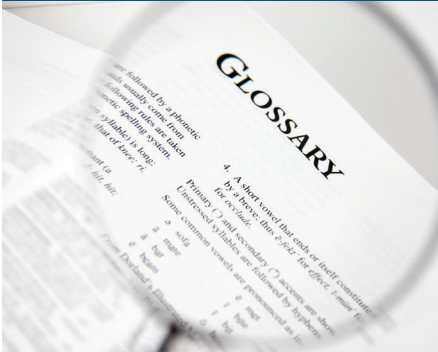# AgGlossary.org

AgGlossary.org

The purpose of the Glossary Working Group

- Follow an established process to gather terms and definitions from all of agriculture
- Identify and classify the authority value of an agriculture term and definition
- Publish terms and definitions that are credible and accurate
- Maintain public access to the Glossary so everyone can have access to terms and definitions used in agriculture.

Please contact us if you are an AgGateway member interested in joining the Glossary Working Group.

AgGateway

Collaboration for eConnectivity

AgGlossary.org is:

- A one-stop location for agriculture terms, definitions, acronyms, key words, and synonyms
- Publicly available, for use by all segments of agriculture
- A tool that supports accurate communication and improved understanding between segments of agriculture and agribusiness
- A wiki that uses an ontological structure and authorization process to estabish the credibility and source of its terms

How to use the Glossary

- Visit **AgGlossary.org** and use the **Search** box.
- Browse an alphabetical list of **All Terms.**
- Browse by category by clicking **Authorization Path.**

Do we have the terms you care about?

We've gotten positive reviews from a few early users who've used **AgGlossary.org** to get definitional agreement in their teams. Do we have the terms that you need and want? Browse for the terms you care about, and let us know what we need to add so you can start using the site as a reference.

Contribute a single term

- Visit **AgGlossary.org**
- In the left-hand menu, click the link to **Contribute** a term.
- Fill out the online submission form for a single term.
- When you **Submit** your term, it will be routed to the Glossary Working Group for processing.
- You will be alerted when it becomes available on **AgGlossary.org.**

Do we need to make an edit?

The wiki interface will allow you to suggest edits to the Glossary Working Group. We have vetted and corrected the base set of terms that are available online today, and we also know that experts like you can make it even better.

Terms of use

AgGlossary.org is publicly available for anyone to use. Contributors or contributing organizations will be asked to file a "permission to use" letter with AgGateway.

Contribute a collection of terms

We want to make it very easy for your organization to share existing lists of terms and definitions that you have created or collected. The Glossary Working Group can use a variety of methods to import your terms and integrate them into the Glossary. This includes (but is not limited to):

- Links to existing glossaries on the web
- Password-controlled access to existing databases
- Hardcopy glossaries that have been scanned and submitted to us electronically
- Excel spreadsheets

Submissions do not have to be in a specific layout or format (we'll do the cleanup!), but they should include:

- The term (individual word or phrase)
- The definition
- The specific source of the term or phrase (the location of the term and the source where it was documented)

To get started, contact **Dennis Daggett (ddaggett@proag.com).**

Thousands of terms are available today…

A sample

Work record

Definition

A Work Record is crop specific and is created at a spatially specific field level by a machine, consultant or service provider. It is a record that identifies, "This is what we did." A grower may have 0 to N number of work records. A Work Record is frequently referred to as "as applied" or "application record" and is the final step in the data sequence. A Work Record must be linked to at least one Work Order and will include the information contained in the Plan, Recommendation, Prescription, and Work Order.

Authorization

- Path: 2.4.5.2.19
  - Authority: 2 Standards
  - Control Category: 4 Resource
  - Source Type: 5 Organization
  - Instrument: 2 Specification
  - Source: 19 AgGateway

Work order

Definition

A Work Order is crop specific and is created at a spatially specific field level by a consultant or service provider. It is a task created by someone with authority (as designated or assigned by the producer/grower, or by one who pays for the task to be created) that identifies, "This is what we are going to do." This spatially specific task may be sent to a warehouse, applicator/retailer/service producer, machinery, etc. A grower may have or use 0 to N number of work orders. A work order will be based on the information contained in the Plan, Recommendation and Prescription and must be linked to at least one prescription.

Authorization

- Path: 2.4.5.2.19
  - Authority: 2 Standards
  - Control Category: 4 Resource
  - Source Type: 5 Organization
  - Instrument: 2 Specification
  - Source: 19 AgGateway

Project Milestones

July 2013: Announced at AgGateway Mid-Year Meeting

Fall/Winter 2013: Project team collects terms, designs initial Glossary structure, builds supporting processes

Summer 2014: AgGlossary.org goes live; press release to agriculture industry

As of November 2015: AgGlossary.org contains over 5,500 terms and has had over 70,000 visits.

Organizations that have contributed terms or expressed interest in contributing to the Glossary include ASABE, several USDA agencies, AEM, ISO, FFSC, and others.

Our long-term vision is for **AgGlossary.org** to be used by the agriculture industry globally, and contain 30,000 – 50,000 terms.

AgGateway

Collaboration for eConnectivity

Interoperability has been a formidable hurdle to the use of precision ag technologies. ADAPT provides an easy-to-use industry framework, with the tools to simplify communication between growers, their machines, and their partners.

"The as-is state of precision ag data management is frustrating to say the least…. Widespread acceptance and use of the new ADAPT framework will reduce our effort and frustration greatly."

– Luke Lightfoot, Ag Technology Manager at Co-Alliance, LLP, an Indiana ag cooperative

Adopt ADAPT! (Here's why…)

Different brands of farm equipment and software currently collect and consume data in a variety of proprietary file formats. While this is a natural consequence of how the industry has grown, it makes it hard for end-users to "connect the dots" and extract value from the data.

The promise of seamless interoperability among precision ag systems – regardless of the system manufacturer – has entered an exciting new stage with AgGateway's ADAPT framework. ADAPT (Agricultural Data Application Programming Toolkit) eliminates this barrier to the broad use of precision agriculture data, by easily enabling interoperability between different software and hardware applications.

