They keep big particles out of the nose and throat but most of them cannot keep out the smaller particles that go deep into the lung. They do not work at all against chemicals. While they are better than nothing, dust masks are inadequate to protect workers in almost any industrial process that creates dust.

Respirators are a form of PPE that protect from airborne hazards by covering the face, mouth, nose or head. Respirators are masks with filters, cartridges, or canister devices that purify air. Respirators should be selected based on the type of respiratory hazard present. Usually the manufacturer or distributor will be able to tell you which respirator canister is needed for which dust or chemical. Physical and chemical properties of the hazard should be considered in choosing a respirator. For chemicals and dusts, the cartridge or canister that comes with the respirator has to be the right one and it has to be fresh. The wrong cartridge type or one that is old and overloaded will not protect the worker. Over days of use, the filters become overloaded with dust, and the absorbing

material becomes overloaded with the chemical they absorb.

To be effective, you have to think about what hazards are present in the workplace and which people who would wear the respirators. Those who do wear respirators should be educated about their proper use and have medical evaluations beforehand to ensure safety. The respirators should be properly stored, kept clean, and inspected to extend the shelf life and to protect the user.

The use of respirators also requires physical effort by the user, so workers should be in good health. This should be checked and workers should be tested for medical conditions before they begin to wear respirators or work in areas with possible respiratory hazards.

Eye protection. An injury to the eye can lead to blindness. Chemical burns or irritation of the eye can also be serious and sometimes lead to blindness. It is so very important that the eyes be protected. Eye protection protects the eyes from chemical irritants, flying particles, harmful liquids, gases and vapors, swinging ropes or chains, flying or thrown tools, and damaging radiation such as ultraviolet light during welding operations.

Eye protection includes goggles or glasses. If a worker already wears prescription glasses, the eye protection should fit over them or should incorporate the prescription into the lens of safety glasses, which are specially made to be very strong to protect the eyes. Eye injuries can also occur from objects attached with a fixed point, such as chains, ropes, or tools. Wearing eye protection can reduce the number of eye injuries occurring in the workplace. Where there is a risk of flying objects, like small parts or chips of metal from a grinder, double eye protection is recommended, wearing both safety glasses and goggles over them.

***Head protection*.** Head protection protects against falling objects, high impact forces, sun, heat, and scalp lacerations from sharp objects. Head protection consists of a helmet called a "hard hat". It has to be strong to give the greatest amount of protection from falling objects and high impact force. It also should not conduct electricity. Most hard hats today are made of high impact-resistant plastic. Hard hats have suspension systems inside that keep the shell off the worker's head for further protection and greater comfort.

***Foot protection*.** Foot protection consists of safety shoes or boots, or enclosed footwear. Foot protection protects the worker from being injured by stepping on sharp objects and helps lessen the injury if heavy objects are dropped on the foot. The best foot protection has skid free soles and is puncture safe. Some industrial work shoes have steel soles, so that nails and other sharp objects cannot cut a worker's foot, and a steel toe protector shield. Sandals should never be worn in the workplace.

Hand Protection. Hand protection consists of gloves, gauntlets, and "barrier creams".

Gloves can protect from chemicals and burns but the same type of glove cannot protect the worker from everything. Gloves have to be made of certain materials to protect against the specific chemicals that workers are handling. (The manufacturer usually tells you this on the product package.) There are specific gloves for high temperatures and others for dealing with harmful chemicals. Gloves that protect from chemical exposure should be made of the right material, so it is important to check the glove for protection against that specific chemical. Some glove materials can dissolve in solvents or may not keep out a particular chemical, so they cannot be used for many purposes. Gloves have to be kept clean on the inside because workers can contaminate the gloves with dirty hands and defeat the purpose. They should be stored in places that keep them clean and that will not damage them.

Gauntlets are metal gloves, usually made out of chain, that protect the hand against cuts and puncture wounds. They are usually used in industries such as meat-cutting, where workers are using sharp knives.

Barrier creams are pastes that you put on your hands to reduce contact with chemicals. They work by creating a barrier between your skin and the chemical. They do not work very well and rub off quickly.

Figure 6.4. *This worker in Nairobi, Kenya, is wearing three types of personal protective equipment: gloves, muff-type hearing protection, and goggle-type eye protection. This is the way it should be. The work of grinding metal parts can cause serious hand injuries, the noise can cause loss of hearing, and the flying particles of metal can severely injure the eyes, so all three are needed. (Photo courtesy of Suvi Lehtinen, Finnish Institute of Occupational Health.)*

Emergency Plans

When a sudden emergency hits, like a fire, a flash flood, a mudslide or an earthquake, your enterprise and its workers can be caught up in it. If your area experiences big disasters like this, or other things that could go seriously wrong in your community, then you and your workers need an emergency plan.

Emergency plans should be based on realistic threats where your workers live and work. It should say what they should do when there is a spill or transportation accident involving hazardous substances, adverse weather conditions (such as floods, earthquakes, mudslides, or storms), and any other situation that could compromise their safety. A written plan should be established and distributed or communicated to workers so they know what to do if an emergency occurs.

The plan should include recommendations for the physical safety and emotional reaction of your workers, the best and most efficient way to get out of the building and away from a fire, and where your workers should gather and wait for instructions from management. (See Chapter 2.) The plan should include the phone numbers and location of the nearest medical assistance, as well as a map on how to get to the nearest medical assistance or facility. Also it is recommended that workers and management should practice emergency drills and evacuation procedures together two or three times a year. This will help make the plan go smoothly when a real event occurs. Other necessary elements include plans for who should speak to the public media (radio, television, newspapers) for the employer during an emergency, routes of evacuation from the area, a list of individuals to contact should an event occur, and a plan for communicating with workers if they have to go home or evacuate. Supporting workers who can be trained in advance to provide first aid at the work site when necessary can help the business deal with emergencies much better.

Box 6.1.
Penalties Motivate Workers to Wear Head Protection on Motorbikes.

In the city of Kolkata (India) the accident rates are very high for two-wheel motorbike (scooter) riders. Motorbike riders typically weave in and out of the congested traffic under dangerous conditions. They are used by many workers to go from one place to another in the course of doing their jobs, particularly messengers or people making deliveries. However, they are also used by better-paid technicians who have to go to different places during the working day.

There is a city ordinance that everyone must wear a helmet when riding a motor scooter or other motorized two wheeled vehicle. There is a ₹100 (₹ is the new symbol for rupia) fine for not wearing the helmet. This is the equivalent of many days work on some people's salary.

One gas and electrical company issued new helmets to all of its workers who rode on company-issued scooters. Most of these workers were well-trained technicians who earned a good salary.

The company required the use of helmets, in addition to the city law. Failure to use the helmet once resulted in a warning and a ₹200 fine. Failure to use the helmet a second time resulted in immediate dismissal. First offenders were common, but there were very few second time offenders.

This was an example of using strong measures to enforce use of PPE use, but it worked and probably saved many lives. Motorcycle accidents often involve serious head injuries that result in death or leave riders alive but crippled for life.

Box 6.2.
Checklist for control of exposure in the workplace..

("No" answers indicate problems.)

Chemical and Dust Exposure

- ☐ If there any chemicals, solvents, pesticides, etc. in your business that can be removed or substituted with safer products, have you done so?
- ☐ Is there an effective, working ventilation system to reduce exposure to gases or fumes?
- ☐ If there is dust that you can see in the workplace, have you installed a system to control it or given the workers personal respiratory protection to use?
- ☐ Does the exhaust from the ventilation system push air to the outside of the building and away from people?
- ☐ Do your workers have personal protection and do they know how to use it? (Respirators, hard hats, eye protection, gloves and other hand protection, foot protection.)
- ☐ Does your enterprise have a written policy on worker health protection?
- ☐ Does your enterprise keep track of hazards in the workplace and who is exposed?
- ☐ Do workers have a place to wash and change clothes before they go home?

