

THE PATH TOWARDS AUTONOMOUS AGRICULTURAL MACHINES

AN INDUSTRY AND TECHNOLOGY OVERVIEW

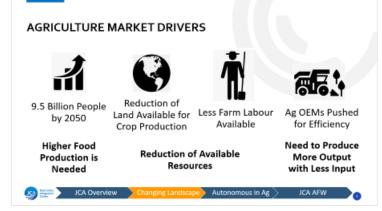
Darcy Cook

VP Engineering / General Manager

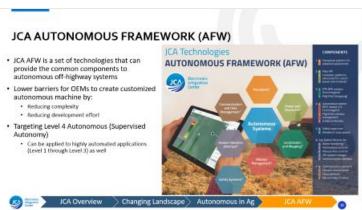
JCA Electronics

PRESENTATION AGENDA











JCA AFW

JCA ELECTRONICS OVERVIEW

- Provide advanced technology control systems to OEMs of Off-highway mobile machines
 - Development of systems from implement controls to autonomous machines
 - Wide variety of applications, primarily agriculture focus
- JCA Products and Services
 - Technology building blocks to facilitate rapid development
 - Engineering team with wide skill set and knowledgeable in latest technologies that apply to the mobile machine industry
 - Electronics and wire harnessing manufacturing



Autonomous in Ag

JCA ELECTRONICS OVERVIEW



Customer-Driven Applications

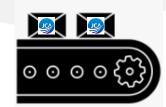








(Enabled with JCA Technologies)



Volume Production



Direct Market Feedback for Technology Roadmap

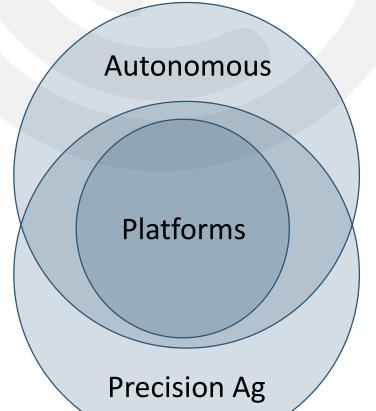


JCA TECHNOLOGY DEVELOPMENT FOCUS AREAS

Autonomous Technologies











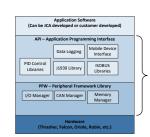
Precision Ag Technologies





Platforms









AGRICULTURE MARKET DRIVERS



9.5 Billion People by 2050



Reduction of Land Available for Crop Production



Less Farm Labour Available



Ag OEMs Pushed for Efficiency

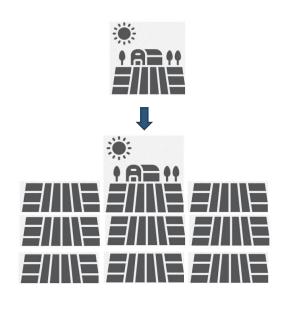
Higher Food Production is Needed

Reduction of Available Resources

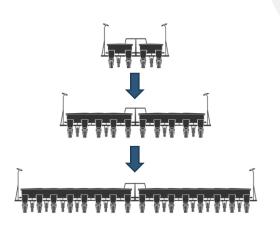
Need to Produce More Output with Less Input



AGRICULTURAL PRODUCTION EFFICIENCY TRENDS



Larger Farming Operations



Larger Equipment

Autonomous in Ag

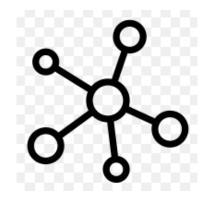


Adoption of Precision Ag Technologies

Going Larger Increases Complexity and has Scalability Challenges



GENERAL TECHNOLOGY TRENDS



Connectivity

(IoT)







