NEBOSH NATIONAL DIPLOMA IN ENVIRONMENTAL MANAGEMENT

Unit ED1: Controlling Environmental Aspects - Part 1

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RRC INTERNATIONAL

NEBOSH DIPLOMA IN ENVIRONMENTAL MANAGEMENT

UNIT ED1: CONTROLLING ENVIRONMENTAL ASPECTS

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Element 1: Key Environmental Cycles and the Effects of Human Activity on the Environment

Element 2: Environmental Leadership

Element 3: Environmental Management Systems and Emergency Planning

Element 4: Environmental Risk Evaluation and Control

Element 5: Environmental Performance Evaluation

Element 6: Sustainability

Suggested Answers

Course Structure

This textbook has been designed to provide the reader with the core knowledge needed to successfully complete the NEBOSH Diploma in Environmental Management. It follows the structure and content of the NEBOSH syllabus.

The NEBOSH Diploma in Environmental Management consists of two units of study. ED1 is assessed by a 3-hour written examination and N/IDEM2 by an 8,000 word project. You need to pass both units to receive the NEBOSH Diploma in Environmental Management.

Unit ED1: Controlling Environmental Aspects (Common Unit)	
Element 1	Key Environmental Cycles and the Effects of Human Activity on the Environment
Element 2	Environmental Leadership
Element 3	Environmental Management Systems and Emergency Planning
Element 4	Environmental Risk Evaluation and Control
Element 5	Environmental Performance Evaluation
Element 6	Sustainability
Element 7	Waste Management
Element 8	Managing Emissions to the Atmosphere
Element 9	Managing Emissions to the Water Environment
Element 10	Control of Environmental Noise
Element 11	Hazardous Substances and Contaminated Land
Element 12	Energy Use

Unit NDEM2: Environmental Regulation	
Element 1	Enforcement of Environmental Legislation
Element 2	Civil Liability
Element 3	Pollution Prevention and Control Legislation

Unit IDEM2: Environmental Regulation	
Element 1	Enforcement of Environmental Legislation
Element 2	Pollution Prevention and Control Multilateral Treaties

More Information

As you work your way through this book, always remember to relate your own experiences in the workplace to the topics you study. An appreciation of the practical application and significance of environmental health and safety will help you understand the topics.

Keeping Yourself Up to Date

The field of environmental health and safety is constantly evolving and, as such, it will be necessary for you to keep up to date with changing legislation and best practice.

RRC International publishes updates to all its course materials via a quarterly e-newsletter (issued in February, May, August and November), which alerts students to key changes in legislation, best practice and other information pertinent to current courses.

Please visit www.rrc.co.uk/news/newsletters.aspx to access these updates.

Element 1

Key Environmental Cycles and the Effects of Human Activity on the Environment

Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain the meaning of the environment and the Earth's key natural cycles.
2. Explain the general effects that human activity has on the environment (including understanding of key terminology).
3. Outline the purpose of the Principles 15 and 16 made under the Rio Declaration on Environment and Development (1992).
4. Outline the role of non-governmental bodies and the media in influencing common environmental standards in a global economy.

Contents

The Environment and Key Natural Cycles

IN THIS SECTION...

- Carbon is cycled around the Earth by photosynthesis, respiration, death, consumption, water bodies, fossilisation and release to air.
- The nitrogen cycle consists of nitrogen fixation, extraction, egestion, denitrification and release of nitrogen gas.
- Phosphorus is cycled by weathering, uptake by plants, eating by animals, excretion and decomposition.
- The water cycle operates through precipitation, soil infiltration and seepage through soil, groundwater formation and evaporation.

Meaning of the Environment

The concept of the 'environment' embraces both the physical resources of the Earth (air, water, land and raw materials) and the living resources (animals, plants and humans).

DEFINITION

ENVIRONMENT

"Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships ...

Surroundings can extend from within an organisation to the local, regional and global system ... [and] ... can be described in terms of biodiversity, ecosystems, climate or other characteristics."

Source: ISO 14001:2015

Natural Cycles

The various elements of the environment are continually interacting; of particular significance is the way in which important nutrients are exchanged between the physical and living components of the environment.

The Earth is essentially a closed system. Apart from energy from the Sun, all the materials that are needed for life to exist are contained within the Earth. After 3.8 billion years of life on Earth, it might seem surprising that these resources haven't all been consumed. However, the essential elements all form intricate cycles in which they are constantly recycled and re-used by natural processes.

Human activities can have a detrimental effect on these cycles, resulting in problems such as climate change, acid rain and water shortages. Remedying such problems requires an awareness of how these cycles work so measures can be implemented to restore the natural balance.

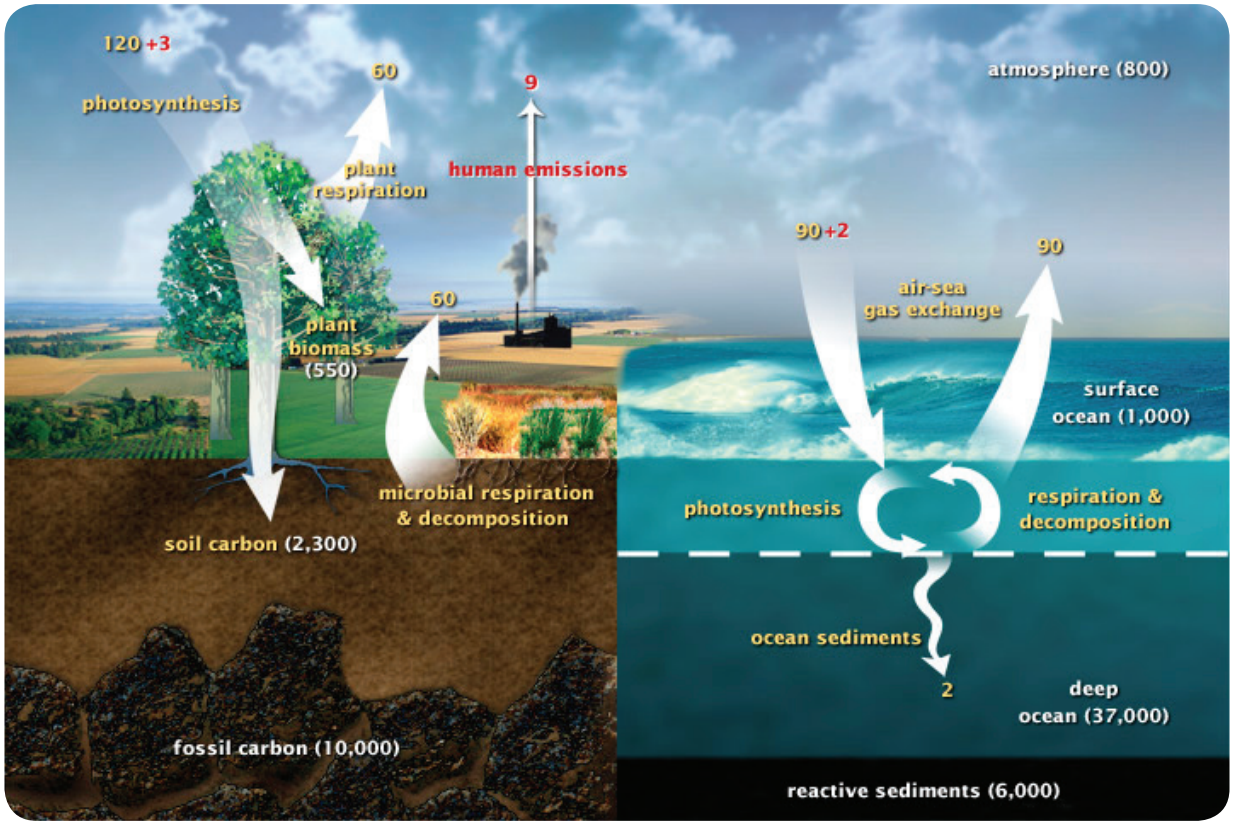
Water - one of Earth's natural resources

In this section we consider some of the key natural cycles that operate on the Earth - to gain an understanding of these is important as the knowledge will help when we consider global impacts later in the course.

The Carbon Cycle

The element carbon is vital for life. It is a primary component of the biological compounds from which all living organisms are made, including proteins, carbohydrates (sugars and starches), lipids (fats and oils), and genetic material (DNA and RNA).

The carbon cycle describes the way in which carbon moves between plants and animals and the physical components of the environment (the atmosphere, ground and water bodies).



The carbon cycle
Source: The Carbon Cycle, NASA's Earth Observatory (http://earthobservatory.nasa.gov/Features/CarbonCycle) adapted from original U.S. DOE, Biological and Environmental Research Information System (http://genomicscience.energy.gov).

The diagram of the carbon cycle shows the movement of carbon between land, atmosphere, and oceans. Yellow numbers are natural fluxes, and red are human contributions in gigatons of carbon per year. White numbers indicate stored carbon.

The carbon cycle consists of four major stores of carbon linked by carbon exchange pathways. The stores are:

- **The atmosphere** - the two main constituents of the Earth's atmosphere are methane (CH_4) and carbon dioxide (CO_2). Carbon dioxide exits the atmosphere via photosynthesis. This is a process undertaken by plants during the day; it involves taking in carbon dioxide from air and using it to form glucose. Carbon dioxide also exits the atmosphere by dissolving into rainwater or directly into water bodies (lakes, oceans, etc.) where it can be absorbed by rocks. Carbon enters the atmosphere through the respiration of plants and animals and volcanic activity.

- **Land biosphere** - this includes carbon stored in plants, animals and other living organisms as well as carbon present in soils. Organic carbon is a major constituent of all living organisms. Carbon leaves this reservoir and is released into the atmosphere by respiration of plants and animals (the opposite of photosynthesis). It may also be passed to oceans by rivers and streams or remain in soils. Animals take in carbon dioxide by eating plants and other animals; when they respire, excrete waste or die they release carbon to the environment. Waste carbon materials are then digested by microbes or fungi that also respire when breaking down organic matter.
- **Oceans** - carbon enters oceans mainly by dissolution from the atmosphere, but also from rivers. It is converted to organic carbon by photosynthesis where it can pass through the food chain or accumulate in shells as calcium carbonate.
- **Geological** - most of the Earth's carbon is stored in rocks in the upper mantle. This is formed of around 80% calcium carbonates from shells of marine organisms and 20% kerogens (fossil fuels such as coal, oil and gas). Carbon leaves this reservoir through volcanic activity.

Effects of Human Activities on the Carbon Cycle

The carbon cycle can be significantly affected by human activities, such as:

- Burning of fossil fuel in energy generation and transportation, which releases large quantities of carbon dioxide into the air contributing to climate change. Normally, this fossilised carbon would be locked away from the carbon cycle.
- Burning of biomass (plants), which releases carbon dioxide to air contributing to climate change.
- Deforestation and other types of land use change, which removes plants that are a key sink for atmospheric carbon through photosynthesis. This increases the amount of carbon dioxide in the atmosphere contributing to climate change.
- Use of carbonate rocks in cement manufacture, which releases carbon dioxide to the air.
- Extraction and transportation of fossil fuels from activities such as coal mining, oil drilling, oil transportation and hydraulic fracturing (commonly known as 'fracking') which also pose a significant risk of water, land and air pollution.

The Nitrogen Cycle

Some biological compounds that are essential for life, most notably proteins and genetic material (DNA and RNA), contain the element nitrogen. All plants and animals therefore require a source of nitrogen and exchange nitrogen with the physical environment. The atmosphere is an enormous reservoir of nitrogen - indeed, 78% of the volume of the atmosphere consists of nitrogen gas - but this is in a form that is unavailable to living things. Nitrogen that is contained in soil and water is more readily available for living organisms:

- Plants absorb nitrogen in the form of nitrates or ammonium from soil and water bodies.
- Animals get most of the nitrogen they need by eating and digesting the proteins contained in plants or other animals.
- Animals return nitrogen to the soil and water bodies in their waste products - for example, in urea and ammonia.
- Dead plant and animal remains release nitrogen into soil, water and eventually the atmosphere through the action of decomposer bacteria and fungi.

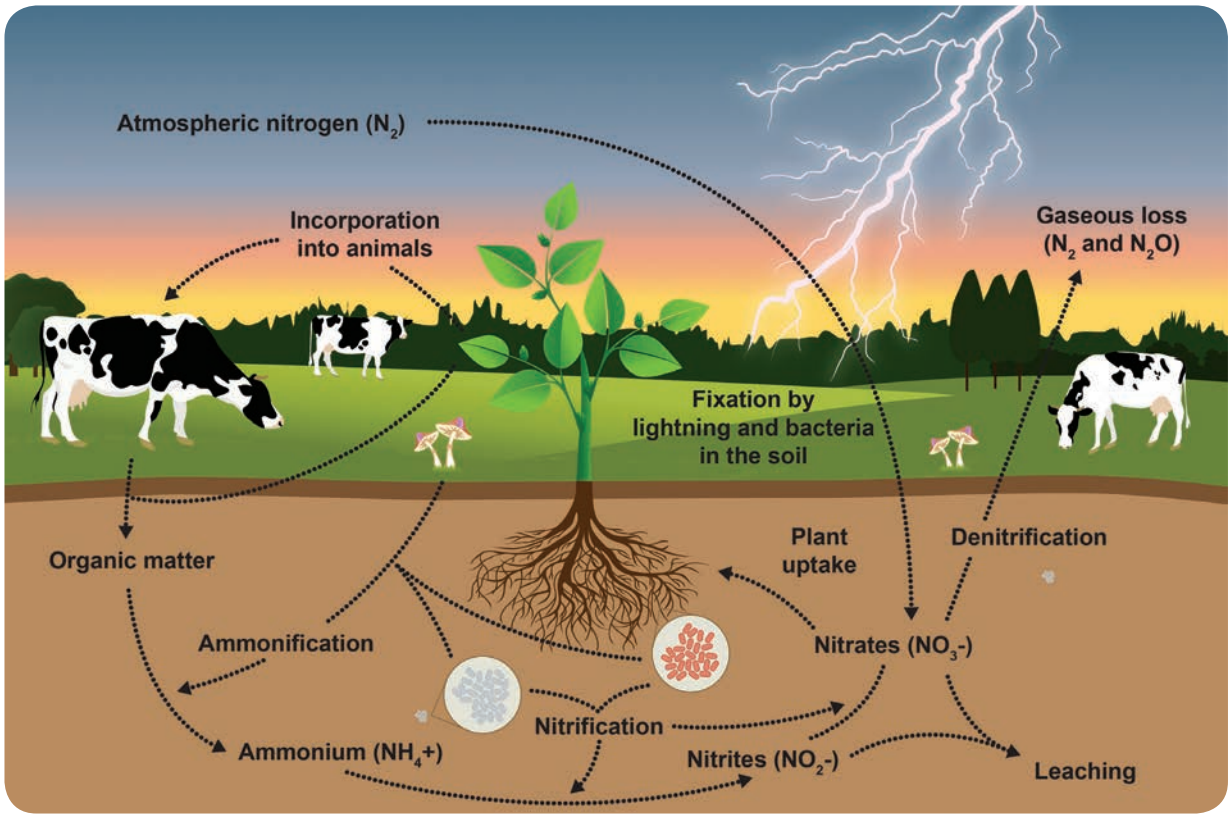
Nitrogen gas from the atmosphere can also be converted into a form that plants can use, through a process of nitrogen fixation:

- Biological nitrogen fixation can be achieved through the action of special nitrogen-fixing bacteria that live in soil and the root nodules of leguminous plants (e.g. clover, beans).

Nitrogen fixation can also occur via physical processes:

- Lightning - the power in lightning can cause nitrogen gas in the atmosphere to be converted into nitrites and nitrates, which are carried into the soil by rain.

- The Haber process - an important industrial process that converts nitrogen gas from the atmosphere into ammonia and, subsequently, nitrate fertilisers.



The nitrogen cycle

Effects of Human Activities on the Nitrogen Cycle

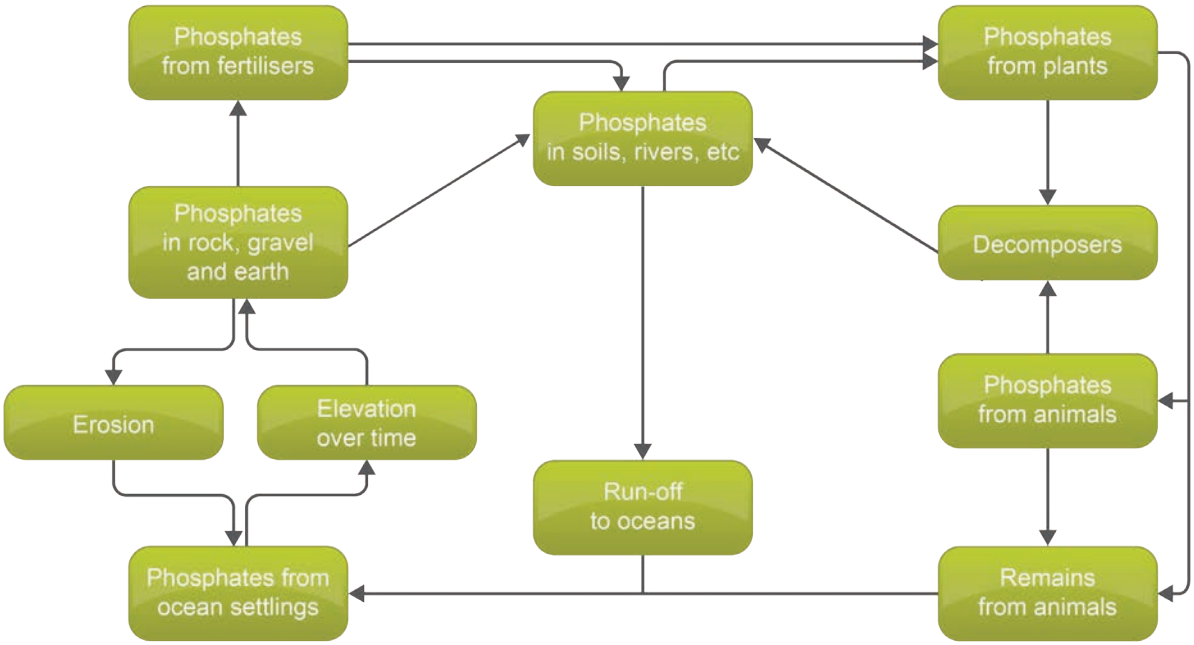
Ways in which humans can interact with the nitrogen cycle include:

- Run-off into water of nitrogen-based fertilisers, both natural and synthetic, causing nutrient enrichment (eutrophication) leading to excessive growth in plants, causing oxygen depletion, blockage of light and nuisance.
- Combustion of fossil fuels, leading to release of nitrogen into the atmosphere, which causes acidification of ecosystems (e.g. damage to forests and lakes).
- Discharge of sewage containing nitrogen compounds into rivers, lakes and streams, which causes nutrient enrichment.
- Emissions of nitrogen (mainly ammonia compounds) from manure to air from intensive rearing of pigs and chickens.

The Phosphorus Cycle

The primary biological importance of phosphorus is as a component of special energy-rich compounds (ATP) that living cells use to transfer energy. Phosphorus is also found in biological membranes (phospholipids) and animal bones (calcium phosphate).

Key steps in the phosphorus cycle are:



The phosphorus cycle

- Geological weathering releases soluble forms of phosphorus (phosphates) into rivers, lakes and oceans.
- Plants absorb phosphates from the soil and incorporate them into useful compounds.
- Animals obtain the phosphorus they need by eating plants and other animals.
- Animals return phosphorus compounds to soil and water via excreta.
- Decomposer bacteria and fungi act on dead plant and animal remains and phosphorus is returned to soil and water, usually in the form of phosphates.

Effects of Human Activities on the Phosphorus Cycle

Ways in which humans can interact with the phosphorus cycle include:

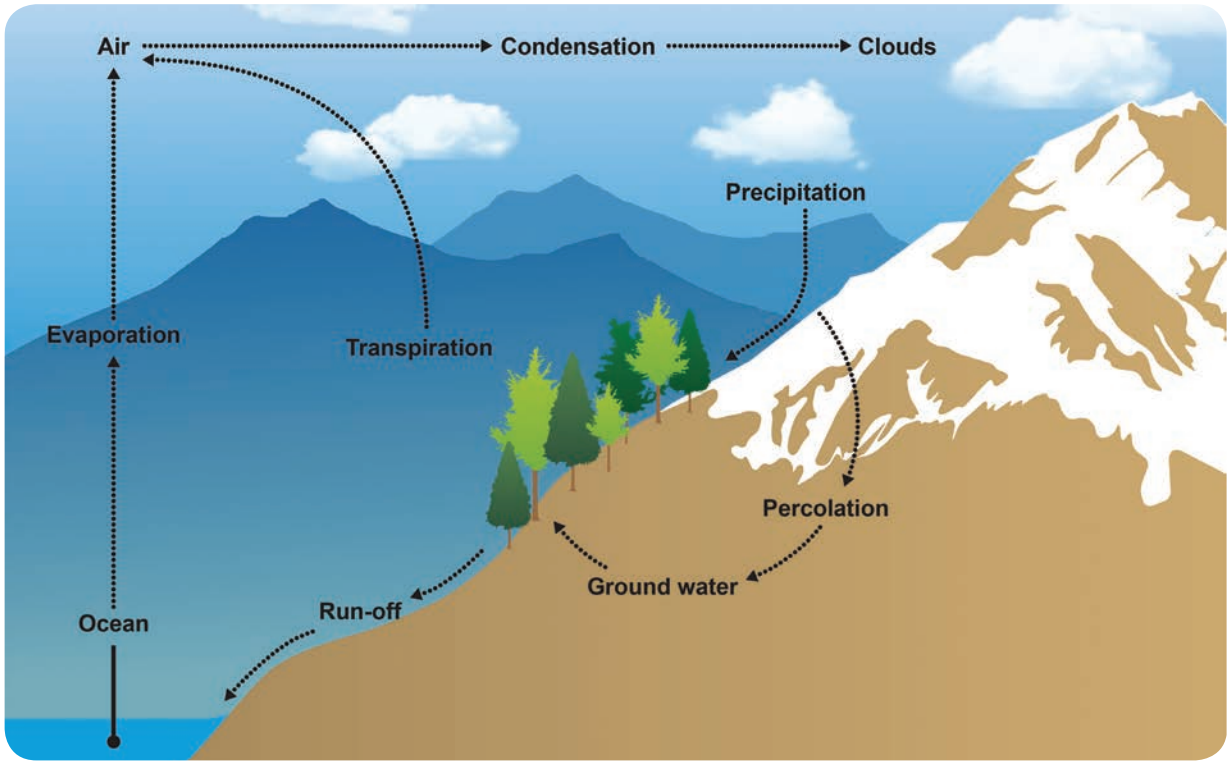
- Phosphorus-containing fertilisers can run off into rivers and cause nutrient enrichment (eutrophication), leading to depleted levels of oxygen and subsequent damage to aquatic life.
- Increased erosion due to deforestation can lead to greater concentration of phosphorus-containing particles in rivers, causing nutrient enrichment.
- Discharges of phosphorus to surface water may also arise from sewage treatment, as not all phosphorus will be removed during the treatment process.

The Hydrological Cycle

Water moves around the Earth through a system known as the hydrological cycle. For water to complete the full cycle it can take thousands of years.

The hydrological cycle is illustrated below.

- The initial input of water in the system is in the form of **precipitation**, which either seeps into the land surface (soil), or runs over the surface.
- The amount of water that will run off will depend on the **permeability** of the ground and the **catchment area**. If conditions are dry, more water will seep in, but after heavy rain the ground can become saturated, resulting in more run-off. Run-off may be greatly increased in urban areas, which can lead to flooding if the drainage systems do not have sufficient capacity.
- **Plant roots** can take up water that has seeped into the soil. If the water contains pollutants, they can be drawn up into the plant and possibly transferred to another natural cycle, i.e. if eaten by animals or humans.
- The water can continue to seep through the soil horizons to reach **aquifers** (water-bearing rocks) and form part of the groundwater supply, i.e. chalk aquifer in southern UK, limestone and sandstone aquifers in northern UK. There is continuity between surface water and groundwater, both of which can be adversely affected by domestic, industrial and commercial activities.



The hydrological cycle

- As both of these processes are happening, the power of the Sun is driving this cycle by causing **evaporation**. This is the change of liquid water to a vapour. Sunlight aids this process, as it raises the temperature of liquid water in oceans and lakes. As the liquid heats, molecules are released and change into a gas. Warm air rises up into the atmosphere and becomes the vapour involved in condensation.

Because of this cycle, there can be an accumulation of pollutants through water catchments, making prevention of pollution particularly important.

Effects of Human Activities on the Hydrological Cycle

Ways in which humans can interact with the water cycle include:

- Depletion of aquifers, with the water in aquifers being used at a faster rate than it can be replenished. Underground water sources provide drinking water and supply water for rivers, streams and other types of surface water.
- Damming of rivers, which can lead to water being impeded, which will harm fish and other aquatic organisms.
- Deforestation, which means that more water will end up in rivers, which may cause flooding.
- Climate change, which is altering the location and amount of water around the planet.
- Changes in land use will increase or decrease the flow of water in a catchment.

STUDY QUESTIONS

1. Explain what is meant by the term 'environment'.
2. Describe the water cycle.
3. Outline how human activities can impact on the nitrogen cycle.

(Suggested Answers are at the end.)

General Effects of Human Activity on the Environment

IN THIS SECTION...

- Biodiversity is the variety of plants, animals and other living things in an area or region. There are many benefits of biodiversity (e.g. ecological, economic, cultural, tourism).
- Ecosystems work on the principle of food chains. A combination of food chains is known as a food web.
- Humans benefit from numerous services that are provided by natural ecosystems.
- Deforestation can lead to numerous environmental problems such as contributing to climate change, soil erosion and reduction in biodiversity.
- Desertification describes the deterioration of land in arid and sub-humid areas as a result of loss of soil moisture and vegetation.
- Destruction of habitats may occur from single events or through cumulative impacts.
- Certain non-native (invasive) species cause significant impacts affecting the economy and important native species.
- Protected species are often listed in law. It is an offence to kill, disturb or harm such species.

Meaning of Ecology, Ecosystems and Biodiversity

DEFINITIONS

BIODIVERSITY

Is simply diversity, or variety, of plants, animals and other living things in a particular area or region. Diversity within the natural environment is important.

ECOLOGY

The study of the relationship between and interactions of living things to one another and their physical surroundings.

ECOSYSTEM

A community of living things in addition to non-living parts of their environment (such as air, water and soil).

We have seen that living things interact with each other and with the physical environment. Ecosystems define the inter-dependency of different plants and animals and the flow of energy and materials between living and non-living components. They are found in:

- Rivers and lakes.
- Estuaries.
- Forests.
- Wetlands.
- Arctic tundra.
- Coral reefs.

Ecology is the science of these interactions.

Forest

Some regions and areas of the world support a wider range of plants and animals than others. Tropical ecosystems such as coral reefs and rainforests, for example, support far greater numbers of different species than Arctic areas. These ecosystems are said to have high biodiversity.

The Earth's biological resources are vital to economic and social development because they:

- Provide us with sustainable materials.
- Maintain the quality of our air, soils, waters and climate.
- Contribute to our health and enjoyment of life.

Estimates of global species diversity vary enormously, as it is difficult to estimate how many species there may be in less well-explored habitats, such as untouched rainforest. Rainforest areas that have been sampled have shown a very high level of biodiversity.

Extinction is a fact of life. However, species are now becoming extinct at an alarming rate, almost entirely as a direct result of human activities. Previous mass extinctions evident in the geological record are thought to have been brought about mainly by massive climatic or environmental shifts. Predictions and estimates of future species losses abound. One such estimate calculates that a quarter of all species on Earth are likely to be extinct, or on the way to extinction, within 30 years.

Biodiversity has many benefits, including:

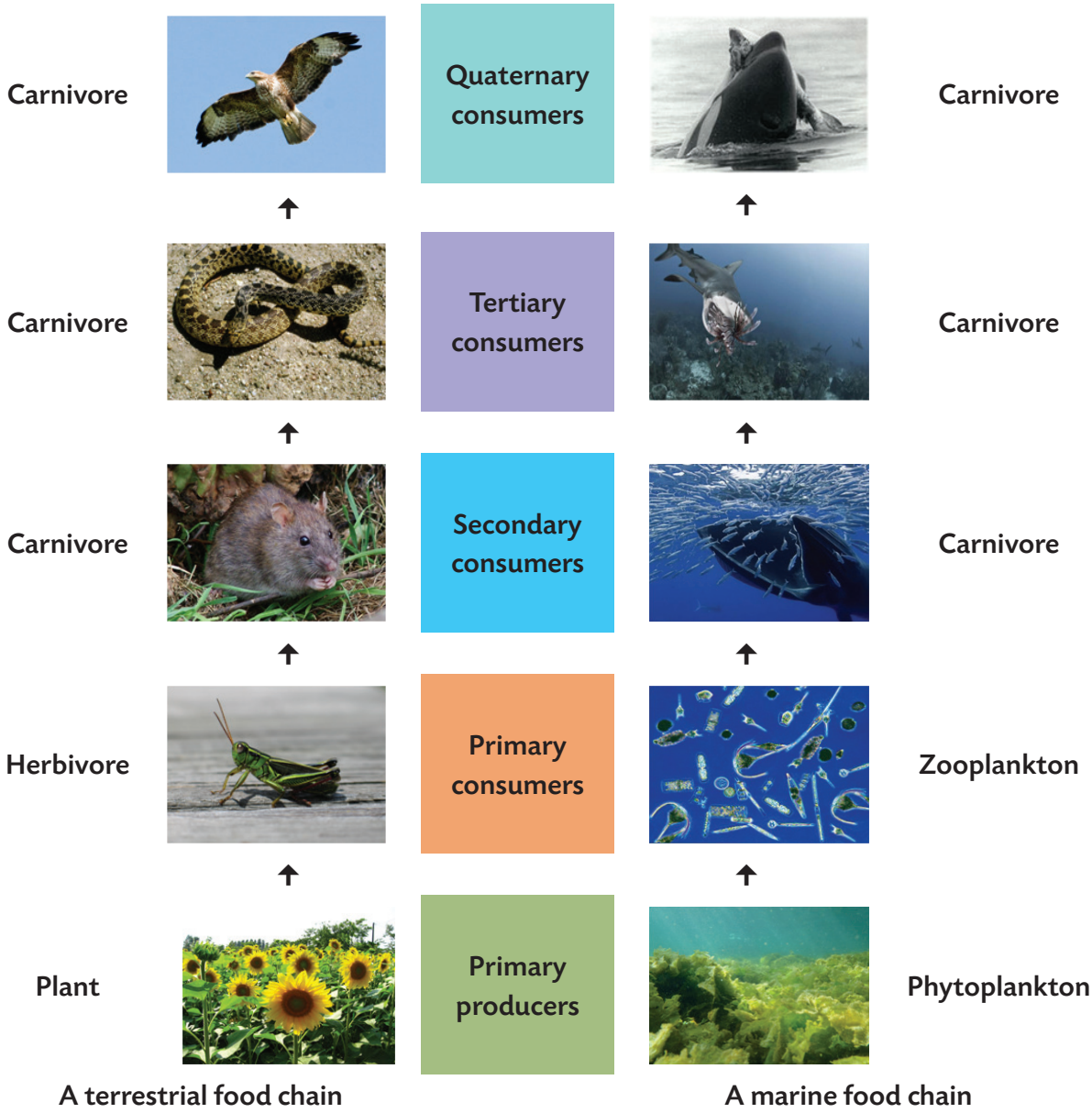
- **Ecological** - individual species and ecosystems have evolved over millions of years into a complex interdependence. If key pieces on which the framework is based are removed then the whole picture may be in danger of collapsing. The ecological arguments for conserving biodiversity are therefore based on the premise that we need to preserve biodiversity in order to maintain our own life-support systems.
- **Economic** - maintaining and enjoying a high-quality natural environment and the regenerative effects of an improved environment can bring substantial financial benefits to an area. Resources can also be taken from nature for consumption.
- **Cultural/spiritual/aesthetic** - the beauty of nature is something many people are captivated by. The natural environment is something to which many people really connect, and it gives them an immense sense of satisfaction when they experience nature. For some, there are also cultural or spiritual meanings attached to the landscape.
- **Recreation/tourism** - many people take day trips and holidays to areas because of the quality of the natural environment, as well as to visit wildlife.
- **Education/information** - unique natural spaces have an important function in enabling society to improve its knowledge of the natural world. Scientists can use these areas to gather data and conduct research, which can materially benefit society.

In most countries there will be numerous legal requirements for the protection of biodiversity. These largely surround compliance with the Convention on Biological Diversity which we will cover in more detail in Element 6.

Effects of Human Activity on Flora, Fauna and Natural Systems

Composition and Dynamics of Communities and Ecosystems

Ecosystems work on the principle of food chains (examples of which are shown below). Energy from the Sun is cycled through the system through photosynthesis, ingestion (eating) or decomposition. This generally covers energy, plants, herbivores, carnivores and decomposers.

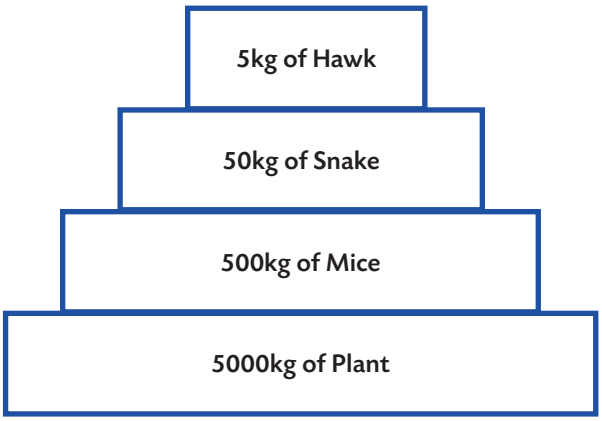


Examples of food chains

A combination of food chains is known as a food web. It is often the case that one animal does not solely feed on another animal, e.g. a fox may prey upon rabbits, rats, birds, etc.

In ecosystems, energy is lost by the herbivore and carnivore components as they must search for food, reproduce and carry out other essential processes (therefore the food consumed does not totally go to make up the weight or biomass of the organisms). This results in only a few carnivorous animals being supported by a larger number of prey, which in turn are supported by an even larger mass of plants as can be seen in the following biomass pyramid diagram.

From a human point of view, food chains are important as some pollutants are known to be easily cycled through the food chain, eventually affecting humans. Destroying certain key plant or animal species may also affect other organisms that depend on them.



Example of a biomass pyramid

Humans benefit from numerous services that are provided by natural ecosystems. These benefits are known as 'ecosystem services' and include treatment of wastes and cleaning up water for drinking. Such services can be classed as the following:

- **Provisioning services** - obtaining products from ecosystems such as timber, fish, pharmaceutical ingredients and energy (e.g. hydropower).
- **Regulating services** - these include:
  - Trees being able to take up water that would otherwise run into a watercourse and cause flooding and erosion of agricultural soils.
  - Decomposition of waste.
  - Pollination of crops.
- **Cultural** - ecosystems provide a cultural input such as tourism and scientific discovery.
- **Supporting services** - required for production of other services such as soils and nutrient cycling, and seed dispersal.

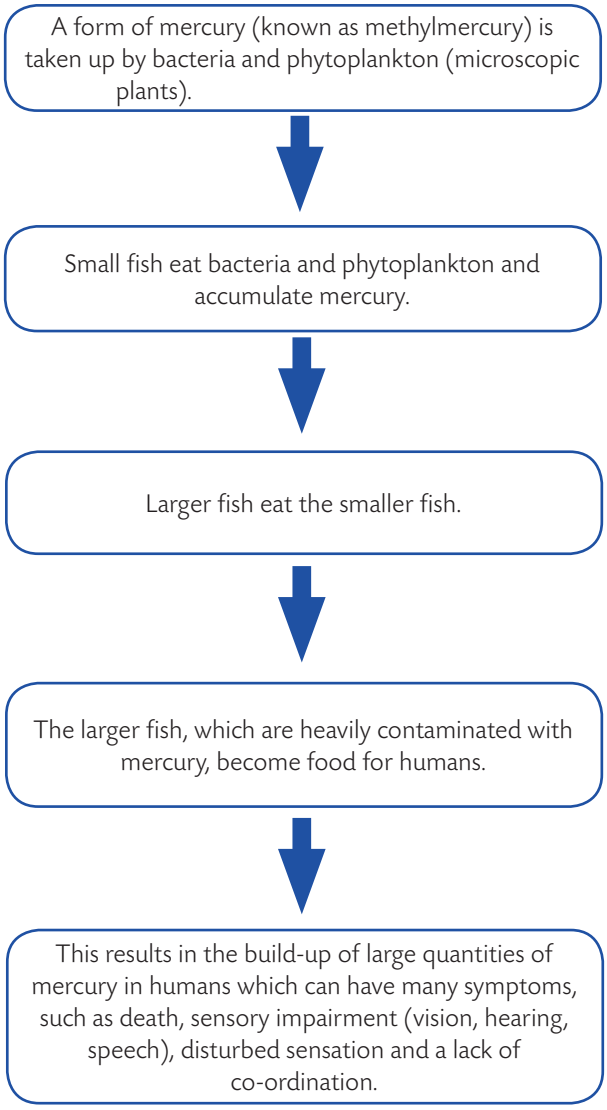
If these services were not provided by ecosystems then they would need to be provided by some other means. For example, if a river catchment is deforested on a significant scale, then an extensive and very costly flood protection scheme would need to be built. In the longer term, it is likely that it would have been more financially prudent to sustainably manage the forest which would have provided timber, flood protection and recreational activities for many years.

Bioaccumulation and Bio-concentration

Bioaccumulation is the term used for the gradual build-up of substances within a living organism by all means possible (such as contact, respiration and ingestion).

Bio-concentration is a similar term but covers the intake and retention of a substance from water in an aquatic system or air in a land-based system. Such process occurs due to either a substance being taken in faster than it can be broken down or because the substance is not able to be broken down at all by an organism.

Certain hazardous substances have the ability to bioaccumulate/bio-concentrate and cause damage to living tissues. Once a pollutant with potential to bioaccumulate/bio-concentrate is present in water or soil it can easily enter food chains. Mercury is a good example of a substance that is able to bioaccumulate or bio-concentrate:



The increase in bioaccumulated/bio-concentrated pollutants from the base of the food chain to the top is known as biomagnification.

Other examples of substances that can bioaccumulate/bio-concentrate and cause harm include other heavy metals, e.g. arsenic, lead and cadmium, organochlorine pesticides (e.g. DDT) and Polychlorinated Biphenyls (PCBs) used as cooling and insulating fluids (e.g. transformer oils).

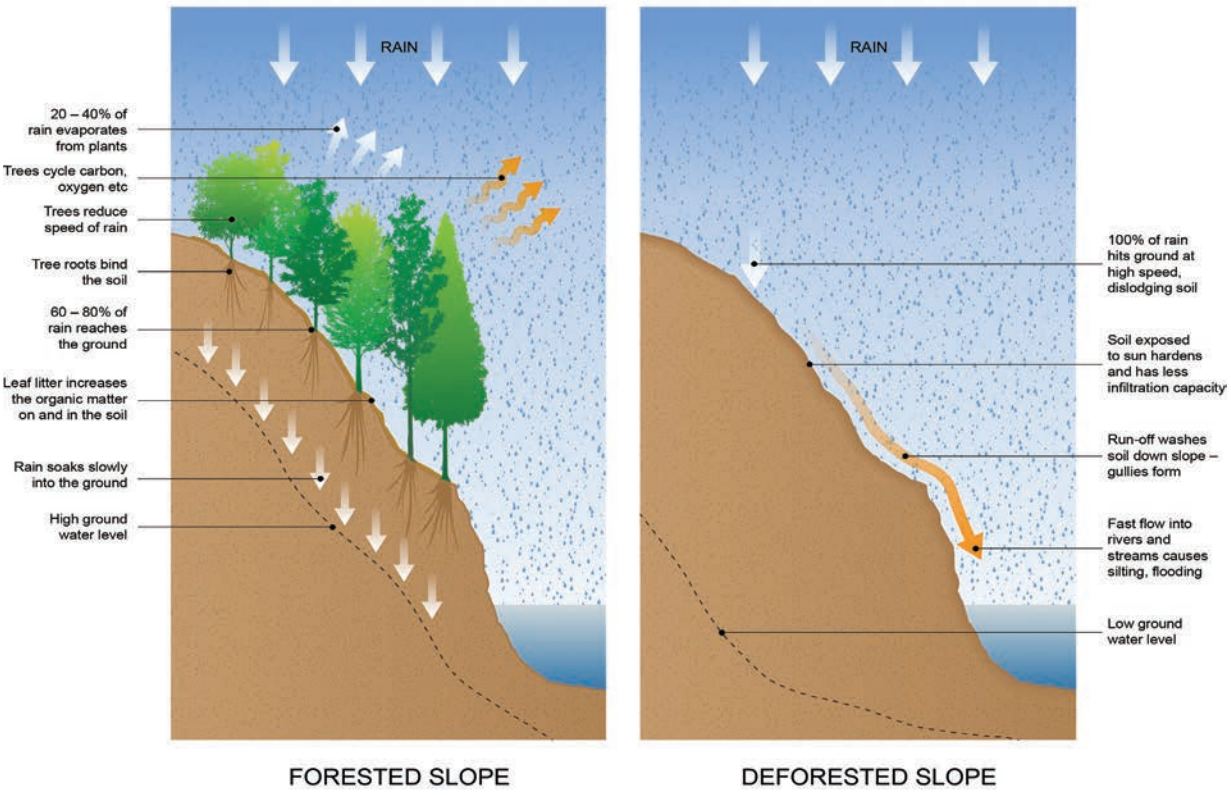
Deforestation

The world's forests have major influences on the biosphere. Deforestation is the removal of trees from large areas of land, e.g. the Amazon basin in South America, and can lead to a number of negative environmental impacts.

DEFINITION

BIOSPHERE

The part of the Earth and its atmosphere in which living things are found.



Some effects of deforestation

Deforestation can lead to numerous environmental problems, for example:

- Burning and decay of wood releases carbon dioxide into the atmosphere contributing to climate change.
- Trees and other plants photosynthesise - this involves removing carbon dioxide from the atmosphere to produce oxygen, thereby reducing atmospheric carbon dioxide levels. If large forests are removed, less carbon dioxide is removed from the atmosphere causing an increased risk of climate change.
- The water cycle can be significantly affected. Trees take groundwater through roots, which is emitted into the atmosphere. When deforestation occurs, the lack of trees and other plants means that water is not evaporated and local climates are much drier.
- The cohesion of the soil is reduced by deforestation, resulting in:
  - Fertile agricultural soils being eroded.
  - Increased risk of landslides on steep slopes.
- A reduction in forest cover means that surface water run-off will increase, which may result in flash floods and increase the risk of localised floods in comparison to what would occur if the forest cover was present.
- Deforestation can result in a decrease in biodiversity as an important habitat for many plants and animals is destroyed. This can also lead to a reduction in genetic variation. Genetic variation can lead to many agricultural benefits such as development of crops that are resistant to pests or have the ability to grow in poor quality soils.
- Forests often contain many plants which are still to be discovered, some of which may have properties which can be used to fight disease and ill health.

Although short-term economic gains can be made from converting forested areas to agricultural land or overly exploiting forests for wood products, if forests are not managed sustainably in the long term, deforestation will lead to a loss of long-term income.

Shifting cultivation ('slash and burn' agriculture) disrupts the forest ecosystem, particularly when it is on a large scale. Trees are cut from the soil, burned and the ash returned. Any nutrients are quickly leached away as they are contained only in the top few centimetres of the soil in tropical forests, therefore the cleared plots soon become infertile.

Desertification

Desertification describes the deterioration of land in arid and sub-humid areas as a result of loss of soil moisture and vegetation. The main causes are overgrazing, taking groundwater and diversion of rivers for industry and drinking water. Its root cause is commonly overpopulation.

The effects of desertification

According to the United Nations Environment Programme approximately 9 to 11 million hectares of agricultural land is becoming desertified each year. An example of desertification is the dust bowl era of the 1930s in the Great Plains of the USA where prolonged drought and poor agricultural practices caused crops to wither and die, with large areas turning into dry dirt. Winds eroded and swept this fertile topsoil into massive dust storms, carrying it to other areas far away from the source. This had numerous impacts such as loss of productive farmland, widespread human migration and large-scale dust storms.

Habitat Destruction

Most plant or animal species are adapted to live in a specific habitat or environment that best meets their survival needs. Without such a habitat the species may not survive. Habitat destruction may be caused by single events such as oil spills, road building or deforestation, or by cumulative incidents such as gradual air or water pollution. Both cumulative and single events have destroyed or damaged available habitats.

Invasive Species

Most non-native species do not have a significant effect on biodiversity. However, some non-native species have the ability to negatively affect native biodiversity and have a significant economic impact. Banning the sale of such species is likely to have little effect where they are endemic. However, it can assist in preventing invasive species becoming established in areas where they could not do this by natural means.

Japanese knotweed

In many countries it is an offence to sell or offer for sale non-native species that are listed. What is an invasive species will vary by country. In the United Kingdom listed non-native species include:

- Floating water primrose.
- Large mouth black bass.
- Signal crayfish.
- American mink.
- Japanese knotweed.
- Zander.

The impact of invasive species can vary but may include negative impacts on native biodiversity and ecosystems, significant financial cost of remedying damage caused by invasive species in addition to the cost of eradication or control and impacts on human health.

Protection Given to Listed Species and Permits Required for their Removal

It is common for laws to be developed that provide a level of protection for listed plant and animal species. In the UK, for example, it is an offence to take from the wild, kill, sell or injure listed animal species such as otters, wildcats or red squirrels. Such protection is also prescribed for specified plant and bird species.

The International Union for Conservation of Nature (IUCN) maintains a highly respected inventory of the global conservation status of biological species that often influences government policies on nature protection. Species are allocated one of the following nine categories, which are based around assessment factors such as distribution, population size, rate of decline and amount of fragmentation:

- Extinct.
- Extinct in the wild.
- Critically endangered.
- Endangered.
- Vulnerable.
- Near threatened.
- Least concern.
- Data deficient.
- Not evaluated.

Examples of species on the Red List in the UK include:

- Eurasian otter (near threatened).
- Red kite (near threatened).
- Eurasian curlew (near threatened).
- White-clawed crayfish (endangered).
- Vendace (endangered).
- Black-tailed godwit (near threatened).

In many countries there is a requirement for those who wish to remove endangered plants or animals to gain a permit, licence or similar legal permission. For example, in the UK it is a requirement for those who wish to handle, disturb or trap protected species or disturb their habitat to gain a licence from a regulator. Activities that may require such a licence include cleaning out a pond or constructing a housing development. Animals that are protected by such licensing include badgers, bats, great crested newts and white-clawed crayfish.

STUDY QUESTIONS

4. Outline three reasons why biodiversity should be conserved.
5. Identify four ecosystem services.
6. Outline the environmental problems caused by deforestation.

(Suggested Answers are at the end.)

Precautionary and 'Polluter Pays' Principles

IN THIS SECTION...

- The precautionary principle is the need to implement changes in the absence of absolute scientific proof, as further delay could lead to adverse effects on present and future generations.
- 'Polluter pays' identifies that the polluter should pay for any significant environmental damage that is created by pollution.

Rio Declaration on Environment and Development (1992)

The Rio Declaration on Environment and Development is an international agreement produced at the United Nations' conference on environment and development in 1992. The Rio Declaration consisted of 27 principles with Principle 15 defining the precautionary principle and Principle 16 defining the 'polluter pays' principle.

Precautionary Principle

It makes sense to prevent potential adversity even if we are unsure of how significant the scale of adversity is likely to be. This forms the cornerstone of the precautionary principle, which is the manner in which society is responding to sustainability (in particular environmental) challenges. The precautionary principle identifies a need to implement changes in the absence of absolute scientific proof, as further delay could lead to adverse effects on society and have significant adverse effects on future generations.

Proportionality, or cost-effectiveness, is an important factor of the precautionary principle and it must be ensured that all environmental benefits of precautionary measures are greater than economic and societal costs. For example, policies to reduce the negative impacts of climate change are likely to be unpopular (e.g. resulting in tariffs on unsustainable travel). The best measures are those that have 'no regrets', i.e. they have significant other benefits, whether or not they decrease the environmental impact in question.

'Polluter Pays' Principle

'Polluter pays' is an important concept within sustainable development and identifies that the polluter should pay for any significant damage to the environment that is created by pollution released. In this concept, the burden of proof in determining whether a technology or procedure, etc. causes pollution will lie with the designer and not the general public.

