ENVIRONMENTAL BUSINESS JOURNAL®
Strategic Information for a Changing Industry

REPRINT *Emerging Technology & the Environmental Industry* Environmental Business International Inc.

AECOM'S $20-BILLION GLOBAL BUSINESS PLATFORM BEING 'TRANSFORMED' BY EMERGING TECHNOLOGY

AECOM delivers professional services across the project lifecycle – from planning, design and engineering to consulting and construction management. They partner with clients in the public and private sectors. The company conducts transportation, buildings, water, governments, energy and environmental projects. AECOM is a Fortune 500 firm with revenue of approximately $20.2 billion during fiscal year 2019. Their environmental services help industrial and public sector clients around the world balance growth with resiliency – achieving compliance and reducing or eliminating risks while protecting the natural environment. AECOM ranked as #1 environmental firm by Engineering News Record in 2019.

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EBJ: The environmental industry has a reputation for being slow in the adoption of new technologies, do you think we are ready for a technological disruption?

AECOM: In some ways, the environmental industry hasn't been fast to adopt new technology. In other ways, it has been the game changer opening doors for advancing technology. One area where environmental has lagged is in mobile data collection. Why? The industry is very documentation-regulated. Like health care, a large portion of environmental work involves reporting observations. Those observations must be clearly captured and leveraged to look for overall patterns in the subject and the related areas. These observations are used to make million-dollar decisions and are governed by federal procedures and guidelines.

In the past, environmental professionals were anxious about leveraging technology due to apprehension about data loss, field functionality, and legal implications. But mobile technology is mature and accepted by most professions now, including the environmental industry. Regulatory agencies have opened doors by allowing and encouraging technology, not only to increase efficiency, but also to make an impact on working toward drawdown of greenhouse gases by encouraging more sustainable and resilient practices. Industry now expects highly technical solutions to appear in every facet of the work flow to help improve quality, efficiency, and drive better decisions.

As our world population is expected to reach 9.7 Billion by 2050 and more adverse impacts are anticipated from climate change, new and more severe stresses will be placed on our natural resources, freshwater systems and infrastructure that will require innovative technologies to be developed to address these growing issues. From a global perspective, we see tremendous growth opportunities in developing sustainable solutions today that can address these emerging challenges. For example, transforming waste products such as cellulosic municipal waste and agricultural residue into liquid fuel to reduce landfill demands, algae into biofoam to reduce the use of the petroleum based, Ethylene-Vinyl Acetate (EVA) in the footwear industry and municipal biosolids into renewable energy.

EBJ: How is the industry being disrupted now?

AECOM: From the viewpoint of "operational" EHS data, there is increased interest and movement towards better leveraging of the data being collected in the application of robust analysis and moving into the realm of predictive analytics. This data is expensive to collect and process, and clients have a desire to use it for more than just compliance obligations for worker and community protection and as contributions to company's operational excellence. AECOM is supporting our clients on this journey through the establishment of a Data Science Center of Excellence, incorporation of IoT technologies and tools, which allow for higher volume, higher quality data, and identification and adoption of industry leading analytics tools.

In many states, the environmental industry has been submitting documents to regulators/clients electronically for over a decade. Procedures are changing and we've realized federal guidelines aren't hard and fast rules. We see the need to push boundaries and collaborate with agencies when guidelines seem too restrictive to be effective. Regulators are seeing the value in legacy environmental data and realizing the need to collect data in a better, smarter way. We are driving better use of technology for data collection and see the market is disrupting itself. We also see that clients are protective of their data and suspicious of its' use, so this represents a challenge. We recognize that contamination does not

always stop at property boundaries, so we see a real opportunity for improvement despite the challenges.

To aid in permitting, AECOM has been using eDNA in the field. eDNA is a cutting-edge survey tool that offers an affordable and efficient solution to replace labor-and time intensive field surveys to detect the presence of species that are rare or difficult to identify. Regulators have been open to use of this technology for permitting both in Canada and the Western US, and we plan to widen use in the future.

EBJ: What is AECOM's strategic approach for the development and implementation of new and innovative technologies throughout the company?

