WORKtoZERO
an nsc program

2020 Work to Zero Summit -- Technology Breakout Summaries

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Hyatt Regency Coconut Point Resort & Spa
Bonita Springs, FL

Automation and Robotics
Moderators: Dawn Castillo, NIOSH
Carole Franklin, Robotics Industries Association

Machine Learning and Artificial Intelligence
Moderators: Donavan Hornsby, Gensuite
Keith Bowers, Bowers Management Analytics

Virtual Reality and Augmented Reality
Moderators: Doug North Cook, Chatham University
Kim Shambrook, National Safety Council

Wearables and Sensors
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What is the role of standardization for robotic technology?
- Consensus standards are different than control standards. Safety zone tends to be very conservative. We're going to write it down after it's been established as a best practice. We don't want to rush into something that might get someone hurt. This is different than non-safety. Sometimes industries are built around the tech because of the standard. Standards are starting to tackle the autonomous mobile robot versus a guided vehicle that follows a certain path (R1508-collaborative robot arm mounted to mobile platform).
- Role for WTZ to collect best practices going on with robotics to feed into the standards development.
- We're always looking for more users and researchers to provide input into the standards formation. Call to researchers. There is overlap with ISO and RIA standards.

How have you used robotics to address safety risks?
- One of our biggest clients has tons of injuries with forklifts. They have a big dock with odd-shaped packages that have to go on different kinds of trucks. They've had deaths from forklifts falling over. Shipping doesn't bring in a lot of money.
    - You can buy those automated forklifts already. But it would require a complete redo of the layout of the warehouse.
    - It depends on their ecosystem. If things are moving around and changing all of the time it's difficult to implement a fully autonomous forklifts.
- We have two kinds of forklifts, one with sensors in a worker badge and also one with a 360 camera that can view its entire surrounding.
- From ergonomic standpoint, there is a huge use for robotics and automation. Make jobs better and less taxing on people. With the bonus of increased efficiency, quality, etc. Across the bottom line, they almost always do.
- We've used robots to help with shingle stacking and eliminated human interaction with machines.
- With drones we build way fewer scaffolds and saves us a lot of money, especially inspection which allows us to have 100% inspection which we couldn't see before.
- We use drones to inspect pipes on roofs and have eliminated risks and increased probability that the PMs will be done.
- We created new jobs with robots. We have our own internal robotics team. We have apprenticeships to teach people how to become drone pilots.

What risks and hazards does this solution set try to prevent?
- Work at height, confined space, electrical energy, environmental (hazardous chemicals), emergency response, crushed by and struck by risks, exposure controls for things like welding.
- We stopped high pressure washing, jet cutting, cleaning
- We use robots to use high pressure CO_2 to return spent metal materials to original state when we used to wash all of these.
- Robots for stainless steel welding because there is a lot of hazardous atmosphere there.
- We have fully automated packaging units.
- We've used automation for building box spring frames to remove workers from having to staple by hand with large tools (sometimes they were stapling themselves).

Greatest successes and barriers in this area?
- Safety with added benefits, e.g. productivity and quality.
- Confined space entries will almost be eliminated. We use crawlers to inspect tanks and don't have to have people go inside and build scaffolding. We are 80% there but need crawlers and drones that can have tools for small repairs. Now there are not enough battery power to have these be completely cable-less.
- There is a sharp learning curve on all the new technology. If you take too much time to learn, it's changed before you get through the curriculum. There are so-called experts that want to sell you stuff.
- Technology is scary to some people.
- One barrier is standards. There are a lot of questions with "Is what I'm doing okay?" And OSHA inspectors don't know how to judge an inspection with using a drone.
- Cost is always an issue.
- Change management is always a concern.

- We need to update our LOTO procedures because there is a lot more involved with you're talking about automation.
- Scalability is a barrier as well. How fast, how much resources will it take, etc. You also just don't have as many jobs that you're coming into contact with robotics.
- It's certainly cost but it would require my clients to re-engineer everything about what they do. The change aspect is real challenging for them. Some clients have a lot of ugly freight.

