

“Does this unit have
a soul?”

Emerging Trends of Artificial Intelligence in OSH

Dr. Matt Law, DrPH, CSP, REHS/RS

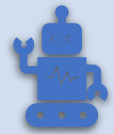
This presentation was last updated February 15, 2024.

The views and opinions expressed in this presentation are my own and do not necessarily represent Grainger’s position, opinion or strategy. I am not here in my capacity as a representative of Grainger.

Learning Objectives



Discuss the range and types of artificial intelligence (AI), machine learning (ML), and how it continues to rapidly evolve for consumer application



Evaluate the current and potential applications of AI and ML for occupational safety and health (OSH)

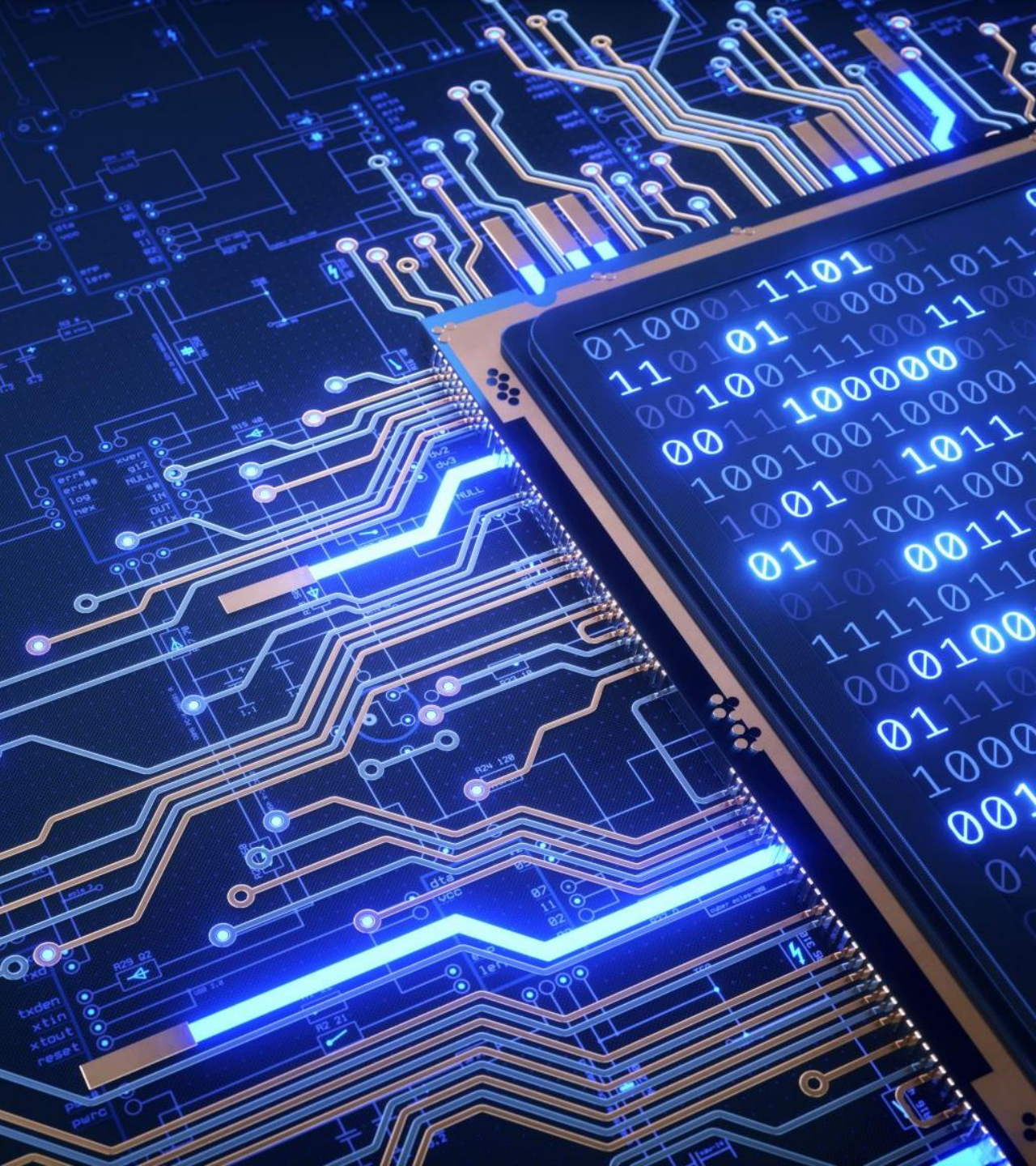


Interpret current market intelligence and academic research about AI + OSH and how both may influence the future state of application

The image features a central graphic of a human brain silhouette filled with intricate circuit board patterns and glowing blue nodes. This brain is positioned above a blurred, high-angle view of a city at night, with lights reflecting on a surface. The overall color palette is dark, with blues, greys, and warm city lights.

What is AI?

Let's level set on what constitutes Artificial Intelligence (AI) and Machine Learning (ML)



Artificial Intelligence

A computer system that shows behavior in a way that could be interpreted as human intelligence, provided the system is dealing with pattern matching

Is it intelligent? Or is it designed to seem intelligent?

Computer and human intelligence start from very different places



The Chinese Room Argument



Imagine yourself in a windowless room with one mail slot on the door. This mail slot is your only method of communication with the outside world



You have a phrase book on a desk and a bunch of Post-it notes with Chinese symbols on the floor



The book tells you which response you should use to answer each note that comes through the mail slot



Your phrase book says, "If you see this sequence, respond with this sequence"



You have no idea what the notes say or what the symbols mean because they are in Chinese Mandarin. You simply follow the instructions given by the phrase book, matching patterns and symbols.