Data Analytics

Robotics

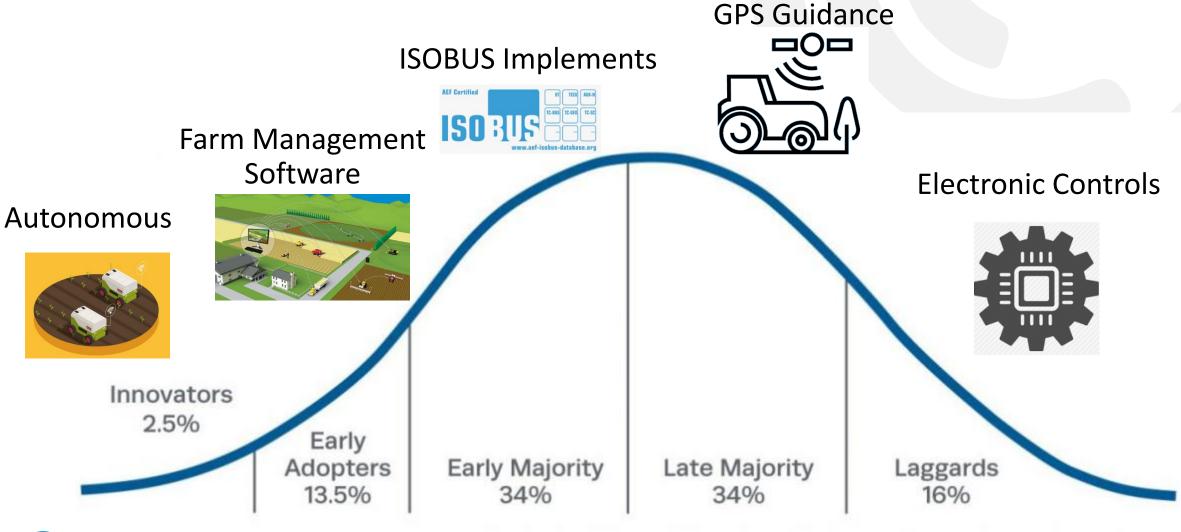
Autonomous in Ag

Autonomous Vehicle **Technology**

As these technologies mature, they are being applied to problems across off-highway mobile machine systems



ADOPTION OF TECH IN AG



Autonomous in Ag















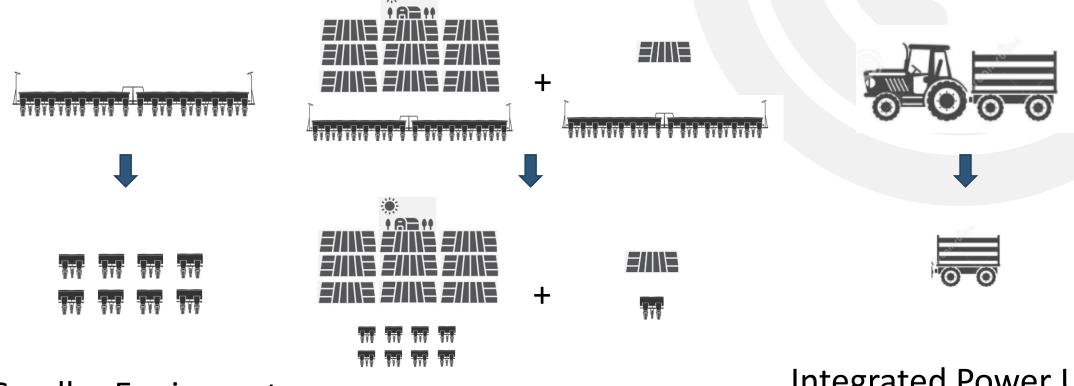
AUTONOMOUS IN AGRICULTURE

- Several early prototypes and research projects announced
- No established solutions
- Many major Ag OEMs are currently working on autonomous systems
- Fundamentally different than autonomous on-highway vehicles
- Eliminates the dependence on the tractor
- Re-imagining the shape and form of implements