AECOM: We systematically cultivate innovation internally; use best practices and innovative technologies and tools in project execution; and continuously strive to identify and implement innovative solutions. We have dedicated teams and resources throughout the company to support innovation. AECOM Ventures is a corporate-level group that identifies, funds, and incubates innovative solutions. AECOM Ventures identifies promising opportunities and new technologies for implementation on AECOM's projects. They incubate these projects, working with our businesses to keep AECOM at the leading cusp of industry changes. In addition to AECOM Ventures, Digital Transformation and Innovation groups exist within each of our major geographies that implement technology to transform our business.

The Digital Transformation (DT) teams are focused on developing digital strategy and promoting adoption of transformative digital approaches and tools across the enterprise. AECOM's Digital Transformation initiative has identified technologies that are transforming the infrastructure industry and bringing them to our clients to improve project efficiency and quality, including generative design, artificial intelligence and machine learning, and virtual and augmented reality.

Digital Transformation technologies are also being piloted in collaboration with clients, supporting co-development of bespoke solutions and digital capacity building within client organizations. Finally, our Technical Practice Networks share innovation. The Technical Practice Network (TPN) connects AECOM employees to the right talent, tools and technical resources to excel in project delivery. With more than 19,000 members and 144 Technical Practice Groups, 10 Functional Groups, 51 Tools Channels, and 87 Capability Channels, the TPN is a critical resource for our technical experts.

Launched in 2016, AECOM's Global Challenge provides an opportunity for employees to propose new services and technologies to meet our clients' most pressing and complex issues. Of several hundred ideas from across the world developed each year, the top ideas are selected to receive corporate funding and progress through an accelerator phase to develop a business plan, prototype, and ultimately launch new services and products. Throughout this process, we engage with clients to ensure the solutions are relevant to them and partner with clients on pilot project demonstrations to test feasibility and refine emerging solutions. In addition to the Global Challenge, Mindblazer Challenges are held throughout our business to focus on more immediate innovations (that can be developed in approximately 40 hours). These ideas focus on technical excellence, innovation, and collaboration. The Mindblazer competitions are accelerated innovation competitions that empower our people to solve some of our more complex, or difficult processes and come up with new solutions. We also identify and implement best practices through our collaboration with universities, other technology companies, and research and professional organizations.

EBJ: AECOM is a big company with many business units and a wide variety of service offerings. Which business units are the ones in which you've been able to integrate a greater variety of innovative technologies?

AECOM: We have been able to integrate a variety of innovative technologies across our business, most notably in the transportation, buildings, energy, and environmental space as these business units are being substantially transformed by emerging technologies (connected and automated vehicles, automation, artificial and machine learning) and impacted by pressing market needs (to lower emissions, increase use of renewable energy, and design more resilient and sustainable

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infrastructure). Some examples of the wide variety of innovative solutions we've developed and implemented include:

Mobilitics: Mobilitics, a 2017 Global Challenge winning idea, is a scenario-planning tool designed to help public agencies, private land owners and developers understand long-range transportation and land use planning scenarios – especially related to connected and autonomous vehicles – to help inform policy, design, and investment decisions. By testing multiple scenarios, Mobilitics helps our clients analyze technology changes to highlight opportunities, hedge for risks associated with making transportation improvements in an uncertain future and allows decision-makers to see the impacts of policy, technology, and pricing. The solution, developed entirely in-house, was progressed from concept, through proof of concept to commercialization. It was the first Global Challenge winner to go to market with a free, web-based version and a full version included as part of AECOM transportation planning and forecasting services. The tool is now used by a variety of departments of transportation, planning commissions, state highway departments, and counties.

The Design Anomaly Detector (DAD) tool is one of a range of new tools we are developing to optimize project delivery using recent advances in technology. Developed in partnership with world-leading AI practitioners, the DAD uses machine learning techniques to automatically detect design errors, improving productivity in the design review process. The goal is to progressively reduce the effort and investment required to perform the design review process and enhance results.

Rosetta is our new web-based, strategic energy planning and project delivery platform to develop custom energy strategies to achieve our clients' diverse energy and resilience goals. Through the use of built-in analytics, dynamic gameboards, and report generation, we are able to take our clients anywhere from assessing the implications of an earthquake or EMP on their energy infrastructure to quantifying and sequencing of thousands of energy projects over a 20-year period to achieve carbon neutrality. Rosetta gives our clients access to better data in a way that's easy to understand through some visualizations and gameboards, while cutting our development time by at least 30%. It applies to a wide range of projects, but is particularly suited to those with large, complex energy portfolios such as federal, education and health campuses, or cities and transportation agencies.

