Blueprints

Building the world safely

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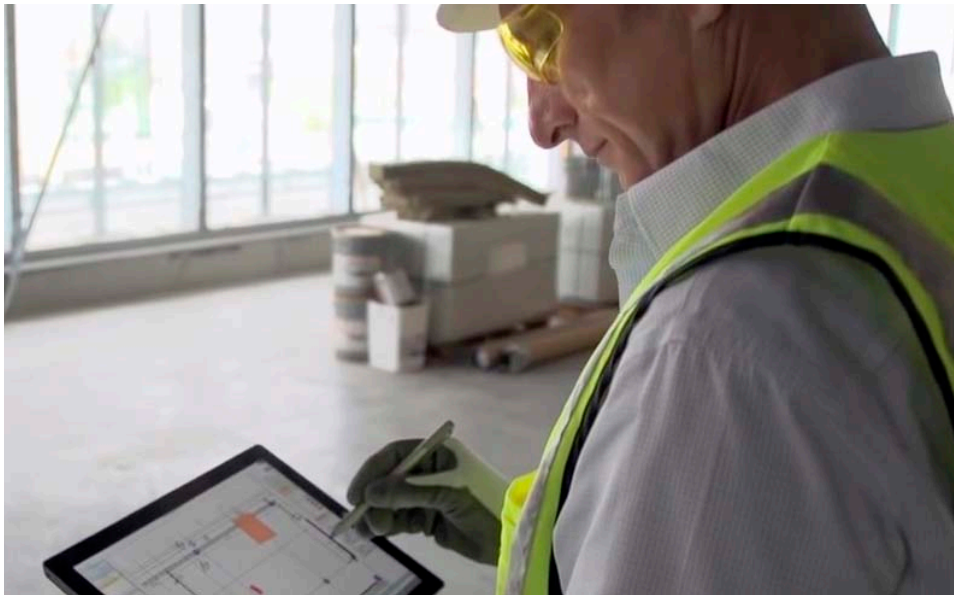
Indoor GPS

A Tool for Creating Safer Construction Sites



REDPOINT POSITIONING CORP.

By Antti Korhonen & Jonathan Horne

According to **Bureau of Labor Statistics**, 75 people die and more than 3,000 people are injured monthly in the U.S. construction industry. Any construction executive would agree that safety is one of the highest priority improvement areas in the industry, and many contractors have already set targets for zero incidents on their projects. Despite this, the incident trends over the past few years show no significant decline.

While the construction industry in the U.S. continues to recover from its years-long downturn, many construction firms have begun to cite the lack of available skilled workforce. The problem is that when less-experienced workers are employed to support increased demand, it may affect not only quality and productivity, but also safety. **AGC's 2015 survey** states, "Troublingly, a small but significant number of firms report that worker shortages have the potential to impact workplace safety."

Improving job site safety, responding to emergencies, and analyzing incidents after the fact are enhanced when worker location can be monitored and recorded throughout a project.

Location-Aware Wearables

For the first time ever, the core technologies required to actively monitor job sites are becoming available and they promise to radically alter the construction industry's safety-risk profile. The convergence of low-power sensors, universal connectivity and precise real-time-location information enables unprecedented visibility into daily operations, catching incidents before they occur, speeding recognition and access to incidents when they do occur, and supplying accurate and meaningful data for post-event analysis.

An electronic device, as small as a standard access badge, can identify a worker's location anywhere on a project to within 8 in. The location information can be used to alert the wearer to nearby hazards, including static dangers such as exposed ledges, or moving risks such as cranes and bulldozers. Sensors built into the device can detect falls and immediately relay accident locations to medical personnel. Site-wide safety information can be broadcast and, in the event of an evacuation, all personnel are immediately accounted for.

Risk Mitigation Techniques

Real-time location monitoring of crews and equipment provides many options for improving the safety and security of everyone on the job site.

Static Geo-Fences for Objective Hazards

Job sites contain many areas that should be off-limits to most workers under any condition or, at the very least, require careful attention and perhaps specialized equipment before entering the area. Examples include working below a lifting operation, high voltage electrical sites, exposed ledges and chemical storage areas.

Traditional safety procedures require erecting barriers and signs that are frequently overlooked or ignored. These measures can be supplemented with electronic detection and alarming that alert not only the individual at risk, but appropriate supervisors as needed.

Project managers can use tablet-based software to visualize and identify static risk across a project and mark hazardous areas on the site plan, and document a reason for the hazard. For example, consider a geo-fenced zone marked "Core drilling above." A worker wearing a tracking tag who enters a geo-fenced area is immediately alerted through an audible alarm and visible strobe, together with a brief text display that reads "DANGER! Core drilling above." The worker's foreman or the project manager may receive an alert as well to expedite corrective action. In all cases, events are logged for later analysis.

Dynamic Geo-Fences for a Job Site in Motion

Dynamic geo-fences, similar to their static counterparts, generate alerts whenever a worker enters a hazardous area. In this case, the location of the hazard area is tied to that of another object. For example, it is possible to define a hazard area as being anywhere within 30 ft of a forklift or within 70 ft of a bulldozer. With struck by incidents second only to falls as leading injury causes, dynamic geo-fencing has the potential to prevent many incidents and even save lives.

Credentialed Access

Some locations should be accessible only to workers with appropriate authority, credentials and skills. Unlike physical barriers and signs, indoor GPS systems can allow a worker trained in confined spaces to walk into a crawlspace, while a coworker without the same training immediately triggers an alarm upon entering the space. With 8 in. accuracy, the protected area can be as small as an electrical closet accessible only to electricians, or as large as an entire job site (e.g., prohibit anyone without OSHA-10 training).

