AEM
Association of Equipment Manufacturers

The Future of Automation & Autonomy



11 Trends Reshaping Farms and Jobsites

AEM FUTURES COUNCIL

Nov. 9, 2026

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Executive Framing: The Age of Intelligent Work

Every technological era changes the relationship between people and work.

Steam multiplied strength.
Electrification multiplied reach.
Computing multiplied information.
Automation and autonomy will multiply judgment, precision, and coordination across the farm and job site.

The future of automation and autonomy will be practical, uneven, and use-case driven. The next five to 10 years will not bring a single moment when farms or construction sites become "fully autonomous." The future will arrive in layers. Some tasks will become nearly unsupervised. Others will remain deeply human. Most will sit in between, with machines assuming more responsibility for execution while people retain responsibility for intent, oversight, safety, exceptions, and business judgment. Highly repetitive, structured, and labor-constrained tasks will move first, while more dynamic or consequential tasks may become more automated. *However, they will ultimately remain in the hands of a person.*

The operating model will increasingly shift from one person operating one machine to one person supervising multiple machines, supported by AI-enabled planning, diagnostics, dispatch, and decision support. **This will not eliminate the human role**. It will move human value toward judgment, supervision, exception handling, maintenance, logistics, safety verification, customer/animal/workforce management, and business strategy.

"The operating model will increasingly shift from one person operating one machine to one person supervising multiple machines, supported by AI-enabled planning, diagnostics, dispatch, and decision support. This will not eliminate the human role."

Artificial intelligence (AI) and data will become the intelligence layer of the autonomous ecosystem. Machines will not simply execute programmed tasks. They will increasingly rely on data from prior operations, real-time conditions, sensors, fleet performance, maintenance history, and operational objectives. Over time, AI may enable machines to diagnose system health, recommend safe overrides, coordinate fleets, and adjust to changing conditions. But this also raises questions about validation, certification, explainability, data ownership, cybersecurity, and liability.

Autonomy will scale when it is treated less as a replacement for people and more as an architecture for getting essential work done with fewer constraints. The best farms and job sites of 2035 will not be those without people. They will be those where human expertise is amplified by connected machines, trusted data, reliable support, and shared rules of the road.

Automation and autonomy will reshape how work gets done, but the path will vary by use case, sector, geography, workforce readiness, safety expectations, and levels of interoperability. The industry should

not treat autonomy as a linear march from Level 0 to Level 5. Instead, machines, operators, dealers, software providers, and end users will operate across multiple levels at the same time depending on task, environment, risk profile, and business value.

The Future State: What Jobsites and Farms Could Look Like

In agriculture, the future will vary significantly by production system. Dairy provides one of the clearest early pictures of operational autonomy. A modern dairy farm will increasingly operate as a connected ecosystem of animals, robots, sensors, feeding systems, environmental controls, and farm-management software. Routine milking, feeding, manure handling, and monitoring activities will become increasingly automated, while farm managers spend more time on strategy, animal welfare, sustainability, labor management, and business performance.

In row-crop and specialty-crop agriculture, the future will likely be a mixed model. Some tasks will become highly automated or autonomous within defined operating domains, while other parts of the operation will still require human judgment and logistics. A central supervisor may dispatch equipment, monitor field status, coordinate support, manage refueling and resupply, respond to weather and machine alerts, and approve AI-generated plans. The ability to move equipment between fields, operate on public roads, coordinate tenders, and manage mixed fleets will remain a major constraint.

In construction, autonomy will also advance by task rather than by entire jobsite. Highly repetitive or controlled applications such as soil compaction, rolling, repetitive grading, commercial mowing, solar-site work, and certain material-handling applications are likely to move faster. Dynamic tasks with many edge cases, changing site conditions, and dense human activity will remain human-augmented. Operators may spend less time in cabs and more time supervising, validating, and coordinating work from a vehicle, command center, or mobile interface.

“Advanced automation and autonomy will create a layered operating model: machines perform more of the work; AI systems support planning and optimization; humans supervise, approve, maintain, verify, and intervene; dealers and technicians become more central to uptime.minate the human role.”