EBJ: How is labor automation changing things?

AECOM: New small environmental sensors are increasing in popularity and use. These sensors, with automatic connection to the cloud for near real-time data visualization and data corrections, can increase available data while decreasing labor. The automatic data connection means operators do not need to collect data manually, and automated QA/QC checks (based on user-entered criteria or AI/machine learning) limit needed operator checks. Environmental factors can interfere with small sensor data, and AI/machine learning procedures are slowly decreasing labor-intensive calibration algorithm derivation.

EBJ: How is AECOM's environmental division using the following technologies:

Artificial Intelligence: AECOM is partnering with a Machine Learning/AI company to pilot and implement a system to support compliance assurance by streamlining and automating the process of deconstructing regulations and permits into requirements, saving clients money. This information can then be used to develop compliance calendars and actionable tasks. Successfully pilots have been conducted and full-scale implementation is in progress. AI also allows our subject matter experts more time to focus on more value-added activities such as applicability determinations and transforming regulatory jargon into actionable tasks aligned with the culture of our client organizations. As part of our Impact Assessment work, AECOM is also using advanced signal processing techniques including artificial intelligence algorithms and remote monitoring systems for railway drainage infrastructure.

Augmented Reality: Immersive Technology, Virtual, Augmented and Mixed Reality, is currently used across the spectrum of our work at AECOM. We are finding and implementing new uses for it nearly every day. This technology is proving to be incredibly effective at communication. It helps increase our efficiency and effectiveness at all stages of a project; from design review, to stakeholder outreach, through to on-going operations training.

Block Chain: AECOM does not currently use block chain, but we are looking at it, and following closely to see how it may be useful in our work in the future.

Drones: AECOM is using Unmanned Aerial Vehicles for Environmental Impact Assessment and Disaster Recovery work UAVs are well suited to areas where it is important to be non-disruptive, or where the areas are large, and access may be otherwise difficult. AECOM has used the technology for stack inspections, floodplain mapping, imaging marine turtle nests, surveying and assessing rail lines, roads, bridges, homes and dams after extreme weather events. Another use is to estimate earth work before construction. Drones increase work efficiency, decrease costs, expedite transfer of information and lessen safety risks

Robotics: Primarily, AECOM's role as it relates to robotics has been in auditing the energy control and machine guarding for the robots at client facilities. There has not been widespread use by AECOM to incorporate robotics into our work.

Virtual Reality: AECOM combines industrial safety and oil & gas technical expertise with the rapid advancements in

virtual reality technology to develop custom, fully immersive safety and emergency response training modules to augment our clients' existing safety training curriculum. Early research shows that VR can improve information retention rates and creates a more engaging and impactful safety training delivery platform.

We recently created a full simulation of an actual gas processing plant control room for a multinational O&G company in which we ran emergency scenarios and conducted operator training. One scenario involves simulating a large gas leak in the plant and training on how and when to properly initiate the emergency shutdown and blowdown systems. Operators can walk around the control room and interact with their gauges, alarms and computer screens just like they would in the actual plant. They can also run through the simulations multiple times, creating both mental and physical "muscle memory" as they work through the problems and train on the correct response sequences. The modules throw in periodic "curve balls" that keep the modules from being overly predictable and teach operators the different things that can happen in a given sequence.

We also create **Hazard ID** training modules where trainees walk around a virtual facility or process and must identify hazards of varying kinds that simulate what is likely to be found in their own work environment, and upon identifying them they see a pop-up box with details about the hazard type and how it can be avoided/mitigated.

Another use case of VR involves building fully navigable simulations of new construction projects. AECOM developed a VR model of a new refinery construction project that allowed the client to conduct a virtual walk-through of the design for safety checks, which led to several late design changes as they flagged congested spaces and awkwardly orientated valves that could be changed to increase the safety of the build. The use of VR also allowed the plant operators an opportunity to walk through the new section of the plant and then write more accurate operating procedures and manuals. This technology is just emerging now across the remediation space, but many clients haven't been ready to take on the cost due to what is perceived as limited benefit/clear payoff.

VIRTUAL REALITY FOR DESIGN

The **Visualization Studio** and our use of Immersive Technology help to reduce ambiguity and clarify complex concepts. We simplify data into visualizations that are accessible by our team members, partners, clients and stakeholders. Ultimately, we aid in reaching the full potential of projects by expediting the design process and helping clients see the work from concept to completion. We communicate ideas by engaging the senses and allowing the viewer to be a part of the bigger picture.

