SLIDE 1

Importance of Quality Data

when using Artificial Intelligence (AI) in Occupational Safety and Health (OSH) practice.

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Hello and welcome.
This presentation is on: Importance of quality data when using AI in OSH practice.

I am going to start this presentation with 6 summary slides.

Abstract

Artificial intelligence-powered models, systems and technology have the potential to significantly improve the management of OSH risks, but it is vital that OSH practitioners understand the limitations and dangers of using AI to protect people at work.

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The foundational triad of an AI system is **computing power**, **machine learning**, and **data**.

Data is used for teaching and training computer algorithms for creating AI models.

(**An algorithm** is a set of rules and instruction that is to be to be followed in the right sequence to complete a task or solve a problem. As like the mirror, signal, manoeuvre (MSM) in driving.)

(An **AI model** is a computer program (algorithm) that has been trained using a set of data to understand patterns or make decision without further human intervention.)

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The resulting AI models have their triad too; that is, **analyse input data**, **recognise patterns in the input data,** and **make autonomous output decisions.**

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In an AI racing circuit, **data is the fuel of AI models**.

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If the data used for teaching and training an algorithm is biased, the resulting AI model's pattern recognition or decision making will end up producing biased outputs.

For example, a chatbot was asked to recommend respirators for protection against ammonia fume. In response, the chatbot model recommended respirators made by 3M, MSA, and Honeywell. It ignored other manufacturers.

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AI models can hallucinate. It means responses generated can contain nonsensical, false, and/or misleading information as fact.

You would have spotted the effects of AI hallucination on this slide.

Here is an example that relates to professional competence. A lawyer got into legal difficulties, as a result of using an AI model for legal research. The model produced legal cases that did not exist and was spotted by a keen-eyed judge. So, consider this type of risk happening when, for example, writing an essay for professional membership examination or CPD submission. Recently, a colleague got caught using AI-hallucinated data in an essay.

Introduction

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Now, let us explore my summary in more detail.

It is always fascinating to think that a typical adult human body consists of about 30 trillion cells.

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In fact, a single cell gave rise to these 30 trillion cells.

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How these 30 trillion cells (and different organs made from them) behave and perform their functions is written in genetic codes made of proteins.

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In simple terms, our codified genomic data, in combination with our brain and its neural network consisting of approximately 80 billion neurones, controls the functions of and interactions between different organs of this intelligent human computing machine.

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Simply speaking, plenty of precisely sequenced proteins, electrochemical reactions, signalling, and switching systems manipulate the data, and its closely associated information to bring and maintain order.

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In this figure, a topography of human neural communication is illustrated by way of an example.

The competence of the human machine improves over time with the aid of more data and information and the ability to analyse them and undertake deductive reasoning. If we fail to analyse and interpret the data correctly, consequences can be severe.

Broadly speaking, if something goes wrong in the data sequencing and communication, a person can end up with problems, for example, work-related lung cancer and allergic contact dermatitis.

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So, isn't it captivating to think that much of the ideas, intelligence and information that led to the development of modern AI models and their machine learning artificial neural networks were learnt from understanding the science involved in developmental biology?

Much more will be learnt, and the new information will be used in the development of future AI models.

Data and Information

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Like the human body, for an AI model to function correctly, among other things, it depends on quality data, the 'fuel' of AI models. Essential features of quality data are summarised in this slide.

They are accuracy, validity, consistency, integrity, conformity, and security. These should be fit for purpose.

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Terms data and information are often used interchangeably giving rise to confusion. In this presentation, **Data** means raw facts and figures that do not make adequate sense or do not have much meaning for decision making. For example, data arising from the use of respiratory protective equipment (RPE), indicated as 'yes' or 'no'

Information means the data is organised, structured, and processed in order for it to make sense and gain insights and make decisions. For example, a fit-tested half-mask respirator with high-efficiency dual dust filters was used for protection against silica dust and in association with on-tool dust extraction. Although one can argue that the information as given lacks further detail such as, was the respirator worn correctly? Was the user trained on correct use? Was the respirator stored correctly? and so on. However, the information as recorded is much more meaningful and useable than just RPE used – yes or no.

In the case of HSE's National Exposure Database, (NEDB) on hazardous substances, much of the 35 years' worth of information on RPE and LEV (local exhaust ventilation) lacks adequate contextual quality information and contains out-of-date information. It means NEDB data would be less useful for training AI models, unless significant time, energy, and money are spent to ensure data quality.

The lesson here is: always aim to collect and use data that is fit for purpose.

Biased Data

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As already alluded to, you should be mindful of the real potential for data and AI-systems-led **biases** when undertaking risk management decisions based on AI models outputs.

The meaning of bias includes the actions of supporting, opposing, thinking, presenting, and/or acting in unfair ways.

This figure shows examples of commonly encountered biases that can impact the correct performance of AI models.

You should always seek assurance from your AI system vendor that their AI model has been **trained and validated** using good-quality data that is relevant to your OSH application.

Furthermore, you should regularly **calibrate your AI model** using quality data. It is necessary to ensure that the model remains reliable in your operational environment in terms of **transparency**, **accountability**, **safety**, **explainability**, and being **fair** to those subjected to the model's decisions.

Three more cautions. First, most of you are not trained to be competent experts in the development and technical management of AI systems, as well as data quality assurance. So, seek competent help.

Secondly, AI systems management accreditation may not ensure that an AI model's development and its use involved quality data. Instead, accreditation helps to ensure that the way AI models are used at your workplace perform in the same way day in and day out.

Here is an example: An operator was crushed to death by an AI robot that failed to differentiate the human operator from the boxes of food it was designed to handle. One of the reasons for the accident could be associated with the judgements arrived at from the input data, its decoding, reading, and interpretation by the AI model for its probability-based pattern recognition.