Assurance bonds are one mechanism via which the principle can be implemented in a practical way. Such bonds would constitute money put into an insurance bond, which would be released for restoration of the environment if a significant pollution incident occurred, causing environmental damage. Ensuring that the bond gains interest would give possible polluters a good reason to put financial resources into it. Other examples include environmental taxation and laws that ensure that the costs associated with a pollution incident are borne by the polluter.

'Polluter pays'

STUDY QUESTION

7. Define the precautionary principle.

(Suggested Answer is at the end.)

The Role of Non-Governmental Bodies and the Media

IN THIS SECTION...

- Employer bodies and trade associations can be a significant influence on workplace standards by providing guidance, information and training courses for their industries.
- Trade unions can have a significant influence on governments, members and businesses in the uptake of robust environmental standards.
- Professional bodies such as the IEMA and CIWEM support a community of environmental professionals.
- The media can significantly influence public opinion on environmental matters.

Influence of Non-Governmental Organisations

Numerous non-governmental organisations have a significant role in influencing common environmental standards in the globalised economy. We shall discuss the key organisations below.

Employer Bodies and Trade Associations

Employer bodies and trade associations can be a significant influence on workplace standards by providing guidance, information and training courses for their industries.

Training and guidance

Trade Unions

Trade unions can have a significant influence on environmental standards by:

- Provision of learning on environmental management for members.
- Influencing governments to increase or strengthen environmental laws and their enforcement.
- Encouraging members to work for a more environmentally aware employer.
- Influencing employers to provide high environmental standards.
- Providing guidance for members on good standards of environmental management.

Professional Bodies

Two key professional environmental bodies are the Institute of Environmental Management and Assessment (IEMA) and the Chartered Institute of Water and Environmental Management (CIWEM).

IEMA is a not-for-profit membership organisation that was founded to promote best practice standards in environmental management, auditing and assessment. It has thousands of individual and corporate members based in numerous countries around the world. The Institute's aim is to promote sustainability by high-quality environmental practice and performance and it offers ongoing assistance to environmental professionals. In addition:

- It is the UK's Competent Body for EMAS, the European Union's Eco Management and Audit Scheme.
- It provides the Acorn Scheme, a phased EMS implementation scheme. Acorn offers accredited recognition for organisations evaluating and improving their environmental performance through the phased implementation of an environmental management system.

CIWEM is a professional body dedicated to the water and environment sector. The organisation supports a community of thousands of members internationally with the aim of improving water and environmental management and the social and cultural issues that surround it. The key activities of CIWEM include:

- Provision of qualified water and environmental managers.
- Delivery of, and promotion of, high standards of professional expertise and conduct.
- Protection of the public from pollution, environmental damage and natural hazards.
- Application of scientific rigour to gain the best outcomes for society.

Pressure Groups

Pressure groups are organisations whose aim is to influence governments or businesses at the local, national and international levels. They can cover a single issue (and, as such, are often classed as 'cause'-based), or may cover multiple issues. Such groups change over time and can be involved in numerous activities.

International environmental pressure groups include Greenpeace, Friends of the Earth, the International Union for Conservation of Nature (IUCN) and the World Wildlife Fund (WWF). Some of the key ways in which pressure groups exert influence include:

- **Lobbying** - discussing concerns with decision-makers, such as those involved in making law.
- **Direct action** - for example, Greenpeace influenced Shell Oil's attempt to dump the Brent Spar platform in the North Atlantic through occupation of the platform as it was being towed to its dumping point, and also staged protests at service stations.
- **Publicity** - pressure groups often try to generate as much publicity as possible for the issue in question in order to gain positive media attention.
- **Legal action** - pressure groups may fight their cause by legal means, inquiring about the legality of the issue.

MORE...

WWW.

Greenpeace - www.greenpeace.org/international/en/

Friends of the Earth - www.foe.org/

International Union for Conservation of Nature (IUCN) - www.iucn.org/

World Wildlife Fund (WWF) - www.worldwildlife.org/t

The implications of pressure groups can be significant for organisations, as they may invoke the following responses:

- Reduced sales.
- Raising consumer awareness of an issue.
- Increasing the costs of a business through improved risk controls, etc.
- Changing current business practices.
- Influencing the making of law and government policy.
- Damaging the reputation of an organisation.

The Public

The public are an important influence on environmental standards. People should have a say in any proposed scheme that is likely to seriously affect their local environment (some of which will be covered in planning legislation). Information on such matters should be accessible (in relation to environmental information held by public bodies, specific laws exist).

The Media

The mass media (including the Internet) have a major influence on how organisations and individuals perceive, interpret and act on environmental concerns. Coverage of environmental news and issues in the media has increased in recent years and the media therefore play a highly important role in educating and making people environmentally conscious, as well as influencing policy decisions.

Media coverage of global events

The media attention received by some environmental summits is part of an increase in environmental coverage. Nevertheless, environmental issues represent a very low proportion of all stories covered by newspapers and television. Also, to make environmental stories more exciting and accessible, the media often present these issues in simple black and white or good versus bad terms, involving dramatic statements and images. Most environmental issues, however, involve complex scientific arguments and conflicting points of view. Quite often, environmental stories can suffer content limitations, typically providing little qualification or support from scientific data, making vague references to the scientific communication, and emphasising sensationalist aspects and personal consequences.

The coverage of environmental issues in the popular media is unlikely to be a straightforward treatment of the 'facts', owing to many practical constraints. Among these practical influences on media portrayals of climate change are misreporting or miscommunication, public misunderstanding, a lack of understanding, media time and space constraints, confusion over complex scientific terminology, and focus on 'newsworthy' drama and novelty rather than the underlying environmental issue and dependence on official sources. In determining the accuracy of a media story, it is useful to consider the following to ensure a true understanding of the issues of the story:

- What is the source of the information?
- How are the different views presented?
- Are they allocated the same amount of time and space?
- Do the facts match the arguments?

STUDY QUESTIONS

8. Identify the role of trade unions in influencing high environmental standards.
9. Identify the responses that may be invoked by the actions of pressure groups.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- Carbon, nitrogen, phosphorus and water are cycled around the planet. Human activities can significantly impact on these cycles leading to major environmental problems.
- Biodiversity defines variety of plants, animals and other living things in an area or region. Biodiversity is beneficial for numerous ecological, economic and cultural reasons.
- An ecosystem is a community of living things in addition to non-living parts of their environment (such as air, water and soil).
- Humans benefit greatly by services that are provided by natural ecosystems.
- Deforestation has serious environmental implications in that it can contribute to climate change, soil erosion and reduction in biodiversity.
- Desertification is the reduction in land quality in arid and sub-humid areas.
- Certain invasive species have a significant impact on the economy and native species.
- It is often an offence to kill, disturb or harm listed protected species.
- The precautionary principle defines the requirement to implement changes in the absence of absolute scientific proof.
- The 'polluter pays' principle states that the polluter should pay for any significant environmental damage that is caused by pollution.
- Trade unions, employer bodies, trade associations and the media are important groups that have a significant influence on the environmental standards in society.

Exam Skills

Introduction

To obtain the NEBOSH Environmental Diploma you need to perform well during the exam. You only have three hours and your performance will be related to two key factors:

- the amount that you can remember about the elements you've studied; and
- your success in applying that knowledge to an exam situation.

Being good at both aspects is essential. Being calm under exam pressure is pointless if you do not have a good knowledge of the information required to answer the exam questions.

Here, we will consider some practical guidelines that can be used to increase success in the exam. Then you will find Exam Skills questions for you to answer at the end of each element, starting with this one.

Exam Technique

The exam consists of eight questions from which five must be answered. Each question is worth 20 marks. The exam is carried out over a period of three hours. Ten minutes is given at the start of the exam for reading the paper, but no writing is allowed during this period. Answers must be written in the answer book, which consists of A4 lined paper.

Around 36 minutes should be allocated for each question, although some questions may require a more in-depth answer than others. Time management is of high importance and it is common for candidates to miss out a question because they have run out of time.

Candidates can often also struggle because they have not understood the question that is being asked. They can interpret questions wrongly and, as such, provide an answer for the question they think is in front of them but in reality is not.

To try to overcome this issue a basic approach can be adopted, which formalises the answering of exam questions:

- **Step 1: READ THE QUESTION**

  Ensure that you read the full question - triggers and clues can often be in the second half of the question.

- **Step 2: REVIEW THE MARKS**

  If a question is worth 20 marks, then the examiners will expect to see 20 pieces of information. Some questions are split into sub parts, with marks allocated accordingly. Ensure that you understand how many marks are available, as this will indicate how long you should spend on each answer, as well as how much should be written.

- **Step 3: HIGHLIGHT THE KEY WORDS**

  Key words are those in a question that are essential in determining the meaning of the question. So, for example, if the question was: "Define the term Eco Management and Audit Scheme", you could say that the key words are:

  – **Define** - that is what you are being asked to do: provide a generally acceptable definition of a word or phrase.
  – **Eco Management and Audit Scheme** - this is the phrase you must define.

  The verb or command word in each question is quite important. NEBOSH have published the following guide to understanding the command words:

Command Word	Meaning
Analyse	To divide or break down the subject matter or topic into parts, reasons, aspects, etc. and then examine their nature and relationship.
Assess	To present judgments of the factors raised, their significance, importance and why they are important and/or significant.
Calculate	To ascertain or determine by mathematical processes.
Comment	To give opinions (with justification) on an issue or statement by considering the issues relevant to it.
Compare and contrast	To provide a point-by-point account of the similarities and differences between two sets of information or two areas.
Consider	To offer some detail about an issue or event and to deliberate about the value of that issue/event.
Define	To give the meaning of a word, phrase or concept, determine or fix the boundaries or extent of. A relatively short answer, usually one or two sentences, where there is a generally recognised or accepted expression.
Demonstrate	To prove or make clear by reasoning or evidence how some relationship or event has occurred.
Describe	To give a detailed written account of the distinctive features of a subject. The account should be factual, without any attempt to explain.
Determine	To come to a decision as the result of investigation or reasoning.
Discuss	To give a critical account of the points involved in the topic.
Distinguish	To present the differences between; to separate into kinds, classes, or categories.
Evaluate	To determine the value or character of something by careful appraisal.
Explain	To provide an understanding. To make an idea or relationship clear.
Give	To provide short, factual answers. NB: Normally a single word, phrase or sentence will be sufficient.
Identify	To give a reference to an item, which could be its name or title.
Justify	To prove or show to be valid, sound, or conforming to fact or reason.
Outline	To indicate the principal features or different parts of.
Recommend	To bring forward as being fit or worthy; to indicate as being one's choice for something.
Review	To make a survey of; examine, look over carefully and give a critical account.

Step 4: READ IT AGAIN

To check again that you have understood the meaning of the question.

- **Step 5: PLAN YOUR ANSWER**

  Consider jotting down a brief answer plan prior to starting your answer. A logical answer is expected - writing a plan will help achieve this. Jotting down key words for the plan will also help you recall information associated with key words.

The form of an answer plan can vary. A structured list can be used similar to the contents page of a book or report. Another approach is to use a mind map (which is often used as a revision aid as well). Don't worry about what a plan looks like - its purpose is to allow the listing of ideas as they occur in the mind and to provide structure to ideas.

Every element includes Exam Skills questions for you to attempt, with guidance on how to answer, in addition to a suggested-answer outline.

Remember that when answering exam questions, information from additional reading and personal experience may be included. Examining bodies encourage this and it will enhance your answers.

QUESTION

Outline how human activities can impact on:

(a) the carbon cycle; and (5)

(b) the water cycle. (5)

Approaching the Question

- Using the system we have covered above, the first thing to do is read the question.
- Next consider the marks available. In this question there are five marks for each sub question, so it is expected that 5 different pieces of information should be provided for each sub question and the question should take in total around 18 minutes to answer.
- Now highlight the key words. In this case these would be (a) Outline, human activities, impact and carbon cycle and (b) Outline, human activities, impact and water cycle.
- Read the question again - make sure you understand it.
- Following this the next stage is to develop a plan. Remember - a plan can be completed in various ways, but using the general outline approach it could consist of the following:

  (a) Fossil fuel combustion, burning of biomass, deforestation, carbonate rock, fossil fuel extraction.

  (b) Depletion of aquifers, damming of rivers, deforestation, climate change, land use.

In order to ensure your answer is relevant it must be based on the key words you have highlighted. So, in this case, you need to outline how human activities can impact on the carbon cycle and water cycle.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

(a) Human activities may impact on the carbon cycle in the following ways:

- Burning of fossil fuel in energy generation and transportation, which releases large quantities of carbon dioxide into the air contributing to climate change. Normally, this fossilised carbon would be locked away from the carbon cycle.
- Burning of biomass (plants), which releases carbon dioxide to air contributing to climate change.
- Deforestation and other types of land use change, which removes plants that are a key sink for atmospheric carbon through photosynthesis. This increases the amount of carbon dioxide in the atmosphere contributing to climate change.
- Use of carbonate rocks in cement manufacture, which releases carbon dioxide to the air.
- Extraction and transportation of fossil fuels from activities such as coal mining, oil drilling, oil transportation and hydraulic fracturing (commonly known as 'fracking'), which also pose a significant risk of water, land and air pollution.

(b) Human activities may impact on the water cycle in the following ways:

- Depletion of aquifers, with the water in aquifers being used at a faster rate than it can be replenished. Underground water sources provide drinking water and supply water for rivers, streams and other types of surface water.
- Damming of rivers, which can lead to water being impeded, which will harm fish and other aquatic organisms.
- Deforestation, which means that more water will end up in rivers, which may cause flooding.
- Climate change, which is altering the location and amount of water around the planet.
- Changes in land use will increase or decrease the flow of water in a catchment.

Element 2

Environmental Leadership

Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain the reasons for improving environmental and social performance.
2. Explain the importance of leadership with regards to an organisation's environmental performance.
3. Outline the importance of personal ethics and professional practice to the environmental practitioner.
4. Outline how the environmental practitioner can manage and maintain their levels of competence.
5. Outline how levels of competence can be managed by an organisation.

Contents

Reasons for Improving Environmental and Social Performance

IN THIS SECTION...

The reasons for improving environmental and social performance can be classed as legal, moral and economic:

- Moral - environment is a shared resource and attitudes towards the environment have improved as a result of society being more knowledgeable about environmental issues than in the past.
- Legal - the repercussions of failing to comply with relevant legislation can be severe for both companies and individuals. Environmental legislation may be international, regional or national in nature.
- Economic - there are numerous financial implications for poor environmental performance, such as legal costs, fines, sanctions and clean-up costs.

Reasons for Managing Environmental Risk

The reasons for managing environmental risk can be broadly classified as legal, moral and economic in a similar way to health and safety risks, although we may extend that thinking into risk to the environment. Often, these legal, moral and financial issues are interlinked.

Moral

The environment covers a broad field and, in the past few years, people have become concerned about the effects of human activities on the environment. Issues such as climate change and resource depletion are now headline news. The increased knowledge about environmental issues has meant that the general public is now much more aware of the damage we are doing to the Earth. However, we should be aware that differing global communities' attitudes to the value of the environment may vary.

Resource depletion

The environment is where we live as well as where we work, and our neighbours are owed a **moral**, as well as legal duty. In many ways, care of the environment is the responsibility of us all and society's attitude towards the environment is much more informed than before.

Perhaps it could be argued that, morally, organisations have a duty to behave in an environmentally sustainable manner, and sustainability surveys and indices have become features of modern business life. Companies with a high rating can hope to attract more inward investment.

A key moral reason for improving environmental and social performance is to prevent/minimise the impact of an organisation's activities on the environment. This is also likely to have economic and legal benefits to the organisation.

There are a number of stakeholders who play a significant part in developing the moral environment in which a business may function. The influence of these stakeholders provides significant drivers for organisations to improve their sustainability development performance (sustainable development is discussed further in Element 6). Such stakeholders are:

- **Consumers** - now more aware of both their impact on the environment and their ability to bring about change in large organisations when they act together.
- **Local communities** - no longer willing to suffer pollution and other negative environmental or health effects for the sake of the potential increased prosperity a business may bring to an area.

- **Employees** - like working for an organisation with good environmental performance, and some organisations may use this as a factor in aiding recruitment and retention.
- **Insurance companies** - likely to reward organisations with a good record in environmental management and which can show evidence of positive management of their impacts.

As we considered in Element 1, Principle 15 of the Rio Declaration on Environment and Development defines the precautionary principle in that it makes sense to prevent potential adversity even if we are unsure of how significant the scale of adversity is likely to be. This principle states a more formalised moral duty towards improving environmental and social performance.

Legal

The repercussions of failing to comply with relevant legislation can be severe for both companies and individuals. As such it is imperative that an organisation understands relevant environmental laws at the international, regional and national levels.

International Law

The top tier of law in many countries is international environmental law. International law can take many forms, including the following:

- **Treaty** - this term is used for matters of high importance that require a solemn agreement.
- **Convention** - describes a multilateral agreement with numerous parties. Conventions are usually open for participation by many nations, or the full international community.
- **Protocol** - generally, this is an agreement that is less formal than agreements using the terms 'treaty' or 'convention'.
  - One type of protocol provides more detailed implementation of the general requirements of a convention. For example, the **Montreal Protocol on Substances that Deplete the Ozone Layer 1987** provides further implementation of the **Vienna Convention for the Protection of the Ozone Layer 1985**.
- **Declaration** - this is a term used for numerous, usually non-legally-binding, agreements made where the parties do not want to create a legally-binding agreement but do want to declare aspirations, for example the **Rio Declaration on Environment and Development 1992**.

International conventions and protocols on the environment

Subject	Convention	Subsidiary Protocols
Climate change	United Nations Framework Convention on Climate Change 1972	Kyoto Protocol 1997; Doha Amendment 2012
Protection of the ozone layer	Vienna Convention for the Protection of the Ozone Layer 1985	Montreal Protocol 1989 Latest revision - Beijing 1999
Air pollution	Convention on Long-range Transboundary Air Pollution ('Geneva Convention') 1979	Oslo Protocol 1994 Aarhus Protocol 1998 Gothenburg Protocol 1999
Marine pollution	Convention for the Protection of the Marine Environment of the North-East Atlantic ('OSPAR Convention') 1992	
Hazardous wastes	Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal ('Basel Convention') 1992	Basel Protocol 1999
Persistent organic pollutants	Convention on Persistent Organic Pollutants ('Stockholm Convention') 2001	
Habitat protection	Convention on Wetlands of International Importance ('Ramsar Convention') 1971	Paris Protocol 1982

Regional Law

The next level of law is that of a group of nations, often in a regional area. An example is the European Union. Types of European law include:

- **Regulation** - applies directly to the intended target (normally member states). There is no requirement to assimilate into national laws.
- **Directive** - binding on EU member states with respect to the objectives to be achieved, but the method for achieving this is left open. Directives are normally implemented by national regulations made in each member state. They must be implemented by a defined date referred to in the directive.

National Law

Individual nations will have some form of national (and possibly more localised) legal system in place. This may be influenced by the international legal systems covered above, but individual countries will have powers to implement other environmental laws as well, providing they do not contradict these two influences on the nation's legal system.

Such legal systems can differ substantially around the world. It is important that a good understanding of local legislation is gained in order to effectively manage environmental issues. The breach of environmental law is often a criminal offence and may result in a fine or a prison sentence.

As well as the criminal-law consequences, there is also the matter of compensation for those affected by environmental issues. Depending on the region/country concerned, this might involve taking legal action against the person who has caused the environmental problem through the civil legal system, and having to prove a negligent act has been carried out and was to blame for the incident.

The role of an environmentally responsible business is to ensure that, as a minimum, it complies with all the relevant environmental legal requirements. However, a progressive organisation will go beyond this and look at further improvements, all of which will help ensure its long-term success.

Economic

Aside from the indirect financial impacts that may arise through the moral and legal routes, there are also direct financial benefits from a good standard of environmental performance.

'Polluter Pays' Principle

The 'Polluter Pays' principle has been implemented through a range of financial tools that can be used to encourage or force organisations to account for the pollution they create through the balance sheet. Some UK examples of these charges are:

Landfill

- The **Climate Change Levy** applied to commercial fuel sources, such as coal, gas, electricity and Liquefied Petroleum Gas (LPG) - some of this income is used to fund organisations such as the Carbon Trust, which works with individuals and organisations to reduce their carbon emissions.
- The **Landfill Tax** applied to all waste deposited in landfill to encourage a movement away from the use of landfill as a means of disposal.
- The **Aggregates Tax** applied to virgin aggregates used in construction - this is designed to encourage the re-use and recycling of material in preference to the continued use of virgin material.
- **Charges for Environmental Permits**, etc., based partly on the level of pollution and partly on the standard of environmental performance recorded through the Operator Risk Appraisal (OPRA) scheme.

Costs Associated with Environmental Incidents

This is an often-used comparison for costs associated with health and safety. It is really the flip side of the business case for managing risks. Environmental costs are no different in this respect. These costs may be divided into two parts:

- Direct Costs

  These are the calculable costs arising from an accident and/or any claim for liability in the civil or criminal courts. They include:

  - repairs or replacement of damaged equipment and buildings;
  - clean-up costs;
  - remediation;
  - product loss or damage;
  - loss of production;
  - public and/or product liability;
  - fines;
  - legal fees; and
  - increases in insurance premiums.

- Indirect Costs

  These are costs that may arise as a consequence of the event, but do not generally actually involve the payment of money. They are often largely unknown, but it is estimated that, in certain circumstances, they may be extremely high. They include:

  - business interruption;
  - loss of orders;
  - cost of time spent on investigations; and
  - loss of corporate image.

The Business Case for Good Standards of Environmental Management

An organisation can benefit in many ways if it maintains a high level of environmental performance:

- Better relations with communities local to an organisation by participation in local environmental schemes.
- Minimised energy costs.
- Decreased cost for managing wastes.
- Improved corporate image resulting in many business benefits.
- The organisation may be competitive on an international basis if it implements an environmental management system to internationally recognised standards, such as ISO 14001.
- Improved sales due to enhanced environmental performance of products or services.
- Opportunities for innovation, including improving existing products or developing new products.
- Reduction in the chances of an incident occurring that could cause significant environmental impacts.
- Provides for a better legal defence should an incident occur.
- Reduced insurance premiums.
- Improved access to finance, such as grants, loans and investments.
- Product with a minimal impact on the environment may stand out from other products.
- Improved staff recruitment to a reputable company that understands its environmental responsibilities.
- Reduced chance of incidents occurring leading to prosecution for breaches of environmental law.
- Reduced abatement control costs.

Supply Chain Pressure

Often, organisations applying Environmental Supply-Chain Management (ESCM) impose certain requirements to bring suppliers in line with the organisation's standards of environmental management. Requirements may be specific, such as lists of substances that are banned, restricted or targeted for phase-out, or specifications on recycled content.

There may also be broader requirements, such as conformance to an EMS. For example, Ford and General Motors have mandated that their tier-one suppliers must implement environmental management systems in conformance with ISO 14001.

Integrating specific environmental considerations into existing practices will generate further value, both within the organisation and in its relationships with suppliers. For suppliers, understanding and meeting environmental requirements of their customers can be a way of developing deeper relationships with their customers and increasing market share.

Corporate Social Responsibility

Corporate Social Responsibility (CSR) is an organisational approach that is very closely aligned with the concepts of sustainability. Organisations that pursue CSR seek to embed social, environmental and ethical management at the heart of their businesses. CSR requires that an organisation should be accountable to its stakeholders - customers, investors, employees, suppliers, local communities and society as a whole - for managing its social, environmental and wider economic impacts.

Many companies now produce regular CSR reports that cover the three main strands of environmental, social and economic sustainability:

Environment	• Resource consumption • Control of pollution • Energy and climate change • Biodiversity • Supply-chain impacts
Social	• Working conditions • Fair wages • Diversity
Economic	• Socially responsible investment • Fair contracts and pricing • Trading with emerging economies • Taxes and subsidies

A consensus is emerging on good reporting practice, and standards have now been developed to guide reporting organisations, notably the international Global Reporting Initiative.

MORE...

Recent examples of corporate environmental reports, together with the latest reporting guidelines, can be found on the Global Reporting Initiative (GRI) website:

www.globalreporting.org/information/sustainability-reporting/Pages/default.aspx

Cost Savings

Significant amounts of money can be saved through good environmental practices.

- **Reducing energy consumption** can sometimes lead to significant cost savings. This may be achieved through numerous ways such as fitting insulation to prevent heat loss, maintaining equipment to ensure it remains efficient or providing suitable training to those who operate equipment.
- **Waste** can also be managed such that it is prevented or minimised. This can be achieved through the application of the 'prevent, prepare for reuse, recycling, other recovery, disposal' hierarchy.
- **Resource management** can be defined as using a company's resources in an efficient way. This can include resources such as goods, equipment and financial and labour resources. From an environmental perspective, we are particularly interested in managing those resources that have or may have a significant impact on the environment, such as energy, water and raw materials used by the company. In addition to reduced environmental impact, this can also have other benefits, such as reduction in costs, improved health and safety and compliance with environmental law.

STUDY QUESTIONS

1. Outline what is meant by the terms 'EU Regulation' and 'EU Directive'.
2. Identify direct and indirect costs that may occur from an environmental incident.

(Suggested Answers are at the end.)

Environmental Leadership

IN THIS SECTION...

Effective environmental leadership involves consideration of the following:

- Commitment and accountability - top management should be accountable for the effectiveness of environmental management and committed to achieving it.
- Resource provision - resources must be provided when needed and in an efficient way. Allocation of resources will involve consideration of both current and future requirements.
- Environmental integration into business processes - for environmental management to be effective it must be integrated into the strategic direction of the organisation and into relevant organisational processes.
- Communication - it is imperative that the importance of continual improvement in environmental performance is communicated to stakeholders.
- Ownership - a key element of successful environmental leadership is ensuring both individual and collective ownership of high standards of environmental management.
- A positive environmental culture - this can be achieved by control, co-operation, communication and competence.

Key Elements of Effective Environmental Leadership

Commitment and Accountability

The management of an organisation determines the mission, vision and values of that organisation taking into account the needs of stakeholders, the context of the organisation and the objectives of the business. The commitment and accountability of top management are highly important for the implementation of high standards of environmental management.

Top management should be effective in their management of environmental issues

Top management should therefore be **accountable** for the effectiveness of the management of environmental issues within the organisation. The **commitment** of top management is gained through the provision of:

- direction to staff;
- adequate physical and financial resources;
- direct involvement in the support of good standards of environmental management; and
- communication of good standards of environmental management.

Such commitment would be highly relevant during the implementation and maintenance of an externally certified environmental management system to a recognised standard such as ISO 14001. However, accountability and commitment is not just a top management function and should be implemented to an appropriate level for all relevant staff within an organisation.

Resource Provision

The implementation and maintenance of high standards of environmental management can involve substantial resources, such as time, money, facilities and people. Such resources are only likely to be available if management are committed, and allocate such resources.

Resources must be provided when needed and in an efficient way. Allocation of resources will involve consideration of both current and future requirements. In allocating resources the organisation can track the benefits that the resources have led to. A periodic review of resource allocation will help determine the adequacy of resource provision. The review should take into account changes and/or new projects.

Environmental Integration into Business Processes

For environmental management to be effective it must be integrated into the strategic direction of the organisation and into relevant organisational processes. As with other workplace issues such as quality management or occupational health and safety, environmental management should not be seen as a side issue that is the responsibility of the environmental management team. Integration is generally an ongoing process and has numerous benefits, such as:

- Effective and efficient operation through resource and process sharing.
- Delivery of elevated value as environmental management will be more closely associated with key processes that the organisation needs to operate effectively.

Key areas where a business may integrate environmental management tasks within its general business management systems include:

- Environmental performance within external reports, e.g. financial reports.
- Environmental criteria in the design of services or products.
- Environmental performance indicators within business key performance indicators.
- Environmental responsibilities within job descriptions.
- Environmental policy commitments within corporate governance.

Ownership

A key element of successful environmental leadership is ensuring both individual and collective ownership of high standards of environmental management. The more that people are involved in environmental management, the greater will be their sense of ownership and job satisfaction, and the more likely it is that the standards of environmental management will improve. Participation of employees in an environmental management system encourages ownership of environmental issues and will assist in controlling environmental risk.

Communication

It is imperative that the importance of continual improvement in environmental performance is communicated to stakeholders. Reasons for such communication may vary but include:

- Management system requirements - the EMAS and ISO 14001 standards both have requirements to communicate environmental matters.
- Motivating employees and others into participating in environmental schemes.
- Helping improve and maintain good relationships with the local community, regulators and other external stakeholders.
- Consulting with both internal and external stakeholders regarding environmental improvements.
- Providing relevant information to contractors and subcontractors with regard to environmental rules with which they must comply.
- For marketing purposes, improving the image of the company.
- Legal requirements (environmental permits often require communication with the public).

Positive Environmental Culture

'Environmental culture' may be defined as the shared attitudes, values, beliefs and behaviours relating to the organisation. The environmental culture of an organisation is the way that everyone within the organisation thinks and feels about the environment and associated issues, and how this translates into their behaviour.

A model often used in health and safety management is to consider a positive health and safety culture as consisting of control, co-operation, communication and competence (the four C's). This approach can also be applied when aiming to gain a positive environmental culture. Consider the following:

- **Control**

  Performance standards are necessary to ensure the effective operations of an organisation. The creation, implementation and maintenance of environmental management systems are, therefore, essential.

- **Co-operation**

  Procedures should be developed and implemented to determine the nature and frequency of:

  – Environment committee meetings.
  – Team briefings.
  – Problem-solving meetings to address particular issues.

- **Communication**

  Standards need to be established to ensure:

  – Senior management involvement in the establishment of procedures, audits, planning and the reviewing of performance, etc.
  – Systems for passing on information to all employees.
  – Documentation of environmental procedures.
  – Liaison with outside agencies.
  – Use of notice boards, newspapers, bulletins, etc.

- **Competence**

  Performance standards need to be established to ensure staff are competent, and should cover the following:

  – Selection of staff.
  – Training of staff at all levels - environmental manager to employee on the shop floor.
  – Supervision.

Liaison with outside agencies

Leadership and Commitment for Environmental Management Systems

ISO 14001:2015 states that top management must demonstrate commitment to the environmental management system (EMS) by:

- Being held accountable for the effectiveness of the EMS.
- Making sure that an environmental policy and environmental objectives are set and align with the strategic direction of the business.
- Ensuring that the EMS requirements are integrated into the organisation's business processes.
- Ensuring that resources required by the EMS are available.
- Communicating the importance of the EMS and conforming to its requirements.
- Making sure that the EMS achieves intended outcomes.

- Providing direction and support to relevant people to provide a contribution to EMS effectiveness.
- Promotion of continual improvement.
- Providing support for management to enable them to demonstrate their leadership as it applies within their area of responsibility.

STUDY QUESTIONS

3. Identify the key components of effective environmental leadership.
4. Identify the four C's which must be considered when aiming to gain a positive environmental culture.

(Suggested Answers are at the end.)

Ethics and Professional Practice

IN THIS SECTION...

- It is important that the environmental practitioner behaves in an ethical manner such as providing a high standard of service, treating others with respect and acting with integrity.
- Professional institutes often develop a code of conduct that identifies the professional standards that an environmental practitioner must meet.

Importance of Professional Ethics

Behaving in an ethical manner is a key part of professional practice for an environmental practitioner. It is therefore important that an environmental practitioner demonstrates the following in all activities that they undertake:

- Provides a high standard of service.
- Takes responsibility for their actions.
- Treats others with respect.
- Acts in a manner that promotes trust in the environmental management profession.
- Acts with integrity.

Professional institutes often develop formalised codes of conduct that their members must follow. As an example, the code of conduct for the Institute of Environmental Management and Assessment (IEMA) for their full and chartered membership levels is shown on the next page.

IEMA Transforming the world to sustainability

IEMA Code of Practice and Code of Ethics

In addition to Full Membership Competencies you are expected to demonstrate understanding of the IEMA Code of Practice and Chartered Environmentalist Code of Ethics which detail your commitment to IEMA as a Full and Chartered Environmentalist member.

By signing your application form for this membership level you agree to the below code in and will expected uphold them to maintain your IEMA Full and Chartered Environmentalist Membership.

As a Full Member I will:

- Uphold and promote the environment and sustainability profession;
- Exercise honesty, impartiality, diligence and objectivity in my professional work;
- Support and promote sustainable action and challenge environmentally unsustainable action;
- Work to, and promote, high standards and best practice in the environment and sustainability profession;
- Ensure that professional judgement is not influenced by a conflict of interest and I shall make all relevant parties aware where there is such a conflict;
- Acknowledge my limitations of competence and not undertake work which I know is beyond my professional capability;
- Develop and maintain standards of professional competence and knowledge through a combination of training, learning and practical experience and through the support of others;
- In giving advice, make the relevant person(s) aware of the potential consequences of actions; and
- Endeavour to be an innovative, lateral thinker in the pursuit of environmental improvement and sustainability.

As a Chartered Environmentalist I will:

- Act in accordance with the best principles for the mitigation of environmental harm and the enhancement of environmental quality;
- Strive to ensure that the uses of natural resources are fair and sustainable taking account of the needs of a diverse society;
- Use my skills and experience to serve the needs of the environment and society;
- Serve as an example to others for responsible environmental behaviour;
- Not engage in conduct involving dishonesty, fraud, deceit or misrepresentation or discrimination; and
- Commit to maintaining my personal professional competence and strive to maintain the integrity and competence of my profession.

Source: www.iema.net/membership/full-membership

STUDY QUESTION

5. List the key ethical considerations of being an effective environmental practitioner.

(Suggested Answer is at the end.)

Competence

IN THIS SECTION...

- Competence can be defined as the ability to apply knowledge, skills and experience to achieve intended results.
- Good standards of environmental management dictate that competency is managed within an organisation.
- ISO 14001:2015 provides guidance on a competency management framework.
- Competency checks apply to all those who work under the control of the organisation who may affect environmental performance.
- Training can be an important way of contributing to the achievement of a desired level of competence. It is therefore imperative that an organisation has a formalised training process.
- Mentoring may be useful in contributing to the achievement of individual competency.
- It is important that an environmental practitioner is aware of, and recognises, their own personal competencies.

Managing Competence within an Organisation

Here we will consider the importance of competence, covering competency management generally and the maintenance and management of the environmental practitioner's competence.

Defining Competence

Competence is defined in ISO 14001:2015 as:

> *"ability to apply knowledge and skills to achieve intended results".*

The skills, abilities, knowledge and understanding of a person enable them to gain the necessary competence with regard to environmental management. All persons who are involved in delivering work tasks that can affect organisational environmental performance must be competent. In this sense, competency will be based on experience, training, education or more likely a combination of these factors. Such persons would not just include the organisation's employees but also those who work under its control such as contractors.

Managing Competence

Good standards of environmental management dictate that competency is managed within an organisation. This is reflected more formally in ISO 14001:2015 where a structured competency management framework is described that requires the organisation to:

- Determine the competency of persons carrying out work under the organisation's control that may adversely affect its environmental performance or its ability to achieve compliance obligations.
- Ensure that such persons are competent on the basis of education, training or experience.
- Assess the training needs of the organisation that are associated with its environmental aspects and its environmental management system.
- Where applicable, undertake actions to acquire the competency required and evaluate the effectiveness of such actions.

Assess the training needs of the organisation

Competence is a key way in which organisations will support achievement of legal compliance. Achievement of the specific responsibilities listed above will all generally assist in increasing the chance that an organisation will be environmentally legally compliant. Indeed, legal requirements themselves will sometimes state specific competency requirements. For example:

- Integrated environmental permits will often state competencies for staff who play an important role in an organisation's environmental management system.
- Waste permits will often specify that an organisation must employ a person who has undertaken a technical competence certificate in waste management.

Competency Frameworks and Checks

The understanding of the types and levels of competencies required by an organisation can be achieved by the use of competency frameworks. This is a defined structure that states the individual competencies that are required by those who are employed by the organisation. Competency frameworks may be developed into a skills matrix where the individual competencies of an employment role are compared to those of the employee.

Competency checks apply to all those who work under the control of the organisation (including both workers and contractors) who may affect environmental performance. This would include those:

- Whose employment has a potential to cause a significant impact on the environment.
- Who have specific responsibilities in the organisation's environmental management system, such as:
  - Determining and assessing environmental impacts or compliance obligations.
  - Assisting in the achievement of environmental objectives.
  - Providing emergency response.
  - Undertaking internal audits.
  - Performing evaluation of compliance with legal and other requirements.

Role of Training and Mentoring

Training and competence are not synonymous, but training can be an important way of contributing to the achievement of a desired level of competence. It is therefore imperative that an organisation has a training process that includes:

- Identification of organisational training needs.
- A training plan or programme to meet the identified needs.
- Delivery of required training.
- Retention of documentary evidence of training received (such as training evaluation sheets).
- Monitoring of the training received.

Mentoring schemes may be useful in contributing to the achievement of individual competency. In a mentoring role the aim is an alliance between the mentor and the mentee. The responsibility for finding the solution to a problem remains with the mentee and the mentor is simply there to guide and support the mentee's exploration.

The Practitioner's Own Competence

It is important that an environmental practitioner is aware of, and recognises, their own personal competencies. This includes consideration of the following:

- Understanding the limits of their own competency and not carrying out work that is beyond their professional capability.
- Provision of advice to employers and others regarding the level of their own competence.

- Achievement and maintenance of professional competence through the combination of learning, practical experience and the support of others.
- Keeping up to date with environmental change (such as changes in law, science or technology).
- Encouragement and mentoring of others.
- Involvement in continuing professional development schemes.

STUDY QUESTIONS

6. Identify what is meant by the term 'competence'.
7. Outline the requirements for competency management in ISO 14001:2015.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- The reasons for improving environmental and social performance are legal, moral and economic.
- High standards of environmental leadership involve consideration of commitment, accountability, provision of resources, integration of environmental matters into business processes, communication, ownership and a positive environmental culture.
- An environmental practitioner must behave in an ethical manner and meet professional standards.
- Competence is the ability to apply knowledge, skills and experience in the achievement of intended outcomes.
- ISO 14001 states requirements for environmental competence within an organisation.
- Having a structured training process is important in the achievement of competency.
- Mentoring others can also contribute to the achievement of competency.
- It is important that an environmental practitioner is aware of, and recognises, their own personal competencies.

Exam Skills

QUESTION

Identify the benefits that may occur to organisations which adopt high standards of environmental management. (10)

Approaching the Question

As before, using good exam technique, you must:

- Read the question.
- Consider the marks available. In this case, there are ten marks available, so you should spend around 18 minutes answering the question and provide ten pieces of significantly different information.
- Highlight the key words. In this case, the key words would include: benefits, organisations, high standards of environmental management.
- Read the question again.
- Jot down an outline plan - this might include:
  - communities, energy costs, waste costs, corporate image, competitiveness, sales, innovation, reduction in chances of an environmental incident, legal defence, insurance premiums, access to finance, competitive edge, staff recruitment, less chance of prosecution and reduced abatement costs.

With this question you need to provide ten benefits that can occur for organisations which adopt high environmental standards.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

Any ten from:

- Better relations with communities local to an organisation by participation in local environmental schemes.
- Minimised energy costs.
- Decreased cost for managing wastes.
- Improved corporate image resulting in many business benefits.
- The organisation may be competitive on an international basis if it implements an environmental management system to internationally recognised standards, such as ISO 14001.
- Improved sales due to enhanced environmental performance of products or services.
- Opportunities for innovation, including improving existing products or developing new products.
- Reduction in the chances of an incident occurring that could cause significant environmental impacts.
- Provides for a better legal defence should an incident occur.
- Reduced insurance premiums.
- Improved access to finance, such as grants, loans and investments.
- Product with a minimal impact on the environment may stand out from other products.
- Improved staff recruitment to a reputable company that understands its environmental responsibilities.
- Reduced chance of incidents occurring leading to prosecution for breaches of environmental law.
- Reduced abatement control costs.

Element 3

Environmental Management Systems and Emergency Planning

Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain the purpose, benefits, limitations and structure of an environmental management system.
2. Outline methods of presenting information on environmental management performance, including communication to stakeholders, and the use of benchmarking.
3. Outline the need for environmental policies, procedures and systems of work and how these would be implemented by an organisation.
4. Outline the need for managing contractors' environmental performance.
5. Outline the requirements of emergency plans for an organisation, including their development, monitoring and maintenance.

Contents

Environmental Management Systems

IN THIS SECTION...

- Effective Environmental Management Systems (EMSs) are built on Total Quality Management concepts (Plan-Do-Check-Act).
- Continual improvement is an integral part of the ISO 14001 EMS standard and is defined as recurring activity to enhance performance.
- EMAS, the Eco-Management and Audit Scheme, is another EMS standard. It is similar to ISO 14001 but has some differences (e.g. requirement for externally verified environmental statement).
- BS 8555 uses a phased implementation approach, breaking down the process of installing a formal EMS into five phases.
- The stages of implementing an EMS to ISO 14001 include:
  - Initial review - this gives a broad view of the environmental performance but is not needed to satisfy the standard.
  - Context of the organisation - understanding relevant issues that affect the organisation and issues which the organisation may affect.
  - Leadership - top management must demonstrate leadership and develop an environmental policy.
  - Planning - aspects and impacts identification, compliance obligations and development of objectives.
  - Support - resources must be made available. Also covers requirements for competency, communication and documented information.
  - Operation - development and implementation of operational control and emergency plans.
  - Performance evaluation - monitoring, measuring and analysing performance; internal audit and management review.
  - Improvement - non-conformances eliminated and prevented.
- There are arguments for and against integrating an environmental management system with other systems (e.g. quality and health and safety).

Management Systems

Most organisations have management systems for one or more aspects of management. Probably the most common management system is the Quality Management System used for the ISO 9000 series.

Environmental Management Systems

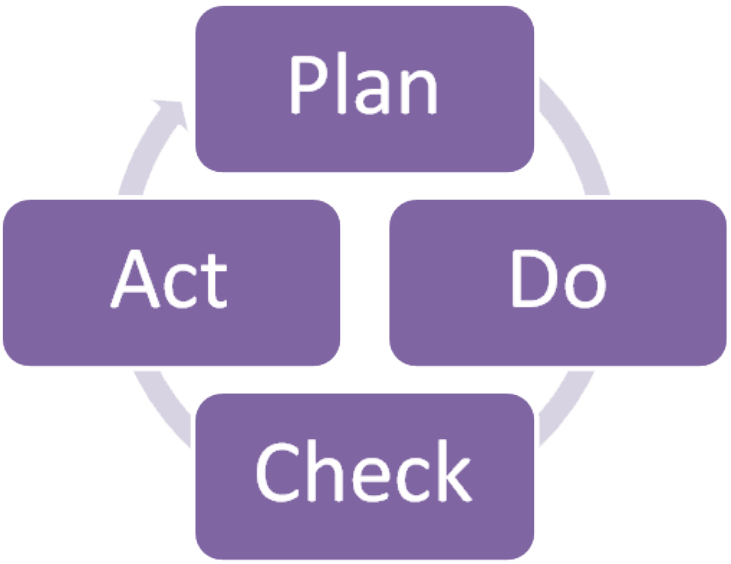
An effective EMS is built on Total Quality Management concepts. In order to improve environmental management within an organisation, focus should be on not just what things happen but also on the reasons why they happen. Over time, this systematic identification and correction of system deficiencies leads to better environmental (and overall business) performance.

An effective EMS is built on Total Quality Management

TOPIC FOCUS

EMS Models

EMS models (including the ISO 14001 standard) are constructed on the "Plan, Do, Check, Act" model introduced by Shewhart and Deming. This model is based on the concept of continual improvement.



The Shewhart and Deming model

Plan - how you intend to make changes in what you do.

Do - what you have planned in the previous step, on a trial basis if possible. Collect objective data.

Check - part of good planning is to decide how you will check whether your plans are working, but then you need to make those checks and see whether you are achieving what you wanted to.

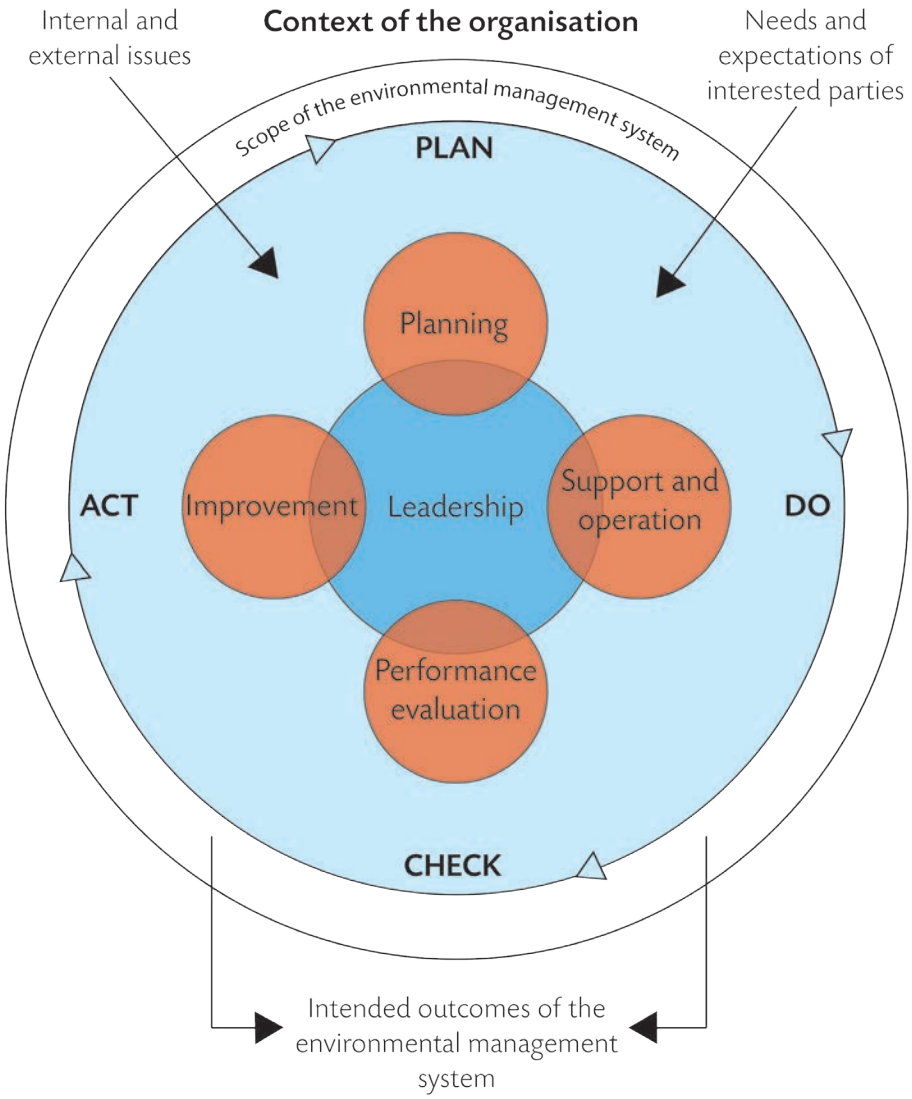
Act - on the outcomes of previous steps by taking appropriate action or standardising the improvement. This will close the loop and is the essential step for continual improvement.

Continual improvement is an integral part of the ISO 14001 standard and is defined as the process of enhancing the environmental management system to achieve improvements in overall environmental performance in line with the organisation's environmental policy.

Basically the concept of continual improvement recognises that problems will occur. However, a committed organisation learns from its mistakes and prevents similar problems from occurring in the future.

In the ISO 14001 EMS standard, the "plan, do, check, act" steps have been expanded into seven key EMS sections.

BS EN ISO 14000 Series



ISO 14001 management system process

An effective EMS must be **dynamic** to allow organisations to adapt to a quickly-changing business environment. For this reason an EMS should be kept flexible and simple. This will help make your EMS understandable for the people who will implement it - you and your organisation's employees.

An organisation can demonstrate its commitment to proactive environmental management to its stakeholders and other interested parties in two ways:

- Have its EMS audited and **certified** by an independent third party, i.e. certification body.
- Make a self-determination and **self-declaration** of conformance to an EMS standard.

DEFINITION

BS EN ISO 14001

Is a stand-alone, auditable, environmental management system standard for certification. A general management framework approach is applied, and there are clear similarities with HSG65 and ISO 9001, as well as ISO 45001.

The benefits of external certification may vary significantly among organisations. In addition, the costs associated with the certification process will vary depending on the size of the organisation and the number of facilities/divisions they choose to certify.

TOPIC FOCUS

The ISO 14001 Model

1. **Context of the organisation:** an organisation must understand all relevant issues that may affect or are affected by the organisation. The scope of the EMS must be determined and documented.
2. **Leadership:** top management must demonstrate leadership. Roles and responsibilities should be assigned and a compliant environmental policy produced.
3. **Planning:** key action includes the identification of relevant environmental aspects and impacts associated with the organisation activities. The organisation must also set objectives and understand its compliance obligations.
4. **Support:** resources must be made available to develop and operate the EMS. Requirements are also stated for competency, communication and documented information.
5. **Operation:** consistent with a life cycle perspective the organisation must develop operational controls. Emergency plans must also be developed and tested where appropriate.
6. **Performance evaluation:** an organisation must monitor, measure, analyse and evaluate its environmental performance. Requirements are also present to develop and implement internal audit programmes. Top management must also review the EMS at suitable intervals.
7. **Improvement:** the cause of nonconformances must be eliminated. Nonconformances should be prevented from happening again.

