The Federal Railroad Administration recently announced that nearly 90 percent of rail agencies tasked with installing critical safety technology by December 2020 will likely meet the mandated and long-awaited deadline. The administration cautioned, however, that “significant work” still is needed to ensure that the technology is properly tested and commissioned before it’s rolled out.

Positive Train Control, or PTC, is a GPS-based technology that helps stop or slow trains before they crash or derail. Following a deadly head-on train crash in California in 2008 that killed 28 and injured 130 more, Congress passed a law requiring larger, Class 1 freight and passenger rail lines to have PTC collision avoidance technology installed before the end of 2015. Congress extended that deadline to 2018, and then 2020, when it became apparent that rail agencies needed more time, but made it clear that the December 2020 date was firm.

Administration chief Ronald Batory reported to Congress in August that “significant progress” had been made, and that PTC has been installed and is now being tested on 50,000 of the nearly 58,000 rail miles where it was required. The announcement was welcome news to lawmakers frustrated over a dozen years of delays and mounting costs.

Just two years ago, the picture didn’t look as rosy, as both commuter and freight rail agencies grappled the best ways to pay for, design, install and test the new technology. “As reliability and stability of PTC systems is still immature, railroads are experiencing significant technical issues with both PTC system hardware and software that often take considerable time to diagnose and resolve, impacting current operations,” Batory told Congress in 2018.

Wayne DeFlaminis, Washington, D.C. director at HKA, an international construction dispute avoidance and resolution firm, agreed that the technology’s complexity and the need for it to be customized from agency to agency has contributed to the delays. “You’re dealing with advanced systems that cover large areas and encompass numerous technologies—there are a lot of moving parts” DeFlaminis said. “While the goal of these PTC systems may be the same across all of the agencies, the scope of work to design and install these systems is not. Each is bespoke in a sense. These aren’t simple, cookie-cutter projects.”

Technology projects can be inherently challenging, said Sid Scott, an HKA partner. “While typical construction projects are linear in nature, with a workflow that is somewhat predictive, IT projects are developmental and iterative, and rarely follow a prescriptive or linear approach,” he explained.

While many rail lines already employed some type of reactive safety technology, such as Automatic Train Control, PTC is a computer-based technology designed to take safe rail operations to the next level. PTC is a more predictive, “smarter” technology. It relies on GPS, wireless radio and other on-board innovations, including on-track transponders in the heavily traveled Northeast, to continuously monitor train’s location and enforce speed. PTC uses that continuous flow of data, along with information from other trains, stations and work areas, to automatically slow or stop the train to avoid crashes, derailments, incursions into work zones, or human error. PTC also knows where civil speed restrictions are imposed, for such things as curves, grades or divergent routing.

PTC’s installation is painstaking, and involves nearly every aspect of rail operations, from locomotives and rail cars to track, signals and communication systems, power, control rooms and maintenance-of-way facilities.
Molding the new technology with legacy systems has been a challenge, said Stephen J. Malaszecki, executive vice president at Envision Consultants, Ltd., a subcontractor on PTC projects in Philadelphia, New York and New Jersey. “Getting new technology to fit—and work well—with existing hardware isn’t easy, and it requires extensive testing to get it right and to pull everything together,” Malaszecki said.

Add in track that is shared by more than one railroad, and the retrofits become even more challenging. “When more than one agency is involved, there are always issues, especially when you’re dealing with track that’s used by both freight and passenger rail, for example,” said Malaszecki, who has nearly 40 years of experience in scheduling and project controls.

Interoperability has been one of the biggest challenges of PTC, said Bill Wiedmann, director of communications and signals at Burns Engineering, which is working with AMTRAK on its PTC initiative. “One system needs to be interoperable with another, which, from an engineering standpoint alone, is difficult. When you add in both sides of the communication factor—the physical connections or links that need to occur, and the need for one agency to communicate with another throughout the process to make the connections work—the task becomes exponentially more difficult,” Wiedmann said.

“Agencies that have been successful have figured out how to put aside concerns over intellectual property and openly share information,” Wiedmann added. “But, you’re dealing with and trying to modify institutional protocols that have been in place for decades. Change takes time.”

Malaszecki agreed. “A detailed, consistently applied communication plan that includes everyone on the project team—internal staff, outside consultants and manufacturers—is incredibly important.”

Procuring equipment and consultants to design, install and commission the technology also has been a challenge, rail agencies have said.

“There were very few engineering firms that were experienced in Positive Train Control when we started,” Wiedmann said. “This lack of experience also caused issues with the availability of parts, and with the availability of skilled technicians who understand the hardware and software, and how to make it all work,” Malaszecki added.

Some rail agencies are handling most of the work in-house. Others are choosing to hire from a relatively small pool of experienced manufacturers, engineers and IT consultants. Either way, keeping up with the technology’s near-constant evolution is paramount, Scott added.