Across sectors, advanced automation and autonomy will create a layered operating model: *machines perform more of the work; AI systems support planning and optimization; humans supervise, approve, maintain, verify, and intervene; dealers and technicians become more central to uptime.*

The Farm as an Operating System

By 2035, more farms will be managed less as collections of equipment and more as operating systems. The day will begin with objectives, not instructions. A grower or farm manager may set the mission: finish planting before a weather window closes, rebalance feed delivery, or map out the most ideal application path.

This future is grounded in the reality of U.S. agriculture today. The 2022 Census of Agriculture counted 1.9 million farms and ranches operating 880 million acres, with the average farm increasing to 463 acres even as the total number of farms declined 7% from 2017. The same release reported that U.S. farms and ranches produced $543 billion in agricultural products in 2022.

Scale, labor scarcity, narrow weather windows, and operating margins will make automation more than a "nice to have." It will become an operating necessity. The average U.S. farm producer is 58.1 years old, and the number of producers age 65 or older increased 12.1% between 2017 and 2022. Autonomy will not solve succession, but it can help remaining operators do more with limited people, limited time, and increasingly complex decisions.



The first visible layer of this future is already here: guidance, section control, machine analytics, variable rate technologies, robotic milking, automated feeding, crop sensing, and automated spot treatment. USDA Economic Research Service found that automated guidance was used on well over 50% of acreage planted to corn, cotton, rice, sorghum, soybeans, and winter wheat. Other digital tools remain unevenly adopted, but the pattern is clear: once technology reduces fatigue, improves precision, and creates return, it becomes part of the operating baseline.

The farm of the early 2030s will likely include several layers of both automation and autonomy. Dairy, livestock, and enclosed or repeatable production systems will continue to show what an operating ecosystem can look like. Field agriculture will scale more selectively: autonomous tillage, spraying, mowing, mapping, and scouting will advance faster than tasks requiring complex field-to-field logistics, public-road travel, or nuanced human judgment. The human will remain central, but increasingly as mission commander rather than machine operator.

The transition is not from "operator" to "no operator." It is from task automation toward supervised operational autonomy, and from single-machine capability toward fleet coordination, data integration, and AI-assisted supervision.

The Jobsite as a Coordinated Work System

The construction job site of 2035 will not be universally autonomous. It will be selectively autonomous with high levels of automation in between. The difference will not be philosophical; it will be operational. Autonomy thrives where the variables are bounded. The industry's most practical deployments will occur where the work is repetitive, the operating domain is known, the economic value is clear, and the safety case can be demonstrated.



Construction needs this productivity lever. Associated Builders and Contractors estimated that the U.S. construction industry needs 349,000 net new workers in 2026 and 456,000 in 2027 to meet demand, and its model converts additional construction spending into labor demand at roughly 3,450 jobs per $1 billion in additional construction spending.

This labor pressure exists inside a sector where productivity gains have been stubborn. McKinsey observed that U.S. construction productivity barely changed from 1947 to 2010, while manufacturing productivity increased by more than a factor of eight and agriculture by more than a factor of sixteen over the same period.

The autonomous jobsite will therefore be a coordination story. A supervisor may sit in a pickup, side-by-side, trailer, or remote command center with real-time visibility into multiple machines. The supervisor will see task status, machine health, fuel or charge state, geofence compliance, productivity, and exceptions. In this future, there is one supervising human connected to multiple machines and noted deployments where one operator managed up to eight machines.

Safety will be an equally important driver. Fatality data should not be used simplistically to claim autonomy is automatically safer, but it does establish the stakes. The Bureau of Labor Statistics (BLS) reported 1,032 fatalities among construction and extraction workers in 2024, including 370 fatal falls, slips, and trips. Autonomous and automated systems that can remove people from high-risk zones, improve awareness, prevent collision, or reduce repetitive exposure will have a public-interest case as well as a business case.