Emergencies

- ☐ Is your company prepared for the most likely emergencies that could happen in your area?
- ☐ Does your workplace have an emergency plan? Has it been tested in a drill so that you know it works? Is it updated regularly and when there is a change in the situation?
- ☐ Do all workers know about the plan and do you hold practice drills?
- ☐ Do all your managers know exactly who to call in an emergency? Is the list updated regularly, at least twice a year?

Chapter 7
VULNERABLE WORKERS

Every workplace is made up of its own special combination of workers. Some workers will be older; some will be very young. Some will be men and some will be women. Most of the time, these workers will be healthy, but at times some of these workers may be sick but still able to work. Workers who are in a position where they can be hurt more easily than other workers, or who are passing through a stage of life where they are more susceptible to health problems, are called "vulnerable workers". They need help.

While it may seem easier only to choose workers that do not have any special needs, in reality it is almost impossible to do so and it would be unfair to try. Many conditions are not obvious and if they are they may have little to do with how productive a worker is. Because some worker populations need a bit more attention than others does not mean that these people aren't just as capable of producing as much and at as high a quality as other workers.

Disabled Workers

Many disabilities are obvious, like blindness, deafness, missing an arm or a leg, or being lame. Most disabilities are not obvious, however. They are simply the gap between what a person is capable of doing and how the workplace is set up. Disability is just a mismatch between what the person can do and the environment they are in. Temporary disability, for example following an injury, gets better and the person's disability goes away. When we speak of "disabled workers", we are talking mostly about workers who have a condition that will not go away and that interferes with their ability to do some but not the most important parts of a job. In this case, the question the manager should ask is "what can the person do and what do they need so that they can do this job?"

The modern concept of disability is to think of it as a mismatch between individual capacity and the environment in which that person functions. The old way of thinking treated disability as a characteristic, a mark or burden of the individual.

A person who is blind can answer the telephone. A person who cannot hear can keep books. A person who cannot lift things may still be a good craftsperson.

When a person with a disability is given a little help in order to be able to do the job, it is called "accommodation". Some simple ways of accommodating people with disabilities include:

- Rebalancing job assignments so that the person with the disability can do those parts within their capacity and other workers can do the rest.
- Modifying work hours, if the disabled worker needs shorter hours.
- Modification of equipment using ergonomic principles, which usually makes the workplace safer and more efficient for everyone.
- Removing barriers to access to the workplace, such as reserved parking spaces or building ramps instead of stairs.
- Removing barriers to access at the workplace, such as placing files in lower drawers for easier access to persons in wheelchairs.
- Making sure that there are no barriers to using washrooms for people with wheelchairs.

People with Infectious Diseases

The basic message we want to get across here is that it is not difficult to protect workers from HIV/AIDS or any of the hepatitis viruses (there are three). Tuberculosis can also spread in the workplace but the risk can be reduced by ventilation and helping workers get treatment.

HIV/AIDS: Many people around the world have AIDS and in places many employees could be carrying the virus HIV, which causes it. However, this does not mean that those carrying the virus cannot work. The HIV/AIDS virus is only spread from an infected person to another person through sex and through body fluids such as blood when they get into that other person's bloodstream directly. It is not spread by urine, saliva, or sweat, or by touching. This means that workers with HIV/AIDS simply do not present a hazard to other workers. It cannot be spread by handling food or touching another person. Even in parts of the world where HIV/AIDS rates are high, the risk for infection in the workplace is so low that outside of hospitals there is no reason to worry about it.

In hospitals and in situations where there has been bleeding, the spilled blood can be cleaned up safely with soap and water and disinfected with a little bleach in water. The person who does this should wear plastic or rubber gloves. These efforts should be made anytime there is a blood spill, for anyone, not just when someone is known to have HIV/AIDS. In hospitals, special precautions are taken to prevent infection of health care workers with hepatitis. These same precautions work very well for HIV/AIDS.

Hepatitis**.** There are three different types of hepatitis: hepatitis A, hepatitis B and hepatitis C. Each is different but all three primarily affect the liver.

Hepatitis A is a short-term illness that comes from food and water contaminated with the virus and is a real concern for people who handle food. The key to preventing hepatitis A is washrooms and clean water so that workers can wash their hands, which they must do often and always after using the toilet if they handle food. Workers with this type of hepatitis should not share food, plates, utensils, or glasses with other workers because the virus can be passed easily from one person to another. Eventually, the virus goes away.

Hepatitis B is the most difficult problem for managers and employers. Hepatitis B is one of the major diseases worldwide, and is a serious global public health problem. It usually makes people very sick within a few months after they get it. Some people who get it cannot get rid of it, even after several months, and they may become seriously ill over the years. It is preventable with safe and effective vaccines. Hepatitis B virus is transmitted by contact with blood or body fluids of an infected person in the same way as HIV/AIDS and is much easier to pass from one person to another than HIV. It can be spread by sex. Hepatitis B virus is not spread by contaminated food or water, and cannot be spread casually in the workplace by touching. However it can spread by sex, by sharing personal items like razors and toothbrushes, or by sharing unwashed plates, utensils, and glasses, although this is rare. These things do not happen often in a workplace – they happen at home. So it is easy to prevent the spread of hepatitis B in the workplace.

Hepatitis C is a similar problem to hepatitis B, but not as well known and involves a different virus. Like hepatitis B, it can spread by sex or by sharing personal objects like razors, toothbrushes, or unwashed plates, utensils, and glasses, even though it is rare for hepatitis C to be spread this way. Again, as with hepatitis B these things do not happen often in a workplace – they happen at home. Therefore it is easy to create a safe working environment where Hepatitis C (HCV) cannot be spread from one worker to another.

Tuberculosis**:** Nearly one third of the world's population is infected with tuberculosis (TB). TB kills almost three million people a year, causing more deaths than any other infectious agent. Tuberculosis is an air-borne disease that can be spread when someone who has it in their lungs coughs or sneezes. Poor air circulation and lack of fresh air also increase the chance of infection. Tuberculosis usually affects the lungs but can be present in almost any part of the body. People around a person with TB can become infected, but it usually requires close contact from six to eight hours a day for a period of four to six weeks. That is why family members often catch the disease but co-workers usually do not, although it is still possible and so it is still important to prevent it.

The general symptoms of TB include feeling sick or weak, and having weight loss, fever, and night sweats. The symptoms of TB of the lungs include coughing, chest pain, and coughing up blood. If a worker reports or displays such symptoms it is

important to encourage the worker to get tested for TB. An employee being treated for tuberculosis usually stops being contagious after two weeks of proper treatment, which these days usually means watching the person actually swallow the drug. After that period of time, the job presents a perfect place to give them their drug and watch them take it under direct supervision, if the employer is willing to take responsibility. Treatment may last six to eight months, although with better drugs and knowledge this is being shortened in some places for some types of TB.

Health care workers who work around patients with TB for long periods of time are at greater risk of catching it than someone who is just in the same workplace. They can protect themselves with respiratory personal protection, as described in Chapter 6. Respirators (the kind called "N95") work very well for this purpose.

New and Emerging Infections. More and more often, diseases appear in the world and present a new risk of spread. These are called "emerging infectious diseases". They include:

- Diseases that are really new to human beings, like HIV/AIDS (which we now know started when humans entered the habitat of infected monkeys) or SARS ("severe acute respiratory syndrome", a completely new disease that broke out in East Asia in 2002).
- Old diseases that break out every once in a while (such as the very dangerous Ebola virus in Africa).
- Old diseases that have become resistant to antibiotics, such as "multiple-drug resistant tuberculosis" (MDR-TB) or MRSA (methicillin-resistant Streptococcus aureus)
- Old diseases that appear in a place where they were not seen before, such as West Nile virus appearing in North America.
- Influenza types that recombine and change their nature so that they can become more of a threat, like the world outbreak of H1N1 influenza in 2009 and the current risk of "bird flu" at the time this chapter was written (2013).