Deploying immersive technologies to digitize the traditional design review process is proving to reduce costs for all stakeholders. As the design is being produced in the 3D environment, less CAD time is needed for the design to reach a state where it can be reviewed. Communication between disciplines have improved as even non-technical people are able to understand the design better, making informed decisions at earlier stages and reducing the need for redesign later in the process. Moreover, the immersive nature of using the HoloLens to view designs offers a level of spatial awareness that simply cannot be found through looking at a paper drawing. This level of increased perception at the conceptual design stage enables us to design out potential hazards, before they have the chance to become risks in practice.

Through implementing digital design review enhanced by the use of the HoloLens, communication between disciplines on the project streamlined, understanding of proposed designs by all stakeholders improved, and the time required to carry out design reviews reduced. In short, the DDR process and the tools used to facilitate it, allow us to spend less time creating drawings and content, and more time designing.

Virtual Reality is also being used for Process and Worker Safety. At some sites, VR is being used to help prevent slips, trips and falls. The program helps new employees get a feel for walking in unfamiliar and unusual environments where tripping hazards are common. Users wear a headpiece with goggles, foot and belt sensors and hand-held controllers to talk through the simulations. For visual impacts analysis, VR can be used to provide visualization and improve presentation of data for potentially sensitive locations/projects, presenting alternative proposals.

EBJ: 3D printing started to penetrate the construction industry. Are you using it in any of your environmental projects?

AECOM: We have been using 3D printing across many practices. For our I95 Girard Avenue Reconstruction project, a multi-million-dollar project, we have been leading one of the largest cultural resources efforts in the country. With a database of 32 archaeological sites discovered in the urban setting, AECOM and PennDOT created the I95 Archaeology Center as a space for the public to interact with the artifacts from their own neighborhood. Part of this center includes the use of 3D scanning, printing, and Augmented Reality. We recreated cultural heritage artifacts by 3D printing them and made them available for the public to hold and feel. It's a great way to engage the public by allowing them to see, touch and feel objects from hundreds of thousands of years in the past and allows us to recreate broken artifacts. We have also printed portions of buildings/structures based on archaeological evidence.

In addition to public engagement, the prints are used as a research tool. We use an in-house 3D scanner and 3D printer to constrain costs. Our expert 3D media

designers produce the models and prints. The Reconstruction project has provided a deep engagement with the public that takes them beyond the object behind a museum glass case, and protects real archaeological artifacts from excessive handling. Disadvantages include expert knowledge needed to do it well, requires good 3D models, the prints are not as precise as hand recreations can be, and there are a wide range of 3D scanners and printers so it can be bewildering choosing.

From the remediation side, we have been using 3D printing of conceptual site models that have been helpful for public comments or round table discussions. There has also been some use of 3D printing to model shoreline protection schemes.

EBJ: How do you think the demand for 3D printing in the environmental industry will increase in the future?

AECOM: We imagine use of this technology/application will expand in the future. For this technology and others, we have been getting input from early adopters – tapping into grassroots efforts from our employees who have used the tool before we adopt the technology as a standard.

EBJ: Innovation brings risks to a company. How do you determine which technologies are worth incorporating? How do you measure the risks that could come along with a particular technology?

AECOM: To control or mitigate risk, AECOM has taken an approach that not only reduces risk but adds additional benefits. In our journey of digital transformation and innovation, we have taken the approach of reaching out to our staff throughout the organization and conducting requirements gathering and gap analysis of existing or evolving technologies.

For many years, AECOM staff have pursued leading edge options to better serve our clients. So, by reaching out to them and forming workstreams and centers of excellence we not only reduce risk of adoption by tapping into their lessons learned and best practices, but it also offers an opportunity for wider engagement in the process, higher levels of user adoption and accelerates our ability to identify, adopt and implement at reduced risk.

Another approach to reduce risk is to develop proof of concepts and pilots which allow us to collaborate with educational institutions, government entities, commercial clients and business partners to develop real world use cases and to deploy technologies and innovations in a controlled way at reduced cost and timeline and then to incorporate the findings from these efforts into expanded pilots or full scale implementations at lower risk/cost.

