



## Cybernetics Automation Technology

Cybernetics Automation Technology (CAT) is on the threshold of providing workerless mining, railroads, sawmills, ships, steel mills and all sorts of production facilities — maybe even management functions? The development of complex electronic control systems appears to be combining with machines to create automation that needs fewer people for normal operation. I wonder how many readers of this article are old enough to remember when elevators in department stores, public buildings, hotels and all multi-storied buildings were manned by human operators? How many devices in your home have automated your hand-labor functions? We take for granted the dishwasher, washing machine, clothes dryer, personal computer, wireless telephone and email. There are clues all around us showing the alarming changes in our global economy.

Look at the impact the automatic elevator has made. No architect who designs skyscrapers designs elevators; that work is outsourced to elevator manufacturers. No building owner inspects or services elevators; inspection is usually a government function and maintenance of elevators is outsourced to qualified licensed contractors. At the time of design, safety is a key issue to ensure safe access during installation and for lifecycle maintenance to eliminate falls in multi-story elevator shafts. When elevators were first developed, they were rated the source of frequent serious accidents. The development of modern elevators created a whole new industry, with high-paying employment.

Airline passengers who change planes at the Dallas-Fort Worth Airport may use the automated sky train to leave one terminal and go to another. The passengers' waiting lobby has closed doors to prevent access to the tracks. When the automated train arrives and stops, two automated doors permit entry. One door prevents access to the track, and the other door, situated on the train car itself, opens into the train car. Just like elevators, both doors open when the automated train arrives. Now, compare the Dallas-Fort Worth

sky train to subway stations, where the passenger waiting area is next to an open, unguarded platform four or five feet above the subway train tracks — tracks that often include a high-voltage third rail. It is a fairly regular occurrence for people to fall off a subway platform and be killed or seriously injured. It's apparent that subway waiting platforms are not as safe as the Dallas-Fort Worth Airport sky train's passenger waiting platforms. Some may say it's too costly to update subway stations, while others may conclude that the public will want safer waiting areas for subways. The cost of any personal injury litigation filed for any injuries or death due to unsafe subway waiting platforms will also provide an incentive for creating safer subway waiting areas.

As functions become automated, people often complain about a loss of jobs. The good news is, as the birth rate declines worldwide, the economy will not suffer for a lack of workers because automation will fill this gap. However, the perpetual public resistance to automation will continue. In 1811, the Luddites, who were identified as organized bands of English weavers, destroyed the new textile machines that were replacing these craft people. Nighttime violence became rampant and soon escalated into destruction of cloth-making factories in Yorkshire, Lancashire and other English communities. In 1812, a band of Luddites was shot down under the orders of threatened weaving factory owners. By 1813, the rule of law resulted in many hangings of Luddites until this activity ended. In the long term, automated production has developed a prosperous middle class. The highly skilled employees who designed, manufactured, operated and maintained such automated equipment have enhanced the public's well-being. Only recently has wealth shifted from the middle class to the "one percent" of rich investors.

As our civilization becomes more dependent on CAT, a new class of specialists who are knowledgeable in combining engineering with cybernetics will become

our highly skilled independent middle class, as are the prosperous people who currently design, manufacture and maintain elevators. It is foreseeable that, as more specialists in CAT become independent high-tech business owners, we will see wealth again shift from the “one percent” of rich investors to an affluent new middle class.

At the local level, another source of interference with CAT has arisen. The public does not yet accept the benefits of their driving performance being evaluated and enforced by automated camera systems. The use of camera recordings and automatic mailing of citations to drivers who run stoplights at busy intersections has brought about a flood of complaints in the “Letters to the Editor” section of newspapers and in television news interviews. It takes

time for the public to become aware of the savings realized by the reduction of deadly intersection collisions. The resulting lower car insurance rates and reduced law enforcement tasks due to automatic cameras — compared to having a salaried patrol person watching to cite a careless driver who runs a red light — aren’t always apparent to the public. This automation frees police officers to pursue other important crime investigations.

CAT has become a newsworthy topic. Many publications tell of the changes to come, including those that predict that in the next two decades, 45 percent of the laboring workforce will be replaced by computerized automation. Some of these predict that the only remaining labor workforce will be cleaning personnel who work in hotels, those who are restaurant servers or those who do housework, gardening, or maintenance and repair.

A recent issue of *The Economist* tells of coming ghost ships without crews. It predicts that marine technology will change first, with automated cargo ships that sail with shore-based captains and navigators. All maintenance will be done when the ship docks. But public mistrust of cruises and ferry boats has already developed because of recent disasters linked to unreliable and dangerous seamanship caused by lapses in human performance. The March 20, 2014 issue of *Engineering News Record*, published by McGraw-Hill, includes a special report titled “Robots on the Jobsite.” The report tells of a semi-automatic brick-laying machine that selects bricks,

mortars and sets them in place to build a wall. The report includes a “Glossary of Terms of Robotics” that defines the following terms:

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- **Autonomous** is work without outside human intervention.
- **Drone** is an unmanned vehicle.
- **Robot** is a machine that performs a task.
- **Semi-autonomous** is something programmed to perform its task in a perceived environment requiring human intervention in changing circumstances.
- **Tele-operation** is remote control by a user. This is presently a major application of partial automation.