Changing Landscape

Autonomous in Ag

IMPACT OF LEVEL 4 AUTONOMOUS IN AGRICULTURE



Smaller Equipment,
Distributed use

Scalability of Operations

Integrated Power Unit & More Electronics

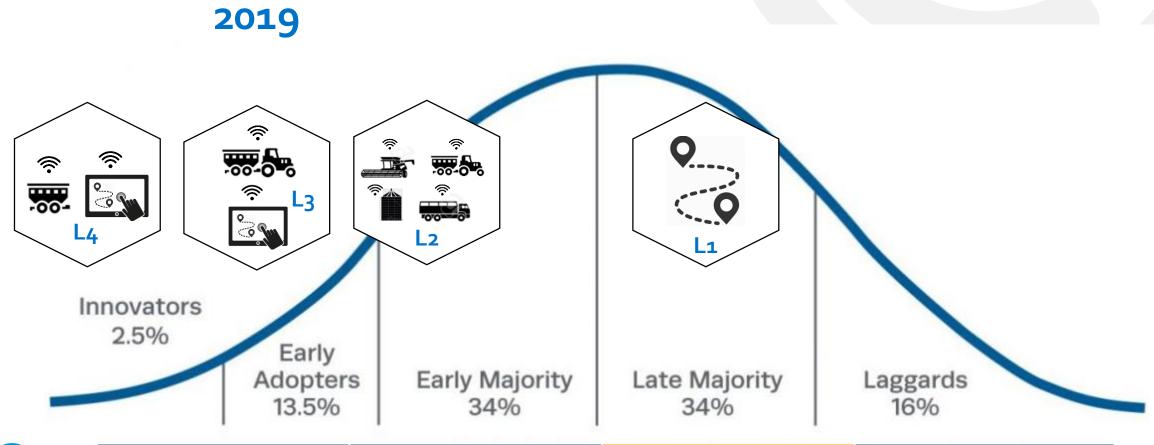
Most significant market change since the introduction of the tractor



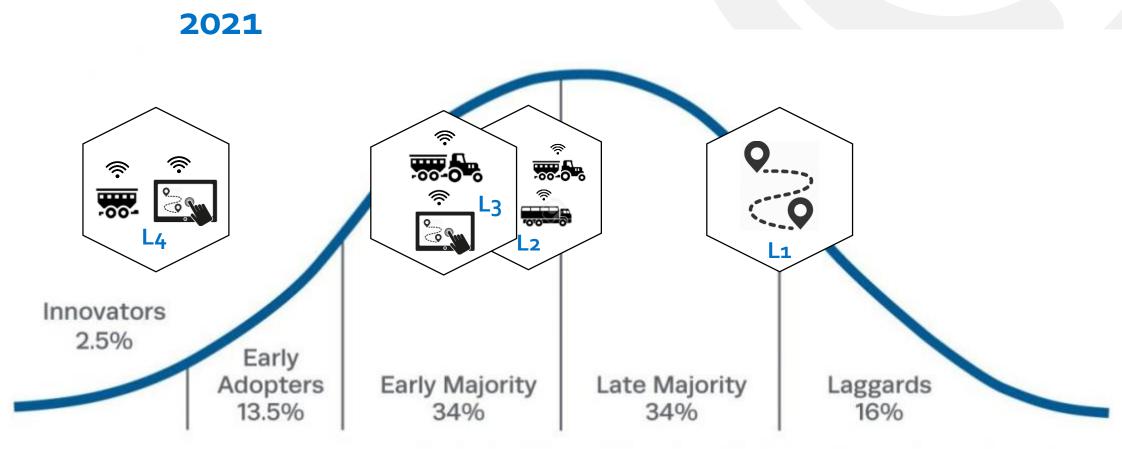
Autonomy in Agriculture

Supervised Autonomy **Coordination & Optimization** High level of automation / Communication autonomous operation, between machines 05 01 supervised by operator in Operation optimization field Coordination of Implement-controlled activities and data power units **? ₩** S. Jun **Operator Assisted Autonomy** Guidance **Full Autonomy Navigation** Direction at mission High level of automation 02 04 Localization or job level directed by operator Off-site monitoring **Mapping** Operator guidance in Fully autonomous machine operation functionality