Worker resistance or acceptance. Is worker knowledge and training something is an issue?
- We got a lot of negative comments from unions and employees because they don't want to lose control of their environment. Which requires that robots be built with capabilities for people to test and see that machines are locked out, for example. Some standards can be very complex. How do you think about risk assessment, especially for smaller companies. Some companies buy equipment and use it for an alternative task that wasn't initially approved.
- Implementation successes are also needed for people to compare.
- Are things like RFID even built to the same standard across manufacturers? Will there be a cheaper version versus a better version?
- We got push back because the automation slowed down the process and plants don't like it.
- Resistance from workforce that thinks they'll be pushed out of the way.
- Rapid advancement is a barrier because people aren't sure when to jump in. How do you choose a vendor if you know nothing about it?
- There is an industry differential here. If you're big there is no problem because you're going to lead in that area. If you're small then you are following trends from big businesses.
- This is where Work to Zero can really have an influence on how to get this information out to medium and small businesses. How do we communicate? We have a lot of knowledge, tools, experience, and appetite it's just a matter of getting it out in the most effective means.

How big of an issue is safety with new technology?
- The issue is the amount of sensors that are around a cobot for recognizing a nearby worker. The worker wants to be able to exert control and be able to lock out the cobot which sometimes can't happen.
- Drones also introduce falling objects exposure. I would certainly take that exposure over working at heights but it is not nothing.
- There is also potential for distraction with drones when people see a drone approaching them.

What research or resources would be helpful going forward?
- Information sharing regarding success stories and application stores. Success stories and failures. NSC could be an anonymous, no fault clearinghouse of what has been done without having to reveal intellectual property.
- Information sharing on how to transfer insights from big to medium and small businesses.
- Most of the great information is not out there for public consumption. It's hidden behind intellectual property and makes it suspicious. Work to Zero has an opportunity for being that trusted source, rather than vendors trying to sell something.
- Can ANSI play a role in pushing information out to their standards committees?
- There is still an important research base that places like NIOSH are better setup to really test implications and outcomes better than companies can do and/or maybe aren't setup to do.
- You see a lot of robotic engineering in the laboratory that is published in the literature. We need to get application information out for real life examples.

- Could Work to Zero collect from industry partners a strategic plan for research questions that are important for the industry to have answers to? It would help funders and wealthy companies in this area move the field forward in terms of application. We can prioritize research questions that people want to pursue. We need a more strategic approach to research.
- The issue about resources is important. Identify gaps. NSC can say here are the issues and we need people to do this research. Having an investment strategy from the public and private sector would be helpful because there are many areas where this would be helpful too.
- We need to think about communication products that federal agencies can put out in tandem based on best practices that we've collected, etc.
- Making sure that employers know what FAQs need to be asked when speaking with vendors so that they are asking the right questions.

Machine Learning and Artificial Intelligence
Moderators: Donavan Hornsby, Gensuite
                 Keith Bowers, Bowers Management Analytics

Background on machine learning and AI:
- An assumption for machine learning (ML) and artificial intelligence (AI) is that it has to be structured in a certain way. But with advances in natural language processing shows that there is potential for other ways.
- Terminology in the field is inconsistently used. AI, ML, PA (predictive analytics) are all kind of the same thing. Try to predict future outcomes with data that has the same patterns. These things see things that we can't see.
- Coders have figured out that they make more advancement and progress if they share algorithms with everyone else. Open source sharing. The value is not in the algorithm, but in the data. IP is almost free.
- Deep learning is a way to use neural nets. You can give it an input and an output and it'll generate a function.

Should we have a hypothesis first, or should we explore the data for insights?
- Traditional groups think that you should have a hypothesis. The computer science approach is more about mining data to see what you can find. You might not have the time, money, or resources for a traditional approach.
- Treasure trove of incident data. Lots of qualitative data of notes that people have taken. Big amounts of data that can be processed with natural language processing.
- AI for equipment, like on cranes and forklifts. Can you take data from sensors and beacons and derive something out of that?