ISO 14001 is only one of several standards dealing with environmental management, but it has achieved the widest international coverage, with well over a million certified organisations worldwide. A key reason for the success of ISO 14001 is that it can be implemented by any type of organisation - from large industrial sites to small service companies. Many large companies now insist that key suppliers have ISO 14001 certification and this has also been an important driver in the uptake of the standard.

Other standards include:

Standard	Application
ISO 14004 *Environmental Management Systems - General Guidelines on Implementation*	Additional guidance to organisations on design, development and maintenance of an EMS.
ISO 14015 *Environmental Management - Environmental Assessment of Sites and Organisations*	Provides guidance on how to estimate business consequences of the environmental condition and risks on a site.

EMAS

DEFINITION

EMAS

The Eco-Management and Audit Scheme (EMAS) (established by **EC Regulation 1221/2009** as amended by **EU Regulation 2017/1505**) is a voluntary initiative designed to improve companies' environmental performance. It requires participating organisations to implement an Environmental Management System (EMS). The EMS must meet the requirements of the international standard BS EN ISO 14001.

EMAS shares a common core framework with ISO 14001 and so provides an organisation with a structured approach for identifying, evaluating, managing and improving its environmental performance. Although similar in content, there are a number of important differences between EMAS and ISO 14001.

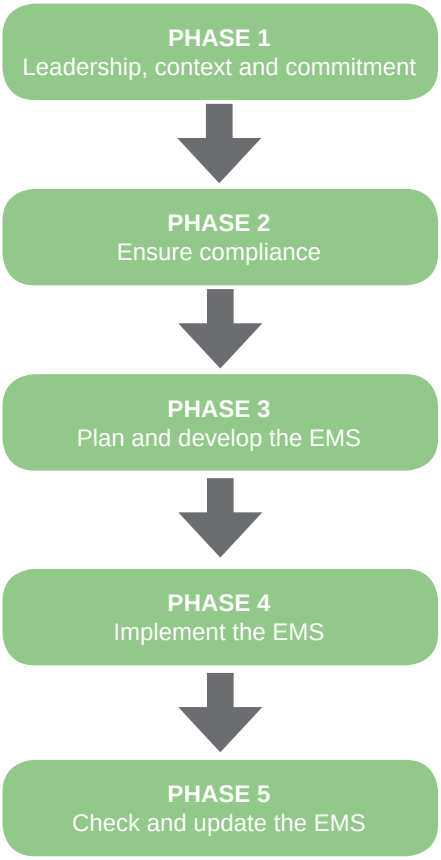
These include:

- A formal environmental review must be documented as a precursor to establishing the system.
- An independently verified Environmental Statement must be prepared, which sets out key information for the public about the organisation's impacts and actions.
- An open dialogue must be established with the public and other interested parties.
- EMAS uses stronger and more specific language about legal compliance than ISO 14001 (for example, the organisation must have identified and know the implications to them of environmental legal requirements). Breaches of legislation may result in EMAS registration being withdrawn.
- EMAS is site-based whereas ISO 14001 can be organisation-wide.
- EMAS specifically states requirements for employee involvement in the management system.
- EMAS has a three-year audit cycle - there is no specific audit cycle set in ISO 14001.

However, the key difference between EMAS and ISO 14001 is that EMAS is a European, rather than international standard. There are many fewer EMAS registrations worldwide - mostly held by larger industrial companies, to which EMAS is best suited.

BS 8555:2016

BS 8555 is a British standard, which describes a phased approach to implementing an EMS. It was introduced to help smaller organisations, which often have limited resources, to progress in a step-wise and cost-efficient manner towards full ISO14001 certification.



BS 8555 - phases of implementation

BS 8555 breaks down the process of implementing a formal EMS into five phases, which take the organisation progressively through the planning, implementation, checking and review elements of a working system.

After each phase has been implemented, the organisation can either assess itself, allow major customers to assess it against the appropriate phase criteria, or be independently assessed by a third party, such as a certification body.

Successful completion of phase 5 of BS 8555 provides an organisation with an environmental management system that conforms to ISO 14001.

ISO 14005:2010

ISO 14005:2010 may be regarded as the international equivalent of BS 8555, in that it provides guidelines for the phased implementation of an EMS. The guidelines have been widely criticised, however, because of their complexity. For example, the standard identifies 71 steps to achieve ISO 14001 certification and 80 steps to gain EMAS certification. This has led to a number of countries rejecting the standard.

The Steps in Implementing an EMS

The ISO 14001:2004 standard was replaced by ISO 14001:2015 in September 2015. From this date there is a period of transition to allow organisations to adapt their environmental management systems to meet the requirements of the new standard.

Key changes incorporated into the revised ISO 14001:2015 standard are as follows:

- The standard follows a new common structure that allows easier integration with other management system standards, such as ISO 9001 on quality management.
- There is greater focus on improving environmental performance taking account of upstream (e.g. supplier) and downstream (e.g. customer use) areas of a company's 'value chain'.
- A greater emphasis is placed on top management involvement and the integration of environmental management into core business practices.
- There is greater focus on the need to evaluate organisational risks in the context of external environmental conditions (e.g. adapting to climate change, or resource shortages).

The main phases of implementing an EMS to the ISO 14001 standard are:

- Context of the organisation.
- Leadership.
- Planning.
- Support.
- Operation.
- Performance evaluation.
- Improvement.

Leadership - one of the main phases of implementing an EMS

Initial Review

Although not a mandatory part of ISO 14001, before implementing an EMS the current environmental performance of an organisation may be assessed by carrying out an Initial Environmental Review (IER). An IER is a one-off process that is undertaken to determine the environmental baseline of the organisation.

The IER has the purpose of:

- Establishing how a company **impacts** on the environment.
- Determining which of the impacts are important or **significant**.

- Helping to identify applicable compliance obligations and the level of **compliance** with them.
- Identifying what **EMS documentation and practices** are being used currently and what needs to be developed in order to show compliance with ISO 14001.

There are various approaches that can be adopted in order to carry out an IER. A common way is by undertaking the following:

- **Review team selection** - development of a team who have the skills, knowledge and experience to carry out the Review. Assistance from consultants and other external bodies may be needed where this is not present.
- **Preparation** - prior to undertaking the Review, the project outline, responsibilities of the review team, collection of background information (e.g. processes, permits, consents), methods of communication and action plan design will need to be developed or carried out.
- **Site review** - the main information-gathering phase includes interviews, observations and review of documents. A standard questionnaire can be used to ensure that a thorough review is undertaken. A common approach is to consider activities present at an organisation and assess the environmental inputs and outputs from each activity.
- **Review report** - a report will be produced that will aid the assessment of environmental impacts, current environmental performance and EMS elements that are present. The report is a key reference document for the development of the system.

The IER should not just consider present activities but also past activities (e.g. spillages, land contamination), and future activities (e.g. new developments), as well as considering normal operating conditions, abnormal and emergency conditions.

Context of the Organisation

An organisation must understand its context. This includes internal and external relevant issues such as the environmental conditions that may be affected by the organisation or environmental conditions that could affect the organisation. Part of this phase of ISO 14001:2015 also requires that the needs and expectations of interested parties are fully understood.

The scope of the EMS must be determined and documented and made available to interested parties. The scope needs to include various issues such as compliance obligations, activities, products and services that the organisation undertakes/offers in addition to what it can control and influence.

ISO 14001 requires that an organisation establish, implement, maintain and continually improve an ISO-14001-compliant environmental management system.

Leadership

Top management must demonstrate leadership and commitment to the EMS. Examples of how this can be achieved are by being held accountable for the EMS, ensuring that the EMS is fully integrated into the organisation and promoting continual improvement.

Environmental roles and responsibilities must be assigned and communicated by top management in order to comply with ISO 14001. Every employee should be made aware of their responsibility in achieving compliance with the policy and specific requirements of the EMS that are relevant to them. Responsibilities can be stated in numerous ways and may be integrated with other job roles in job descriptions and/or a section in the environmental manual.

It should be noted that organisational structures are different in different organisations; however, a sample list of responsibilities is provided in the following table.

Sample environmental responsibilities

Example Environmental Responsibilities	Responsibility
Identify overall direction of the EMS.	Chief Executive/Managing Director.
Design policy.	Chief Executive/Managing Director/Environmental Manager.
Identify environmental objectives, targets and programmes.	Departmental Managers.
Monitor EMS performance.	Environmental Manager.
Identify training needs/retain training records.	Environmental Manager/Human Resources Manager.
Track cost associated with the EMS.	Finance.
Identify customer requirements.	Sales and marketing staff.
Compliance with procedures.	All staff.
Undertaking audits.	Audit team.

By determining key on-site issues, it is possible to identify the required roles and responsibilities to ensure effective control. Important areas where responsibilities should be defined are:

- Environmental management programmes (action plans).
- Legislative requirements.
- Control of significant environmental impacts.
- Current responsibilities for environmental management or other management systems (e.g. quality).

Environmental Policy

After significant aspects have been identified (see below for further information), an environmental policy statement can be written. The purpose of a policy statement is to document the environmental intentions and principles of an organisation and to provide a framework for setting objectives. An environmental policy statement is usually of about one page in length and forms a useful marketing tool for the organisation.

DEFINITION

ENVIRONMENTAL POLICY

"Intentions and direction of an organisation related to environmental performance, as formally expressed by its top management."
(ISO 14001:2015)

ISO 14001 states the following principles that a policy must comply with:

- Be **appropriate** to the purpose and context of the organisation such as the nature, scale and environmental impacts of its activities, products or services.
- Include a commitment to **continual improvement** and to the **protection of the environment** (including prevention of pollution and other relevant specific commitments).
- Include a commitment to fulfil the organisation's **compliance obligations** (both legal and other requirements).
- Provide the framework for setting environmental objectives - the policy must identify general aims on how the organisation is to improve; these are backed up by more specific objectives.
- Be **documented, communicated** within the organisation and available to **interested parties**.

The **purpose** of the environmental policy is to show the company's commitment to regulatory compliance and continuous improvement by identifying and managing environmental impacts, issues and performance. The targets and timescales should be realistic and address overall environmental performance. However, it is important that the environmental policy includes intentions and principles, and should not detail any specific objectives and targets.

The policy should be influenced by the findings of the **environmental review** and should be agreed after this has taken place. There is a requirement to **review** the policy periodically in the light of changing conditions and information. This should be done at least annually.

Commitment from senior management should be clearly stated and the most senior person in your organisation should sign the policy.

The policy should be relevant to the organisation's activities, products and services and should not contain any vague statements.

The following are guidelines on how to write an environmental policy:

- A title should be included, such as "ACME Ltd Environmental Policy".
- An opening paragraph should briefly describe the activities, products and/or services of the facility.
- A statement should be included that details the organisation's commitment to complying with acceptable environmental practices, including the commitment to fulfil compliance obligations, achieve continual improvement and protection of the environment.
- Include a list, in general terms, of strategic objectives or programmes relevant to significant environmental aspects - this will help make the policy organisation-specific.
- The most senior person within the organisation should sign the policy.
- The policy must be publicly available and should be posted at the entrance to the organisation. Copies must be provided to the public and other interested parties on request.

Planning

Actions to Address Risks and Opportunities

- General

  Processes to establish, implement and maintain must be developed to meet the requirements of the planning section of the standard. While planning, the organisation must consider numerous factors such as context of the organisation, the needs and expectations of interested parties and the scope of the system. Planning also requires that the organisation determines the risks and opportunities related to its environmental aspects, compliance obligations and other issues. The scope of the EMS must include potential emergency situations.

  Documented information must be maintained stating the organisation's risks and opportunities that are required to be addressed in addition to the processes needed to ensure that the requirements of the general section are met as planned.

- Environmental Aspects

  The organisation must determine aspects and impacts that it can control and influence. This is a key part of ISO 14001.

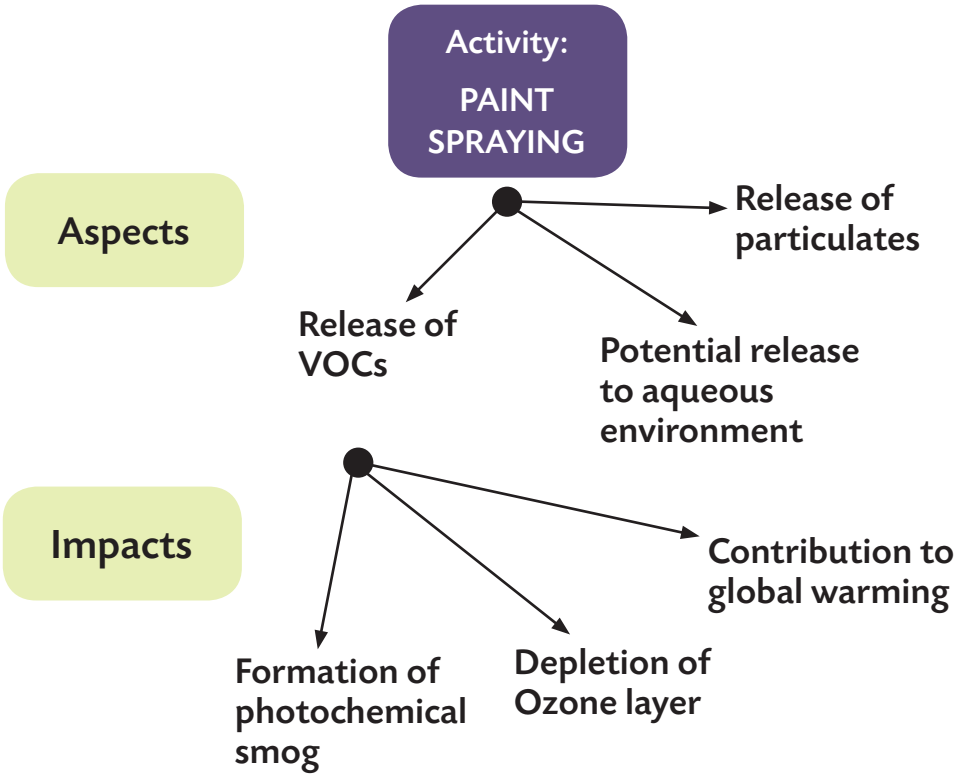
DEFINITIONS

ENVIRONMENTAL ASPECT

"Element of an organisation's activities or products or services that interacts or can interact with the environment." (ISO 14001:2015)

ENVIRONMENTAL IMPACT

"Change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects." (ISO 14001:2015)



Example of aspects and impacts for the activity of paint spraying

In simple terms, an aspect can be classed as either an emission from an activity (output) or the use of materials or resources (input), whereas an impact is the effect that the aspect has on the environment.

ISO 14001 states that identification of environmental aspects should be carried out for activities, products or services that can be **controlled** by an organisation, or the activities, products or services that an organisation is expected to have reasonable **influence** over. It allows identification of aspects that have a significant environmental impact.

Organisations therefore have some flexibility when identifying the scope of the EMS:

- **Control** - these are likely to result from **direct activities** associated with emissions from processes and compliance issues.
- **Influence** - this is much broader and mainly includes **indirect issues**, such as suppliers, contractors and customer activities. Influencing can be achieved by communication and supply chain pressure.

Many organisations will initially concentrate their effort on identifying direct activities that they can control. As an EMS matures, it will consider more indirect activities. For banks, insurance companies, etc., the significant aspects are mainly likely to be surrounding indirect activities.

ISO 14001:2015 states that a **life-cycle perspective** should be considered when determining environmental aspects and impacts. This means identification of aspects and impacts 'from the cradle to the grave' (from the development of raw materials all the way to the final disposal of the product). We will cover this concept in more detail later.

The way in which significant aspects are identified and assessed must be documented. This details responsibilities and arrangements for identifying aspects, determining significance and periodically updating the information.

We will cover the techniques for identifying aspects and impacts in Element 4.

Establishing Environmental Objectives for Environmental Management Performance

To ensure that the commitments stated in the policy are met, objectives need to be developed. Objectives change the nature of the EMS from identifying areas of concern (aspects and impacts) to improving them.

An important part of an EMS is the commitment to, and attainment of, continual improvement. It is the objectives that help provide evidence for this improvement.

ISO 14001:2015 is vague as to the types of objectives that must be set. There is just a requirement to set objectives and no mention is made as to specific mandatory requirements.

One method, however, is that organisations initially develop high level environmental objectives which are broad areas of improvement that are normally not quantified. Lower level objectives (sometimes known as targets) are more detailed and are linked to higher level objectives. Usually such lower level objectives are SMART:

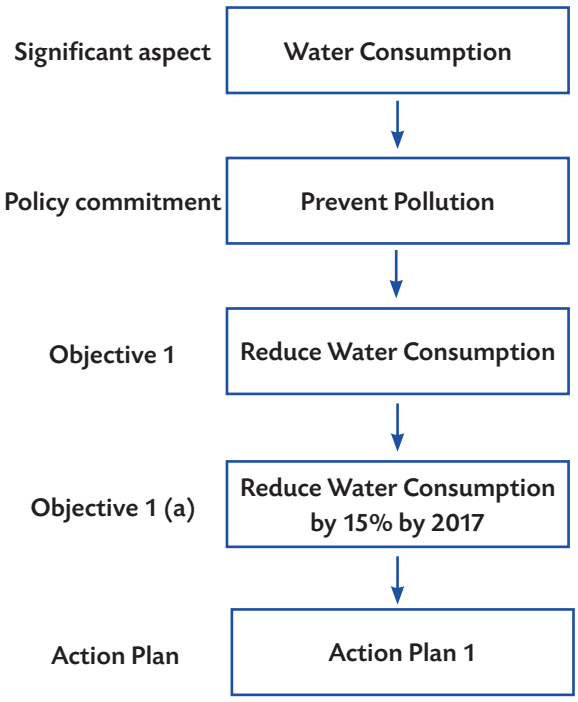
- **S**pecific.
- **M**easurable.
- **A**chievable.
- **R**ealistic.
- **T**ime-bound.

Each policy commitment should link to at least one objective. They are an important part of an EMS and commit organisations to making improvements by set timescales (see the following):

DEFINITION

OBJECTIVE

Result to be achieved. An objective may be strategic, operational or tactical. It may apply to different disciplines and different levels. An objective may be expressed in other ways such as an intended outcome, as an environmental objective or by use of other words (aim, goal or target).



Environmental objectives example

Action plans tend to be very low level objectives - they identify how the requirements of the linked higher level objectives will be met. As a minimum they tend to consider:

- **Tasks** - to be completed to meet a linked objective.
- **Timescale** - by when a task will be completed.
- **Responsibility** - who will be responsible for ensuring that the task is completed.

In practice, they are often limited to addressing significant aspects but they may consider other issues for business or financial reasons.

The ISO 14001 standard states that environmental objectives must be documented and be:

- Consistent with the environmental policy.
- Measurable (the standard states if practicable).
- Monitored.
- Communicated.
- Updated as appropriate.

Policy meeting

Whichever method is used to set objectives, the ISO 14001 standard states that when planning objectives an organisation must determine:

- What needs to be done.
- What resources will be needed.
- Who will hold responsibility for the objective.
- When the objective is due for completion.
- How results will be evaluated.

Organisations will develop environmental performance indicators (a form of key performance indicator) that measure reductions in significant environmental impacts. These are routinely used internally to measure performance but can be externally validated.

- ### Types of Objectives

  Three types of objective exist:

  - **Monitoring objectives:** these may be set where the management of a significant impact could potentially be improved, but where financial, technological or other resource constraints mean that action is presently not possible. Objectives such as these could state a commitment to monitor/research specific issues likely to bring about change in circumstances and which will allow for improvement objectives to be set.
  - **Management objectives:** these are appropriate where an impact is already being successfully managed, or where improved performance is not feasible. They will relate to the need to ensure that all controls are systematically applied. An impact may be linked to more than a single management objective and could be associated with a monitoring objective, e.g. ensure that all employees undergo ongoing training so that they understand specific roles in the management of the organisation's environmental impacts.
  - **Improvement objectives:** these are clearly associated with an improvement programme, and may apply to areas where the organisation is required, or has decided, to improve its management of one or more environmental impacts. Such objectives demonstrate that environmental performance is being improved and will always be necessary within a system to demonstrate continual improvement. An example would be: 'the company aims to reduce solvent consumption by 25% by 2018'.

No fixed methodology exists for determining what type of objective should be set. Establishing objectives will involve balancing stakeholders' requirements against the influence of those stakeholders, the extent to which the impact is already being effectively managed, and resources available. In many cases, the need for improvement must be built into legislative requirements, e.g. the achievement of **Best Available Techniques (BAT)** over a set timescale. In such cases, the resources needed to make such improvements may be, in themselves, as much as an organisation can cope with.

- Developing Objectives and Targets

  Consider the following general rules when developing objectives and targets:

  – If an environmental impact is deemed significant it usually requires one or more related objectives.
  – If an impact is significant but is already managed in an acceptable and effective manner with regard to stakeholders now and in the future, then it should be linked to one or more management objectives.
  – If an impact requires controlling (e.g. through legislation) and is not presently adequately controlled, then it should be linked to an improvement objective.
  – If an impact could be better controlled than an improvement objective, then a monitoring objective should be set, depending on the ability to control it and available resources; management objectives may also apply.

- Quantification

  Lower level objectives are generally quantified as these provide more detail on the performance standard that is expected than a high level environmental objective. The quantification can be a set amount or, more commonly, is normalised to some kind of measure, e.g. tonnes of product produced or m^3 of floor space. The key feature with all of the performance indicators is that they are measurable. They must be measured in a way which enables comparison over time:

  – This means that the indicator should be related to a fixed feature, e.g. one tonne of product, so that comparisons can be made every month or every year.
  – Without these fixed parameters it is not possible to measure genuine improvement. For example, energy use may be much higher in the winter, or if production has risen.
  – Using the bare data could indicate that energy use has risen when in fact it has fallen due to efficiencies within the process. Fixing the parameters is not always easy, particularly if production varies and many different products are made with different demands upon energy, effluent or wastage.
  – Product lines often offer the best comparisons, although each company will make its own judgment depending on its own knowledge of its activities, plant and equipment.

  No set method is present to measure progress against objectives; however, the organisation must have a way that gives an accurate reflection of how well it is coping with reaching its objectives. For example, progress towards objectives could be tracked through discussion at monthly environmental meetings or similar. Alternatively, where environmental performance indicators are identified for objectives, these could be tracked and provide quantified information as to the extent to which the organisation will meet its requirements.

Support

Resources

The organisation must understand and provide the resources required for the implementation, maintenance and continual improvement of the EMS.

Competence

Various requirements for competence are present in this part of the standard such as:

- Understand the required competence of those whose work could affect environmental performance or compliance obligations.
- Ensure that such persons are competent (education, training or experience).
- Understand training needs associated with the environmental aspects and EMS.
- Take action to gain necessary competence and evaluate such actions.
- Documented information as evidence of competence must be retained.

Awareness

Those who carry out work under the organisation's control must be aware of the environmental policy, significant environmental aspects and impacts, their contribution to the effectiveness of the EMS and implications of not complying with the EMS.

Communication

Having effective communication structures is important to:

- Motivate the workforce.
- Explain the environmental policy (both internally and externally) and how it relates to the overall vision/strategy of the organisation.
- Ensure understanding of roles and responsibilities.
- Demonstrate management commitment.
- Monitor performance.
- Identify potential system improvements.

Motivated workforce

ISO 14001 requires that an organisation has processes that cover:

- internal communications between the various levels and functions of the organisation, and
- external communication of information relevant to the EMS as stated in the organisation's communication process and required by compliance obligations.

Such processes need to cover:

- What will be communicated.
- When to communicate.
- With whom to communicate and the methods of communication.

The organisation must also consider processes for external communication on its significant environmental aspects and record its decisions.

Documented Information

Specific requirements are present in the standard for various information to be documented, in addition to information deemed to be necessary for the EMS by the organisation. There are also document information requirements for:

- **Creating and updating**: documented information should be able to be identified (e.g. date, title, reference number), a correct format should be used (language, software version, etc.) and the information reviewed and approved for suitability and adequacy.

- **Document control**: documents must be controlled to ensure availability, and adequate protection (loss of integrity). More specifically an organisation must consider distribution, storage, preservation, control of changes and retention.

Operation

Certain activities and operations must be controlled within the EMS. The standard states that controls can be both procedural and engineering and may follow a hierarchy of elimination, substitution and administrative.

Consistent with a life-cycle perspective the organisation must:

- Develop controls to ensure environmental requirements are considered at each life-cycle stage during the development process of products and services.
- Determine what requirements are needed for the procurement of products and services.
- Communicate relevant environmentally related information to external providers (e.g. contractors).
- Consider whether to provide information regarding significant impacts associated with transport, delivery, end-of-life treatment and end-of-life disposal of products and services.

Activities which may require operational control include:

- Management or disposal of wastes.
- Operation of an effluent treatment plant.
- Waste water treatment.
- Operation of plating systems (when metal components are placed in a bath - often of acid - to put a different finish on them).

When determining what should be included within an operational control system, the following should be considered:

- What parameters need control?
- In what way can these be controlled to decrease environmental impact?
- Are there any checks, measurements or tests that would improve control?

Significant aspects should be controlled. This would be carried out by considering the activities that cause these aspects and what type of control is required to manage or minimise impacts. A draft procedure could then be developed, which should be trialled and amended as required, prior to issuing the final version.

Emergency Preparedness and Response

Organisations must develop and maintain documented processes to identify and respond to accidents and emergencies and to prevent or reduce environmental impacts that are associated with them. The processes must be reviewed and revised on a regular basis, particularly after an accident has occurred. They must also be tested.

Common accidents that have an environmental impact include:

- Fires.
- Floods.
- Waste water releases.
- Air releases.

The number and type of procedures that are required to be developed depend on the type and complexity of an organisation; e.g. a large chemical company will need a relatively complex emergency plan, whereas an office would require a few simple procedures.

Performance Evaluation

Monitoring, Measurement, Analysis and Evaluation

An organisation's environmental performance must be monitored, measured, analysed and evaluated. An organisation must determine:

- What should be monitored and measured.
- The methods for monitoring, measuring, analysing and evaluating.
- What criteria the organisation performance is compared against.
- The frequency of monitoring.
- When monitoring results should be analysed and evaluated.

The organisation is also required to communicate performance both internally and externally (should be identified in communication process). Documented evidence of monitoring must be kept.

Processes must be developed, implemented and maintained to demonstrate that the organisation has fulfilled its compliance obligations.

Such an evaluation process must include the frequency of compliance evaluation, any action required and maintenance of knowledge and understanding of organisational compliance status.

Documented evidence of the evaluation of compliance must be retained by the organisation.

Internal Audit

ISO 14001 also states that audit programmes and procedures should cover:

- The activities and areas to be considered in audits.
- The frequency of audits.
- The responsibilities associated with managing and conducting audits.
- The communication of audit results.
- Auditor competence.
- How audits are to be conducted.

An EMS audit sees whether the EMS conforms to ISO 14001

The scope of an EMS audit is vast, but it basically seeks to determine whether the EMS conforms to ISO 14001, legal issues and procedures. It should also provide information to show if the EMS is properly implemented and maintained. The audit report is required to provide information to management on the results of audits. The internal audit plays an important role within the EMS and therefore is an important component of the certification assessment.

Bearing the above in mind, internal EMS audits can be based on:

- **Compliance** - to assess legal compliance.
- **Technical** - to assess technical management and control, e.g. pollution treatment equipment.
- **EMS** - to assess against 'planned arrangements' for the environmental management system.

The objective of auditing is to find root causes beyond the symptoms that are causing a problem. The following are root cause categories:

- Training - have the staff been trained incorrectly?
- Procedures - is the procedure itself incorrect?
- Equipment - is the equipment available and in a suitable location?
- Records - are the records not being maintained?

- Communication - have the requirements been communicated?
- Responsibilities - have responsibilities been defined?
- Document control - is an out-of-date procedure being used?

Management Review

The ISO 14001 standard identifies that an organisation's top management must review the EMS to ensure that it is suitable, adequate and effective. The review should also be completed at specified intervals. The management review must be developed to assess the needs for EMS improvements. Review frequency is not identified in **ISO 14001**; however, most organisations undertake a management review on an annual basis.

The standard states that the management review must include:

- status of actions from previous reviews;
- changes in significant aspects;
- internal and external issues;
- the extent to which objectives have been reached;
- information on the environmental performance of the organisation such as trends in monitoring results, fulfilment of compliance obligations and audit results;
- how adequate resources are;
- communications from interested parties (this includes complaints); and
- areas where there are opportunities for continual improvement.

The output of the management review will include:

- Whether the EMS is still suitable, adequate and effective.
- Decisions that are linked to continual improvement.
- Action when environmental objectives have not been met.
- Areas where the EMS could be integrated with other business processes.
- Implications for the strategic direction of the organisation.

Documented evidence of the results of the management review must be kept.

Improvement

An organisation must determine where improvement opportunities exist and implement actions to ensure achievement of EMS outcomes.

Nonconformity

If a nonconformity occurs, an organisation must take necessary action to ensure that it is controlled and rectified. It must also react to the consequences of the nonconformity such as mitigating the adverse environmental impacts that may occur.

Action is also required to eliminate the cause of the nonconformity to ensure that it does not happen again. This is to be achieved by undertaking a review of the nonconformity, to understand the causes and to determine whether a similar nonconformity exists or could occur. Any corrective action implemented must be reviewed for its effectiveness.

Documentary evidence must be retained as to the nature of nonconformities, action undertaken to correct them and the results of the corrective actions.

DEFINITIONS

CONFORMITY

Fulfilment of a requirement.

NONCONFORMITY

Non-fulfilment of a requirement.

Continual Improvement

The organisation is required to ensure continual improvement of the EMS's suitability, adequacy and effectiveness to enhance environmental performance.

DEFINITION

CONTINUAL IMPROVEMENT

Recurring activity to enhance performance. Enhancing performance is related to the use of the EMS to improve environmental performance consistent with the environmental policy.

Benefits and Limitations of Integrating Management Systems

For organisations wishing to have control over more than one aspect of risk management, e.g. safety, environment and quality, it may be possible to implement an Integrated Management System (IMS) rather than individual systems. Though it may make sense in theory, implementing an IMS is not an easy task and there are a variety of factors to be taken into account.

TOPIC FOCUS

Benefits of Integration

- A well-planned IMS is likely to operate more cost-effectively than separate systems and facilitate decision-making that best reflects the overall needs of the organisation.
- An IMS offers the prospect of more rewarding career opportunities for specialists in each discipline.
- The objectives and processes of management systems are essentially the same.
- Integration should mean duplication of effort is avoided - for example, in terms of personnel, meetings, electronic record-keeping software, audits and paperwork.
- Integration should reduce the possibility of resolving problems at the expense of creating new difficulties in other disciplines.
- An IMS should involve timely overall system reviews, where momentum in one element of an IMS may drive forward other elements that might otherwise stagnate. In contrast, independent systems could develop without regard to other management-system elements, leading to increasing incompatibility.
- A positive culture in one discipline may be carried over to others.

Limitations of Integration

- Existing systems may work well already. Integration may threaten the coherence and consistency of current arrangements that have the support of everyone involved.
- With independent systems, relevant specialists may continue to concentrate on the area of their core expertise and further specialist training may not be needed.
- Uncertainties regarding key terms would be exacerbated in an IMS.
- System requirements may vary across topics covered, e.g. an organisation may require a simple quality system, but a more complex environmental or health and safety performance system. An IMS could introduce unreasonable bureaucracy into, in this case, quality management.
- Health, safety and environmental performance are underpinned by statute law, whereas quality management system requirements are largely determined by customer specification.
- Regulators and single-topic auditors may have difficulty evaluating their part of the IMS when it is interwoven with other parts of no concern to the evaluator.
- A powerful, integrated team may reduce the ownership of the topics by line management.
- A negative culture in one topic may unwittingly be carried over to others.

STUDY QUESTIONS

1. Name the seven principal elements in the ISO 14001 environmental management system.
2. What is the purpose of an environmental audit?
3. What issues should an ISO-14001-compliant audit procedure cover?
4. Identify the issues that would be covered by a management review.
5. What is continual improvement?

(Suggested Answers are at the end.)

Presentation of Information on Environmental Management Performance

IN THIS SECTION...

- Environmental data may be absolute or normalised, qualitative or quantitative and should be accurate and relevant.
- Corporate Environmental Reporting (CER) now includes information on sustainability, social issues, such as working conditions, and economic factors, such as fair contracts.
- Good-practice guidelines on writing corporate environmental reports include those produced by the Global Reporting Initiative (GRI).
- Corporate Social Responsibility (CSR) reports include both social and environmental information.
- Benchmarking is a term used in industry for internal and external comparative assessment and is becoming increasingly popular as an environmental management tool.

Internal and External Sources of Information on Environmental Performance

TOPIC FOCUS

Sources of Environmental Information Internal to the Organisation

- Inspection/audit reports: identify any evidence of defects and a lack of suitable controls.
- Incident data and investigation reports: indicate where there has been a failure in a process or procedure.
  - The frequency and extent of such a failure will help determine the probability and severity of such an incident.
  - Investigation will help determine causes and additional controls.
- Maintenance records: provide information on machine reliability and types of failures experienced in the past.
  - This can be used as an indication of what may occur in the future and therefore what precautions need to be put in place.
- Job/task analysis: although usually used to identify safety hazards, a thorough analysis of tasks - by breaking them down into smaller steps - may help identify potential environmental impacts from the activity.
- Environmental monitoring data: the results can show trends, such as pollution levels increasing slowly over a period of time, and identify any times of increased risk when it may be necessary to implement stricter controls.
- Raw-material usage and supply: volumes of raw material used should be consistent with the volumes of final product produced. If there are significant changes, this may be an indication of a problem in the production process. Consideration should also be given to the sources of supply and the potential impacts this may have, e.g. using timber from a sustainable supply.
- Environmental permits: will provide detailed information on what activities may be carried out and the levels of pollution that are permitted from those processes. They will usually also include details on how frequently monitoring must take place and what parameters must be monitored, such as total volume, rate of discharge, suspended solids, etc.

(Continued)

TOPIC FOCUS

Sources of Environmental Information External to the Organisation

- Manufacturers' data, including information such as Safety Data Sheets and operating or maintenance instructions.
- In many countries, legislation is made freely available online, or available to purchase as a hard copy.
- Enforcement bodies publish guidance documents on compliance with environmental law and promoting good practice.
- Government-supported organisations whose role is to support and encourage environmental improvements in specific areas. Examples of these in the UK include the Waste and Resources Action Programme (WRAP) (www.wrap.org.uk) and the National Industrial Symbiosis Programme (www.nispnetwork.com).
- The European Environment Agency produces information for EU member states on environmental issues.
- Trade associations (such as the Chartered Institution of Wastes Management (CIWM), the Royal Institution of Chartered Surveyors (RICS), the Mineral Products Association and many others in the UK, for example) can provide specific advice and information on the areas of expertise in which they operate.
- Professional institutions (such as the Institution of Occupational Safety and Health (IOSH) and the Institute of Environmental Management and Assessment (IEMA) in the UK) exist to provide support to professional members and to promote a higher standard of training and competency for those working in these areas. Many of them also have a wide range of consultancy services and technical information available.
- International Organisation for Standardisation/British Standards Institution publish the standards such as ISO 14001:2015 for environmental management systems and often have guidance documents to support these standards.
- Commercial organisations such as Barbour, Technical Indexes, etc. all offer either online, CD or book-based systems for accessing legislation and guidance. Some of them also offer specific helpline services and documents, such as checklists and form templates.
- Encyclopaedias and textbooks are also available.

Environmental Data

Environmental Data Types

There are two ways in which environmental data can be expressed - these are known as '**absolute**' and '**normalised**'.

- **Absolute data** on environmental performance refers to data that are usually collected over a set period of time, such as total annual waste production (tonnes), or total annual water consumption.
- **Normalised data** ensure that relationships between data are clear by comparing two sets of absolute figures with each other, e.g. waste produced per employee or mileage travelled by litres of fuel.

Normalisation of data is commonly used when representing environmental data, as it allows for organisations to compare performance over time. It can be advantageous because:

- It is not always possible to measure genuine improvement by considering absolute data - e.g. energy use may be much higher in the winter, or if production has risen. At such times, using the absolute data could indicate that energy use has risen when, in fact, it has fallen owing to efficiencies within the process. Fixing the parameters is not always easy, particularly if production varies and many different products are made with different demands on energy, effluent or wastage.

- Product lines often offer the best comparisons, although each company will make its own judgment depending on its own knowledge of activities, plant and equipment.

Qualitative data (sometimes known as 'soft' data) is a term used to describe meaning rather than some kind of analytical consideration. It generates data that is non-numerical. **Quantitative data** (sometimes known as 'hard' data) is a type of data that represents numbers and frequencies. The table below gives you some examples of the different environmental data types:

Qualitative	Quantitative
Level of odour perceived by a person	Analysis of mercury concentrations in river water
Noise complaints from the public	Miles travelled in a vehicle
Colour of an emission to air	Amount of energy used from meter readings
Anecdotal evidence	Noise measured using a sound-level meter

Qualitative data can act as a useful complement to quantitative data as they give an idea of an environmental problem before it becomes known via quantitative methods. They also provide a back-up to quantitative data by broadening their scope to include people's experiences and perceptions. However, using qualitative data to understand environmental performance is fraught with challenges in terms of validation, verification, reliability and comparability.

Data Management

We will now consider a three-stage framework for the management of environmental data.

1. Identification of Sources of Data

When determining data sources it is common for an inventory to be developed for the defined scope of the data collection exercise. Appropriate data sources for the inventory will be dependent on the nature of an activity or process. Data sources may be simple or complex:

- Simple data sources are easy to obtain and could include sources such as water, energy and raw material invoices and direct measurement of emissions concentrations.
- Complex data sources are those that require working out from other types of parameters, e.g. emissions calculated from chemical formula and mass balance analysis.

2. Generating Data

Having identified the sources of data, a review should be carried out to determine their reliability. This could include consideration of:

- Maintenance and calibration of monitoring equipment.
- Identification and use of appropriate calculation methodologies.
- Understanding errors associated with monitoring devices.
- Accessibility and security of spreadsheets and other data storage tools.

When assessing the uncertainty in data, the following components should be considered:

- **Error** - this is the difference between a measurement and the actual value of the quantity that is measured.
- **Accuracy** - how near a measurement is to the actual value.
- **Precision** - the repeatability of the data; a measuring device that is precise will give the same value over and over again.

Errors in meters and measurement devices that lead to uncertainty include:

- Inherent uncertainty of the meter - this results from the design of the meter and is based on testing under ideal conditions. It cannot be altered provided that the meter is used or installed properly.
- Associated uncertainty - this results from the way that a meter or other measurement device has been used, calibrated and maintained. This uncertainty can be changed and therefore must be reduced to the lowest level reasonably possible.

3. Management of Data

The success of a data management process will largely depend on how well data is managed at an organisation. A formal system to manage data is essential if data is to be relied upon for the purpose intended. Such a system can be integrated into the environmental management system of an organisation.

They should take into account where relevant:

- **Inventory** - description of the organisational reporting values, process flows, which data sources have been included and excluded, assumptions made when generating the data and sampling and analysis regimes (e.g. methods used by external laboratories).
- **Critical equipment** - up-to-date records of equipment critical to the generation of data should be prepared (e.g. meters); such records should include description of the equipment as well as identification numbers. This will assist in ensuring that equipment is correctly maintained, operated and calibrated.
- **Roles and responsibilities** - clear roles and responsibilities for persons involved in data management are essential; this would include the data co-ordinator and any persons involved in collecting data (e.g. operatives).
- **Procedural controls** - clear instructions should be provided on how data should be collected and managed to ensure consistency. For example, how data is to be obtained, where it is transferred to and how data is manipulated and presented.
- **Hard-copy records** - data that is in hard copy, e.g. invoices or control room logs, needs to be stored, in such a way that it can be easily retrieved by auditors, management and others. Records need to be retained for the period of time stated by law or internal procedures.

Data Security

A broad appreciation of security should be present when ensuring that data is secure and standards such as ISO 17799 Information Technology - Security Techniques - Code of Practice for Information Security Management should be considered. Lack of information security can lead to problems such as open access to vital information and locally produced records not passing through data verification checks.

Quality Control

Quality checking of environmental data is a key part of data management. Checking of data should occur during all parts of the management process from original source data through to final calculation. Without these checks, errors can occur, such as those associated with:

- Transfer and transcription errors on manual data entry.
- Errors with a spreadsheet used to calculate and analyse data (e.g. formulae and function errors).
- Missing or duplicated lines in logs, spreadsheets or other records.
- Double counting of data.
- Using the incorrect version of a spreadsheet or record.
- Not using the correct conversion factors for units, metrics or default factors.

Verification and Assurance of Data

Comparison against the following factors is often used to verify and assure the quality of accountancy data and they can be applied in a similar manner to environmental data:

MORE...

www.accountability.org/about-us/publications/aa1000-guidance.html

- **Materiality** - requires that all the expected data regarding environmental performance is present. For example, in the context of a sustainability report it would be expected that all the information is present to allow stakeholders to make informed judgments and decisions and to take action. Information is classed as being of material value if an omission or misstatement could influence the decisions of users of the data. For example, if an organisation does not provide data on energy use when it is known to be an important issue in the business sector.
- **Completeness** - an organisation's presentation of data must be fair and balanced. Fairness will take into account factors such as the understandability, comparability, reliability, relevance and importance of the data. Data should be of the correct detail to enable users to make decisions based on them with a high degree of confidence. Balance requires that the data user is provided with information that does not overemphasise unimportant areas and cover up others. Both favourable and unfavourable data should be presented within the realm of the declared scope.
- **Responsiveness** - this refers to whether the data provided has responded to stakeholder concerns, policies and relevant standards and has adequately communicated these. All organisations should have systems in place to respond to stakeholders' concerns, such as the development and implementation of policies, strategies and plans.

Corporate Environmental, Sustainability and Social Responsibility Reporting

Public reporting of environmental information has evolved over the past 25 years and continues to do so in response to a variety of drivers (see below).

In the 1980s a number of large organisations operating in sectors that were perceived to have a high level of environmental risk - for example, in the oil and gas, chemicals and utilities sectors - pioneered the production of standalone Environmental Reports. These reports were produced voluntarily and were attempts to inform key stakeholders and also to influence the environmental debate and enhance the reputation of the reporting organisations. Early environmental reports focused on pollution issues, but the scope of reporting rapidly evolved to embrace other sustainability and then corporate responsibility concerns.

The oil and gas industry was perceived to be of high risk to the environment

It is now very rare to find reports that only cover environmental issues and **Corporate Social Responsibility Reporting (CSR)** reporting has become the norm. There is still confusion surrounding exactly what CSR is and what should be reported, but there is a wide recognition that reporting should cover the three main strands of environmental, social and economic sustainability.

- Environment
  - Resource consumption.
  - Control of pollution.
  - Energy and climate change.
  - Biodiversity.
  - Supply chain impacts
- Economic
  - Socially responsible investment.
  - Fair contracts and pricing.
  - Trading with emerging economies.
  - Taxes and subsidies.
- Social
  - Working conditions.
  - Fair wages.
  - Diversity.

There is also a consensus emerging on good reporting practice, and standards have now been developed to guide reporting organisations, notably the international Global Reporting Initiative.

CSR reporting remains largely a voluntary activity, but is now expected from large organisations, especially companies listed on international stock-markets.

Drivers for CSR Reporting

Organisations report on environmental and other CSR information in response to a range of drivers and to satisfy the needs of a variety of different stakeholders:

Legal

- There is a mandatory requirement to produce corporate environmental reports in certain countries, e.g. Denmark, the Netherlands and New Zealand.
- Rules on corporate governance and statutory financial reporting increasingly include CSR elements.

Financial

The emergence of Socially Responsible Investment funds, which specialise in investing only in companies with a good ethical record, has encouraged many stock market-quoted companies to participate in voluntary reporting through schemes such as the Carbon Disclosure Project, FTSE4Good and DOW Jones Sustainability Index.

Voluntary Standards

- Organisations certified to ISO 14001 must disclose their environmental policy and respond to environmental communications from stakeholders.
- EMAS-certified companies must prepare a verified Environmental Statement and publicise this.

The Media, NGOs and the General Public

- The Media and Non-Government Organisations (NGOs) often play a key role by raising the profile of environmental and social concerns, such as:
  - Destruction of rainforests.
  - Employment discrimination.
  - Working conditions in developing countries.
- Media and NGO campaigns can seriously damage the reputation and trading performance of companies that are consumer-facing, such as the major retailers, and encourage these organisations to be more open and transparent about their policies and practices.

Producing and Presenting Meaningful Information

There are three main stages to ensuring that this occurs and a report is produced to a high standard.

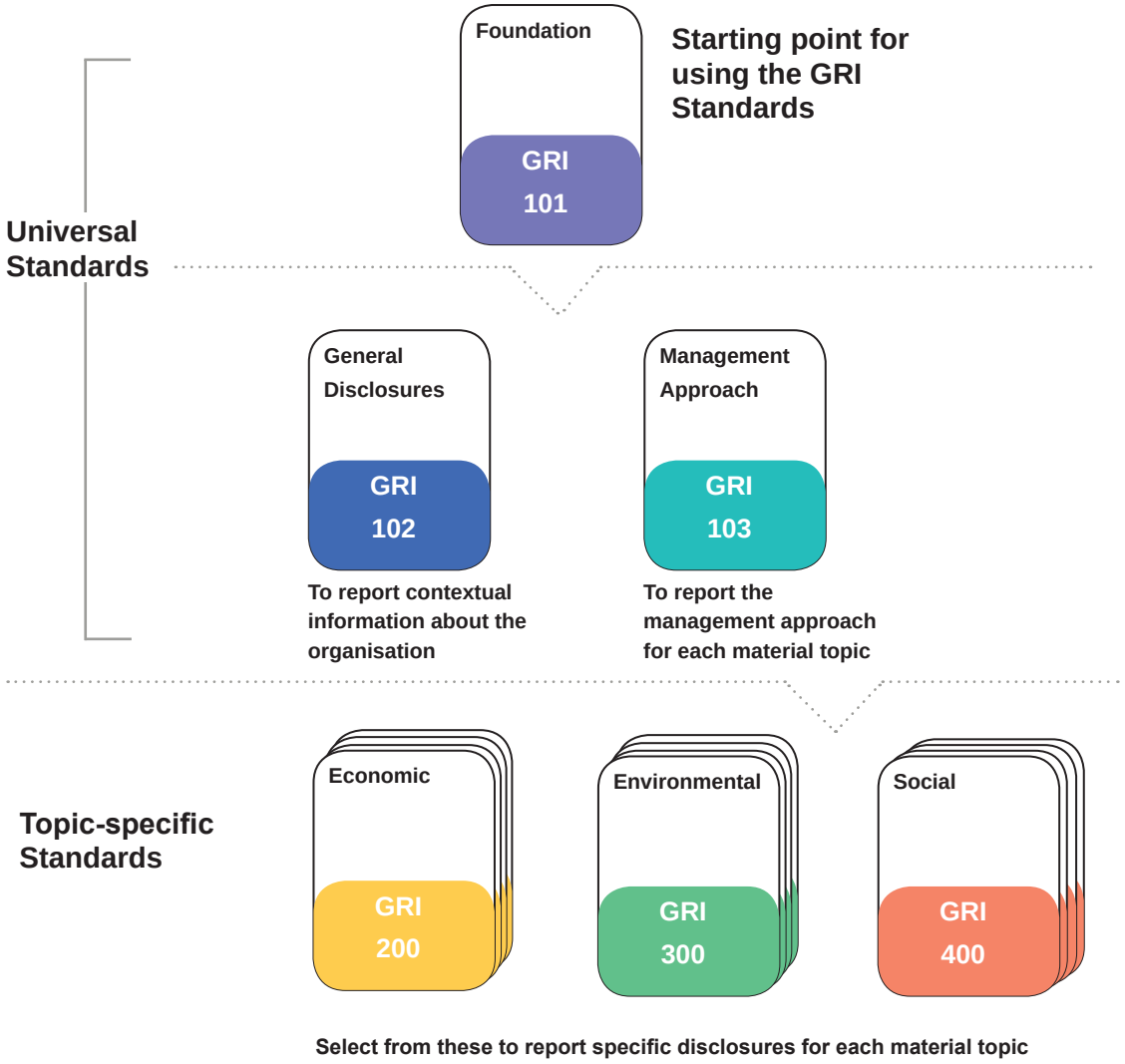
- **Secure management commitment** - as with other programmes or activities, having senior management commitment is key, as it will help you secure funds and allow you to gain co-operation of relevant colleagues.
- **Develop a reporting team** - a cross-functional reporting team should be developed, as CSR can cut across many disciplines within an organisation. Some companies will also engage consultants to assist in writing the report.