Also, the system did not have integrated and appropriate safety governance to prevent the accident from happening. This accident may not have been prevented simply by having an accreditation certificate for the AI- systems management.

Thirdly, never take it for granted that your AI vendor's sales and marketing technique, known as ''AIDA"—creating **attention** to their model, creating **interest** in their model, creating a **desire** in you to buy their model, and **achieving** the sale of their model—is the guarantee of data quality.

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Modern AI-based systems are only several decades old and are developing at breakneck speeds. During the last fifty years or so, several definitions and explanations have been proposed for the term AI.

Briefly speaking, AI means it thinks and acts almost like a human.

In a nutshell, an AI system includes hardware, software, and models, as well as data. It is the outcome of an integration of various aspects such as cognitive science, computer science, physics, mathematical science, data science, engineering principles, and design technology.

This slide provides an overview of typical AI model development and deployment. You will note that the need for data arises in every part of the model development and its use.

In essence, based on its training, an AI model acts as a probability-based pattern-recognising tool and provides answers to input prompts. In this example, if an appropriately chosen algorithm is trained to recognise different types of tower cranes, their installation, and operation, the resulting AI model should be capable of recognising the relevant features of a crane at your worksite where you are risk-managing the operation.

Types of AI technology

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AI models could be categorised into four classes: **reactive, limited memory, theory of mind, and self-aware**. At present, reactive and limited memory models are in day-to-day use.

Reactive

A reactive AI is a kind of rule-based expert system. It performs specific and specialised tasks based on what it has learnt from a large amount of data and statistical analysis. Reactive AI models do not have memory of past events. It means they cannot recall past experiences, including inputs received from previous users, to inform and influence current decisions. This type of AI has existed for many decades, like the 'Deep Blue' chess-playing computer model that beat Garry Kasparov in 1996.

Slide 19 – RPE selector too front page

Many of you will be familiar with the RPE selector tool. In this case, RPE selection rules and their accuracy and precision were assured by specialist experts in RPE selection and use. Using the rules created by the experts, software programmers created the reactive AI model. The performance of the model was validated using hundreds of case studies.

Slide 20 – LEV 14 monthly examination & testing and a limited memory AI tool

A limited memory AI uses its artificial neural network. It can recall time limited past events and use present input data to make decisions. It means that the model learns from stored and present data to improve performance over time.

For example, by developing a limited memory AI model for testing the performance efficacy of LEV hoods and its associated system, it is practicable to eliminate the need for 14 monthly through examination and testing. But the AI model and its output data should be under the oversight of a competent occupational hygienist.

Other examples include hazard and control banding AI models for chemicals, noise, and vibration, as well as exposure control effectiveness indicator models. *Another example is autonomous motor vehicles. In this case, their sensors would collect data around them and make decisions such as limiting the speed of travel based prevailing conditions; some drones instantaneously adjust their flying operation to suit prevailing environmental conditions.*

Human-led meaningful control

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By using a large pool of relevant quality data, the potential for bias and hallucination can be minimised.

On the other hand, unethical persons could use AI models and data for abusive purposes, for example, AI-generated child sex abuse images.

Therefore, the use and application of AI models in your organisation should operate within a meaningful human-led control (i.e., responsible human-in-the-loop), instead of letting the models and bad actors play their games without adequate and suitable oversight. Just imagine the scenario of someone at work manipulating data to harm a fellow colleague.

Slide 22 – Perceived safe operation of AI

If the applications of AI models at work aren't diligently managed; there is a significant potential for work-related stress arising among workers. One way of managing this issue is to ensure that the contributory components (ie: AI models and the associated systems, work tasks and processes, work environments, and workers) function safely and securely.

Furthermore, actions should be taken to ensure that workers 'perceived safety' forms part of overall risk management. It means human interaction with AI systems (ie.: worker comfort, predictability of the behaviours of AI systems, transparency of operation during use, sense of control among workers, their trust in the system, and their experience and familiarity to operate the system.

Open-access general-purpose large language models

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When using general-purpose open-access large language models (LLMs) like chatbots, you will often come across limitations. For example, if you ask, "What respirator should I use against ammonia fume?" or "What type of LEV system should I use for controlling exposure to ammonia fume?" At present, the answers you get may not be as good as the ones you get from HSE guidance documents like HSG53, HSG258, RPE selector tool, and the web-based COSHH-Essential direct advice sheets.

In other words, AI models are not a panacea, but are tools in your toolbox.

As an intelligent user of AI systems, you should use them in conjunction with competent advice, human-led meaningful control, and within the bounds of applicable legislative principles.

Conclusion

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Increasingly, OSH professionals are using digitally enabled technologies (DETs) and the associated AI systems to perform a variety of OSH risk management tasks.

The Alan Turing Institute, in association with the UK government, has published guidance to ensure that non-technical employees and decision-makers understand the opportunities, limitations, and ethics of using AI in business settings. It is a good idea to read their guidance.

At the same time, it must be noted that if AI systems are developed, implemented and used without necessary governance processes for safe and ethical operation, they can harm people at work, as well as the reputation and well-being of organisations.

As discussed in this presentation, one of the key quality determinants of any AI system is data, the fuel of AI models.

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*Inspiration for this presentation came from a practical book on **"AI in Occupational Safety and Health"** written by the author of this article. You can obtain copies of PDF and paperback versions from CIP-Books.com.*

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Would you please explore the application of AI in the following situations:

First, when you are creating case-stated matters for defending an OH-related case.

secondly, when writing an essay for your professional membership examination or CPD submission.