Last Known Location & Mustering

During incidents that may affect several crew members (e.g., explosions, gas leaks), one key to providing workers with the best chance for survival is to know either where they are or what their last known location was right before the incident. During an emergency, tracking solutions can provide rescue personnel with the exact locations of missing workers and, thereby, save valuable search time.

Indoor GPS eliminates the need for manual accounting during a muster event as well. Through a tablet-based visualization tool, supervisors can identify at a glance anyone not at a designated muster point, and pinpoint their location anywhere on the site.

Protecting the Lone Worker

Location-aware badges can also provide tracking of lone workers in an emergency, in confined spaces or during the night shift to help manage efficient emergency response. The call button on a wearable safety badge enables the worker to manually trigger an emergency help request that indicates his/her exact location. The message can be sent to the closest colleagues based on their proximity to the incident.

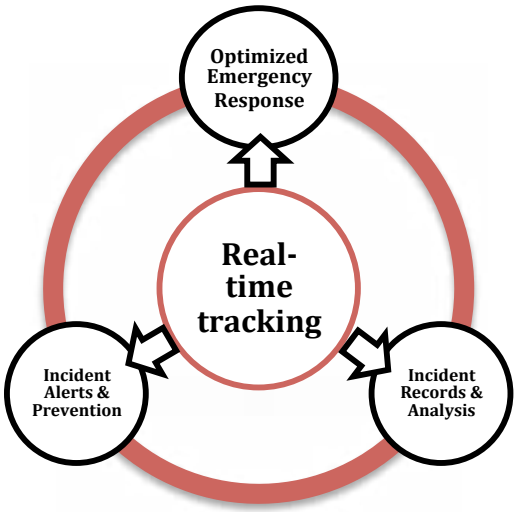
The technology can also detect man-down events by monitoring workers' movements with an accelerometer inside the badge. If the person is not moving, an automated emergency request and location will be dispatched.

Incident Prevention

High Traffic & Occupancy Areas

When workers, equipment and materials are tracked across a site, high-traffic areas are easily identified and rerouted. High occupancy areas shared by multiple crews become apparent, and work can be rescheduled to mitigate spatial conflict and attendant hazards. Without real-time location records, project managers lack the visibility to

FIGURE 1
Benefits of Real-Time Tracking



understand the flow of people and machines throughout a site; with the aid of indoor GPS, collisions and occupancy-related accidents can be averted before they happen.

Powerful Metrics for Continuous Improvement

Researchers have studied the link between lean construction and worker safety and shared empirical results. The benefit is derived from the continuous improvement feedback loop where best practices are regularly reviewed and adapted to incorporate new findings. While this is a step in the right direction, current practices operate on limited information about what is really happening on a project. Job site injuries are readily documented but near-hits may never be reported or even recognized.

Real-time tracking on the job site provides a new level of granularity and comprehensiveness to incident awareness. A worker walking dangerously below a lifting operation will be immediately flagged (and alerted) by the automated tools, while no human may ever notice that it happened, unless that action results in an incident. With indoor GPS and connected reporting tools, project managers are given powerful metrics and site-wide visibility that they can use to adapt the company and project procedures to improve safety.

Privacy Concerns

Workers may question whether tracking technologies represent an invasion of their privacy. However, these concerns can usually be allayed if the deployed system is clearly designed to reduce risk and improve safety. Further, badge identification can be made anonymous to the degree desired. Nameless badges may have only a group name or a color code, per trade or subcontractor. With this method, a worker's identity is not disclosed, but his/her location, used for safety purposes, is still known. Helping a worker in an emergency does not require checking the individual's ID.

Technology Considerations

Accuracy

Not all connected and wearable safety solutions are created equal. The cost, accuracy and reliability can differ greatly based on the vendor and underlying technology. While RFID, Wi-Fi, Bluetooth and cellular-based solutions can provide some helpful data, the biggest problem typically encountered is inaccuracy, prohibitive cost or the high complexity of system deployment. The most accurate and affordable tracking solutions today are based on the new radio frequency standard called ultra-wideband (UWB), which can support up to 8 in. (20 cm) real-time tracking capability due to its RF characteristics. Location accuracy and reliability are highly important in enabling reliable hazard zone identification and proximity alerts.

Low Latency

Seconds count. A vehicle traveling at 20 mph covers more than 29 ft per second. When it comes to alerting a worker on a collision course with a machine, there is no time for shipping radio measurement data off to a remote server and waiting for it to compute a location before shipping an alert message back. That information needs to be available to the worker immediately so that preventive action can be taken at the earliest sign of trouble. Modern safety tracking systems can generate alerts on site and with minimal delay.

Global Visibility With History

A comprehensive safety solution must address more than collisions. An overall view of where a project's resources are at any given time—from the present moment back to the start of the project—is needed.

Efficiency Through Safety

According to **Liberty Mutual's 2016 Workplace Safety Index** more than $62 billion in direct workers' compensation payments were generated in 2013 for all industries, including construction, for workplace injuries and illnesses. In an earlier **Liberty Mutual survey**, 60% of financial officers stated that a $1 investment in injury prevention generated returns of more than $2. **Other surveys** indicate a savings of at least $3 for every $1 invested.

Investing in safety technology has a clear financial return on investment. This is particularly true when many of these new solutions, such as job site tracking technologies, also positively affect project workflows, practices and efficiency. Let's call it "efficiency through safety."

Conclusion

Technology exists to dramatically improve safety on industrial construction job sites. Real-time location monitoring of construction workers can prevent serious injuries and fatalities. Should an incident occur, tracking can expedite response and recovery actions. Real-time and historical project visibility gives actionable data for improving corporate and project safety processes. Combined, these components will help companies achieve the zero incident target as highlighted in **this video** that shows how Skanska is using Redpoint Indoor GPS. ■

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