Companies' reputations can be damaged by media campaigns

- **Define your reporting objectives and scope** - this will enable a company to clearly describe them to internal and external stakeholders and secure their support. Consider:
  - Who your audience are - you may not be able to meet the needs of all stakeholders in a single report.
  - Report scope - your report may develop over time. Initially you may cover your main operation, but as the years progress the report might progress to look at activities beyond direct control.
  - What standards you will use for reporting - e.g. GRI Sustainability Reporting Guidelines (see below) and sector supplements, or industry-specific guidelines.
  - Limitations in approach - it is often seen as a positive sign if you identify areas that you need to do more to understand, deal with and report.
  - Report publishing - a decision needs to be made on whether you will produce a stand-alone document, or integrate reporting of social and environmental performance. Different audiences may also require different types of report, e.g. some companies produce shorter reports for staff, customers and shareholders.

Global Reporting Initiative (GRI)

The Global Reporting Initiative (GRI) is a not-for-profit organisation, based in the Netherlands, that has strong support from the UN and many worldwide business and governmental organisations. The aim of the GRI is to promote sustainability reporting by companies, and the organisation's sustainability reporting guidelines have become established as an important global standard. The guidelines consist of three **universal standards** (relevant to all reports) and a series of **topic-specific standards** (used to report information on an organisation's specific environmental, social and economic impacts).



The GRI Sustainability Reporting Standards

(Adapted from www.globalreporting.org/standards/gri-standards-download-center/)

The **GRI Universal Standards** are divided into three standards (GRI 101, GRI 102 and GRI 103).

GRI 101: Foundation

This Standard sets out the reporting principles for report content and quality. It also provides information on how to prepare a sustainability report in accordance with the GRI Standards. More information on reporting principles includes:

- Content of Reports

  This includes consideration of:

  – **Materiality** - a report is required to include topics and indicators that cover an organisation's significant social, economic and environmental impacts, or those that would affect or influence the assessments or decisions of stakeholders.

  – **Stakeholder inclusiveness** - a report should identify stakeholders and the ways in which it has responded to their interests and expectations.

- **Sustainability context** - the report should identify the organisation's performance in the context of sustainability.
- **Completeness** - topics and indicators and defining of reporting boundaries should be sufficient to reflect the social, economic and environmental impacts and allow stakeholders to determine performance during the reporting period.

- Quality of Reports

  Reports should be of the necessary quality. This includes consideration of:

  - **Balance** - reports should be unbiased. The report should include both favourable and unfavourable results. Reports should distinguish between factual presentation and the reporter's interpretation of information.
  - **Comparability** - this is required for evaluating performance. Stakeholders viewing the report must be able to compare information reported on economic, environmental and social performance against an organisation's past performance and stated objectives, and against the performance of other organisations.
  - **Accuracy** - the report should be sufficiently accurate and detailed for stakeholders to determine the organisation's performance.
  - **Timeliness** - reporting must happen on a regular schedule (e.g. annually) and information should be available at the correct time for stakeholders to make informed decisions.
  - **Clarity** - information should be available so that it is understandable and accessible to stakeholders viewing and using the report. Graphics and tables can help make the information in the report clearer.
  - **Reliability** - information used in the preparation of a report must be gathered, recorded, compiled, analysed and disclosed in a manner that could be subject to investigation and that determines the quality and materiality of the information. Confidence by stakeholders that a report could be checked to establish the accuracy of its contents and the extent to which it has appropriately applied reporting principles must be gained.

GRI Standard 101 also provides information on the basic process for sustainability reporting using the GRI Standards. This includes:

- **Application of reporting principles** - reporting principles for quality and content (see above) must apply to sustainability reports.
- **Reporting general disclosures** - the general disclosures in standard 102 (see below) must be reported.
- **Identification of material topics and their boundaries** - material topics must be identified using the reporting principles for report content and reporting organisation to identify the boundary for each material topic.
- **Reporting on material topics** - for every material topic the management approach disclosure (as described in GRI 103), topic-specific disclosure and other appropriate disclosure (if not covered by an existing GRI standard disclosure) should be reported.
- **References** - where reference is made to another source of information when reporting a disclosure, the location of the reference must be provided and it must be accessible.
- **Compiling and presenting information in the report** - when preparing a sustainability report the information on the current period should be provided and at least two previous periods. Information should be presented using accepted international metrics (e.g. litres or kilograms). Absolute data should be provided when using ratios and normalised data. A consistent reporting period should be defined.

The GRI 101 standard also provides guidance on making claims related to the use of the GRI Standards. This includes guidance on using GRI Standards to report specific information, making claims that a report has been prepared in accordance with the GRI Standards, reasons for omission of information and notifying the GRI of the use of Standards.

GRI 102: General Disclosures

This Standard is used to report contextual information regarding an organisation and its reporting practices. This includes:

- **Strategy** - the main compliance requirement would be to provide a statement from the most senior decision-maker and summary of key impacts, risks and opportunities.
- **Organisational profile** - this includes information such as the name of the organisation; key brands, products or services; location of headquarters; scale of the organisation; and membership of industry associations.
- **Stakeholder engagement** - an overview should be provided of the stakeholder engagement process during the reporting period. This would include information on the process by which stakeholders were engaged, and their key topics and concerns.
- **Governance** - information regarding the governance structure and composition; their role in setting values, purposes and strategy, competencies and performance; their role in risk management, sustainability reporting and evaluation of sustainability performance.
- **Ethics and integrity** - including information regarding the organisation's values, principles, standards and norms of behaviour. It also includes information regarding procedures for gaining advice both internally and externally on ethical and lawful behaviour and unethical and unlawful behaviour.

GRI 103: Management Approach

This Standard's purpose is to provide guidance about the way in which an organisation manages a material topic. It is designed for each material topic reported and consists of the following three disclosures:

- Explanation of the material topic and its boundary.
- The management approach and its components.
- Evaluation of management approach.

Topic-Specific Standards

The 200, 300 and 400 series are topic-specific standards that are used to report an organisation's economic, environmental and social impacts. Examples of these standards include:

- 200 Series: Economic
  - 201: Economic Performance.
  - 204: Procurement Practices.
  - 205: Anti-Corruption.
  - 206: Anti-Competitive Behaviour.
- 300 Series: Environmental
  - 302: Energy.
  - 304: Biodiversity.
  - 305: Emissions.
  - 307: Environmental Compliance.
- 400 Series: Social
  - 403: Occupational Health and Safety.
  - 406: Non-Discrimination.
  - 409: Forced or Compulsory Labour.
  - 413: Local Communities.

Communication of Data to Stakeholders

The type of information that would be needed to be communicated to internal and external stakeholders is stated in the table below:

Stakeholder	Information
Employees	The ethics and environmental impacts of an organisation.
Shareholders/investors	The sustainable image of an organisation and the impacts that an incident can have on reputation.
Suppliers	The impacts that an organisation's corporate image can have on their business; suppliers may not want to be associated with a business that has a poor reputation.
Customers	The ethics of the organisation and the responsible business practices that are being undertaken.
Regulators	The organisation's compliance with environmental law.
Local Community	The local environmental impacts that an organisation may have on people who live close to the site, e.g. noise, odour, air pollution, traffic and public safety.

Benchmarking and the Use of Indicators

Benchmarking is internal and external comparative assessment. It is becoming increasingly popular as an environmental management tool. Performance against benchmark activities or processes is often identified in corporate environmental reports.

DEFINITION

BENCHMARKING

A term used in industry for internal and external comparative assessment.

TOPIC FOCUS

Benchmarking can serve several objectives, including:

- **Assess significance** - how significant are the emissions or discharges in comparison to similar operations?
- **Identify areas for improvement** - if certain emissions or discharges are relatively high then it may be technically feasible to reduce these.
- **Justify performance** - if certain emissions or discharges are relatively low then this would make their reduction less of a priority.
- **Set performance targets** - it would make sense to set reduction targets in line with what seems achievable.

These objectives are derived from the wider need to prioritise measures to improve environmental performance.

The higher-level question to which benchmarking contributes is: "Which environmental measures should be taken first?" That question can be approached from a number of angles, including the environmental, political, legislative, financial and public-concern perspectives.

There are a number of different types of indicators that can be used when benchmarking environmental performance. These include:

- Emissions and discharges.
- Environmental impact.
- Environmental risk.
- Resource usage and efficiency.

The information available for comparing environmental performance can therefore consist of several of the environmental benchmarking types listed above.

Due to the large differences in the size of individual installations and in the portfolio of different operators, normalisation is required in most instances. The difference in the size of operations affects impacts and requires normalising if performance is to be meaningfully compared. For example, it is common practice to normalise emissions and discharges to tonne of equivalent product produced. We will cover indicators in more detail in Element 5.

STUDY QUESTIONS

6. Identify the key drivers for CSR reporting.
7. Identify five factors that are considered in the GRI Sustainability Reporting Standards for the quality of the content of reports.
8. Explain the meaning of the terms 'absolute' and 'normalised' data.
9. What is meant by the terms 'qualitative' and 'quantitative' data?
10. What are the four objectives of benchmarking?

(Suggested Answers are at the end.)

Environmental Policies, Procedures and Systems of Work

IN THIS SECTION...

- Policies, procedures and systems of work are important for the effective functioning of a robust environmental management system.
- For specific health and safety policies, procedures and systems of work a decision should be made as to whether it would be beneficial to integrate environmental requirements.
- Policies, procedures and systems of work need to be implemented to ensure that relevant staff are aware of the contents and understand what is expected of them.
- Environmental training is required for all employees.
- A process should be developed to deal with employee and third party complaints.

Development and Implementation of Policies, Procedures and Systems of Work

Documentation in the form of policies, procedures and systems of work is vital for the effective functioning of an environmental management system.

Policies, procedures and systems of work often cover general activities that are carried out within the workplace. Examples might include a purchasing or transport policy or procedures covering the operation of plant. In such cases it is imperative, where relevant, that environmental issues in addition to safety, quality and other issues are covered.

Environmental and health and safety implications for the management of dangerous chemicals

For specific health and safety policies, procedures and systems of work a decision should be made as to whether it would be beneficial to integrate environmental requirements. The two disciplines can often be relevant to a single defined scenario. For example, there are environmental and health and safety implications for the management of dangerous chemicals. It would be illogical to develop two procedures, one covering management of the environmental risks and the other covering health and safety. The general benefits and limitations of such an approach are broadly similar to those we covered previously for the integration of environmental and health and safety management systems.

Policies, procedures and systems of work need to be implemented to ensure that relevant staff are aware of the contents and understand what is expected of them. Implementation can take many forms depending on factors such as importance, relevance and complexity but may involve:

- setting of roles, responsibilities and authorities;
- competence, training and awareness;
- communication; and
- the development of relevant documentation.

Training and information plays a key role in the implementation of policies, procedures and systems of work. The training needs of the organisation must be analysed to ensure that training is appropriate to the EMS. This has to be balanced against the resources of the company.

Three levels of environmental training should be identified and provided where relevant:

- Environmental awareness - to create an appreciation and basic understanding amongst all staff of environmental issues.
- Specialised skills/knowledge - individual-specific-based training need for personnel involved with environmentally significant processes or activities.
- EMS training needs - certain individuals within an organisation are aware and capable of implementing an EMS (i.e. capable of writing procedures and policies, etc.).

Dealing with Complaints

Complaints are likely to be a good indication of the adequacy of environmental measures. These opinions may be voiced through the normal consultative channels - environmental/employee representatives and the environmental committee - or may be individual issues raised with management.

Generally, the fact that employees have seen fit to raise an issue, in whatever form, may be taken as an indication of a failure in the current arrangements. This may be because there are actual physical failings in the control systems that are in place. Alternatively, it may indicate a lack of understanding of the control systems, so that they feel there is a risk, even though the risk is actually properly controlled. Either way, there is a need to address the issue.

If concerns are raised, it is important that they are acted on. This not only demonstrates management commitment but also encourages a positive environmental culture in which the contribution of employees is valued.

Additionally, complaints from interested parties, such as members of the public residing in housing surrounding a site, should be recorded. They provide a useful indicator of the success of measures to reduce environmental impacts of an organisation and identify when corrective actions need to be undertaken to reduce certain types of impacts.

Analysis of complaint records can provide valuable information on determining improvement opportunities that will increase environmental performance. Documentary evidence of complaints will assist in the identification and evaluation of environmental impacts and it may also need to be retained for legal reasons (e.g. requirement of an environmental permit).

STUDY QUESTION

11. Identify ways in which policies, procedures and systems of work may be implemented in an organisation.

(Suggested Answer is at the end.)

The Principles of Assessing and Managing Contractors

IN THIS SECTION...

- When a client takes on the services of a contractor, both parties have shared responsibilities for ensuring good standards of environmental management.
- The client must carefully select contractors on the basis of their environmental competence. This can be done by looking at the contractor's policy documents, accident and enforcement history, references, qualifications and experience.
- The client must ensure that contractors carry out environmental impact assessments and develop method statements for their work.
- The client must monitor contractors to ensure that they work to agreed methods.

Scale of Use of Contractors

Contractors are used widely in the workplace, either to deliver a specific project or skill or to deliver extra labour when needed. For example, a site wanting to extend the premises would usually take on a building contractor to deliver the project rather than employing the manpower directly; in the same way a company may engage a training contractor to deliver a NEBOSH course.

The Client/Contractor Relationship

Contractors are engaged by clients in lots of different circumstances at work. A contractor may be engaged to perform a one-off service, such as the refitting of an IT suite, or they may be engaged on a more permanent basis to provide in-house catering or cleaning services.

Quite clearly it is not in the interest of good standards of environmental management for the client to ignore the impacts associated with the contractor's work or for the contractor to ignore the impacts inherent in the client's workplace.

DEFINITIONS

CONTRACTOR

A person or organisation engaged to undertake certain work on behalf of a client but not under the client's direct supervision and control.

CLIENT

A person or organisation that engages a contractor.

Contractor Management

The way that a client manages contractors can be broken down into three key areas:

- Selecting the contractor.
- Planning the work.
- Monitoring the work.

Selecting the Contractor

It is good practice to select a contractor carefully on the basis of their environmental competence. To help in this, you can ask to see evidence of competence, such as:

- A copy of their environmental policy.
- Examples of impact assessments.

Monitoring contractor work

- The qualifications and training records of staff.
- Membership of a professional organisation or certified body.
- Records of maintenance and testing for plant and equipment.
- Names of previous or current clients.
- Accident history records.
- Records of enforcement action taken by authorities against them.
- Proof of adequate resources, such as access to specialist environmental advice.
- Proof of adequate insurance.

Planning the Work

Information must be exchanged between the client and the contractor. The client should tell the contractor about the impacts in the workplace, and the contractor should tell the client about the impacts created by the contract work. In this way, the work can be planned so that the risk of an environmental incident is reduced.

The contractor should carry out environmental assessments on the work involved and develop operational controls to control the impacts identified. Operational controls must be documented and are often referred to as a 'method statement'.

Monitoring the Work

Arrangements must be made by the client to ensure the contractor complies with agreed working practices. These arrangements should include:

- Having a signing in and out procedure.
- Ensuring that the contractor provides a named works foreman.
- Carrying out site induction training for all contractor workers.
- Controlling high-risk activities with a permit-to-work system.

The client will need to monitor the contractor's work to ensure that the contractor is working to agreed standards. This can be done by monitoring against the method statement that was developed during the planning stage.

DEFINITION

PERMIT-TO-WORK

A formal, documented safety procedure forming part of a safe system of work, which ensures that all necessary actions are taken before, during and after particularly high-risk work.

Contractor Responsibilities

Contractors are responsible for their own environmental impacts. They must also ensure that:

- They do not create significant environmental impacts for their client from the work that they undertake.
- Third parties are not significantly affected by the work that they do. For example, when carrying out construction work, noise, dust and other nuisance issues should be controlled such that they do not impact on residents of housing in close proximity to the site.

STUDY QUESTIONS

12. List the evidence that could be gained to enable an assessment of a contractor's environmental competence.

13. Identify the three-step approach to managing contractors in the workplace.

(Suggested Answers are at the end.)

Development, Monitoring and Maintenance of Emergency Plans in Relation to Environmental Pollution

IN THIS SECTION...

- Natural events, such as high winds, storms or excessive rainfall can cause emergency conditions, in addition to spillages and containment failure.
- Two emergency plans are often required to be developed - on-site and off-site plans. They should, however, be complementary.
- Emergency plans can be tested by using drills, seminar exercises, walk-through exercises, desktop exercises and live exercises.
- A business continuity plan identifies the key business functions of an organisation and how to get them up and running after a crisis, in addition to the role of individuals in an emergency.

The Need for Emergency Preparedness Within an Organisation

Many environmental impacts are associated with emergency situations. A number of severe examples are given in the table below, such as the release of toxic gas into the atmosphere at Bhopal in India in 1984. Incidents like this are very rare, however, and, hopefully, will never be experienced by most organisations. But smaller-scale incidents, such as spills of oil and minor fires, are much more common and so all organisations have a responsibility to consider emergency and abnormal events in their environmental management planning. Indeed, this is a requirement of ISO 14001.

Cleaning up after an oil spill

Often the need for an emergency plan will be defined in law. In the European Union, for example, the **Control of Major Accident Hazards Directive (2012/18/EU)** set a requirement for both internal and external emergency plans for organisations that store significant levels of dangerous substances at their sites. Reference to legislation at both the regional and national level is imperative, therefore, when developing emergency plans.

Environmental and human harm

Location and Year	Incident	Outcome
Minamata Bay, Japan, 1953-1960	The Chisso Corporation's factory discharged methyl mercury in its waste water into the bay over a number of years.	The methyl mercury built up to high levels in fish and when contaminated fish were eaten by humans, it caused chronic mercury poisoning affecting the central nervous system, causing sensory impairment, numbness, dizziness, loss of vision and hearing, coma and, in some cases, death. It is thought to have affected more than 3,000 people.
Bhopal, India, 1984	A leak of methyl isocyanate gas from the Union Carbide factory.	Killed 2,000 people and affected many more. Acute effects included burning in the eyes and respiratory tract, breathlessness, stomach pains, vomiting and choking, and pulmonary oedema. Many deaths resulted from choking. Many more people are thought to have died from the long-term consequences of exposure to the gas.
Chernobyl, Ukraine, 1986	Overheating of a water-cooled reactor caused the release of radiation from a nuclear power plant.	30 people were killed immediately. The radioactive particles spread across Scandinavia and Western Europe. Several thousand people could still die from the effects of the radiation.
Basel, Switzerland, 1986	A fire at a chemicals factory resulted in fire water carrying mercury and pesticides into the river Rhine.	Half a million fish were killed and drinking water was contaminated and unusable.
Buncefield, UK, 2005	A leak of petrol from an oil storage depot resulted in an explosion.	Much of the site and buildings in the vicinity were seriously damaged or completely destroyed. Drinking-water sources in the area were contaminated by fire-water run-off. No lives were lost.
Gulf of Mexico, 2010	Explosion on the Deepwater Horizon oil well resulted in the spillage of five million gallons of oil into the Gulf of Mexico.	More than 100 miles of the USA's Louisiana coastline were affected. Over 60,000 square miles were closed to fishing. Long-term economic and ecological effects are yet to be assessed.

Emergency conditions may arise from a number of different circumstances.

Natural Events

Natural events, such as high winds, storms or excessive rainfall can cause emergency conditions to arise at a factory - for example:

- Winds may cause wind-blown dust.
- Rain can cause flooding, or prevent discharges flowing away easily.
- Storm sewers may overflow.

Natural events can cause emergency conditions to arise

Spillages and Containment Failure

Spillages can be caused by a variety of circumstances - for example:

- Road traffic accidents.
- Failure of pipes, hoses or other equipment.

An analysis of the risks should be carried out. A source-pathway-target analysis should identify the pathways and targets. Appropriate emergency procedures and equipment should then be put in place to reduce the risk to a condition that is as low as practicable. The number (and cost) of risk reduction measures will depend on the potential damage that could be done if the substances escaped, and the sensitivity of the receptor.

Emergency plans can vary from complex internal (on-site) and external (off-site) plans involving the local authority and emergency services, evacuation procedures and closure of roads and railways, to a small number of local procedures and spillage kits, to cover the spillage of a low-risk chemical in a low-risk situation.

Preparation of Emergency Plans

The two emergency plans - internal and external - should be complementary. The internal plan should include details of the arrangements in place to assist with an external emergency. Similarly, the external plan should include details of the arrangements for providing assistance for the on-site emergency.

The emergency plan should cover what response is required during each phase of the emergency, both immediately and in the longer term. During the first few hours after the accident - the 'critical' phase of an accident response - key decisions must be made quickly and under considerable pressure. A detailed understanding of the likely sequence of events and appropriate actions will help anyone who may be expected to play a part in the response.

Internal Emergency Plan

Information that should be included in an internal emergency plan:

- The names or positions of persons authorised to set emergency procedures in motion, and the person in charge of co-ordinating the internal (on-site) mitigatory action.
- The name or position of the person with responsibility for liaison with the local authority responsible for preparing the external emergency plan.
- For foreseeable conditions or events that could be significant in bringing about a major accident, a description of the action that should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and the resources available.
- The arrangements for limiting the risks to persons on site, including how warnings are to be given and the actions persons are expected to take on receipt of a warning.
- Arrangements for providing early warning of the incident to the local authority responsible for setting the external emergency plan in motion, the type of information that should be contained in an initial warning, and the arrangements for the provision of more detailed information as it becomes available.
- Arrangements for training staff in the duties they will be expected to perform, and, where necessary, co-ordinating this with the emergency services.
- Arrangements for providing assistance with external mitigatory action.

In developing an emergency plan the following should be practical considerations in the working of the plan:

- Identify the major-incident risks on the site (so you need information on the types of chemicals, their effects and properties, together with likely release scenarios).
- Get input from relevant external agencies (fire service, utilities, etc.) in developing a workable plan.

- Part of the equipment and resources mentioned earlier is the provision of an **Emergency Control Centre (ECC).** This is often a dedicated building/room in a relatively safe location (i.e. far enough away from the likely starting point of a major incident). As the name implies, this is the focal point for the emergency operations. The ECC should be kitted out with ready access to such things as site plans, contact information, chemical information and, of course, the necessary communication equipment (radios, telephones).
- Specific individuals should have clearly defined roles and responsibilities. A hierarchical incident management structure (Main Controller, Incident Controller/Officer, etc.) should be adopted; this is the model used by the emergency services.
- Provide the **necessary equipment**. This will include communication equipment (e.g. radios, in addition to those used in the ECC), spill containment (absorbents, diking equipment), necessary PPE (such as gas-tight chemical suits and breathing apparatus).
- **Maintain** all the emergency equipment and facilities. These should all be in a state of readiness. Plan for backup - have spares available in case of failures, make sure you replenish stocks that get used (absorbents, air from self-contained breathing apparatus, etc.).
- **Train** emergency personnel and practise the plan. People are naturally uncertain and confused early in an emergency where there may be little information and lots of things happening. The plan should not just be a written document, which is only ever brought out in a (hopefully rare) emergency. Personnel should be trained so that they are familiar with the procedures and their part in them. This will involve practising the plan on a regular basis.
- **Test and review** the plans regularly (at least every three years) and especially if there are significant changes that might affect them.
- For extended emergencies, you should consider arrangements for **welfare facilities** (including outside catering) and also relief of staff who were first on the scene. A major incident may not only be physically demanding for emergency responders it can also be extremely draining mentally and emotionally for decision-makers higher up the chain of command.
- Appoint and train people with the specific responsibility to manage the **press**.
- Consider **business recovery/continuity** issues - a major incident can destroy a factory. Many businesses do not recover after a major fire.

External Emergency Plan

The information that should be included in an external emergency plan:

Responsibilities must be set down and understood

- The names or positions of persons authorised to set emergency procedures in motion and of persons authorised to take charge of and co-ordinate off-site action.
- Arrangements for receiving early warning of incidents, and alert and call-out procedures.
- Arrangements for co-ordinating resources necessary to implement the off-site emergency plan.
- Arrangements for providing assistance with on-site mitigatory action.
- Arrangements for off-site mitigatory action.
- Arrangements for providing the public with specific information relating to the accident and the behaviour they should adopt.
- Arrangements for the provision of information to the emergency services of other European member states in the event of a major accident with possible trans-boundary consequences.

To enable local-authority emergency planners to draw up the external plan, the following key pieces of information are required from the operator's safety report (which amounts to an assessment of the major incident risks).

Emergency Contacts

As part of any emergency plan, there needs to be emergency contact numbers for the relevant environmental regulators. Many companies also have arrangements with emergency contractors who must arrive within a specified timescale. An emergency plan is a formal, written document designed to assist management with the control of specific hazards or incidents, so that minimum disruption to normal work activities will occur and the good name of the company will not be damaged.

Emergency Plans Content

When the range of major disruptive circumstances that could arise have been identified, individual emergency plans will then cover the following main points with regard to each of the identified hazards:

- Event.
- Location.
- Potential for harm.
- Existing instructions for dealing with the problem.
- Immediate actions to be taken.
- Control of the event.
- Assessment of the event.
- Response.
- Damage limitation action.
- Recovery plan.

In order that such a plan operates smoothly and efficiently, it is important that responsibilities are set down and understood. This will include non-company personnel, as external services such as the following are likely to/may be involved in both the development and implementation of the plan:

- Police.
- Fire.
- Ambulance.
- Welfare.
- HSE.
- Local companies.
- Environment Agency.
- DEFRA.
- Technical expertise.
- Electricity company.
- Gas company.
- Water company.
- Local transport.

Someone within the company should be trained in the responsibility for dealing with the media, as this can have a profound effect on company image.

It is important that emergency plans are monitored for ongoing effectiveness. One method of undertaking this is by testing. As described below, testing of the plan is essential and will provide a great deal of useful information on its effectiveness, such as the:

- Completeness, consistency and accuracy of the emergency plan and other documentation used by organisations responding to an emergency.
- Adequacy of the equipment and facilities and their operability, especially under emergency conditions.
- Competence of staff to carry out the duties identified for them in the plan, and their use of the equipment and facilities.

Testing Emergency Plans

Emergency plans need to be tested to ensure that they are adequate and, in particular, to assess whether staff are competent to carry out the roles assigned to them and that the necessary equipment is in place and functioning correctly. Organisations therefore need to carry out practice exercises at specified intervals. Practice exercises are usually based around acting out likely emergency scenarios (for example, a major spill of hazardous liquid). Practice exercises need to be documented and any problems and recommended corrective actions clearly identified and implemented.

Emergency plans should be tested on a regular basis. This applies to both internal and external emergency plans, and effectively sets a minimum standard. Testing must give confidence that the plans are accurate, complete and practicable. It should be able to show that people following the emergency plan could cope with the range of accidents that could occur. The testing should give an indication of the conditions that may exist on and off the establishment in the event of an emergency. It should also show that the plan would work as proposed: controlling and mitigating the effects of an accident; communicating the necessary information; and initiating the measures that should lead to the necessary restoration of the environment.

- Tests should address the response during the **initial emergency phase**, which is usually the first few hours after the accident occurs. This is the phase of an accident response when key decisions, which will greatly affect the success of any mitigation measures, must be made under considerable pressure and within a short period of time.
- Testing internal and external emergency plans (or parts of plans) at the **same time** can produce considerable benefits. These benefits include ensuring that both emergency plans work effectively together, and offering potential financial savings by avoiding duplicate testing.

TOPIC FOCUS

Exercises to test internal and external emergency plans, and which form part of the ongoing training of key personnel in preparation for dealing with an emergency, can take a number of forms:

- **Drills** using different combinations of tests in fully testing some or all aspects of the emergency plan for the internal (on-site) and external (off-site) response.
- **Seminar** exercises training staff and developing emergency plans - they facilitate discussion about the different organisations' responses in particular circumstances during an emergency.
- **Walk-through** exercises demonstrating that information on the emergency, and the response to it, is passed to all participating organisations and to the appropriate media; training staff or developing emergency plans. The emergency response is 'walked through', including visiting appropriate facilities, such as ECCs.

(Continued)

TOPIC FOCUS

- **Desktop exercises** include preparing briefs for the media and should sometimes include establishing a media briefing centre. In addition, consideration should be given as to the effect of the media in the event of an emergency, and the ability of the ECC to make information available for handling their enquiries. Desktop exercises allow information exchange and dissemination between organisations and the ECC, together with decision-making, to be tested. They are carried out in relation to a model, plans or photographs to depict the establishment. They could involve using information technology or virtual-reality systems.
- **Live exercises** fully testing some or all aspects of the emergency plan for the internal and external response.

Review of Emergency Plans

It is important to review the lessons learned from testing, to determine whether **modifications** are required to the emergency plan. With the different organisations involved in emergency plan tests, there will be more than one method for evaluating the effectiveness of the emergency plan, and each organisation may want to establish its own self-evaluation criteria relevant to its own response. For example, organisations may want to set quantitative measures like timeliness of response, or subjective measures for quality of performance.

This evaluation process needs to include the dissemination of information and the lessons learned, as appropriate, to the relevant response organisations, who need to be kept informed of progress on any actions to amend emergency plan responses. This will also cover any recommendations arising from the testing and the progress of actions to maintain an effective plan.

Crisis Management

DEFINITION

BUSINESS CONTINUITY PLAN

Identifies the key business functions of an organisation and how to get them up and running after a crisis, in addition to the role of individuals in an emergency.

Unplanned events can have a significant impact on an organisation. Crises such as fire, flooding or spillage could make it almost impossible for an organisation to carry out its day-to-day activities. Good planning, however, can lead to identification and implementation of steps to minimise the impacts of a crisis and hopefully prevent it from occurring in the first place. Such planning often takes the form of a **business continuity plan**.

Without such a plan, a natural or man-made crisis may result in:

- Work being lost to competitors.
- A failure in a supply chain, holding up production.
- Effect on corporate reputation.
- Issues with human resources.
- Significant health, safety and environmental liabilities.
- Increased insurance premiums.

A business continuity plan should therefore consist of the following:

1. Analysis of the business.
2. Assessment of the risk.
3. Development of a strategy.
4. Development of a plan.
5. Plan rehearsal.

Handling the Press and Other Media

Dealing with the press and other media is often an issue that is not given full consideration until an emergency incident takes place and it then becomes clear that there is significant interest from local and possibly national media organisations. The reputation of an organisation is arguably one of its most important assets and one that is easily lost or damaged through poor communication to the public via the media.

In the absence of any accurate, open and honest information coming from the organisation, it is potentially inaccurate information that is publicised. Once that information is in the public domain, the organisation is in the position of having to deny or correct the information.

During the planning process for emergencies, it is important that:

- Specific people are identified as being those who will communicate with the media during an emergency.
- All other employees are given clear instruction not to talk to reporters and to direct any enquiries to those members of staff who have been allocated this role.
- Nominated staff members are properly trained in how best to communicate with the media.
- When an emergency occurs, there are systems and procedures in place to ensure that nominated staff are kept fully informed of the situation regarding the emergency.

Building good relationships with local press, radio and television reporters can be very beneficial, should an emergency incident occur, as they will automatically approach the member of staff they normally deal with, who is likely to be someone trained and experienced in dealing with the media. Local media can also be supportive in getting important mitigation information to the local population, such as the need to stay indoors and close all windows. This information will be more effectively distributed if the different parties involved are used to dealing with each other.

STUDY QUESTIONS

14. Outline the contents of an internal emergency plan.

15. Outline the key ways in which an emergency plan could be tested.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- Environmental management systems are based on the Plan-Do-Check-Act model.
- ISO 14001 consists of seven key parts: context of the organisation, leadership, planning, support, operation, performance evaluation and improvement.
- The Eco-Management and Audit Scheme (EMAS) contains elements additional to those in ISO 14001 (e.g. publicly verified environmental statement).
- An initial environmental review is the starting point to implementing an EMS. It enables organisations to determine the current level of environmental performance.
- Implementing an EMS is beneficial for numerous stakeholders, including the company, customers, shareholders, the local community, lenders, insurers, etc.
- Health and safety and quality management systems can be integrated with environmental management systems. There are both advantages and disadvantages to this approach.
- Environmental data may be quantitative, qualitative, absolute and normalised.
- Corporate environmental reports, CSR reports and sustainability reports are commonly used by organisations to publicly report their environmental performance.
- Benchmarking is commonly used as a tool for organisations to assess their environmental performance either internally or externally.
- Environmental requirements should be implemented into general business policies, procedures and systems of work.
- Contractor management involves selecting the contractor, planning the work and monitoring the contractor.
- Emergency plans are often required by law.
- An emergency plan may consist of two elements, an internal (on-site) and external (off-site) plan, although the two should be closely linked.
- Emergency plans can be practised by undertaking drills, seminar exercises, walk-through exercises, desktop exercises, or live exercises.

Exam Skills

QUESTION

BS EN ISO 14001:2015 does not set specific requirements for the method of development and type of objectives to be set. Using suitable examples:

(a) **Explain** the difference between strategic and low level objectives (targets). (8)

(b) **Explain** how an organisation should proceed in setting its objectives. (6)

(c) **Describe** actions that should be considered if an objective is unlikely to be achieved within the specified time period. (6)

Approaching the Question

- Read the question.
- Consider the marks available - this time there are three sub-questions so the time allocated should be approximately 14 minutes for (a) and 11 minutes each for (b) and (c).
- An outline plan might include:

  (a) Strategic objectives - long-term, linked to policy, examples; low level objectives - requirements of performance, SMART.

  (b) Environmental review/policy, present performance, measures, objective-setting.

  (c) Data review, corrective measures, project effect of changes, objective revision.

This is the first example of a 20-mark question, which is the format of all the questions in the NEBOSH Diploma in Environmental Management exam. This question is, however, split up into three sub-questions of varying marks, which is how a 20-mark exam question is sometimes formatted.

Part (a) focuses on strategic objectives and low level objectives, which are linked but consist of some fundamental differences. Your answer to all parts must be based on objectives and use specific examples. You must also identify differences (not similarities). For part (b) the word "proceed" is used, so you must identify the key stages of the setting of objectives. The last part requires a description of what should occur if an objective is not likely to be achieved; it does not state that failure to reach the objective has occurred.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

(a) Strategic objectives are classed as longer-term goals that have a direct link to a commitment in an organisation's environmental policy. The policy commitments themselves are largely based around the significant environmental impacts of the organisation. For example, for a food manufacturer an objective may be set to reduce water consumption, which will be directly linked to a policy commitment to reduce the number of resources that are used by the organisation. The aspect in the case would be water consumption, with the impact being use of a natural resource.

Every significant impact is likely to have at least one strategic objective. Low level objectives have a direct link to strategic objectives. They provide further detail on how the objective (and associated policy commitment) is to be achieved.

Low level objectives are often Specific, Measurable, Achievable, Realistic and Time-bound (SMART). As such, measuring against the low level objective can be a method used to assess the environmental performance of the organisation. Examples of low level objectives include 'Reduce water consumption by 20% by 2017 (based on a 2015 baseline)' or 'Increase recycling of cardboard by 30% by 2016 (based on a 2011 baseline)'. Action plans are set following the identification of a low level objective and provide further detail on how the objective will be achieved.

(b) Objectives identify information that is usually collected as part of the Initial Environmental Review (IER). The IER process will provide information on the organisation's current environmental performance. It will help identify the significant environmental impacts of the organisation. For each significant impact at least one strategic objective and associated low level objective will often be set. The improvement measures required would then need to be considered, which will form the basis of the objectives.

Following this, a means of determining how to track performance with the objective would need to be considered. Environmental performance indicators could be set for each low level objective. For example, for an objective to reduce waste to landfill by 30% by 2017 (2014 baseline) the kg of waste per unit of product produced could be measured. This would allow tracking of performance against objectives, which is a requirement of ISO 14001.

When setting objectives, there are numerous factors which should be considered - for example, legal requirements. Environmental permits often require an organisation to use the Best Available Techniques to deal with environmental issues covered by the scope of the permit. Another factor will include the cost of the improvement. The resources of the organisation may only allow for a limited budget for improvements to be made. The organisation will therefore need to carefully consider what the financial implications are of implementing an improvement. This may mean that a reduced objective is set. Other limitations might include the technological options available to the business to initiate an improvement. In some cases, a reduction in environmental impacts may not be achievable, as the technology is either not available or excessively costly.

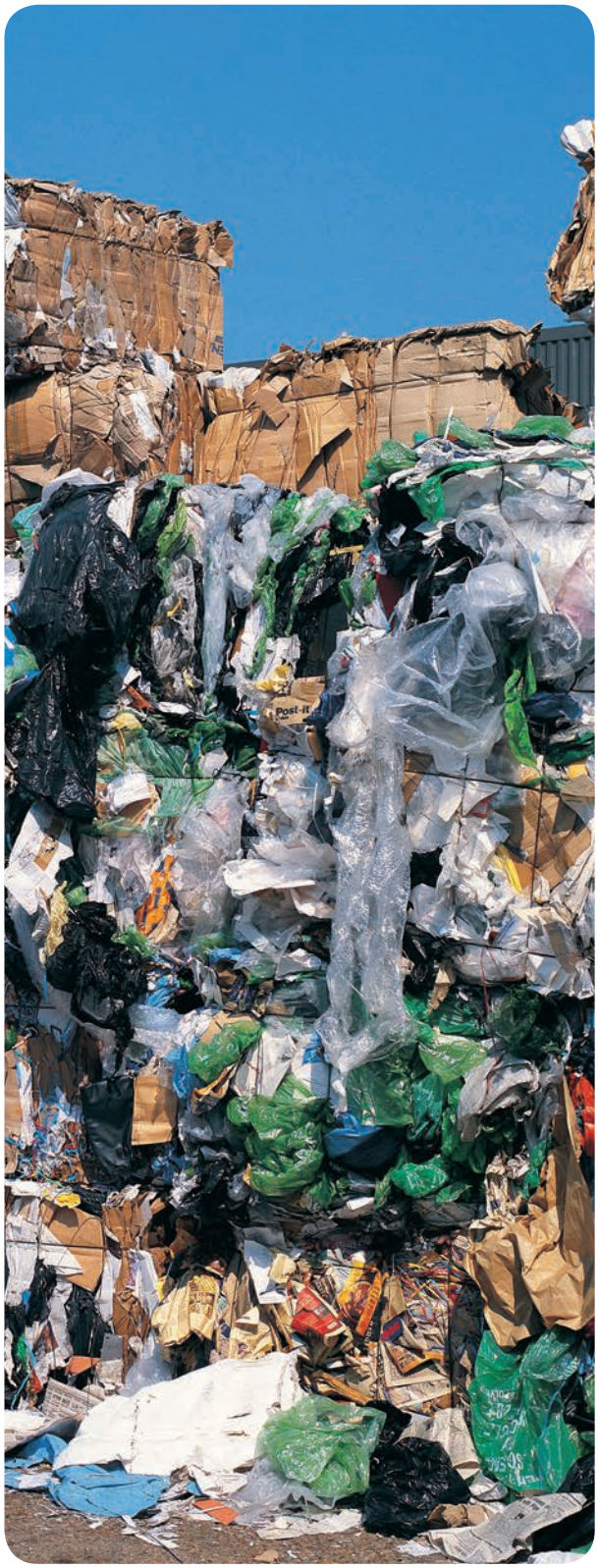
(c) Should objectives not be achieved within a time period specified by an organisation within its EMS then there are many actions that could be implemented. For example, the organisation may consider undertaking a check of performance data associated with the objective to work out in more detail why the objective is not being complied with. This will assist in determining why an objective is unlikely to be achieved and will help with the identification of measures to be implemented to ensure that the objective is complied with in the future and environmental performance improved. For example, budgetary constraints may limit compliance with an objective for training staff. By identifying such a financial constraint, an alternative supplier of training could be found, meaning that more environmental courses could be delivered in the time period owing to the reduced cost of the courses.

The organisation should also estimate the results of the change in the future, as this will help improve compliance with the objective. For example, by purchasing and implementing pollution abatement technology as an improvement to help meet an emissions reduction target, the organisation should be able to accurately estimate the reduced amount of a pollutant that is emitted from a stack to air. This will then provide a greater level of reliability that the objective will be met.

Another action that could be considered is amendment of the objective. This might include altering the timeframe, which will provide more time to implement the objective. An example might include giving another year to implement an energy-reduction objective. Additionally, the level of improvement in environmental performance may have been set too high, so the organisation could set a lower level of performance improvement, e.g. reducing water consumption by 20% by 2015 rather than by 40% by 2014 (the initial low level objective).

Element 4

Environmental Risk Evaluation and Control



Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain the principles of environmental aspect identification.
2. Explain the principles of operational planning and control relating to the organisation's significant environmental aspects.
3. Explain the techniques for evaluating environmental aspects arising from workplace activities.
4. Outline the purpose of an environmental impact assessment and environmental statement in relation to large developments.

Contents

Principles of Environmental Aspect Identification with Reference to ISO 14001:2015

IN THIS SECTION...

- An environmental aspect can be defined as any "element of an organisation's activities or products or services that interacts or can interact with the environment".
- An environmental impact can be defined as any "change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects".
- The Source-Pathway-Receptor (SPR) model can aid the identification of environmental impacts.
- Environmental aspects and impacts can be identified and assessed by selecting an activity, determining the aspects and impacts of that activity and evaluating significance.
- Monitoring is an essential tool in the management of environmental risk. Biological indicators such as fish or macroinvertebrates can be used to monitor quality of the environment.

Environmental Aspects and Impacts

As we saw in Element 3, an organisation must determine aspects and impacts that it can control and influence. This is a key part of ISO 14001.

Reminder:

- An **environmental aspect** is any "element of an organisation's activities or products or services that interacts or can interact with the environment".
- An **environmental impact** is any "change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects".

Source, Pathway and Receptor

The Source Pathway Receptor (or Target) approach is of fundamental importance in the evaluation of environmental risk and is widely applicable and a relatively straightforward tool to use. It works on the premise of:

- Identification and quantification of sources of hazards (e.g. chemicals, noise).
- Determination and possible quantification of transport (pathway) processes and mechanisms (e.g. air, soil, water).
- Characterisation, distribution and responses of sensitive receptors, such as humans, plants and animals.

Plants are sensitive receptors

TOPIC FOCUS

The **SPR approach** can be used to identify the potential effects on any of the environmental media (air, water and land).

Examples

SPR analysis

Source	Pathway	Receptor or Target
1. Spill of chemicals or oil	Drain	Watercourse
2. Release of acid gases	Air	Land* or water

*In sensitive situations this could lead to chemical changes to the groundwater.

Note: Pathways may also be receptors (such as in the case of a watercourse), and receptors can include people or land of varying sensitivities.

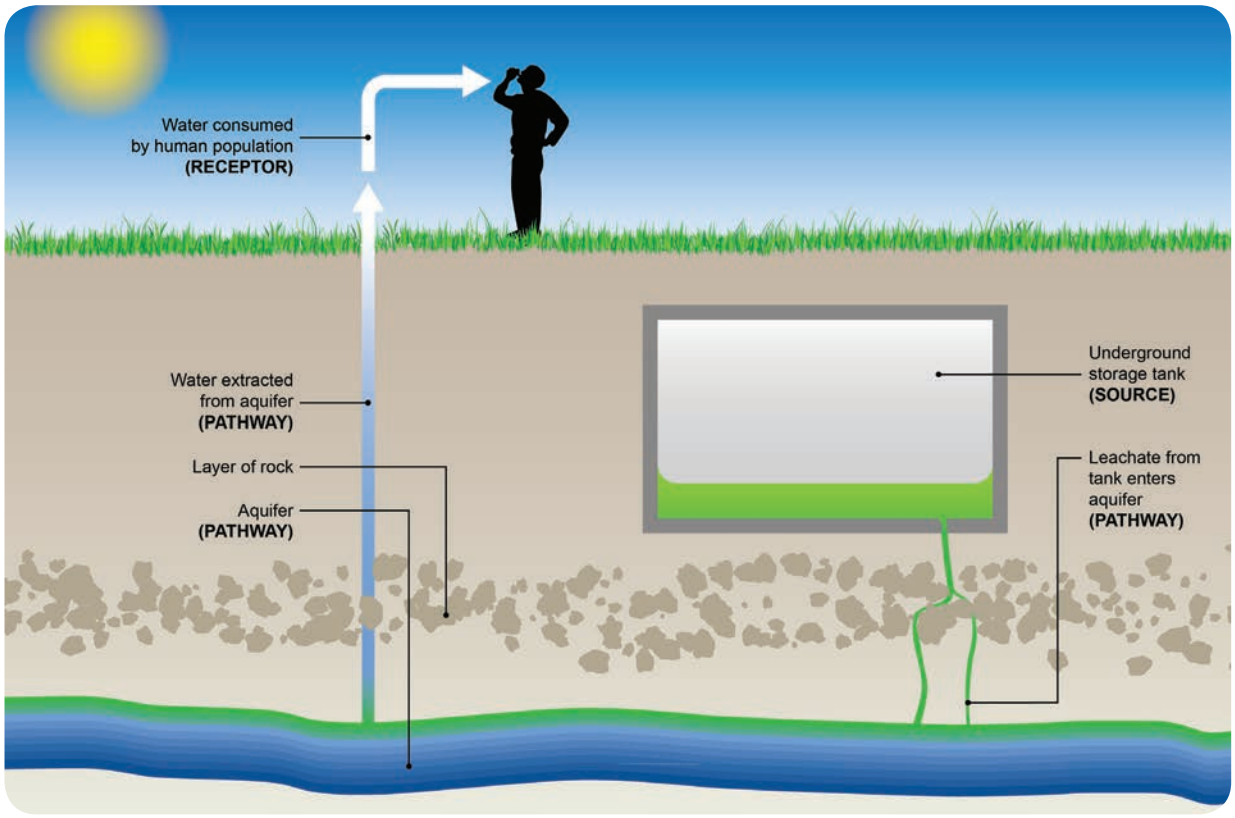
Example: A petrol-filling station - there are numerous sources, pathways and receptors, including the following:

SPR analysis

Source	Pathway	Receptor or Target
Underground fuel tank	Product loss and dissolution in groundwater	Groundwater in aquifer
	Vapour transport through soil	Humans
Fuel dispenser	Air-inhalation	Humans
Spills by users	Forecourt drains	Local watercourses

Following the above methodology, you will appreciate that a great amount of analysis is required to understand environmental harm. Although the receptor may be a watercourse, the effect may be on the fish or invertebrate life in that watercourse, or to the humans or others who have use of that water.

An SPR analysis can be represented in a figure, as you can see below:



Source, pathway and receptor - an example

Global, Regional and Local Environmental Effects

We have seen that the environment can extend from the workplace to the global environment (known as **transboundary**). Environmental impacts do not respect countries' borders - indeed it is a requirement under the **Convention on Environmental Impact Assessment in a Transboundary Context 1991** (sometimes known as the Espoo Convention) for governments to notify and consult each other on major projects that may have a significant adverse impact across borders.

Consider, as an example, two very different air emissions: a nuisance dust and a solvent emission. The former may be confined to being a local problem, whereas the latter has the potential to affect the global system (although it does not follow that the solvent emissions from one particular factory can do this on their own).

There can be direct effects of day-to-day activities; but some broader issues, e.g. purchasing, may have far-reaching effects, well beyond the company's boundaries, and will depend on the sourcing area.

Relationship between local, national and international environmental issues

Effects on Quality of Life

Nuisances such as Noise, Dust and Odour

Nuisances are matters that interfere with the normal common-law enjoyment of the use of our land or property. Common nuisance issues include:

- Premises.
- Dust, steam, smell, etc.
- Smoke.
- Animals.
- Accumulations or deposits.
- Noise.
- Fumes and gases.
- Lights.
- Insects.

Visual Amenity

Visual amenity is an issue that is normally managed through planning law under development control responsibilities. Among other things, these would cover the colour and design of buildings, landscaping, tree-planting, advertising signs, etc.

There are other matters that are visually unacceptable, such as litter or fly-tipping. Matters such as graffiti may be the underlying indicators of deeper social problems, but lessen the quality of life. Therefore, measures such as the provision of certain surfaces or planting, which can deter these problems, may be a planning requirement.

Transport Effects

In the control of air pollution, transport effects include the emission of combustion gases, such as carbon dioxide, carbon monoxide, nitrogen and sulphur oxides (NO_x and SO_x), particles, and, in lesser quantities, up to 40 other gases, such as butadiene and benzene.

Effects of traffic

Other effects of traffic should not be overlooked, including:

- Noise.
- Dust.
- Congestion.
- Changes to the landscape.
- Land-take (land used for the building of new roads, etc.).
- The effects of refuelling, etc.