POTENTIAL RISKS OF INNOVATION

AECOM proactively addresses risks associated with new innovations in the solution development process. As part of the Business Plan for new innovations, AECOM conducts a Risk Assessment to identify business risks that could affect the earning potential of a product or service. We evaluate risk from multiple perspectives: market risks related to customers, market size and growth, and sales and distribution channels; product risks related to the product or service offering such as cost, materials, components, design, and technology; competitive risks directly related to competitors and their competing products or services in the market; financial risks associated with the cost and availability of capital and the expected return on investment in funding the development and exploitation of the products or services; legal and IP-related risks including government regulations, federal and state laws, standards and industry rules, and IP owned by third parties; and internal risks relating to internal resources, talent, and capabilities.

In each category, idea teams are required to identify risks and proactive mitigation measures. In addition to this risk register and mitigation identification, we use internal reviews and consultations to minimize risk. If the idea involves introducing new technologies, entering new markets, or performing work in risky markets, AECOM's Office of Risk Management is consulted. Our Legal Department is also consulted for intellectual property considerations or significant contract negotiations.

We then determine which technologies are worth incorporating through a multiphased evaluation and review process that includes input from subject matter experts, our Ventures and Digital Transformation teams, open voting by employees, and evaluations by business and technical leads. Evaluation criteria consider customer demand, market potential, competitive advantage, strategic alignment, feasibility of implementation, leadership support, team capabilities, financial impact, and confidence in financials. Through the evaluation and measuring done as part of the Business Plan and consultation with our technical, business, Risk Management, and legal departments we strive to identify and mitigate risks to the extent possible, and weigh these against potential benefits in order to make informed decisions about which innovations to pursue.

EBJ: What other innovative technologies are you using in each of the following services:

AIR QUALITY CONSULTING AND ENGINEERING

AECOM uses a real-time continuous fenceline air monitoring system and electronic dashboard for refineries. The system includes fixed and portable air monitoring stations and a meteorological system connected to a central on-site computer, which provides real-time alarm notifications via auditory, visual and electronic text/email notifications. Some versions are solar powered, uploading data to the cloud.

Our air quality specialists use a web camera to capture visible emissions for regulatory compliance data collection. The webcam photographs/transmits a view of facility stacks to meet air permit requirements for periodic checks for visible

emissions. We are using a new real-time benzene monitor that uploads data to an online dashboard and automatically generates programmable alerts of high benzene levels.

CLIMATE ADAPTATION

Data Analysis Tools for Assessing Climate Change Vulnerability - Forecasting Local Extremes (FLEx) Tool quickly and efficiently condenses climate-related data to a few key statistics that guide the analysis of local climate projections, facilitating comprehensive local and regional flood planning initiatives. GIS tools are used to graphically depict what future floodplains could look like in different climate scenarios and how it could change over time. AECOM is also using climate data on temperature change and drought to assess water resource availability in a changing climate.

Disaster Resilience Scorecard - Developed jointly with IBM, the Scorecard helps cities understand their ability to withstand and bounce back from disruptive events. It establishes a baseline measurement of a city's current level of disaster resilience and tracks progress against preliminary or detailed indicators. AECOM can support clients through full Scorecard completion or use as the basis of a one- or two-day workshop. The Scorecard was the basis for AECOM's Disaster Resilience Survey tool for Small Businesses that was applied to over 200 small businesses in New Orleans. The Scorecard was also tailored specifically for utilities and was the basis for workshops for a large SE water utility. This approach to disaster resilience could be applied to companies and agencies, as well.

3D Visualization – Photorealistic renderings, 3D computer animations, and virtual reality tools for use as design aides and public outreach materials. These tools can help envision the future of climate change impacts, such as sea level rise, with and without recommended changes.

EHS MANAGEMENT CONSULTING & COMPLIANCE

Web-based Survey Platform. AECOM developed an in-house web-based survey platform using open source software to collect field data including collection of EHS compliance information (inspections) or assessment information. The tool is desktop and mobile friendly with outputs in various formats including Excel, Access, Power BI, and ESRI ArcGIS. The tool allows the flexibility to use the best features of multiple tools and software to fit exact requirements of projects.

Multimedia Assessment Data Collection with Tablets. AECOM is deploying 2 in 1 tablet and laptops for digital data collection during audits/assessments and developed an audit data collection tool. The tool allows the concise repository for audit planning and execution including pre-audit instructions, audit work plan, health and safety requirements, audit protocols/standards, and audit reporting. The tablets allow auditors to take notes by typing, speaking or writing, take photographs, review and markup documents, complete protocols and compile audit reports in an efficient manner.