Entrepreneurs and managers and the workers in their enterprises may be concerned about these emerging infections. The public health department for the area or country should have all the information an employer will require in case of a disease outbreak or threat. In general, emerging infectious only become a threat to an enterprise when workers are in the health care sector and might be exposed or when the disease becomes widespread and disrupts travel and business. Common diseases in the area, such as malaria where it is found, are usually much more of a threat to workers and the enterprise.

The Pregnant Worker

In many countries, women make up a large part of the workforce. At some point during their employment, many young women will start families at home. This should not keep managers from hiring young women. Workers who are pregnant can usually work well into the pregnancy and will usually be able to return shortly after giving birth, if that is what they want.

When it becomes known that a female employee has become pregnant (in many countries it is illegal to ask), the plant manager should speak with her individually and come up with a work plan that suits her as an individual. Not all women experience pregnancy in the same way, and each worker will have her own needs that have to be met. Here are some general issues that should be considered:

- A change in the nature of the duties, e.g., reduction in heavy or standing work and an increase in light or seated duties.
- Protection from certain chemicals, particularly lead and mercury.
- Protection from safety hazards, particularly the risk of an accident that hurts the abdomen.
- Protection from extreme heat, which may be dangerous to the unborn child.
- Flexible working hours or the reduction of working hours.
- Rest breaks if they are needed and a place to sit.

Pregnancy-related work issues usually come during the early and late stages of pregnancy, less so in the middle. Nausea ("morning sickness") and sometimes vomiting may lead to a lower work performance during the first 12 weeks of pregnancy and the woman may get tired more easily than

usual. A manager should realize that this slowed work pace is only temporary.

In the second stage (13 to 28 weeks of the pregnancy), many pregnant women experience back aches because of the weight gain and body growth. Their legs may swell uncomfortably when they stand for a very long time. Dizziness and fainting may also occur, particularly in a hot environment or with prolonged standing. Sometimes pregnant women need to leave the workplace for medical appointments and need better nutrition. However many women feel fine during this period and can easily put in a full day's work.

It is very safe for a pregnant woman to use a seat belt if it is placed properly: the lap belt should go around the hips and the shoulder belt should go over the shoulder and not the abdomen. The seat belt strongly protects the unborn child from harm. As the abdomen grows, the unborn child becomes more susceptible to injury if an accident hurts that part of the body, but this rarely would limit a woman's ability to work.

Women can work as late into the pregnancy as they feel able to, but every woman is different. At the point that she feels she needs to, a woman should be allowed to take leave of her job with the assurance that she can return once she has had her child.

As long as the woman is breast-feeding, she should take similar precautions to avoid exposure to chemicals.

Any worker, man or woman, should be careful to wash and change clothes before going home to children if their work involves lead or other chemicals that can be carried home on skin and clothing.

Young Workers

We do not want this section to make anyone think that we accept child labor or think that it is good. The worst forms of child labor are against international law. Child labor is guided by standards of the International Labour Organization (ILO), which say that children should not be employed before at least the minimum of compulsory schooling or 15 years, possibly 14 in developing countries. Any work that might cause a risk to the physical or mental health of a child should not be allowed until age 18 (16 under unusual conditions). ILO recognizes some flexibility for developing countries and allows light work for children 13 to 15 years if it does not interfere with their life, schooling, or well-being. The goal is to eliminate child labor entirely in the future. Most countries have already adopted these rules, but some countries have their own laws that are different. Actual practice may be very different.

Some children in some places have to work, but this is not what we should want for our children. Employers should encourage young workers to go to school whenever possible, both boys and girls. Children who are able to read, write and do math will be better citizens in their community. A manager must think about the future of the workplace and the community. Educated children can make a small difference today and a larger difference as they become adults. It will be a better day when all children go to school and not to work.

Children work for a variety of reasons but mostly to earn money for their family and themselves to live. Children are often forced to work by their parents and by poverty. Children often come into the workplace not even knowing what it means to work. Young workers are blind to the troubles that could be facing them in a workplace. As an employer, it is important to protect children from the possible dangers in the workplace and not to make the problem of child labor worse.

Children are usually more affected than adults by the same hazards. Lead, for example, is much more dangerous to children than to adults and can cause lifelong brain damage. Pesticides can kill or make children very sick at lower exposures than adults. Loads that are too heavy may interfere with the child's growth. A child is much more likely to have a serious injury while working with tools or machinery because strength and coordination are not as well developed as in an adult.

Children are not just small adults. A child does not have the stamina or concentration that an adult does, and in a work setting this could mean that a child is more likely to be injured in an unsafe situation. It is important, therefore, to pay extra attention to young workers to ensure their safety as well as the safety of others in the workplace. Adults are able to work harder for longer periods of time. If young workers

are becoming sick today, they may be unable to work as adults.

Young workers want to please their bosses as well as their parents. Often times children will agree to perform tasks in the workplace even though they do not feel comfortable doing so. It is a plant manager's responsibility to make sure that if they must work, young workers are only taking on jobs that they are fully capable of doing.

Children should never be around heavy machinery or dangerous tools. And if a child must be around such equipment, the child needs protective gear that fits properly. And just because a child is small, this does not mean that he or she requires less workspace than an adult would to do the same job. In fact giving a child extra space to do the job will lessen the chance that he or she will injure someone working nearby.

Figure 7.1. *Children should not work if it means missing school and if the work is dangerous or too hard for them. This child is making bricks, a job that is dirty and unsafe, because it requires more strength than a child normally has. (Photo by Miguel Barrientos, from the proceedings of the First International Symposium on the Rights of Children, Antioquia, Colombia, 1995, with permission.)*

Older Workers

Improvements in public health, health services, education, the quality of life, better environmental conditions, and higher incomes, mean that people are living longer almost everywhere. Not only are people living longer, but people are also living better, healthier lives. Most older adults are now healthy enough to work and can be as valuable in the workplace as the younger workers who are just starting jobs. Some older workers are stronger than younger workers, because of a lifetime of hard work.

Often an employer may not want to hire an older worker because they are afraid that the older employee is more of a risk than the younger worker. Sometimes an older worker may require some extra attention to do their best:

- Some older workers may not be able to stand for long periods of time.
- Some older workers may not be able to react quickly to a dangerous situation. It may not be wise to have an older worker operating heavy machinery.
- Some older workers may not be able to perform fine work, such as sewing, as well as younger workers. As people age, they may get arthritis and their eyesight may not be as strong as it was.
- Some older workers may not be as strong as a younger worker.

However, an older worker often brings advantages that come from age:

- An older worker has experience that can often make the workplace more efficient overall.
- An older worker can watch over the younger workers and guide them.
- An older worker can be seen as an elder in the workplace community, who can lead the younger workers through respect.

Expatriate, Immigrant, Refugees, and Non-Native Workers

In many countries, much of the workforce is made up of people from other countries who may not speak or read the language and who may have a different legal status from other workers. These workers can be vulnerable to health and safety hazards. They may need additional or different training, in their own language appropriate to their educational level, on safe work practices, They are often less likely to ask questions if they do not understand, are often less likely to speak up if they are having a problem, and may feel intimidated by authority.

Preparation and general training of expatriate workers should be part of the recruitment contractor's responsibility but some training on the job is always necessary by the employer to be sure that safe work practices are followed on the employer's property. When company employees work around contractor employees, everyone experiences the same risk if something goes wrong. It is important that everyone have the same commitment to safety.

