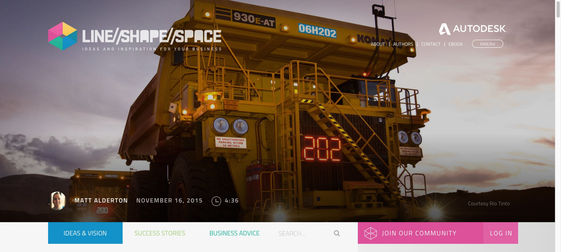

Courtesy Rio Tinto

MATT ALDERTON NOVEMBER 16, 2015 4:36

The Robots Are Coming! Driverless Dozers and the Dawn of Autonomous Vehicle Technology in Construction

If Paul Revere were making his famous midnight ride today, he wouldn't be bellowing about the British. Instead, he'd likely be alerting his fellow countrymen about machines. "The robots are coming!" he'd shout from atop his horse—or from inside his Prius. Unlike his original broadcast, Revere's revised bulletin wouldn't be a warning. Rather, it would be a birth announcement: Autonomous vehicle technology isn't reserved for some distant tomorrow—it's here today.

At the nucleus of this robotic revolution are driverless cars, which are now legal in five U.S. states and the District of Columbia, and are expected to be available to the public as early as 2020. But cars aren't the only vehicles ripe for automation. Buses, trains, and trucks also are poised for driverless upgrades, as are construction fleets—automation of which could yield the same benefits for industry that self-driving cars promise to yield for consumers.

"When it comes to adopting technology, heavy equipment tends to follow the automotive sector by about 10 years," explains Tudor Van Hampton, managing editor of construction-industry publication *Engineering News-Record*. "When you look at the automotive sector, the Mercedes-Benz S-Class is the bellwether of future technology; whatever you see happening on the S-Class eventually will work its way into the over-the-road trucking sector, and from there into off-road heavy equipment."

Courtesy Rio Tinto

The 2014 S-Class sedan—which includes an "Intelligent Drive" system that automates parking, lane changing, steering, and even braking—became the first-ever mass-production self-driving car last year. It's only a matter of time before tractors, bulldozers, cranes, dump trucks, and excavators are similarly automated.

Mining for Efficiency. Experiments in the mining industry offer a glimpse at what eventually could materialize in construction, according to Todd Gurela, senior director of Cisco's Internet of Everything division, which has worked closely with international mining company Rio Tinto to enable automation at its Pilbara iron ore mines in Western Australia—home to Rio Tinto's Mine of the Future program.

Autonomous dump trucks at Rio Tinto's Pilbara site. Courtesy Rio Tinto.

"Rio Tinto is on the leading edge of optimizing efficiency in its mining operations," explains Gurela, who says Rio Tinto first outfitted its mining fleet with diagnostic sensors so it could monitor its assets' performance; leveraging the data it collected, it then looked for opportunities to do things better, faster, smarter, and safer using automated equipment. For instance, Rio Tinto currently has 57 autonomous dump trucks—manufactured by Tokyo-based Komatsu—operating at its Pilbara sites, each of which leverages GPS to move high-grade ore without a driver. It is also developing and testing an autonomous heavy-haul long-distance railway system, and has deployed an automated blast-hole drill system that allows a single operator to remotely control multiple drill rigs.

"These driverless vehicles deliver their loads more efficiently, minimizing delays and fuel use, and are controlled remotely by operators who exert more control over their environment and ensure greater operational safety," Rio Tinto says of its Autonomous Haulage System, adding of its Autonomous Drilling System, "It is much safer for the operators and it maximizes precision and equipment utilization."

Building a Better Job Site. Heavy-equipment manufacturers are hard at work on autonomous vehicles that replicate on construction sites the efficiencies realized by Rio Tinto in Australia. In 2013, for example, Komatsu introduced the semi-autonomous D61i-23 dozer, the world's first dozer with fully automatic blade control. Caterpillar and John Deere are working on similar vehicles, which likewise will be semi-autonomous to start with, but ultimately will evolve toward full, driverless automation.

Located in a trailer about 300 feet away, an operator is remotely controlling a Caterpillar D11T dozer. The views on the screens are from the cameras installed onboard the dozer. Courtesy Caterpillar.

When those machines eventually arrive on construction sites—within 10 to 20 years, Van Hampton predicts—they'll deliver increased:

- **Safety.** Rio Tinto controls its driverless vehicles remotely, which means their human operators are out of harm's way. Even in vehicles with drivers, however, automation can protect operators. "Operators historically have had tough jobs," Van Hampton says. "You're driving something that's off-road, so your neck, arms, and hands get tired. More construction is being done at night nowadays, too, so operators take little micro naps while they're working. All of this increases risk on projects. Automating safety—for instance, by making machines smart enough to detect if the operator is falling asleep, then wake them up—can reduce those risks."
- **Productivity.** "Safety alone will never sell these systems . . . it's safety plus economic value," says Gurela, who cites as an example Canadian oil company Suncor Energy, which is deploying self-driving hauler trucks in Alberta's oil sands with the hypothesis that they will increase productivity by eliminating human error. "In the oil sands, 400-ton hauler trucks make around 20 trips per day. If you can get two more trips out of the mine per truck per day, that's a pretty significant improvement in the total production output of that mine."
- **Efficiency.** A key feature of automated heavy equipment is remote diagnostics, also known as telematics, which utilizes Internet-connected sensors to monitor vehicles to ensure they're running at peak performance. As a result, equipment lasts longer—tires on autonomous hauler trucks, for example, last up to 50 percent longer, according to Gurela—requires less labor to operate, and uses less fuel, all of which saves money. "Fuel efficiency, for example, is in large part driven by how skilled the operator is at making that tool do its job; an operator who's using more horsepower than he needs uses more fuel," explains Van Hampton, who says integrating 3D models will allow for even further time and cost savings. "You can plug a three-dimensional terrain model into a machine, and it will go to work on its own and optimize to the grades that are specified in the model. It's just like BIM [building information modeling], but for horizontal instead of vertical construction."

Caterpillar dozer controlled by driver in previous image. Courtesy Caterpillar.

Driverless Design. Even with its generous returns, automation won't likely lead to operator extinction. "Operators in the future will probably be more like commercial airplane pilots," Van Hampton says. "They'll still be needed to make the right inputs and intervene if things go south. Their knowledge, therefore, will be a lot more important than the mechanical part of it—pulling levers and holding onto joysticks."

Operators or not, in the same way that driverless cars will lead to more enjoyable commutes, autonomous dozers, cranes, trucks, and excavators ultimately could lead to more enjoyable buildings by yielding savings in time, labor, and money that owners and developers can then invest into better design.

"The more you can optimize construction with digital modeling, then execute it with autonomous or semi-autonomous machinery," Van Hampton says, "the better the quality of the construction is going to be, the faster it can get built, the more profit that will be returned to the people building it, and the more value end users are going to get out of it."

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