Virtual Reality (VR) for Training. AECOM has a Visualization and Immersive Technology team that integrates VR into various training modules to effectively integrate VR systems with operational teams. At some sites, VR is being used to help prevent slips, trips and falls. The program helps new employees get a feel for walking in unfamiliar and unusual environments where tripping hazards are common. Users wear a headpiece with goggles, foot and belt sensors and hand-held controllers to talk through the simulations.

EHS Compliance Assurance. AECOM is leading pilots of artificial intelligence (AI) systems to more efficiently and consistently deconstruct permits and regulations, saving clients' money. AI also allows our subject matter experts more time to focus on more value-added activities such as applicability determinations and transforming regulatory jargon into actionable tasks aligned with the culture of our client organizations.

AIM (AECOM Information Management) is AECOM's cloud solution for storing, managing and presenting Environmental, H&S and Sustainability data. The system allows our teams to collect, manage, analyze and report EHS data in a consistent, streamlined and efficient way. Our EHS professionals spend less time processing data and more time identifying systematic compliance issues and developing comprehensive solutions.

AECOM Virtual Analyst. Ava is AECOM's virtual analyst that is currently being tested for use in inspection and assessment programs. Ava utilizes real-time visual and audio communications to facilitate the collection of EHS information at a client site with no travel required or a reduction in the number of assessors required to travel resulting in a significant reduction in travel-related costs and GHG emissions. This attribute allows the onsite team access to 1,000s+ of AECOM technical experts in real time so the appropriate technical expertise is brought to the task.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT AND PERMITTING

AECOM has been implementing eDNA sampling technology in North America for the last several years. It is a groundbreaking sampling and analytical process that reduces bias, provides confidence in proof of absence and offers an affordable and efficient solution to replace labor and time intensive field surveys. This enables field staff and scientists to detect the presence of species that are rare or difficult to identify even under demanding field conditions. By using laboratory-based, cutting-edge, DNA barcoding techniques that identify species-specific DNA sequences, our team can analyze genetic material in samples of water, air, and soil to determine whether the DNA of a target species is present.

Archaeology and Cultural Heritage Predictive Modeling - Predictive modeling to assist in project design, efficient planning and execution of field reconnaissance/site investigation. Involves consideration of multidisciplinary environmental issues, resulting in holistic understanding of archaeological landscapes. Modeling data can include topography, geology, hydrology, known trade routes, landmarks, etc.

3D Visualization - Over 25 years of 3D modeling/rendering experience. Our visualization staff creates and delivers photorealistic renderings, 3D computer animations, and virtual reality tools for use as design aides and public outreach materials. These tools can help a client envision the future of climate change impacts, such as sea level rise, with and without recommended changes.

Immersive Sound Studio - Our sound demonstration tool allows professionals and laymen to compare an environment's original and predicted sound — inside or out, natural or built — to consider the audible impact of development, giving them the ability to reach common ground reliably.

Visual Impact Analysis Using Virtual Reality - VR can be used to provide visualization and improve presentation of data for potentially sensitive locations/projects, presenting alternative proposals.

Data Collection Approach for Site-Specific Remote Groundwater Sensing - AECOM combines data from the GRACE satellite tool that provides data on earth's water balance with recent UAV/drone technology to provide a higher level of resolution and data quality. This combined technology reduces the need for large-scale, expensive and intrusive drilling for geotechnical/hydrogeological design, reducing health and safety risks and costs.

MANAGEMENT INFORMATION SYSTEMS

MIS was the first digitally focused Environmental (EHS) practice. In the past decade, many innovations and digital solutions have been impacting this area as part of Industry 4.0 including: higher volume, automated data collection including tools such as drones, sensors, beacons and digital tags; expanding use of mobile applications and associated tools such as Chatbots/AI; and tools designed to support data analysis and predictive or prescriptive analytics.

REMEDIATION, RESTORATION AND REDEVELOPMENT

AECOM worked with Firmographs this year to collect and analyze Coal Combustion Unit data across the industry into a data-analytics tool called AshMart. The tool provides vital industry data across multiple sites to help entities assess closure risk/approach for environmental liabilities.