“The technology keeps evolving. The software, for example, has been updated some 15 times over the past few years,” he said.

Each time the software is updated, it must undergo testing to ensuring that it is fully vetted and meets stringent safety requirements. Agencies have complained that the intricate, multi-step installation and rigorous testing—which requires taking cars out of service—is disrupting schedules and revenue streams, and forcing unhappy passengers to deal with months or years of overcrowding and delays.

The Southeastern Pennsylvania Transportation Authority (SEPTA) in Philadelphia was one of only a handful of U.S. rail agencies to operate all of its trains with PTC ahead of the federal deadline. All SEPTA regional rail trains, operating in both SEPTA and AMTRAK territory, were PTC-compliant as of May 1, 2017. SEPTA is the nation’s sixth-largest transit agency, with a daily ridership of more than one million, serving Philadelphia and its five surrounding counties. Regional rail service extends as far north as Trenton, New Jersey and as far south as Newark, Delaware. SEPTA also is one of only two U.S. transit agencies to operate all five types of on-land transit vehicles: regional commuter trains, heavy rapid transit (subway/elevated) trains, light rail vehicles (trolleys), trolleybuses and motorbuses.

“Completing the installation of PTC for a system as complex and widespread as SEPTA was, and continues to be, a hard and challenging project,” a SEPTA spokesperson said. “First it required significant changes to four individual systems—signals, communications, vehicles, and the control center—and then involved the full integration each of these components to function in perfect unison.”

SEPTA General Manager Jeffrey D. Knueppel, P.E., who rose through SEPTA’s ranks to lead the agency, said that early planning was essential. “We got a wake-up call in 2006. We had an accident, and it was a head-on collision. We had some Automatic Train Control systems in place at SEPTA, but not uniformly. Even though [the collision] was at low speed and there were no fatalities, it was still very upsetting,” Knueppel said. “So, we started an in-house program of installing ATC on all of the lines where we didn’t have it. That [decision] really helped us get a jump on this.”

SEPTA established an in-house department to plan and manage the work, installed ATC on its Warminster Line, and then systematically applied the technology and lessons learned to all of its branch lines.

“When we got the mandate in 2008, we doubled our workforce to handle two branch lines at a time,” Knueppel said. “But, really, we had started well before that. We decided that we weren’t going to put Automatic Train Control on a layout that was inefficient and not helpful to our operation. So, at the same time we were installing Automatic Train Control, we added additional interlockings, passing sidings, and other improvements.”

While SEPTA’s in-house team handled necessary signals upgrades and fiber optic cable installation, the agency hired a consultant to handle the technology. SEPTA also made the pivotal decision to use the same advanced collision prevention technology as AMTRAK. AMTRAK already was installing an Advanced Civil Speed Enforcement System (ACSES) as an overlay to its existing ATC system, which accomplishes
the goal of PTC and satisfies the federal mandate. "ACSES plus ATC equals PTC," Knueppel explained.

"Forty-seven percent of our trains run on AMTRAK at some point on their trips. For us to do anything else other than ACSES, what AMTRAK was using, just didn't make sense," Knueppel said.

Knueppel also credits the SEPTA board of directors for being willing to push ahead with the work without fully knowing how it was going to be financed. "The SEPTA board's support was phenomenal," Knueppel said. "[Our success] was due in large part to the board's commitment, even during a time of historically low capital funding, to make PTC a priority."

"At the time, we had a $5 billion-dollar backlog of state of good repair [work], with historically low capital funding, down to around $300 million. Most agencies of SEPTA's size back then were about $1 billion in capital funding per year, so we were really running on fumes," he explained. "Making this a priority, putting all of our eggs in one basket so to speak, wasn't easy, but it was necessary, and the board recognized that."

Knueppel also asked the board to approve organizational changes to facilitate progress, collaboration and communication work. In 2012, when much of SEPTA's prep work was done and its contractor, Ansaldo STS (now Hitachi Rail Systems), was ready to begin ACSES installation, the board granted Knueppel's request to become deputy general manager. The move from assistant general manager of Engineering, Maintenance and Construction/chief engineer to deputy general manager gave him more clout to push PTC ahead. Knueppel then tapped long-time SEPTA colleague Mike Monastero, head of signals and communications, to be a single point of contact for the ACSES work. "So, Ansaldo dealt with one person—Mike—and he had the power to do whatever he needed to do to facilitate the work."

If Mike said, 'I need more test trains,' for example, that was what happened," Knueppel continued. "Mike was boots on the ground, and I was there making sure everything worked for him."