The overall trend is towards better technology, improved combustion, use of catalysers and alternative fuel sources (e.g. Liquefied Petroleum Gas (LPG), biodiesel, hydrogen fuel cell) for commercial as well as private vehicles. Many organisations, particularly in the public sector, have also implemented travel plans, with the aim of making transportation more sustainable.

Waste from Consumer Products

The environment is the ultimate resource for society, providing air, water, minerals and food. It is also the sink for unwanted by-products of society: waste.

Waste and waste disposal are among the greatest issues of the 21st century. As our lifestyles change, so do the types and quantities of waste we produce. More takeaway and convenience food, individual portions in supermarkets, ready meals and DIY pre-packaged goods, all produce waste in large quantities. Packaging waste constitutes 24-30% of household waste in the UK.

The impacts of waste disposal can be significant, including:

- Nuisance caused by:
  - Noise from waste transportation and site activities.
  - Odours from landfill sites or waste incineration.
  - Dust and litter.
- Release of methane containing landfill gas causing climate change and presenting a fire and explosion risk to those near the site.
- Leachate discharged from a landfill site causing water pollution.

Environmental Impact Assessment

As we saw in Element 3:

- ISO 14001:2015 states that a **life-cycle perspective** should be considered when determining environmental aspects and impacts, which means identification of aspects and impacts 'from the cradle to the grave'. We will cover this concept in more detail later in the element.
- The way in which significant aspects are identified and assessed must be documented, detailing responsibilities and arrangements for identifying aspects, determining significance and periodically updating the information.

Below we will cover a methodology to identify and evaluate environmental aspects and impacts.

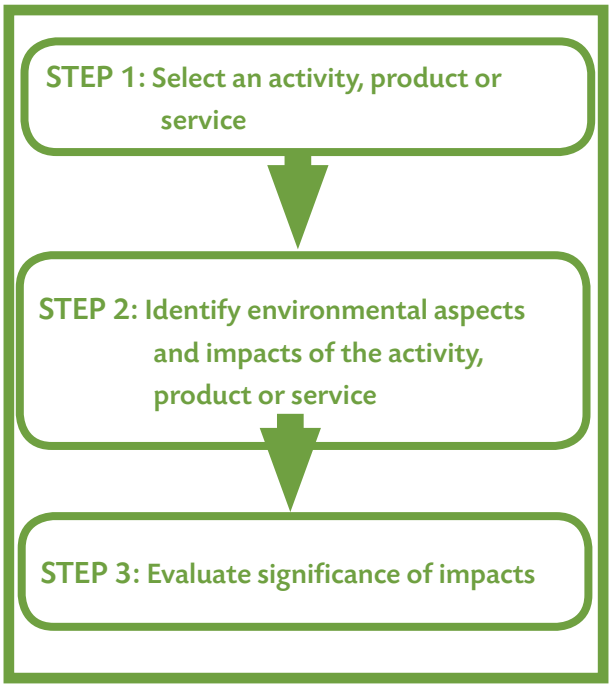
Techniques to Identify Aspects and Impacts

There are numerous techniques that can be used to identify environmental aspects and impacts and the Standard is flexible as to which is used. Probably the most common tool used is the IER. This provides the sources of information for an organisation to identify aspects and associated impacts. Other mechanisms include:

- **Life-Cycle Analysis (LCA)** - considers aspects and impacts across the full life cycle of a product.
- **Environmental impact assessment** - considers aspects at the planning stage of a development.
- **Environmental audit** - provides useful information that can be used to identify aspects and impacts.

Aspect and Impact Identification and Evaluation

A technique that can be used to identify aspects and impacts that may be included as part of the IER is as follows:



Step 1: Select an Activity

The activity, product or service selected should be large enough for meaningful examination and small enough to be sufficiently understood; e.g. an organisation may have many different compressors that use energy on-site, so depending on the size of the site, the energy use for compressors may be identified as one aspect. A process-flow diagram is often developed to identify activities on a site (from goods in to despatch) and ancillary activities that are not part of the main process should not be forgotten (e.g. maintenance, fuel storage, office activities).

Step 2: Determine the Aspects and Impacts of that Activity

Following determination of activities, the next stage is to work out the aspects and impacts of that activity as you can see below. A simple way is to consider the inputs and outputs from the activity - these are the environmental aspects.

Input/output method of identifying environmental aspects

Issues that are commonly addressed include:

- Emissions to air.
- Releases to water.

- Waste management.
- Contamination of land.
- Use of raw materials and natural resources.

Following the aspects identification, we need to determine environmental impacts that the aspects cause or can potentially cause. Research of what impact is caused by the aspect may be required. You should be aware that an aspect can have more than one impact on the environment.

Environmental impacts are usually considered within a number of contexts:

- Direct/Indirect

  Impacts can arise as a direct result of an organisation's activities. For example, in the case of a coal-fired power station, the operator of the power station clearly has management control and responsibility for the facility. The environmental impacts associated with the power station are therefore the operator's direct environmental impacts.

  But we all use electricity, don't we? We create a demand for electricity, and the more electricity we use, the more emissions the power station makes. We also have some capacity to reduce the environmental impacts associated with electricity generation by using less energy. We therefore accept some responsibility by recognising the consumption of electricity as an indirect environmental impact of our activities.

  Indirect environmental impacts are associated with many of the goods and services that we buy. For example:

  – Use of a third-party distribution contractor (air pollution from lorries).
  – Purchase of paper (cutting down forests; pollution from paper mills).

  For many organisations, especially in the service sector, indirect environmental impacts may therefore have a very high significance in their environmental programme.

- Normal/Abnormal Conditions

  All planned activities need to be considered. These will include not only those associated with normal running but also those associated with the non-routine ('abnormal'), such as maintenance and cleaning.

- Accidents/Incidents/Emergencies

  Reasonably foreseeable incidents should also be considered, e.g. fire or chemical/oil spillage.

- Past/Future Activities

  You should consider the impact from past and planned activities. For example:

  – Past land contamination has impacts that continue into the present.
  – Business plans, such as increasing production, will have future impacts that should be taken into account.

Aspects and impacts must be documented - this is often done by producing an aspects and impacts register.

Step 3: Evaluate Significance

The next stage is to determine the significance of the list of aspects and impacts. There are many ways of doing this and ISO 14001 does not provide guidance as to which technique should be used.

We will look at two examples:

- **Example 1: Simple Questions**

  For each aspect and associated impact the 'yes or no' answer to a set of questions may be used; e.g. a 'yes' answer to any of the following questions will mean that an aspect is significant:

  – Compliance obligations - is there a general legal requirement, policy commitment, or corporate/office-specific requirement?
  – Risk - does the activity present a significant risk to the environment, local or global?
  – Customers - is the aspect of concern to customers, visitors or members of the public?

- **Example 2: Risk Assessment**

  A scoring system can be developed that looks at the likelihood and consequences of an aspect (as is often used for general health and safety risk assessment).

  The following process is used to assign a priority rating for each environmental aspect:

  1. Likelihood scored according to the criteria identified in Table 1.
  2. Consequences scored according to the criteria identified in Table 2.
  3. Calculate a rating score:

     Rating Score = Likelihood × Consequence

  4. Those with a rating score greater than 6 are identified as significant.

Table 1: Example of likelihood scoring scheme

Likelihood	Definition	Score
Certain	Once a year	4
Probable	An incident which is reasonably foreseeable	3
Possible	An incident which may occur	2
Unlikely	An incident which is extremely unlikely to occur	1

Table 2: Example of consequence scoring scheme

Consequence	Definition	Score
Severe	High environmental impact Causing or may cause breach of law Causing complaints and/or concern to stakeholders	4
Medium	Medium environmental impact Small change causing breach of law Small change causing complaints or concerns to stakeholders	3
Low	Slight environmental impact Controlled by law but very unlikely to be a breach Highly unlikely to cause complaints and/or concern to stakeholders	2
Negligible	Negligible environmental impact Not controlled by law No risk of complaints or concerns to stakeholders	1

Factors to Consider in Environmental Significance Evaluation

In order to determine the significance of environmental impacts, consideration should be given to a number of sources of information.

Data on Environmental Problems

The subject of the environment, and hence environmental risk, is growing almost by the day. No course text could hope to keep fully up to date with such constantly changing material. However, there is a very wide availability of such information, largely through official and authoritative websites.

If you have access to the Internet, it is well worth while looking at the key websites, as they will prove to be useful sources of information throughout the course, for the execution of your practical project (which is part of the course), and for your future career.

There is a wide range of data available on environmental problems. Unfortunately, it is not available from a single source. The following text shows where information may be found. It is important that both as part of this course and in your work on your practical project you make use of these sources of information.

Sources of Information and Advice on Environmental Risks

Important sources of information and advice on environmental matters are numerous. Key sources include the following:

- Regulatory bodies - their websites have a great deal of guidance with regard to compliance with legislation.
- Local authorities - may provide guidance and information regarding pollution control, nuisance, etc.
- Government departments' websites - often contain a huge amount of information explaining policy and providing official guidance to environmental law, plus consultation on planned regulations, discussion and research papers. There is also a very useful section on environmental statistics and public-opinion surveys.
- Professional bodies - such as the Institute of Environmental Management and Assessment (IEMA) and the Chartered Institution of Water and Environmental Management (CIWEM) provide members with a wide range of resources, including guides to legislation and current best practice.

Use of Environmental Monitoring Data to Evaluate Risk

Monitoring is an essential tool in the management of environmental risk. Monitoring enables the environmental manager to:

- Ensure efficiency of the process, and any pollution control equipment.
- Ensure compliance with any relevant environmental controls.
- Ascertain whether the controls are adequate.
- Review the environmental impact of a process or activity.

The requirements of monitoring are frequently specified in any permit, consent or licence but monitoring may be required continuously or periodically. There are many types of monitoring regime, but three are common:

- **Controlled emissions monitoring** - used for checking operating conditions, or against a particular specification (e.g. for compliance).
- **Ambient air-quality monitoring** - to assess the general air quality, which comprises a mixture of emissions from industrial and domestic premises, traffic and other sources.
- **Fugitive emissions monitoring** - which concerns emissions that escape through open sources such as landfills, or escape from premises through leaks in pipelines, flanges, etc.

All physical forms of materials can be subject to a monitoring regime. Solids, liquids and gases have different issues, but all may require monitoring for environmental purposes.

In addition to monitoring carried out by companies, environmental regulatory bodies carry out monitoring to check for compliance with legislation. These results are usually available to the public.

Use of Biological Indicators to Evaluate Risk

Harmful substances on the land, in the air and in the water can go unseen and unnoticed. How, then, do we determine if there is any danger to ourselves or to others?

Clues can be gained about the condition of the environment by observing the plants and animals. Some plants and animals react to conditions in the environment that are otherwise difficult to identify. For this reason, they can be used as biological indicators or "**bioindicators**". They provide a good understanding of the consequences of environmental hazards.

Miners used to carry a canary in a cage into the mine shaft with them. If they hit a pocket of natural gas, the canary would pass out before any of the workers would be affected. Observing the bird gave them time to retreat out of the mine before they were in danger.

Likewise, the observation of the types and numbers of different animals can give us clues to the environmental conditions. For example, some fish and invertebrates thrive in comparison to others in certain conditions. They may flourish in waters with low oxygen content, an overgrowth of weeds, or abundant algae cover, and eat other plants and animals that also do well in these conditions. Others may do better in clear, oxygen-rich waters, feeding off other plants and animals that also do well in those conditions.

Macroinvertebrates are the most widely used organisms for biological assessment because they:

- Do not move far.
- Respond to a wide range of pollutants in the water.
- Are present in the water throughout the year and can reflect any changes in water quality that have occurred.

Biological indicators are sensitive to a wide range of stresses and, as such, provide a measure of the quality or health of ecosystems. The improvements seen largely reflect reduced pollution.

Uses of External Data Sources

Land and Water Protection

Environmental regulators' websites often have a wealth of information on water quality, groundwater source protection, flood plains and vulnerable zones, and wastes. They can be a good source of information on pollution prevention. There are often detailed guidance notes to explain the legislation. They may also provide up-to-date information on current consultation papers and legal actions.

Commercial Sources of Information

There are many commercial databases that provide updates on legislation and topical articles on environmental matters.

The Institute of Environmental Management and Assessment (IEMA) also has a large website (www.iema.net) containing current issues of importance to the environmental manager, and produces a regular magazine, The Environmentalist.

Records Search

In order to ascertain likely past history, the following types of records may be searched:

- Topographical maps.
- Special maps and plans, and other maps.
- Enforcement authority registers.
- Geological survey borehole logs and memoirs.
- Environment Agency groundwater vulnerability plans.
- Coal-mining records.

Many sources must be used if environmental risk is to be correctly evaluated. Examples are:

- Trade directories for past business use of the site - current trade directory entries also provide valuable information regarding surrounding land uses. They may indicate certain types of business that could generate pollution or nuisances.
- Aerial photographs.
- Local site history.
- Enforcement history.
- Local knowledge.
- Property deeds.
- Local planning records.

Checking external data sources

The following will also provide very useful information in evaluating risk:

- Location of any nearby landfill sites.
- Location of any site holding authorisations/permits under legislation.
- Abstraction points of drinking water.
- Explosive sites.
- Sites registered for handling radioactive substances.
- Fuel stations.
- Pollution incidents of controlled waters.
- Prosecutions for discharges to controlled waters.
- Prosecutions related to an authorised process.

Site Sensitivity

The magnitude of the effect on the receptor may vary according to a number of factors. These factors include sensitivity - for example, whether the site is protected under specific environmental legislation, including:

- Special Areas of Conservation (SACs).
- Special Protection Areas (SPAs).
- Ramsar sites (protected wetlands).

All these have special status in law, above and beyond the protection afforded to the environment in general.

Other factors include biological concentration effects and the ease and speed of transmission, which will depend on the geology and hydrogeology of the land and soil.

Limitations of Data Sources

Whatever source of information is used to assess environmental risks, certain simple quality-control checks should be undertaken to ensure that it is:

- **Accurate** - uncertainties and assumptions within the data source are understood and taken into account.
- **Complete** - any specific exclusions must be disclosed and justified.
- **Consistent** - consistent methodologies allow for comparison of data over time.
- **Faithful** - the data should be capable of being depended upon by users to represent faithfully that which it purports to represent, or could reasonably be expected to represent.

A mass of information is available on the Internet

- **Not biased** - data must avoid bias in the selection and presentation of information, and provide a credible and balanced account.
- **Relevant** - services the decision-making needs of external users.
- **Transparent** - addresses all relevant issues in a factual and coherent manner and discloses relevant assumptions and appropriate references to data sources.

A mass of information is available on the Internet, but there are no guarantees as to the quality of this free information.

Recording of Aspects and Impacts

As we saw earlier, environmental aspects and impacts are often recorded in the form of a register. Although there is no set format for an aspects and impacts register, as a minimum it will often contain the following information:

- Activity that has been assessed.
- Environmental aspects associated with the activity.
- Environmental impact(s) associated with each aspect.
- Identification of whether the aspect is from normal, abnormal, or emergency context.
- Identification of the results of the assessment against significance criteria - for example, likelihood, consequence and total scores if using a semi-quantitative method to assess significance.

Action Plan Development

Following completion of the aspects and impacts identification and evaluation process, it will be necessary to develop an action plan consisting of recommendations and timescales for action to be undertaken for significant impacts. At its simplest for each significant impact this would include developing tasks to prevent or control the significant impact, setting a responsibility for the tasks and developing an appropriate timeframe for their completion.

Monitoring and Review

An aspects and impacts assessment may need to be reviewed if monitoring or other forms of performance evaluation identify the following:

- An incident relevant to the assessment has occurred, particularly if there appear to be inadequate controls.
- Processes and/or equipment changes.
- Staff changes, particularly if there is a loss of experience and/or historical knowledge.
- Legislation changes, imposing more onerous or new requirements.
- There has been a lapse of time since the last review - technology moves on and what is considered the best available technique, or best practicable environmental option, today may not be in the future.

STUDY QUESTIONS

1. Develop a source, pathway, receptor model for a fuel spill in a haulage yard.
2. What are the three steps that are required to determine aspects and impacts?
3. What are bioindicators and how can they be used to evaluate environmental risk?
4. Outline the factors that should be considered when assessing the quality of environmental data.
5. List four key environmental issues associated with transportation.

(Suggested Answers are at the end.)

Principles of Operational Planning and Control with Reference to ISO 14001:2015

IN THIS SECTION...

- 'Best practicable environmental option' involves the analysis of alternatives. The preferred option is that which minimises harm to the environment as a whole, taking account of what is affordable and practicable.
- The fundamentals of 'best available technique' are that the selection of techniques to protect the environment should achieve a balance between the environmental benefits that they bring and the costs expended to implement them.
- Practical control strategies follow a hierarchy of: elimination; substitution; and reduction/change to the process.
- Factors affecting the choice of a control measure are long term/short term, applicability, practicability and cost.
- Health and safety and environment can sometimes conflict, creating a greater overall risk. Measures should be implemented to ensure that the impact of such issues is minimised.
- Fiscal controls are those that implement policies by using some kind of financial incentive or disincentive. They do not state what or how change should be achieved.

Best Practicable Environmental Option (BPEO)

DEFINITION

BPEO

"A BPEO is the outcome of a systematic and consultative decision-making procedure, which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term."

(Royal Commission on Environmental Pollution)

The concept of Best Practicable Environmental Option (BPEO) was first introduced in 1976 by the Royal Commission on Environmental Pollution. (Note: this organisation closed at the end of March 2011.) BPEO involves the analysis of alternatives. The preferred option is that which minimises harm to the environment as a whole, taking account of what is affordable and practicable.

A BPEO assessment uses the following framework:

- Identification and quantification of all releases.
- Determination of whether the release will comply with statutory emission limits.
- A screening exercise to identify environmentally significant releases.
- Whether or not releases will comply with statutory environmental quality objectives in the foreseeable future.
- A determination of the acceptability of the releases.
- Identification of the BPEO from a number of environmentally acceptable options.
- Identification of the process control and monitoring requirements.

Some of these, particularly acceptability options, are difficult. To assess the impact of a pollutant on the environment it is necessary to have a detailed knowledge of its structure and its chemical, physical and biological properties, seasonal fluctuation, biodegradability and persistence. In several instances, this information is not known in the literature and companies have had to carry out research to identify the effects (and hence the acceptability) of releases.

Assessment of Control Systems to Determine the Best Available Techniques (BAT) and the Importance of an Integrated Approach to Pollution Control

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities.

Operators of certain industrial processes are required to obtain an installation permit to operate (see **EU Directive 2010/75/EU** on industrial emissions (integrated pollution prevention and control)).

In order to successfully obtain a permit, operators have to show that:

- Their proposals represent the Best Available Techniques (BAT) to prevent and minimise pollution from the organisation.
- No significant pollution is caused.

TOPIC FOCUS

Best Available Techniques (BAT)

"**Best**", in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole.

"**Available Techniques**" means those techniques that have been developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the cost and advantages, whether or not the techniques are used or produced inside the United Kingdom (as long as they are reasonably accessible to the operator).

"**Techniques**" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

Various factors are considered when determining the best available technique, including:

- The use of low-waste technology.
- The use of less hazardous substances.
- The furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate.
- Comparable processes, facilities or methods of operation which have been tried with success on an industrial scale.
- Technological advances and changes in scientific knowledge and understanding.
- The nature, effects and volume of the emissions concerned.
- The commissioning dates for new or existing installations or mobile plant.
- The length of time needed to introduce the best available technique.
- The consumption and nature of raw materials (including water) used in the process and the energy efficiency of the process.

Environmental Assessment for BAT

BAT can be determined by conducting an **Options Appraisal** of candidate techniques.

The methodology involves six stages:

1. Define the objective of the assessment and the options for pollution control.
2. Quantify the emissions from each output.
3. Quantify the environmental impacts of each option.
4. Compare options and rank them in the order of the lowest environmental impact.
5. Evaluate the costs to implement each option.
6. Identify the option that represents the best available technique, taking costs and benefits into account.

The fundamentals of BAT are that the selection of techniques to protect the environment should achieve a balance between the environmental benefits that they bring and the costs expended to implement them. BAT is described in guidance that is produced at both the European and national government levels.

Selection of Operational Controls

The selection of appropriate operational controls should be based on the following factors:

- ### Control Hierarchy

  In general, the following strategy should be adopted:

  – Elimination.
  – Substitution.
  – Reduction/changes to the process.

  Elimination and Substitution is straightforward - the substance or process can be stopped, shut down or an alternative (less hazardous) substance used instead - but there has to be an awareness of potential conflicts between health and safety and the environment in carrying out this substitution.

- ### Reduction of Emissions and Changes to the Process

  Process redesign and the introduction of new plant or equipment can bring environmental benefits in terms of recovery and recycling of materials, energy savings and reduction of waste.

- ### Process Design

  The design of the plant and the introduction and strengthening of engineering controls can greatly reduce the likelihood of an environmental incident. Appropriate pollution controls should be adopted and, wherever practical, process design should consider prevention of error and consistency of results.

Process design

- ### Use of Competent Workers

  In order to ensure the success of an operational control measure, those involved with its design and implementation must be competent. As we considered in Element 2, competency can be defined as the ability to apply knowledge, skills and experience to achieve intended results.

- ### Procedural Controls

  Procedures/safe systems of work need to be developed to ensure that processes are performed in a repeatable manner.

- Monitoring and Measurement

  Performance evaluation of the operational control must be considered in order to ensure the adequacy and effectiveness of design and implementation.

- Documentary Information

  An operational control will often need to be documented and will create documented records. A system needs to be developed to ensure that such documents are controlled and managed.

Factors Affecting Choice of Operational Control Measures

There has to be a combination of methods. Control measures can basically be divided into 'physical' and 'human'. Examples include:

- Physical controls - bund walls, drip trays, safety devices.
- Human controls - information, instruction and training.

Note that the factors that affect health and safety risk also affect environmental risk in many aspects. All the control measures have valid parts to play in the management of risk.

Long Term/Short Term

Wherever possible, risks should be '**designed or engineered out**'; i.e. the equipment should prevent the possibility of the event occurring. For example:

- A detector to identify a leak in a tank will avoid the necessity of operators having to constantly monitor the situation.
- A pH meter connected to a valve that cuts in as soon as a certain pH value is reached is preferable to an operator carrying out physical checks periodically.
- Providing firewater lagoons of sufficient capacity.

Measures used in a **temporary** way usually involve higher risk than permanent solutions, e.g. the provision of spillage control equipment close to a tank containing oil not surrounded by secondary containment. Many examples of this can be found in both health and safety and the environment. Temporary solutions should be closely monitored and removed or made permanent, as soon as practicable.

Applicability

The relevance of a control technique can be described in law in similar ways to health and safety. For example, organisations under the auspices of an installation **environmental permit** are required to implement controls that represent BAT. This is a broadly similar concept to reasonable practicability in health and safety in that the cost and benefits of control measures need to be compared. BAT is described in industry-specific guidance notes produced by regulatory organisations.

Practicability

Control measures chosen must be usable and practical if they are to be effective. Employees are unlikely to use control measures correctly if they are complicated and difficult to understand. Procedures can be made easy to read and understand by using photos or flowcharts, for example.

Cost

Usually, quick gains can be made with relatively little investment, but as risk requirements increase and greater and greater reductions are required, a point of diminishing returns is met where additional risk reductions are only achievable at excessive investment costs.

Here, considerable trade-offs are apparent - for example, the increased energy requirement and subsequent carbon-dioxide release of reducing micropollutants to lower concentrations from industrial and municipal wastewaters involves a trade-off between reducing chemicals in the environment and increasing contributions to global warming through energy use.

Again, the cost of risk reduction is often detailed in law. The essence of BAT is that the techniques selected to protect the environment should achieve an appropriate balance between environmental benefits and the costs incurred by organisations. However, whatever the costs involved, no installation may be permitted where its operation would cause significant pollution.

Possible Conflicts between Protection of Workers and Protection of the Environment

It is often very difficult to separate health and safety and the environment, and, on occasions, this can lead to **conflicts**.

Significant risk to health and safety should be a priority for risk control. Specifically, it must be ensured that when environmental control options are considered (for example, the use of pollution abatement technologies, or the recovery or recycling of materials), they do not reduce the standard of occupational or public health and safety. In fact, where possible, they should reduce health and safety risk.

Example: The Vapour-Degreasing Process

Trichloroethylene (1.1.2.trichloroethylene) is a common degreasant. It is also widely used as a solvent and in the manufacture of glue and rubber products. It enters the body by inhalation, where its principal effect is depression of the central nervous system; it is also carcinogenic.

The use of trichloroethylene requires a **safe system of work** to be in place when cleaning out vapour degreasing tanks. The normal strategy, following good health and safety principles, would be elimination of the process or, if this is not possible, substitution of the substance with a less harmful one. Elimination of the substance may involve a change to soap or detergent for washing, or dry degreasing using crushed walnut shells may be appropriate in some circumstances. Solvent alternatives include terpenes and paraffin derivatives.

Because of the health issues associated with the use of trichloroethylene, an alternative solvent was eagerly sought by industry. The solvent **1.1.1 trichloroethane** seemed to be such an alternative, being **less toxic** to the human body.

However, this solvent is a strong ozone-depleting substance, implicated in creating holes in the ozone layer, and, as a result, was banned from production under the **Montreal Protocol** and the EU regulations which brought that protocol into effect.

In this case, industrial users who are unable to change their process to a non-solvent application have had to continue using trichloroethylene, and increase the protection given to the workforce through extraction, PPE, etc.

Other Examples of Conflicts

- The widespread use of **electric vehicles** will prove extremely beneficial in terms of reducing air and noise pollution, as well as significantly cutting fuel consumption. However, the silence of an electric engine will increase the safety risks for pedestrians, cyclists and other vulnerable road users, as they may not be aware of the moving vehicle until it is too late.
- The use of **de-icing salt** to improve the safety of winter driving may be harmful to the environment.
- In recent times, **porous asphalt pavement** has been used widely to take advantage of its capacity to reduce road noise and channel rainwater off the road, thus having a positive impact on the environment and road safety. However, there are indications that it may actually encourage motorists to increase their speed, and therefore their safety risks, because the low noise level makes them feel overconfident.

Reconciliation of Such Conflicts

In most cases, solving environmental problems will have a positive impact on health and safety. In some situations, however, an action contributes positively to one sector but negatively to the other.

Decisions should be made on the basis of costs and benefits in order to resolve the problem when all dimensions of the conflict have already been identified. Therefore, to find the best compromise between improved safety and a better environment, an **early evaluation** of the impact of the control measure on both the environment and safety is required to find solutions that will have the best results. This will also result in a significant **cost reduction** by limiting the need to take curative measures to mitigate unexpected effects after implementation.

Additionally, the following measures will assist in conflict resolution between the two disciplines:

- Addressing most significant environmental risks of products or services at the design stage, with due regard to health and safety.
- Employing competent people to deal with health, safety and environmental matters and obtaining competent advice where necessary.
- Environmental professionals should have access to proper training in key principles of health and safety management, such as hazard and risk assessment.
- Similarly, health and safety professionals should understand how their work might impact on the environment.

Environmental Opportunities

In addition to presenting risks to an organisation, environmental issues can also present opportunities. These will be dependent on the specific issue and organisation but common areas where opportunities can be realised include:

- **Financial savings** - through reductions in waste, energy and raw materials use.
- **Regulatory** - having good standards of environmental management will reduce the probability of an organisation breaching legal requirements and the consequent associated adverse issues such as prosecution, regulatory cost and negative corporate image.
- **Sales improvement** - where an organisation is considered to have a high level of environmental performance it can lead to an increase in sales and/or profit through access to new markets and increased customer share.

Good environmental performance can lead to an increase in sales

- **Investment** - investors are more likely to lend at a preferential rate to organisations that have a lower overall risk. Environmental risk is an important form of risk that can have a financial bearing on an organisation.
- **Staff** - potential employees are more likely to want to work for an organisation that has reputable values.

Selection of the Best Solution for an Organisation Based on Relevant Risk

The risk reduction strategy adopted by an organisation will depend on numerous factors, but will generally comprise both **human** and **physical** (or engineering) controls. Controls should aim, where possible, to eliminate harmful substances, or reduce harmful effects to a minimum. In doing so, the organisation will be complying with the spirit of environmental law, the aim of which is the prevention of harm to the environment.

In the same way that **physical controls** can reduce the risk to operators and others in the field of health and safety, they can be used to protect the environment.

Examples of physical controls include:

- Leaks in bulk storage tanks can be contained within a bund wall.
- Spillages can be prevented from reaching a sensitive receptor by spill-containment devices and equipment.
- Abatement equipment can be used to collect and treat air emissions.
- Effluent-treatment plant can be used to prevent untreated effluent reaching the drains.

Human controls - information, instruction, supervision and training - are human strategies for controlling risk. Providing adequate explanations is essential - explaining **why** something should be done, rather than a straight instruction, is usually the most successful.

Depending on the circumstances, a combination of procedural and technical control strategies will be necessary. Technical knowledge of the chemicals, machinery, etc. is essential before embarking on a risk reduction strategy.

Influence of Legislation on Control Strategies

Some control strategies may be specifically imposed by legislation; others through more general legislation, or as part of EU and UK government policy.

- General Legislation

  Legislation covers most areas of environmental management. There is legislation in place to reduce harm to health and to the environment from air emissions, waste disposal, transport of chemicals, noise and other nuisances, and water pollution, and to protect wildlife (this list is not exhaustive).

- Fiscal Strategies

  Fiscal measures, such as levies and taxes, are frequently used as a control strategy - examples include carbon taxes and emissions trading.

Effects of Government and Company Policy on Control Strategies

Some control strategies are imposed by policy, both Government policy and internal company policy.

Effects of Government Policy on Control Strategies

It is the policy of many governments to encourage waste reduction and recycling. There is a hierarchy of controls - prevention, prepare for reuse, recycling, other recovery, and disposal - introduced as part of the **Waste Framework Directive**. For this reason, recycling and recovery targets are imposed under legislation.

Effects of Insurers on Control Strategies

In some countries most environmental matters will normally be managed through a public liability insurance policy. However, since 1991 these policies do not give cover for incidents unless they are 'sudden and accidental'. The ABI (Association of British Insurers) wording is:

"This policy excludes all liability in respect of Pollution or Contamination other than caused by a sudden, identifiable, unintended and unexpected incident, which takes place in its entirety at a specific time and place during the Period of Insurance."

In practice this means that pollution from leaking tanks, or run-off from contaminated land, would not be covered by a general insurance policy. Further, many policies only cover third-party damages and do not cover own site clean-up, or regulatory authorities' orders to clean up rivers, or third-party land.

This means that work is required to ensure that these incidents do not occur and insurance companies may also require, or recommend, controls to reduce the risk of incidents.

Effects of Internal Policies on Control Strategies

Companies may also impose control strategies in the form of an Environmental Policy. These policies should be backed up by management systems, appropriate control procedures and associated information and training. Companies may further develop specific policies to cover particular areas, such as purchasing, transport, or the use or elimination of certain chemicals that are known to harm the environment, e.g. chlorofluorocarbons (CFCs).

Consideration of Fiscal Controls

Fiscal controls are those that implement policies by using some kind of financial incentive or disincentive. They do not state what or how change should be achieved, unlike most legislative instruments, but work by altering price. They will still often need some kind of legislative basis to be implemented.

Examples of fiscal controls include:

- Taxation
  - The **Landfill Tax** is a levy on the disposal of waste to landfill in the UK and was implemented as a method of reducing waste production and increasing waste recycling and recovery.
  - The **Climate Change Levy** is a UK tax on the use of energy that has been produced from the combustion of fossil fuels.
  - The **Aggregates Levy** is a UK initiative to address, by taxation, the environmental costs associated with quarrying operations (noise, dust, visual intrusion, loss of amenity and damage to biodiversity). It is also intended to reduce demand for aggregate and encourage the use of alternative materials where possible.

Landfill tax was implemented as a way of reducing waste

- Tariffs
  - There are incentives in the form of **feed-in tariffs** and the **renewable heat incentives** which constitute payment from the UK Government for the micro-generation of electricity generated from solar power and heat from renewable sources respectively.
  - **Renewables obligation** - electricity suppliers are required to purchase renewable obligation certificates that are generated from those that produce renewable electricity.
- Emissions Trading

  Tradable allowances are derived for emissions of specific environmentally hazardous substances (e.g. tonnes of carbon dioxide) that can be bought or sold. The amount of allowances that can be allocated is, however, capped. Those that release over their cap can buy extra allowances on an open market where those that have emitted under their cap can sell allowances. This works as a financial incentive to organisations which have emitted under their cap and a financial disincentive to those which have emitted over their cap. This mechanism is used for schemes such as the EU emissions trading system where carbon emissions from energy-intensive organisations must be traded.

STUDY QUESTIONS

6. Define BPEO.
7. What strategy is used by the pollution prevention and control regime to prevent and minimise pollution?

(Suggested Answers are at the end.)

Evaluation of Environmental Aspects and Impacts

IN THIS SECTION...

- Cost-Benefit Analysis (CBA) compares the value of costs and benefits in a single monetary unit of measure.
- CBA is seen by some as a prerequisite for sustainability; others believe CBA does not encourage sustainability.
- Models are used to test environmental systems that it may not be possible to field-test. Examples include air-quality impact assessments, dispersion analyses and water-quality modelling.
- Conceptual models are written as diagrams and provide a compact visual statement of a problem.
- A quantitative model is a set of mathematical expressions, coefficients and data attached to a conceptual model.
- A life-cycle assessment is an assessment of the impacts of a product on the environment through its whole life cycle, from 'cradle to grave'. It consists of four stages: definition, inventory analysis, impact assessment and interpretation.
- Ecotoxicology is the study of how chemicals affect the environment. Lethal Concentration (LC50) is one example of a measure of ecotoxicity.

Cost-Benefit Analysis

Cost-Benefit Analysis (CBA) aims to translate all impacts into **monetary values**. The aim is to help decision-makers by 'translating' environmental and social costs into a single unit of measure - money - that they already use to make decisions. In theory, this allows all impacts to be put on the same footing. It is a general technique with no specific approach or methodology, so, if asked to perform a CBA, one should always clarify what is needed or expected.

CBA translates all impacts into monetary values

Examples of cost-benefit analyses include:

- Environmental impact of an industrial plant.
- Convenience for users of a new railway.

The major constraint in applying CBA is that not all environmental changes are readily amenable to economic valuation. As a result, hybrid approaches have been developed. They generally take the economic valuation as far as is credible and leave the remaining impacts in non-monetary terms.

CBA is an important tool to inform the decision-making process, but it does not by itself make decisions. One should not automatically pursue the most economically efficient project, without weighing efficiency against the other important criteria that affect overall social desirability.

Cost-Benefit Analysis as Applied to Environmental Risks

There are several different CBA techniques that may be used to derive the monetary value of environmental and social costs. These techniques are described in the table that follows.

Cost-Benefit Analysis techniques

Technique	Description
Dose-response approach	Determines the links between pollution (dose) and its impacts (response), and values the final impact at a market or shadow price (e.g. cost of crop/forest damage from air pollution).
Replacement cost approach	Ascertains the environmental damage done and then estimates the cost of restoring the environment to its original state.
Avertive expenditures	Measures expenditures undertaken by households that are designed to offset some environmental risk (e.g. noise abatement).
Travel cost method	A detailed sample survey of travellers to a site determines how they value the (mainly recreational) characteristics of the site and the time spent travelling to the site (e.g. visiting a nature area).
Hedonic price methods (house prices approach)	Applies to environmental attributes that are likely to be capitalised into the price of housing and/or land. Involves assembling cross-sectional data on house prices, together with data on factors likely to influence these prices, and analysing these using multiple regression techniques.
Contingent valuation	Involves asking people for their willingness to pay and/or accept compensation for changes in environmental resources.
Contingent ranking	Individuals are asked to rank several alternatives rather than express a willingness to pay.

Application of CBA

CBA and Sustainability

Society as a whole prefers to receive goods and services now and defer costs to later. This 'social time preference' is the rate at which society values the present with respect to the future. CBA calculates its results from the perspective of the present generation.

Opinion therefore differs about the ways in which CBA can be made consistent with sustainable development:

- CBA is seen by some as a prerequisite for sustainability, since CBA is concerned with ensuring that actions are not taken where costs exceed benefits.
- Others see CBA as not encouraging sustainability as a result of CBA giving cost in the future less weight than cost incurred now. Therefore, there is a risk that this would lead to an emphasis on short-term gain over the needs of future generations.

CBA and Stakeholder Analysis

Although in individual cases, overall policy benefits may exceed policy costs, the spread of those costs and benefits for individual stakeholders may be very different. Stakeholder analysis enables the decision-maker to identify the potential winners and losers. Losers may well block or delay a policy, even though the net societal benefits are positive.

Environmental Modelling

This is a useful tool for understanding and predicting environmental changes over various times and areas.

TOPIC FOCUS

Models can be used to explore ideas regarding environmental systems that may not be possible to field-test for logistical, political or financial reasons. Examples of scenarios where environmental models are commonly used include:

- Air-quality impact assessments and dispersion analyses.
- Water-quality modelling.
- Groundwater risk assessments.
- Long-range and near-field pollutant transport investigations.
- Contaminated land studies.

The process of formulating a model can be extremely valuable for organising thought, identifying hidden assumptions and identifying data needs.

In this course, you are not expected to be able to develop or use the models discussed below, but you do need an understanding of what models are used for, their applications and some of their limitations.

Principles and Application of Environmental Modelling

Conceptual Models

These are generally written as diagrams with boxes and arrows, to provide a compact visual statement of the problem. The model should incorporate sufficient detail to capture the necessary environmental structure and processes, and still be simple enough to be useful. It should enable the analyst to formulate hypotheses, identify the available data and what additional data is required.

Quantitative Models

A **quantitative model** is a set of mathematical expressions, coefficients and data attached to a conceptual model.

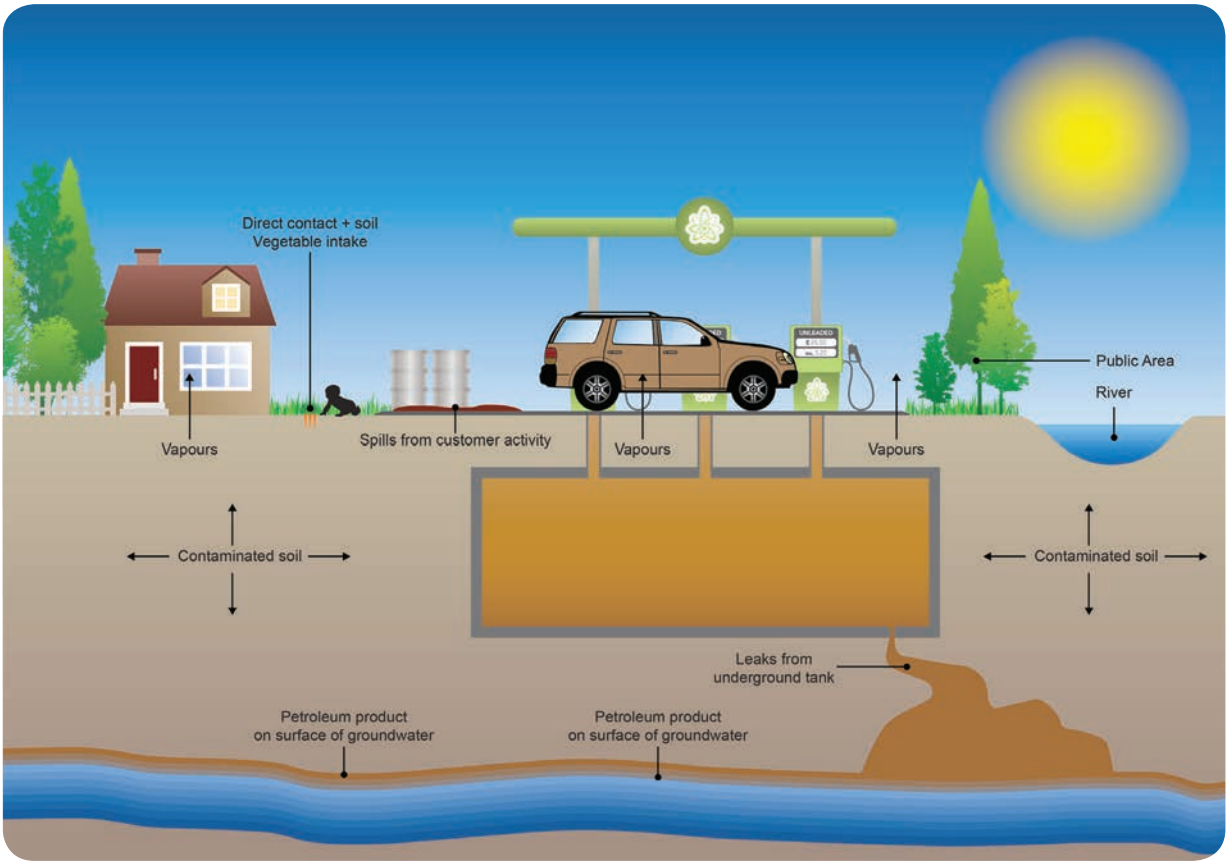
These enable predictions to be made for the values of stated variables under varying circumstances (e.g. differing weather conditions, increase in river flow). Often, they are used to generate predictions for situations where actual tests are impossible to run, owing to environmental, social or economic reasons, or where the timescales involved are too long, e.g. impact over 100-year time span.

Sensitivity analysis of a quantitative model can identify which processes and coefficients have the greatest effect on the results. It explores whether the conclusions would change if the parameters, initial values, or equations were different.

Models can be based on:

- **empirical** (observed) data; or they can be
- **mechanistic**, being based on hypotheses regarding the processes involved.

They can become quite complex, particularly when they are used as a basis for policy and resource-management decisions.



Simplified, illustrative conceptual model for exposure to hydrocarbon fuels at petroleum retail sites
(Based on original source Guidelines for Environmental Risk Assessment and Management, DETR (now DEFRA), 2000)
The most recent government guidelines are available at:
www.gov.uk/government/uploads/system/uploads/attachment_data/file/69450/pb13670-green-leaves-iii-1111071.pdf

Deterministic and Stochastic Models

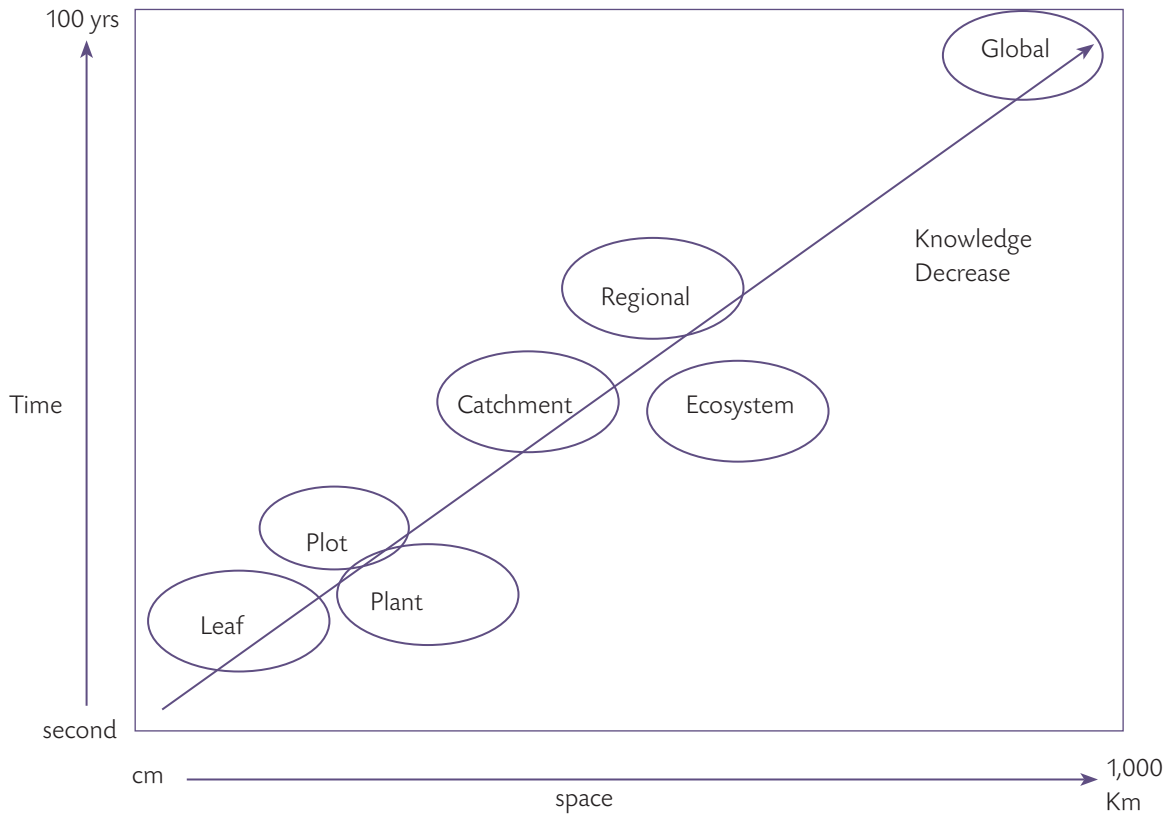
Consider the following quantitative model types:

- A **deterministic** model has no random components and every time it is run with the same parameters and conditions, the same results will be produced.
- A **stochastic** model has at least one random factor, so as to produce different results each time the model is run, simulating environmental variability. The randomness can be introduced using probability distributions, by adding random errors, or by using random number generators. Results are usually cast as probabilities.

Although stochastic models provide more information than deterministic models, they are not necessarily more correct and they are certainly more work to create.

Scaling

Scientific knowledge of environmental processes has largely been developed by studying those processes at a local level. Study at this level reveals the critical causes of environmental change and the processes can be accurately simulated. However, the problems affecting us now are often expressed on regional and global scales.



Typical scales of environmental models

Some common scaling problems include:

- Difficulties in aggregation of large-scale behaviour from local processes due to spatial variation and non-linear processes.
- Different processes predominate at different scales; correlations derived at one scale may not be appropriate at another.
- The interaction between processes operating at different scales, e.g. small, fast local processes may be constrained by large, slow ones.
- Emergent properties from mutual interaction of small-scale components.
- Time lags in the response of a system to change.

GIS and Environmental Modelling

As many environmental models involve a spatial component, they lend themselves to the use of GIS (Geographical Information and Spatial Referencing Systems). The inputs and outputs can be stored in an efficient fashion and easily related to information from other sources, e.g. farm boundaries or land use, and it is possible to link these to the high-quality graphics and animation capabilities of GIS, in a way that makes it possible to convey abstract technical concepts and modelling to a non-technical audience.

Example applications:

- Climate change.
- Surface water.
- Groundwater.
- Watershed/water catchment.
- Ecosystem.

Dispersion and Transport of Pollutants in the Atmosphere

A pollutant plume emitted from a single source will be transported in the direction of the mean wind. It is acted upon by the prevailing level of atmospheric turbulence, which causes the plume to grow in size as it entrains the (usually cleaner) air. There are two main methods of generating atmospheric turbulence: mechanical turbulence (generated as the air flows over obstacles on the ground), and convective turbulence (associated with solar radiation).

Air Modelling - Use of Models

Models are used for regulatory purposes to show compliance with a given set of parameters, given as part of a legal permit. They are also used for support of a given policy or course of action, for the provision of public information, or for scientific research.

Dispersion models link measured air quality with emissions data.

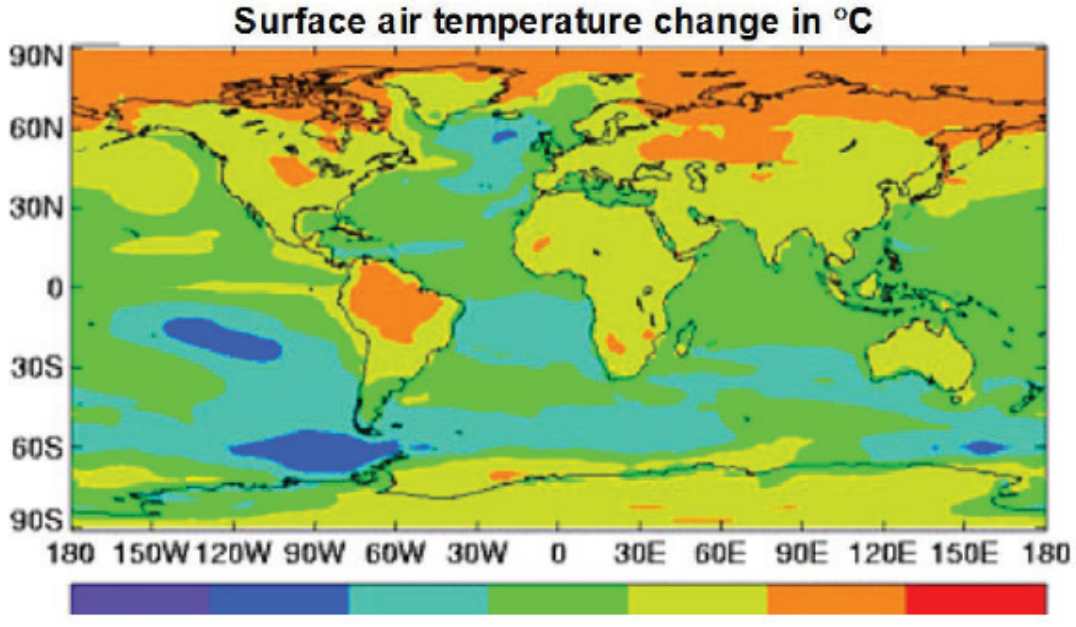
DEFINITION

DISPERSION MODELS

Describe how pollutants are spread and mixed in the atmosphere. Mathematical procedures are used to calculate pollutant concentrations based on emission rates (mass of pollutant emitted over time) and dilution rates (the volume of surrounding air into which the pollutant is being mixed, per unit of time).