ADAPT contains:

- A **common object model** for field operations.

- A set of **data conversion plug-ins** (both open source and proprietary).

- A **plug-in management framework** (a software development kit) that enables all the parts to work together.

Plug-ins convert data between the common object model and other formats. A major goal of the ADAPT team is to reach the point where plug-ins exist for all the formats of interest to the industry. The ADAPT team wrote and maintains two fundamental plug-ins, which have been tested successfully: one for ISO 11783, the other to serialize ADAPT for FMIS-to-FMIS communication. Manufacturers and third parties are encouraged to write plug-ins for their formats of interest.

ADAPT is an open-source project, allowing stakeholders worldwide to use the software and to contribute to its continued development. The toolkit has been developed over several years by a large, collaborative group of AgGateway members from a variety of terminal equipment manufacturers and farm management information system (FMIS) software companies, who all recognized that the grower and other agricultural users have a critical need to use data from multiple sources in field operations decision-making. ADAPT's open-source structure now encourages participation by everyone – AgGateway members and non-members alike.

More ADAPT Features

- **Simple to use:** A common object model that you can use in your farm management software. Plug-in libraries that allow the farm management software to convert to and from the common object model and different file formats.

- **Eclipse Public License 1.0:** The open-source license allows you to include ADAPT in your software and modify it if needed.

- **Plug-ins are licensed by their developer:** Anyone can build a plug-in for ADAPT; the developer is free to license their plug-in based on their business needs.

- **Farm Management Information System (FMIS) companies** are responsible for the implementation of reading and writing to/from the object model.

- **Cross platform:** ADAPT can run on Windows, Mac or Linux if your software runs the .NET Framework or Mono.

- **Strong support for different geographies, languages and geopolitical contexts.**

- **Transparent governance:** Open-source, governed by AgGateway's ADAPT Committee. Non-members can participate.

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ADAPT's Mission

To support the ongoing process of providing open-source solutions to enhance interoperability between systems that create and manage agricultural data.

The ADAPT Committee is composed of two teams, Business and Technical.

ADAPT Members

As of October 20, 2017

Ag Connections, Ag Leader, AGCO, Agrian, CNH Industrial, Central Valley Ag Coop, CLAAS, Independent Data Management, John Deere, Land O' Lakes, Monsanto, Premier Crop Systems, ProAg, Raven Industries, Red Wing Software, Software Solutions Integrated, SST Software, Syngenta, Topcon Agriculture, Trimble, Uptake and ZedX

Questions?

Email us at:

Adapt.Feedback@AgGateway.org

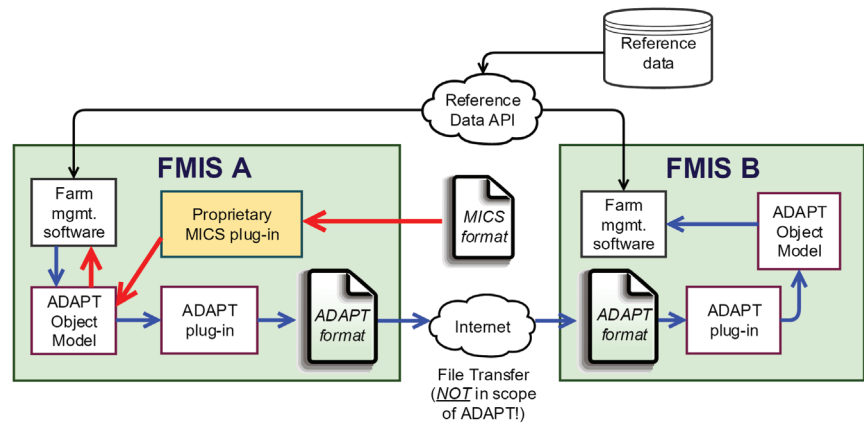For more information, including materials for joining ADAPT, visit:

http://www.AdaptFramework.org

www.AgGateway.org

Member.Services@AgGateway.org

Phone: (+1) 866.251.8618

Twitter: @AgGateway

How ADAPT works to enable data conversion

The figure above shows two examples of data conversions and flows.

Incoming data from a Mobile Implement Control System (MICS, i.e., the controller in the cab. *Data flow shown in red*): A proprietary-format data file coming from a controller in the field is converted by a manufacturer-specific plug-in into an instance of the object model; a Farm Management Information System ("FMIS A") consumes the data.

Communication between Farm Management Information Systems (FMIS, i.e., farm management software. *Data flow shown in blue*): FMIS A creates an instance of the object model, populates it with the data it wants to transmit, and uses the ADAPT plug-in to serialize it to a file. This ADAPT-formatted file is transmitted to another FMIS using the Internet or another means. (File transport is out of scope of ADAPT, accommodating the various solutions available in the industry.) FMIS B uses the ADAPT plug-in to convert the ADAPT-formatted file to an instance of the object model, and then consumes the data.

Note how FMIS A and FMIS B are both supported by Reference Data, a distributed system of common unique identifiers for products to be shared across the industry by manufacturers and third-party data providers.

A Robust, Open-Source Project

The ADAPT team is working in the context of the continuing cooperation between AgGateway and relevant standards organizations such as the **Agricultural Industry Electronic Foundation (AEF),** which implements the **ISO 11783 standard.**

ADAPT has received the bulk of its requirements from AgGateway's SPADE (http://bit.ly/26vg7ry) and PAIL (http://bit.ly/1Sz69kR) projects.

Remember: You can use and contribute to ADAPT without being an AgGateway member!

How you can get involved

Go to **www.ADAPTFramework.org** to review the ADAPT model and to access a growing set of resources to help with implementation!

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AgGateway's ADAPT Framework

A description of the Minimum Viable Product

*This Application Note summarizes the purpose and current scope of the **minimum viable product (MVP)** for AgGateway's ADAPT framework.*

More detailed information can be found at www.AdaptFramework.org or www.AgGateway.org.