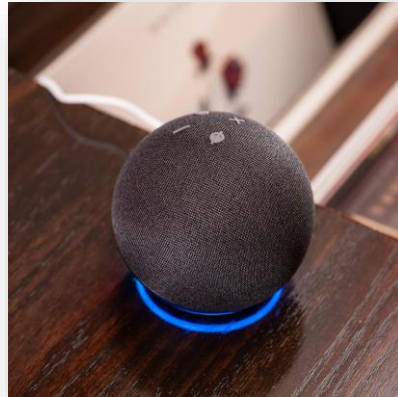
The person on the other side of the mail slot may think you are fluent in Chinese Mandarin, but you are only following a set of rules that allow you to appear fluent

A system may appear intelligent, but it is more like a parrot with a great memory

Weak AI vs Strong AI

Weak AI

AI system is confined to a very narrow task



Strong AI

Machine displays all behavior associated with a human being



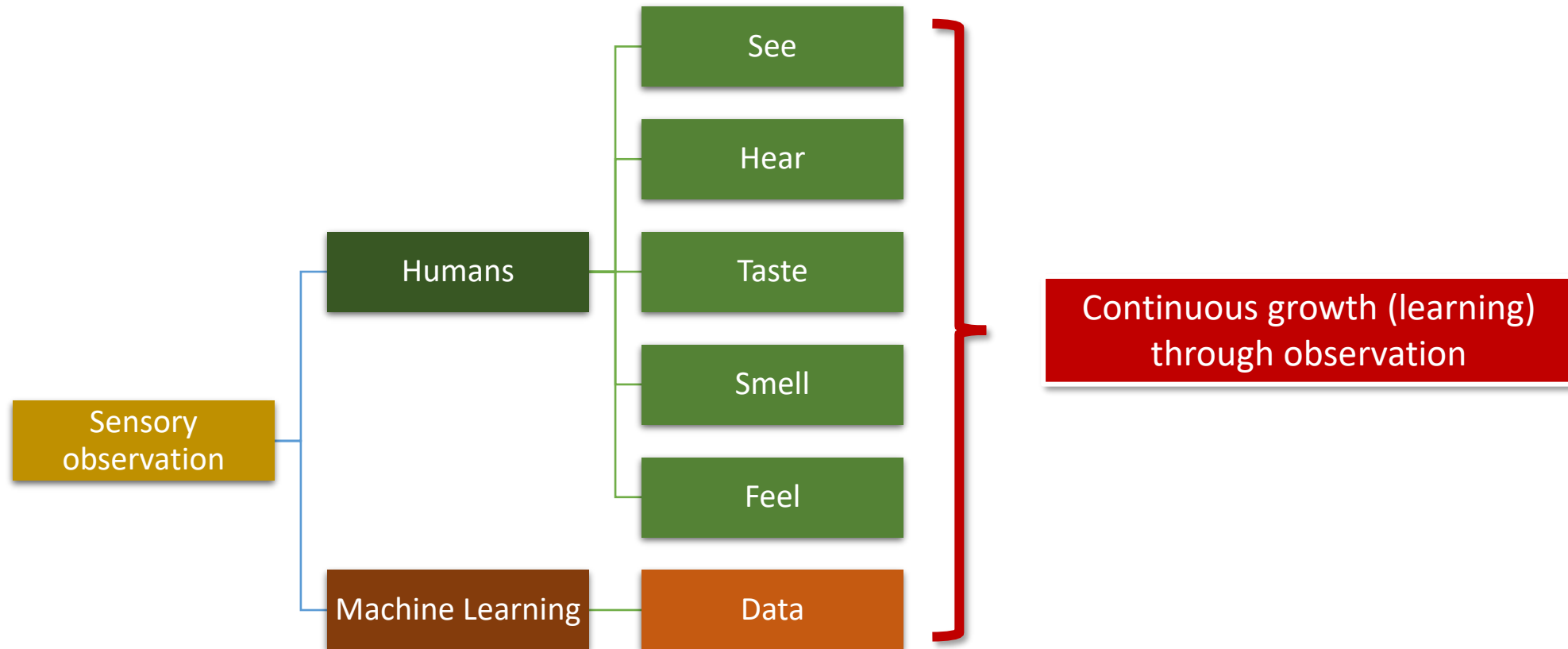
We are here



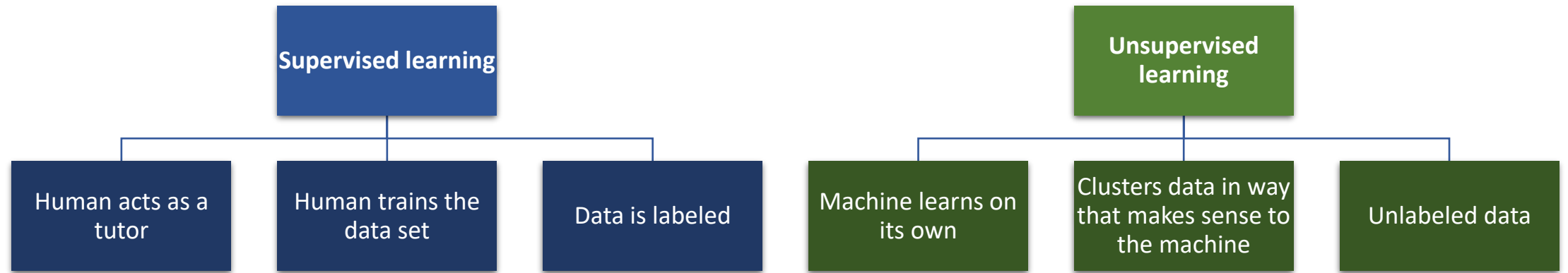
The rest is still Sci Fi

Let's talk about Machine Learning

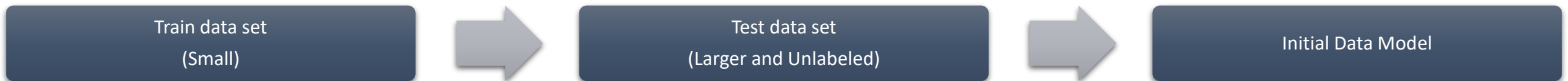
Machine learning (ML) is a process in which machines start by identifying patterns, and then learn more as they work through additional data



How do machines learn?



A programming model is needed for the machine to learn



Let's clear up a few more things before moving on...

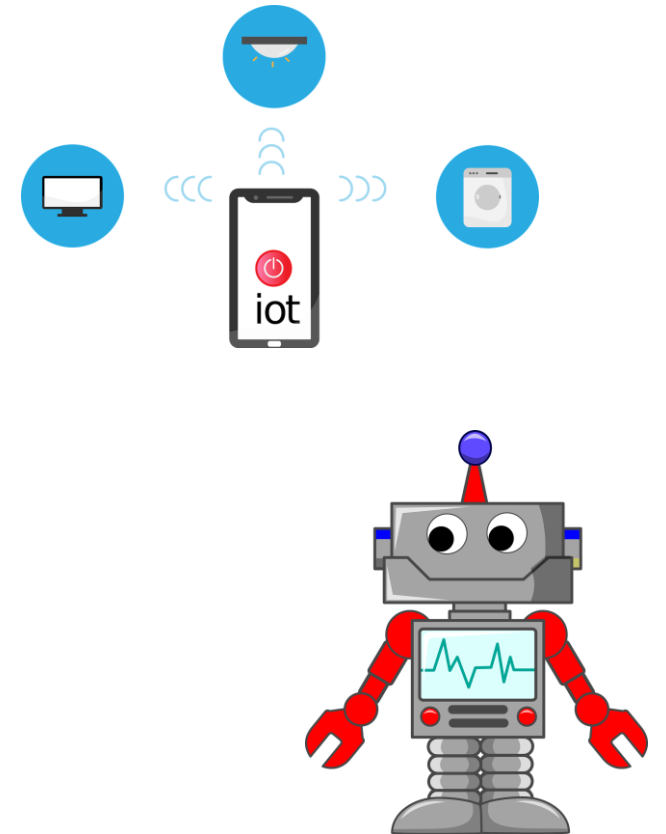
Widgets are not AI

Internet of Things (IoT)

- Collect data through sensors that communicate with the world
- Create data to then be analyzed
- Can connect ML in the digital world to physical world application

Robotics

- Machines that behave like living objects
- Combined with ML can do many more tasks than previously possible
- Still need time and human input to train the system
- E.g. humans are still in the driver seat of self-driving cars



Let's clear up a few more things before moving on...