The job site of 2035 will look less like a science-fiction landscape and more like a coordinated industrial system:

- Fewer blind spots
- More digital planning
- More machine-to-machine communication
- More human attention focused on the decisions machines should not make alone

11 Trends Reshaping Automation and Autonomy

The future of automation and autonomy will not be defined by a single breakthrough technology, a universal adoption timeline, or a sudden transition to fully autonomous farms and jobsites. Instead, it will emerge through a series of interconnected trends that, together, are reshaping how work is planned, executed, supported, and managed across the non-road equipment ecosystem.



Some of these trends are technological, such as advances in AI, connectivity, and machine intelligence. Others are operational, including shifts in workforce roles, equipment lifecycle management, and new business models. Still others are social and institutional, encompassing public trust, safety expectations, interoperability requirements, workforce readiness, and the industry's ability to develop common language and shared standards. These forces are not evolving independently. They are converging to create a future in which machines, software, data, and people work together in fundamentally different ways than they do today.

Importantly, these trends should not be viewed as predictions of a single future. Adoption will vary by application, operating environment, economics, customer readiness, and regional factors. Some sectors' end use cases will advance rapidly, while others will remain heavily dependent on direct human involvement for years to come. What is consistent across all scenarios, however, is the direction of travel: toward greater automation, more connected systems, higher levels of machine intelligence, and new models of human-machine collaboration.

1. The shift from task automation to operational autonomy

The industry is moving from automating individual functions toward machines and systems that can complete defined jobs inside specific operating conditions. For much of the past two decades, automation in agriculture and construction has largely meant improving the performance of a single task: steering straighter, applying inputs more precisely, maintaining grade, detecting an obstacle, reducing operator fatigue, or improving repeatability. Those functions created real value, but they still largely assumed that humans remained the primary coordinators of the work.

The next phase will be different. The defining shift will be from task automation to operational autonomy, not simply asking whether a machine can automate one function, but whether it can complete a meaningful portion of the job with less direct human control.

This transition will not happen uniformly. Many machines will continue to move fluidly between levels of automation and autonomy depending on the task, environment, supervision model, and risk profile. A machine may operate autonomously in a geofenced field but require human control for transport. A jobsite machine may be highly automated during repetitive grading but human-directed around other trades or changing site conditions. The future will not be a simple march from Level 0 to Level 5; it will be a layered operating model in which machines take on more responsibility where the job is clear and conditions are bounded.

This is why the industry should avoid framing autonomy as an all-or-nothing destination. The more important question is not whether every machine becomes fully autonomous. It is which tasks can be reliably completed with less direct human control while maintaining safety, trust, productivity, and customer

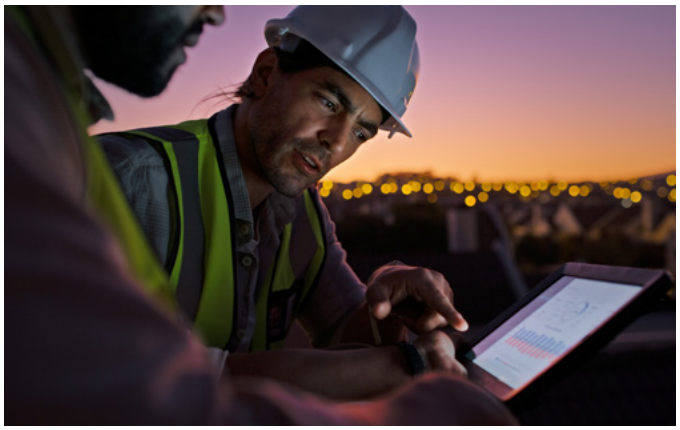
value. That distinction matters because it gives the industry a practical adoption roadmap. It allows companies to talk about autonomy in terms of use cases, operating domains, customer outcomes, and readiness rather than abstract levels alone.

The future is not simply about predicting when a machine reaches a certain autonomy level, but about identifying where autonomy creates value, what barriers must be addressed, and how the industry can prepare customers, dealers, regulators, and the public for that transition.

2. Human-in-the-loop becomes the dominant near-term model

In the next five to 10 years, most agriculture and construction operations will still involve people. The difference is that people will increasingly work around, above, and alongside autonomous systems rather than only operating machines directly. The operator's role will not disappear; it will evolve into supervision, mission planning, exception handling, maintenance coordination, safety validation, and decision approval.