The promise of seamless interoperability among precision ag systems – regardless of the system manufacturer – has entered an exciting new stage with AgGateway's ADAPT framework. ADAPT (Agricultural Data Application Programming Toolkit) will eliminate this barrier to the broad use of precision agriculture data, by easily enabling interoperability between different software and hardware applications.

ADAPT is an open-source project, allowing stakeholders worldwide to use the software and to contribute to its continued development. The toolkit has been developed over several years by a large, collaborative group of AgGateway members from a variety of manufacturer and farm management information system (FMIS) software companies, who all recognize that the grower and other agricultural stakeholders have a critical need to use data from multiple sources in field operations decision-making. **ADAPT's open-source structure encourages participation by everyone – AgGateway members and non-members alike.**

Scope and Content of the Minimum Viable Product (MVP)

The interoperability issue in agricultural field operations data incorporates a large range of data elements. As a result, the ADAPT framework incorporates many aspects of field operations data translation. For the MVP, we've limited the technical scope to be the smallest possible that at the same time creates the largest possible degree of interest by a wide range of FMIS companies to become ADAPT-MVP-compatible. We also want to make it as easy as possible for manufacturers to create MVP-compatible plug-ins. The MVP is a good representation of the current tested status of ADAPT.

Application Notes for current MVP scope:

- **Getting started with ADAPT** – Keys to getting started
- **Record linkage** – Recommendations on how to handle IDs that come into the FMIS that didn't originate from the FMIS
- **Grower, Farm, Field (GFF) data** – Foundational data
- **Product set-up data to MICS and FMIS** – Relevant data going to MICS to simplify an operator's process of in-field documentation
- **Field boundary data**
- **Simple totals generated by MICS**
- **Seeding spatial data, as-planted generated by MICS**
- **Yield spatial data generated by MICS**

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Support for ADAPT

In addition to the 100 or so companies involved with AgGateway's Precision Ag Council, ADAPT has been endorsed by the **Agricultural Retailers Association (ARA)** and 12 major grower organizations including the **American Farm Bureau Federation, National Corn Growers Association, American Soybean Association, National Association of Wheat Growers and the National Cotton Council.**

We have seen good response by original equipment manufacturers (OEMs) of Mobile Implement Control Systems (MICS) who have committed to create ADAPT-compatible plug-ins for their various data formats. AgGateway anticipates that these MVP Application Notes will make it easier for manufacturers to begin planning and creating plug-ins.

AgGateway is a non-profit consortium of businesses serving the agriculture industry, with the mission to promote, enable and expand eBusiness in agriculture.

www.AgGateway.org

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The AgGateway ADAPT team is creating a series of Application Notes to describe the MVP. Our goal is to provide focused documentation on how to implement different aspects of the MVP, and why that adoption is useful. Each application note provides use cases and includes the "what" and the "how" of implementing ADAPT. The team has already posted three Application Notes (accessible through www.AdaptFramework.com and www.AgGateway.org), covering Field Boundary Data, Identification and Record Linkage, and Grower-Farm-Field.

We encourage companies to use the Application Notes in the MVP series that describe the existing capabilities of ADAPT for a target audience of managers (i.e., a technical manager) and implementers (i.e., a developer). These notes should help as FMIS companies choose where to start with implementation, and to clarify how to integrate ADAPT.

Some companies may want to broaden the MVP scope to include additional aspects of the ADAPT framework. AgGateway hopes that the MVP process will empower these companies to engage as part of the larger ADAPT community to lead in the documentation of the relevant aspects of the framework.

Your Next Steps

For customers that want the business system (FMIS) of your choice to be able to easily read from and write to different field computer systems, ask your software providers if: 1) those systems are ADAPT-MVP-compatible, and 2) whether your provider is actively engaged in the ADAPT open source software community.

For business systems (FMIS), Go to www.AdaptFramework.org to review resources related to the ADAPT MVP, and to find resources for implementing ADAPT. Look at your integration projects and ask integration partners to expose ADAPT-compatible interfaces (focused on the relevant data elements). Also, expose your own ADAPT-compatible interfaces for systems that wish to integrate with you! Help the ADAPT community document best practices.

For manufacturers of field computer systems (MICS), consider creating an ADAPT-compatible plug-in for your proprietary data format - visit www.AdaptFramework.org to get assistance.

For ISO-compatible systems (FMIS or MICS), consult with www.AdaptFramework.org for the latest information. Several companies are focused on creating an ISO plug-in for ADAPT that is available under the same open source software licensing terms as the ADAPT framework, and complies with the ISO 11783 part 10 conformance tests. The current status meets the TC-BAS level of conformance testing.

AgGateway's Core Documents

SPADE:
A project identifying data needs throughout the supply chain to drive implementation of industry standards.

ADAPT:
A framework enabling exchange of precision ag data.

PAIL:
A project working to standardize data for irrigation, weather and related sensors.

What's inside a Core Document?

What: The products or services being applied, or the data being reported.

Where: Grower / farms / fields / cropzones / GPS locations.

Who: People involved and their roles: operator, agronomist, trucker, etc.

When: When should / did the operation happen?

How: Product rates, equipment settings, etc.

With What: What equipment is involved?

Context items: FSA, EPA, DOT numbers, harvested commodity codes and other geography-specific data that growers track for insurance and other purposes.

Core Documents for Field Operations:

The Foundation for Efficient Communication in Precision Agriculture

"Dig into AgGateway's Core Documents for Field Operations today!"

A significant outcome of AgGateway's SPADE Project is a set of Core Documents, which standardize how to organize critical information being exchanged in managing field operations. Modern farming requires increasingly detailed records of operations such as planting, spraying, fertilization and harvest. The need for detail is increasing due to regulatory pressure, supply-chain interest in traceability and sustainability, and the grower's interest in managing fields on a more granular level for improved profitability. Growers and their partners use multiple "documents" to exchange field operations information as part of their business processes. While some work had been previously done to standardize farm processes (e.g., ISO 22006), there was still a need to precisely define documents and many of the terms used within them.