Applications and barriers for technology:
- Just because you know when, where, and how serious injuries and fatalities (SIF) occur doesn't mean you know what to do with that data. Dow has done excessive analysis of data. But what to do with that data?

- Incident data isn't really big data, maybe medium-sized data. Incident data is really un-safety data. The real big data is looking for the operational precursors. The real safety data is knowing when and where safety barriers and controls are in place.
- Looking to leading indicators for leaders and culture. When incidents happen, it's typically a leadership or culture issue. What are the things in the culture that drive people toward unsafe behavior? What is the tipping point at which cultural factors become ingrained? How can ML help us determine those tipping points and alert us to it?
- Image processing. Train the machine to get used to seeing a condition as safe. When the machine sees something out of ordinary, it shuts down the system or sends out an alert.
- How do you deal with privacy issues of using surveillance cameras? Not used in union facilities. Cameras can also be used to capture the good things happening in a facility too. So if you're willing to share the good things, there may be more acceptance of surveillance cameras and body cameras.
- Behavior influencers. A region may be incident free for years, but as soon as workers find out that a facility is shutting down, there are several fatalities in a year. The breakout of the coronavirus has coincided with several serious incidents occurring.
- Drones that learn the heat signature and shape of humans versus other animals. When weather is bad, can use drones to perform patrols and keep people out of adverse conditions.
- Have to tie the sensors and alarms to an action. It's not enough to have flashing lights and an alarm if the forklift still runs someone over. Need to tie the sensors and alarms to the telematics and motion of the forklift so that it stops operation. May create some other hazards too, if a forklift suddenly stops with a heavy pallet high in the air.
- Sometimes simple solutions have a big impact. Training IBM Watson to memorize entire safety manuals and guidelines and creating a chat bot so that workers can ask questions. Doesn't take a lot of time to program, but can save a lot of time for workers in looking up information.
- Can we build in randomized, intentional false positives? That way people have an out in terms of privacy and disclosure.

Machine learning and AI use cases:
- Image processing. Privacy and morale impact
- Big data: incident data, operational, behavioral, pre-operations
- Equipment
- Behavior influencers
- Industrial design to eliminate harm/risk

Virtual Reality and Augmented Reality
Moderators: Doug North Cook, Chatham University
          Kim Shambrook, National Safety Council

What is AR/VR? Do we need it? How do we use it?
- VR is a headset that immerses you into the entire display, and tracks your movement
- AR allows you to see your space and add in a layer on top of what you see
- There is no true head-mounted AR – very expensive, still in R&D phase

Pros/Cons with AR/VR:

- Very expensive
- VR headset – oculus quest released last spring – is wireless – fits into a case and is $400 apiece – that is the hardware – but the expense comes from content creation – Lowes has a robust program – need to build the content.
- Striver has been building content for companies like Walmart – they bought oculus go – and Walmart is doing 360 degree video training content. 360 degree video is a film that can be interactive, but is not true virtual reality as your physical actions will not be captured. 360 is more about being a spectator – is a lot cheaper to produce – more expensive than traditional video, but much less expensive than VR.
- How are they working on motion sickness? This is a huge issue for the developers – when watching VR, if you get in a car and drive, your fluid in your ears doesn't know what is going on and then triggers nausea. If you can maintain the one to one motion, you can prevent the nausea. Adjusting the view can help. Females are often more affected, but it has been shown that that could be due to most developers are male and are creating oculars to fit them and their needs and these items are not calibrated for women's physical.

