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The Technology Revolution in the Construction Industry: The Rise of Artificial Intelligence

Technological advances are revolutionizing the construction industry. Robots, exoskeletons, autonomous equipment, unmanned aircraft systems, and wearable technology are already making their way to construction projects around the world–and more are coming!

Advanced technology is not new to many industries, such as e-commerce, medicine, and transportation. They have been immersed in advanced technology over the past decades and are no strangers to the use of artificial intelligence (AI). For instance, Amazon (the world's largest e-commerce marketplace) reportedly uses over 200,000 robots in sorting distribution centers worldwide.[1]

In contrast, the construction industry has been one of the *least* digitized industries.[2] Over the past decades, there has been significant resistance industry-wide to the use of advanced technology for a variety of reasons, ranging from lack of understanding advanced technology to fear that advanced technology will eliminate human jobs.[3] "As an industry, we are fighting against AI," said William Carney, design technology leader at DLR Group (a global integrated construction design firm).[4] According to Carney, "AI is an extremely powerful tool that we are barely leveraging."[5]

Globally, construction is a $10 trillion a year industry with increasingly sophisticated customers, yet it remains behind the curve in implementing advanced technological solutions.[6] In an effort to "catch-up," in recent years, the construction industry has experienced sharp rises in investments and funding for technology start-ups to develop solutions

incorporating advanced technologies.[7] Since 2013, it is estimated that $18 billion has been invested in the construction tech industry, and we are starting to see the results.[8]

Cutting Edge Technology in Construction Today

Advanced technology, including artificial intelligence, is being used to perform age-old tasks on construction sites, such as surveying, excavating, bricklaying, welding, and demolition, as well as being used to optimize overall project development, scheduling, product testing, and structural engineering. A few of the industry's technological advances and trends are highlighted below.

Robots

SAM100 – Bricklaying Robot

SAM100, short for Semi-Automated Mason, is a bricklaying robot designed and engineered by Construction Robotics.[9] SAM100 is the first commercially-available bricklaying robot for onsite masonry construction.[10] SAM100 uses a metal robotic arm to spread mortar on bricks before a laser-guided system lays the bricks in rows.[11] On average, a human mason can only lay approximately 250 bricks per day; SAM100 can lay in excess of 250 bricks *per hour*.[12] In fact, SAM100 has set a world record for the most bricks laid in eight hours, totaling 3,270. [13] SAM100 is not completely independent of human assistance, however, as it requires two human counterparts to build a brick wall—one to feed bricks into the machine and the other to follow and smooth excess joint mortar.[14] According to Construction Robotics, SAM100 can improve a mason's productivity and reduce lifting tasks by at least 80%, thereby reducing risk of injury.[15]

TyBot – Rebar Tying Robot

TyBot is an autonomous rebar-tying robot created by Advanced Construction Robotics.[16] TyBot autonomously navigates its work area, identifies rebar, and ties rebar intersections with limited human assistance.[17] After human crews carry, place, and frame-in a portion of the deck rebar, TyBot ties the rebar.[18] TyBot requires one human (a quality control tech) to monitor performance, reload the tie wire spool, and ensure the robot does not impede the project's safety protocol.[19] TyBot reports that it decreases labor costs by taking over the bulk of rebar tying operations.[20]

Mule135 – Material Lifting Machine

MULE135, short for Material Unit Lift Enhancer, is a smart lift assist device created by Construction Robotics and designed for handling and placing material weighing up to 135 pounds on a construction site.[21] MULE135 has a 12-foot arm with two pivot points, allowing it to reach and lift materials around obstacles.[22] MULE135 directly interacts with humans by lifting materials as the human workers maneuver and place the materials.[23] It is reported that MULE135 makes material feel almost weightless, thus reducing worker fatigue/injuries and increasing productivity. [24]

Robotic Exoskeletons

While robots are used in place of humans, robotic exoskeletons are used to augment human performance.[25] Exoskeletons, or exosuits, are robotic metal suits with motorized muscles worn on the body that mirror the wearer's skeletal structure (limbs, joints, and muscles). They multiply the wearer's strength, making objects feel much lighter, sometimes even weightless.[26] An exoskeleton works in tandem with the body, reinforcing a human's performance through the use of sensors and actuators inserted into the suit.[27] There are several different types of exoskeletons including full-body suits, back support suits, and limb support suits which help workers support body weight, lift heavy objects, maintain loads/large tools, and correct posture/positioning thus decreasing stress on muscles.[28]

In November 2018, Sarcos Robotics, announced its Guardian XO Max, reportedly the world's first all-electric, battery-powered, full-body exoskeleton system capable of enabling humans to safely lift and maneuver up to 200 pounds for extended periods of time.[29] The exoskeleton uses a system of sensors, integrated into the suit, enabling the Guardian XO Max to respond to the human's movements in milliseconds.[30] Sarcos Robotics is scheduled to ship to industry customers in early 2020.[31]

Autonomous Equipment

Many technology companies are working to develop tomorrow's fully autonomous equipment systems for the construction industry, and remote control technology is the first step in reaching that goal.[32] In an effort to maximize a contractor's investment in its current equipment, technology companies have developed autonomous upgrade systems or "kits" that can be retrofitted onto existing construction equipment, allowing the equipment to navigate their surroundings and perform repetitive tasks by responding to commands remotely.

For example, Caterpillar (Cat) has developed a suite of technology products, including remote-control systems for hauling, drilling, bulldozing, and underground mining.[33] Cat's remote-control systems allow onsite operators with direct visual contact, or offsite operators in "virtual cabs," to control equipment.[34] Trucks equipped with Cat systems remotely respond to commands to their shovels, move into position, haul loads to designated dump points, and report for maintenance–all without an operator onboard.[35] Cat reports that only a few years ago it had a handful of autonomous trucks at customer sites, but today it has the single largest autonomous truck fleet in the world.[36]

Similarly, Built Robotics has designed autonomous upgrade kits that retrofit existing construction equipment (such as excavators, bulldozers, skid steers, compact track loaders, etc.) with hardware, GPS, Wi-Fi, Lidar, sensors/cameras, and emergency stop buttons, all controlled remotely by equipment operators.[37] In early 2019, Built Robotics and Sunstate Equipment Company announced the industry's first partnership to rent autonomous construction equipment to contractors around the nation.[38]

Unmanned Aircraft Systems/Drones

While many industries are using unmanned aircraft systems, also known as "drones," the construction industry is the fastest growing commercial adopter of drones—with their use skyrocketing this past year by 239%.[39] In 2018, an industry study reported that time spent at projects on non-optimal activities, such as fixing mistakes, looking for project data, and

managing conflict resolution, accounts for $177.5 billion in labor costs per year in the United States.[40] Contractors have quickly learned that they can cut those labor costs by using drones.

The primary uses of drones on construction projects include real-time data collection, aerial surveillance, and communication; however, drones also have valuable, widespread use in pre-construction site planning, quality control, bidding, and jobsite risk mitigation/safety.[41] There are even future plans for drones to control robotic construction vehicles, paving the way to fully automated construction sites.[42] In spring 2018, the Japanese construction giant, Komatsu, placed an unprecedented order for 1,000 drones for use in surveying and monitoring projects—reportedly the largest order for commercial drones to date in the construction industry.[43]

Wearable Technology

Wearables are expected to proliferate in the construction industry in the near future. New wearable technology can perform tasks such as collect data on human body movements, track workers' locations, send fall notifications, and determine whether safety equipment is being properly operated and whether equipment is being operated by properly certified workers. Some examples of construction wearables include:

- ***Spot-r Clip**:* a small clip-on device that allows automatic time/attendance records, real-time location of workers by floor/zone, detection of location and distance of falls, and alarms for jobsite emergencies;[44]

- ***HoloLens 2**:* glasses that mix hologram/digital overlays with the existing physical environment to assist in design and planning;[45] and

- ***SmartCaps**:* bands worn inside hardhats that monitor fatigue levels of workers in real-time using brainwave technology.[46]

Comprehensive Software Platforms

Software programs have been available to contractors for some time, but new comprehensive platforms of integrated construction management software have been developed that can connect all project teams with real-time data through the entire lifecycle of a project. Some such platforms also provide 3D modeling of buildings and infrastructures to help explore design options, create visuals and determine necessary changes as a project progresses.