Studies by researchers at the University of Oxford are included in the report to show which construction labor functions are close to being replaced by robots. These functions include reinforcing iron and rebar workers, roofers, crane operators, cement masons and operators of construction equipment. Recently, I visited the Caterpillar Proving Ground 11 miles west of Green Valley in Southern Arizona to see a demonstration testing of huge, driverless ore-hauling trucks. This system can handle 200 trucks simultaneously, night and day, 24 hours a day, using Global Positioning System (GPS) routings with no downtime for shift changes as required by conventional driver-operated trucks.

Opposition to CAT comes from many diverse bedfellows. Some environmentalists who oppose such development speculate that automated production facilities are unsafe and dangerous to the environment. Some management groups that made bad decisions that injured or killed people looked for a scapegoat to blame — now, they allege that the automated system was unsafe. Even some of the professional societies and trade associations that are reducing the number of people on their boards of directors are engaging in a self-destruct program, which limits the diversity of expertise on their boards. Unfortunately, this type of society governance is completely blind to emerging CAT. Years ago, the emerging elevator industry expanded its leadership groups to ensure the diversity of knowledge of technology. Simply stated, opposition to CAT is not about pro-

tecting the public from unsafe automated equipment; it is about gaining the power of political leadership. Those who oppose CAT, and limit their boards of directors to a few, are often concerned about advancing their power over technology.

What is the future of CAT? Here in the United States, Amazon has demonstrated the delivery of small packages to customers' doorsteps using small helicopters and notifying receivers by telephone that the package has just arrived. It is also known that Google is also reportedly buying firms that manufacture sensors and controls to develop, market and service new automated systems. To return the U.S.'s outsourcing of low-priced clothing from Bangladesh to the garment industry in this country, it is CAT that can compete with the \$9 per week salaries of workers in Bangladesh.

Historically, since the 1950s, the military has established electronic and similar proving grounds to ensure the reliability of military hardware, systems and components that rely on CAT. The most startling change will be the demand for system safety design specialists who are in design, testing, manufacturing and maintenance to ensure reliable performance. Currently, 80 to 90 percent of those in the practice of safety are involved in worker behavior modification. When the workplace has no employees, the need for worker behavior modification evaporates. The safety practitioners who survive will be those highly trained as system safety authorities who can advise corporate leadership on design-based CAT safety. The new safety authority will ensure the integration of reliable and safe CAT performance by assisting engineers whose training and experience is in conventional disciplines. These new safety experts will be able to target and eliminate CAT failure modes at time of design, and be able to inform the public of how CAT improves their expectations of safe well-being.

Driverless cars have already safely navigated more than 10,000 miles on city streets, in addition to nearly 700,000 miles of freeway travel. It will be possible to reliably automate many functions that will overcome known lapses in human performance. Absolute failure-free automation will no longer support the need for insurance. Google's technology can now read stop signs, including those hand-held at school crossings, and can predict the actions of jaywalkers. Our space exploration efforts have been able to identify the contents of soil and rocks on other planets. They have also provided remotely controlled vehicles to explore Mars and, soon, Mercury.

The transition to CAT will not be easy. There was a recent revelation that the new president of General

Motors was shocked to learn that an unsafe ignition key switch was the cause of several deaths, that GM knew of the problem for 10 years and that reliance on its internal risk management processes failed to eliminate the hazard. It is these entrenched people who are most uncomfortable with what may be waiting for them in the near future.

According to the May, 2014 *Smithsonian* magazine article, "Science Friction," of 1,000 people interviewed by telephone, only 48 percent would take a ride in a driverless car. Many people are not ready to live in what the future holds with CAT. They consider it to be "awesome," but feel it's not for them. Nearly 60 percent of interviewees consider CAT as "mostly better," while 30 percent consider it to be "mostly worse" and will actively oppose adoption. As expected, 10 percent will be "fence-sitters."

Efforts to oppose specific adaptations will be diversionary in nature, as well-organized professional and trade groups will not directly oppose progress, but will engage in distracting issues. Often, small boards of directors, without diversity of knowledge in new technology, are closed-minded, petty and engulfed in ignorance. Others will seek to develop conflict between governmental agencies as a process of delaying specific CAT applications.

To overcome this foreseeable organized reluctance to accommodate CAT, system safety experts need to become conversant with CAT and become messengers spreading the news of the benefits of specific CAT applications in which they have professional experience and of which they have congruent knowledge and expertise. What is really needed is to have system safety specialists write articles supporting specific CAT applications that will reach management and the public. The scope of system safety is already experiencing a strikingly new function. To achieve a compatible match of software with hardware, the safety director becomes a primary player in management. Jeff Speer, a long-time member of the International System Safety Society, provides assurance for the safe integration of cybernetics with automated network communications for the U. S. Army.

After more than 62 years in the safety profession, I am heartened to see that the pendulum of our system safety practice is beginning to swing toward more enterprise acceptance of design as the "Holy Grail" of safety. CAT is the forerunner of a future safer civilization utopian in nature — with a high standard of living and leisure. I speculate that the system safety engineer will have a new role as a certified automation safety technologist (CAST). ●