The Service Sector

Up to now, this booklet has concentrated on manufacturing, retail, and construction. Another industry sector of particular interest for owners and managers in the middle-sized range of business is the service sector. Businesses in the service industry also have occupational health problems. One service industry with problems representative of the service sector is cleaning of commercial and office buildings, which will be used as an example. (See Box 7.1.)

Services are work products that are not tangible, concrete, or permanent in nature, as a manufactured product would be. A service does something for someone that they cannot do for themselves or that is better or cheaper to have someone else do for them.

Services are provided at many different levels, across the entire range of skills. They include doctors who treat patients, lawyers who represent clients, engineers who give advice, information technology support staff, architects who design buildings, mechanics who repair cars, customer service representatives who take calls at call centers, and so on, to the person who empties the dustbins. They can be on a huge scale, such as call centers serving the customers of multinational companies, or on the very smallest scale of business, such as a part-time receptionist who works as a temporary worker on contract with a placement firm.

Services can be indispensable in building economies. In many countries in the world, for example, people in villages or in poorer parts of big cities sell time on their mobile phone to people who need it and either cannot afford their own or do not have it with them. The clients need this service to find jobs, get current prices for agricultural products or other goods, arrange delivery from suppliers, and transfer money (often in the form of phone credits). Those small business people are providing the same product as the entrepreneur who starts a mobile phone company: one-on-one communication of information important to the client. The product is not the phone or the electricity to run it. The phone is only a tool and the electricity is only an expense to provide the service.

Service industries can be big businesses, such as hotels, hospitals, banking, insurance, railroads, big bus companies, software companies, and communications, such as mobile phone companies or television studios. They are often closely linked to their communities, such as journalism and media, local transportation, education, medical services, lawyers, public health protection, tourism, waste disposal, accounting, and building cleaning and maintenance. They can be very local and important to the neighborhood, such as restaurants, personal care (such as barbers and hair shops), laundry, and bookkeeping.

The service sector, particularly at the local level, operates mostly face-to-face businesses, where clients form opinions of the business based on the person they speak to and how satisfied they are. Service providers offering such consumer services are highly dependent on the perceived quality of the service they provide. An employee who is unproductive or who does not communicate well leaves a bad impression in a service industry but would not be seen in manufacturing. A well-trained and well-prepared employee is more likely to deliver a service that will satisfy the client or customer.

There are many opportunities for stress and conflict in relationships in the service sector. Customers and clients may be unhappy and take out their feelings on the workers. There is often pressure to do the work too quickly, to cut corners, or to promise too much. Many service providers operate on very small margins of profit and so are always at risk of going out of business. Many jobs in the service sector are paid low wages and jobs are often insecure. There is often a lot of competition, especially for small service businesses that do not require much money to start.

Box 7.1.
AN EXAMPLE FROM THE SERVICE SECTOR: CLEANING.

Cleaning and maintenance services make it practical to do business. If office workers or service providers had to take time from their real jobs to dispose of trash and to clean their workspace, their work would not get done very efficiently. If shopkeepers and small businesses owners had to clean their own shops as thoroughly as a cleaning worker will do the job for them, they would have less time to serve customers and would make less money.

Cleaning workers support the people who work in the businesses in the building. However, workers who clean buildings do not receive the same recognition or respect that other service providers enjoy. Their work is considered low in status.

This is unfortunate because the work they do has an effect on the health of people in the building. Properly done, cleaning reduces exposure to dust, dirt and germs, reduces exposure to mold that can cause allergy, contributes to safety (for example by keeping floors dry), reduces rats and other pests, prevents worn or malfunctioning equipment from becoming a hazard, prevents corrosion and rust, and prevents certain health problems (called "the sick building syndrome") that are often related to particular buildings. A good building manager and proper cleaning can help prevent these problems.

Since 2000, especially, there has been a lot of interest in how clean, well-ventilated, and well-maintained buildings keep the people who live or work in them healthy. There is some evidence that people who work in a building that meets the highest modern standards have fewer illnesses such as colds and feel healthier. They can also help avoid several types of building-related illnesses that make people sick, tired, and unproductive, one of which is related to inadequate ventilation.

A clean and well-kept building also sends a message to visitors that the building is safe and the people who own it have the resources to keep it in good shape. It also shows that the people who are responsible for those who work or live there pay attention to detail, care about people, and can be trusted.

Commercial cleaning companies usually have contracts with the owners of several buildings in their city or town. They provide cleaning crews who sweep or vacuum the carpet in offices, empty the trash, mopping and waxing floors, wipe dust off furniture and shelves, polish brass, clean toilets and sinks, replace towels and soap and toilet paper, and do many other tasks. Some companies provide higher value that is worth more to clients, such as building maintenance or cleaning to a higher than usual standard, especially in places where it is most important, such as hospitals.

However, cleaning workers find many hazards in the course of their work, from electrical hazards to slips and falls to ergonomic problems. They have a high rate of injuries because of the nature of their work. They often develop back pain and other strains and sprains from moving furniture around and from ergonomic problems (see Chapter 3).

Cleaning workers are exposed to cleaning chemicals that many of them can cause irritation of the eyes and lungs and skin, and sometimes can cause asthma. (See Chapter 5.) Some of these chemicals can be dangerous. For example, when either vinegar or ammonia is mixed with chlorine bleach, dangerous poisonous gas is released (a different one for each), and this can kill the worker.

Cleaning workers experience a lot of stress and face many problems like that described in Chapter 4. For example, cleaning is usually done after business hours when few people are around, and so cleaning workers may not be safe when they work alone in their part of the building or when they go home late at night. Sometimes people are disrespectful to them or leave an unnecessary mess for them to clean up. Often they are bossed around or forced to work overtime by supervisors who know that they cannot easily change jobs.

Cleaning staff are usually also very vulnerable, in all the ways described in this chapter. Because the jobs are considered low in status, they are often poorly-paying. Cleaning workers almost always come from social classes of low status and usually have little education. Cleaning workers are often

recent emigrants or are from minority communities if in their own country. Many cannot read or cannot read or fully understand the language of the country they work in, which means that they may not be able to read instructions or warnings on the label or a chemical product. They often need training, in their own language and at a level they can absorb, to protect themselves and to become more productive and valuable employees. (An exception to the usual profile is refugees, who sometimes are highly educated and experienced but can only find work at these jobs in their new country of residence.)

However, cleaning workers often have hidden strengths. They are often in that job because it is the best opportunity available to them at the time and they are supporting families, who may be in another country. They may be doing this job now because they need the money but they are also willing to work hard. Many of them are also ambitious and willing to learn in order to advance.

Many employers in the cleaning sector have become interested in adding more value to their services they provide so they can charge more for a better, more thorough and healthy cleaning product. This may mean providing more training for their employees, using safer chemicals, adding additional business service such as building maintenance, and meeting new industry standards.

Cleaning workers need protection the same as production workers in a manufacturing business. The principles from Chapter 6 on how to control unsafe conditions apply as much to cleaning and maintenance workers as to anyone else in the workplace.

Figure 7.1. *Cleaning workers deal with many workplace hazards. They are also a particularly vulnerable group of workers*.

Chapter 8
RISK ASSESSMENT AND MANAGEMENT

In the earlier chapters we talked about many types of hazards: those that cause injury, physical hazards related to energy (such as heat and noise), hazards that cause strain on the body and inefficiency at work, chemical hazards, biological hazards like germs (only a little), and psychological hazards related to stress at work. We could have talked about many more hazards, but this book is an introduction to the science of protecting workers, not a complete reference. We talked about how these hazards are controlled, one at a time. We also talked about who among workers is more likely to be hurt than others. With this knowledge understood, we can now talk about an overall plan for making the workplace safer.