For example, Autodesk (a leader in 3D and engineering software), offers advanced Building Information Modeling (BIM), an intelligent 3D model-based process that aides architecture, engineering, and construction professionals in planning, designing, constructing and managing projects.[47] These BIM modeling advances allow much more accurate detailing of a building and its infrastructure, providing unprecedented visualization of the building before site construction begins.[48]

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Benefits of Intelligent Construction

Although robots, exoskeletons, autonomous equipment, drones, and wearables are only some of the technological advances making their way to construction projects around the world, contractors are finding their benefits undeniable. Companies are using these advanced technologies in all stages of the construction process to optimize overall project development. These technologies produce two vital benefits: (1) they keep humans safe; and (2) promote productivity.

Every construction project has risks—safety, quality, time and cost—with the greatest risk being loss of human life. In fact, construction workers are killed on the job five times more often than other laborers.[49] With the emerging use of advanced technology on modern-day jobsites, humans are performing dangerous tasks less, decreasing the chance for human error and boosting onsite safety.[50] Moreover, for those workers who continue to work alongside the robots, autonomous equipment, and drones, their workloads and physical stresses can be significantly decreased through the use of exoskeletons, exosuits, and wearables, resulting in less fatigue and injuries.

Advanced technology even anticipates safety hazards by detecting risks early through site monitoring, allowing time for the hazards to be remedied before injuries occur.[51] Contractors monitor and prioritize risks on the jobsite, so their project teams can focus time and resources on the biggest risk factors.[52] For example, drones can reduce risk by constantly surveying the sites, comparing photos with design blueprints, and identifying potential inconsistencies or errors. When errors are identified, an automatic notification is sent to the crew, allowing immediate action to be taken.[53] Newly developed technology can also analyze photos from jobsites, scan the photos for safety hazards (such as workers not wearing personal protective equipment), and report the information to project management.[54]

Advanced technology is also proving to be more cost-effective and productive for contractors by performing more tasks in less time, reducing labor costs, conducting real-time data analyses, and providing instant connectivity to the project site with increased energy efficiency. Thus, companies have begun using advanced technology in all phases of construction, including pre- and post- construction phases.

In the pre-construction phase, contractors use advanced software programs to predict customer trends and reactively adapt business models to the market.[55] This is beneficial in determining what will likely be the most attractive option for the client, saving both time and money.[56] Advanced technologies capture data to provide more realistic timelines and budgets, and predict cost overruns on large scale projects based on factors such as project size, contract type, and the competence levels of project managers and personnel.[57] Companies report that the use of advanced technology can lower installation costs up to 50%.[58] A contractor's ability to lessen labor costs and complete tasks more quickly allows the contractor to be more competitive in the bidding process. Advancing technologies also have the capacity to gather information from each project division, test possible alternative designs using learned data analysis, and provide contractors with blueprints to complete the project in the most effective manner. [59]

Once onsite, advanced technology reportedly increases productivity by three to five times due to the fast, repetitive work performed by drones, robots, and autonomous vehicles.[60] Advanced software systems give contractors instant connectivity to data from the field and constant contact with the worksite. These new technologies are able to communicate with and align the various contractors within a particular project.[61] A drone or robot constantly evaluating job progress and the location of workers and equipment, enables project managers to timely determine which jobsites have enough workers and equipment to complete the project on schedule, and which projects might be falling behind, thus requiring additional labor to be deployed.[62] The technology allows workers to update contract-compliance checklists,

collect information on project updates, and track jobsite progress in real time.[63] Project staff can automatically import field data through new technologies in order to manage performance on worksites.[64]

Even after projects are completed, contractors continue to use new technology for their future needs at those projects. As mentioned, advanced software systems store information about the structure of the building and can be used to monitor developing problems and even offer solutions to prevent future problems.[65]

Despite the clear benefits of advanced technology on construction projects, there is still room for error in that the technologies themselves are designed by humans and require human oversight and assistance. So who is liable when things go wrong—the contractors who used the technology, the engineers who developed the technology, or the manufacturers who created the technology? How are laws and policies changing to address the use of advanced technology? How can we help clients better protect themselves in the changing world of advanced technology? The following sections will take an in-depth look at the current legal framework involving advanced technology, the liability questions raised by the use of advanced technology, and potential ways to protect clients through contracts and insurance.

Laws and Regulations for Advanced Technologies

As development and implementation of advanced technologies continue to soar, the legislative bodies and executive agencies charged with governing their use have been working to pass legislation and implement policies. Although the legislation does not specifically address use of advanced technologies in the construction industry, the statutes' broad language would clearly encompass many of the advanced technologies in construction.

Unmanned Aircraft Systems (UAS)/Drone Laws

Federal

Although the terms "unmanned aircraft," "unmanned aircraft systems," and "drones" tend to be used interchangeably by the general public, it is important to note that the United States Code distinguishes the terms. Per 49 U.S.C. § 44801, a "*small unmanned aircraft*" means an unmanned aircraft weighing less than 55 pounds, including the weight of anything attached to or carried by the aircraft; an "*unmanned aircraft*" means an aircraft that is operated without the possibility of direct human intervention from within or on the aircraft; and an "*unmanned aircraft system*" means an unmanned aircraft and associated elements (including communication links and the components that control the unmanned aircraft) that are required for the operator to operate safely and efficiently in the national airspace system.[66] Note that the U.S.C. does not define the term "drone."

In addition to defining relevant terms, federal legislation has been working to stay abreast of the quickly growing unmanned aircraft systems (UAS) industry, both commercially and recreationally. Congress enacted the FAA Modernization and Reform Act of 2012, directing the Federal Aviation Administration to develop a comprehensive plan governing the operation of unmanned aircraft systems in the United States.[67] Under this directive, the FAA promulgated 14 C.F.R. part 107, effective August 29, 2016, which applies to the operation, registration, and airman certification for small unmanned aircraft systems within the United States.[68]

In summary, part 107 imposes the following operational limitations for small unmanned aircraft:

- must weigh less than 55 lbs;

- must remain within the visual-line-of-sight (unaided by any device) of the remote pilot, and any person manipulating the flight controls; or alternatively, within the visual-line-of-sight of the visual observer;
- may not operate over any persons (other than those directly participating in its operation), under a covered structure or inside a covered stationary vehicle
- daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting;
- maximum groundspeed of 100 mph;
- maximum altitude of 400 feet above ground level (AGL) or, if higher than 400 feet AGL, remain within 400 feet of a structure;
- minimum weather visibility of 3 miles from control station;
- operations in Class B, C, D and E airspace allowed with the required ATC permission; operations in Class G airspace are allowed without ATC permission;
- no person may act as a remote pilot or a visual observer for more than one unmanned aircraft operation at the same time;
- no operations from a moving aircraft, and no operations from a moving vehicle unless the operation is over a sparsely populated area;
- a person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS;
- external load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft;
- no careless or reckless operations; and
- no carriage of hazardous materials[69]

Several of these restrictions above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver.[70]

In order for a small unmanned aircraft to be compliant with part 107, it must also be registered with the FAA.[71] Registration requires paying a nominal fee and labeling the drone with its registration number; registration is valid for three years.[72] Registering helps to protect public safety in the air and on the ground, aids the FAA in enforcing safety-related requirements for operating UAS, and builds a culture of accountability and responsibility among users operating in U.S. airspace.[73] No state or local UAS law may relieve an owner/operator from complying with the federal UAS registration requirements.[74] Because federal registration is the exclusive means for registering UAS for purposes of operating an aircraft in navigable airspace, no state or local municipality may impose any additional registration requirements on the operation of UAS in navigable airspace without first obtaining FAA approval.[75]

Further, part 107 establishes a pilot certification which requires an individual be at least 16 years old, be able to read/speak/write/understand English, be in physical and mental condition to safely fly, pass the initial aeronautical knowledge and safety exam, and complete a TSA security background check.[76] As the name indicates, the aeronautical knowledge and safety exam is designed to adequately demonstrate an operator's understanding of aeronautical safety and Federal Aviation Administration regulations pertaining to the operation of an unmanned aircraft system in the national airspace system.[77]

Even operators of small unmanned aircraft for recreational purposes must follow the rules in part 107 unless they satisfy all the conditions in the Exception for Limited Recreational Operation of Unmanned Aircraft (Exception), codified in 49 U.S.C. § 44809.[78] (Chapter 448, entitled Unmanned Aircraft Systems, was added to the U.S.C. per the FAA Reauthorization Act of 2018). The Exception for Limited Recreational Operation of Unmanned Aircraft replaced the previous Special Rule for Model Aircraft (Public Law 112-95, section 336).[79]

Per 49 U.S.C. § 44809, the eight statutory conditions to qualify for the Exception are as follows:

(1) The aircraft is flown strictly for recreational purposes.
(2) The aircraft is operated in accordance with or within the programming of a community-based organization's set of safety guidelines that are developed in coordination with the Federal Aviation Administration.
(3) The aircraft is flown within the visual line of sight of the person operating the aircraft or a visual observer co-located and in direct communication with the operator.
(4) The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft.
(5) In Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport, the operator obtains prior authorization from the Administrator or designee before operating and complies with all airspace restrictions and prohibitions.
(6) In Class G airspace, the aircraft is flown from the surface to not more than 400 feet above ground level and complies with all airspace restrictions and prohibitions.
(7) The operator has passed an aeronautical knowledge and safety test and maintains proof of test passage to be made available to the Administrator or law enforcement upon request.
(8) The aircraft is registered and marked in accordance with chapter 441 of this title and proof of registration is made available to the Administrator or a designee of the Administrator or law enforcement upon request.[80]

Per Section 44809, unmanned aircraft operations that do not conform to these eight limitations must comply with all statutes and regulations generally applicable to unmanned aircraft and unmanned aircraft systems.[81]

As outlined above, 14 C.F.R. part 107 and 49 U.S.C. § 44809 provide important regulations for unmanned aircraft usage today, however Congress acknowledges that more are needed. Congress's FAA Reauthorization Act of 2018 contains numerous provisions outlining Congress's plans for development and implementation of *future* programs, regulations and standards relative to unmanned aircraft systems. For instance, the FAA Reauthorization Act of 2018 contains provisions for the following:

- development of a comprehensive plan to safely accelerate the integration of UAS into the national airspace system;
- establishment of a process for accepting safety standards related to the design, production, and modification of small unmanned aircraft;
- formation of a pilot program (entitled "Unmanned Aircraft Systems Integration Pilot Program") to accelerate existing UAS integration plans by working to solve technical, regulatory, and policy challenges;
- development of a comprehensive strategy for identifying and responding to public safety threats posed by unmanned aircraft systems and identifying advantages of using unmanned aircraft systems to enhance local law enforcement; and

- coordination with NASA to develop a plan allowing for the implementation of an unmanned aircraft systems traffic management (UTM) service that would expand operations beyond visual line of sight, has full operational capability, and ensures the safety and security of all aircraft.[82]

In a further effort to address the ever-changing world of unmanned aircrafts and promulgate new rules and regulations relative to these systems, on February 13, 2019, the FAA issued an Advance Notice of Proposed Rulemaking (ANPRM), informing the general public that it was considering additional rulemaking in response to public safety and national security concerns associated with the ongoing integration of unmanned aircraft systems into the national airspace system.[83] In the ANPRM, the FAA acknowledged that as technology continues to improve and new uses for small unmanned aircraft are identified, it anticipates an increased demand for flexibility in operational restrictions under part 107 in that new uses for unmanned aircraft may have public safety and national security risks that have not been anticipated or envisioned.[84] The FAA sought public comment on existing and future operational requirements and limitations contained in part 107 that may be necessary to reduce risks to the public and users of the national airspace system.

Additionally, the FAA recently issued proposed rules on the operation of small unmanned aircraft over people and the safe and secure operation of small unmanned aircraft systems, as well as an interim final rule pertaining to external marking requirements for small unmanned aircraft. All these rules were issued for public comment and the comments are currently under review.[85]

State/Local

In addition to federal laws regarding unmanned aircraft systems, state laws and local ordinances also control unmanned aircraft usage in Illinois. On January 1, 2014, Illinois enacted the Freedom from Drone Surveillance Act, prohibiting a law enforcement agency's use of drones for information gathering other than when the agency's activities fall within one of the statutory exceptions.[86] On August 18, 2015, Illinois enacted the Unmanned Aerial System Oversight Task Force Act, establishing a task force to study and make recommendations for the operation, usage, and regulation of unmanned aircraft systems.[87] The task force submitted its report to former Illinois Governor Bruce Rauner and members of the Illinois Senate and House on June 30, 2016.[88] The Unmanned Aerial System Oversight Task Force Act was later repealed on September 1, 2017.[89]

In August 2018, the Illinois General Assembly enacted Section 42.1, amending the Illinois Aeronautics Act, 620 ILCS 5/1 *et seq*.[90] Presumably to avoid an onslaught of conflicting drone regulations throughout Illinois, Section 42.1 specifically precludes Illinois municipalities (other than Chicago) from regulating "unmanned aircraft systems."[91]

Section 42.1 states as follows:

(a) As used in this Section:

"Unmanned aircraft" means a device used or intended to be used for flight in the air that is operated without the possibility of direct human intervention within or on the device.

"Unmanned aircraft system" means an unmanned aircraft and its associated elements, including communication links and the components that control the unmanned aircraft, that are required for the safe and efficient operation of the unmanned aircraft in the national airspace system.

(b) To the extent that State-level oversight does not conflict with federal laws, rules, or regulations, the regulation of an unmanned aircraft system is an exclusive power and function of the State. No unit of local government, including home rule unit, may enact an ordinance or resolution to regulate unmanned aircraft systems. This Section is a denial and limitation of home rule powers and functions under subsection (h) of Section 6 of Article VII of the Illinois Constitution. This Section does not apply to any local ordinance enacted by a municipality of more than 1,000,000 inhabitants.

(c) Nothing in this Section shall infringe or impede any current right or remedy available under existing State law.

(d) The Department may adopt any rules that it finds appropriate to address the safe and legal operation of unmanned aircraft systems in this State, so that those engaged in the operation of unmanned aircraft systems may so engage with the least possible restriction, consistent with their safety and with the safety and the rights of others, and in compliance with federal rules and regulations.[92]

Although Section 42.1 gives the state the exclusive power to regulate unmanned aircraft system, Illinois has yet to pass such additional regulations.

Approximately three years prior to the enactment of Section 42.1, the City Council of Chicago enacted a comprehensive drone ordinance, making Chicago the first big city to regulate unmanned aircraft systems.[93] (Said ordinance has not been preempted by Section 42.1 due to Chicago's population being nearly 3 million residents). The City Council amended Chapter 10-36 of the Municipal Code of Chicago by adding Article IV (Small Unmanned Aircraft), Section 10-36-400.[94] Although not as detailed as the federal and state legislation passed after Article IV was added to the Municipal Code, it contains similar provisions to part 107 (as discussed above) relative to operating regulations. The Municipal Code also provides for a fine not less than $500 and not more than $5,000 for each violation of this section of the Code.[95]

Artificial Intelligence and Other Advanced Technology Laws

As outlined above, legislation regarding unmanned aircraft systems/drones has already been passed by both federal and state governments and their use is one of the fastest growing technological trends. Similarly, as use of other technological advances (including artificial intelligence) increases, federal and state governments have recognized the need for new legislation, recently proposing laws that outline future regulations and programs for these other technological advances. The following Section highlights proposed federal legislation and recently passed state legislation regarding artificial intelligence and other advanced technologies. As noted above, this legislation does not specifically address use of advanced technologies in the construction industry, however their anticipated impact on the industry is evident based on the broad language of the legislation.

Federal

In September 2018, the Artificial Intelligence (AI) in Government Act of 2018 was introduced in the Senate. According to the AI in Government Act, it seeks to establish an emerging technology policy lab within the General Services Administration to advise and promote the efforts of the federal government in ensuring that the use of emerging technologies by the government, including artificial intelligence, was/is in the best interest of the public and to improve cohesion and competency in federal agency rulemaking in the use of emerging technologies.[96] Additionally, the bill directs the Office of Personnel Management to identify skills necessary for roles related to artificial intelligence and, further, to establish or modify occupational series to include positions that primarily deal with artificial intelligence.[97] Although the initial AI in Government Act of 2018 stalled, the AI in Government Act of 2019 was introduced in the House and Senate, and referred to committees for further consideration in May 2019.[98]

In January 2019, the Artificial Intelligence Job Opportunities and Background Summary Act of 2019 (also known as the AI JOBS Act of 2019), was introduced in the House; it proposes the commissioning of research to evaluate how artificial intelligence will impact the current and future job market.[99] If passed, after one year of the AI JOBS Act's enactment, the Secretary of Labor will report to various committees regarding the industries with the most growth in artificial intelligence use, and individuals who may either experience expanded career opportunities or be vulnerable to career displacement.[100] The Secretary will also provide recommendations relative to alleviating workforce displacement and preparations for a future artificial intelligence workforce.[101] The bill has been referred to the House Committee on Education and Labor.