This human-in-the-loop model is likely to become the dominant near-term pathway because agriculture and construction environments are complex, variable, and high consequence. Farms operate across changing weather, soil conditions, crop stages, field boundaries, roadways, and input logistics. Jobsites involve changing terrain, multiple trades, temporary hazards, material movement, and dense human activity. These are not controlled factory floors. They are dynamic environments where autonomy can create tremendous value, but where human judgment will remain essential.



It may be where a person may no longer be in and out of a cab all day but rather connected to the workflow through a command center, vehicle, pickup, side-by-side, or mobile interface. That person would have visibility into machines under their purview, monitor performance in near real time, and respond to edge cases such as maintenance needs, refueling, unexpected obstacles, or changes in work priorities.

This model changes the unit of productivity. Today, productivity is often measured by what one operator can do with one machine. Tomorrow, it may be measured by how effectively one person can supervise a coordinated set of machines, supported by AI, fleet software, machine health data, and remote diagnostics. That is a significant shift for manufacturers, dealers, contractors, farmers, and workforce-development partners.

A human-in-the-loop future also gives the industry a more credible public narrative. It avoids the false choice between "people or machines" and instead emphasizes human capability multiplied by technology. This will matter for customers who are concerned about reliability, for workers who are concerned about job displacement, for regulators who are concerned about safety, and for policymakers who are trying to understand how autonomy fits into essential industries.

The near-term opportunity, therefore, is not to remove people from the system. It is to place people where their judgment creates the most value.

3. Adoption will be task-specific, not sector-wide

The future of autonomy on farms and jobsites will not unfold evenly across agriculture or construction. It will move first where the task is repetitive, the operating domain is controlled, the labor challenge is acute, the economic return is clear, and the safety case can be demonstrated. This means the industry should resist talking about autonomy as if "agriculture" or "construction" will adopt it all at once. The more useful lens is task by task.

In agriculture, dairy robotics, automated feeding, robotic milking, selected tillage, machine guidance, crop scouting, targeted application, and certain mowing or vegetation-management tasks have clearer near-term pathways. These uses tend to involve repeatable actions, defined spaces, or measurable outcomes. In construction, commercial mowing, solar-site work, soil compaction, rolling, repetitive grading, and certain material movement applications may advance faster for similar reasons. These tasks offer autonomy a more manageable operating domain and often provide a direct return through labor savings, consistency, safety, or utilization.

By contrast, complex excavation, foundation work, construction framing, multi-purpose equipment use, public-road movement, highly variable specialty-crop operations, strategic farm-management decisions, animal-health decisions, and mixed human-machine work zones will remain more human-augmented over the next five to 10 years. These tasks involve more nuance, greater contextual judgment, and higher variability. They may become increasingly automated, but they are less likely to become unsupervised quickly.

This task-specific adoption model aligns with broader automation research. McKinsey has noted that fewer than 5% of occupations can be fully automated with demonstrated technologies, while about 60% of occupations have at least 30% of activities that could be automated. That distinction is crucial: autonomy will often automate activities within jobs before it automates whole jobs.

The industry should therefore build its roadmap around use-case readiness rather than sector labels. The most important questions become:

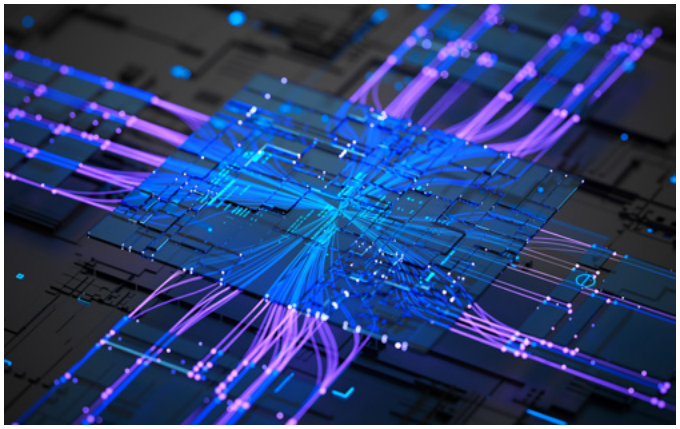
- Is the task repetitive or dynamic?
- Is the environment controlled or variable?
- Is the equipment supervised or unsupervised?
- Is the value proposition clear?
- Is the support model ready?
- Is the safety case explainable?
- Is the customer prepared to trust the system?