In air-pollution assessments, all parts of the cause and effect 'chain' have to be evaluated, and whereas air-quality monitoring may be defined as the systematic collection of information from measurements and other means, monitoring alone will not achieve the best possible description of the concentration or space/time relationships. Spatial scales may vary from street level up to the global scale, and although measurements may form an important part of monitoring, for many purposes, models are often needed to establish larger-scale average exposures or deposition fields.

The reasons for modelling include greater representation of effects under changing conditions, such as release quantities, meteorological conditions, or to account for the local topography. Models can also be used to predict the effect of various sources and emission scenarios.



This figure shows some key results from climate change experiments conducted using Hadley Centre (part of the Meteorological Office) computer models of the climate system. It is important to be aware that predictions from climate models are always subject to uncertainty because of limitations in our knowledge of how the climate system works, and in the power of the computing resources available. Different climate models can give different predictions.

Dispersion in Water

The impact of a discharge on any water body is dependent on discharge quality and quantity, and prevailing physical and chemical conditions of the waters receiving the discharge. In contrast to a river, the physical and chemical conditions of tidal waters are highly variable, both spatially and temporally, owing to tide and wind currents, the bathymetry of the seabed and seasonal river flow and quality.

Therefore, in order to assess the impact of a discharge to a tidal water body, it is necessary to predict the duration over which the pollutants may act, the area of impact and whether any other discharges (diffuse or point) might impact the same area. This assessment is normally made with some form of predictive model to enable simulation of different discharge quality parameters, in combination with the different physical and chemical conditions of the receiving waters.

Models vary greatly in type and complexity, but it is essential that the model chosen is appropriate to the situation in which it is being used. It is also important that the model is properly calibrated and validated, in order to ensure that the model output is reliable and accurate. This is a specialist area which requires an expert in the field to carry out the modelling process.

In the case of water modelling, the amount of data and the complexity of the data will depend on whether the water system is a river, an estuary, or coastal system. This is because tidal effects, mixing effects and degrees of salinity all affect the behaviour of pollutants.

Limitations of Environmental Modelling

A single sample for one process will seldom be an adequate basis for control decisions.

The means of data collection, the accuracy of the data analysis, and the limits of accuracy of the test/detectable limits and all the factors relating to the reliability of the information, must be sought. The relevant factors relating to the monitoring and/or sampling must be recorded, along with the results as a reference. This information may include nature of the sample, method of collection and analysis, relevant local conditions including meteorological conditions, and time and temperature at the time of sampling.

Modelling, Monitoring and Control

Remember that monitoring is not a means of control - it is a means by which failure and defects in control are made apparent, and a means of demonstrating the continued effectiveness of controls.

Life-Cycle Analysis

DEFINITION

LIFE CYCLE

Refers to the notion that accurate assessment of the impacts of a product on the environment should take into account the effects of the product in its whole life cycle, including raw-material production, manufacture, distribution, use and disposal.

The sum of these phases is known as the life cycle of the product.

The theory may be used to improve the environmental performance of an individual product, or a whole organisation. A classic application of Life-Cycle Analysis (LCA), for example, is to determine whether a milk bottle made of glass is more or less burdensome than a plastic milk bottle.

LCAs may be carried out:

- By a sector of industry to highlight where environmental improvements can be made.
- To provide environmental data for the general public or government.

Major companies also use LCAs and they are often referenced in advertising campaigns to add value to claims of a product being kinder to the environment.

Cradle-to-Grave Concept

The cradle-to-grave approach involves a full assessment of the impacts of a process or product.

It is often necessary to look beyond the immediate effects (say, of manufacturing) to study all the effects associated with the process or product, starting with the raw materials and their production, and ending with the final disposal. For example, it may be the case that the major effects of a washing machine are not in the manufacture but in its use.

The cradle-to-grave approach enables a 'holistic' view of the environment and would include:

- Extraction of raw materials.
- Transport of raw materials.
- Construction effects of the process plant.
- The production process.
- Use of the product.
- Disposal of the product.
- Demolition of the process plant.

Transport of raw materials

Principles and Techniques of Life-Cycle Analysis

There are four key steps to LCA:

- **Definition** - defining the goal and scope of the study.
- **Life-cycle inventory analysis** - gathering data and making a model of the product life cycle with all the environmental inflows and outflows.
- **Life-cycle impact assessment** - understanding the environmental relevance of all the inflows and outflows.
- **Life-cycle interpretation** - evaluating their relative importance.

Key Steps of Life-Cycle Analysis

Step 1 - Definition of Goal and Scope

The scope should be sufficiently well-defined to ensure that the breadth, the depth and the details of the study are compatible and sufficient to address the stated goal.

One of the early problems with LCA was that it was almost impossible to make meaningful comparisons between different materials or products. To help solve this, comparisons are now usually based on the function served by a product or service. The functional unit sets the unit of comparison for two or more products fulfilling the same function.

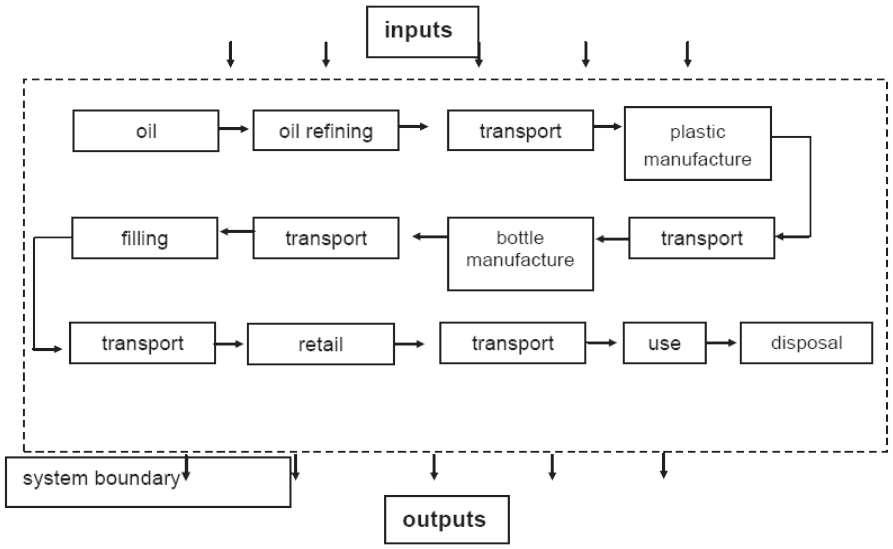
A functional unit must be measurable and may be, for example:

- The packaging used to deliver a given volume of toothpaste.
- The amount of detergent required for a standard household wash.
- For paint, the unit surface protected for a specified time period.
- For building insulation materials, the thermal insulation value of a kilogram, or one centimetre thickness of material.

The functional unit is the pivot of the LCA study - it provides the reference to which inputs and outputs are related, and helps make it easier to clearly compare LCA results.

The processes connected to the functional unit are generally referred to as the 'product system'.

Product systems tend to be interrelated in a very complex way. For example, in an LCA on milk cartons, trucks are used. However, trucks are also products with a life cycle. To produce a truck, steel is needed; to produce steel, coal is needed; to produce coal, trucks are needed, etc. It is clear that one cannot trace all inputs and outputs to a product system, and that one has to define boundaries around the system. It is also clear that by excluding certain parts as outside the system boundaries, the results can be distorted. It is helpful to draw a diagram of the system and to identify the boundaries in the diagram.



Simplified system for the life cycle of a plastic bottle, based on information supplied by SmithKline Beecham; from IEM Journal, Vol. 5, June 1998

Step 2 - Life-Cycle Inventory Analysis

The most demanding task in performing LCAs is data collection. Depending on the time and budget available, there are a number of strategies used to collect such data.

It is useful to distinguish two types of data:

- Foreground data - very specific data which you need to model your system. Typically, these data describe a particular product system and particular specialised production system.
- Background data - for generic materials, energy, transport and waste management systems. These are typically data you can find in databases and literature.

In many cases, you will have to collect foreground data from specific companies. One or more questionnaires usually need to be developed to collect such data. It is important to establish good contacts with the people who are supposed to fill in the questionnaire and to understand what they know, in what way data are available, and what terminology is used.

Often, 80% of the data you need is background information that you do not have to collect via questionnaires, as it is readily available in databases, or can be found in literature or on the Internet (e.g. www.ecoinvent.ch).

Step 3 - Life-Cycle Impact Assessment

In this step, inventory results are linked to physical impacts on the environment. There are three phases to consider:

- Classification and characterisation.
- Normalisation.
- Evaluation or weighting.

In the classification phase, all substances are sorted into classes according to the effect they have on the environment. For example, substances that contribute to the greenhouse effect, or ozone-layer depletion, are divided into two classes. Certain substances are included in more than one class. For example, NO_x is found to be toxic, acidifying and causes eutrophication.

Characterisation provides a basis for aggregation of inventory results within each category. For example, many emissions are thought to contribute to global warming. At the characterisation stage, the relative significance of each of the contributors is calculated by converting to a common indicator.

In global warming, the Global Warming Potential in CO_2 equivalents is the most common indicator. For example, if a product results in the releases in column A, then the CO_2 equivalent will be as shown in column B:

Substance	A (kg)	B (equiv./kg)
Carbon Dioxide	3.2	3.2
Nitrogen Dioxide	0.15	43.5
Tetrachloromethane	0.0003	0.6
Total GWP in CO_2 equivalents		**47.3**

Environmental categories and common indicators used in LCA studies

Reserve depletion:	Application of depletion factors for reserves to the inventory.
Greenhouse effect:	Application of global warming potentials to the inventory.
Acidification:	Application of acidification potentials to the inventory.
Nitrification:	Application of nitrification potentials to the inventory.
Smog formation:	Application of photochemical ozone creation potentials to the inventory.
Potential toxicity:	Expert assessment based on potential for toxic effects. This includes both the risk of uptake in the human food chain and phytotoxic effects.

In order to gain a better understanding of the relative size of an effect, a normalisation phase is required. Each effect calculated for the life cycle of a product is benchmarked against the known total effect for this class. Normalisation enables you to see the relative contribution from the material production to each already existing effect.

Normalisation considerably improves insight into the results. However, no final judgment can be made as not all effects are considered to be of equal importance. In the evaluation phase the normalised effect scores are multiplied by a weighting factor representing the relative importance of the effect.

Step 4 - Life-Cycle Interpretation

Interpretation is likely to involve a review of all elements of the LCA process, checking that these have been systematic and that assumptions made are consistent.

Results should be structured to show inventory and assessment data associated with specific operations, with a view to identifying areas of greatest environmental significance.

It is likely that the methodologies used will be similar to those used to determine significant environmental aspects and impacts in ISO 14001. Significance will be gauged with reference to both the operator (and its stakeholders) and the environment.

Reporting the Findings

A full report will typically contain a clear statement of the study objectives; an explanation of the scope of the study; a clear explanation of and the reasoning behind the drawing of the system boundary; flow diagrams which clearly describe the system and all important inputs, outputs and products (the relationship between different diagrams should be clear); and a description of the methodology used, with an explanation of value judgments and assumptions made.

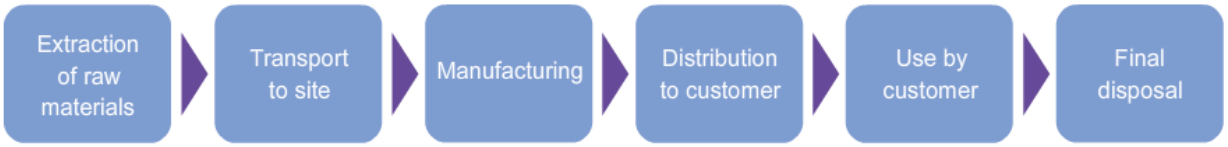
The following International Standards apply to LCA:

- ISO 14040:2006 *Environmental Management - Life-Cycle Assessment - Principles and Framework.*
- ISO 14044:2006 *Environmental Management - Life-Cycle Assessment - Requirements and Guidelines.*
- ISO/TS 14072:2014 *Environmental Management - Life-Cycle Assessment - Requirements and Guidelines for Organisational Life-Cycle Assessment.*

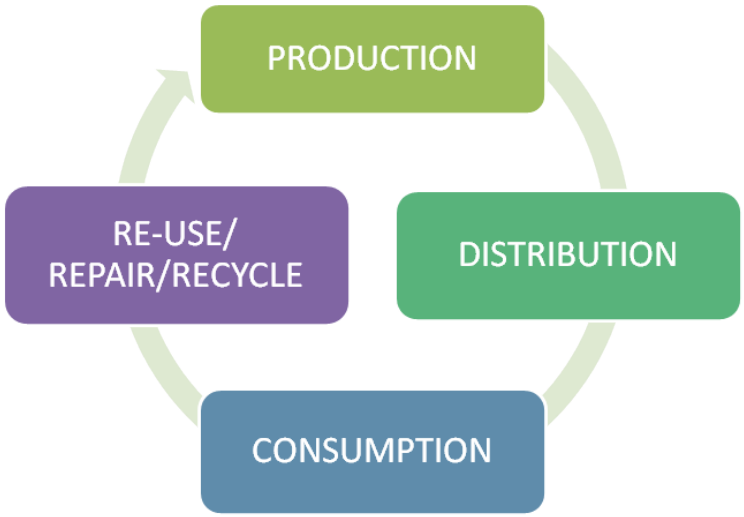
Circular Economy

A circular economy can be defined as an economy where resources are retained in use for as long as is possible. During use the maximum value of the product is extracted and when the product comes to the end of its life then as much material as possible is recovered. Such recovered materials can be used to make new products.

A circular economy differs from a linear economy, where the raw materials for a product are extracted, the product is manufactured and then used. When the product comes to the end of its use phase it is disposed of either by landfill or incineration without energy recovery. The difference between the two types of economy can be summarised in the following two diagrams:



Example of a linear economy



Example of a circular economy

The benefits of operating a circular economy in comparison to a linear economy are:

- Resources are kept in use for as long as is possible.
- The maximum value of each resource is extracted while in use.
- Products are recovered or regenerated at the end of their life.
- Reduction in pollution and waste.
- Delivers a more competitive economy.
- Reduces the environmental impacts associated with resource extraction.

Assessment of Environmental Toxicity

The Meaning of Predicted No-Effect Concentration (PNEC)

Any concentration of a substance above the Predicted No-Effect Concentration (PNEC) will cause harm. The PNEC is determined by applying an assessment factor to the results of toxicity tests on a few specific organisms.

DEFINITIONS

PREDICTED NO-EFFECT CONCENTRATION (PNEC)

Concentration of a substance below which adverse effects are not expected to occur.

ECOTOXICOLOGY

The study of how chemicals affect the environment and the organisms living in it.

Ecotoxicity: Lethal Concentration and Effective Concentration

We have already considered one method of determining ecotoxicology on organisms, the PNEC.

Other methods commonly used to assess the effects of chemicals on species include:

- Lethal Concentration (LC_{50})

  The Lethal Concentration 50 (LC_{50}) is a statistically-derived concentration of a test substance in water, which kills 50% of a test batch of organisms within a continuous period of exposure (usually 96 hours).

- Effective Concentration (EC_{50})

  The Effective Concentration is that concentration which has a harmful, but not necessarily lethal, effect on a test batch of organisms (e.g. immobilisation of daphnia, or reduction in growth of test algae).

- Lethal Dose (LD_{50})

  The Lethal Dose 50 (LD_{50}) is the quantity of a substance that will kill 50% of a batch of test organisms in a single oral administration.

Ecotoxicity has been assessed using data from many sources, including commercial databases:

- The ECOTOXicology database (ECOTOX) produced by the US Environmental Protection Agency provides a source for locating single chemical toxicity data for aquatic life, terrestrial plants and wildlife.
- Hazardous Substances Data Bank (US National Library of Medicine).
- CHEMBANK - hosted by the Broad Institute of Harvard University and Massachusetts Institute of Technology.
- Dictionary of Substances and their Effects (Royal Society of Chemistry).
- Handbook of Environmental Data on Organic Chemicals, 4th edition, by K. Verschueren.

The following terms are used:

Classification	LC_{50} or EC_{50}
Very High Ecotoxicity	<1mg/litre
High Ecotoxicity	1-10 mg/litre
Moderate Ecotoxicity	10-100 mg/litre
Low Ecotoxicity	>100 mg/litre
No effects in acute test	No toxicity in tests

MORE...

The ECOTOX website (http://cfpub.epa.gov/ecotox/) provides ecotoxicology values for a range of species and chemicals.

Principles of Environmental Toxicity and Ecotoxicity Testing

Risks from Chemical Substances

In the European Union the evaluation of the risks from all chemicals is now largely covered by the **European Regulation (EC 1907/2006) on Registration, Evaluation, Authorisation and Restriction of Chemicals** (abbreviated to **REACH**). **REACH** also deals with other things, such as the requirement to provide safety data sheets, previously covered by other legislation.

Because it is a very far-reaching piece of legislation, **REACH** is being phased in over a long transition period. REACH now deals with so-called "new substances". New substances are defined as those that are not already listed in the European Inventory of Existing Commercial Chemical Substances (EINECS). From 1 June 2008, these have been brought within the scope of **REACH**, replacing requirements under the **Notification of New Substances Regulations 1993 (as amended)**, abbreviated to "**NONS**".

From 1 June 2008 under **REACH**, all substances that have not been previously manufactured must be registered and are not eligible for the 'phase in' scheme for existing substances. Registration involves collecting and collating information regarding the properties of a substance. The amount of information required is dependent on the **hazards** and **tonnage** of the substance that will be registered. This information is then required to be used to undertake a risk assessment that will identify how potential risks from the substance can be controlled. The assessment and collected information must then be submitted to the **European Chemicals Agency (ECHA)** in Helsinki.

For many common hazardous chemicals, available data have already been evaluated and a harmonised, European-wide classification adopted. Classification and labelling data for these chemicals are published as Table 3.2 of Annex VI to the **Regulation (EC) No. 1272/2008 on Classification, Labelling and Packaging of substances and mixtures**, and amending **Directive 67/548/EEC** and the **REACH Regulation**.

MORE...

For further information on **REACH**, see the relevant part of the HSE's website available at: www.hse.gov.uk/reach/index.htm

STUDY QUESTIONS

8. What is an environmental model?
9. When might you use an environmental modelling technique?
10. Outline what is meant by the 'cradle-to-grave' concept.
11. When might you use the technique of life-cycle analysis?

(Suggested Answers are at the end.)

Environmental Impact Assessments and Statements for Large Developments

IN THIS SECTION...

- Planning Environmental Impact Assessments (EIAs) are required to ensure that the environmental impacts of developments are considered in the planning stage, to comply with legislation and to ensure that the public's views are taken into account at an early stage.
- The stages of an EIA are screening, scoping, baseline studies, impact assessment significance, mitigation, application environmental statement and monitoring.
- Common environmental issues considered within an EIA include, where relevant, air pollution, land contamination, effects on the communities, water pollution, effects on ecosystems, archaeology and the built heritage and noise and vibration.

Planning Environmental Impact Assessment (EIA)

DEFINITION

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

As defined in planning law is an assessment of the impacts of a specified major industrial or civil engineering project on the environment as a whole. It is undertaken during the planning phase of a project.

The Purpose of a Planning EIA

From a planning viewpoint, the broad impact of a project must be determined, examining every aspect of the project, as certain developments may impose adverse environmental impacts in terms of land usage, pollution or infrastructure stress. Very few projects will be wholly beneficial; there will be **losses** as well as **gains**. In the case of the impact of large development projects, statutory control can be exercised by planning control legislation.

An EIA also considers the views of the public, ensuring that they are informed of the development at an early stage and have the ability to be involved in the decision-making process.

Planning EIAs are often required by law. In the EU, for example, **Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (as amended by Directive 2014/52/EU)** requires an impact assessment of developments likely to have significant environmental impacts, prior to them being granted consent by local and/or national authorities. The documentation that is submitted to relevant regulators is usually known as an environmental statement.

DEFINITION

ENVIRONMENTAL STATEMENT (ES)

A document or series of documents assessing the likely environmental impact of a development proposal and the significance of the effects arising from its impact.

Often the following types of project will require an EIA to be developed and submitted with a planning application:

- Crude-oil refineries.
- Coal gasification or liquefaction plants.
- Major power stations.
- Iron and steel plants.
- Chemical installations.
- Hazardous and radioactive waste-disposal facilities.
- Major roads, railway lines and ports.

Power stations require an EIA

Preparing an EIA

The process of preparing an EIA is usually defined in law which will vary around the world. However, common stages of an EIA will often include:

- Screening.
- Scoping.
- Baseline studies
- Impact assessment significance.
- Mitigation.
- Application environmental statement.
- Monitoring.

Process and stages of environmental impact assessment

1. Screening	This stage is a formal decision about whether the development requires an EIA or not.
2. Scoping	Decide which environmental impacts are to be considered in detail. This will depend on the type of development, for example: • Air emissions? • Noise emissions? • Discharges to water?
3. Baseline Studies	For the impacts selected above: determine the current status. For example, what is the current air or water quality like?
4. Impact Assessment Significance	Consider whether your proposed or existing development will have a significant impact. For example, will your development cause the air quality to deteriorate significantly?
5. Mitigation	If there will be a significant impact, what can you do to reduce it? For example, can you fit abatement technology to control air emissions, or not operate at night to prevent noise nuisance to residents?
6. Application and Environmental Statement	Development of an environmental statement (different terminology may be used, but this is essentially a report) to document the EIA.
7. Monitoring	All developments or existing industries will need to monitor their significant impacts to ensure mitigation measures remain effective.

To support the preparation of an Environmental Impact Assessment and Statement many individual assessments may have to be carried out. Among them will be the effects on the air or water, flora and fauna, or the interaction of emissions from the project. They may require in-depth modelling to predict effects or events (such as may occur in emergencies), which may not be possible to measure by any direct monitoring. Predictions will also be made for a plant that is still on the 'drawing board'.

Environmental Considerations

An environmental statement will often be required to cover the following:

- A description of the development.
- A description of the measures required to avoid or reduce significant environmental impacts.
- The data needed to identify and assess the significant impacts which a development is likely to have on the environment.
- An outline of the key alternatives to mitigate significant environmental impacts and the main reasons for the choice made.
- A non-technical summary of the environmental statement.

The current and future environmental issues that are included in an EIA will vary depending on the type of development and its location. However, current and future environmental considerations will cover, where relevant, the following:

- Air pollution.
- Land contamination.
- Effects on the communities.
- Water pollution.
- Effects on ecosystems.
- Archaeology and the built heritage.
- Noise and vibration.

STUDY QUESTIONS

12. Identify the stages of an environmental impact assessment.

13. Identify the content of an environmental statement.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- An environmental aspect is an "element of an organisation's activities or products or services that interacts or can interact with the environment".
- An environmental impact is a "change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects".
- The Source-Pathway-Target model is a way to model environmental risks.
- Key environmental issues include climate change and depletion of the ozone layer.
- Nuisance (from noise, odour, premises, etc.), visual impacts and transportation can affect people's quality of life.
- Environmental impacts can be determined by selecting an activity, determining the aspects and impacts of that activity and evaluating significance.
- Best Practicable Environmental Option (BPEO) and Best Available Techniques (BAT) describe the extent to which control measures are implemented.
- When choosing control measures, factors such as long/short term, applicability, practicability and costs should be considered.
- Ways to evaluate risks to the environment from workplace activities and substances released to the environment include:
  - Cost-benefit analysis (a comparison of monetary values and costs).
  - Environmental modelling (representation of an environmental system that can be used for predictive purposes).
  - Life-cycle analysis (assessment of the environmental impacts of a product from 'cradle to grave').
  - Assessment of environmental toxicity (indicators such as LC50 or PNEC can be used).
- An Environmental Impact Assessment (EIA) must be undertaken for specified large developments.

Exam Skills

QUESTION

Describe a methodology for the identification and assessment of environmental aspects and impacts for compliance with the ISO 14001:2015 environmental management system standard. (20)

Approaching the Question

- Read the question.
- Consider the marks available - there is one question worth 20 marks which should take no more than 36 minutes to answer.
- An outline plan might include select activities, determine the aspects and impacts of the activities, evaluate significance, record aspects and impacts, monitor and review.

This question focuses on describing a methodology to identify and assess environmental aspects and impacts. There are many methodologies that could be considered, in addition to the ones covered earlier in this element.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

A methodology to identify and assess environmental impacts can be described as consisting of the following.

The activity, product or service selected should be large enough for meaningful examination and small enough to be sufficiently understood; e.g. an organisation may have many different compressors that use energy on-site, so depending on the size of the site, the energy use for compressors may be identified as one aspect. A process-flow diagram is often developed to identify activities on a site (from goods in to despatch) and ancillary activities that are not part of the main process should not be forgotten (e.g. maintenance, fuel storage, office activities).

Following determination of activities, the next stage is to work out the aspects and impacts of the activity. A simple way is to consider the inputs and outputs from the activity - these are the environmental aspects.

Issues that are commonly addressed include:

- Emissions to air.
- Releases to water.
- Waste management.
- Contamination of land.
- Use of raw materials and natural resources.

Following the aspects identification, the next stage is to determine environmental impacts that the aspects cause or can potentially cause. Research of what impact is caused by the aspect may be required. An aspect can also have more than one impact on the environment.

Environmental impacts are usually considered within a number of contexts:

- **Direct/indirect:** impacts can arise as a direct result of an organisation's activities. For example, in the case of a coal-fired power station, the operator of the power station clearly has management control and responsibility for the facility. The environmental impacts associated with the power station are therefore the operator's direct environmental impacts.

Indirect environmental impacts are associated with many goods and services. For many organisations, especially in the service sector, indirect environmental impacts may therefore have a very high significance in their environmental programme.

- **Normal/abnormal conditions:** all planned activities need to be considered. These will include not only those associated with normal running but also those associated with the non-routine ('abnormal'), such as maintenance and cleaning.
- **Accidents/incidents/emergencies:** reasonably foreseeable incidents should also be considered, e.g. fire or chemical/oil spillage.
- **Past/future activities:** you should consider the impact from past and planned activities. For example, past land contamination has impacts that continue into the present. Business plans, such as increasing production, will also have future impacts that should be taken into account.

The next stage is to determine the significance of the list of aspects. There are many ways of doing this and ISO 14001 does not provide guidance as to which technique should be used.

Two ways to evaluate significance are with simple questions or by using risk assessment.

- Simple Questions

  For each aspect and associated impact the 'yes or no' answer to a set of questions may be used; e.g. a 'yes' answer to any of the following questions will mean that an aspect is significant:

  – Compliance obligations - is there a general legal requirement, policy commitment, or corporate/office-specific requirement?
  – Risk - does the activity present a significant risk to the environment, local or global?
  – Customers - is the aspect of concern to customers, visitors or members of the public?

- Risk Assessment

  A scoring system can be developed that looks at the likelihood and consequences of an aspect (as is often used for general health and safety risk assessment).

  The following process is used to assign a priority rating for each environmental aspect:

  1. Likelihood scored according to previously identified criteria.
  2. Consequences scored according to previously identified criteria.
  3. Calculate a rating score:

  Rating Score = Likelihood × Consequence

  4. Those with a rating score greater than a predetermined value are identified as significant.

Environmental aspects and impacts and associated information are often recorded in the form of a register. Although there is no set format for an aspects and impacts register, as a minimum it will often contain the following information:

- Activity that has been assessed.
- Environmental aspects associated with the activity.
- Environmental impacts associated with each aspect.
- Identification of whether the aspect is from normal, abnormal, or emergency context.
- Identification of the results of the assessment against significance criteria - e.g. likelihood, consequence and total scores if using a semi-quantitative method to assess significance.

An aspects and impacts assessment may need to be reviewed if monitoring or other forms of performance evaluation identify the following:

- An incident relevant to the assessment has occurred, particularly if there appear to be inadequate controls.
- Processes and/or equipment changes.
- Staff changes, particularly if there is a loss of experience and/or historical knowledge.
- Legislation changes, imposing more onerous or new requirements.
- There has been a lapse of time since the last review - technology moves on and what is considered the best available technique or best practicable environmental option today, may not be in the future.

Element 5

Environmental Performance Evaluation

Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain appropriate indicators that may reflect an organisation's environmental management performance.
2. Outline appropriate monitoring techniques and differentiate between active (proactive) monitoring and reactive monitoring.

Contents

Performance Indicators

IN THIS SECTION...

- **Environmental Performance Indicators (EPIs)** are developed depending on the risk level and environmental issues relevant to a company.
- Common EPIs include those for incidents, emissions, waste, water, energy, transport and travel, carbon dioxide and carbon (measurement conversion).

Environmental Management Performance Indicators

The international standard ISO 14031 gives guidance on Environmental Performance Evaluation (EPE). This uses the Plan - Do - Check - Act model to identify and collect information on environmental performance indicators:

- **Plan** - mainly consists of the selection of indicators - either those that are new, or those that are currently being tracked.
- **Do** - collecting information that is required by indicators, analysing and converting the data, assessing the information against the organisation's environmental performance objectives, and communicating the information that identifies the organisation's environmental performance.
- **Check** and **Act** - a periodic review should be carried out to determine opportunities for improvement of the EPE system. Recommendations should be considered in the management review process.

The standard suggests the use of two main types of environmental performance indicators **(EPIs)**:

DEFINITION

ENVIRONMENTAL PERFORMANCE INDICATORS (EPIs)

Are a business tool for the measurement of environmental performance. They should be quantifiable metrics that identify the environmental performance of a business, e.g. tonnes of waste sent to landfill per tonne of product produced.

- Management Performance Indicators (MPIs)

  These provide information regarding the efforts of management in relation to environmental performance.

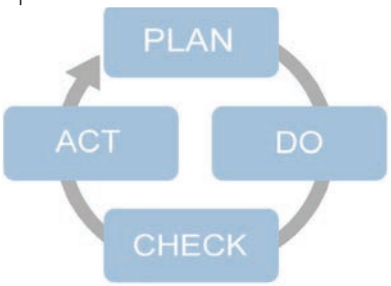
  The standard gives examples of MPIs being set in the following categories:

  – Management policies and programmes.
  – Regulatory compliance.
  – Financial performance correlated with environmental performance.

- Operational Performance Indicators (OPIs)

  These provide information regarding the environmental performance of operations and are measures of the environmental inputs and outputs from an organisation's activities. Categories where these could be set include:

  – Inputs:
    – Materials.
    – Energy.
    – Physical facilities and equipment.



- Outputs:
  - Products.
  - Wastes.
  - Emissions.

Combined indicators are also identified in the standard. These are indicators that may provide information on more than one issue, e.g. by collecting information on fuel usage per mile, information on the emissions of greenhouse gases, particulates and other emissions can be derived.

The standard suggests that all types of indicators are relevant, complete, consistent, accurate and transparent.

Examples of these types of EPIs are provided in the table that follows.

Management Performance Indicators (MPIs)	Operational Performance Indicators (OPIs)
Number of achieved objectives and targets	Quantity of material used (per unit of product)
Level of compliance with environmental regulations	Quantity of energy used per year
Number of audits completed in comparison to planned	Average fuel consumption per vehicle
Quantity of implemented pollution prevention initiatives	Number of products that are/can be recycled
Number of audit findings per period	Rate of defective products Total waste for disposal

Each company will develop its own OPIs depending on the most relevant issues associated with its activities and the level of risk. OPIs are almost always numerical and should be capable of being used to indicate performance trends over time. Numerical OPIs can be either absolute or normalised measures. Absolute measures usually express an overall total - total energy consumption in kWh, for example. Absolute measures may not, however, accurately express an organisation's performance over time. A decrease in an organisation's total energy consumption, for example, may simply reflect the disposal of certain assets, rather than a genuine improvement in energy efficiency. It is good practice, therefore, to relate whatever is being measured to a normalising factor - for example, energy consumption per tonne of product, or per employee, or per m^2 of floor space.

The standard also identifies the use of **Environmental Condition Indicators (ECIs)** - these provide information about the condition of the ambient environment surrounding the organisation, which might be affected by its activities. ECIs are usually established by governmental organisations and regulators, and the areas covered include:

- Air quality.
- River quality.
- Bathing-water quality.
- Global climate change.
- Concentration of specified contaminants in living tissue in the local population.

Legislation covering financial reporting by companies requires specific environmental performance information to be included. The **EU Accounts Modernisation Directive**, for example, has requirements for companies to include a balanced and comprehensive analysis of the development and performance of the business in their Directors' Report. The analysis should include both financial and, where appropriate, non-financial **key performance indicators** relevant to the particular business, including information relating to environmental and employee matters.

Incidents

As we will consider in more detail later, indicators of performance might include incident and near-miss frequencies and complaints.

Incidents are an indicator of performance

Business may also accrue fines and costs as a result of regulatory actions. These can be associated with EPIs, which will ensure that financial information is reported to stakeholders. Costs can be allocated to a specific EPI, such as wastes, and, in such cases, should be reported alongside the relevant EPI. Other costs are more difficult to allocate to a specific EPI and should be reported individually. Businesses are under a duty to comply with environmental law and any breaches must be reported including the number of prosecutions, the amount of any fines and any costs accrued.

Emissions

EPIs that identify emissions from a company are often used by organisations wanting to report environmental performance. Performance indicators often reported include emissions of greenhouse gases (see below), acid rain and smog precursors, such as sulphur dioxide (SO_2), nitrous oxides (NO_x), ammonia (NH_3) and carbon monoxide (CO).

Noise may also be reported.

Waste

Wastes produced by an organisation can be measured relatively easily, e.g. by estimating the number and weight of waste items that leave a site for disposal or treatment. Waste is often reported in **tonnes per annum**. Waste should be measured by individual types (e.g. glass, wood, metal) and the final waste management option (e.g. landfill, recycling) should be recorded. In some cases this may need to be carried out for regulatory reasons.

Water

Common indicators used for discharges to water include discharges of nutrients, organic substances and metals.

Organic matter is present in groundwater and surface water and may cause widespread pollution when it is found in large quantities (usually from human activities). Discharges of sewage and from industry that consist of a high level of organic material, such as nitrogen and phosphorus, can cause **eutrophication**. This is when organic materials cause aquatic plant life to flourish, which, following death and decomposition, deplete oxygen, causing adverse changes to the ecosystem. Other organic materials include Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs) and Hexachlorocyclohexanes (HCHs), which can have significant effects on watercourses.

Parameters that are commonly used to estimate the potential effect of eutrophication of wastewaters include Biological Oxygen Demand (BOD), Total Organic Carbon (TOC) and Chemical Oxygen Demand (COD). Effluent discharges are often reported in cubic metres per annum.

It is also common to record spillages (amount, substances, etc.) of organic pollutants if these contribute significantly to pollution.

Metal and metal compounds are other relatively common aquatic pollutants. Commonly reported metal discharges include mercury, cadmium, arsenic and zinc. Metals can be found in cooling water and industrial discharges. Metal may affect the aquatic ecosystem in many ways. Some metals, e.g. cadmium, can biomagnify - their concentration can increase as they travel up the food chain.

Energy

Most electricity is produced from fossil-fuel combustion. Industry and commerce have a significant impact on climate change, being indirectly responsible for emissions of large quantities of carbon dioxide and other greenhouse gases. Emissions of greenhouse gases can be determined by contacting the relevant electricity supplier, or using a standard factor for electricity. Those companies that have a non-typical combination of electricity supplies (e.g. purchase energy from renewable sources) should contact their supplier, whereas organisations with a standard supply may use the standard generation factor to determine carbon emissions.

Transport and Travel

Transport has a key role in a much wider environmental agenda. For example, the impact of global warming is becoming more accepted as a critical risk, and a continued rise in CO_2 concentrations means that a catastrophic change in the Earth's temperature cannot be discounted.

- Traffic impacts on the environment through pollution from engine exhaust gases, particularly in urban areas. However, pollutant concentrations have fallen owing to cleaner fuels and new technologies.
- Plants, animals and habitats are sensitive to the vehicle pollutants. For example, nitrogen oxides from exhausts form acid rain in the atmosphere, which can damage trees and soil.
- Transport affects the environment in other ways. Land and habitats are lost when new roads are built. Oil slicks from wrecked tankers can damage the marine environment.

Oil slicks damage the marine environment

Transport can also affect human health. Consider the following:

- Vehicle emissions release potentially harmful substances, such as nitrogen oxide, carbon monoxide and fine particles into the air. These pollutants can reach high levels of concentration in towns and cities.
- Air pollution triggers asthmatic attacks. Fine particles, in particular, may have long-term health effects, especially for those with heart and lung problems.
- Lead used to be added to petrol to give it more power. The UK Government reduced the amount of lead allowed in petrol in 1985 and banned it in 2000. Lead emissions have decreased by about 98% since 1980.

EPIs used for travel and transport could include:

- Vehicle miles per average weekday.
- Number of journeys undertaken by sustainable modes (cycling, walking and public transport).
- Total number of Green Travel Plans and School Travel Plans implemented in a borough.

MORE...

Further information on environmental performance indicators is available in the DEFRA guide *Environmental Key Performance Indicators: Reporting Guidelines for UK Business at:*

www.gov.uk/government/publications/environmental-key-performance-indicators-reporting-guidelines-for-uk-business

Carbon Dioxide and Carbon (Measurement Conversion)

Many organisations report on the emissions of **Greenhouse Gases (GHGs)**. Different GHGs, however, have different potential to cause global warming - this is known as **Global Warming Potential (GWP)**. The GWP used in the Kyoto Protocol is defined as the warming caused over 100 years in comparison to carbon dioxide. For example, methane has a GWP of 21 and nitrous oxide 310. GHG measurement may be directly at source by monitoring, or the amounts emitted can be estimated by using activity data (e.g. fuel consumption) and conversion factors.

STUDY QUESTIONS

1. Name five impacts where indicators can be set to track environmental performance.
2. What are the environmental reporting requirements in the **EU Accounts Modernisation Directive**?
3. Identify a possible environmental performance indicator for travel and transport.

(Suggested Answers are at the end.)

Monitoring Techniques

IN THIS SECTION...

- Active monitoring is a means of identifying environmental problems before they happen and includes environmental audits and workplace inspections.
- Reactive monitoring is a means of identifying loss incidents, such as near-misses, complaints or regulatory action.
- Environmental auditing is a systematic, documented, periodic and objective evaluation of how well the organisation's management systems are performing.
- Undertaking an audit consists of the following stages: pre-audit preparations; information gathering (opening meeting, information collection, closing meeting); and report writing.
- There are numerous types of environmental audits - examples include corporate audits, compliance audits and due-diligence audits.

Active and Reactive Monitoring

No single measure, by itself, will effectively measure the performance of the organisation. While we will be favouring the use of active monitoring, there is still a role for the reactive monitoring of accidents, spillages, etc.

The essential element is to find some factor that can be measured which will relate directly to some specific objective in the environmental policy.

Active Monitoring Measures

Objectives of Active Monitoring

The purpose of active monitoring is to check that the environmental plans have been implemented and to monitor the extent of compliance with:

- The organisation's systems and procedures (check that practice reflects the written procedures).
- Legislation and technical standards.

By identifying non-compliances, steps can be taken to ensure that any weaknesses are addressed, thus maintaining the adequacy of the plans, and helping to avoid any incidents.

Measurement Techniques

These include environmental audits and workplace inspections.

Active Monitoring Data

This should determine the extent to which plans and objectives have been set and achieved, and includes:

- Staff perceptions of management commitment to environmental management.
- Whether a director for the environment has been appointed.

DEFINITIONS

ACTIVE

Means 'before it happens'.

REACTIVE

Means 'after it has happened'.

ENVIRONMENTAL AUDIT

Is an in-depth, systematic, critical investigation into all aspects of environmental management. It needs to include management systems, policy, attitudes, training and practice.

WORKPLACE INSPECTION

Involves someone walking round a part of the premises, looking for environmental aspects and impacts, or non-compliance with legislation, rules or good environmental practice, and taking notes. The task is made easier and more methodical if some form of checklist is used.

- Whether environmental-management specialist staff have been appointed.
- The extent of influence of environmental specialists.
- Whether an environmental policy has been published.
- Whether the environmental policy has been communicated adequately.
- The effectiveness of environmental training.
- Number of risk assessments completed as a proportion of those required.
- Extent of compliance with risk controls.
- Extent of compliance with statutory requirements.
- Staff attitudes to risk and risk controls.
- Staff understanding of risk and risk controls.
- Frequency of environmental audits.
- Frequency and effectiveness of environmental committee meetings.

Monitoring of Performance Standards and Criteria

The basis of planning the arrangements for environmental management is the risk, or aspect, and impact assessment. Risk assessment provides the means for identifying new issues for control and ensuring that the existing measures are effective. The controls that are put in place may be specified as written 'performance standards' comprising, for each risk, a statement of:

- What has to be done:
  - Physical aspects of the working process (such as noise/dust/light levels, containment measures) and/or certain actions that are required to be taken at predetermined intervals (such as maintenance checks, health surveillance).
  - Physical or chemical monitoring of the quality of emissions to atmosphere, or discharges of effluent to sewer, or controlled waters.
- Who does it, how often and with what equipment.
- What records should be created and maintained.

Records are maintained

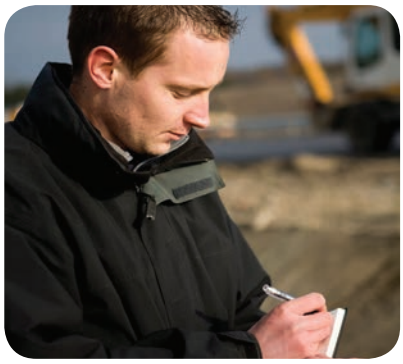
We can assess performance by measuring how well the stated standards are being achieved, e.g. the level of accident rates, numbers of environmental failures identified on inspection, degree of compliance with the requirements in respect of who does what, when and with what result.

This measurement should be set against the 'levels of acceptability' built into the standard, in respect of what is deemed an acceptable level of performance. It could be argued that there is no leeway in this - that 100% effectiveness is required in all cases and at all times. However, in all but the most high-risk operations, there is likely to be some degree of tolerance of imperfections. Thus, a single incidence of a failure to maintain noise levels below the stated level may not be of great consequence, but several would. The important thing is that we know what is happening and can make a judgment as to its adequacy.

This approach to measuring performance can also be applied successfully across the various elements comprising the environmental management system. Performance standards can be stated in terms of who does what, when and with what result in respect of the organisational arrangements for:

- Conducting risk assessments, including frequency, suitability and involvement of different personnel.
- Preparation of rules, procedures and documentation.
- The active involvement of senior managers in environmental matters, including tours, incident investigations, etc.
- Specifying the key environmental posts and roles, and ensuring that they are filled at all times.

- The structure and functioning of consultation processes, including membership of environmental committees, the frequency of meetings and the distribution of minutes, etc.
- How incidents are to be reported, investigated and acted upon.
- Collection and dissemination of information from external sources.
- Audit and review.



Effectiveness of control measures is management responsibility

It is important that monitoring takes in the whole range of arrangements, not just the actual control measures. The effectiveness of those measures - in terms of both how comprehensive they are in protecting against risks and how well they operate in practice - is a management responsibility. If there are failings in that responsibility, the result may well be an accident. Not only is the avoidance of that outcome a moral duty but it is also a statutory requirement, so a failing may result in criminal prosecution, or civil liability.

Thus, active monitoring is concerned with the totality of performance standards for environmental management at work.

Assessing effectiveness of environmental performance implies that we must first have something that can be measured, and some goal or standard against which to judge that measurement.

Systematic Inspection of the Workplace

In the same way that health and safety inspections are a useful tool so, too, are environmental inspections. In some organisations, it is possible to combine environmental inspections with health and safety inspections, which allows a more holistic approach to the management of both disciplines.

Inspections are the least formal activities out of all the environmental improvement tools. However, if carried out conscientiously in a positive and proactive manner, they can have an immediate impact on the effectiveness of the organisation. Inspections are scheduled checks on premises, activities or equipment carried out by personnel within that organisation. In some cases, particularly with respect to plant and equipment inspections, they are carried out by external specialists. An example of this is the Local Exhaust Ventilation (LEV) inspection on equipment carried out by an external surveyor.

Use of Environmental Inspections

To be effective, inspections should be planned according to a published schedule and have the full support of senior management. However, ***ad-hoc*** inspections are also valuable - for example, when used to enforce EMS procedures. Any non-conformance to plans and specifications should be formally noted and suitable corrective actions applied and monitored.

While it is recognised that the use of a checklist is not always practicable, it is recommended that checklists are used to facilitate the inspections. This has the added bonus of providing evidence to any auditor or interested party that inspections are a formal part of company procedures.

Inspections can also be used to monitor performance through the use of an **end-of-shift** checklist, e.g. for housekeeping, to ensure that company standards of tidiness are maintained, recording the results as a tick list. A check sheet is a valuable tool, which can aid the more formal audits at a later stage.

Role within a Monitoring Regime

Systematic **active monitoring**, involving inspections and other forms of examining environmental arrangements and control measures, will be based on the nature and severity of the risks.

High-risk situations will require a greater depth and frequency of monitoring than situations of lower risk. Thus, some measures may need to be checked on a daily basis, or even before any work activity. Others may only need examining every week or month, and others every few months or every year.

There is a variety of means of doing this, including:

- **Workplace inspections** - the systematic examination of the controls in operation, such as the condition of secondary containment and the level of compliance with environmental procedures, and the effectiveness of the level of information, instruction, training and supervision.
- **Performance review** - the systematic collection and review of information drawn from inspections, interviews/ consultation and reports, etc. to assess the achievement of the organisation's objectives in respect of environmental management.
- **Environmental audits** - the regular, comprehensive review of all management systems that support the procedures and measures for ensuring effective environmental management in the workplace.

Reactive Monitoring Measures

The objective of reactive monitoring is to analyse data relating to:

- Accidents.
- Other loss-causing events.
- Any other factors that degrade the system.

Reactive monitoring looks at accidents and other loss-causing events

It is obviously preferable to identify, and address, any potential problems by means of **active monitoring**, rather than waiting for an event to happen to highlight any shortcomings in the systems. Hopefully, accidents are very rare occurrences. This means that there are not many cases to count, and the numbers may not be regarded as statistically significant.

Variations from year to year might be due to pure chance rather than any accident reduction measures that we have introduced. This is why we often have to resort to national statistics, or even international data in order to find significant numbers to target environmental programmes. If we keep data for many years, it is possible to iron out these fluctuations by finding the moving average. As we get another year's, or month's, figure we are able to enter this into the average and so determine a trend.

Accident statistics tend to reflect the results of actions that were taken some time ago, so that there is not a rapid cause-and-effect situation. It is also unfair to blame a manager for accident situations when the present situation is to some extent dependent on actions taken some time ago, and the present actions will take some time to show.

Accident data is **relatively easy** to collect. There are a number of standard calculations of accident rate, which are fairly easy to understand. Management can easily link accidents with environmental performance, so it is easy to discuss accident reports, and get management to take action.

Accident recording has some value, therefore, but it is of limited use in relation to assessing future risk. There are problems with under-reporting of minor accidents. Also, if the staff are made aware of environmental matters, they tend to report more accidents. The picture may then look worse when, actually, the environmental culture is improving.

Reactive Monitoring Data

- Incidents.
- Near misses.
- Reportable emissions (i.e. those over an emission limit value).
- Monitoring of water, energy, waste, etc.
- Complaints.

- Criticisms from regulatory agency staff.
- Regulatory agency enforcement actions.

Incidents

The likelihood of an incident can be minimised by effective planning through the development of site pollution incident-response planning. The plan needs to identify on-site risks and appropriate responses. Suitable equipment, such as spill kits, should be held at appropriate locations on site. An effective pollution incident-response system relies on the following elements:

- Effective pre-planning (e.g. use of drip trays, bunds, etc.).
- Identification of contact numbers.
- Definition of personnel responsible.
- Appropriate training.
- Dry running of an incident scenario - spill drills.
- Availability of suitable spill kits at appropriate locations on the site.