On April 10, 2019, the Algorithmic Accountability Act of 2019 was proposed to regulate artificial intelligence systems and any "automated decision system" that makes a decision or facilitates human decision-making.[102] The Algorithmic Accountability Act defines the term "automated decision system" as "a computational process, including one derived from machine learning, statistics, or other data processing or artificial intelligence techniques, that makes a decision or facilitates human decision making, that impacts consumers."[103] The Algorithmic Accountability Act proposes an "automated decision system impact assessment," meaning a study evaluating an automated decision system's development process, including the design and training data of the automated decision system, for impacts on accuracy, fairness, bias, discrimination, privacy, and security.[104] The bill has been referred to the House Committee on Energy and Commerce.

In May 2019, the Artificial Intelligence Initiative Act was introduced in the Senate in an effort "to establish a coordinated federal initiative to accelerate research and development on artificial intelligence for the economic and national security of the United States, and for other purposes."[105] As written, the Artificial Intelligence Initiative Act would organize a widespread, coordinated national strategy for developing AI and provide a $2.2 billion federal investment over five years for research and development.[106] If passed, it will create the National Artificial Intelligence Research and Development Initiative for establishing objectives, priorities, and metrics for strategic plans to accelerate development of science and technology applications for artificial intelligence in the United States, as well as establish many other new offices and committees addressing AI issues and concerns.[107] The bill has been referred to the Committee on Commerce, Science and Transportation.

In addition to the above proposed legislation, on February 11, 2019, the President reinforced the United States' commitment to global leadership in advanced technologies by signing Executive Order No. 13859—Maintaining American Leadership in Artificial Intelligence—aiming to solidify the United States as a domestic and global leader in

artificial intelligence.[108] The Executive Order empowers federal agencies to drive breakthroughs in research and development, establishes technological standards to support reliable and trustworthy systems that use artificial intelligence, provides guidance to regulatory approaches, and addresses artificial intelligence issues in the workforce.[109]

State

Like the federal government, Illinois has recognized the need for regulations pertaining to other advanced technologies, in addition to unmanned aircraft systems. For example, the Illinois legislature recently passed the Artificial Intelligence Video Interview Act, imposing restrictions on employers' use of artificial intelligence in hiring practices.[110] In the wake of many U.S. companies using AI "interview bots" in the hiring process to evaluate personal characteristics such as an applicant's facial expression, body language, word choice, and tone of voice through software, the Artificial Intelligence Video Interview Act imposes disclosure and informed consent rules.[111] Specifically, when artificial intelligence is utilized in the hiring process, prior to the interview, employers are required to: (1) notify each applicant in writing that artificial intelligence may be used to analyze facial impressions and consider fitness; (2) provide written explanation of how artificial intelligence analysis technology works and identify personal characteristics to be evaluated; and (3) obtain written consent for use of the technology.[112] The Artificial Intelligence Video Interview Act goes into effect January 1, 2020.[113]

Although not new, Illinois' Biometric Information Privacy Act (BIPA) has received significant attention recently due to the Illinois Supreme Court's decision in *Rosenbach v. Six Flags Entertainment Corporation*.[114] The Illinois Supreme Court reversed the appellate court's decision by ruling that an individual need not allege actual injury or adverse effect, beyond violation of his/her rights under the Illinois Biometric Information Privacy Act, in order to qualify as an "aggrieved" person under BIPA. The *Rosenbach* ruling, by way of entitling a person to seek liquidated damages and injunctive relief, has the potential to significantly impact future legislation regarding the use of advanced technologies.[115]

As new federal and state laws governing advanced technology continue to be proposed and work their way through the legislative process, the scope of these measures remains broad–none are specific to the construction industry; however, as technology advances and the appropriate governmental entities identify areas that need to be regulated, the possibility of industry-specific standards rapidly increases.

Advanced Technology in Common Law

There are a number of cases involving unmanned aircraft systems/drones, and some involving autonomous vehicles and robots, in the federal and state court systems across the country, however most remain in the lower courts. Because these technologies are still being developed, implemented, and understood, these cases involve a wide range of issues pertaining to various industries. Although not directly addressing construction, they provide insight on how the judiciary may decide future cases involving advanced technology in the construction industry context. Several cases that have received attention from the legal industry are highlighted below.

In *Holbrook v. Prodomax Automation Ltd.*, filed in the United States District Court, Western Division of Michigan, the estate of a maintenance technician filed a wrongful death suit after the technician was killed by a robot in her employer's facility; the robot allegedly crushed the technician's head after unexpectedly entering an area where the technician was working at the subject facility.[116] The estate filed suit based on product liability (design defect,

manufacturing defect, breach of implied warranty, and failure to warn), negligence, and *res ipsa loquitor* against the manufacturers and the engineers of the robot.[117] On August 26, 2019, defendant Nachi Robotics (one of the alleged manufacturers of the robot) obtained summary judgment, with the court finding that none of Nachi Robotics' robots/robot products were at the scene of the accident, thus no duty was owed to the deceased. Due to the fact that only limited discovery was conducted prior to the court granting summary judgment, the court ordered that plaintiff may file a motion if discovery leads to any evidence that would support a claim against Nachi Robotics. Further, on September 3, 2019, defendant FANUC Corporation's motion to dismiss for lack of personal jurisdiction was denied. This case remains pending.

In Connecticut's federal district court, *Huerta v. Haughwout* illustrates the FAA's investigative authority over drone usage by private citizens.[118] In *Huerta*, a drone owner uploaded two videos on YouTube—one of a drone firing a handgun and another of a drone with a flame-throwing contraption emitting fire.[119] The district court confirmed that the FAA has authorization to conduct an investigation on its own initiative if it has reasonable grounds (1) to believe that a person is violating FAA regulations, or (2) about any question that may arise under the Federal Aviation Act or the FAA's regulations.[120] Per the district court, Congress empowered the FAA to subpoena witnesses and records related to a matter under investigation as part of the FAA's investigative authority, and if a recipient of an administrative subpoena declines to comply, then the agency may seek judicial enforcement of the subpoena.[121] In particular, the court noted that the FAA's regulatory and enforcement authority derives from 49 U.S.C. § 40103(b) which states, in part:

(1) The Administrator of the Federal Aviation Administration shall develop plans and policy for the use of the navigable airspace and assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace.
(2) The Administrator shall prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes) for . . . (B) protecting individuals and property on the ground.[122]

Pursuant to this authority, the FAA has promulgated safety regulations in 14 C.F.R. § 91.13, stating that "[n]o person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another."[123]

In *Huerta*, the court found that the broad statutory language in 49 U.S.C. § 40103(b) could plausibly include drones in the definition of "aircraft" for purposes of federal law and that there was no dispute that the weaponized devices shown on the YouTube videos at least gave rise to questions about possible danger to life or property.[124] The court held that the FAA had a legitimate purpose to issue subpoenas to investigate these weaponized drones.[125] A significant implication of this ruling is that drone operators may be required to produce records (not limited to the drone's photography and video) in addition to being compelled to answer questions under oath. Accordingly, construction companies utilizing drone technology need to know that courts have found that the FAA has the investigative authority, including issuance of subpoenas to drone operators, if a potential violation of FAA regulations is reasonably suspected.

In *Philadelphia Indemnity Insurance Co., v. Hollycal Production, Inc.*, Hollycal used a drone to take photos at a wedding and, while taking photos, flew low to the ground and struck a guest in the eye.[126] The injured guest required surgery and subsequently lost her eye.[127] The guest filed suit against Hollycal in California's federal district court, asserting general negligence. Philadelphia Indemnity Insurance Company agreed to defend Hollycal, under reservation of rights, including the right to recoup defense expenses and any indemnity paid.[128] Philadelphia then filed a declaratory

action seeking relief from the duty to defend and indemnify, in addition to recoupment of defense and indemnity payments.[129]

Philadelphia asserted that Hollycal's policy specifically excluded bodily injury arising out of the use of an aircraft operated by an insured.[130] California's federal court held that a drone, by ordinary and plain definition, is an "aircraft" and, due to the specific policy exclusion, granted Philadelphia all requested relief.[131] This case is significant–especially for the construction industry–in that it illustrates, as discussed below, the importance for contractors to discuss advanced technology coverage with their insurers to guarantee there are no gaps in coverage; a failure to obtain proper coverage for activities performed on a jobsite could be a multi-million dollar mistake.