There are benefits

- AI and ML can analyze data much faster than humans
- AI and ML systems may sense things that humans cannot perceive
- ML continues to get better at understanding the nuances of human language (e.g. Natural Language Processing [NLP])
- AI does not (cannot) replace the human – it enhances the human's ability to perform

There are risks

- ML should not be used to make decisions that humans cannot understand
- AI and ML can enhance what is already good, but will not fix what is inherently bad
 - Bad data in = bad data out
 - Bad model training = bad analysis
- Data privacy is still a thing
 - Caution when using open source
 - Caution when using cloud storage

Those are the basics...

OSH professionals need
not be AI programmers
nor software developers

However, it is important
to understand the basic
purpose and function of
AI

By knowing the ways AI
and ML could be used,
we can set expectations
for the future



AI + OSH

Current and proposed applications of AI in Occupational Safety and Health

Key Applications for AI + OSH



Data analysis and pattern recognition

- Analyze large volumes of safety data, including:
 - Incident reports
 - Inspection records
 - Maintenance logs
- Identify patterns and trends
- Detect anomalies and correlations



Risk prediction and early warning systems

- Develop predictive models that assess the likelihood of future safety incidents based on historical data
- Analyze various parameters such as:
 - Equipment condition
 - Environmental factors
 - Employee behavior
- Identify potential safety hazards in advance for proactive measures to be taken



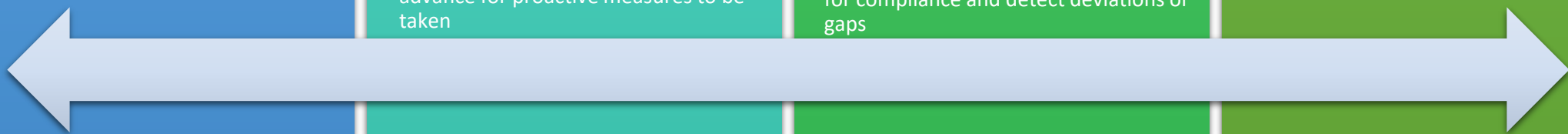
Natural language processing (NLP) for compliance monitoring

- AI can understand and extract information from textual documents, such as:
 - Safety regulations
 - Policies
 - Audit reports
- Scan and analyze documents to check for compliance and detect deviations or gaps



Image and video analysis

- Analyze images and video captured during safety inspections or monitoring processes
- Can identify
 - Safety hazards
 - Equipment malfunctions
 - Unsafe practices
- Example: Identify whether employees are wearing appropriate PPE; detect structural defects in infrastructure