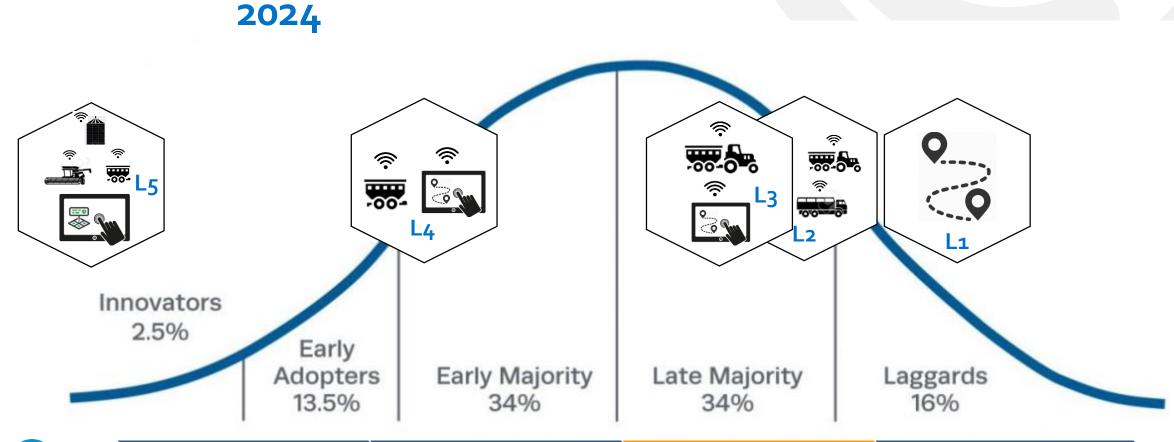






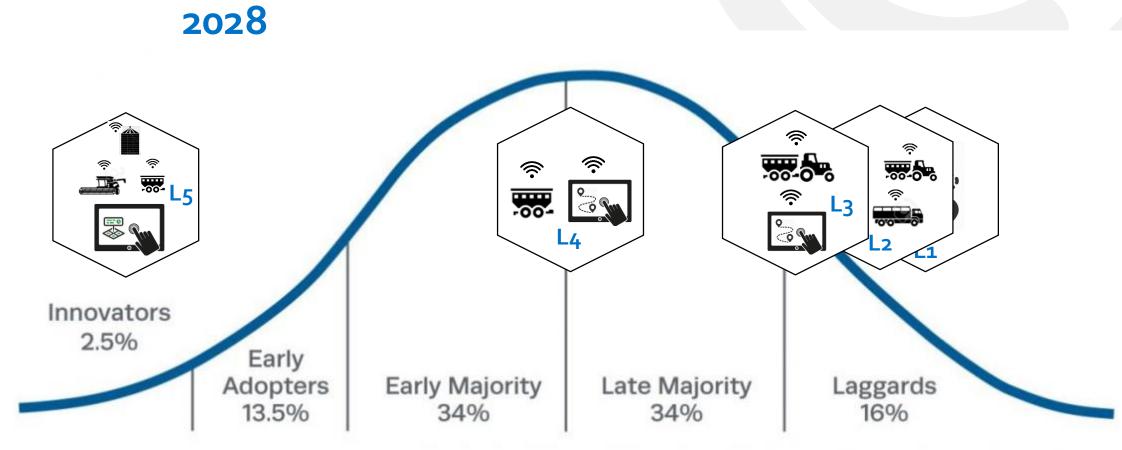








JCA Overview



TECHNICAL CHALLENGES

High-speed, reliable communication, in remote areas

User interface for mission management, diagnostics & calibration, manual control, alarm notification

> Alarm management, Wireless E-stop, functional safety for autonomous machines

Sensing and Perception Comms and Power and Drivetrain Data Autonomous Agricultural Human-Localization Machine and Interface Mapping Mission Management