Broader ideas for AR/VR:
- NSC needs to create a library of VR technology – a marketplace per se – of high-risk activities – a base for further development. Many safety concerns go across companies and industries – developing safety applications – perhaps we could pool resources into one place and create a VR training for all industries – purely from a safety perspective – not involving IP.
- When manufacturers are selling their products, they should also include VR safety training on how to use the equipment. United Rentals has an excellent VR training.
- NSC creates general type industry VR training – for general safety issues.
- Microsoft is looking into combining VR/AR with headsets that can connect to one another and talk and work in real time – still in "fantasy" mode – still in process and not ideal

VR – Risks/Hazards:
- Trip and fall hazards – need to make sure the surrounding area is safe
- Initial test was too brutal – need to keep emotional safety in mind as well
- What harm are you causing your employee by trying to change their behavior – you can cross a line with the training – too intense can cause mental concerns
- Headsets don't work with glasses

AR – Risks/Hazards:
- Slips, trips and falls
- Ergonomic concerns – too heavy
- Overreliance
- Reduction in field of view
- Might mask the sounds that you should be hearing
- Headsets don't work with glasses
- How does it interact with PPE?

Benefits of VR/AR:
- Can train people in difficult situations and reduces exposure to environmental hazards and situations
- Can help with retention of information because provides more focus and it can be repeated

- VR could be used to retrain and reinforce training
- Retraining for new procedural changes – one part of procedure changes could be added in and shared more easily
- Flat training to 3D training is retained better
- Increase hazard awareness
- Can detect fatigue
- Scalability could be easier
- Collect barometric info
- Can help with hazard recognition
- Finding all the overlays with the various technologies is critical too
- Location – "the facility comes to you" – lowers cost
- Cost effective on a large scale
- Create 12 modules for general safety – more small companies could tap into this
- Provides opportunities for more real practice skills – particularly for expensive training like "crane time" – how can we utilize to help individuals to gain experience, but some equipment doesn't allow it, so the best option is to simulate it.
- Want to provide familiarity
- AR allows the opportunity to see the real space while you are in it to see if it is going to work before it is set up – can call out safety concerns before building
- Allows the opportunity to mitigate risks
- Could draw in a younger generation – need to educate them beyond video games – understanding the true value – the greater good – use this technology to make positive changes in society – we need to recast the vision for what this should look like
- Could be used to educate upper leadership on the hazards their employees are facing – everyone should be aware of the situations – could help lead to designing the hazard out

Research/Resources You Need:
- Need use cases
- Provide value to help make cases to higher leadership
- Create collaboration group to develop base training that can be virtual modules
- Need more research on how VR affects the user long term – What should we be concerned about? – we need standard usage so we know from a medical standpoint. Do we need industry standards on safety usage, collecting data – cross organization, etc.?
- NSC chapters are creating generalized VR training modules – they have 3 that are in development – what is our role in this?
- We need NSC to validate what is out there – validate and certify one – create a marketplace – make recommendations – don't need to recreate, but validate one that works
- Resources listed on the website – demonstrate our expertise that we have validated this as good safety resources – put NSC's stamp of approval on it.
- Could do that with research and resources as well – pick the best and put them on our website

Wearables and Sensors
Moderators: Andrew Ronchi, DorsaVi
             Chuck Geraci, NIOSH

Categories of sensors:

- Proximity sensors
- GPS tracking & geofencing
- Exoskeletons
- Movement, muscles & fatigue
- Environmental quality
- Other
  - Wellness monitoring (fitbit, etc.)
  - Heat stress
  - Mental health

Hazardous worker conditions:
- Lone workers
- Fall from height
- Equipment of worker
- Confined space/enclosed
- Fatigued worker
- Ergonomics
- Chemical and noise exposure
- Vehicles, third party, public hazards in work environment

Case study structure:
- Sensor type
- Situation
- Barrier
- Stage of development

Data privacy issues:
- Internal: HR, sleep, physiological, impairment
- External: environmental sensors
- Who owns data? Personal data? Work environment data?

Barriers:
- User acceptability (sensor data can't just be about assigning blame to worker; share success stories from mitigating hazards through sensor data)
- Millennials v. boomers tech adoption