The organizational structure and agency-wide support for the program was especially helpful during testing, Knueppel said. "It was tough. At times, we had 10 cars or more out of service to install the ACSES equipment. We had test trains running continually and, at times, we had engineer shortages like other railroads. Also, our control center wasn't happy because our updated computerized train control system had to be upgraded with PTC, and it was challenging."

Testing was aided by an innovative, ad-hoc test track put in place and built at its rail yard at Frazer Yard in Chester County. "We built a test track early on so our vendors and staff could see what worked and what didn't... if the software worked in 'real-life' situations before the cars went out onto the main line," Knueppel explained. "Doing that took away a lot of the uncertainty and the 'freak-out' factor, and allowed us to make necessary tweaks more efficiently."

Keeping the PTC cut-over process moving during a crisis with Silverliner V rail cars—roughly a third of the total regional rail fleet—was one of his most difficult decisions, Knueppel said. The impacts to customers were considerable during this time. Knueppel credits SEPTA Board Chairman with keeping attention focused on the long game, which was safety.

Challenges often lead to resistance within an organization, slowing projects even further, Knueppel said. Getting organization-wide support, and rallying that support during tough times, was essential. "We sat down and figured out how to make things happen even if there was some pain, he said.

Such buy-in is crucial, especially if it's cultivated early, Malaszecki added. "You have to sit down and come up with a mutually derived plan that works for everyone, especially on projects that involve technology," he said.

Even earlier, lean times were ironically beneficial. "We already knew how to do more with less," Knueppel said.

Remarkably, there were few personnel changes on the PTC project team, and the familiarity kept relationships strong and communication flowing. Convenient access to AMTRAK's body of knowledge also helped. SEPTA shares lines and facilities with AMTRAK in and around Philadelphia, and the city is a major AMTRAK hub. "AMTRAK engineering has done PTC before, and they're right here. So, it was easy to ask questions and to learn from them," Knueppel said.

"AMTRAK facilitated the testing of our trains on its already-operational system," Knueppel said. "We were able to in-service three lines that run on AMTRAK in one weekend, because we had done so much testing."

SEPTA also proactively purchased the radio bandwidth and dedicated frequencies it would need later on. Wiedmann said, PTC systems rely on radio frequency bandwidth and a dedicated, ground-based network to handle communications.

"As soon as the federal mandate came out, SEPTA bought the bandwidth and frequencies it needed to make it happen. SEPTA was way out ahead on that," Wiedmann said. "A lot of other agencies didn't take that first step. Then, when they went to acquire the bandwidth they needed, it either wasn't available or it was extremely expensive."

SEPTA's early dive into PTC also kept the agency out of the FRA spotlight, and the agency has passed lessons learned on to peer agencies throughout the country.

Those lessons also will inform future technology projects, all five executives said. "PTC is really the first wave of a technological revolution in the rail industry," Wiedmann said. "We're at the beginning of a massive overhaul of traditional signaling as we know it. The systems will continue to get smarter and smarter as wireless improves and technology continues to evolve."

"I tell my staff all of the time, 'If you're not in front of the wave, you're behind it,'" Wiedmann continued. "Technology doesn't evolve in a linear progression, and innovations are coming faster and faster. We need to keep up."

To catch that wave, and to be able to navigate around technology's inherent complexities and challenges, industry engineers and consultants need to build flexibility into their approach from the outset, and renew their commitment to flexibility as work progresses.

"It all starts with ensuring your contracts are clear, and that you've tied each milestone to a specific completion date," Scott said. "It's also a good idea to use and routinely update an accurate Critical Path Method schedule, and actively use that schedule to manage the work."

Maintaining accurate records and documenting agreements and decisions in writing also helps, Scott added.

Knueppel agreed that the lessons his team learned on PTC will be invaluable as SEPTA moves forward. "PTC gave us an opportunity to make things better, not just in terms of PTC, but also in terms of reliability and operational flexibility through the addition of new crossovers and passing sidings," he said. "Those improvements will be invaluable as SEPTA continues to grow and serve increasing numbers of passengers in the years ahead."

Knueppel is careful to credit his staff and larger project team of suppliers, designers for SEPTA's success. Many members of the project team, including Ansaldo STS and Burns Engineering, are now helping the Massachusetts Bay Transportation Authority complete its PTC work, Knueppel added.

"We were fortunate to work with some really talented, experienced people, and we had top-to-bottom support," he said. "Our train crews were also supportive and helpful during our change-over to PTC operations—a huge benefit to our efforts."

Knueppel is uncomfortable talking about his own role in SEPTA's PTC success.

He does admit that he's rarely dissuaded when he feels strongly about something, and was determined to make SEPTA's PTC program a success.

"Have you met me? I approach projects like an Army general," he said with a laugh. "But, really, it was really all about working together. I was there to put the battle plan in place, and then Mike [Monastero] would run through with his forces and take us to victory. I was just there to make that happen."

By Tricia M. McCunney