This chapter is where we begin to put it all together into a management plan for protecting workers. For the owner or manager of a business, making the workplace safer and more efficient begins with figuring out what dangers there are in the workplace, which are the most important, and how to control the hazards that are there to prevent risk of injury or illness.

We needed specialized words to talk about this. The exact meaning of words is important in this chapter and some words in this field are hard to translate. (Many languages do not have different words for "hazard" and "risk", for example.)

Risk Assessment

A "hazard" is something that has the capacity to cause harm, whether it is a chemical or a condition in the workplace. Hazards can come in many forms, as we have seen in the earlier chapters. Table 8.1 lists all of the categories of hazard that we have already discussed and some that we have not, because this book is only an introduction. It cannot cover everything or it would be too long. This category system is practical, not theoretical. For example, fire is a chemical reaction but it is listed here, together with heat, as a physical hazard. "Location" brings together hazards that are found together in a particular place where the job is done, separate from the job itself. This is to make the list more useful in your company's operations because it is easy to use as a general checklist and to remind you or your managers of what to look for as you try to identify specific hazards.

When you identify a hazard in your workplace and decide to learn more about it, this is called "hazard identification". You can read more about the different types of hazards in one of the references listed at the end of this book. Once a hazard is identified, you can start to manage it but you cannot manage something if you do not know it is there.

Table 8.1. Categories of Hazards in the Workplace

- Chemical (Chapter 5 and Chapter 9)
  - Chemicals that cause toxicity
  - Chemicals that cause allergy
  - Chemicals that release energy (fires, explosions, heat)
- Physical (Chapter 2 and Chapter 8)
  - Ergonomic (Chapter 3)
  - Radiation (not discussed in this book)
  - Heat, fire, cold (Chapter 2)
  - Noise and vibration (Chapter 2 and Box 8.1 in Chapter 8, Chapter 9)
- Mechanical (safety from injury, Chapter 9)
- Biological agents
  - Agents that cause infection (Chapter 7)
  - Agents that cause allergy (not discussed in this book)
  - Agents that produce toxic chemicals, like natural poisons (not discussed in this book)

- Stress (Chapter 4)
  - Work organization
  - Interpersonal stressors
  - Conflict and violence
- Location (hazards that are not part of the job itself but that are present where the workplace is located and will affect people who take a job there)
  - Infectious diseases that are more prevalent in certain places where people work, like malaria, dengue, HIV/AIDS, and tuberculosis (Chapter 7)
  - Diseases of poor sanitation, like diarrhea from unclean water (not discussed in this book)
  - Dangerous traffic and road accidents (checklist in Chapter 2)
  - Violence in the community that could affect workers (Chapter 7)
  - Fire in unsafe housing and work camps (Chapter 2)

"Exposure" is when a person comes into contact with a hazard, for example by inhaling, ingesting, absorbing a chemical through the skin or touching something that is sharp or hot, or working on a scaffold above the ground. We often say "overexposure" when the exposure is more than worker health standards allow. The consequence of enough exposure to a hazard is something serious happening, such as an injury or a disease.

The consequences that result from exposure to any hazard can be described as "acute" (short-term) or "chronic" (long-term). Acute consequences happen right away: injuries, most asthma attacks, immediate poisonings. Acute consequences are usually obvious but sometimes hard to figure out. Chronic disorders develop over time and last for a long time, often the rest of the person's life: heart disease, lung disease, arthritis. They are almost always hard to figure out, take time to develop, and are hard to count accurately, but in every country they add up to a huge burden on society.

Some consequences always occur with enough exposure to the hazard, like getting the lung disease "asbestosis" from breathing asbestos dust without protection. (See Chapter 5.) Others have some chance to them, a probability. Disorders like cancer happen to some workers but not to all of them, even when they have the same level of exposure in the workplace. In other words, if a group of workers is exposed to the same level of a cancer-causing dust, like asbestos, or a cancer-causing chemical (called a "carcinogen"), not everyone will get cancer. Some will and some will not. Who exactly will get cancer is unpredictable but it is sure that some workers will, in time. This risk will occur over the rest of their lives, because cancer takes years to develop.

Fatalities (deaths) are often counted separately in the statistics but they can arise from either acute or chronic health problems. Of course, fatalities not only take the life of a worker but also cause serious hardship to families and are destructive to the workforce and communities.

A "risk" is the probability of something unwanted happening, such as an injury or a disease. A "consequence" is the result, the occurrence of that unwanted and unexpected outcome. Risk depends on exposure. For example, all workers in a group that are exposed to asbestos (even at low levels) without adequate protection will have a higher risk of cancer than any other group that was not exposed. Most of the time when we are dealing with the workplace we do not calculate the probability (say, one in a hundred) or odds (a hundred to one) of a serious consequence, because we do not have enough information, our predictions cannot be that accurate, and it is not necessary. Instead, we usually talk about "high", "medium" and "low" risk. A "high risk" situation is dangerous and should not be allowed to continue without doing something to reduce the risk. A "medium risk" situation requires management in order to lower the risk further for the protection of workers, prevent loss to the employer, and control costs that come from disruption and lost productivity due to injury. A "low risk" situation is usually acceptable but sometimes measures to reduce risk further will improve efficiency. Even "low risk" situations need to be watched, however, to make sure that they do not get worse unexpectedly.

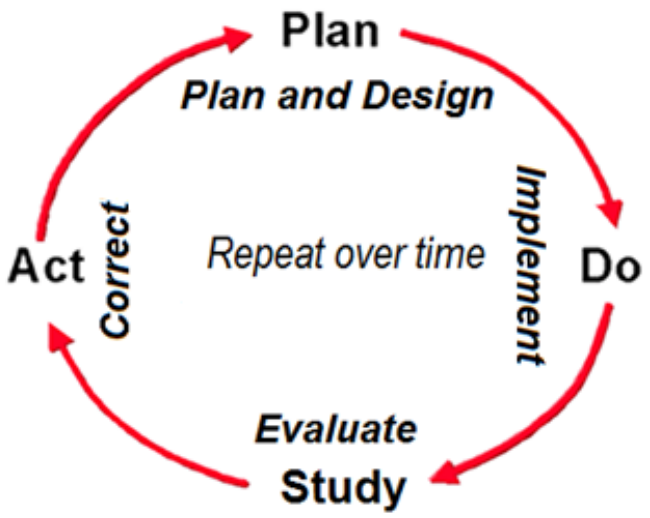
"Risk assessment" is a way to evaluate how likely it is that bad things will happen and how serious the consequences could be. It does not have to be complicated but it does have to gather and organize the most important information you need to evaluate the problem. The next chapter shows how to do this for many hazards, but especially chemicals.

Risk Management is Process Management

"Risk management" is what you do about these risks once you identify or estimate them. Chapter 6 described many methods of managing hazards in the workplace to reduce risks. Risk management is your overall plan for how to reduce risk by managing hazards and keeping the consequences as small as possible.

Most people who have studied business management have heard of process management. They learned it as a cycle, where managers first plan a work or production process on the basis of as much information as they can get, do it as planned for a time, then study the results, and finally act on that knowledge to make the existing process better. The manager then starts the cycle over again in a constant effort to improve production and reduce costs. This "Deming cycle" (named after the person who made it an essential management tool) is usually presented as a simple formula: "Plan→ Do→ Study→ Act". (The cycle is shown in Figure 8.1)

The Deming Cycle is standard practice for improving efficiency and quality control in manufacturing and high-cost services. It is also the basis of health protection. Protecting the health of workers is not only a form of process management but one of the most important. Risk assessment and risk management, followed by evaluation (a follow-up risk assessment) and improvement (another risk management), are the same as
"Plan→ Do→ Study→ Act".