AECOM developed a PFAS destruction technology called *DE-FLUORO* that uses a proprietary electrode to mineralize PFAS with evidence of complete defluorination and desulfurization. The technology can be integrated easily with existing primary separation technologies. We are currently in field demonstration phase with the technology.

AECOM's algae harvesting program is a viable and scalable solution that physically removes excessive nutrients from water and simply put, leaves clean water. Recovered algae biomass can be treated with a hydrothermal liquefaction process that can generate fuel and employ algae biofoam as a supplement to reduce the use of ethylene and vinyl acetate in the footwear and foam industries. AECOM's algae harvesting program was effectively used last year to mitigate the algae bloom crisis in the state of Florida.

AECOM is collaborating with an industrial partner to pilot a forensics/fingerprinting technique for DNAPL that uses compound-specific isotope analysis. The targeting of specific remedies based on this fingerprinting strategy reduces overall remediation costs substantially.

For high concentration explosives, AECOM has pioneered the use of a resistive heating process to address challenges associated with heterogeneity in explosive contaminant sizes in soils. Resistive heating of high concentrations of nitroaromatics in soils facilitates subsequent treatment using alkaline hydrolysis.

AECOM is pioneering in situ stabilization on contaminated sediments at a former MGP site. This project, the first full scale application of its kind, involves mixing of stabilization agents and sediment with augers through the water column, and will decrease the likelihood of sediment movement and resuspension, eliminate human and ecological exposure pathways, and result in substantial cost savings relative to conventional technologies.

AECOM developed a patent-pending device that automatically measures and records light nonaqueous phase liquid (LNAPL) thicknesses in wells. The device greatly enhances the physical understanding of LNAPL occurrence, mobility, and recoverability by safely acquiring high-resolution data at a lower cost than manual fluid level measurement.

EBJ: How do you think that technologies will evolve in the near future?

AECOM: Soon, advances in natural language processing (NLP) has the potential to create a sea change with respect to EHS data collection and analysis. Over the past 20-30 years as EHS data has moved from paper to electronic forms and from spreadsheets to databases, there has been the challenge of requiring ever increasing volumes of structured data (validation picklists, checkboxes) in order to report and analyze. NLP combined with tools such as Chatbots would allow staff to record information more naturally, taking less time and effort and therefore less resistance, higher volumes of data collected, with the resulting potential for the identification of commonalities and proactive event triggers, supporting the prevention of adverse EHS incidents.

EBJ: Which technologies do you think we will have available 10 years from now?

AECOM: We expect expansion of technologies already in use. With the record levels of global carbon dioxide already in our atmosphere and climate temperatures forecasted to continue to increase over the next decade, adverse environmental impacts such as harmful algal blooms are predicted to become more frequent, last longer and increase in intensive. To combat these forecasted events, technologies like our algae harvesting program will be needed to not only to mitigate HABs, but to provide a sustainable feedstock for production of liquid biofuel fuels to help reduce our dependency on fossil fuels. Advancement of technologies like, pyrolysis and hydrothermal liquefaction (HTL) that can transform wet biomass and lignocellulosic biomass (Wood, agricultural and forestry waste) into liquid fuels provide the platform that can revolutionize our environmental industry in a positive manner.

EBJ: How does your Innovation Hub work? Which interesting technologies have come out from it?

AECOM: We have several innovation platforms that facilitate the development and sharing of innovative solutions. AECOM's Global Challenge and Mindblazer Challenges are run off from a web-based Spigit platform. This platform enables employees from any part of the company to submit innovative product or service ideas while an innovation challenge is open. Any employee can apply, and their ideas could include co-development with subconsultant contractors or clients. Guidance is provided to participants in several ways, including Challenge webinars explaining the process and highlighting lessons from past successful applicants; in-office live presentations and workshops by Innovation Agents; and an Innovation Playbook that includes access to innovation resources, guidance on developing innovative solutions, ideation resources (innovation workshop, hackathon, and innovation challenge toolkits), and evaluation and implementation materials (business plan template, financial plan template, project plan template).

AECOM also uses a Bloomfire platform to support a Digital Hub for knowledge sharing of digital and innovative products and solutions. This Hub is accessible to AECOM employees with a license and AECOM employees contribute content to it mainly for internal sharing, although some content is approved for external distribution. The Digital Hub includes content on our digital projects, Ventures and Digital Transformation solutions, software and technology, and our technical experts in the digital and innovation space. ¤