4. AI becomes the intelligence layer of automated work

AI will increasingly become the intelligence layer that connects machines, data, people, and decisions. Earlier generations of automation were largely deterministic: a machine followed rules, executed a

programmed path, maintained a grade, or responded to a specific input. Future systems will increasingly use AI to interpret context, recommend action, prioritize work, optimize resources, support diagnostics, and coordinate machines across fleets.

In the near term, AI is likely to support decision-making rather than replace it. It may help a farm manager decide which field to prioritize before a storm, recommend a machine dispatch plan based on soil conditions and equipment availability, flag a maintenance issue before downtime occurs, or help a jobsite supervisor sequence machines more efficiently. Over time, AI may coordinate multiple machines around a defined mission: move material, prepare a field, maintain a property, compact a site, or optimize a repeated field operation.



AI will become a system that may one day sit alongside the supervising operator, helping that person choose the most efficient course of action based on past and real-time data.

This shift will be especially important because the agriculture and construction industries already generate far more data than many users can interpret manually. Yield maps, as-planted maps, machine telemetry, soil data, weather information, jobsite models, maintenance logs, and performance histories can overwhelm decision-makers. AI's promise is not simply to create more data. It is to convert data into recommendations, prioritization, and execution logic.

But this also introduces new risk. AI-enabled systems raise questions about explainability, validation, cybersecurity, liability, training data, operational design domains, and human override. A machine that makes recommendations must be trusted. A machine that executes must be validated. A system that learns from historical data must be governed. The more intelligence moves into the system, the more important it becomes for the industry to define safe, responsible, and supportable use.

AI will not make autonomy inevitable everywhere. But it will make autonomy more capable, more adaptive, and more valuable where the operating conditions are right.

5. Data and connectivity become core infrastructure

Autonomy depends on data. A machine must know where it is, what it is doing, what task it has been assigned, what constraints exist, what the environment looks like, what the operator or supervisor expects, what the machine has done before, and whether it remains safe to continue. Without reliable data, autonomy becomes fragile. Without usable data, autonomy becomes confusing. Without trusted data, autonomy becomes difficult to scale.

This is why data and connectivity should be viewed as core infrastructure, not optional add-ons. The future farm or jobsite will depend on machine data, sensor data, environmental data, maintenance data, geospatial data, work-order data, fleet data, and performance history. These data streams will increasingly feed AI systems, fleet-management tools, dealer-support systems, and customer dashboards.

Connectivity remains a real constraint. USDA reported that farms with internet access increased from 75% in 2017 to 79% in 2022, which represents progress but also means more than one-fifth of farms still lacked internet access in that Census release. For autonomy, this matters. Systems must be designed for rural realities:

- Intermittent coverage
- Offline operation
- Edge processing
- Delayed synchronization
- Cybersecurity
- Practical support when connectivity is limited

6. Interoperability moves from convenience to requirement

As machines, implements, sensors, software platforms, and worksites become more connected, interoperability will move from a customer convenience to a requirement for scaling autonomy. A farm or jobsite often consists of a multiple brands, multiple machines, and even multiple software platforms. Customers often operate mixed fleets, use multiple vendors, rely on dealer support, and expect equipment to work together in practical ways.

In a low-autonomy environment, lack of interoperability is frustrating. In a highly automated or autonomous environment, it can become a barrier to adoption. If machines cannot exchange task plans, operating boundaries, field data, safety alerts, implement status, jobsite models, or service information, the customer is forced to become the integrator. That increases complexity, reduces trust, and slows adoption.

The industry does not need every company to build the same product or use the same marketing language. But it does need enough shared understanding for customers, policymakers, regulators, and companies to communicate clearly about capabilities, safety, and performance.