In Massachusetts, a federal district court addressed the preemptive effect of FAA regulations on a local city ordinance for the first time in *Singer v. City of Newton.*[132] In *Singer*, plaintiff was an FAA certified small unmanned aircraft pilot (not just a hobbyist) and owned/operated multiple drones in Newton, Massachusetts.[133] The City of Newton is a municipality in the Commonwealth of Massachusetts organized under a charter pursuant to the Home Rule Amendment of the Massachusetts' Constitution.[134] Singer challenged portions of a certain City of Newton ordinance (Ordinance), arguing that the Ordinance was preempted by federal law.

The district court agreed with Singer and held the Ordinance's requirements were preempted by FAA regulations in that they thwarted Congress's and the FAA's objectives to integrate drones into national airspace.[135] Specifically, the court found that the federal registration requirement is the exclusive means for registering unmanned aircraft systems for purposes of operating an aircraft in navigable airspace, no state or local government (including Newton) may impose an additional registration requirement on the operation of an unmanned aircraft system in navigable airspace without first obtaining FAA approval, and Newton did not obtain FAA approval before enacting the Ordinance.[136] Additionally, Newton's restriction against drone use below 400 feet (where the FAA mandated that drone operators keep drones below 400 feet) essentially eliminated any drone use in the confines of the City of Newton, absent prior permission.[137] Further, the Ordinance limited the methods of piloting a drone beyond that which the FAA had already designated, intervening in the FAA's careful regulations of aircraft safety.[138] As construction companies' use of drones increases, knowledge of FAA regulations and local rules/ordinances will be imperative to avoid violations of both.

In *Boggs v. Merideth*, Boggs brought a declaratory judgment action in the United States District Court for the Western District of Kentucky after Merideth (Boggs' neighbor) shot down his drone with a shotgun.[139] Boggs sought a declaratory judgment finding that:

1) an unmanned aircraft is an "aircraft" under federal law; 2) an unmanned aircraft operating in Class G airspace is operating in "navigable airspace" within the exclusive jurisdiction of the United States; 3) Boggs was operating his unmanned aircraft in this navigable airspace in the exclusive jurisdiction of the United States, rather than on Merideth's property; 4) the operating of his unmanned aircraft in this manner did not violate Merideth's reasonable expectation of privacy; and 5) a property owner cannot shoot at an unmanned aircraft operating in navigable airspace within the exclusive jurisdiction of the United States when operating in the manner in which Boggs alleges his unmanned aircraft was operating.[140]

Merideth filed a motion to dismiss for lack of subject matter jurisdiction pursuant to Rule 12(b)(1) of the Federal Rules of Civil Procedure, asserting no federal question was involved. In response, Boggs argued he was flying his unmanned aircraft in the "sovereign navigable airspace of the United States," and therefore resolution of his claims in federal court was

proper.[141] The court disagreed, finding Boggs' claims did not rise to the level of a federal question and therefore the case should be in state court.[142] The court was not persuaded that claims of privilege regarding the airspace, in which Boggs' unmanned aircraft was flying, necessarily raised "a disputed federal issue."[143] Some have speculated Boggs was attempting to set precedent for future drone cases in establishing subject matter jurisdiction in the federal courts, but, if so, such an attempt was unsuccessful.

In *Taylor v. Federal Aviation Association*, one of only a handful of cases in an appellate court regarding unmanned aircraft systems, Taylor (a model aircraft hobbyist) brought an action on behalf of himself and a putative class of all model aircraft owners who paid $5 to register their aircraft with the FAA.[144] Taylor claimed the registration requirement violated the Privacy Act and the Little Tucker Act, and violated his constitutional right of privacy. He also pled the common law tort of unjust enrichment.[145] Taylor demanded that the FAA return the more than $4 million it collected in registration fees and pay over $836 million in statutory penalties.[146] The FAA moved to dismiss the action and the court granted the motion on the basis that Taylor lacked standing.[147]

Specifically, the court found that Taylor did not satisfy the injury-in-fact or redressability elements of standing. Taylor failed to satisfy the injury-in-fact requirement because he did not show the alleged injury was both "concrete and particularized" and "actual or imminent" (*i.e.*, not conjectural or hypothetical), when he alleged only a loss of the use of funds during the period in which the FAA lacked statutory authority to collect registration fees and intangible harm caused by the FAA's unlawful maintenance of his personal information.[148] Regarding redressability, Taylor failed to show the federal court possessed authority to grant the remedies sought; specifically, a refund of his $5 registration fee, compensation for the lost use of the $5 fee, and statutory damages under the Privacy Act as a result of the FAA's alleged unlawful, intentional, and willful conduct. Essentially, the court found it lacked the power to grant these forms of relief.[149]

In the lower state courts, there are numerous cases involving injuries to persons or property damage due to collisions with drones. For example, in *Pituch v. The Perfect Event*, a California college student at USC filed a negligence suit against a fraternity, Pi Kappa Phi, and an event-planning company after a drone hit her head.[150] The lawsuit claims the plaintiff suffers permanent scarring on her head and forehead, and that her ability to focus on school work has been "compromised" due to headaches after the incident.[151] This matter was reportedly settled.

In *Ellis v. Searles Castle* (pending in New Hampshire), a groom was flying a drone at his wedding reception and placed the controller on a table.[152] While the groom was dancing, another wedding guest picked up the drone controller and flew the drone into two other wedding guests.[153] The wedding guests sued the groom and the venue for damages and alleged permanent physical and emotional injury.[154]

In Washington, in *City of Seattle v. Skinner*, a drone operator was flying a drone over a gay pride parade and the drone struck a woman, rendering her unconscious.[155] Skinner was charged and found guilty of reckless endangerment. As a result, Skinner was fined $500 and sentenced to 30 days in jail.[156] This is one of several cases where a local authority has sought criminal charges against a drone operator.

There are also lower court cases involving autonomous vehicles. For instance, *Wood v. State of Arizona*, filed on March 18, 2019 in an Arizona state court, involves an autonomous vehicle designed by Uber Technologies, Inc.[157] The vehicle, while driving autonomously through the streets of Arizona with a distracted "back up" human driver behind the wheel, struck and killed a pedestrian crossing the street. Shortly after the incident, Uber settled with the decedent's family, and almost a year later, Uber was relieved of all criminal liability, most likely due to a lack of proof of any criminal *mens rea*.[158] But after the criminal investigation results became known, the decedent's family filed the March 2019 civil lawsuit against two entities: the state of Arizona and the city of Tempe. The complaint alleges two counts of negligence against

both the state and the city, accusing the political bodies of inadequate oversite of driverless vehicles and a violation of a non-delegable duty to provide reasonably safe roads.[159]

New Liability Issues with Advanced Technology

Although advanced technology is quickly becoming an integral part of the construction industry, it is not a perfect science.[160] Eliminating the human element from all stages of a project–from the initial design process through delivery–may reduce "traditional" liabilities related to human error, but advanced technology comes with its own set of potential liabilities and risks.

Consider the cases highlighted above regarding personal injuries and property damage caused by advanced technologies; it is not hard to imagine injuries caused by drones, robots or autonomous vehicles being the subject of construction-related cases in the near future. Also, consider the complications caused by advanced technologies regarding construction defects. Tracing a construction defect back to its source, with a myriad of potential new sources of the defect due to advanced technology, will make the determination more complicated than ever before. It will be more difficult, time consuming and costly to definitively determine whether the defect was the result of computer error versus human error. The parties will have to assess whether any computer-generated error was the result of a software flaw, improper programming, or user error, among other potential causes. Even software errors experienced while using advanced technology, resulting in freezes or computer system crashes, can result in damages such as loss of work, data, or information. According to Dan Drecoll, global BIM leader at DLR Group, "when the [software] program slows down, crashes or experiences corruption, there is always a risk that something will be lost."[161] Significant damages could result.

Further, as architects, engineers and contractors become more and more comfortable relying on advanced technology, some fear that the amount of time and resources dedicated to their own quality assurance and quality control process (QAQC) may naturally decrease as a result.[162] If industry leaders begin to view the human QAQC process as redundant to an automated process, they may be less inclined to appropriately allocate funds and resources to QAQC or may be willing to eliminate it from the process entirely. In future litigation, investigation may be needed to determine whether the QAQC process by any particular entity or contractor could and/or should have identified the issue/defect prior to the completion of the project.

Given the risk of significant losses, the question quickly becomes who is legally liable for damages caused by advanced technology and what legal theories will be used to assess such liability?