The Core Documents

The Core Documents have been defined with flexibility in mind, in view of the many ways in which different growers manage record-keeping. The documents also include the representation of data requirements within the new ADAPT object model.

Crop Plan: "This is how we are going to grow this crop this season"

Observations and Measurements: "This is happening out in the field"

Recommendation: "This is what I recommend we do about it"

Work Order: "This is what we are going to do"

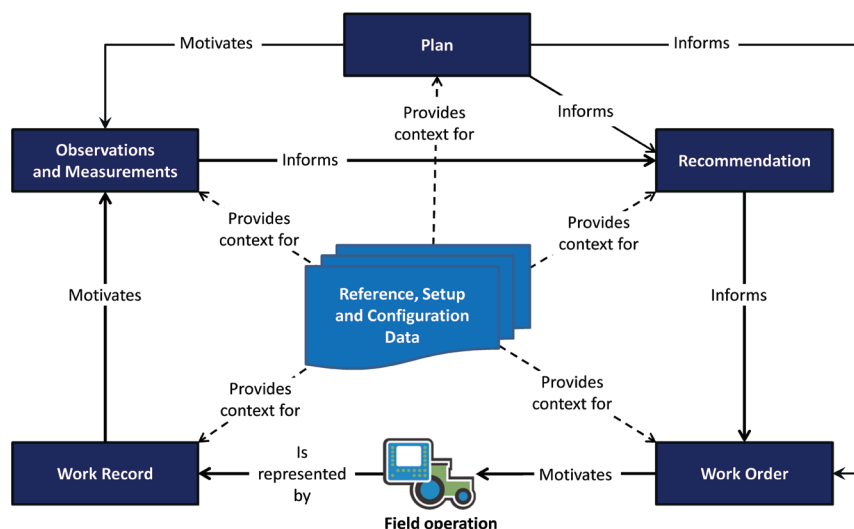**Work Record:** "This is what we actually did"

Figure 1: AgGateway's Core Documents and the relationships among them.

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Reference / Setup Data

The Core Documents are afforded context by Reference Data (i.e., a framework of data that can be shared across the industry, such as common product identifiers). The exchange of documents is further enabled by Setup Data (which can be regarded as another core document) that provides information needed to establish data exchange between growers and their partners: a grower-farm-field tree, field boundaries, products used by the grower, machine settings, and so forth.

Questions?

Contact Jim Wilson
SPADE Project Manager
(+1) 816.516.8847
jim.wilson@aggateway.org

For more information, including materials for joining SPADE, visit:

https://aggateway.atlassian.net/wiki/x/vgFwAw

www.AgGateway.org
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Phone: (+1) 866.251.8618
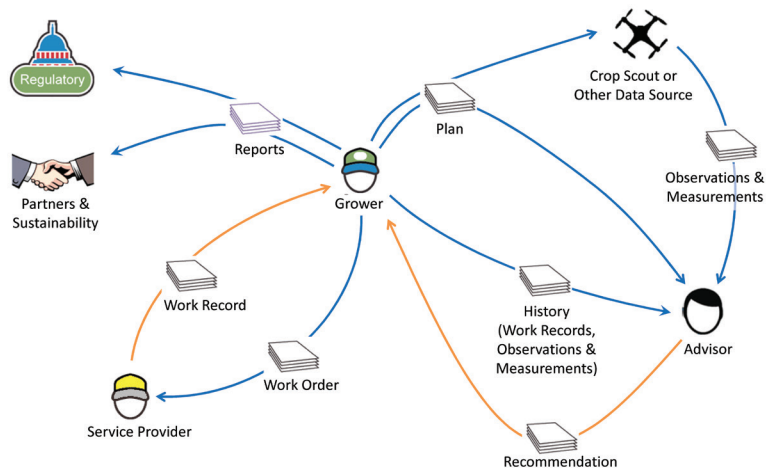**Twitter: @AgGateway**

How the documents flow

Figure 2: Examples of document flow between the grower and other actors.

Growers exchange documents with multiple partners *(Examples in figure 2).*

Example 1: The grower sends the advisor a plan for the season and the management history of the fields; a crop scout sends the advisor a set of field observations. All that data informs *(fig. 1)* the creation of a recommendation by the advisor (to spray a chemical, for example) which is sent back to the grower.

Example 2: The grower makes a decision informed by the above recommendation along with the plan, knowledge of market conditions, etc. If the grower decides to spray, he or she will create a work order and send it to a service provider.

Every grower runs their business differently; some have formal workflows in place that use all of the Core Documents (often with different names), while others may use only one or two, and very informally. The AgGateway Core Documents for Field Operations were defined with that flexibility in mind which carries through to the ADAPT Framework. These differences in management approaches necessitated the ability to capture the relationships among Core Documents within ADAPT, enabling comprehensive traceability and the documentation of decisions.

Make SPADE, PAIL and ADAPT Work for You and Get Involved!

- Study the documents for ADAPT's open-source object model and format conversion toolkit to see how it could help you. Start at **www.adaptframework.org.**

- The SPADE Core Documents are living documents that continue to be refined: the SPADE, PAIL and ADAPT teams will be adding to them as new field operations and additional processes come into scope. If you're an expert in the business or agronomy aspects of what we're working on, your user stories would help enrich the project deliverables and make SPADE/PAIL deliverables better for the entire industry. Likewise, technical contributions are welcome! Contact **Jim Wilson (SPADE Project Mgr.)** and discuss how to join the effort!