Key Benefits of AI + OSH

Human error reduction

Automation of dangerous tasks

Employee monitoring

Harassment monitoring

Equipment control

Crime detection and prevention





AI + OSH applications
currently on the market

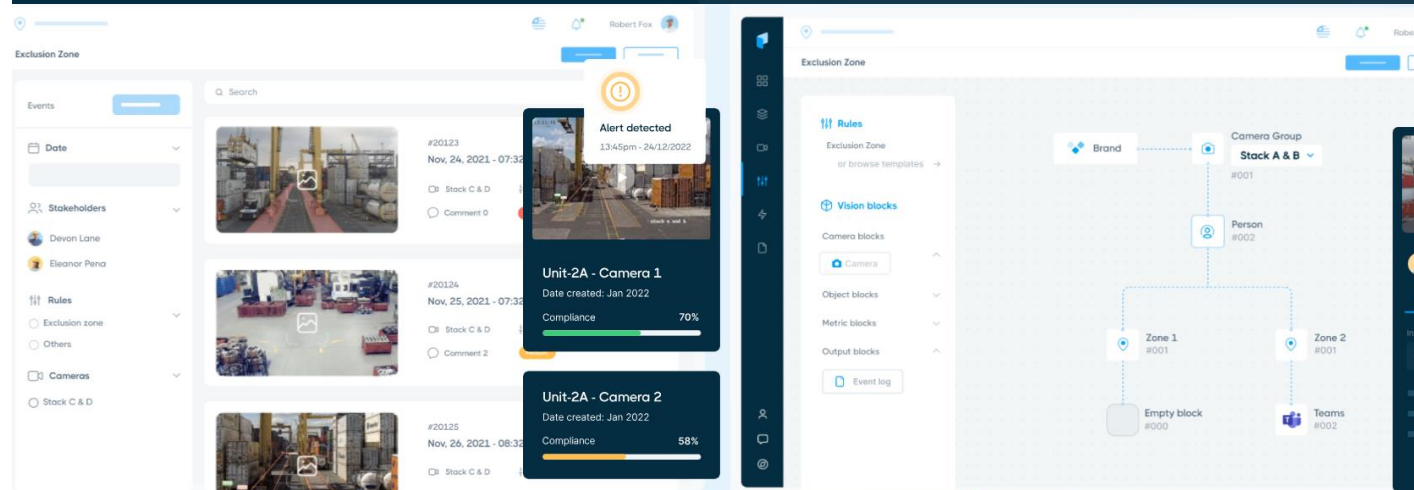
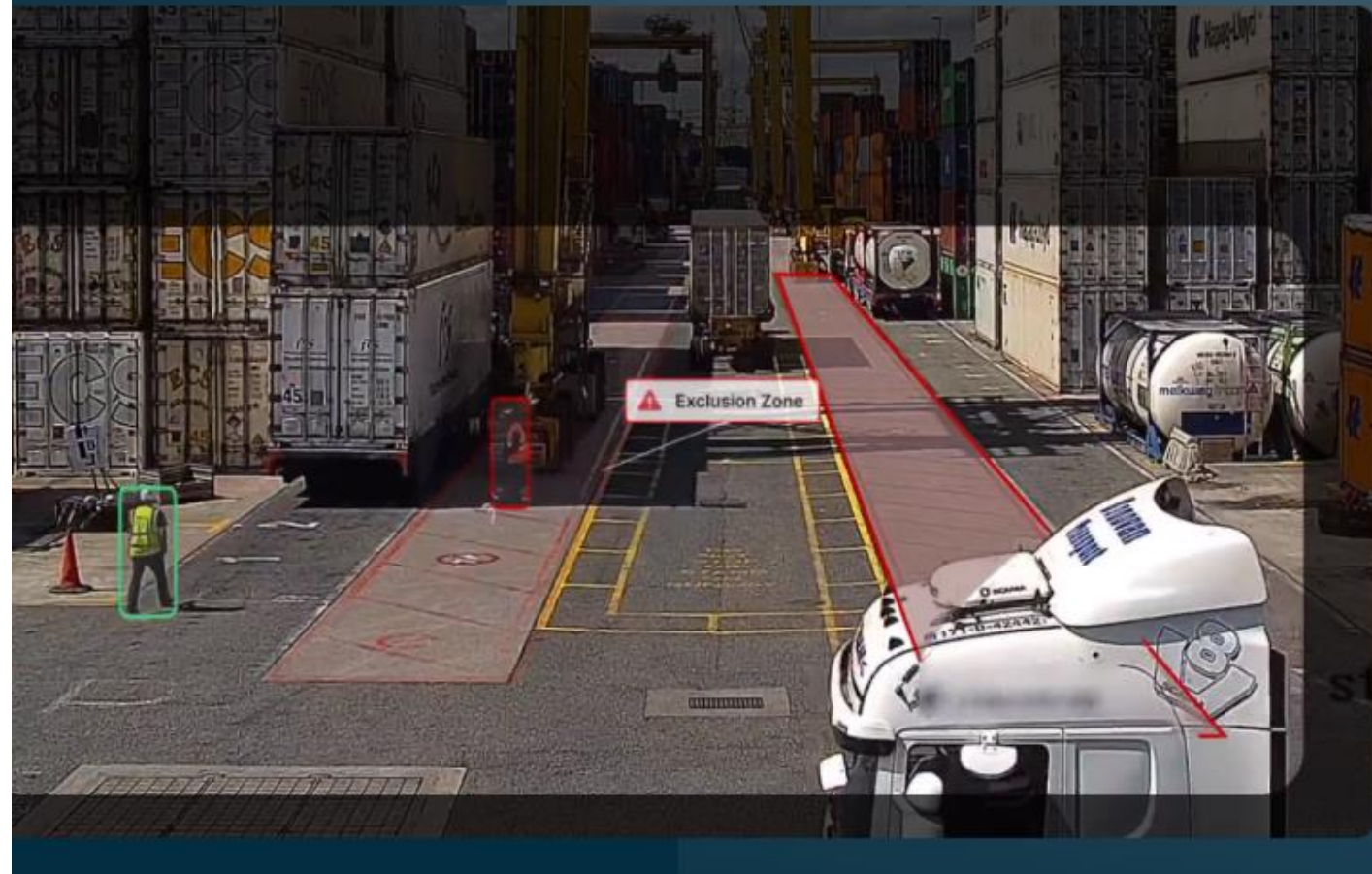


Computer Vision

- Uses existing closed-circuit television (CCTV) infrastructure to process data and detect hazards and anomalies using AI (Computer Vision)
- Case study: Marks and Spencer reduced incidents by 80% in their first 10 weeks of deployment

[Using AI to reduce incidents in the workplace \(protex.ai\)](#)

[AI's role in promoting a proactive safety culture \(protex.ai\)](#)

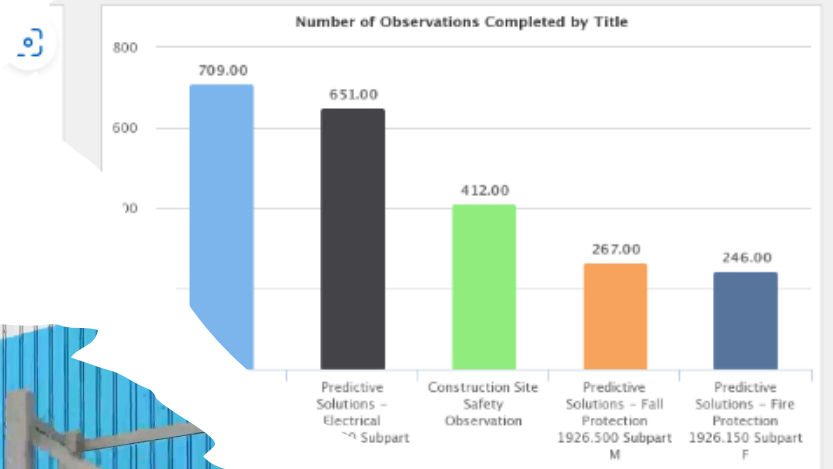


Hazard Recognition Training & Inspection Management Platforms

- trainPOINT – transitional reality training system developed on Unity Engine
 - [Unity + AI](#):
 - Capture environments and assets through CAD, images, and videos
 - Train assets through machine learning to behave more accurately and independently
- Safety Auditing Platforms + AI
 - Potential to use image and video analytics to immediately recognize issues
 - Potential to use NLP and speech recognition to identify gaps and recommend solutions



deployment of observations with the flexibility to assign to a specific observation, and questions can have both a percentage and weight. Time dashboards for a particular facility or roll up divisions to compare observations online or offline from a mobile device. Offline capabilities to the system once a data connection of any kind is reestablished.



Considerations for AI + OSH

Customer concerns and competitor differentiators:

- Privacy
 - Anonymizing data
- Employee engagement
 - Transparency about what data is collected and how it is used
- Scalability
 - Enterprise and multi-site
 - Diversity in application