Potential New Parties and New Liability Theories in Construction Claims

It is clear that with the increased use of advanced technology, construction-related litigation may now theoretically include new entities not traditionally named in construction-related cases. Specifically, for technology-related failures, one can envision all entities involved in the digital journey of the construction project being sued under a variety of causes of action, such as:

- Engineers, designers, and/or software programmers that developed the advanced technology;
- Manufacturers of the advanced technology (or any component of the technology);
- Owners of the advanced technology;

- Direct operators of the advanced technology;
- Advanced technology/machine learning specialists overseeing the project;
- Suppliers and vendors of the advanced technology (or any component);
- Lessors and/or lessees of the advanced technological equipment;
- Any entity/individual retained to provide instruction, training, or guidance related to the use of the advanced technology; and
- Any entity that eliminated or under-funded its QAQC department in response to its utilization of advanced technology.

One may even ask—could the artificial intelligence, itself, be held liable for its own actions, including "machine learning?" Indeed, much advanced technology moving into the construction industry involves "machine learning," a branch of artificial intelligence. Computer Scientist and machine learning pioneer, Tom M. Mitchell, defines machine learning as "the study of computer algorithms that allow computer programs to automatically improve through experience."[163]In other words, "machine learning" involves computers that train themselves rather than simply following detailed programs inputted by humans.

With the advent and increased use of machine learning artificial intelligence, consideration must be paid as to whether such advanced technology can and should be held liable for its own conduct.[164] "Once an AI develops a mind of its own, even its creators won't understand why it makes the decisions it makes."[165] When AI is truly autonomous, harm may be caused by conduct so unexpected that it could not be reasonably foreseen by its developer, owner, and/or manufacturer. Under those circumstances, the AI may logically appear the entity most culpable for any resulting damages.

The U.S. legal system, however, does not currently permit litigation against robots, machines, or other AI.[166] In 1984, the United States Court of Appeals for the Third Circuit, in *United States v. Athlone Industries, Inc.*, addressed this issue and specifically found that "robots cannot be sued."[167] Despite 35 years of technological advancements, the legal system remains entrenched in that position. To date, no jurisdiction has recognized any AI as a legal entity capable of being sued.

In addition to potential new parties to litigation, new theories of liability may arise in construction claims due to existing legal theories being insufficient to address the harm alleged when caused by machine learning AI. For instance, the vast majority of construction claims filed in Illinois are brought under Sections 414 and/or 343 of the Second Restatement of Torts, and, in a generic sense, sound in negligence. The legal analysis used in negligence claims to assess liability is "built on legal doctrines that are focused on human conduct, which when applied to AI, may not function."[168]

Black's Law Dictionary defines negligence as "the omission to do something which a reasonable *man*, guided by those considerations which ordinarily regulate the conduct of *human* affairs, would do, or doing something which a prudent and reasonable *man* would not do."[169] What may constitute carelessness or negligence turns on the "prudent and reasonable *man*" standard. Arguably, artificial intelligence is incapable of human shortcomings of the type that are typically at the heart of a negligence claim—such as carelessness, inattention, or failure to exercise due care.

Additionally, if AI conduct was to yield results so unexpected as to prompt legal action, the complex inner workings utilized by the AI to reach said results may be outside the comprehension of even the most tech savvy persons. As such, it is difficult to imagine a human able to determine whether the AI's conduct was in compliance with the applicable standard of care and/or appropriate under the circumstances. Thus, these traditional negligence theories will need to look to the product manufacturers, designers, programmers, and operators for human error, likely resulting in detailed (and costly) discovery.

Due to the anticipated insufficiency of negligence theories for some claims involving advanced technology, many legal scholars predict new, potential liability theories in future litigation. For example, a common enterprise theory of liability has been suggested.[170] Under such theory, all individual persons and entities creating, implementing, and utilizing AI would jointly bear some responsibility for any damages the AI may cause.[171] The system would not attempt to assess degrees of culpability or find fault, recognizing that such a finding "may be impossible because of the black-box nature of AI."[172] The implementation of such a system would require significant oversight to avoid resulting in a windfall to potential claimants since the system would include an "inference of liability" as to all relevant parties "allowing the injured party to be made whole."[173]

Some commentators have also proposed expanding products liability theories against the creators of autonomous robots based on the idea that, if a robot causes harm, this is implicit proof of some defect with the robot.[174] This would likely resemble a strict liability standard—if a robot causes harm, the creator must pay. This approach may make sense in that the creator is in the best position to prevent harm and absorb economic losses stemming from such harm, but it may also go too far in removing any inquiry into human fault for the harm and may stifle innovation with autonomous AI.[175]

Attorney Matthew Wagner, in his article, "*You Can't Sue a Robot: Are Existing Tort Theories Ready for Artificial Intelligence*?" also points to another possible solution in looking to modern workers' compensation schemes.[176] As Wagner notes, "the purpose of workers' compensation laws is to avoid endless litigation over who is at fault when an employee suffers an injury at work."[177] Workers' compensation insurance spreads the risk across all employers, provides remedies for individual workers, and shields individual employers from catastrophic damages.[178] This approach may properly expand into AI use as well.

Other possible theories have also been recognized, including treating robots as chattel or children for legal purposes, or requiring robot creators and/or users to register robots as some variation of a corporate entity.[179] However, each of these theories has downfalls and do not quite cover all aspects of machine learning AI liability issues. As such, it has been suggested that a new synthesis be developed based on the strengths and weaknesses of existing legal theories, much like what was done for corporations in the 19th and 20th centuries; courts attempted to fit corporations into one of the existing folds, but in time the shortcomings of such an approach became apparent and courts and legislators went to work, over many decades, crafting litigation rules for corporations that were attentive to the unique nature and functioning of corporations.[180] This is likely where machine learning AI is headed—toward a new set of legal rules and standards governing liability issues.

Pending cases may also assist in giving some insight into the direction of future litigants and causes of action in liability suits for malfunctions/losses due to autonomous AI. Two cases—purportedly the first of their kind—are currently playing out; both are in their nascent stages though, so only time will tell how useful either of them will be in providing direction for future claims.

The first case, already highlighted above in the Advanced Technology in Common Law section, is *Wood v. State of Arizona*, which involved the autonomous vehicle designed by Uber Technologies, Inc. that struck and killed a pedestrian while autonomously driving with a distracted "back up" human driver.[181] As noted, the case is currently pending against the state of Arizona and the city of Tempe for negligence.[182]

Interestingly, after conducting its own independent investigation into the incident, the National Transportation Safety Board determined that the accident was, in fact, caused by a variety of factors, none of which involved the state of

Arizona's or the city of Tempe's negligence. An article in The Economist Magazine summarized the NTSB's findings as follows:

> The vehicle recognized the pedestrian in the road, but its perception system got confused: it classified her as an unknown object, then as a vehicle and finally as a bicycle, whose path it could not predict. Just 1.3 seconds before impact, the self-driving system realized that emergency braking was needed. But the car's built-in emergency braking system had been disabled, to prevent conflict with the self-driving system; instead a human safety operator in the vehicle is expected to brake when needed. But the safety operator, who had been looking down at the self-driving system's display screen, failed to brake in time.[183]

So, according to the findings, a system-design flaw and human oversight error caused the accident, but nevertheless, because the decedent's family have already settled with Uber Technologies, they now also seek to hold the state of Arizona and the city of Tempe responsible for even allowing autonomous vehicles on the streets. Time will tell about these entities' culpabilities, but regardless, it is fascinating to see where liability for damages caused by artificial intelligence may be assessed, now and in the future.

The second suit, filed in the United Kingdom in May 2019, seeks $23 million in damages allegedly caused by artificial intelligence.[184] The plaintiff, Samathur Li Kin-kan, is suing Tyndaris Investments, a company that utilized a supercomputer called "K1" to manage plaintiff's investment money.[185] The supercomputer engaged in machine learning and studied Internet sources such as news and social networks for forecasting of investment transactions in the United States. Then, based on the information it gathered, it made investment transactions, and continued to study and adjust investment strategies according to its own research.[186] The plaintiff alleges K1 did not perform as promised—the supercomputer lost him over $20 million in a single day.[187]

This case has garnered significant publicity as an opportunity for courts to finally address where liability should fall for decisions made entirely by a machine.[188] However, it is worth noting the actual allegations are against Tynardis' CEO, Raffael Costa, who convinced Li Ki-kan to utilize K1 for investment trading, and the crux of the lawsuit centers around Costa's representations to Ki-kan about K1's money-making abilities.[189] This case has the potential to iron out some liability issues for cases involving damages caused by AI—for example, who is responsible for the losses: Tyndaris as the company selling the product? Costa as the CEO who personally marketed K1's capabilities? K1's software developer or other vendors who contributed to making K1? Li Kin-kan himself for how he utilized K1? However, in the end, the case may only result in a ruling on the limited issues of misrepresentation/false advertising.[190] The case will reportedly proceed to trial in early 2020.[191]

Protecting Clients through Contract and Insurance Coverage

The increased use of advanced technology in the construction industry, and the potential/unknown liabilities involved, make protecting against risk more important than ever for contractors. As any contractor knows, two significant tools in the industry for protecting against risks are contractual indemnity provisions and insurance coverage. However, many may not know that traditional indemnity provisions and insurance policies leave significant gaps in exposure for contractors utilizing advanced technology. Although a full, in-depth discussion on these topics is beyond the scope of

this Article, this Section touches on some important contractual indemnity considerations, as well as some different types of insurance coverage currently available to better protect against some advanced technology related risks.