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Reference Data and APIs
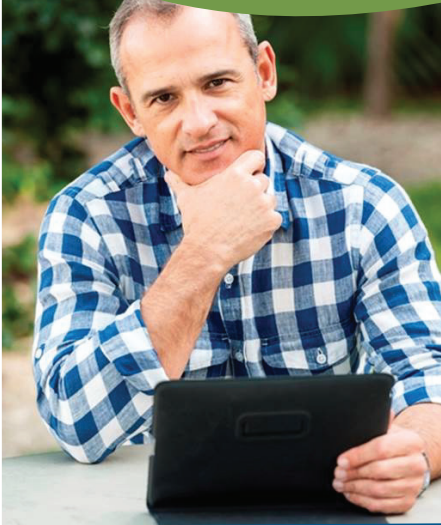
Reference Data

Information needed to unambiguously **identify a product**, and to enable its use in a farm management information system (FMIS) or a field operation. It changes rarely, and a great part of its value lies in the different actors in the business process having access to it. Think of this as a set of controlled vocabularies, like pick list items, that can be shared across the industry.

What's an API?

Application Programming Interface (API), a software mechanism to deliver data from a web server to users. To date, the SPADE projects have defined APIs to use in delivering seed, crop protection, and equipment Reference Data.

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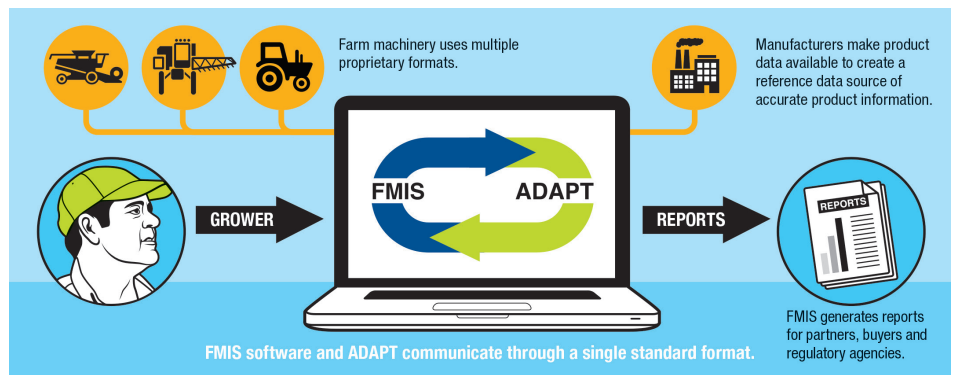## Reference Data APIs: Key to Interoperability

Precision agriculture is a set of technologies that has shown great promise to enable converting vast amounts of farm-equipment-collected data into actionable information in Farm Management Information Systems (FMIS) and other tools. However, precision ag has not quite delivered on this promise, partly because different manufacturers' hardware and software are not interoperable.

AgGateway's SPADE and PAIL family of projects has targeted this problem, modeling business processes, identifying the data needed to support them, and working with manufacturers and software companies to develop a toolkit, ADAPT, to help convert seamlessly between various manufacturers' data formats and an industry standard common data model.

A critical component of this system is a common way to **identify products** such as seed, crop protection and equipment, so when a grower shares data about planting or spraying (or other field operations) with a partner (say, a retailer or a custom applicator) the recipient of the data understands exactly what is meant. The SPADE project developed a **standardized, distributed** mechanism to source this "Reference Data".

- **Standardized:** We propose a single mechanism and format for industry partners to source data (think a uniform way for everyone to organize their filing cabinet), and

- **Distributed,** because each manufacturer can host its own Reference Data through a delivery tool (API) themselves, or rely on existing third parties to do it.

The Reference Data API system allows manufacturers to make label and other data available in a standardized way that any FMIS can understand, and to engage to whatever degree they want in its distribution: source/control the data and API themselves, have a third-party do it, or count on existing reference data providers that already provide that data.

Farm machinery uses multiple proprietary formats.

Manufacturers make product data available to create a reference data source of accurate product information.

GROWER

FMIS ADAPT

REPORTS

REPORTS

FMIS generates reports for partners, buyers and regulatory agencies.

FMIS software and ADAPT communicate through a single standard format.

AgGateway's vision for data flow in precision agriculture. Reference Data helps ensure things have the same meaning for all participants.

How does Reference Data relate to AGIIS?

AGIIS is a source of:

- Unique identifiers and associated attributes for businesses, consumers and locations (global location numbers: GLNs) heavily used in supply-chain messaging;

- Product information including packaging (global trade item numbers: GTINs);

- Data regarding seed trait licenses and agreements.

Reference Data APIS

- are oriented towards field operations and production record-keeping.

- Intended to complement AGIIS by **linking** to AGIIS records, **extending** the information AGIIS can supply about your products, and **increasing the value** of your existing investment in AGIIS by taking your product information to the field through FMIS and mobile solutions.

Questions?

**Contact Jim Wilson,
SPADE Project Manager
(+1) 816.516.8847
Jim.Wilson@AgGateway.org**

www.AgGateway.org

Member.Services@AgGateway.org

Phone: (+1) 866.251.8618

We need your help!

What am I being asked to do?

We want your company to commit to this vision:

- Source reference data in this new way that makes it machine-readable.

- Host an API if you want. Otherwise, source the data though a partner; engage that service provider and encourage them to source the data in this standardized format.

How do the APIs benefit my company?

Reference Data APIs allow you to:

- **Enable better data continuity through the supply chain:** All parties can use the same set of product identifiers.

- **Provide accurate and timely product documentation to business partners** in a standardized way.

- **Increase the chances that your products are used according to their label.** For example, by allowing farm management software to calculate and show users active ingredient loads over time, REIs, and so forth.

- **Efficiently use your resources:** With one implementation your label information is shared with a maximum number of business partners in an easy-to-consume format, regardless of the software they use.

- **Control the documentation of your products.** If you implement your own API you can ensure that users have the latest information available.

- **Have a gradual path to implementation:** You can begin sourcing data through a third party, and host your own API later as you see value in it.

- **Deliver special content to your premium users** through the API.

- **Help users find your products** more easily.

How do I start?

- **Contact Jim Wilson** (contact info on sidebar) for more information about the role of Reference Data in farm information management, and how you can get involved.