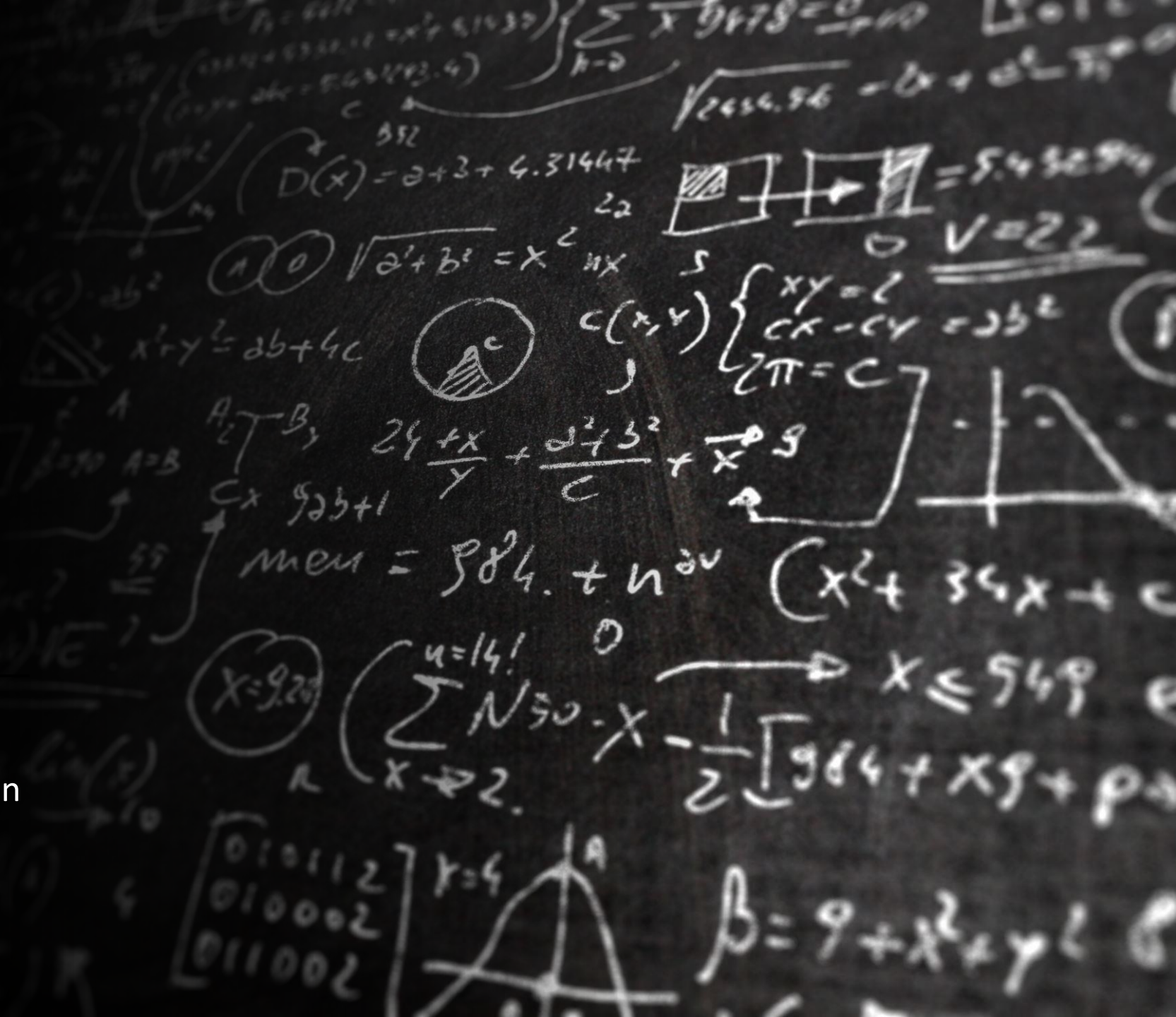
Ethics

- Enhancement vs. replacement of human performance
- AI should provide a better way to look at data
- Humans, rather than AI, should still be making the decisions based on the data provided