Doing It in Practice

Here is how it works in practice: A hazard, or threat, causes a risk of injury or disease when a person is exposed to it. (If a person is not exposed to it, or if there is no hazard present in the workplace, then there can be no risk from it.) When a person is exposed to the hazard, there is a risk of an unwanted serious consequence, for example an injury, illness, or even death or the risk of many deaths. Once the hazard is identified, you can anticipate what the worst consequence will be and how likely it is to happen through risk assessment. You can then set priorities depending on whether the risk is high or medium, and how serious the consequences would be if it happens. You can then take the most serious risks, your highest priorities, and figure out ways to reduce the risk through risk management. As you work through the list of priority hazards, the workplace will not suddenly become completely safe but over time it will become safer year by year. Injuries will become less frequent, expenses from disruptions and lost time will fall, and very often (because a safe workplace is usually more efficient) production will improve as well as the company's relationship with the workers. However progress will not be even, month by month. Injuries do happen even in safe workplaces and sometimes things go wrong. It is the long-term trends that matter, not month to month.

Box 8.1 presents an example of risk management using noise, a very common physical hazard. Noise is also discussed in Chapter 2.

Figure 8.1. *The "Deming Cycle" of process management applies to health and safety just as much as it does to production and quality improvement.*

Box 8.1.
CASE STUDY: A VERY NOISY FACTORY.

There was a small company that manufactures steel pipe for use in oil drilling. It was very noisy and some workers were complaining of ringing in their ears and difficulty hearing after work.

Risk Assessment

The most important hazard was obvious - noise. [Hazard Identification] (Solvents were also used and the combination of solvents and noise is particularly bad for the nerves in the ear.) The ringing in the worker's ears and their inability to hear for a while after they left work was a sign that the levels of noise were much too high and that their hearing was being affected. [Consequence] These things are an early sign of hearing damage and they showed that there was a very high risk that the workers would lose their hearing. [Risk] The consequence of exposure to continuous noise would be deafness among the workers, a serious communication problem that would affect their lives, their relationship with their families, and their ability to work at other jobs. Studying the type of noise and where it was coming from showed that there were two sources of noise: 1) Continuous noise from making the pipe that was much too high. It was at a level that would definitely cause the workers to lose hearing over time. (A simple test is whether two people can understand each other talking when they are standing at one arm's length from each other. If they cannot, then the noise level is so high that it can damage hearing.) 2) Loud clanging noise that came every few minutes from stacking the metal pipe or when it hit the floor. This is called impulse noise and can hurt the ears just from the force of the noise on the eardrum. By measuring the noise level, a consultant was able to show management that both types of noise were too strong and that the hearing of workers was being damaged by both. Therefore, two problems had to be solved, not just one. The information gathered in this risk assessment pointed in the direction of a plan.

Risk Management

Based on the information available and with the help of a consultant specializing in noise, the management of the company developed a plan. [Plan] The company got (muff-type) hearing protection for the workers in the form of personal protection to deal with the continuous noise and figured out a way to put wooden boards between the pipes so they would not make as much impulse noise. [Do] The managers of the plant later evaluated what had happened. They found that this change actually helped workers to stack the pipe more easily and quickly, and so made the workplace more efficient. [Study] This information allowed them to improve production in other areas of the plant. [Act] This is not unusual. Risk management often brings additional benefits.

Chapter 9
RISK MANAGEMENT AND CONTROL BANDING

Once a hazard is recognized, there is an obligation to manage it! Risk assessment is the step in which the hazard is evaluated and a decision is made as to whether it is a big risk requiring high priority or a medium or small risk that can be prioritized among other business priorities and wait its turn for management attention. It also includes the step of weighing the possibilities for what can be done to reduce or control the risk. Risk management in the workplace is mostly a problem of hazard control. The best solutions are technical and depend on changes in the workplace itself, as shown in Chapter 6.

Figure 9.1. *These chemicals are present in the workplace in gram or milliliter quantities. (Photograph ©dreamstime.)*

This chapter gives you a simple but powerful tool to use in your workplace. It is called "control banding" and it is a simple approach to risk assessment and risk management that works especially well for chemicals. Most managers find chemical hazards particularly hard to control. The logic of control banding, however, applies to all other hazards. It is a simple way of applying risk assessment and management.

Risk Assessment in Practice

After the hazard has been identified, it has to be evaluated. In occupational health and safety, this is done by determining how serious a risk it poses to employees, contractors, visitors, and other people who are likely to be exposed.

Four pieces of information are needed to evaluate the risk of chemicals, as well as other types of hazards:

1. 1Exposure opportunity: how likely is it that workers in your workplaces will come into contact with the hazard (most often by inhaling it) at levels that could be harmful? This is best done by watching your workers as they use a chemical or as they perform a job with it, or by asking them individually about what they do and what chemicals they use.
2. Quantity: how much is used or is present in the workplace (grams, kilograms, tonnes)? This can be done easily by looking at how much is in inventory or how much is routinely ordered. (Figures 9.1, 9.2, 9.3)
3. Level of hazard: how dangerous is the hazard? This can be determined in several ways, described below. The level of hazard is usually determined by looking up the occupational exposure level (OEL) or other standard that applies to the hazard in your country, by consulting standard references, or by referring to the manufacturer's information on the safety data sheet (SDS) which comes with the chemical. Sometimes this information is right on the label.
4. How severe the consequences will be if the worst possibility of (over)exposure occurs? The most important dimension of risk prioritization is how serious the consequences of an incident involving the hazard might be. If an

uncontrolled hazard can lead to death or serious injury or could affect a large number of workers, it is obviously a very high priority and need immediate attention. If nothing much will happen at all, then the issue is of little or no consequence, except possibly for business efficiency. Most risks are somewhere between.

Figure 9.2. *These chemicals are present in the workplace in kilogram or liter quantities. (Photograph ©dreamstime.)*

Figure 9.3. *The chemicals that were in these drums were present in the workplace in quantities of tonnes or hundreds of liters. (Photograph ©dreamstime.)*

One tool for estimating how severe the consequences of an event might be is given in Table 8.1. It is only a general guide to setting priorities based on consequence.

Table 9.1. Figuring out priorities based on how big are the consequences.

Probability of Occurring	**How Big is the Consequence** →		
	Low	Medium	High
High (Very Likely to occur)	Medium Priority	High Priority	Highest Priority*
Medium	Low Priority	Medium Priority	High Priority
Low (Unlikely to occur)	No Priority	Low Priority	Medium to High Priority

* These risks should not exist in a well-run operation. If they are present and uncontrolled, something is wrong.

Control Banding

"Control banding" is a simplified system that works well for most problems involving chemicals, and also works for noise, heat, and biological hazards. It does not work quite as well for safety hazards but still can be used for this purpose. In this section we will mainly show how it is used for chemical hazards.

With the information from worksite risk assessment, risks can be classified and prioritized for risk management. Control banding puts chemical hazards into risk categories. Each category then points to a "menu" of mostly simple control measures. The word "banding" refers to color-coding risks and solutions and how they are drawn as stripes (or "bands") across the tables that are commonly used in the system.

Control banding works well for most, but not all, problems. It can be done by business owners and managers without help, if their operations are simple. The idea behind control banding is to make figuring out how to control the hazard easier by

working in categories that are labeled and even color-coded.

Control banding recognizes five levels of health hazard:

A. The least dangerous hazards. They may cause, for example, some skin irritation or mild eye irritation. The occupational exposure limits (OELs) or recommended exposure levels in air for these chemicals and dusts are high because people can tolerate higher exposures. The OEL can be used as an indication of the level of risk associated with exposure to this dust or chemical. These chemicals can be managed with simple methods.