- SPADE's Reference Data API Team is preparing implementation toolkits to help manufacturers implement crop protection, seed, and equipment APIs to source the reference data, as well as to help FMIS companies use those same APIs to consume it. We'll be happy to share these materials with your company.

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Precision Agriculture: The PAIL Project

PAIL Assists
- Irrigation Planning
- Soil Moisture Monitoring
- Field Weather
- Remote Weather
- Irrigation Schedules
- Pumping Systems
- Asset Management
- Regulatory Compliance

PAIL Delivers
- Best Practices
- Use Cases
- Process Models
- International Context
- Specs and Toolkits
- Reference Data
- Data Exchange APIs

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Precision Irrigation Through Data

From soil mapping to irrigation system operations and reporting, precision irrigation is ever more dependent on the automated capture, transfer and management of data. Standards that allow the free flow of data across multiple brands of equipment allow growers and consultants to make decisions that use water and energy optimally, while maintaining or increasing yield.

The **PAIL (Precision Ag Irrigation Language)** project is the result of a collaborative effort of a strong cross-section of the irrigation market. Its main deliverable, developed with the American Society of Agricultural and Biological Engineers (ASABE), is a draft U.S. national standard for data exchange in irrigation field operations. This work provides three main benefits for implementing companies:

- **Financial Benefits:** By reducing the time and effort currently required for growers to interact with multiple vendors' products, vendors increase the likelihood of purchase of their irrigation products and services by removing the barrier to growers of having to learn multiple data systems.

- **Technological Benefits:** Vendors can enable their equipment, farm management information system (FMIS) or decision support system (DSS) software to interact with a new irrigation application without having to rewrite specific code every time a partner's software program or application changes.

- **New Market Opportunities:** Working in partnership or in short-term alliances, vendors can create new market opportunities with data-driven products and services.

PAIL Irrigation Flow
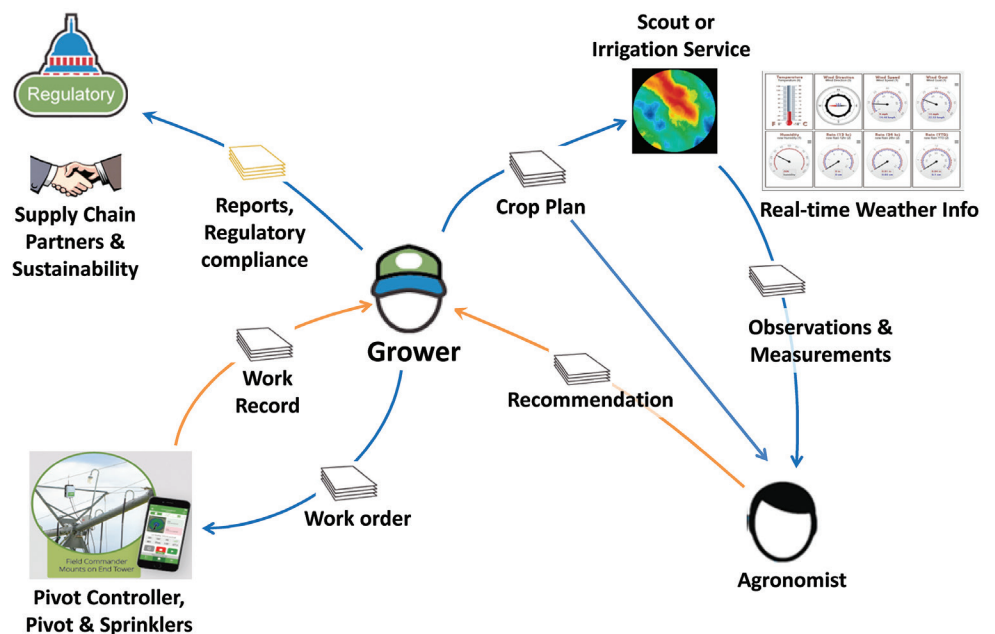
PAIL's vision for data flow in precision irrigation. Data sent by the grower is shown in blue; data going to the grower is shown in orange.

Questions?

Contact Dan Berne,
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(+1) 360.904.0968

pail.feedback@aggateway.org

For more information, including materials for joining PAIL, visit:

https://aggateway.atlassian.net/
wiki/x/1gATB

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Twitter: @AgGateway

What's in PAIL – Featured content

Field Observations: This body of work, an agricultural implementation of ISO 19156, standardizes observations and measurements from instruments in the field: readings from soil moisture monitors and sensors, probes, and weather stations. Weather forecasts for regional weather stations are also supported.

Irrigation Work Orders: Once the data is analyzed the irrigator can send a work order in standard PAIL format to a controller or equipment control system, where an OEM's proprietary commands can execute the request.

Irrigation Work Records: A record of how much water was applied, and where, can be sent for reporting or record-keeping purposes when requested.

The scope of PAIL and how it fits in with other AgGateway projects

	User Requirements	Process definitions	Data requirements	ISO Gap-checking	Infrastructure	Implementation
Reference data APIs	P1	P1	P1	P1	A, P2	P2
Soil Moisture Sensors	P1	P1	P1	P1	A, P2	P2
Field Weather Stations	P1	P1	P1	P1	A, P2	P2
Remote Weather	P1	P1	P1	P1	A, P2	P2
Irrigation Operations	P1	P1	P1	P1	A, P2	P2
Irrigation Work Records	P1	P1	P1	P1	A, P2	P2
Pumps, Flow Meters, Energy	P2	P2	P2	P2	A, P2	P2
Drip Irrigation	P2	P2	P2	P2	A, P2	P2
Surface & Laterals	P2	P2	P2	P2	A, P2	P2
Common Climate Data	P1	P1	P1	P1	P2	P2

KEY - A: ADAPT; P1: PAIL1; P2: PAIL2.

ADAPT is an open-source toolkit being developed by AgGateway to provide the industry with a common, standards-based data model for field operations, and to facilitate data format inter-conversion. Visit *www.adaptframework.org* for more information.