Contractual Indemnity

Indemnity provisions in construction contracts are limited by statute in most states and thus typically only protect the indemnitee for liability caused by the indemnitor's (or, in general, anyone working for, or on behalf of, the indemnitor) negligence or fault. For example, the AIA standard indemnity provision for a general contractor's subcontract provides indemnification of the owner, contractor, architect, and their agents/employees by the subcontractor; said provision reads, in pertinent part:

> To the fullest extent permitted by law, the Subcontractor shall indemnify and hold harmless the Owner, Contractor, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Subcontractor's Work under this Subcontract, provided that any such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), ***but only to the extent caused by the negligent acts or omissions of the Subcontractor, the Subcontractor's Sub-subcontractors, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable***, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder.[192]

Similarly, the AIA standard indemnity provision in an owner's contract with a general contractor provides indemnity for the owner and architect by the general contractor only to the extent losses were "***caused by*** *the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such [loss] is caused in part by a party indemnified hereunder*."[193]

Even though most advanced technology is designed to make construction sites and the finished project safer, as highlighted above, we know that things can go horribly wrong with the technology and cause significant losses to the indemnitor at no fault of the indemnitee. For example, if a subcontractor uses a bricklaying robot (such as a SAM100) whose software malfunctions, causing the robot to seriously injure workers onsite, the malfunction may not be due to the subcontractor's negligence or fault, but instead the fault of SAM100's manufacturer and/or software programmer.[194] Because the subcontractor was not at fault, under the typical indemnity provision such as § 4.7.1 above, the owner and the general contractor likely would not be contractually protected for such losses, unless they can somehow show the manufacturer or programmer are entities for whose negligent acts the subcontractor should be held liable.

To avoid risk, it is important, if advanced technology is to be utilized—particularly technology that may be inherently dangerous—to steer clear of generalities and carefully craft indemnity language designed for the particular technology that will be used. For example, if a subcontractor intends to employ a SAM100 on a jobsite, the general contractor could consider including a provision in the subcontract whereby the subcontractor agrees to defend and indemnify the general contractor and/or owner from all claims (or alleged claims) and all liability "arising from injury or damage to property or person, caused in any manner by the possession, use or operation of the SAM100 whether or not [subcontractor] was in any way negligent or otherwise at fault in [subcontractor's] possession, use, or operation of the SAM100." If more

than one type of advanced technology will be used by a subcontractor on a jobsite, to avoid repetitive clauses, using the above example, "SAM100" could be replaced with "Advanced Technology as defined in Exhibit A [or as defined in the subcontractor's Scope of Work]." Then Exhibit A (or the subcontractor's Scope of Work) would list all the advanced technology the subcontractor intends to use at the jobsite.

Alternatively, language could be added to an indemnity provision such as § 4.7.1 or § 3.18, cited above, that clearly makes the advanced technology's vendor, manufacturer, programmer, creator, etc. entities for whose acts the subcontractor or contractor utilizing the advanced technology on the jobsite may be liable. For example, a sentence could be added to § 4.7.1 or § 3.18 stating: "[General contractor/Subcontractor] is utilizing Advanced Technology on the jobsite and the Advanced Technology vendor, and any person and/or entity involved in any manner in the sale, creation, design, manufacture or that in any way contributed or contributes to the Advanced Technology's existence or operation shall be included as an individual '*for whose acts [General contractor/Subcontractor] may be liable.*'" In this way, the subcontractor or contractor utilizing the technology can be held responsible for malfunctions of the advanced technology even if the malfunction was not due to their negligence or fault. Of course, with this alternative, "Advanced Technology" must be defined in the contract and/or the contract could include an exhibit (or Scope of Work) attached listing all the advanced technology to be utilized.

For general contractors or subcontractors contracting directly with a technology vendor for the use of advanced technology on a jobsite, such as, for example, a subcontractor purchasing an autonomous equipment upgrade kit, it is important for the contractor to review the vendor contract for the vendor's indemnification requirements. In most cases, these vendor contracts are written in favor of the technology company, and contractors may not fully understand the implications.[195] Many vendors specify they will not indemnify for losses caused by the technology, or they may limit indemnification to the cost of the contract (so if the contract amount is only $5,000, that is all a contractor will be indemnified for in the event of a malfunction), or they specify a flat fee indemnification.[196] If the risks associated with the technology could significantly increase potential exposure, negotiations for amending or expanding these provisions are suggested. In a best case scenario for the contractor, the vendor would be required to indemnify the contractor for all liability arising out of or related to the use of the technology; if full indemnity is not an option, the contractor would do well to attempt to negotiate some form of appropriate indemnity in relation to the associated risks.

Further, costly lawsuits are frequently filed against advanced technology users claiming the technology illegally infringes federal patent rights. A contractor purchasing or utilizing patent infringing technology may be none the wiser, but could nevertheless be subject to liability. Or even if no infringement occurred, the contractor could be on the hook for excessive defense costs in having to defend the infringement claim. In 2015, the *average* all-in cost just to defend a patent infringement lawsuit was $2,000,000 where the amount in dispute was under $10,000,000.[197] To attempt to protect against such risk, a patent indemnity provision should be considered in any contract that involves advanced technology, whether it is a direct contract with the product's vendor for the purchase/use of advanced technology, or a contract with a subcontractor who intends to utilize the advanced technology on the jobsite. A sample patent indemnity clause would read as follows:

> [Technology vendor/Contractor/Subcontractor/etc.] will at its own expense defend any claim brought by others against [Buyer/Owner/Contractor/Subcontractor/etc.] because the sale or use of the [Advanced Technology] or performance of the Work infringes, or is alleged to infringe, directly or contributorily, on IP Rights or is the basis for a claim of unfair competition resulting from similarity in design, trademark, or appearance of goods by reason of

> the sale or use of the Work; and [Technology vendor/Contractor/Subcontractor/etc.] will indemnify and hold [Buyer/Owner/Contractor/Subcontractor/etc.] harmless from any liability of any nature or kind (including advancement of all costs or expenses including attorneys' fees), arising out of any infringement or alleged infringement or claim of unfair competition. In addition, [Technology vendor/Contractor/Subcontractor/etc.] will indemnify and hold [Buyer/Owner/Contractor/Subcontractor/etc.] harmless against, and will pay all awards and damages assessed and all costs of suit adjudged against [Buyer/Owner/Contractor/Subcontractor/etc.] in all such suits or proceedings.

Simply including language similar to the above may significantly reduce a contractor's risk of high exposure in relation to patent infringement claims.

Insurance Coverage

Because of the limitations on indemnity, insurance coverage is even better protection than contractual indemnity for liability risks associated with advanced technology in the construction arena. However, since there is simply not enough data to analyze risks involved with advanced technologies, the insurance industry does not yet offer *comprehensive* policies for advanced technology and artificial intelligence.[198] As advanced technology and artificial intelligence use increases, and regulations and claims evolve, insurers will gain a better understanding of the risks being insured against and be able to underwrite and draft applicable policies for the use of advanced technology in construction. Currently, for much advanced technology use, such as autonomous equipment and wearable technology, piecemeal coverages must be procured; *it is critically important to discuss with an insurer/broker any type of advanced technology intended to be utilized during a construction project to determine what specific coverages are needed to avoid any gaps in coverage*.[199]

There are, however, some specific advanced technology coverages that do exist. For example, drone and robotics coverages are available from some insurers. Below is a brief discussion of these two types of coverages and why contractors utilizing these types of technology should consider their needs and risks relative to these specific policies.