B. Chemicals that can be harmful under certain circumstances, such as heavy exposure or long or repeated exposures. These chemicals can be managed with basic methods but require some attention to be sure that exposure is kept low.

C. Chemicals that can cause injury or illness with a single exposure. These chemicals have to be controlled tightly. They may require more advanced methods to keep exposure levels low.

D. Chemicals that are dangerous, that can cause serious poisoning and that can harm the mother or the unborn child during pregnancy. (An example is lead.) They require the highest level of attention. If possible, they should be removed or replaced with less dangerous substitutes.

E. Chemicals that cause cancer or asthma. Some very toxic chemicals that can cause nerve damage or harm the unborn child during pregnancy (such as mercury) should probably also be treated in this category. These hazards usually require experts to advise on special measures to manage them. (Some of them are currently classified in the D band because the simplest problems involving them can be managed without experts.)

Table 9.2. Control banding by level of hazard.

Control Band (Letter and color)		**Description in words ("toxic" here means poisonous)**	**The chemical is described as having these effects, or effects that are similar or just as bad**	**The OEL or exposure standard is in this range.**	
				Exposure levels for dusts (in mg/m^3)*	Exposure levels for chemicals (vapors in air, in ppm)**
A		Minimal hazard. Not very toxic.	Skin irritation or mild eye irritation	1 to greater than 10	50 to greater than 500
B		Harmful, moderate hazard.	Harmful on a single exposure	0.1 to 1.0	5 to 50
C		Severe hazard, can cause serious health problems	Irritating to skin and eyes, corrosive	0.01 to 0.1	0.5 to 5
D		Very toxic, highly dangerous. Can cause death or serious health problems.	Can be poisonous on a single exposure, may have bad effects during pregnancy or other serious disease or death	Less than 0.01	Less than 0.5
E		Special cases	Chemicals that cause cancer or that can cause asthma	Any level – these are special cases that require a professional evaluation.	

*mg/m3 means the mass (as weight) of dust in a cubic meter of air and is the measurement most commonly used for dusts.

**ppm means "parts per million" of a chemical as a gas in air and is the measurement of concentration most commonly used in OELs for chemical vapors and gases.

Once the hazard has been evaluated in this way, you know how dangerous it could be. The next step is deciding what to do about it. Control banding recognizes four main "levels" of control:

Table 9.3. Control banding for managing hazards.

Level and Color	**Basic approach for airborne hazards.***	**Basic approach for other risks.**
Level 1	General ventilation	Basic occupational hygiene practice, such as housekeeping, administrative controls
Level 2	Local exhaust ventilation	Engineering controls
Level 3	Isolation, containment	Enclosure, containment, strict engineering controls
Level 4	(Requires specialist advice.)	(Requires specialist advice.)

* Airborne hazards are dusts and chemical vapors.

Table 9.3 shows the bands for control measures to manage problems, as outlined in Chapter 6. Level 1 and Level 2 can often be done by workers themselves with guidance by managers. Level 3 requires more technical skill and may require a craftsman or engineer to design a solution. Level 4 is highly specialized and usually requires a consultant with experience.

Control banding gives simple guidelines for dealing with most hazards. The following table is for chemical vapors. You have already decided which control band the vapor falls into by checking the OEL or referring to the Safety Data Sheet or a reliable reference. This table tells you which approach you should take, in general, to reduce exposure to the hazard:

Table 9.4. Control banding for problem solving. (Find the combination of hazard level and the amount in the workplace that applies to the problem. Then read across the row to find the necessarily level of control, on the right.)

How much of it do you have in the workplace at any one time? (The colors and letters in these boxes correspond to hazard color bands in Table 8.2.)				**What should you do about it?** (The Level of hazard control corresponds to the control band color and number in Table 8.3.)
A little (ml or a small amount)	Some (many ml, a few liters, cubic meters)	A lot (many liters, a few cubic meters)	Bulk (many cubic meters, metric tonnes, tanks)	
C	B	A	A	→Level 1: General ventilation, basic hygiene
D	C	B	A	→Level 2: Local exhaust, engineering controls
D	D	C	C	→Level 3: Enclosure, containment, strict engineering controls

The colors in the boxes on the right correspond to control bands, as in Table 8.3. Control bands indicate the Level of controls that should be used. This table uses both letters and colors to identify the hazard level and both colors and numbers to identify the control measure levels. We use letters and Level numbers in addition to colors because some people have trouble seeing or interpreting the colors.

The main use of control banding is for chemical hazards. However, it also works for some other types of hazard, such as noise and heat. For noise and heat, the questions just need to be asked and answered a little differently.

Heat can be measured with a thermometer, of course. Noise can also be measured with an instrument called a "sound level meter", but there is also a simple test that can be done without an instrument: If a worker with average hearing cannot hear and understand another worker one meter away (approximately the length of an arm) who is speaking in a normal voice, then the noise level in the workplace is already too high and is dangerous for hearing.

1. Exposure opportunity: how often do workers in your workplaces have to be in an area with noise levels that are loud and could be harmful? Where are those areas?
2. Quantity: how much noise is there at the source? If the noise level at a machine or in a particular location is much louder than in other places, then the noise should be controlled or workers should be kept far away.
3. Level of hazard: how dangerous is the noise hazard? Almost every country has an occupational exposure level (OEL) or other standard for noise, and hazard levels can be determined by consulting standard references. The easiest way to determine this, however, is to go to the workplace and try a simple test.
4. How severe the consequences will be if the worst possibility of (over)exposure occurs? For noise, the consequence is loss of hearing (deafness). This is a very serious consequence. The person who experiences noise-induced hearing loss loses much of the ability to communicate through speech, will not be able to hear the voices of their children, will not be able to enjoy music, and may not be able to hear alarms and shouts warning of danger. Noise-induced hearing loss is much more disabling than most people think.

Heat can be managed in much the same way, as discussed in Chapter 2.

Control banding, used in this way, can help owners and managers deal with perhaps 80% of common work-related dust and chemical hazards and most noise and heat problems. It will not solve every problem but it will guide you to a solution for most problems and identify problems that you will need help in order to solve.

Chapter 10
WHERE TO GET MORE INFORMATION

The internet is a great place to find information for free. There are many sources of information out there, but not all of them are credible. Listed below are a few websites funded by national governments and international organizations. These sites will provide you with the most credible information on occupational health and safety.

In English

- International Occupational Safety and Health Information Centre, http://www.ilo.org/public/english/protection/safework/index.htm
- International Commission on Occupational Health, http://www.icoh.org.sg/
- European Agency for Safety and Health at Work, http://europe.osha.eu.int/
- Canadian Centre for Occupational Health and Safety, http://www.ccohs.org
- International Labour Organization, http://www.ilo.org
- U.S. Occupational Safety and Health Administration, http://www.osha.gov/
- U.S. Agency for Toxic Substances and Disease Registry, http://www.atsdr.cdc.gov/
- U.S Environmental Protection Agency, http://epa.gov
- U.S. National Institute for Occupational Safety and Health, http://www.cdc.gov/niosh/homepage.html
- Finnish Institute of Occupational Health, http://www.ttl.fi/en/Pages/default.aspx

The Finnish Institute of Occupational Health also publishes a series of excellent magazines in English, covering challenges and solutions in various parts of the world. They are:

The African Newsletter on Occupational Health and Safety

The Asian-Pacific Newsletter on Occupational Health and Safety

The Barents Newsletter on Occupational Health and Safety (in English and Russian)

Alli B. *Fundamental Principles of Occupational Health and Safety*. Geneva, International Labour Office, ILO Publications, 2001.