Influencing the Future

How market trends and academic research may influence the evolution of AI + OSH

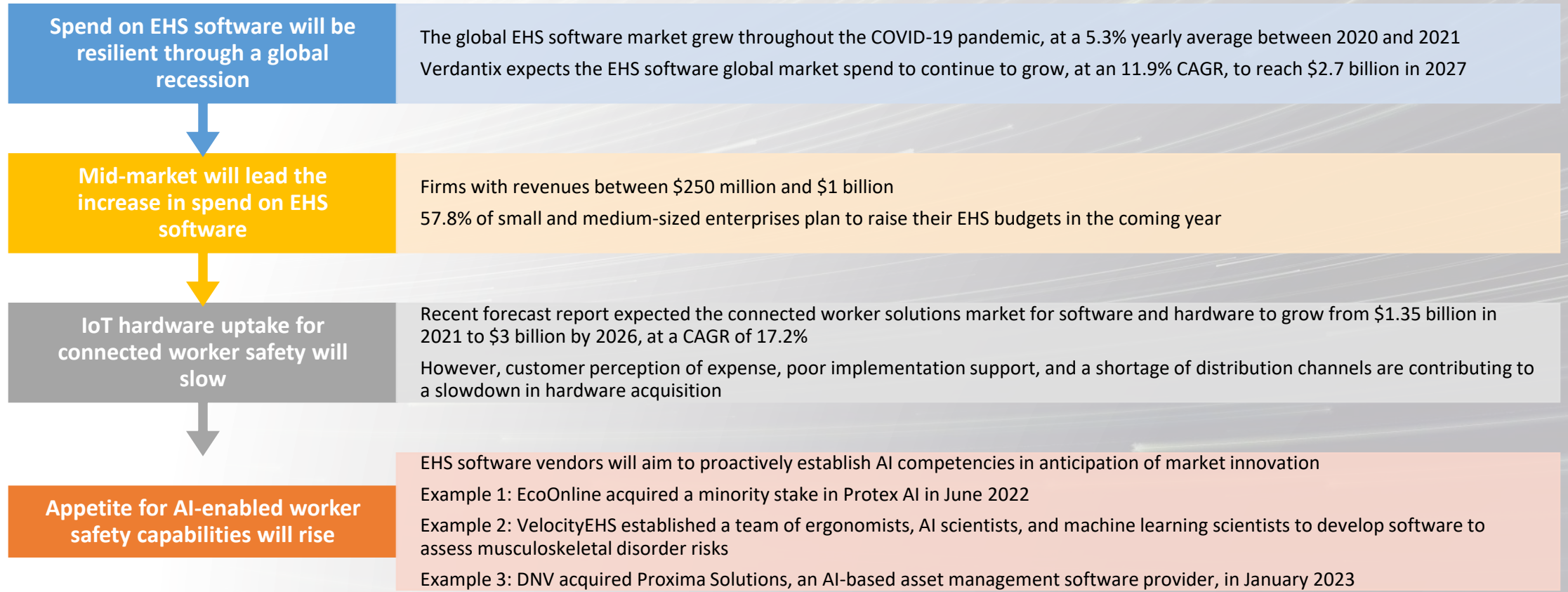




Market Trends for AI + OSH



Important Insights



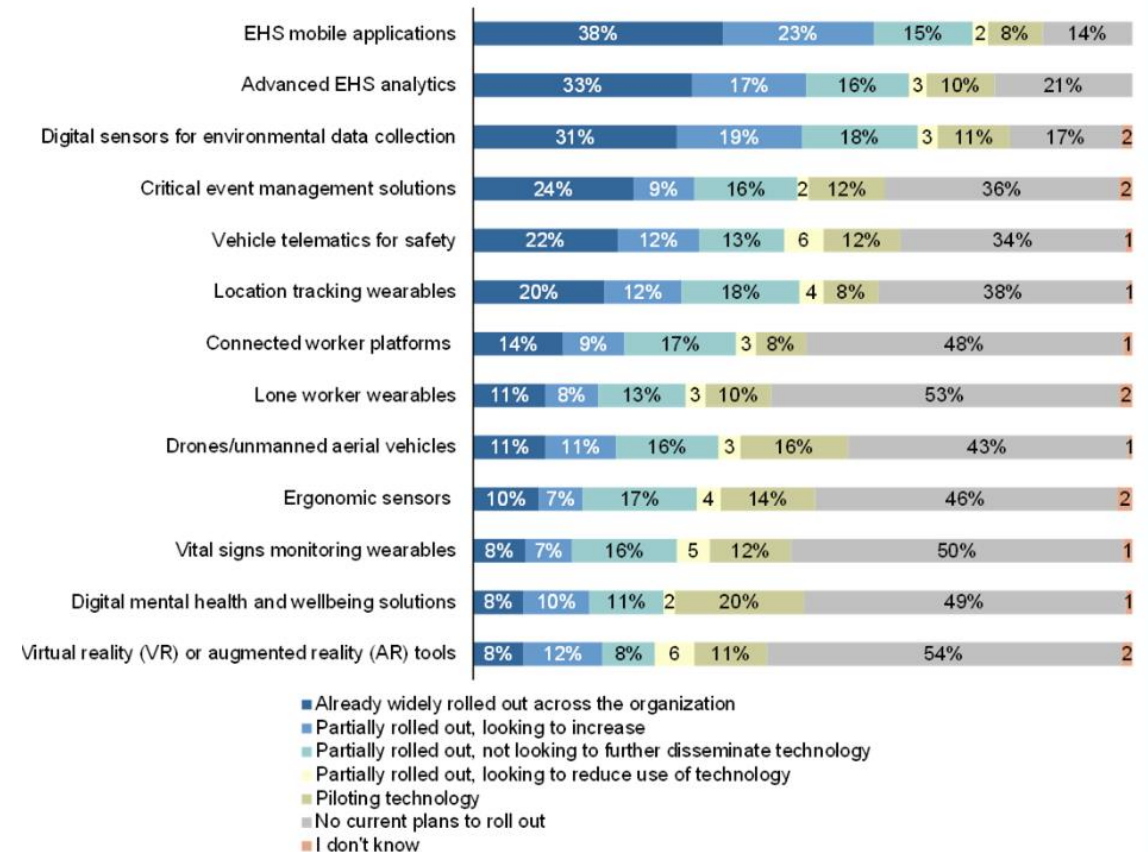
Additional Insights

- Technology is transforming the EHS paradigm from reactive to proactive safety management
 - AI algorithms are being used to automate data collection and perform compliance actions
 - AI-enabled learning management systems are being used to ensure workers receive targeted training information

FIGURE 1

Digital EHS Technology Uptake In 2022

"To what extent will your firm roll out the following digital technologies in 2022?"



Note: Data labels are rounded to zero decimal places; percentages less than 7% have been written as numbers.

Source: Verdantix Global Corporate Survey 2021: EHS Budgets, Priorities And Tech Preferences

N=301

What does the future market look like?

Right now, AI+OSH competition is low

- E.g., less than 5 firms globally in the image and video analysis space for OSH

Following OSH software trends, AI+OSH market may flood in the next 5-10 years

- New applications
- Copycat competitors

With the increased awareness of AI occurring this year (i.e. ChatGPT) computer vision vendors have seen a 40% increase in inbound activity, including:

- Prospective clients
- Investor stakes

Exact projected growth is difficult to pinpoint due to:

- Small sample of successful application
- Unknown demand even if interest is increasing



Recent Academic Research

ADA-SR: Activity detection and analysis using security robots for reliable workplace safety ([Zhang et al., 2021](#))

- Activity detection and analysis (ADA) using security robots in the workplace (human-robot interaction [HRI]).
- Processing image and sensor data for event and activity detection.
- This research serves as a baseline technology for detecting certain workplace activities, such as standing, walking, and running events with superior accuracy compared to previously used methods.

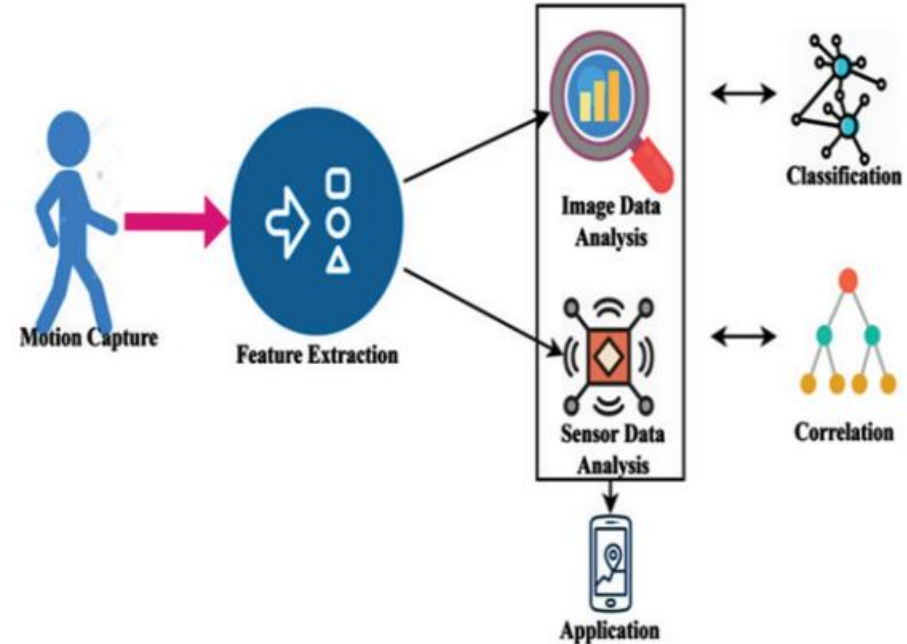
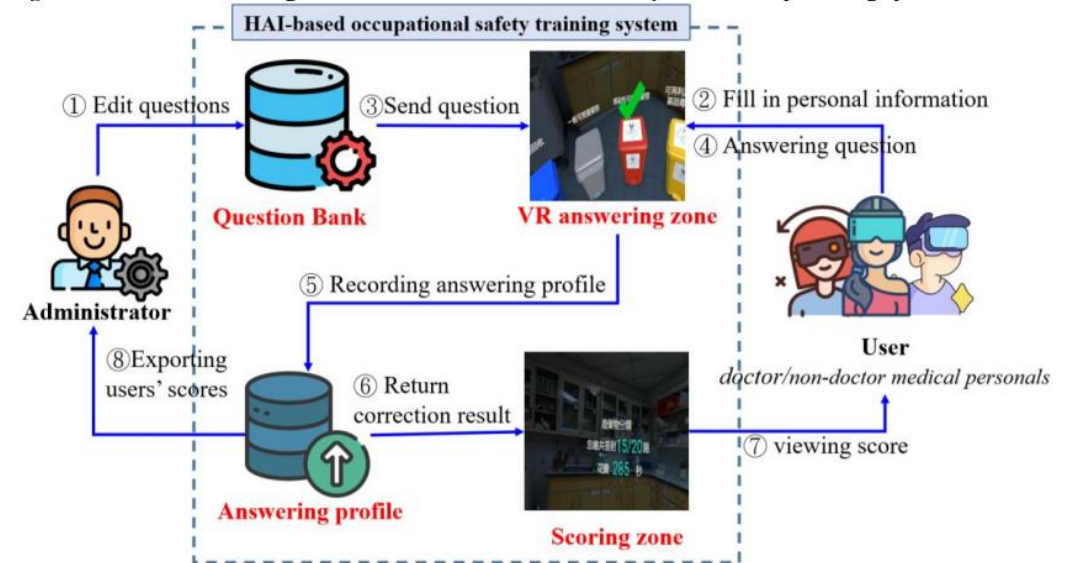