Interoperability will also matter for safety. A machine operating autonomously in a dynamic environment may need to understand more than its own task. It may need to recognize other machines, people, implements, workzones, geofences, and emergency-stop conditions. In mixed fleets and mixed worksites, machine-to-machine and machine-to-system communication will become part of the safety and productivity case.

This is particularly important in agriculture, where implements, tractors, tenders, applicators, irrigation systems, field boundaries, and management platforms may come from different providers. It is equally important in construction, where site plans, grade models, attachments, fleet-management tools, contractors, and subcontractors must coordinate around changing conditions.

7. Safety, validation, and liability define the license to operate

Safety will determine whether autonomy earns the right to scale. Technical capability alone will not be enough. Customers, regulators, workers, dealers, insurers, policymakers, and the public will need confidence that autonomous systems are designed, validated, maintained, and operated responsibly.

The safety challenge is complex because non-road environments are often more variable than roads or factories. Farms and construction sites may include uneven terrain, dust, mud, slopes, people on foot, animals, implements, temporary obstacles, changing weather, limited connectivity, and machines operating near public roads or other workzones. This makes operational design domains, fail-safe behavior, human-machine interaction, perception performance, cybersecurity, maintenance status, and emergency intervention especially important.

BLS reported 1,032 fatalities among construction and extraction workers in 2024, including 370 fatal falls, slips, and trips. These figures do not prove that autonomy is automatically safer, but they make clear why safety is central to the value proposition. If automation can reduce human exposure to high-risk environments, improve situational awareness, prevent collisions, reduce fatigue-related mistakes, or allow remote operation in hazardous conditions, it has a meaningful public-interest case.

“If automation can reduce human exposure to high-risk environments, improve situational awareness, prevent collisions, reduce fatigue-related mistakes, or allow remote operation in hazardous conditions, it has a meaningful public-interest caseminate the human role.”

Companies and industry groups will also need practical ways to explain what a system is designed to do, where it can operate, what assumptions it makes, how it fails safe, what the human is responsible for, what data is retained, and how lessons from incidents are incorporated. The goal should not be to create overly rigid rules that slow innovation. The goal should be to build enough shared expectations that customers and regulators understand what responsible autonomy looks like.

Safety is not only an engineering issue. It is the license to operate.

8. Public trust and narrative become strategic infrastructure

The public will not judge autonomy only by technical performance. It will judge autonomy by the stories that surround it: what people believe it does, who they believe benefits, what risks they believe it creates, and how the industry responds when something goes wrong. For that reason, public trust and narrative should be treated as strategic infrastructure.

The industry already faces predictable concerns: autonomy will replace jobs, autonomous equipment is unsafe, companies will move too fast, customers will lose control, data will be misused, or regulators will be left behind. These concerns may not always reflect the full reality, but they will influence adoption. If the industry does not explain autonomy clearly, others will define it for the industry.

A proactive narrative should emphasize that autonomy is not a human-removal strategy. It is a capability strategy. It can help scarce workers manage more machines, reduce fatigue, improve precision, strengthen safety, support sustainability, maintain productivity, and keep agriculture and construction competitive. This is especially important because the benefits are often practical rather than dramatic: fewer repetitive passes, better input placement, earlier maintenance detection, lower exposure to dangerous tasks, and more consistent execution.

> **"Autonomy is not a human-removal strategy. It is a capability strategy."**

AEM's precision agriculture work provides a useful model for fact-based storytelling. The AEM/Kearney study translates technology value into measurable outcomes:

- 5% higher crop farming productivity
- 8% lower fertilizer use
- 9% lower herbicide use
- 5% lower water use
- 7% lower fuel use

Those types of numbers help policymakers, customers, and the public understand why technology adoption matters.

9. Workforce roles evolve from operation to oversight, service, and strategy

The most important workforce question is not whether autonomy removes people from work. It is whether the industry can prepare people for higher-leverage work. The operator becomes a supervisor. The technician becomes a diagnostician and software-enabled service expert. The dealer becomes an uptime partner. The manufacturer becomes both equipment provider and system steward.

People will continue to define the mission, handle exceptions, validate outcomes, manage risk, maintain systems, and make business decisions. But the unit of value will change. Today, one person may operate one machine. Tomorrow, one person may supervise a fleet, supported by AI that prioritizes work, flags anomalies, and recommends action.