Many unique jobspecific vision systems problems to solve

> Very similar to existing machine systems

RTK GNSS, GPS-denied positioning, IMU orientation in 3D space

Multi-machine coordination and mission management















JCA Overview

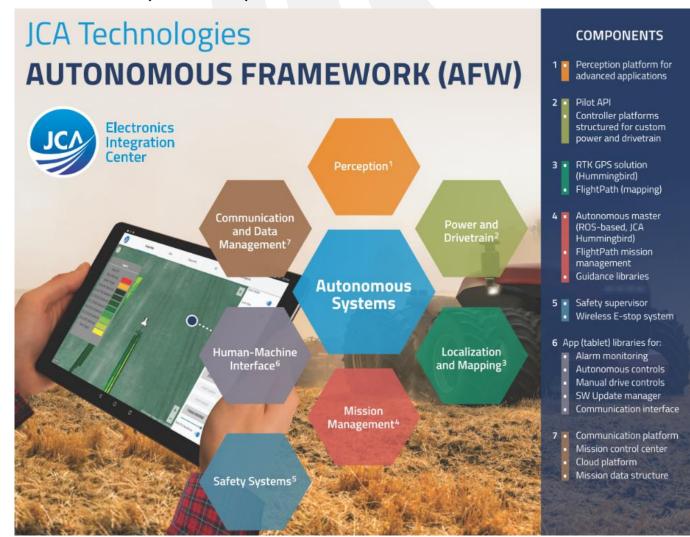
Safety Systems

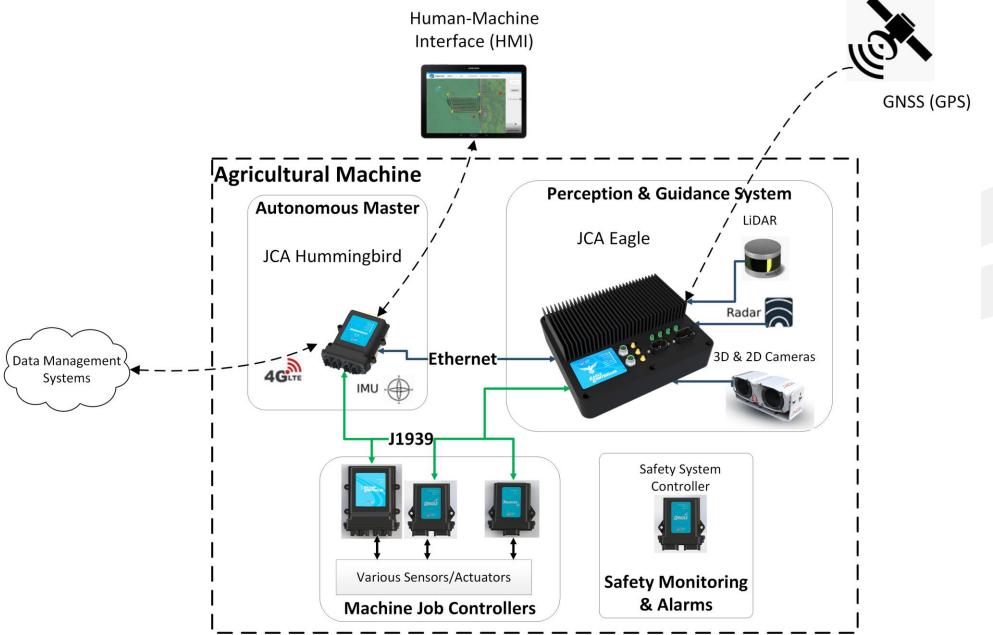
Autonomous in Ag

JCA AFW

JCA AUTONOMOUS FRAMEWORK (AFW)

- JCA AFW is a set of technologies that can provide the common components to autonomous off-highway systems
- Lower barriers for OEMs to create customized autonomous machine by:
 - Reducing complexity
 - Reducing development effort
- Targeting Level 4 Autonomous (Supervised Autonomy)
 - Can be applied to highly automated applications (Level 1 through Level 3) as well



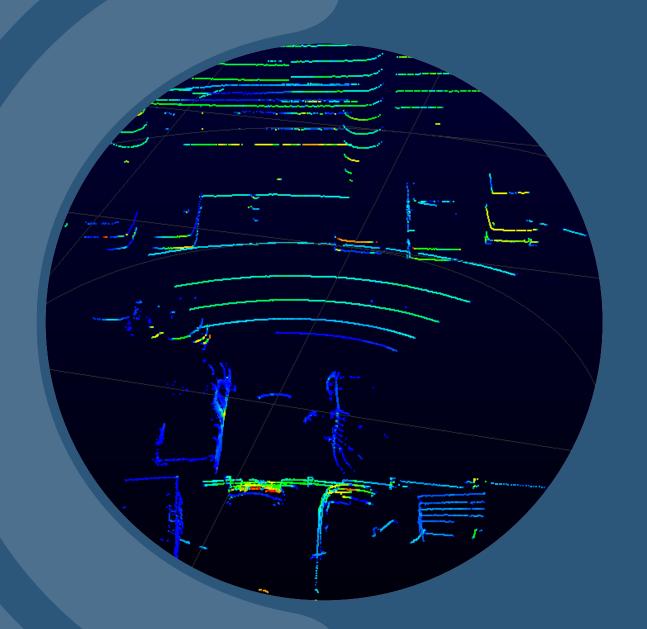




CONCLUSION

- Autonomous in ag offers a path for scalable efficiency improvements
- Technologies are available to solve the key problems
- On-highway and Off-highway use similar technologies, but are solving fundamentally different problems
- Integration of these technologies for a robust & reliable operation is the near-term challenge
- JCA's Autonomous Framework provides the technology infrastructure for common areas to lower the barrier for OEM to develop unique autonomous machines







THANKYOU



D.COOK@JCAELECTRONICS.CA



WWW.JCAELECTRONICS.CA