Drone (UAV) Coverage

The use of drones (referred to as unmanned aerial vehicles (UAVs) in many insurance policies) in the construction industry poses several risks, including not only bodily injury and property damage from a malfunction or crash, but also the potential for cyberattacks, invasions of others' privacy rights, and implications involving trade secrets.[200] A separate drone liability policy should be considered because the standard CGL policy may not provide comprehensive coverage, and in many cases provides no coverage, for liability resulting from drone use. For example, as found in the *Hollycal Production* case discussed above, the standard CGL policy excluded coverage for "bodily injury" or "property damage" (Coverage A) caused by a drone "operated by," or "rented or loaned to," any insured because a drone is treated as an "aircraft" and included in the standard aircraft exclusion.[201]

Moreover, the Insurance Services Office, Inc. (ISO) filed standard UAV liability endorsements, effective in 2015, specifically limiting or excluding UAV coverage. These include: (1) CG 21 09 06 15 which removes *all* coverage for liability arising out of the ownership, maintenance, use, or entrustment to others of any UAV;[202] (2) CG 21 10 06 15 which removes coverage for bodily injury and property damage (Coverage A) arising out of the ownership, maintenance,

use, or entrustment to others of any UAV, but still allows coverage for personal and advertising injury (Coverage B);[203] and (3) CG 21 11 06 15 which removes coverage for personal and advertising injury (Coverage B) arising out of the ownership, maintenance, use, or entrustment to others of any UAV.[204]

To ensure coverage for drones in a standard CGL policy, the insured must not only verify that none of the above 2015 drone exclusion endorsements are added, but should also strongly consider adding an endorsement with language that takes drones out of the aircraft exclusion. Such language might look like the following:

SECTION I–COVERAGES
COVERAGE A – BODILY INJURY AND PROPERTY DAMAGE LIABILITY

The following provision (5)(c) is added to exclusion g. Aircraft, Auto or Watercraft:
This exclusion does not apply to:
(5) "Bodily injury" or "property damage" arising out of:
(c) the ownership, maintenance or use of an unmanned aircraft

A contractor can also preserve drone liability Coverage A and/or Coverage B in a standard CGL policy by using one of the ISO schedule endorsements that limit or remove coverage for all UAV except for specifically designated UAV on scheduled operations or projects. These include: (1) CG 24 50 06 15 which removes all coverage for all liability arising out of the ownership, maintenance, use, or entrustment to others of UAV *other than* designated UAV used in conjunction with scheduled operations or projects;[205] (2) CG 24 51 06 15 which removes coverage for "bodily injury" or "property damage" (Coverage A) arising out of the ownership, maintenance, use, or entrustment to others of UAV *other than* designated UAV used in conjunction with scheduled operations or projects;[206] and (3) CG 24 52 06 15 which removes coverage for "personal" and "advertising" injury (Coverage B) arising out of the ownership, maintenance, use, or entrustment to others of UAV *other than* designated UAV used in conjunction with scheduled operations or projects.[207] If any of these endorsements are used, all drones intended to be utilized on the project, as well as the name of the specific project, should be included on the schedule.

Some CGL insurers are willing to cover UAV exposure (through the use of the endorsements outlined above or manuscript endorsements with similar language) for little or no additional premium for companies that use small UAVs to perform tasks that are incidental to the company's revenue-generating operations, but they may require restrictions on the type, size, or usage of the device in some cases.[208] If a contractor plans to utilize several drones, large drones, and/or drones that are critical to the construction project, the most comprehensive coverage option is to purchase a separate drone policy; particularly because drone insurance policies can specifically include coverage for losses arising out of electronic malfunctions or failures of electronic components–something a CGL policy typically does not offer.[209]

Drone policies are usually divided into two parts: (1) liability; and (2) hull damage.[210] Liability coverage typically covers damage and claims by third parties and hull damage coverage covers damage related to the drone itself.[211] A list of potential losses covered under commercial drone insurance includes: loss or damage to the UAV and associated equipment; coverage for aircraft operators, including other non-pilot, on-ground crew; manufacturer product liability; third party legal liability; premises liability; aviation and premises medical payments; fire legal liability; independent contractors liability; personal injury; advertising liability; contractual liability; fellow employee coverage; war, hi-jacking and terrorism; damage to rented premises; and property and office/studio content damage coverage.[212] There are also

"non-owned" drone liability policies for companies that use or hire drones owned and operated by third parties.[213] These policies typically provide much of the same coverages as owner operator policies, minus hull damage coverage.[214]

Finally, it should also be noted that at least one insurance carrier, Verifly, offers a propriety underwriting app that drone operators can install on their phones that allows them to instantaneously purchase drone insurance coverage by the hour.[215] This may be useful to contractors who only intend to use drones for a few hours on a particular project.

Robotics Coverage

As recently as 2013, robotics–defined by many as the branch of advanced technology that works with the design, construction, operation, and application of robots or automated machines[216]–were not insurable beyond standard products liability coverage, unless significant excess costs were expended for specially designed policies.[217] Today, some insurers—though admittedly not many—are offering comprehensive robotics insurance coverages. These robotics insurance policies would likely cover advanced technology products such as SAM100s, TyBots, MULE135s, and robotic exoskeletons. They typically provide general liability, product liability, professional liability, and property liability coverage for such robotics products.[218] Some insurers offer special services for robotics use. For example, American International Group, Inc. (AIG) offers a special service called Robotics Shield which, in AIG's words, provides "end-to-end risk management for the booming robotics industry."[219] This product includes not only robotics-related policies, but also risk management support services and access to a robotics claims team that handles only robotics-related claims.[220]

Cyber Insurance

As the construction industry becomes more connected through internet-connected solutions and remotely accessible systems, it creates more opportunities for hackers to launch cyberattacks.[221] The Department of Homeland Security has already deemed a number of construction-related sectors at risk for cyberattacks, including highway infrastructure, mass transit and passenger rail, and pipeline systems.[222] Construction companies face ever-growing risks to their reputation, finances, continuity of operations, and even to the safety of jobsites and equipment due to hackers.[223]

As just one example, a 2013 Target store data breach, costing Target hundreds of millions of dollars, originated with an HVAC vendor who was responsible for managing "smart" thermostats at Target facilities. The hackers were able to get into Target's network using the HVAC vendor's passwords, and once inside the network, the hackers traversed the connected IT architecture and penetrated Target's payment card information databases.[224] Unfortunately, hackers are growing increasingly sophisticated and are targeting companies in industries like construction, who may mistakenly believe they are safe. Many construction companies likely do not even realize that through the use of advanced technology, they have a wealth of electronic information that may be desirable to hackers, including but not limited to: intellectual property, proprietary assets, architectural drawings and specifications, and building schematics and blueprints.[225] Also, as in the Target example, hackers often go after general contractors and subcontractors as a means to gain access to their clients' networks.[226]

Many losses due to cyberattacks are typically excluded from a standard CGL policy. General liability policies are intended to provide coverage against loss resulting from bodily injury, property damage, and personal and advertising injury, not expenses related to a hacker's breach of a system. Dating back to the *Sony Entertainment*'s case against its

CGL insurer Zurich American in 2011, court rulings have been clear that cyber incidents are rarely among the risks intended to be underwritten by CGL policies.[227]

While cyber liability policies vary, in general, these policies cover losses resulting from data breaches and other cyber events.[228] They can include such first party coverages as losses of or damage to electronic data; loss of business income or extra expenses; cyber extortion losses; notification costs; and reputation damage losses.[229] Third party cyber liability coverages can include: network security liability; network privacy liability; and electronic media liability.[230] Because cyber policies vary significantly, it is important for contractors to discuss with their insurers/brokers the exact cyber coverages necessary for their business. Also, contractors should be aware that often times cyber policies contain requirements the insured must follow related to cybersecurity, such as cyber checks and the installation of certain malware in order to effect coverage. In this age of advanced technology, cyber insurance is increasingly becoming more of a necessity than a luxury for contractors.

Conclusion

As technological advances revolutionize the construction industry, laws will continue to evolve, and new claims and litigants will continue to emerge and develop, resulting in unprecedented change in construction litigation. As the use of advanced technology rises in construction, those in the legal profession will be challenged with protecting clients as legislators work to close the gap between emerging technologies and the laws addressing them. To that end, the information and insight provided herein was an overview of the advanced technological changes occurring now, and those anticipated in the future, in the construction industry. The day when crews of robots, flocks of drones, and fleets of autonomous vehicles control construction sites with no human counterparts may be well into the future, but perhaps not as far as we think.

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