Near-Misses

As with health and safety, it is important that a company has a system in place to record near-misses and ensure that they do not occur again, as the next time they may turn out to be accidents that have a significant impact on the environment.

DEFINITION

NEAR-MISS

Is defined as an incident that could have resulted in an accident.

Examples of environmental near-misses include:

- An oil drum falling from a forklift truck, which spilled oil onto a roadway. The oil was, however, prevented from entering a surface-water drain by a quick-thinking employee, who temporarily capped the drain.
- An item of hazardous waste was disposed of in the general waste skip prior to being taken by the waste contractor from the site. The item of hazardous waste was seen by an employee before collection and removed from the skip.
- A tanker containing diesel almost colliding with a car while undertaking a delivery to an industrial site.

An effective near-miss reporting system will include both mandatory and voluntary reporting. A key to near-miss reporting is to learn lessons so that remedial actions can be implemented to prevent the situation from occurring again. **Root-cause investigation** should be undertaken on all near-misses to determine the errors in the system that may have occurred, leading to the incident.

Emissions

As we saw earlier, greenhouse gas emissions may be determined by using conversion factors or direct monitoring. Metal discharges to water can be determined by using emissions estimation methods.

Waste

Processes that produce large and variable amounts of waste can often benefit from improved process control. The first step is to identify the parameters affecting the amount of waste. An effective process control system typically consists of a method of measuring key parameters, with a controller and a control device (e.g. a valve) linked in a feedback loop. The controller can range from manual monitoring to a fully automated system.

Legal requirements often specify that a system should be in place and maintained that records the quantity, nature and origin of any waste that is disposed of or recovered - and also, where relevant, the destination, frequency of collection, mode of transport and treatment method for those wastes.

Water and Energy

Water and energy consumption can be monitored by using varyingly complex methods depending on the specific requirements of an organisation. Methods commonly used include:

- Viewing and recording energy/water consumption from bills received by an organisation. Commonly, such information is recorded on a spreadsheet, allowing graphs of water/energy consumption over a set period to be produced.
- Recording meter readings on a regular basis (daily, weekly or monthly), allowing an organisation to identify trends in water/energy consumption.
- Sub-metering systems, which allow an organisation to measure energy or water consumption within particular areas of a site, or by particular items of equipment. This technique allows much more specific identification of saving opportunities than is possible by using data from the primary utility meter. Sub-metering is appropriate for energy- or water-intensive organisations and those that are already familiar with basic energy/water-management practices.
- Online monitoring for water, which involves the fitting of a remote data-logging device to the existing water meters on a site, which then records flow readings at programmed intervals and sends this information daily to your water company. The customer can then access this data via a secure website in graphical, summary, or individual-value formats. Similar systems are also available to monitor effluent production and energy consumption.

Complaints by Workforce and Neighbours

Complaints and **suggestions** are likely to be a good indication of the adequacy of environmental measures. These opinions may be voiced through the normal consultative channels - environmental/employee representatives and the environmental committee - or may be individual issues raised with management.

Complaints and suggestions may be raised with management

Generally, the fact that employees have seen fit to raise an issue, in whatever form, may be taken as an indication of a failure in the current arrangements. This may be because there are actual physical failings in the control systems that are in place. Alternatively, it may indicate a lack of understanding of the control systems, so that they feel there is a risk, even though the risk is actually properly controlled. Either way, there is a need to address the issue.

If concerns are raised, it is important that they are acted on. This not only **demonstrates management commitment** but also encourages a positive environmental culture in which the contribution of employees is valued.

Additionally, complaints from interested parties, such as **members of the public** residing in housing surrounding a site, should be recorded. They provide a useful indicator of the success of measures to reduce environmental impacts of an organisation and identify when corrective actions need to be undertaken to reduce certain types of impacts.

Enforcement Action

Regulatory authorities usually have a statutory right to inspect premises at any time, particularly where a breach of statutory duty is suspected.

Any indication by an enforcement officer that standards of the existing arrangements are deficient must be taken seriously. In the case of the issuing of notices, action is required immediately (or within a defined timeframe), but any advice about improvements that should be made will be indicative of a failure of the existing system, which needs to be remedied.

In some cases, the issuing of advice may be on a technical issue and there may be no underlying problem - indeed, the seeking of external advice may be seen as a demonstration that the management system is working effectively. However, where a notice is issued, this is clear evidence that management controls are not effective.

Workplace Inspections

Role of Inspections

Workplace inspections are concerned with ensuring that the control arrangements specified in the environmental policy statement and associated procedures are operating effectively and that they cover all the risks. As such, they are the foundation of systematic environmental monitoring. They demonstrate management's commitment to the environment, and afford an opportunity to involve employees, thereby giving them ownership of environmental concerns. By identifying problems, making recommendations, and eliminating or controlling the risk before an accident happens, the morale of employees is raised.

There are a variety of types of inspection, as discussed below, but they all comprise the same three basic elements:

- An **assessment** of the standards of the workplace against the specified performance standards and risks.
- The identification and reporting of any **deficiencies**.
- The identification of causes and of action to be taken to **remedy** the problem.

In addition, the inspection should be carried out by a competent person, i.e. someone with the knowledge and skills to appreciate the requirements of the performance standards and assess the actual situation against them.

Factors Governing Frequency and Type of Inspection

The frequency of the inspections will be determined by the nature of the risks and the importance of the measures required to ensure their control. However, workplace inspections also provide an active demonstration of commitment to environmental management and, as such, should be a sufficiently regular occurrence to assure the workforce that environmental issues are important and demand constant vigilance.

The types and frequency of inspections will reflect the nature of the risks in the workplace and the methods used to control them. There is, therefore, a range of inspection regimes designed to ensure the effectiveness of control systems:

- Routine Inspections

  The first level of inspections is those that are carried out as a matter of routine at all times, or at very frequent intervals.

  Some precautions needed to control a particular risk may need to be monitored on an almost continuous basis to ensure their effectiveness, e.g. air-abatement systems to remove toxic fumes. Others need to be checked on a regular, scheduled basis, e.g. that required spillage equipment is present.

  Any deficiencies must be reported

  The requirement to carry out such inspections will be written into environmental procedures, or work instructions for the particular operation, and it will be the responsibility of the operator and/or the immediate supervisor to ensure compliance.

  It will not generally be necessary to document that routine inspections have been carried out, although where they form part of a health and safety permit-to-work system this will be required. However, any deficiencies must be reported to a supervisor or manager immediately and work should not commence before the issue has been resolved.

- **Maintenance Inspections**

  Many physical control systems, or items of plant, machinery and equipment, need to be checked on a regular basis to ensure that they remain fit for purpose. These inspections will involve examining, testing and making repairs/adjustments to such items as secondary containment (e.g. bund walls), flooring, vehicles, etc. This should be done in accordance with a maintenance schedule, which is designed to ensure that all items are checked within defined periods, depending on the rate at which they may be expected to deteriorate and thus present a risk in their use. Thus, for vehicles, the requirement may be that they are inspected every six months or after having travelled 10,000 miles, or for air-abatement equipment it may be every two weeks.

  The maintenance schedule is very often specified by the manufacturer or supplier of the plant and machinery, etc., and, in some cases, it is reinforced by legal requirements (as in the case of fire-fighting equipment).

  Maintenance inspections will normally need to be documented and the record should include the general state of repair of the item, results of any tests, and what repairs/adjustments were made, if any.

- **One-Off Equipment, etc. Inspections**

  There will always be a need to specifically inspect particular items of plant, machinery and equipment in certain circumstances, such as:

  – After a breakdown, accident or other incident affecting the item.
  – After a period of non-use, e.g. on resuming operations after a weekend or holiday period.
  – After resetting the equipment, e.g. checking the positioning of the fixed guard that had been removed to allow for the changing of a grinding wheel.

  The circumstances in which any items of plant, machinery and equipment will need to be inspected will generally be stated in procedures.

  Such inspections will normally be documented.

- **Environmental Inspections**

  These are formal inspections of a whole area or section of the workplace to check on either all the environmental measures applicable, or particular aspects of them. They are often combined with safety inspections. This will include such issues as:

  – General maintenance, including the condition of floors, work surfaces, etc.
  – Compliance with procedures.
  – Housekeeping and cleanliness.
  – Condition of information and warning signs.
  – Fire precautions.

  These inspections are usually conducted by a team of people, including the workplace supervisors, section manager and safety representative. Depending on the level of technical detail or complexity, an environmental officer may also be involved. Such inspections may also include examination of documentation, such as maintenance records, and discussions with workers about the general approach to environmental issues and any particular concerns they may have.

  Note that the whole workplace does not necessarily have to be inspected, nor all the items included in an inspection checklist (see below) covered, during each inspection. Selection of certain activities, priority lists and discussions on specific topics can often be far more beneficial than a tedious 'walk-through' survey of the whole department. It is vital that enthusiasm and interest are maintained.

  Environmental inspections should be fully documented and any problems encountered reported.

- **Environmental Tours**

  These are generally unplanned inspections by an environmental officer, environmental representative and/or manager designed to observe the workplace in operation without any prior warning. Again, these are often combined with health and safety inspections. They will not be as thorough as a full inspection, but have the advantage of being quick, easy to organise and relatively informal.

  Tours usually follow a predetermined route through the area or workshop, which is designed to cover the main environmental measures applicable. They are relatively short - say, just 15 minutes - and can be conducted at regular intervals to keep workers on their toes.

  They are a particularly effective method of checking that standards of housekeeping are acceptable and that gangways and fire exits are unobstructed.

An environmental survey

  Environmental tours will not generally be documented in detail, except in so far as any deficiencies are found. These will need to be reported and follow-up action checked (perhaps on the next tour or, if urgent, by a special inspection).

- **Environmental Surveys**

  These are a narrower, more in-depth examination of specific issues or procedures following such events as the introduction of new equipment, or changes in working practices. They may also be initiated after problems have been highlighted by other monitoring techniques, e.g. where there has been a rise in particular types of accident, or a deficiency has been disclosed by an environmental audit.

  Environmental surveys are conducted by the managers responsible for the workplace(s) being inspected, together with environmental officers. The findings will be fully documented in the form of a formal report to management.

In the case of environmental inspections and surveys, the length of time allocated to the inspection can be crucial in maintaining a good standard of observation and interest. Inspections should not generally take more than two hours. It may be necessary, then, to allocate time to discuss the findings and the construction of the report.

Competence of Inspector

The person responsible for conducting the inspection must be **competent** to carry out all the necessary checks and draw the correct conclusions from them in terms of deficiencies in any aspect of the workplace environmental arrangements. This will involve reporting problems in the appropriate form to the appropriate person, and may involve identifying causes and remedial action.

The extent of knowledge and skills necessary to demonstrate competence will, obviously, vary with the extent of the responsibilities involved in the inspection. The more detailed and extensive the inspection, and the wider the implications of deficiencies, the greater the competence required.

Environmental inspections, tours and surveys will invariably involve the environmental officer. In addition, inspections carried out under specific statutory requirements must usually be led by a person with specific competence in that area of work.

Use of Checklists

In order to ensure a consistent and comprehensive approach to checking all the environmental elements to be covered during an inspection, it is usual to develop a **checklist** or inspection form, which covers the key issues to be monitored. This will identify all items that need to be inspected in that particular type of inspection - i.e. pre-operational checks, maintenance checks for particular types of equipment, items to be covered in a full departmental environmental inspection, etc.

Checklists should also be structured to provide a coherent approach to the inspection process. This aids monitoring the process of inspection and analysing the results, as well as simplifying the task of actually carrying out the inspection itself.

While checklists are often included in procedures and manuals, they should not be seen as set in tablets of stone. In particular, in terms of maintenance and environmental inspections, the list should not act as a constraint on the inspector(s) identifying other potential problems or hazards. Checklists should also be reviewed from time to time to take account of recent or proposed developments in environmental issues in that particular workplace.

In order to get maximum value from inspection checklists, they should be designed so that they require **objective** rather than subjective judgments of conditions. For example, asking the people undertaking a general inspection of the workplace to rate housekeeping as good or bad begs questions as to what good and bad mean, and what criteria should be used to judge this.

Allocation of Responsibilities and Priorities for Action

Since there is a general duty on employers to ensure the competence of their employees to carry out their workplace roles effectively, this means that appropriate instruction and training must be provided.

The various persons involved in inspections are as follows:

- Individual Employees

  Although there is no direct legal requirement under environmental law, the environment can be affected by their acts and omissions. Therefore, operators must make sure, for all appropriate inspections, that their work area is free from environmental hazards, e.g. all hazardous-liquid containers are placed on a drip tray.

- Supervisors

  They have greater responsibilities, involving ensuring that operators under their control are operating in a manner that prevents or limits impact on the environment, in accordance with environmental procedures. This applies to the operation of all control measures. Supervisors have specific responsibility for ensuring routine inspections are carried out and for leading maintenance and one-off inspections. They will also be involved in all other inspections affecting their own work areas.

- Environmental Officers

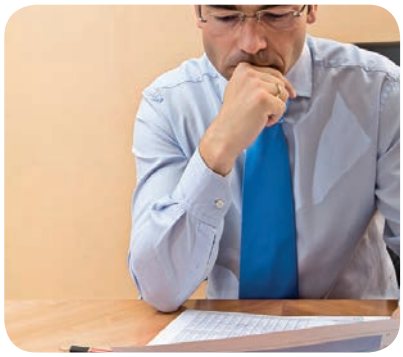
  They have a much wider role in inspections, particularly with regard to the identification of causes of problems and identifying remedial actions. They will be involved in all environmental inspections, tours and surveys, in some cases leading them.

- Management

  Middle and senior managers, while not having any specific front-line responsibility for the more regular inspections, must ensure that supervisors are fulfilling their responsibilities. Part of this will be the review of inspection reports, particularly where action is required. Section/departmental managers are responsible for environmental inspections covering their entire work area and are likely to be involved in safety tours and surveys as well. Visible management participation in all types of inspection, from all levels of management and from the environmental committee, is valuable in demonstrating commitment to the environment and is an essential element in promoting a positive environmental culture.

- **Enforcement Authority Inspectors**

  Enforcement authorities usually have statutory rights to inspect workplaces where a breach of statutory duty is suspected. They will normally be accompanied by a member of management.



Any results should be communicated to all personnel

As a general point, inspections are not designed to provide a problem-solving mechanism at the very instant an environmental aspect or risk is identified. It would normally be more appropriate to analyse any deficiencies in the environmental arrangements during a post-inspection discussion. However, action may need to be taken if there is an **immediate risk** to the environment.

The purpose of inspection is, though, to identify remedial action to be taken in respect of deficiencies. This needs to be based on an assessment of the causes of the problem - immediate and underlying. Priority should be given to remedying any immediate causes of risk, since they may have the potential to cause accidents, and action should be taken at the earliest opportunity. Other underlying causes also need to be addressed, but these are likely to involve further investigation and consultation with management to identify the roots of the problem. They must not, though, be overlooked.

It is also useful to rank the outstanding issues - i.e. those that are not earmarked for immediate action - so that priority can be given to those deficiencies that appear to present the greatest risk.

It is important, too, that the outcome of any environmental inspection, tour or survey is communicated to all personnel involved - whether the results are positive or negative. This will help improve environmental awareness and develop the environmental culture.

Summaries of the findings, using graphical presentation where appropriate (e.g. simple graphs and bar charts, etc.), may be displayed on noticeboards or in environmental bulletins, and comparisons drawn with previous inspections and other similar workplaces. Discussion could be held to consider the outcomes and encourage involvement in the identification of improvements.

The Requirements for Effective Report Writing

There are three main aims to the writing of reports and they are all about good communication. A good report should aim to:

- Get the message through to the reader.
- Make the message and arguments clear and easy to understand.
- Make the arguments and conclusions persuasive.

Communication starts with trying to get into the mind of the reader, imagining what would most effectively catch the attention, what would be most likely to convince, what would make the report stand out among others. A vital part of this is presentation, so while a hand-written report is better than nothing, a clearly organised, typed report will be much clearer. To the reader, who could be busy with a lot of written information to consider, a clear, well-presented report will produce a positive attitude, with immediate benefits to the writer.

Style

Style means the tone of language you use to address the reader. There are the following points to consider:

- **Clear**

  Clarity is achieved through the use of the right language - words that the recipient will understand, set out in a logical order with appropriate structuring of the information. Take your reader through the points you want to make one by one, so that each leads on to the next.

You need to use meaningful language that avoids ambiguity and puts your points across in a way that can be easily understood by the reader - words and phrases need to be chosen with care, unavoidable jargon, terms and lesser-known concepts and procedures need to be explained. Short, simple, structured sentences help, as do headings and graphical forms of presentation such as diagrams, etc.

One problem often encountered is the need to refer to other documents or extracts from them, or to detailed background information, say about particular measurements. The inclusion of such material in the body of a report can upset the flow and be quite confusing as the reader feels they have to read through and understand it. Such material, if it is necessary at all to getting your points across, should be placed in appendices, or attached as a supporting document. This helps keep the main communication to the point throughout.

- **Concise**

  Being concise means keeping the report as short as possible. You do not want the reader to have to wade through vast amounts of material to find the key points, nor do you want your arguments or points to get lost in a clutter of waffle.

  Being concise does not necessarily mean simply stating the bald points. The use of explanations and examples contributes to clarifying the key issues and should be employed where appropriate. However, the essence is to stick to the point and not over-elaborate or wander off into other areas that may confuse the issue or lose the reader.

  Brevity, compatible with the complexity of the information to be conveyed and the necessary style and tone, is of the essence. Thus, it is better to say 'Unfortunately ...' rather than 'I regret that I have to say that ...'. One of the trends in report writing has been to be more direct and use less of the rather obtuse and long-winded language of formal business communications from the past. That tendency has not disappeared completely, particularly from some formal, old established organisations, but where the flow of language is not damaged, every effort should be made to cut down on the number of words used to say something.

- **Correct**

  The information conveyed must be as accurate as possible at the time of presentation - a seemingly obvious point, but one which has a number of implications.

  In order to be truly accurate, it may seem necessary to use incredibly complicated language, particularly legal language, e.g. when explaining the limitations of what you were able to observe (such as not being able to check the condition of certain measures because, say, they were not operational at the time or you lacked the necessary testing equipment for one reason or another). This may be very off-putting or difficult to understand for many recipients and needs to be avoided. (It clashes with C for clear.) In most circumstances, some degree of absolute accuracy may be sacrificed for clarity.

  All reports should be dated. This sets the information in a particular timeframe and allows for variations to be made to reflect new information at a later date.

  Being accurate is not always easy. In many situations, the information being conveyed is not precise or complete, and this needs to be openly recognised where the reader needs to be aware of any limitations.

- **Courteous**

  It pays to consider a report as a personal address to the reader(s). Therefore, in trying to be brief, do not be curt - be polite and use friendly language rather than formal 'officialese'.

- **Complete**

  The report should contain everything you want to say - nothing more and nothing less. As far as possible nothing should be left out, although you may have to say that certain points cannot be covered at this particular time and will be dealt with later. In that way, the reader will be aware that they have everything they need.

This may mean going beyond what were the original terms of the inspection when writing the report - additional information may need to be brought in, in order for the complete picture to be presented.

- Consistent

  The flow of language is considerably aided by consistency in its use, such as standardising the use of person and tense in verbs, and sticking to a particular style and tone throughout. A number of problems arise from this:

  – Adopting a consistent and clear usage of non-gender-specific phrasing (to avoid the use of 'he' all the time which you will find in most older texts) can mean using rather convoluted phrasing or an overuse of 'he/she' or '(s)he', which can look and sound clumsy.
  – The convention of writing reports in the passive tense ('it may be seen that ...') can give rise to phrasing difficulties and also conflicts with the more direct and courteous use of active tenses ('you will see that ...'), but it can be confusing to switch between the two too often.

- Convincing

  This last point is often overlooked. It is very important to show confidence and commitment in what you write, even though there may be times when you do not actually feel that in what you have to do at work. Doubt, ambiguity and vagueness come through very clearly in all forms of communication. Messages need to be conveyed with conviction or they will not be taken seriously.

Structure

A written report needs to say what you have done and what you have found out. It needs to make a clear distinction between what is factual and what is opinion. Perhaps most importantly the report needs to be written in a style that is easy to read and understand, and it should only include text that is relevant (sometimes "less is more" - try to avoid 'waffling'). The audience that it is aimed at should also be considered: non-technical people will not understand technical wording or jargon, so this should be avoided; the managing director doesn't have time to wade through a huge report, so either a short report or a good summary at the front of the report should be provided.

TOPIC FOCUS

Report formats vary depending on the audience. Scientific reports typically adopt a far more formalised approach (with many more sections). Below are the typical components of a workplace report (such as the project required for this course):

- Title and Author

  The title should be as short as possible and make it clear what the report is about. You should give your name.

- Abstract or Short Summary

  This is a short summary which the reader can use to decide if they want to read the report.

- Introduction

  This sets the scene and gives the reason for the piece of work, as well as background and basic methodology.

- Main Body of Report

  This is where you include the main presentation of results, together with an analysis and discussion. To aid the flow of the report, some large sets of data, tables and figures, etc. might be relegated to an appendix and just summarised in the main body.

(Continued)

TOPIC FOCUS

- **Conclusions**

  This is a brief statement of what your report has discovered.

- **Recommendations**

  This is where your suggested course of action will be outlined. Recommended actions should be clearly stated and will often be accompanied by appropriate timescales, as well as the responsible person for completing the action. Recommendations should be numbered and, where appropriate, priority should be indicated.

- **References**

  Where you have made use of other people's publications or data then you will need to acknowledge this. Usually, the references are put in alphabetical order by author surname. The title, date of publication and the publisher involved should be included.

- **Appendices**

  There is often material that might be of use to others, but which would only confuse the more casual reader. Tables of raw data, forms used for collection of data and statistical calculations would come into this category.

Emphasis

As report writers using computers today have access to a wide variety of fonts and textual effects, they are no longer limited to underlining to show emphasis.

Visual text devices for adding emphasis:

- Italics or underlining are often the preferred ways to emphasise words or phrases when necessary. Writers usually choose one or the other method and use it consistently throughout an individual report.
- Overuse of various emphatic devices like changes of typeface and size, boldface, all-capitals, and so on in the text of a report creates the impression of a writer relying on flashy effects instead of clear and precise writing to make a point.
- Boldface is also used to show emphasis, as well as to highlight items in a list.
- Some report writers use all capital letters for emphasis, but they are usually unnecessary and can cause writing to appear cluttered and 'loud'. In e-mail correspondence, the use of all caps throughout a message can create the unintended impression of shouting and is therefore discouraged.

Punctuation Marks

- Some punctuation marks prompt the reader to give a word or sentence more than usual emphasis. For example, a command with a full stop does not evoke the same emphatic response as the same command with an exclamation mark.
- A dash or colon has more emphatic force than a comma.
  - The employees were surprised by the decision, which was not to change company policy.
  - The employees were surprised by the decision - no change in company policy.
  - The employees were surprised by the decision: no change in company policy.

Choice and Arrangement of Words

The simplest way to emphasise something is to tell readers directly that what follows is important by using such words and phrases as: especially, particularly, crucially, most importantly, and above all.

Sentence Arrangement

- An abrupt, short sentence following a long sentence or a sequence of long sentences is often emphatic.
- Varying a sentence by using a question after a series of statements is another way of achieving emphasis.

Persuasiveness

The goal of the report is to convince the reader to accept the writer's point of view. To accomplish this, the report needs to be persuasive. Building a reasoned argument is more complex because more is involved. Five features of a good argument are as follows:

- Evidence consisting of facts, opinions (ordinary and expert), and material things is absolutely essential when building an argument. Statements of evidence should be:
  - **Reliable**: reliability means that the writer has the facts right so that, while different individuals may draw different conclusions from the facts, there can be no disagreement over the facts of the situation.
  - **Precise**: a common error is lack of precision in statements, which emasculates the persuasiveness of an argument. Specificity shows that the writer appreciates the situation in all its subtleties.
  - **Realistic**: shocking statements are avoided because they only provoke the reader's distrust and suspicion.
- Arguments are built using as much observable evidence as possible.
- Assumptions about probable relationships, quantities or results are made and stated when needed to carry the reasoning further. Stating assumptions means the reader has critical information created by the writer when developing the argument.
- Arguments are built by tying pieces of evidence and assumptions together and drawing inferences from them.
- Shortcomings, weaknesses and limitations are admitted when the arguments are presented. Dealing with both the positive and the negative suggests objectivity and treats the reader as a mature, informed individual. Doing so also makes the reader feel that the writer has performed a thorough analysis.

Auditing

Scope and Purpose of Auditing Environmental Management Systems

Auditing is a long-established tool originating in financial management, and subsequently adapted for monitoring quality, environmental and safety performance. It provides a systematic, documented, periodic and objective evaluation of how well the organisation's management systems are performing by a critical examination of each area of activity.

ISO 19011:2011 provides guidance on the management of audit programmes, the conduct of internal or external audits of quality and/or environmental management systems, as well as on the competence and evaluation of auditors. It provides a useful source of information on auditing and should be consulted for further information regarding this topic.

DEFINITION

ENVIRONMENTAL AUDIT

"*Systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled.*" (ISO 19011:2011)

Although this International Standard is applicable to the auditing of quality and/or environmental management systems, the user can consider adapting or extending the guidance provided within the standard to apply to other types of audits, including safety management system audits.

The **purpose** of an environmental audit defines what is to be accomplished by the audit and may include:

- Determination of the extent of conformity of the auditee's management system, or parts of it, with audit criteria.
- Evaluation of the capability of the management system to ensure compliance with statutory, regulatory and contractual requirements.

- Evaluation of the effectiveness of the management system in meeting its specified objectives.
- Identification of areas for potential improvement of the management system.

The audit **scope** describes the extent and boundaries of the audit, such as:

- Physical locations.
- Organisational units.
- Activities and processes.
- The time period covered by the audit.

Difference between Audits and Inspections

In relation to environmental management, the term auditing is sometimes used loosely for describing various monitoring activities, such as workplace inspections. This should be avoided.

- **Monitoring** is principally a line-management role, undertaken continuously or frequently to ensure compliance with the organisation's adopted standards and procedures.
- **Auditing** is a more fundamental examination undertaken by people outside the line-management structure, challenging whether the standards and procedures are appropriate, as well as their application.

Auditing usually requires some sampling and selectivity, and is undertaken periodically. It includes checks on the monitoring programme. Just as an annual financial audit is a check on the company's solvency (that the business has been managed prudently and cash has not been misappropriated), so an environmental audit is a check on the management of environmental impacts.

DEFINITION

AUDIT CRITERIA

Are used as a reference against which conformity is determined and may include applicable policies, procedures, standards, laws and regulations, management system requirements, contractual requirements or industry/ business sector codes of conduct.

Auditing involves sampling and selectivity

Pre-Audit Preparations, Information Gathering, Notifications and Interviews

TOPIC FOCUS

Pre-Audit Preparations

Prior to the on-site audit activities the auditee's documentation should be reviewed to determine the conformity of the system, as documented, with audit criteria.

The **documentation** may include relevant management system documents and records, and previous audit reports. The review should take into account the size, nature and complexity of the organisation, and the objectives and scope of the audit.

In some situations, this review may be deferred until the on-site activities commence, if this is not detrimental to the effectiveness of the conduct of the audit. In other situations, a **preliminary site visit** may be conducted to obtain a suitable overview of available information. If the documentation is found to be inadequate, the audit team leader should inform the audit client, those assigned responsibility for managing the audit programme, and the auditee. A decision should be made as to whether the audit should be continued or suspended until documentation concerns are resolved.

(Continued)

TOPIC FOCUS

The audit team members or individual auditor should review the information relevant to their audit assignments and prepare work documents as necessary for reference and for recording audit proceedings.

Such work documents may include:

- Checklists and audit sampling plans.
- Forms for recording information, such as supporting evidence, audit findings and records of meetings.

The use of checklists and forms should not restrict the extent of audit activities, which can change as a result of information collected during the audit.

Information Gathering

When on the site, an **opening meeting** should be held with the auditee's management or, where appropriate, those responsible for the functions or processes to be audited.

The purpose of an opening meeting is to:

- Confirm the audit plan.
- Provide a short summary of how the audit activities will be undertaken.
- Confirm communication channels.
- Provide an opportunity for the auditee to ask questions.

During the audit, information relevant to the audit objectives, scope and criteria, including information relating to interfaces between functions, activities and processes, should be collected by appropriate **sampling** and should be **verified**. Such sources of information may include:

- Interviews with employees and other persons.
- Observations of activities and the surrounding work environment and conditions.
- Documents, such as policy, objectives, plans, procedures, standards, instructions, licences and permits, specifications, drawings, contracts and orders.
- Records, such as inspection records, minutes of meetings, audit reports, records of monitoring programmes and the results of measurements.
- Data summaries, analyses and performance indicators.
- Information on the auditee's sampling programmes and on procedures for the control of sampling and measurement processes.
- Reports from other sources, e.g. customer feedback, other relevant information from external parties and supplier ratings.
- Computerised databases and websites.

Only information that is **verifiable** may be audit evidence. Audit evidence should be recorded. The audit evidence is based on samples of the available information ,therefore there is an element of uncertainty in auditing, and those acting on the audit conclusions should be aware of this uncertainty.

The auditor or audit team should determine prior to the closing meeting the **conclusions** of the audit.

(Continued)

TOPIC FOCUS

A **closing meeting** should then be undertaken, which would present the audit findings and conclusions in such a manner that they are understood and acknowledged by the auditee, and to agree, if appropriate, on the timeframe for the auditee to present a corrective and preventive action plan.

In certain instances, e.g. internal audits in a small company, the closing meeting may consist of just communicating the audit findings and conclusions. For other audit situations, the meeting should be formal and minutes, including records of attendance, should be retained.

Following the meeting a report should be produced, which identifies the findings of the audit. According to ISO 19011, the report should include:

- The objectives of the audit.
- The scope of the audit, especially the organisational and functional units/processes audited and the time period of the audit.
- Identification of the audit client.
- Identification of the audit team and participants from the auditee.
- The dates when and places where the on-site audit activities were conducted.
- The audit criteria.
- The findings of the audit and related evidence.
- The audit conclusions.
- The degree to which the audit criteria have been fulfilled.

Notifications

A company's management should in most cases be aware of the date of the audit as soon as possible, enabling them to adjust and become used to the concept. However, in some companies little or no warning is given of an imminent audit. Organisations that employ such tactics give a true evaluation of the facility's operations as they normally function. Additionally, care must be taken that only appropriate personnel are informed of the audit, as the true reason for the audit being undertaken, especially for due-diligence audits (e.g. company takeover, merger or divestment), may not be known by the majority of employees.

Interviews

These are an important means of collecting information and should be carried out in a manner adapted to the situation and the person interviewed. However, the auditor should consider the following:

- Interviews should be held with persons from appropriate levels and functions, performing activities or tasks within the scope of the audit.
- Interviews should be conducted during the normal working hours and, where practical, at the normal workplace of the person being interviewed.
- Every attempt should be made to put the person being interviewed at ease prior to and during the interview.
- The reason for the interview and any note-taking should be explained.
- Interviews can be initiated by asking people to describe their work.
- Questions that bias the answers (i.e. leading questions) should be avoided.
- The results from the interview should be summarised and reviewed with the person interviewed.
- The people interviewed should be thanked for their participation and co-operation.

Responsibility for Audits

The responsibility for managing an audit programme should be assigned to one or more individuals with a general understanding of audit principles, of the competence of auditors and the application of audit techniques. They should have management skills as well as technical and business understanding relevant to the activities to be audited.

Those assigned the responsibility for managing the audit programme should:

- Establish the objectives and extent of the audit programme.
- Establish the responsibilities and procedures, and ensure resources are provided.
- Ensure the implementation of the audit programme.
- Ensure that appropriate audit programme records are maintained.
- Monitor, review and improve the audit programme.

Advantages and Disadvantages of External and Internal, In-House and Proprietary Environmental Audit Systems

Every organisation carrying out auditing develops its own auditing systems. In addition, there are specialist companies that have developed audit systems that can be purchased and used in a company's own audit system. It is not our task here to describe these systems, and each company should decide for itself whether purchasing such an audit system will be advantageous. Some of these systems are paper-based, basically comprising banks of questions; others (more common) are electronic. Some offer the possibility of integration with other management systems, although the more complex the system, the more time should be spent inputting data, etc. However, many companies find them very helpful, particularly for recording audit results, issuing audit reminders, etc.

Some systems are very broad and would not be suitable for specialist applications; however, for straightforward applications they may be very suitable. Many systems are electronic and enable easy retrieval of results together with ongoing records of achievement. Each company should evaluate its own needs in this respect, but caution should be exercised to ensure that the system chosen meets the exact needs of the organisation. Sometimes, a combination of in-house and proprietary systems may work best.

With any scheme, **cost and benefits** have to be taken into account. Common problems include:

- Systems that are too **general** in approach. These may need considerable work to make them fit the needs and risk of the organisation.
- Systems that are too **cumbersome** for the size and culture of the organisation.
- Scoring systems may conceal problems in underlying detail.
- Organisations may design their management systems to gain maximum points rather than using one that suits the needs and hazard profile of the business.

Regulators encourage organisations to assess environmental performance of their management system using in-house or proprietary schemes but without endorsing any particular one.

The Range of Environmental Audit Applications

There are several different types of **environmental audits**. They all follow similar principles, but differ widely in their application.

Environmental audits

1	**Corporate Audit**	Checks every aspect of a company's operations against set standards (Corporate Governance).
2	**Compliance Audit**	Checks legal compliance. Before this type of audit is undertaken, research should be carried out into the detailed requirements of the law, and copies of relevant regulations, consents, licences, etc. obtained.
3	**Environmental Due-Diligence Review**	Review of a site or a company prior to a takeover, merger or land acquisition. These are external investigations carried out on behalf of a purchaser, lender, etc. The purpose is to ascertain actual or potential environmental liabilities created for the purchaser/lender.
4	**Site Audit - Environmental Management Audit**	Examines every aspect of single-site or multi-site operations. This is a wide-ranging audit, which may cover issues such as resource management, raw-materials sourcing, nature conservation, ecology, wastes, emissions, discharges, and environmental aspects of emergency planning and training.
5	**Activity Audit**	Examines a particular activity, such as purchasing or distribution.
6	**Single-Issue Audit**	Reviews performance in relation to a single issue, such as paper usage, energy or waste management. This type of review may also be undertaken following a non-conformance or environmental incident, such as a spillage that has led to contamination or pollution.
7	**Audit Against Document or Management System Standard**	An audit against any agreed document, e.g. an authorisation, or ISO 14001.
8	**Procedures Audit**	An audit against agreed procedures. This may be part of an EMS.
9	**Environmental Impact Assessment Audit**	An audit covering compliance with the requirements to undertake and implement an Environmental Impact Assessment (EIA). The need for and content of an EIA is often defined in law.
10	**Sustainability Audit**	Examines the environmental, social and economic performance of the audit scope.

STUDY QUESTIONS

4. What are the objectives of active monitoring?
5. What data might be used to reactively monitor environmental performance?
6. What is a near-miss?
7. What are the three basic elements of all types of environmental inspections?
8. List the constituent sections of a report.
9. Name any three of the Cs that relate to style of reporting.
10. Define the term 'environmental audit'.
11. What is the purpose of an opening meeting when undertaking an audit?
12. List three types of environmental audit.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- Appropriate indicators that may reflect an organisation's environmental management performance include:
  - Incidents.
  - Emissions.
  - Waste, water and energy.
  - Transport and travel.
  - Carbon dioxide and carbon (measurement conversion).
- No single measure, by itself, will effectively measure the performance of the organisation.
- Active monitoring includes techniques to check that plans have been implemented and followed, e.g. environmental audits and workplace inspections.
- Reactive monitoring's purpose is to track loss such as accidents, near-misses, complaints, etc.
- A report should consist of title and author, short summary, introduction, main body, conclusions, recommendations, references and appendices.
- An audit is a systematic, independent and documented process to check that the audit criteria are fulfilled - it is not to be confused with an inspection.
- The stages of an audit include pre-audit preparations, information gathering (opening meeting, information collection, closing meeting) and report writing.
- There are numerous types of environmental audits, including compliance audits, due-diligence audits and procedures audits.

Exam Skills

QUESTION

(a) **Identify** the aims and objectives of an environmental audit. (4)

(b) **Describe** the specific issues that should be addressed by an environmental audit. (16)

Approaching the Question

You should spend about seven and 29 minutes, respectively, answering the two parts of the question. The plan for the answer might take the following form:

(a) Variety, legal compliance, EMS (policies, procedures), risk control systems and procedures, costs, generate awareness of EMS.

(b) Management controls, impacts (e.g. waste, air, water), energy efficiency, nuisance.

The key words in the question are:

(a) Identify, aims, objectives, environmental audit.

(b) Describe, specific issues, addressed, environmental audit.

Part (a) requires a short description of the aims and objectives of an audit. You should try to identify at least four of these. Part (b) is tougher and a description of issues that should be addressed by the audit must be provided. Make sure that you provide a wide range of issues. The question does not have to be solely based around undertaking internal EMS audits - other types of environmental audits could also be considered, e.g. due diligence. Try to think beyond the obvious.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

(a) Environmental audits can be undertaken for numerous reasons. The specific aims and objectives of an environmental audit will therefore depend slightly on the type of audit that is being undertaken. However, the aims and objectives common to most types of environmental audit will include checking compliance. Compliance may be checked against legal requirements or management system requirements (including policies and procedures). Additionally, environmental audits will usually cover the effectiveness of systems to control risks. This is likely to include checking as to whether systems, procedures, etc. are missing, or do not function correctly. Environmental audits will also commonly help identify areas where financial reductions can be obtained, e.g. for energy and water consumption or waste production. Audits can also help raise awareness of environmental issues among those who are being audited, or those who are involved in other ways, or who view the audit process.

(b) There are numerous issues that could be considered by an environmental audit. An important issue, depending on the type of audit, could include management controls. This issue might include an audit of performance of an organisation against a recognised management system standard such as ISO 14001. There are numerous areas that would need to be considered, such as whether the organisation has identified aspects and impacts and evaluated the significance of the impacts. The organisation would also need to consider whether training needs have been identified and training provided for relevant staff. ISO 14001 also requires that specific procedures and other documentation are provided - this might include reviewing the environmental manual of the organisation. Additionally, the procedures for dealing with emergencies would need to be evaluated to ensure that they identify potential emergency situations in addition to planned ways of dealing with them.

Waste minimisation may also be considered, as this could be an area where significant cost savings and other benefits can occur. The audit may, in more detail, consider how well the waste hierarchy (i.e. prevent, reduce, re-use, recover and dispose) has been applied to significant waste streams on the site and the best practical environmental option chosen.

The energy efficiency of the plant could also be considered. This could cover whether a survey has been undertaken of energy reduction improvements and the success of any improvements identified. More specifically, this might include energy awareness-raising initiatives such as switch-off schemes, or the purchasing of more energy-efficient equipment.

Nuisance issues may also be considered such as the emission of noise from the site to local neighbours in domestic housing. Relevant noise sources (e.g. transportation, use of equipment, tannoys, etc.) should be identified, in addition to the location of relevant sensitive receptors and the level and type of noise that is received by them. The presence and implementation of control measures to control or reduce noise should be considered, such as keeping windows and doors closed (especially important at night when background noise levels are likely to be lower than daytime ones). Noise monitoring should also be carried out, as this will assist in determining noise levels and whether or not the noise constitutes a nuisance.

Air pollution may also be considered - this could include consideration of the sources of air pollutants and the relevant controls implemented. Air pollutants may occur from powering boilers, production activities, transportation, etc.

Water consumption and effluent production may also be addressed during an environmental audit. This would include issues such as significant uses of water and whether water reduction initiatives have been implemented. Such initiatives might include leak detection and maintenance, using alternative cleaning techniques, or fitting trigger locks to hosepipes. Legal requirements for discharge of effluents should also be considered, as described in an environmental permit/consent.

Element 6

Sustainability

Learning Outcomes

Once you've read this element, you'll understand how to:

1. Explain the principles of environmental sustainability.
2. Outline the role of environmental corporate social responsibility and self-regulation.
3. Outline the drivers for global adoption of sustainability.

Contents

Principles of Sustainability

IN THIS SECTION...

- Sustainable development involves a balance of social, economic and environmental needs.
- Ecological footprinting is a standardised measure for monitoring demand for resources by people and processes.
- The Five Capitals Model of sustainable development focuses on five different types of capital - natural, human, social, manufactured/built and financial - which must all be maintained at the same level, or increased.
- Product stewardship is a concept that involves protection of the environment centring on a product.
- The need for sustainable development reporting and auditing is legal, a requirement of voluntary standards and as a result of pressure from the media, NGO's and the public.

The Three Pillars

In the recent past there has been a growing realisation that the current model of development is unsustainable, i.e. we are living beyond our means. Examples include the loss of biodiversity with the felling of rainforests or overfishing, and the negative effect our consumption patterns are having on the environment and the climate. In order to ensure that such problems are solved, we must live more sustainably.

TOPIC FOCUS

Sustainable development is defined by Principle 3 of the Rio Declaration on Environment and Development as follows:

"The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations."

Another commonly used definition is:

"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs."

It involves a balance of social, economic and environmental needs or pillars:

- **Economic** - the right to a high standard of living, required for a country to be successful. Businesses are required to offer high-quality products that are wanted by customers. For this situation to occur, a highly-qualified and educated workforce is needed.
- **Environmental** - environmental threats must be minimised to ensure a high standard of human and environmental health. For example, the economy must move from the use of fossil fuel to renewable resources to generate energy.
- **Social** - meeting the diverse needs of all people in existing and future communities, promoting personal well-being, social cohesion and equal opportunities for all.

Sustainable development is required to be at the heart of good business practice, being an important element of a company's long-term strategy. It is involved in every aspect of business, from product research to product use by the consumer.

Importance of Sustainability and Resource Efficiency in Decision-Making

Specifically, considering sustainability and incorporating sustainability considerations into core business decisions can benefit organisations through:

- **Resource efficiency** - evidence now points to the fact that reduction of resources needed to run a business will lead to higher business growth than 'business as usual', while at the same time reducing pressure on the environment and enhancing employment.
- **Impacts of climate change** - climate change is set to impact on all our lives by creating unpredictable weather patterns, leading to a shift in the availability of certain raw materials.
- **Risk management** - adapting to changing global conditions and creating opportunities and value within planetary limits. In our resource- and carbon-constrained world, a new framework for business decision-making is evolving where ecological limits are paramount and will be key success criteria for future business operations.
- **Attracting and retaining quality employees** - facilitated by maintaining an ongoing sustainability improvement programme, identifying employees as major stakeholders.
- **Managing and enhancing reputation** - this has been a major driver for many corporations engaging in Corporate Social Responsibility (CSR), and the same principles apply to any size organisation.
- **Stakeholder engagement** - improving relations with key partners. Identifying appropriate communication methods to engage with priority stakeholders will help the ongoing success of an organisation by ensuring relationships are optimised to meet the exact requirements of the organisation and stakeholder, from suppliers to customers.

MORE...

WWW.

You can read more about resource efficiency on the WRAP website, including guides and case studies, at:

www.wrap.org.uk

Design, Construction and Resource Efficiency with Sustainability as an Objective

There are many benefits for organisations in improving efficiency and implementing innovative methods of production. Innovation undertaken in a sustainable manner will decrease costs, improve risk management and produce a working environment more conducive to increased productivity.

A product that has been designed with sustainability in mind takes into account social, economic and environmental effects throughout its life cycle. For example, during design the durability and recyclability of goods should be taken into account. Ensuring that designers are trained and aware of sustainable practices is key to ensuring products are developed in a more sustainable manner.

The construction industry in its own right has a great effect on sustainable development. It can contribute to sustainable development in many ways, including:

- By delivering buildings and structures that improve the health and wellbeing of users, as well as enabling them to lead more sustainable lives.
- By using materials that have low energy intensity and minimise environmental damage in their extraction, production, construction, and the occupation and dismantling of the building.
- By producing high-quality designs that are capable of long life and have minimum impact on the environment.
- By providing employment and stimulating the economy.
- By minimising use of natural resources and energy during the construction and operational phases.
- Choosing the best building materials, which are manufactured from renewable resources and by low-impact processes.

Resource Efficiency and Sustainability

More sustainable business operation, such as ensuring businesses are more resource-efficient, can result in significant financial savings. Resource-efficient practices can also lead to a better understanding of the environmental impacts of production processes and reduction in their scale. The material management and resulting financial benefits can also lead to economic and social benefits.

Companies usually have the opportunity to minimise their consumption of resources throughout the entire life cycle of a product - from raw materials selection to final disposal. For example, significant improvements in sustainability can be accrued from reducing energy consumption, minimising the production of waste and implementing a systematic method of identifying resource reduction opportunities.

Precautionary Principle and 'Polluter Pays' as Examples of Drivers for Sustainability

As we considered earlier, it makes sense to prevent potential adversity even if we are unsure of how significant the scale of adversity is likely to be. This forms the cornerstone of the **precautionary principle**, which is the manner in which society is responding to sustainability (in particular environmental) challenges.

'**Polluter pays**' is a key concept within sustainable development and requires that the polluter should pay for any significant damage to the environment that is created by pollution.

'Polluter pays' is a key concept

Population Growth

Overpopulation does not just refer to the size of the population, but the ratio of population to sustainable resources that are present and the way the resources are used and distributed within a population.

Overpopulation can result from an increase in birth rates, decrease in mortality rates (due to medical advances), increase in immigration and unsustainable use of resources. This makes it possible for very sparsely populated areas, such as the Sahara desert, to be overpopulated due to the limited capacity of the environment. With increased population comes increased pressure on the environment in areas such as resources, pollution, biodiversity and habitat degradation.

When considering the ability of the environment to sustain a population, factors such as clean water, clean air, warmth, food and shelter, etc. should be taken into account.

Increased populations also put pressure on other needs such as housing, education and public services. The vast increase in human population over the 20th century has raised concerns about the Earth's ability to sustain such large numbers of people. Current estimates from the United Nations Department of Economic and Social Affairs suggest that the Earth's population is around seven billion. Projections of population growth are difficult to forecast and largely depend on fertility, mortality and migration, with fertility being a key factor. Current projections show that the Earth's population is expected to increase to 8.5 billion by 2030 and 9.7 billion in 2050 (based on a medium-variant level of fertility).

Slow population growth as a consequence of low fertility leads to a population where the proportion of older people is much greater than the proportion of younger people. Such population ageing is a significant problem in developed countries and is less advanced in developing countries.

The least developed countries in the world tend to have the fastest growing populations. The UN projects that the population of the 48 least developed countries will double from 954 million in 2015 to 1.9 billion in 2050.

Of particular concern is the development of large countries, such as China and India, in a similar way as has occurred in other nations. The Worldwatch Institute postulated that if China and India were to consume the same level of resources per person as the USA or Japan, then by 2030 their new way of life would require the resources of the whole world to sustain them.

Footprints

Ecological Footprint

Ecological footprinting is a measure of the demand of humans on the ecosystem of the Earth. It represents a standardised measure of the demand on nature for products, services, etc. and the plants' ability to regenerate. It is identified as an area of land and sea that is needed to supply the resources that are consumed by people and to assimilate wastes.

Using this method, it has been estimated that the current total human footprint is 1.5 Earths, in that humanity uses ecological services 1.5 times as quickly as natural systems can renew them.

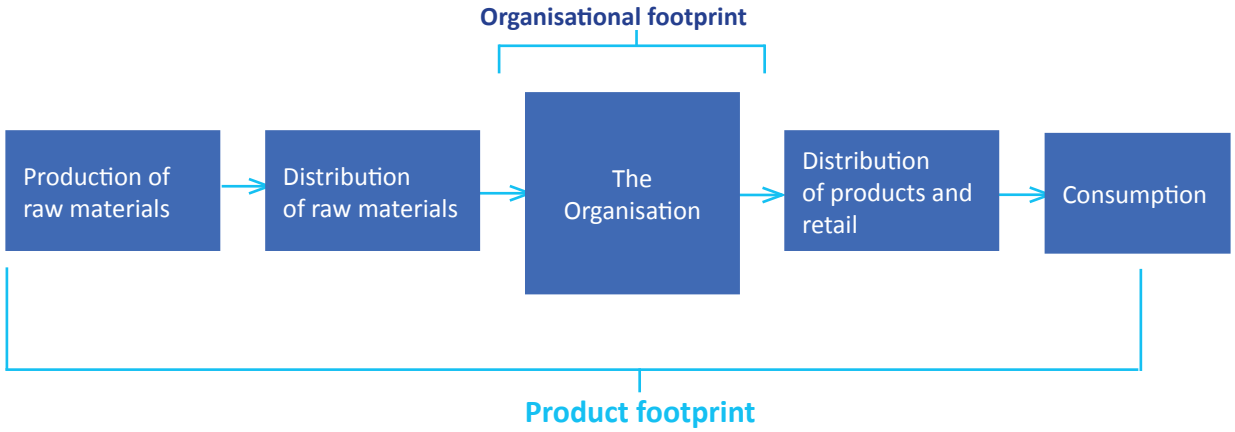
MORE...

www.footprintnetwork.org/our-work/ecological-footprint

Carbon Footprint

A carbon footprint can be defined as the total emissions of greenhouse gases produced both directly and indirectly from an individual, organisation, event or product. Carbon footprints tend to be calculated as carbon dioxide equivalent (CO_{2e}) so that they take into account other greenhouse gases as well as CO_2.