Fig. 1. Application scenario.

Feasibility and accessibility of human-centered AI-based simulation system for improving the occupational safety of clinical workplace ([Wang et al., 2023](#))

- Human-centered AI (HAI)-based occupational safety training system for two training topics:
 - Needle stick/sharps injury prevention
 - Clinical waste management
- 3-year study showed significant learning improvement among 342 medical personnel (doctors and non-doctors) using the HAI-based simulated training.
 - Decreased anxiety
 - Increased mastery

Figure 1. The schematic diagram for the flow of HAI-based occupational safety training system



Towards the “third wave”: An SCO-enabled occupational health and safety management system for construction ([Niu et al., 2019](#))

- Research sought to develop a smart construction object (SCO)-enabled occupational health and safety (OHS) management system
- AI-based machines that perform functions normally requiring human intelligence
- Study demonstrated and validated the use of SCOs in real-life construction practice and in a controlled lab test with a tower crane
- The SCO-enabled OHS management system can identify dangerous situations and respond to them autonomously

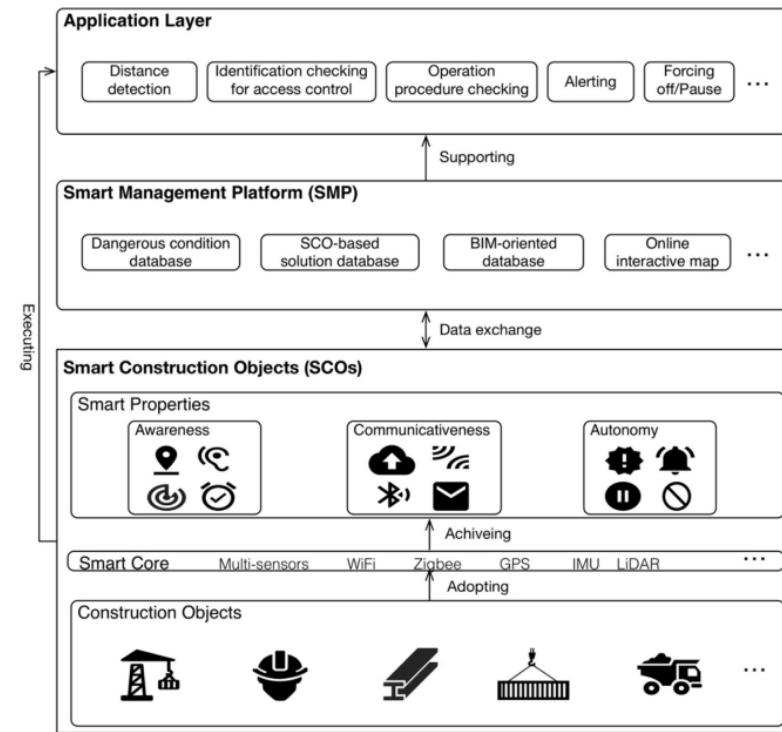


Fig. 2. The architecture of the SCO-enabled OHS management system.

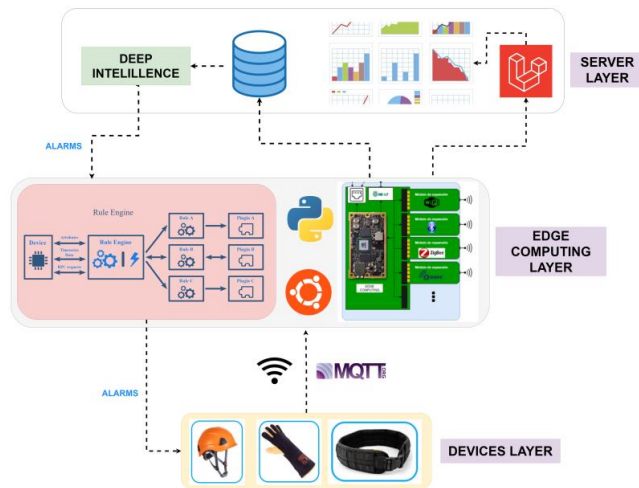


Figure 1. System architecture.

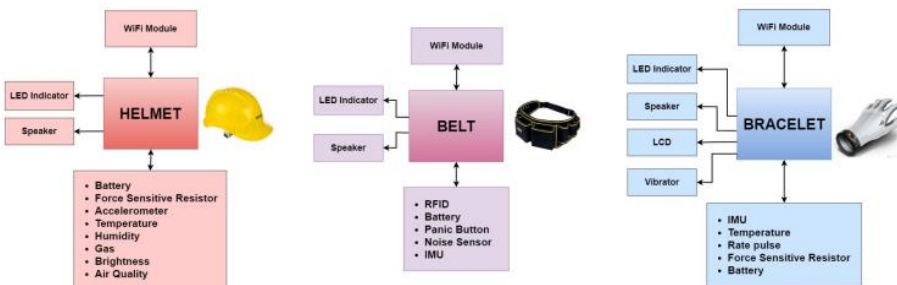


Figure 2. Devices diagram [8,42,43].