Bark K, Camacho A, Weick V, Miller J, Tischer M, Vosseler CH, Scholaen S, Kürzinger E, Steinberg R, Wendland M. Chemical Management Guide for Small and Medium Sized Enterprises. Eschborn/Bonn, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH., German Federal Ministry for Economic Cooperation and Development (Hrsg.), 2008. On-line at: http://www.mtpinnacle.com/pdfs/Guide_E_300708.pdf. This guide was first produced for use in Indonesia.

Elgstrand, K., and Petersson, N.F., editors. Occupational Safety and Health for Development. Stockholm (Sweden), KTH (Royal Institute of Technology), 2009. This book is a good next step, if you want to learn more after reading our book. It has over 800 pages and is available on-line at: http://kth.diva-portal.org/smash/get/diva2:465599/FULLTEXT01

Guidotti, T.L., editor. *Global Occupational Health*. London and New York, Oxford University Press, 2011. This book is for health professionals, such as doctors and nurses. You may wish to give it to the doctor who usually treats your employees.

International Labour Organization. *Guidelines on occupational safety and health management systems*. Geneva, ILO, 2001.

Levy, B., Wegman, D., Baron, S. L., and Sokas, R. *Occupational and Environmental Health: Recognizing and Preventing Disease and Injury.* London and New York, Oxford University Press, 2010. This book is also a good next step, if you want to learn more after reading our book.

Definitions and Word Use

About the words we use. This Guide is written for the reader who is not an expert. We have stayed away from technical language and kept the vocabulary simple so that it would be easy to translate. When you start reading the internet, books, and articles about health and safety in the workplace, you may find different English words being used.

To help you read other sources, here is a guide to words that are commonly used in worker protection:

Accident.
We use the word here just for an injury that happens when things go wrong, but it can also be used when there is no injury but something is damaged. Accident is a problem word in English for professionals, because the way many people learned the word means that an accident is going to happen whatever we do. Obviously we do not agree because accidents can be prevented. We have chosen to keep the word, instead of using "incident resulting in injury", because it is much easier to understand.

Accommodation.
An accommodation is something that is done or made available so that a worker with a disability can do the job. Examples are given in Chapter 7. Most accommodations cost nothing or are very inexpensive. Sometimes they are so effective that they improve efficiency for everyone.

Acute.
An injury or disease or other consequence that happens right away. If a workers falls off a ladder and breaks his ankle, that is an "acute" injury.

Chronic.
An injury or disease or other consequence that is permanent or occurs over along period of time. If a worker breathes asbestos dust and gets asbestosis (the lung disease asbestos causes), the asbestosis will last for the rest of the worker's life and so it is a "chronic" disease. Cancer (which can also be caused by asbestos), is always considered a chronic disease.

Consequence.
What happens after a cause has acted. In the field of worker protection, it usually means an injury or a disease that happens as the result of the action of a hazard.

Contaminant.
A chemical or substance that is not normally present or supposed to be there but is an unwanted, small part of a chemical or product.

Exposure.
Exposure in the way we are using it in this book means to come into contact with a hazard. For chemicals, this means inhaling, ingesting, or absorbing it through the skin. For safety hazards, this means being in a place or position where there is a high risk of injury. For biological agents, which we do not discuss much in this book except for the section on chronic diseases in the chapter on vulnerable workers, this means taking into the body germs that could cause an infection or a material that could cause an allergy. For stress, this means being in a workplace or relationship that places psychological demands on a worker that are hard to cope with. Everyone is "exposed" to chemicals that are in the workplace to a small degree, so we use

the word "overexposure" when we mean an exposure that is higher than it should be.

Gases and *Inhalants*.

As used here, these are chemicals that are mostly a gas and float in the air. A chemist will make a distinction between gases, fumes, and vapors, but we are trying to keep things simple in this book.

Hazard.
We use the same meaning for the word as it is used by professionals. A hazard is something that can hurt someone who is "exposed" to it, meaning that they come into contact with it. Hazards can be physical (forms of energy like noise, or heat), mechanical (the motion of an unprotected saw blade), chemical (see Chapter 5 for many examples), biological (germs that can cause disease or material that causes allergies like asthma), or psychological (mainly, stress – see Chapter 4).

Minerals.
We use the word to mean naturally-occurring substances, often with a crystal structure.

OEL.
The occupational exposure level (OEL) is the standard in a particular country that limits exposure of a worker to a chemical or physical hazard. For example, in the European Union, allowable levels of exposure to chemicals are listed in Directive 2006/15/EC (which at this time is still incomplete because laws of each country still apply) and are called "occupational exposure limit values". They are mostly set for 8-hour averages so that they apply to a work shift and protect against chronic effects. Short-term exposure levels are usually set for 15 minutes for protection from chemicals that have acute effects. Many countries have maximum allowable concentrations (MAK) or "ceiling" standards that limit the highest allowable exposure that can ever occur at any time. Different countries have different systems but over the years they have borrowed from each other and became similar.

Overexposure.
We use this word when we mean an exposure that is higher than it should be. For example, if a worker is exposed to a chemical above the OEL or other standard, or above the level known to cause health effects, or to a physical hazard like noise. The word is necessary because everyone is exposed to some degree to chemicals and noise when they are in the workplace but low exposures are not a risk to health.

Poison.
A poison is a chemical that causes illness or disease. In the professional literature you will see the word "toxicity" used more often. "Toxic" means that poisoning can happen and "toxicity" covers a wider range than poisoning, because it includes a lot of effects on the body that are not obvious. Poisoning can be acute, meaning that it is develops quickly, or chronic, meaning that it develops over time. Poisoning can be "reversible", meaning that it is short-term, and the person will get over it, or "irreversible", when the person will be injured for the long term or life, in other words a "chronic" effect. (A professional toxicologist, who is a scientist who studies poisons, is more likely to use the word "toxic substance" than poison.)

Risk.
A risk, as we use the word, is the probability of something unwanted happening and how bad the consequences will be. Risk assessment is how to figure out how this happens and how often it could happen, and risk management is how to stop it from happening or make it less likely. There is a practical problem with the word risk, because an equivalent does not exist in many languages. The key idea is the possibility or chance of some serious consequence happening.

Safety and *Security*.
In many languages, these words are the same (for example, Spanish "seguridad" and French "sécurité"). In English, "safety" means a low risk of something unwanted happening and therefore a high level of protection – this is how we use the word in this book. In English, the word "security" generally means a high level of protection from intentional injury or violence or being robbed.

Toxic.
Toxicity is how poisonous something is but it means more than that. It means the whole range of effects a chemical has on the body, from how the body initially reacts to it all the way to the development of symptoms of acute poisoning. A "toxic substance" is a chemical that causes a disease, which many people would call a "poison", or that contributes directly or indirectly to poor health in other ways.

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b) What is the target audience, the readers for whom the translation is intended? What is known about their needs and interest?

c) Who will be responsible for distributing the guide in the country (the "sponsor") and describe the sponsor: Is it an NGO? Is it a chamber of commerce? Is it a government agency?

d) Who will pay for the reproduction of the guide and how many copies will be made?

e) (ICOH requires that it be made available free.)

f) Who will it be given to and how it will be distributed to the target audience?

g) If a translation will be made, which languages will be used?

h) How the impact of the guide will be evaluated? Will injury rates be monitored before and after? Will recipients be asked their opinion? Will workplaces be visited?

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The International Commission on Occupational Health

c/o INAIL, Italian Workers' Compensation Authority Department of Occupational Medicine (formerly ISPESL) Via Fontana Candida 1 I-00040 Monteporzio Catone (Rome, Italy)

Please send the translations or publications immediately after they are produced, for inspection and quality control. The copies should be exactly the same as those that will be distributed, in the language of translation.

If it is not possible to print the new version in color, please just use plain black letters against a white background for all the tables in Chapter 5. The letters will not reproduce well against the background colors if you try to use shades of gray.

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