How you can get involved

- Contact us to discuss how to implement PAIL in your own solutions, and also to participate in future phases of the PAIL project.

- Contact Dan Berne (PAIL Project Manager, contact info at left) and discuss how to join the effort!

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Collaboration for eConnectivity

PICS in a Nutshell

PICS seeks to take the friction and guesswork out of using remote sensing in agriculture.

It uses an existing format (GeoTIFF) and metadata tags defined within it to specify what images *mean.*

The main deliverable of PICS is a freely-available implementation guideline.

"Before PICS we had to talk to the customer for hours, even days, to understand the content of their images, and everyone got frustrated. With PICS it takes seconds, and the computer does it alone." –Nathan Stein, senseFly

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Maximize the Value of your PICS!
Implement this new standard to better extract data from remote images

Remote sensing imagery has the potential to deliver great value to growers. Images from satellites, airplanes, and unmanned aerial systems ("drones") can be used to detect drought, pest damage, flooding, spatial patterns of canopy growth, and provide growers with an edge in crop management.

Growers need seamless interoperability to bring the images into their farm management information systems (FMIS) and convert them into actionable information in a straightforward way. This should happen regardless of the system manufacturer.

Remote sensing data formats have reached a point where they can describe the **geometry** of an image very accurately: the location of any image pixel is typically very clear to an FMIS without any human intervention. This is the natural consequence of decades of industry experience using imagery for photogrammetry and other mapping-related purposes.

The **meaning** of the data is a different problem, however. Over time images have become more complex: the black-and-white pictures used in photo-grammetry have given way to complex multispectral images involving red, green, blue, and infrared bands, often with very specific wavelengths and band widths. **The usability and scalability of remote sensing solutions in ag are often limited by incomplete descriptions (metadata) of this complexity;** i.e., the grower's FMIS can't automatically understand what the image means. The user has to get involved, and that leads to inefficiency and frustration.

PICS, a project of AgGateway's Precision Ag Council was chartered to tackle the problem. It was organized following a simple plan:

- Agree on gaps in current remote sensing image data that lead to interoperability pain points.

- Agree on a stepwise strategy to tackle the problem, based as much as possible on existing standards.

- Narrow the scope; focus initially on a single, popular image format.

- Create implementation guidelines as PICS' main deliverable.

Gaps and pain points

PICS focused on fundamentals with immediate impact for the industry: ensuring we can understand **when** an image was taken, **where** it was taken, **what** bands it contains and in what order, and identifying if the writing software is PICS-aware. Future PICS phases may involve creating a registry of derivative products (NDVI, etc.), expressing mathematical conversions from digital values to reflectances or irradiances, and so forth.
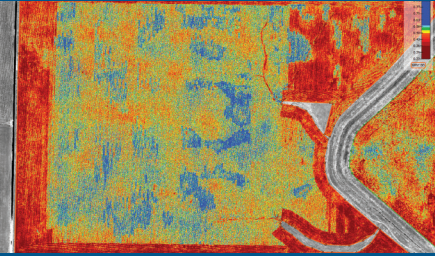
Modified Triangular Vegetation Index (MTVI) showing moisture in a corn crop captured by a drone in late season.

The PICS Deliverable

PICS members wrote an implementation guideline showing how to use GeoTIFF tags to solve the pain points in scope. Find it at http://bit.ly/2z90aeD or scan the QR code below.

PICS Members

As of November 17, 2017

Ag Connections, Ag Leader, Agrian, Agritrend, BASF, Bayer, DuPont Pioneer, Entira, Farmers Mutual Hail, John Deere, Land O' Lakes, Planet Labs, senseFly, Syngenta, SSI, Wilbur-Ellis

Questions?

Email us at:

pics.feedback@aggateway.org

For more information, including materials for joining PICS, visit:
http://www.aggateway.org

www.AgGateway.org

Member.Services@AgGateway.org

Phone: (+1) 866.251.8618
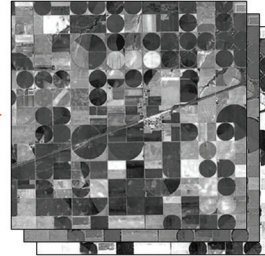
Twitter: @AgGateway

Scope, and how PICS works to enable data conversion

PICS narrowed its scope to GeoTIFF, a popular, royalty-free format with a sophisticated tagging system. The figure below shows how PICS uses it.
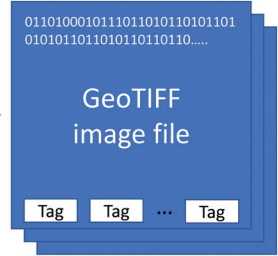

The satellite, airplane or UAV observes a scene.

The camera or radiometer captures one or more spectral bands

The band data is stored digitally in a file. The GeoTIFF format defines tags for metadata.

PICS' deliverable is an implementation guideline to ensure the tags are used consistently and convey information needed by FMIS software: band definitions, band order, geometry and acquisition time.

Pain points and the GeoTIFF tags used to solve them

Pain point	Why it hurts	The PICS solution
Band order	Identifying individual bands in multi-channel images often requires a sidecar file or arbitrary naming conventions.	**Implement the standard tag** Xmp.Camera.BandName
Band Definition	An accurate description of a band's width and central wavelength enables knowing if it can be used to make specific indexes and other products.	**Implement two standard tags:** Xmp.Camera.CentralWavelength Xmp.Camera.WavelengthFWHM
Acquisition Time & Duration	Knowing when an image was captured helps sort files for proper analysis, and flag / filter unwanted data. This is important with long UAV acquisition times.	**Implement three standard tags:** Exif.GPSInfo.GPSDateStamp Exif.GPSInfo.GPSTimeStamp Xmp.Camera.AcquisitionDuration
Projection Information (Geolocation)	It's critical to locate individual image pixels, and support multiple coordinate systems and projections.	PICS chose the GeoTIFF image format because it natively enables the needed functionality.
PICS compliance & version	Can the FMIS trust that the tags are used in a PICS-compliant way?	A private AgGateway tag is added to the image. See the implementation guide for details.