That shift will demand new competencies. Operators will need to understand autonomy boundaries, human-machine interfaces, remote intervention, geofencing, emergency stop protocols, and system alerts. Technicians will need software literacy, sensor calibration skills, cybersecurity awareness, remote diagnostics, and mechatronics depth. Managers will need to understand data governance, machine utilization, software service contracts, and lifecycle economics. Education and training will be as important as hardware.

This is why the future cannot be reduced to "labor-saving technology." Labor scarcity may be the trigger, but workforce transformation will determine whether adoption succeeds. In agriculture, producers are aging and farms are consolidating. In construction, hundreds of thousands of workers are needed just to meet near-term demand. The practical result is a market pull toward systems that help scarce people manage more work with less fatigue and more consistency.

10. Business models evolve to become trusted performance partnerships

As automation and autonomy mature, the most significant shift may not be a shift at all, but rather a continuance of the importance of the OEM–dealer–customer relationship and the industry's ability to deliver confidence, uptime, and continuous operational support throughout the lifecycle of increasingly sophisticated machines.

In a future where autonomous capabilities are delivered through software, connectivity, machine learning, remote diagnostics, over-the-air updates, and fleet orchestration systems, customers will increasingly evaluate not just the equipment itself, but the ecosystem that stands behind it. Equipment purchases may be supplemented by software-enabled features, seasonal autonomy packages, utilization-based services, dealer-supported uptime programs, remote monitoring, fleet optimization services, and outcome-oriented support agreements. Some operators may continue to prefer traditional ownership models, while others may seek flexible access to autonomous capabilities during critical operating windows such as planting, spraying, harvest, construction seasons, or specialized contracting jobs.

As these models emerge, dealers are likely to become more critical to customer success. Historically, dealers have been trusted partners for equipment sales, service, and support. In an autonomous future, that role may expand to include technology integration, software support, remote diagnostics, fleet performance monitoring, cybersecurity assistance, operator training, and rapid response when connected systems experience issues. When autonomous equipment becomes responsible for critical operations, customers will place a premium on trusted local partners who can quickly restore functionality, minimize downtime, and provide confidence that systems will perform as intended.

Market activity outside the non-road sector suggests this broader shift is already underway. The International Federation of Robotics reported that robot-as-a-service fleets grew by approximately 31%, reflecting growing demand for models that align costs with utilization and reduce barriers to automation adoption. While agriculture and construction may not adopt identical approaches, the trend reinforces a larger reality: customers increasingly value outcomes, reliability, and support as much as ownership itself.

This evolution raises the strategic importance of the OEM–dealer partnership. Manufacturers will need to support recurring software delivery, cloud infrastructure, cybersecurity, predictive maintenance tools, data services, and continuous product improvement. Dealers will increasingly serve as the operational bridge between OEM technology and customer outcomes, helping translate complex autonomous systems into practical business value. The organizations that succeed may not necessarily be those with the most advanced autonomous technology, but those that can consistently deliver confidence, reliability, responsiveness, and measurable performance improvements to customers.

Business model innovation could also accelerate adoption among small and mid-sized operators. Flexible access models may allow customers to leverage autonomous capabilities without making significant upfront capital investments. However, the success of these approaches will depend on whether customers trust both the technology and the support network behind it. A grower or contractor considering an autonomous solution may ultimately place as much value on knowing who will answer the phone when a problem occurs as they do on the machine's technical specifications.

While it may not be a new concept, the greatest opportunity will continue to be strengthening long-term customer relationships through enhanced support, higher uptime, and increased operational confidence. The greatest risk is creating business models that feel overly complicated, disconnected from customer needs, or reliant on technology without sufficient support.

In an autonomous future, the industry may discover that technology alone does not create customer value. In many cases, the competitive differentiator may shift from the machine itself to the trust, responsiveness, and performance assurance delivered through the OEM–dealer–customer ecosystem. Success will increasingly depend on how effectively OEMs and dealers work together to deliver a seamless ownership experience: ensuring uptime, building confidence in new technologies, and helping customers realize the promised value of automation and autonomy.