Intelligent platform based on smart PPE for safety in workplaces ([Márquez-Sánchez et al., 2021](#))

- Proposed an architecture that employs three pieces of PPE to collect and process information using AI:
 - Helmet
 - Bracelet
 - Belt
- Improvement upon existing Internet-of-things (IoT) technology
- Improves the predictive capacity of systems while implementing emerging technologies in PPE hardware

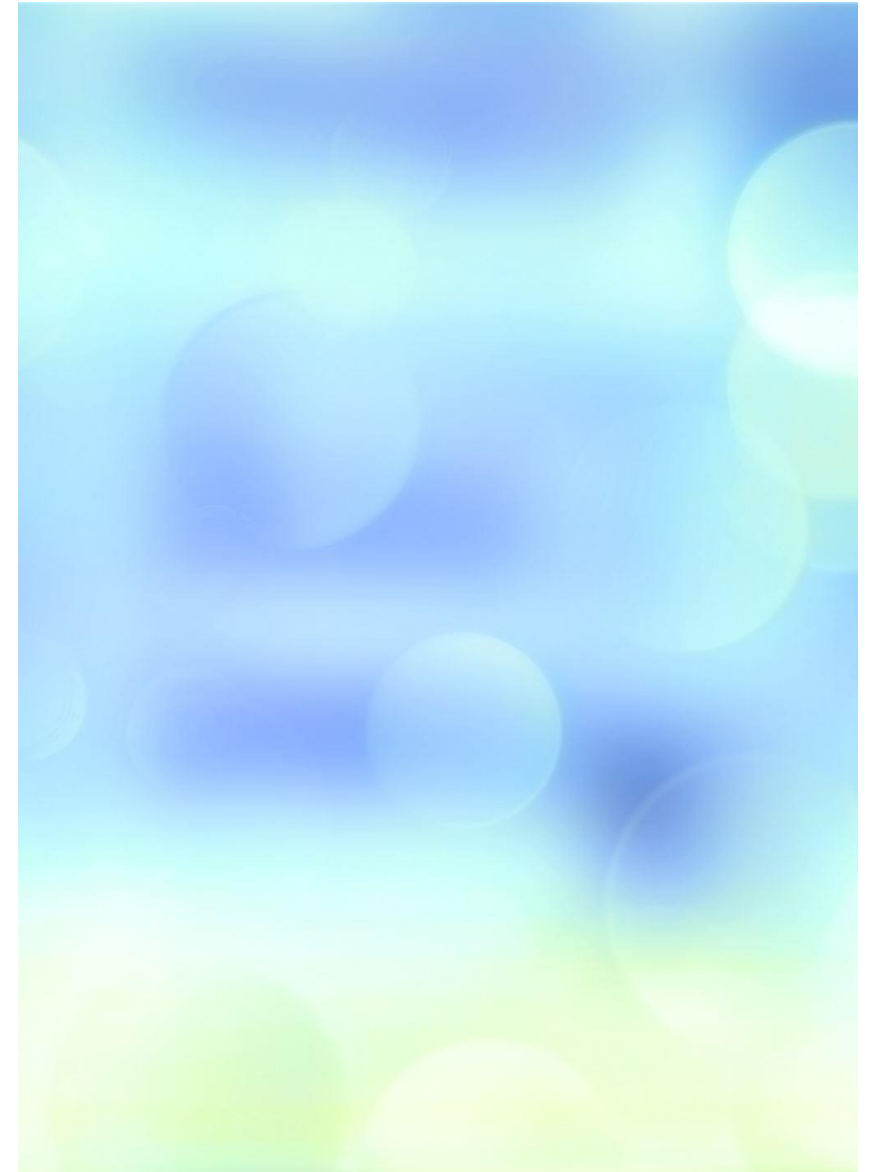
Summary

AI and ML are rapidly evolving and have several prospective applications that can enhance OSH functional performance

The market for AI application in OSH is young but estimated to grow quickly

OSH professionals do not need to be AI programmers, but should be familiar with the potential to qualify opportunities for future application

OSH professionals must also understand the risks, noting that AI can only enhance what is good, not fix what is bad



References

- Chiang, R. & Pennington, B. (2023). Market insight: 10 predictions for EHS technology in 2023 and beyond. <https://www.verdantix.com/report/market-insight-10-predictions-for-ehs-technology-in-2023-and-beyond>
- Márquez-Sánchez, S., Campero-Jurado, I., Herrera-Santos, J., Rodríguez, S., & Corchado, J. M. (2021). Intelligent platform based on smart PPE for safety in workplaces. *Sensors* (14248220), 21(14), 4652. <https://doi.org/10.3390/s21144652>
- Niu, Y., Lu, W., Xue, F., Liu, D., Chen, K., Fang, D., & Anumba, C. (2019). Towards the “third wave”: An SCO-enabled occupational health and safety management system for construction. *Safety Science*, 111, 213–223. <https://doi.org/10.1016/j.ssci.2018.07.013>
- Pennington, B. & Brown, T. (2021). Best practices: Moving EHS to dynamic risk management. <https://www.verdantix.com/report/environment-health-safety/best-practices-moving-ehs-to-dynamic-risk-management>
- Rose, D. (2023). Introduction to artificial intelligence [LinkedIn Learning Course]. <https://www.linkedin.com/learning/introduction-to-artificial-intelligence>
- Sheen Media. (2023) Artificial intelligence can be used in safety audits [YouTube Video]. <https://www.youtube.com/watch?v=n4C6SdNmbSk&t=3s>
- Wang, P.-H., Huang, A. Y., Huang, Y.-H., Yang, Y.-Y., Lirng, J., Li, T.-H., Hou, M.-C., Chen, C.-H., Yang, A. C., Lin, C.-H., & Sheu, W. H.-H. (2023). Feasibility and accessibility of human-centered AI-based simulation system for improving the occupational safety of clinical workplace. *Educational Technology & Society*, 26(1), 160–170. [https://doi.org/10.30191/ETS.202301_26\(1\).0012](https://doi.org/10.30191/ETS.202301_26(1).0012)
- Wizata. (n.d.). How artificial intelligence can enhance workplace safety. <https://www.wizata.com/knowledge-base/how-artificial-intelligence-can-enhance-workplace-safety>
- Zhang, G., Jing, W., Tao, H., Rahman, M. A., Salih, S. Q., AL-Saffar, A., Zhang, R., Kumar, P. M., Pandey, H. M., & Srivastava, G. (2021). ADA-SR: Activity detection and analysis using security robots for reliable workplace safety. *Work*, 68(3), 935–943. <https://doi.org/10.3233/WOR-203427>

Questions?

Dr. Matt Law, DrPH, CSP, REHS

(443) 603-7690

Matt.Law500@gmail.com