More PICS features

- All the PICS metadata is contained within the GeoTIFF file itself: there are no sidecar or auxiliary files to lose!
- Most of the tags used by PICS are standard XMP or EXIF standard tags, and can be read with open-source tools like GDAL.
- The metadata is public domain, and the format is free to use.
- The PICS approach enables adding AgGateway field operations data to the image. This can grow in the direction of including weather data, scouting, etc.

If you are interested in remote sensing in ag, contact us! Learn more about the project and implement this standard in your organization!

Collaboration for eConnectivity

SPADE Assists
- **Seeding**
- **Crop Scouting**
- **Crop Nutrition**
- **Crop Protection**
- **Harvesting**
- **Grain Handling**
- **Asset Manage ment**
- **Regulatory Compliance**
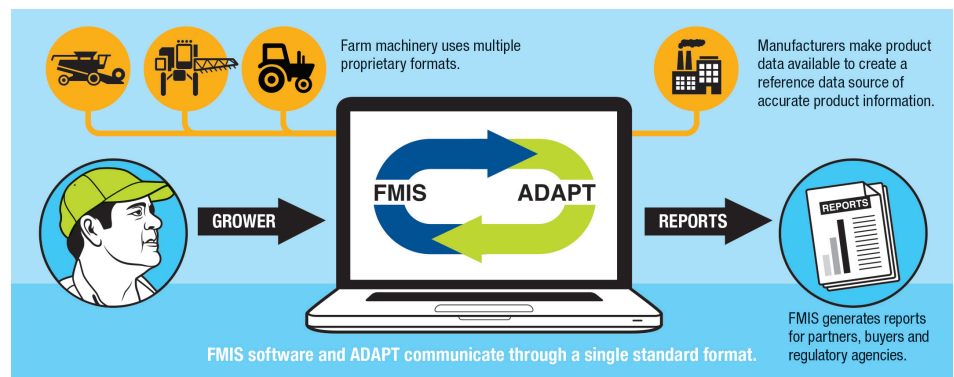
SPADE Delivers
- **Best Practices**
- **Use Cases**
- **Process Models**
- **International Context**
- **ISO11783, ISO19156, and AgXML standard alignment**
- **Specs and Toolkits**
- **Reference Data**
- **Data Exchange APIs**

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Data Challenges?

The Standardized Precision Ag Data Exchange (SPADE) Project is a collaboration among suppliers of agricultural hardware, software, inputs, services, implements and vehicles for improved data exchange and interoperability. It targets field operations of seeding, tillage, crop nutrition, crop protection and harvest to maximize the value of precision agriculture through seamless and transparent data exchange.

SPADE seeks to:

- Establish a framework of standards to simplify mixed-fleet field operations, regulatory compliance, crop insurance reporting, traceability, sustainability assessment and field or crop-scale revenue management.

- Allow seamless data exchange between hardware systems and software applications that collect field data across farming operations.

- Make it easier for growers to share data with their trusted advisors, suppliers, and other value partners, who often use different system components.

- Lower the cost of entry for growers and ag retailers who want to use precision ag, through transparent data exchange and interoperability.

- Support growers' field operations management data needs in local, state, national and international environments.

Farm machinery uses multiple proprietary formats.

Manufacturers make product data available to create a reference data source of accurate product information.

GROWER

FMIS   ADAPT

REPORTS

REPORTS

FMIS software and ADAPT communicate through a single standard format.

FMIS generates reports for partners, buyers and regulatory agencies.

SPADE's vision for data flow in precision agriculture. Reference data helps ensure that things mean the same for all participants.

Questions?

Contact Jim Wilson,

SPADE Project Manager

(+1) 816.516.8847

jim.wilson@aggateway.org

For more information, including materials for joining SPADE3, visit:

https://aggateway.atlassian.net/wiki/x/vgFwAw

www.AgGateway.org

Member.Services@AgGateway.org

Phone: (+1) 866.251.8618

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What's New in SPADE3 – Featured content

WAVE: Originally arising from work by the Precision Ag Council's Telematics group, this product will identify standards and provide tools for mobile and fixed asset management.

CART: Originating in AgGateway's Grain Council, CART looks to expand and implement standardized messages from the widely-adopted AgXML standards for rail and truck grain transport. The scope includes tying loads from field machinery to scale data.

Crop Nutrition: SPADE3 will capture data exchange requirements for chemical fertilizer and manure use cases, propose enhancements to ISO11783 as needed, and provide requirements to the ADAPT toolkit.

The scope of SPADE3, and how it fits in with other AgGateway projects

	Requirements	Process definitions	Data requirements	Standards Gap-Checking	Infrastructure	Implementation
Reference data APIs	S1	S2	S2	-	S3	S3
Seeding operations	S1	S1	S1	S1	A	S3
Harvest operations	S2	S2	S2	S2	A	S3
Crop protection operations	S2	S2	S2	S2	A	S3
Crop nutrition operations	S3	S3	S3	S3	A	
Grain handling (CART)	S3	S3	S3	S3		
Crop scouting operations	S3	S3	S3	S3	A	
Telematics (WAVE)	S3	S3	S3	S3		
Sensor and weather data	P1	P1	P1	P1	P2	P2
Irrigation Operations	P1	P1	P1	P1	P2	P2

KEY - S1: SPADE1; S2: SPADE2; S3: SPADE3; A: ADAPT; P1: PAIL1; P2: PAIL2.

PAIL is a sibling project within AgGateway's Precision Ag Council; ADAPT is an open-source toolkit being developed by AgGateway to provide the industry with a common, standards-based data model for field operations, and to facilitate data format interconversion.

How you can get involved

- SPADE needs much more than strictly technical work: if you're an expert in the business or agronomy aspects of what we're working on, your user stories will help enrich the project deliverables and make SPADE deliverables better for the entire industry.

- Contact Jim Wilson (SPADE Project Mgr.) and discuss how to join the effort!

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