11. Several drivers will push industry toward automation and autonomy

Several forces will push the industry toward automation and autonomy, even if adoption remains uneven. The first is labor. Agriculture and construction both face structural constraints in the availability, age, skills, and location of workers. Automation becomes a way to preserve operating capacity when labor supply is uncertain.



The second driver is productivity. Farms face pressure to produce more with fewer inputs, less land pressure, tighter margins, and greater environmental scrutiny. Contractors face similar pressures to complete jobs faster, cheaper, and with the same environmental scrutiny that farmers are facing.

The third driver is safety and risk reduction. The non-road world includes dangerous work: moving equipment, heavy loads, slopes, roadways, trenches, dust, debris, weather, humans in proximity to machinery, and fatigue. Automation offers a pathway to reduce exposure, but only if systems are validated, explainable enough for users to trust, and designed around fail-safe behavior.

The fourth driver is data. Autonomy depends on knowing where the machine is, what it is doing, what it sees, what it has done before, and what the mission requires next. That data becomes an operational asset as AI uses various sources of data to inform execution and support more efficient decisions.

The fifth driver is simply capital momentum. Grand View Research estimated the autonomous farm equipment market at $21.1 billion in 2025 and projected it to reach $44.8 billion by 2033. It separately estimated the autonomous tractor market at $1.68 billion in 2023 and projected $4.22 billion by 2030. Forecasts vary by methodology, but the direction is consistent: **autonomy is moving from experiment to investable category**.

The Road to 2035: Task-by-Task, Trust-by-Trust

The realistic pathway towards autonomy within the non-road industry will be task-by-task, operating-domain-by-operating-domain, and trust-by-trust.

Near-term autonomy will scale first where the environment can be bounded, human exposure can be reduced, and productivity gains can be measured.

The middle phase will be mixed-fleet coordination. Here, autonomy becomes less about whether one machine can complete one task and more about whether multiple machines can complete connected work. This means mission planning, obstacle detection, geofencing, job sequencing, data exchange, remote oversight, predictive maintenance, and exception management.

The far horizon is not "lights out everywhere." It is selective lights-out within defined domains: a dairy system running around the clock with human oversight; a compaction fleet completing passes while one supervisor manages quality and safety; or a farm operation where AI-generated plans are approved by a manager and executed by a combination of manned and unmanned machines.

"The realistic pathway towards autonomy within the non-road industry will be task-by-task, operating-domain-by-operating-domain, and trust-by-trust."

The road to 2035 therefore has three lanes:

1. Technical advancement
2. Institutional readiness
3. Social license

If technology moves faster than readiness, adoption may stall. If readiness advances with technology, autonomy can become boring in the best possible sense: *expected, reliable, useful, safe, and trusted.*

Conclusion

The future of automation and autonomy will be built through disciplined progress, not hype. The industry will move fastest where the job is clear, the environment is controlled, the value is obvious, and the support model is ready. It will move more slowly where tasks are dynamic, trust is fragile, liability is unclear, or interoperability and workforce readiness lag behind technology.

By 2035, the most successful farms and jobsites will not be measured by how few people they employ. They will be measured by how effectively people, machines, software, data, dealers, and support networks work together. The promise of autonomy is not machine independence. It is human capability multiplied.

About the AEM Futures Council

"Without disruption and innovation, progress isn't possible."

The global impact of non-road equipment manufacturing on our communities and our economy is well known. Taking that knowledge and the strong commitment of our 1,000-plus member companies to make a difference in our world, our AEM Futures Council has worked to tackle the disruptive trends poised to shape the industry of tomorrow.

Chaired by Dr. Ray Gallant of Volvo Construction Equipment North America, the AEM Futures Council brings together industry leaders and subject matter experts to identify disruptive trends and help members prepare for future challenges and opportunities.

Supported by AEM's Industry Sector leadership teams, the Council delivers value through thought leadership, strategic initiatives, industry insights, and member engagement opportunities designed to strengthen the industry's long-term success. For more information, visit www.aem.org/futurescouncil

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