There are many types of carbon footprint. A **product** carbon footprint refers to greenhouse gases produced over the full life cycle of a product from the extraction of raw materials to the final disposal, recycling, recovery, etc. of the product as waste and all stages in between. An **organisation** carbon footprint, however, includes greenhouse gas emissions from activities across the organisation such as energy used for powering buildings, vehicles or industrial activities. The differences between the two types of carbon footprint can be seen in the following figure:



Product and organisational footprint compared
(Based on original source CTV043 Carbon Footprinting, The Carbon Trust, 2012)

Greenhouse gas emissions covered by a carbon footprint may include:

- **Scope 1** - direct emissions from the organisation such as greenhouse gases from the combustion of fuel in vehicles or boilers or production processes.
- **Scope 2** - indirect emissions from electricity, heat or steam bought and used by an organisation.
- **Scope 3** - other indirect emissions out of the direct control of an organisation such as outsourced transportation or employee commuting.

MORE...

PAS 2050:2011 provides guidance on calculating product carbon footprint and can be downloaded for free at:

http://shop.bsigroup.com/en/Browse-By-Subject/Environmental-Management-and-Sustainability/PAS-2050/

Water Footprint

Large quantities of water are used in agriculture, processing and transportation of products that are consumed and used on a regular basis by society. The following figures show the quantity of water used for irrigation of the food crop, or irrigation of the food required to rear cows to produce beef:

- 140 litres of water to produce 1 cup of coffee.
- 1,000 litres of water to produce 1 litre of milk.
- 3,000 litres of water to produce 1kg of rice.
- 15,000 litres of water to produce 1kg of beef.

It's possible to produce a water footprint to demonstrate the average total volume of freshwater that is used to produce products and services that are used by an individual, organisation or even country. For example:

- Global water footprint - 1,385m^3 /person/year.
- United Kingdom - 1,258m^3 /person/year (75% from outside).
- United States of America - 2,842m^3 /person/year (20% from outside).
- India - 1,089m^3 /person/year (2.5% from outside).
- China - 1,071m^3 /person/year (10% from outside).
- Ethiopia - 1,167m^3 /person/year (2.3% from outside).

Understanding the water footprint is important, as many countries import goods that have a significant amount of virtual/embodied water that put a great amount of pressure on exporting regions that do not have the governance mechanism to ensure that water is used sustainably.

MORE...

For more information on water footprints visit the following website:

www.waterfootprint.org/?page=cal/waterfootprintcalculator_national

Five Capitals Model of Sustainable Development

The **Five Capitals Model**, developed by the UK charity Forum for the Future, is a framework which considers sustainable development in terms of capitals and income. Under this framework, sustainability will only be possible if the stocks of the capitals are kept at the same level or increased over time. The Five Capitals are defined as being:

- **Natural capital** - stock or flow of energy and material that produces valuable goods and services. This includes renewable (wood, fish and water) and non-renewable resources (e.g. fossil fuels); resource sinks that have the ability to absorb and make safe pollutants and waste; and processes like climate regulation.
- **Human capital** - human health, motivation, knowledge, skills, etc. Investment in this capital, e.g. through education, is highly important for economic success.
- **Social capital** - value gained through human relations and co-operation, e.g. through institutions including families, schools, businesses and trade unions.
- **Manufactured/built capital** - material goods that contribute to a manufacturing process but are not used up by it, e.g. railways (and other infrastructure), tools, machinery and buildings.
- **Financial capital** - this enables the other types of capital to be owned and traded, but does not have inherent value outside of that context.

It is important to understand how natural capital is converted to products and services that create employment, financial wealth and a generally beneficial life. This framework is intended to highlight the need for sustainability and provide a structure for achieving a more sustainable balance in the long term.

MORE...

www.forumforthefuture.org/project/five-capitals/overview

Product Stewardship

This is a concept that involves protection of the environment centring on a product. All those involved in the product's life cycle have some responsibility for the impacts that the product could cause. Protection of the environment could be partly achieved by better design so that the product lasts longer and can be reused or recycled or, in its use, produces fewer harmful substances. For people who sell the product and those who purchase it, this entails proper disposal or recycling at the end of its life.

Ethical Probity

Ethical probity can be considered to be the evidence of ethical behaviour in a particular process. It means ensuring that conduct is not corrupt or dishonest and is impartial, accountable and transparent. It may mean going beyond the requirements of the law.

Need for Sustainability Reporting and Auditing

As we considered in Element 3, sustainability or Corporate Social Responsibility (CSR) reporting is an important activity for organisations. The need for such CSR reporting and auditing arises from:

- **Legal requirements** - in some countries it is a legal requirement to publish a verified CSR report.
- **Financial initiatives** - many stock-market-quoted companies participate in voluntary reporting through schemes such as the Carbon Disclosure Project, FTSE4Good and the DOW Jones Sustainability Index.
- **Voluntary standards** - EMAS, for example, requires that organisations develop a publicly verified environmental statement.
- **Media, NGO's and the public** - all of these groups have the potential to highlight poor environmental practices and seriously damage the reputation of an organisation.

STUDY QUESTIONS

1. Define sustainable development and list the three component parts.
2. Name four ways in which the construction industry can contribute to sustainable development.
3. In the context of carbon footprinting, outline what is meant by the terms scope 1, scope 2 and scope 3 emissions.
4. Identify the reasons for sustainable development reporting.

(Suggested Answers are at the end.)

Environmental Corporate Responsibility and Self-Regulation

IN THIS SECTION...

- Corporate Social Responsibility (CSR) is an organisational approach that is very closely aligned with the concept of sustainability.
- Corporate governance is the system of rules, practices and processes by which a company is controlled. It involves balancing the needs of stakeholders.
- CSR involves undertaking actions to improve the sustainability performance of the organisation in addition to that of others who are controlled or influenced by the organisation's activities.
- The control of social irresponsibility is a key part of a CSR strategy. What requires to be controlled will vary with organisations due to differing activities but common issues include child labour, forced labour, water abstraction and waste dumping.
- An effective CSR strategy will encompass the ownership by the organisation of high standards. The key to achieving such ownership is through self-regulation.

The Role of CSR

Corporate Social Responsibility (CSR) is an organisational approach that is very closely aligned with the concept of sustainability. Organisations that pursue CSR seek to embed social, environmental and ethical management at the heart of their businesses. CSR requires that an organisation should be accountable to its stakeholders - customers, investors, employees, suppliers, local communities and society as a whole - for managing its social, environmental and wider economic impacts. CSR therefore plays a key role in promoting sustainability.

Corporate social responsibility

Appropriate management of CSR is largely achieved by effective **corporate governance**, which is the system of rules, practices and processes by which the company is controlled. It involves balancing the needs of stakeholders such as the government, regulators, customers and the public. An effectively governed company will embed sustainability principles into the heart of its organisation, ensuring that it takes responsibility for the environmental burdens associated with the organisation.

CSR involves undertaking actions to improve the sustainability performance of the organisation in addition to that of others who are controlled or influenced by the organisation's activities. Those that could be influenced by the organisation include contractors, suppliers and customers. An effective CSR strategy, therefore, will not just involve controlling the organisation's own impacts but will also consider strategies for influencing external stakeholders. As we considered in Element 2, one mechanism for influencing suppliers is through Environmental Supply-Chain Management (ESCM) where a customer will impose certain requirements to bring suppliers in line with the organisation's standards of environmental management. Requirements may be specific, such as lists of substances that are banned, restricted or targeted for phase-out, or specifications on recycled content.

The control of social irresponsibility is also a key part of a CSR strategy. What requires to be controlled will vary with organisations due to differing activities but common issues include:

- **Child labour** - defined by the International Labour Organisation (ILO) as being work that deprives children of their childhood, their potential and their dignity that is harmful to physical and mental development. At its most extreme it involves children being separated from families, exposed to serious hazards and left to fend for themselves. Conventions 182 and 138 have been developed by the ILO to cover child labour issues.
- **Forced labour, modern slavery and human trafficking** - this involves work that has been undertaken on an involuntary basis under the menace of any penalty. It is a situation where people are forced to work through violence, intimidation, manipulated debt or renunciation of identity papers.
- **Water abstraction** - excess demand for water, leading to over-abstraction from water sources, can also have detrimental impacts on aquatic wildlife. Water removed from ground and surface waters rarely returns to the source from which it has been taken. Impacts of over-abstraction on rivers and aquifers include:
  - Reductions in river-water flow, reducing the size of the populations of aquatic species that the river can support.
  - Wetland habitats that are supported by river flows drying up and disappearing.
  - Aquifers drying up, removing important sources of water for human consumption and agriculture.
  - In coastal areas, removing water from aquifers at an excessive rate can lead to saltwater intrusion, making the water unfit for use.
- Waste dumping - the illegal disposal of waste, or waste that is disposed of legally and inadequately stored, causes numerous environmental and social problems. These may include surface water contamination, land contamination, air pollution, nuisance and odour. These can have significant impacts on humans and other living entities.

Risk management controls are vital in ensuring that sustainability issues are identified and dealt with in an appropriate manner. An organisation with an effective CSR strategy must assess and manage its environmental and social risks. This will assist in ensuring that priority is given to key issues. The approach used to assess and manage environmental risks that was considered in Element 4 can be expanded to additionally cover social risks. The implementation of a social and environmental risk management strategy will assist in reducing and avoiding associated risk.

As we considered earlier, CSR goes beyond the direct activities of the organisation. It should also involve the application of **life-cycle thinking.** This is the principle that identifies that the environmental impacts of an activity, product or service should be addressed and solutions developed that consider the full life cycle (from 'cradle to grave'). Traditionally, environmental management has concentrated more on the impacts of the manufacturing process, but for some products the most significant impact may occur during raw material extraction or growth, transportation, use or disposal. Similar social risks may also extend beyond the organisation's direct activities.

The organisation should not only develop strategies for sustainability but must also communicate commitments, performance and other information regarding its social and environmental responsibility to relevant stakeholders. A common way to achieve this would be through the development of a CSR report which would be made available to the public at no cost. Communication of acceptable strategies would assist in an organisation gaining a 'social licence' to operate.

DEFINITION

SOCIAL LICENCE

The ongoing acceptance or approval of an organisation's activities by local communities and other stakeholders.

The effects on a business if it does not take into account the needs of its stakeholders can be significant. It may include breaches of the law, impacts on share price, breach of standards such as ISO 14001, in addition to bad publicity and the significant harm that can be done to the organisation from it.

An effective CSR strategy will encompass the ownership by the organisation of high standards. The key to achieving such ownership is through **self-regulation**, which may involve the following:

- The setting and maintenance of industry-wide standards by industry bodies.
- Internal control strategy of an organisation for improving its social and environmental performance.
- Voluntary participation of an organisation in schemes administered by non-industry bodies.
- Requirements set in contracts.

Self-regulation for sustainability can take many forms. The implementation of a formal environmental management system to a recognised standard such as ISO 14001 is an example of a form of self-regulation as the achievement of ISO 14001 is voluntary. The production of a CSR report or most types of sustainability labelling schemes (such as those administered by Fairtrade and the Forest Stewardship Council (FSC)) are largely voluntary initiatives that implement self-regulation within a defined scope.

Such an approach when applied to CSR in comparison to government regulation will have a greater level of emphasis on persuasion such as collaboration training and less on the development of new legislation or greater enforcement of existing legislation. Self-regulation of the sustainability impacts of the organisation should be thoroughly entrenched in its corporate governance approach, going beyond what is expected by legislation that is applicable to the organisation.

Forest Stewardship Council (FSC) logo

STUDY QUESTIONS

5. Outline the meaning of the term 'corporate governance'.

6. Outline the impacts of over-abstraction of water from a river or aquifer.

7. Identify four ways in which self-regulation can be implemented.

(Suggested Answers are at the end.)

Global Recognition of the Importance of Sustainability

IN THIS SECTION...

- The Convention on Biological Diversity (CBD) has three main goals: conservation of biological diversity (biodiversity); sustainable use of its components; and the fair and equitable sharing of the benefits arising from genetic resources.
- The function of the International Tropical Timber Agreement (ITTA) is to promote the expansion and diversification of the international trade in tropical timber from forests that are sustainably managed and legally harvested.
- The Convention Concerning the Protection of the World Cultural and Natural Heritage aims to provide protection of 'cultural heritage' such as monuments, groups of buildings and sites and 'natural heritage' such as geological formations or habitats containing rare species.
- The United Nations Framework Convention on Climate Change (UNFCCC) recognises that the climate system is shared resources that can be affected by emissions of greenhouse gases.
- Each local authority has had to draw up its own Local Agenda 21 (LA21) strategy following discussion with its citizens about what they think is important for the area.
- The UN Global Compact is an international movement of sustainable companies and stakeholders which supports companies to carry out business in a responsible manner by aligning strategies and operations with the ten principles of human rights, labour, environment and anti-corruption.
- A set of sustainable development goals and targets was developed at the UN Sustainable Development Summit. They were developed for the general categories people, planet, prosperity, peace and partnership. The goals must be achieved by 2030.

Introduction to Global Recognition of the Importance of Sustainability

Sustainable development has been recognised as being a key issue by many governments, industry and people around the world. This is reflected by the development of international laws that cover various aspects of sustainable development. In this section we will consider some of those key international laws and how they have influenced sustainable development at the international level.

Convention on Biological Diversity

The **Convention on Biological Diversity (CBD)** was opened for signatures in 1992, coming into force in December 1993. It has three main goals:

- conservation of biological diversity (biodiversity);
- sustainable use of its components; and
- the fair and equitable sharing of the benefits arising from genetic resources.

DEFINITIONS

GENETIC RESOURCES

Genetic materials of actual or potential value.

GENETIC MATERIAL

Material of any plant, animal, microbial or other containing functional units of heredity.

The key objective of the CBD is for the development of national strategies to enable the sustainable use and conservation of biodiversity. This is achieved by considering the following:

- **Co-operation** - contracting parties will co-operate on matters of mutual interest surrounding the conservation and sustainable use of biological diversity.
- **General measures for conservation and sustainable use** - national strategies, plans or programmes must be developed for the conservation and sustainable use of biological diversity or current strategies adapted for this purpose.
- **Identification and monitoring** - each contracting party is required to identify components of biodiversity important for conservation and sustainable use, considering guidelines set in Annex I of the Convention. Each party must also monitor the components of biodiversity.
- ***In situ* conservation** - each contracting party is required, as far as possible and appropriate, to:
  - establish biodiversity protected areas;
  - promote the protection of ecosystems and natural habitats;
  - restore and rehabilitate degraded ecosystems;
  - prevent the introduction of species that may threaten ecosystems, habitats or other species; and
  - introduce legislation, etc. for the protection of threatened species and populations.
- ***Ex situ* conservation** - conservation measures are required to be implemented for components of biological diversity outside their natural habitat.
- **Sustainable use** - consideration of conservation and sustainable use of biodiversity must be integrated into national decision-making; biological resources must be used in accordance with traditional cultural practices and support local populations.
- **Research and training** - programmes for scientific and technical education and training in the identification, conservation and sustainable use of biological diversity must be developed and research in these areas must be promoted.
- **Impact assessment** - contracting parties must introduce requirements for the environmental impact assessment of projects that are likely to have a significant adverse impact on the environment.

The **Cartagena Protocol on Biosafety** to the Convention on Biological Diversity is an international treaty made under the CBD that governs the movement of living modified organisms resulting from biotechnology between countries.

MORE...

www.cbd.int/convention/

International Tropical Timber Agreement

The function of the **International Tropical Timber Agreement (ITTA) 2006** is to promote:

- the expansion and diversification of the international trade in tropical timber from forests that are sustainably managed and legally harvested; and
- the sustainable management of forests that produce tropical timber.

This is achieved by the establishment of the International Tropical Timber Organisation (ITTO). The ITTO regulates the trade in tropical timber by:

- Providing a framework for consultation, international co-operation and policy development.
- Contributing to sustainable development and poverty alleviation.
- Promoting and supporting research and development with a view to improving forestry management and efficiency of wood utilisation.
- Promoting increased and further processing of timber gained from suitable sources.
- Encouraging members to support and develop tropical timber reforestation.

- Strengthening the ability of members to improve forestry law enforcement and governance and to address illegal logging.
- Encouraging members to recognise the role of forest-dependent indigenous and local communities and develop strategies to enhance the capacity of the communities.

The 2013-18 ITTO strategic action plan states six strategic priorities for the organisation:

	Strategic Priority
1	Promote good governance and enabling policy frameworks for strengthening SFM and related trade, and enhancing SFM financing and investment.
2	Increase the contribution of tropical forests to national and local economies, including through international trade.
3	Enhance the conservation and sustainable use of biodiversity in tropical timber- producing forests.
4	Reduce tropical deforestation and forest degradation and enhance the provision of environmental services.
5	Improve the quality and availability of information on tropical forests, forest product markets and trade.
6	Build and develop human resource capacity to implement SFM and increase trade in forest goods and services from sustainably managed forests.

Source: *ITTO Strategic Action Plan 2013-2018*, ITTO, 2013

MORE...

www.

www.itto.int

Convention Concerning the Protection of the World Cultural and Natural Heritage

The **Convention Concerning the Protection of the World Cultural and Natural Heritage 1972** is a key agreement that aims to provide protection of:

- '**cultural heritage**' such as monuments, groups of buildings and sites (combined works of man and nature - included in this are archaeological sites which are of an outstanding universal value); and
- '**natural heritage**' which can be considered as natural features consisting of physical and biological formations, geological features and natural sites in an area that constitute the habitats of internationally threatened plant and animal species and natural sites that have an outstanding universal value from the point of view of science, conservation or natural beauty.

The key requirements of the Convention are as follows.

Each country must:

- Identify, protect, conserve and rehabilitate cultural and natural heritage to ensure its transmission to future generations.
- Develop services for the protection of natural and cultural heritage.
- Take legal, scientific and technical, and administrative measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage.
- Develop centres for training in the protection, conservation and presentation of its heritage.

Such heritage relevant to the Convention is defined as 'World Heritage'.

Protection of world heritage involves:

- A system of internal co-operation and assistance.
- Establishment of the 'World Heritage Committee' to which countries must submit an inventory of property that forms cultural and natural heritage. The committee must establish, keep up-to-date and publish a 'World Heritage List" which shall be distributed every two years. Inclusion on the list requires the consent of the state concerned. A 'list of world heritage in danger' needs also to be developed. They must also define the criteria on which a site becomes a world heritage site.
- Development of a world heritage fund which provides financial support for the protection of world cultural and natural heritage to which compulsory and voluntary contributions by states must be made.

MORE...

The World Heritage List can be viewed at:

http://whc.unesco.org/en/list

Framework Convention on Climate Change

The **United Nations Framework Convention on Climate Change (UNFCCC) 1994** has been the focus of international efforts to reduce greenhouse gases. Its requirements are very generic in nature and largely set an overall framework for international efforts to combat climate change. It recognises that the climate system is shared resources that can be affected by emissions of greenhouse gases. The Convention specifically requires that governments:

- Obtain and share information on greenhouse gas emissions, policies and best practices.
- Launch national strategies for addressing greenhouse gas emissions and adapting to climate-related impacts (this includes providing financial and technological support to developing countries).
- Co-operate in the preparations required for adapting to the impacts of climate change.

The **Kyoto Protocol** was adopted by parties to the UNFCCC in 1997, with the intention of establishing a legally-binding framework of GHG emission reductions, but was the subject of protracted negotiations. As a result, the Protocol did not enter into force until 2005, and the so-called "first commitment period" did not commence until 2008. Signatories to the first commitment period (2008-2012) agreed to meet binding reductions in their emissions of greenhouse gases.

The **Doha amendment** to the Kyoto Protocol was adopted in December 2012 and sets out the binding agreements that cover the "second commitment period", which runs from January 2013 to December 2020.The first commitment period was adopted by 37 industrialised countries and the EU, who committed to reduce emissions of a set of six greenhouse gases by an average of 5% against 1990 levels. Signatories to the second commitment period have agreed to reduce greenhouse-gas emissions by at least 18% below 1990 levels. However, a number of countries (Japan, Russia, New Zealand) that participated in the first commitment period have not agreed to participate in the second commitment period, and other countries (notably the USA and Canada) have either never ratified the Protocol, or have subsequently withdrawn. It should also be noted that developing countries do not have any binding reduction targets under the Protocol.

Key aspects of the agreement:

- Participant countries will have to review climate plans on a regular basis and ensure that action is taken to deal with climate change.
- Development of an aim of net zero emissions by the end of the century.
- A specific legal requirement to reduce emissions on a five-yearly basis from 2025. All participant countries must be independently reviewed for progress towards their emission reduction pledges.
- Developed and emerging economies must mobilise $100 billion per year from public and private funding to assist vulnerable and poor countries in protecting themselves against the consequences of climate change.

The **Paris Agreement** was developed at the Paris climate conference in December 2015 and formally entered into force in November 2016 when a sufficient number of countries (representing at least 55% of the world's greenhouse gas emissions) had ratified the agreement. The agreement is planned to enter into force in 2020.

The Paris Agreement provides a framework to reduce global warming to well below 2 degrees C above pre-industrial levels and plans to achieve climate-neutrality by the end of the century. Other key requirements are:

- A specific legal requirement to reduce emissions on a five-yearly basis from 2025. All participant countries must be independently reviewed for progress towards their emission reduction pledges.
- Governments must report to the public and each other on progress towards achieving their targets in a robust, transparent and accountable way.
- Developed and emerging economies must mobilise $100 billion per year from public and private funding to assist vulnerable and poor countries in protecting themselves against the consequences of climate change.

Climate-neutrality to be achieved by the end of the century

Agenda 21

At the Rio Earth Summit in 1992, the United Nations agreed that the best starting point for the achievement of sustainable development is at the local level. Each local authority has had to draw up its own Local Agenda 21 (LA21) strategy following discussion with its citizens about what they think is important for the area.

Sustainable development is required to be a key part of LA21 and it is regarded as involving community issues and including all members of society regardless of their ethnic background, including community groups and business.

LA21 is based on the key principles of sustainable development. Its central theme is developing economic, social and environmental improvements for all. It takes into account that sustainable development can only be reached if quality of life is not sacrificed.

Many local authorities have developed indicators to help determine sustainable development and track progress to achievement. Such indicators may include education standards and crime figures.

UN Global Compact

The UN Global Compact is an international movement of sustainable companies and stakeholders which supports companies to carry out business in a responsible manner by aligning strategies and operations with the ten principles of human rights, labour, environment and anti-corruption.

The Ten Principles

"Human Rights

Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights; and

Principle 2: make sure that they are not complicit in human rights abuses.

Labour

Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;

Principle 4: the elimination of all forms of forced and compulsory labour;

Principle 5: the effective abolition of child labour; and

Principle 6: the elimination of discrimination in respect of employment and occupation.

Environment

Principle 7: Businesses should support a precautionary approach to environmental challenges;

Principle 8: undertake initiatives to promote greater environmental responsibility; and

Principle 9: encourage the development and diffusion of environmentally friendly technologies.

Anti-Corruption

Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery."

Source: United Nations Global Compact (www.unglobalcompact.org/what-is-gc/mission/principles)

Environmental Principles of the UN Global Compact

- "Principle 7: Businesses should support a precautionary approach to environmental challenges."

  As we have considered earlier, this principle states that where there is a threat of serious or irreversible damage, full scientific certainty should not be used as a reason for preventing environmental damage.

- "Principle 8: undertake initiatives to promote greater environmental responsibility."

  Identified in Agenda 21, this principle states that businesses should:

  – Increase self-regulation guided by codes, charters and initiatives fully integrated into all areas of business planning and decision-making.
  – Foster an openness and dialogue with the public and employees.

- "Principle 9: encourage the development and diffusion of environmentally friendly technologies."

  Environmentally sound technologies are required to protect the environment, are less polluting, use resources in a sustainable manner, and recycle more of their wastes in a more acceptable way than technologies that they substitute. They may include know-how, procedures and equipment. Where production processes do not follow this principle, they may lead to operating inefficiencies, emissions of contaminants, exposure of workers to hazardous materials and increase the risk of environmental disasters.

MORE...

www.

www.unglobalcompact.org

UN Sustainable Development Goals and Targets

Rio+20 Conference on Sustainable Development

The Rio+20 Earth Summit in June 2012 signed off a plan that will help put sustainable development on the international agenda. Key points include:

- Commitment to develop Sustainable Development Goals (SDGs) covering the elements of sustainable development (social, economic and environmental).
- Recognition of the key role of the green economy as a massive economic opportunity that countries should adapt to in the future.

2030 Agenda for Sustainable Development

A set of sustainable development goals and targets was developed at the United Nations Sustainable Development Summit in September 2015. They were developed for the general categories people, planet, prosperity, peace and partnership. The goals must be achieved by 2030 and are:

"Goal 1. End poverty in all its forms everywhere

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 3. Ensure healthy lives and promote well-being for all at all ages

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Goal 5. Achieve gender equality and empower all women and girls

Goal 6. Ensure availability and sustainable management of water and sanitation for all

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation

Goal 10. Reduce inequality within and among countries

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12. Ensure sustainable consumption and production patterns

*Goal 13. Take urgent action to combat climate change and its impacts**

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Goal 17. Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

** Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change."*

Source: *Transforming our world: the 2030 Agenda for Sustainable Development*, United Nations, 2015

STUDY QUESTIONS

8. What are the three goals of the Convention on Biological Diversity?
9. Explain the meaning of the term 'Natural Heritage' in the context of the Convention Concerning the Protection of the World Cultural and Natural Heritage.
10. Identify the three environmental principles of the UN Global Compact.

(Suggested Answers are at the end.)

Summary

Key topics covered in this element:

- Sustainable development is a balance of social, economic and environmental needs.
- The Five Capitals Model of sustainable development states that natural, human, social, manufactured/built and financial capitals should be maintained at the same level, or increased.
- Corporate Social Responsibility (CSR) is an approach that should deliver sustainable development in an organisation.
- Child labour, forced labour, water abstraction and waste dumping are examples of social irresponsibility.
- Self-regulation is an approach that will help embed CSR within an organisation.
- The Convention on Biological Diversity aims to conserve biodiversity and fairly share its benefits.
- The World Heritage List identifies internationally important cultural and natural heritage.
- The United Nations Framework Convention on Climate Change sets broad requirements for the prevention of, and adaptation to, climate change.
- Sustainable development goals have been developed under the people, planet, prosperity, peace and partnership categories.

Exam Skills

QUESTION

(a) **Explain** what is meant by the term 'sustainable development'. (8)

(b) **Describe** the five capitals model of sustainable development. (12)

Approaching the Question

Part (a) requires more than just a definition of sustainable development as it is an 'explain' question and is worth a maximum of 8 marks. Part (b) requires a detailed description of the Forum for the Future's five capitals model of sustainable development.

Plan

(a) Definitions of sustainable development, balance, three pillars, economic, social and environmental.

(b) Forum for the Future, stock of capitals retained/increased, natural capital, human capital, social capital, manufactured/built capital, financial capital.

Suggested Answer Outline

Now you have completed your answer, compare it to the following suggested answer.

(a) Sustainable development is defined as follows by Principle 3 of the Rio Declaration on Environment and Development:

"The right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations."

Another commonly used definition is;

"Development which meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development involves a balance of social, economic and environmental needs or pillars:

- Economic - the right to a high standard of living, required for a country to be successful. Businesses are required to offer high-quality products that are wanted by customers. For this situation to occur, a highly-qualified and educated workforce is needed.
- Environmental - environmental threats must be minimised to ensure a high standard of human and environmental health. For example, the economy must move from the use of fossil fuel to renewable resources to generate energy.
- Social - meeting the diverse needs of all people in existing and future communities, promoting personal well-being, social cohesion and equal opportunities for all.

(b) The Five Capitals Model, developed by the UK charity Forum for the Future, is a framework which considers sustainable development in terms of capitals and income. Under this framework, sustainability will only be possible if the stocks of the capitals are kept at the same level or increased over time. The Five Capitals are defined as being:

- Natural capital - stock or flow of energy and material that produces valuable goods and services. This includes renewable (wood, fish and water) and non-renewable resources (e.g. fossil fuels); resource sinks that have the ability to absorb and make safe pollutants and waste; and processes like climate regulation.
- Human capital - human health, motivation, knowledge, skills, etc. Investment in this capital, e.g. through education, is highly important for economic success.
- Social capital - value gained through human relations and co-operation, e.g. through institutions including families, schools, businesses and trade unions.
- Manufactured/built capital - material goods that contribute to a manufacturing process but are not used up by it, e.g. railways (and other infrastructure), tools, machinery and buildings.
- Financial capital - this enables the other types of capital to be owned and traded, but does not have inherent value outside of that context.

It is important to understand how natural capital is converted to products and services that create employment, financial wealth and a generally beneficial life. This framework is intended to highlight the need for sustainability and provide a structure for achieving a more sustainable balance in the long term.

Unit ED1

Suggested Answers - Part 1

No Peeking!

Once you have worked your way through the study questions in this book, use the suggested answers on the following pages to find out where you went wrong (and what you got right), and as a resource to improve your knowledge and question-answering technique.

Element 1: Key Environmental Cycles and the Effect of Human Activity on the Environment

Question 1

The environment is:

"Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelationships ...

Surroundings can extend from within an organisation to the local, regional and global system ... [and] ... can be described in terms of biodiversity, ecosystems, climate or other characteristics."

Question 2

Water is transferred to the atmosphere by evaporation from water bodies, soil and vegetation. As a vapour it will rise, cool and condense to form clouds, which eventually release rain, sleet and snow. The water is then used within biological systems, or seeps into the ground, from where it is eventually recycled by evaporation.

Question 3

Human activities can impact on the nitrogen cycle in the following ways:

- Run-off into water of nitrogen-based fertilisers, both natural and synthetic, causing nutrient enrichment (eutrophication) leading to excessive growth in plants, causing oxygen depletion, blockage of light and nuisance.
- Combustion of fossil fuels, leading to release of nitrogen into the atmosphere, which causes acidification of ecosystems (e.g. damage to forests and lakes).
- Discharge of sewage containing nitrogen compounds into rivers, lakes and streams, which causes nutrient enrichment.
- Emissions of nitrogen (mainly ammonia compounds) from manure to air from intensive rearing of pigs and chickens.

Question 4

Reasons why biodiversity should be conserved include:

- Ecological - if key pieces of the ecological framework are removed then the whole framework may be in danger of collapsing. The ecological arguments for conserving biodiversity are therefore based on the premise that we need to preserve biodiversity in order to maintain our own life-support systems.
- Economic - maintaining and enjoying a high-quality natural environment and the regenerative effects of an improved environment can bring substantial financial benefits to an area. Resources can also be taken from nature for consumption.
- Cultural/spiritual/aesthetic - the beauty of nature is something many people are enthralled by. There is something within the natural environment which people really connect to, and which gives them an immense sense of satisfaction when they experience nature. For some, there are also cultural or spiritual meanings attached to the landscape.
- Recreation/tourism - many people take day trips and holidays to areas because of the quality of the natural environment, as well as to visit wildlife.
- Education/information - unique natural spaces have an important function in enabling society to improve its knowledge of the natural world. Scientists can use these areas to gather data and conduct research which can materially benefit society.

(Only three were required.)

Question 5

The four ecosystem services are:

- Provisioning.
- Regulating.
- Cultural.
- Supporting.

Question 6

Deforestation can cause the following environmental problems:

- Burning and decay of wood releases carbon dioxide into the atmosphere contributing to climate change.
- Trees and other plants photosynthesise - this involves removing carbon dioxide from the atmosphere to produce oxygen, thereby reducing atmospheric carbon dioxide levels. If large forests are removed, less carbon dioxide is removed from the atmosphere causing an increased risk of climate change.
- The water cycle can be significantly affected. Trees take groundwater through roots, which is emitted into the atmosphere. When deforestation occurs, the lack of trees and other plants means that water is not evaporated and local climates are much drier.
- The cohesion of the soil is reduced by deforestation, resulting in:
  - Fertile agricultural soils being eroded.
  - Increased risk of landslides on steep slopes.
- A reduction in forest cover means that surface water run-off will increase, which may result in flash floods and increase the risk of localised floods in comparison to what would occur if the forest cover was present.
- Deforestation can result in a decrease in biodiversity as an important habitat for many plants and animals is destroyed. This can also lead to a reduction in genetic variation. Genetic variation can lead to many agricultural benefits such as development of crops that are resistant to pests or have the ability to grow in poor quality soils.
- Forests often contain many plants which are still to be discovered, some of which may have properties which can be used to fight disease and ill health.

Question 7

The precautionary principle defines much of the way we are beginning to respond to the challenges of sustainable development, particularly within the environmental context. It urges a willingness to take action in advance of scientific proof of evidence of the need for the proposed action, on the grounds that further delay could prove ultimately most costly to society and nature and, in the longer term, selfish and unfair to future generations. Central to the application of the precautionary principle is the concept of proportionality or cost-effectiveness. Will environmental benefits of precautionary action outweigh the economic and societal costs?

Question 8

The role of trade unions in influencing high environmental standards is:

- Provision of learning on environmental management for members.
- Influencing governments to increase or strengthen environmental laws and their enforcement.
- Encouraging members to work for a more environmentally aware employer.
- Influencing employers to provide high environmental standards.
- Providing guidance for members on good standards of environmental management.

Question 9

Pressure groups may cause the following:

- Reduced sales.
- Raising consumer awareness of an issue.
- Increasing the costs of a business through improved risk controls, etc.
- Changing current business practices.
- Influencing the making of law and government policy.
- Damaging the reputation of an organisation.

Element 2: Environmental Leadership

Question 1

EU Regulation - applies directly to the intended target (normally member states). There is no requirement to assimilate into national laws.

EU Directive - binding on EU member states with respect to the objectives to be achieved, but the method for achieving this is left open. Directives are normally implemented by national regulations made in each member state. They must be implemented by a defined date referred to in the directive.

Question 2

Direct costs:

- repairs or replacement of damaged equipment and buildings;
- clean-up costs;
- remediation;
- product loss or damage;
- loss of production;
- public and/or product liability;
- fines;
- legal fees; and
- increases in insurance premiums.

Indirect costs:

- business interruption;
- loss of orders;
- cost of time spent on investigations; and
- loss of corporate image.

Question 3

The key components of effective environmental leadership are commitment and accountability, resource provision, environmental integration into business processes, communication, ownership and a positive environmental culture.

Question 4

The four C's are control, co-operation, communication and competence.

Question 5

Key ethical considerations of an effective environmental practitioner are:

- Provision of a high standard of service.
- Taking responsibility for their actions.
- Treating others with respect.
- Acting in a manner that promotes trust in the environmental management profession.
- Acting with integrity.

Question 6

Competence can be defined as the "ability to apply knowledge and skills to achieve intended results".

Question 7

The requirements for competency management in ISO 14001:2015 are:

- Determine the competency of persons carrying out work under the organisation's control that may adversely affect its environmental performance or its ability to achieve compliance obligations.
- Ensure that such persons are competent on the basis of education, training or experience.
- Assess the training needs of the organisation that are associated with its environmental aspects and its environmental management system.
- Where applicable, undertake actions to acquire the competency required and evaluate the effectiveness of such actions.

Element 3: Environmental Management Systems and Emergency Planning

Question 1

The seven principal elements of an ISO 14001 EMS are:

- Context of the organisation.
- Leadership.
- Planning.
- Support.
- Operation.
- Performance evaluation.
- Improvement.

Question 2

The purpose of an environmental audit includes the following:

- Determination of the extent of conformity of the auditee's management system, or parts of it, with audit criteria.
- Evaluation of the capability of the management system to ensure compliance with statutory, regulatory and contractual requirements.
- Evaluation of the effectiveness of the management system in meeting its specified objectives.
- Identification of areas for potential improvement of the management system.

Question 3

An ISO-14001-compliant audit procedure should cover issues such as:

- The activities and areas to be considered in audits.
- The frequency of audits.
- The responsibilities associated with managing and conducting audits.
- The communication of audit results.
- Auditor competence.
- How audits are to be conducted.

Question 4

The issues that would be covered by a management review include:

- Status of actions from previous reviews.
- Changes in significant aspects.
- Internal and external issues.
- The extent to which objectives have been reached.
- Information on the environmental performance of the organisation such as trends in monitoring results, fulfilment of compliance obligations and audit results.
- How adequate resources are.
- Communications from interested parties (this includes complaints).
- Areas where there are opportunities for continual improvement.

Question 5

Continual improvement is recurring activity to enhance performance.

Question 6

The key drivers for CSR reporting are:

- Legal.
- Financial.
- Meeting voluntary standards.
- Meeting the concerns of the media, non-governmental organisations and the general public.

Question 7

Any five factors from:

- Materiality.
- Stakeholder inclusiveness.
- Sustainability context.
- Completeness.
- Balance.
- Comparability.
- Accuracy.
- Timeliness.
- Clarity.
- Reliability.

Question 8

Absolute data is data that has been collected over a set period of time, such as total electricity consumption in a year.

Normalised data is data that compares two sets of absolute figures to each other, such as electricity consumption per tonne of product.

Question 9

Qualitative data is non-numeric, 'soft' data that describes meaning, such as whether a person perceives a sound to be a nuisance.

Quantitative data is 'hard' data in that it provides numbers, for example the loudness of a sound measured using a sound level meter.

Question 10

The four objectives of benchmarking are:

- Assessing significance.
- Identifying areas for improvement.
- Justifying performance.
- Setting performance targets.

Question 11

Policies, procedures and systems of work may be implemented by:

- Setting of roles, responsibilities and authorities.
- Competence, training and awareness.
- Communication.
- The development of documentation.

Question 12

Competency of a contractor may be determined by referring to:

- A copy of their environmental policy.
- Examples of impact assessments.
- The qualifications and training records of staff.
- Membership of a professional organisation or certified body.
- Records of maintenance and testing for plant and equipment.
- Names of previous or current clients.
- Accident history records.
- Records of enforcement action taken by authorities against them.
- Proof of adequate resources, such as access to specialist environmental advice.
- Proof of adequate insurance.

Question 13

The three-step process for managing contractors is:

- Selecting the contractor.
- Planning the work.
- Monitoring the work.

Question 14

The contents of an internal emergency plan include:

- The names or positions of persons authorised to set emergency procedures in motion, and the person in charge of co-ordinating the internal (on-site) mitigatory action.
- The name or position of the person with responsibility for liaison with the local authority responsible for preparing the external emergency plan.
- For foreseeable conditions or events that could be significant in bringing about a major accident, a description of the action that should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and the resources available.
- The arrangements for limiting the risks to persons on site, including how warnings are to be given and the actions persons are expected to take on receipt of a warning.
- Arrangements for providing early warning of the incident to the local authority responsible for setting the external emergency plan in motion, the type of information that should be contained in an initial warning, and the arrangements for the provision of more detailed information as it becomes available.
- Arrangements for training staff in the duties they will be expected to perform, and, where necessary, co-ordinating this with the emergency services.
- Arrangements for providing assistance with external mitigatory action.

Question 15

An emergency plan can be tested by:

- Drills using different combinations of tests in fully testing some or all aspects of the emergency plan for the internal (on-site) and external (off-site) response.
- Seminar exercises training staff and developing emergency plans - they facilitate discussion about the different organisations' responses in particular circumstances during an emergency.
- Walk-through exercises demonstrating that information on the emergency, and the response to it, is passed to all participating organisations and to the appropriate media; training staff or developing emergency plans. The emergency response is 'walked through', including visiting appropriate facilities, such as ECCs.
- Desktop exercises which include preparing briefs for the media and should sometimes include establishing a media briefing centre. In addition, consideration should be given as to the effect of the media in the event of an emergency, and the ability of the ECC to make information available for handling their enquiries. Desktop exercises allow information exchange and dissemination between organisations and the ECC, together with decision-making, to be tested. They are carried out in relation to a model, plans or photographs to depict the establishment. They could involve using information technology or virtual-reality systems.
- Live exercises fully testing some or all aspects of the emergency plan for the internal and external response.

Element 4: Environmental Risk Evaluation and Control

Question 1

The following is one example of a possible Source Pathway Receptor model for a fuel spill in a haulage yard:

Source	Pathway	Receptor (Target)
Underground fuel tank	Product loss and dissolution in groundwater	Groundwater in aquifer
	Vapour transport through soil	Humans
Fuel Dispenser	Air-inhalation	Humans
Above-ground fuel tank spills by users	Forecourt drains	Local watercourses

Question 2

Environmental aspects and impacts can be identified and assessed by selecting an activity, determining the aspects and impacts of that activity and evaluating significance.

Question 3

Bioindicators are plants and animals that show reaction to varying conditions in the environment that are difficult to identify. The observation of the types and numbers of different animals can give clues to the environmental conditions. For example, some fish and invertebrates thrive in comparison to others in certain polluted conditions.

Question 4

The factors that should be considered when assessing the quality of environmental data include:

- Accurate - uncertainties and assumptions within the data source are understood and taken into account.
- Complete - any specific exclusions must be disclosed and justified.
- Consistent - consistent methodologies allow for comparison of data over time.
- Faithful - the data should be capable of being depended upon by users to represent faithfully that which it purports to represent, or could reasonably be expected to represent.
- Not biased - data must avoid bias in the selection and presentation of information, and provide a credible and balanced account.
- Relevant - services the decision-making needs of external users.
- Transparent - addresses all relevant issues in a factual and coherent manner and discloses relevant assumptions and appropriate references to data sources.

Question 5

Transportation issues include:

- Air pollution.
- Noise.
- Dust.
- Congestion.
- Changes to the landscape.
- Land-take (land used for the building of new roads, etc.).
- The effects of refuelling.

(Only four were required.)

Question 6

BPEO stands for Best Practicable Environmental Option. The RCEP definition is:

"A BPEO is the outcome of a systematic and consultative decision-making procedure, which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term."

Question 7

Best Available Techniques (BAT) is the strategy used under the PPC regime to prevent and minimise pollution.

Question 8

An environmental model is usually a mathematical representation of some defined part of the environment, which can be tested in various ways that would be impractical in the real world. Models are used to predict or measure the consequences of different input variables using the same parameters or conditions, giving probabilistic results.

Question 9

An environmental modelling technique might be used simply as a predictive tool, or for revealing overlooked assumptions, or unexpected consequences, for identifying data deficiencies, to formulate hypotheses, to establish the value of existing data, or as a basis for policy and resource management decisions.

Question 10

The 'cradle-to-grave' concept involves assessing the full impact of a process or activity from raw materials and production through to final disposal, when discarded.

Question 11

When considering a quantitative review of the life cycle of a product or service.

Question 12

The stages of an EIA are:

- Screening.
- Scoping.
- Baseline studies
- Impact assessment significance.
- Mitigation.
- Application environmental statement.
- Monitoring.

Question 13

The content of an environmental statement is:

- A description of the development.
- A description of the measures required to avoid or reduce significant environmental impacts.
- The data needed to identify and assess the significant impacts which a development is likely to have on the environment.
- An outline of the key alternatives to mitigate significant environmental impacts and the main reasons for the choice made.
- A non-technical summary of the environmental statement.

Element 5: Environmental Performance Evaluation

Question 1

Indicators may be set for incidents, emissions, waste, water, energy, transport and travel, and greenhouse gases.

(Only five were required.)

Question 2

The EU **Accounts Modernisation Directive** introduces requirements for companies to include a balanced and comprehensive analysis of the development and performance of the business in their Directors' Report. The analysis should include both financial and, where appropriate, non-financial key performance indicators relevant to the particular business, including information relating to environmental and employee matters.

Question 3

EPIs used for travel and transport could include:

- Vehicle miles per average weekday.
- Number of journeys undertaken by sustainable modes (cycling, walking and public transport).
- Total number of Green Travel Plans and School Travel Plans implemented in a borough.

(Only one was required.)

Question 4

The objectives of active monitoring are to check that the environmental plans have been implemented and to monitor the extent of compliance with:

- The organisation's systems and procedures.
- Legislation and technical standards.

Question 5

Examples include:

- Incidents.
- Near-misses.
- Reportable emissions (i.e. those over an emission limit value).
- Monitoring of water, energy, waste, etc.
- Complaints.
- Criticisms from regulatory agency staff.
- Regulatory-agency enforcement actions.

Question 6

A near-miss is defined as an incident that could have resulted in an accident.

Question 7

The basic elements of environmental inspections are:

- An assessment of the standards of the workplace against the specified performance standards and risks.
- The identification and reporting of any deficiencies.
- The identification of causes and of action to be taken to remedy the problem.

Question 8

A report should consist of:

- Abstract or short summary.
- Introduction.
- Main body of report.
- Conclusions.
- Recommendations.
- References.
- Appendices.

Question 9

The C's that relate to style of reporting are:

- Clear.
- Concise.
- Correct.
- Courteous.
- Complete.
- Consistent.
- Convincing.

(Only three were required.)

Question 10

An environmental audit can be defined as a:

"systematic, independent and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the audit criteria are fulfilled".

Question 11

The purpose of an opening meeting is to:

- Confirm the audit plan.
- Provide a short summary of how the audit activities will be undertaken.
- Confirm communication channels.
- Provide an opportunity for the auditee to ask questions.

Question 12

Types of environmental audit include:

- Corporate Audit.
- Compliance Audit.
- Environmental Due Diligence Review.
- Site Audit - Environmental Management Audit.
- Activity Audit.
- Single-Issue Audit.
- Audit Against Document or Management System Standard.
- Procedures Audit.
- Environmental Impact Assessment Audit.
- Sustainability Audit.

(Only three were required.)

Element 6: Sustainability

Question 1

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The three component parts of sustainability are social, economic and environmental.

Question 2

Possible contribution to sustainable development by the construction industry includes:

- By delivering buildings and structures that improve the health and well-being of users, as well as enabling them to lead more sustainable lives.
- By using materials that have low energy intensity and minimise environmental damage.
- By producing high-quality designs that are capable of long life and have minimum impact on the environment.
- By providing employment and stimulating the economy.
- By minimising use of natural resources and energy during the construction and operational phases.
- The industry should ensure that it chooses the best building materials, which are manufactured from renewable resources and by low-impact processes.

(Only four were required.)

Question 3

- Scope 1 - direct emissions from the organisation such as greenhouse gases from the combustion of fuel in vehicles or boilers or production processes.
- Scope 2 - indirect emissions from electricity, heat or steam bought and used by an organisation.
- Scope 3 - other indirect emissions out of the direct control of an organisation such as outsourced transportation or employee commuting.

Question 4

The reasons for sustainability reporting are:

- Legal.
- Financial.
- Voluntary standards.
- Pressure from the media, NGO's and the public.

Question 5

'Corporate governance' is the system of rules, practices and processes by which the company is controlled.

Question 6

The impacts of over-abstraction are:

- Reductions in river-water flow, reducing the size of the populations of aquatic species that the river can support.
- Wetland habitats that are supported by river flows drying up and disappearing.
- Aquifers drying up, removing important sources of water for human consumption and agriculture.
- In coastal areas, removing water from aquifers at an excessive rate can lead to saltwater intrusion, making the water unfit for use.

Question 7

Self-regulation can be implemented through:

- The setting and maintenance of industry-wide standards by industry bodies.
- The internal control strategy of an organisation for improving its social and environmental performance.
- Voluntary participation of an organisation in schemes administered by non-industry bodies.
- Requirements set in contracts.

Question 8

The three goals of the Convention on Biological Diversity are:

- Conservation of biological diversity (biodiversity).
- Sustainable use of its components.
- The fair and equitable sharing of the benefits arising from genetic resources.

Question 9

'Natural heritage' can be considered as natural features consisting of physical and biological formations, geological features and natural sites in an area that constitute the habitats of internationally threatened plant and animal species, and natural sites that have an outstanding universal value from the point of view of science, conservation or natural beauty.

Question 10

The three environmental principles of the UN Global Compact are:

- "Principle 7: Businesses should support a precautionary approach to environmental challenges."
- "Principle 8: undertake initiatives to promote greater environmental responsibility."
- "Principle 9: encourage the development and diffusion of environmentally friendly technologies."