The John Deere Harvester ID Data Import Plugin for ADAPT

Authored by Michael Figura
Sponsored by Cotton Incorporated

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Purpose

The purpose of this plugin is to import information from the harvester ID data file into the ADAPT data model. The ADAPT data model acts as a universal agricultural lexicon for ag data. Once data is in the ADAPT data model, you can leverage this format for easy interoperability into other formats that share communication between their format and the ADAPT data format. This allows for multiple input and output formats to be interoperable with each other within the Agriculture community.

The ADAPT initiative was designed for this reason, so that all the Agricultural data formats around the world can coexist in an agreed upon data format. Getting your data into the ADAPT data model means you are one step closer to being exported into another Ag related information system, and one step closer to better information results.

Audience

The recommended audience for the harvester ID ADAPT plugin are individuals who are familiar with harvester ID data, as well as those familiar with or interested in ADAPT formatted data. The USDA Harvester ID database produces a flat file that serves as the expected input for this plugin. Individuals using this plugin can find the information related to the flat file layout in the architecture section of this document.

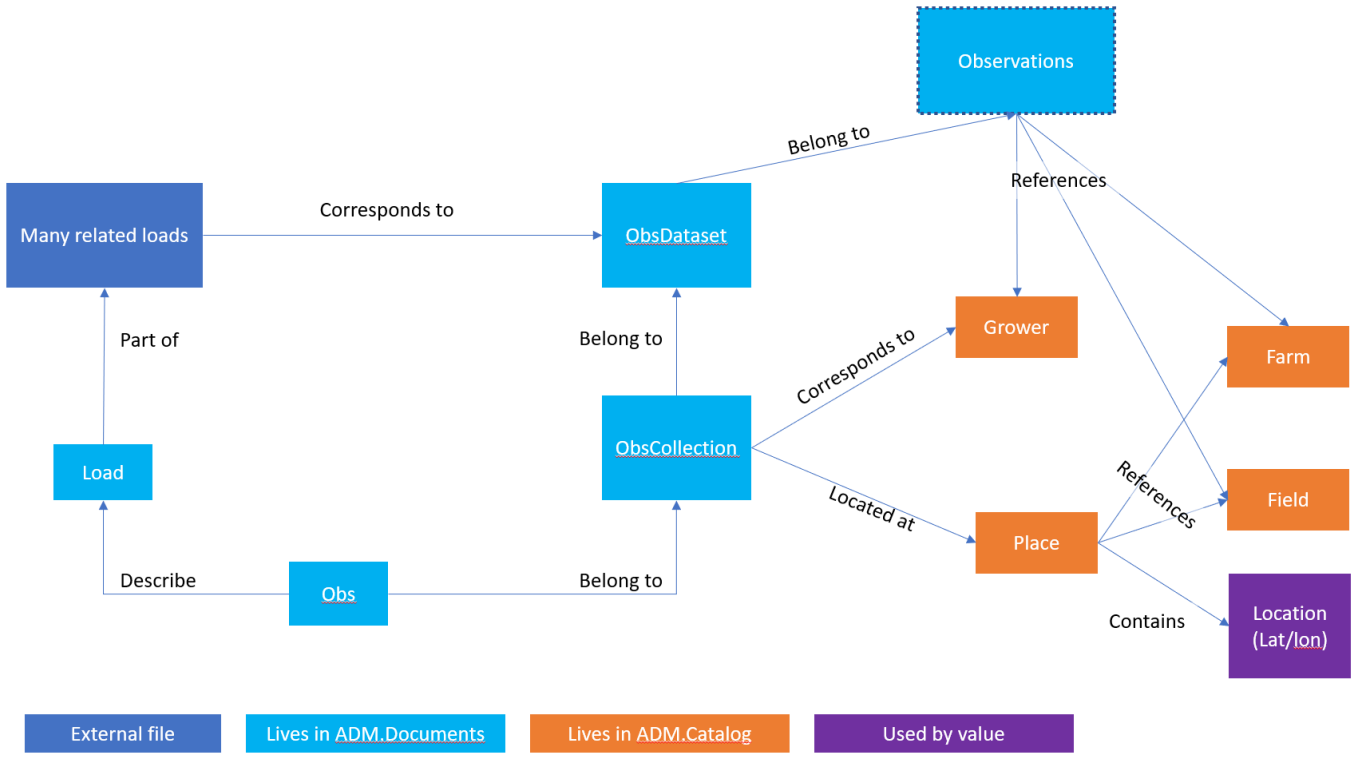
Finally, developers who are interested in using this plugin and modifying it must be familiar with the technologies in the next section.

Development Requirements

The ADAPT data model is written in C#, and this plugin is written in C#. Developers interested in using and modifying this plugin must be proficient in C#. Additionally, developers must have a proficient understanding of modern object-oriented programming techniques. Anyone interested in learning the ADAPT framework can find valuable resources including video tutorials at the ADAPTFramework.org website.

Architecture

During the import process, the cotton plugin converts the data from flat file to a basic object model. After converting the information into a model in memory, the plugin creates an ADAPT document object, and loops through each individual record (considered a load), creating a set of observations for that unique load.



Cotton Keys

The following cotton keys were required for this ADAPT import implementation:

Observations:

Name	Description	Class	Comments	Data Type	Example

CC_FOI_CROP	EPPO code for crop	CC on ObsColl	Code Component on the Observation Collection with Crop EPPO Id as a Feature of Interest.
			We have heard from both Cotton Inc. and John Deere that we cannot determine whether the crop is Upland (GOSHI) or Pima (GOSBA) from the file. Moreover, this field is NOT being sent or used? We will use the EPPO code 1GOSG for the Gossypium genus.
				String	If 1, then value = GOSHI; if 2, value = GOSBA
					{
					"componentCode": "CC_FOI_CROP",
					"componentType": "FEATURE_OF_INTEREST"
					"selector": "CROP",
					"value": "<insert crop here>"
					}

CC_FOI_CROP_VARIETY_NAME	Name of crop variety	CC on ObsColl	Cotton variety inside the module. Code Component with variety name as a Feature of Interest. We can determine crop variety, only if the variety information is entered as we know what varieties are pima and upland. But no flags are set for cotton species. Add the FOI to observation collection.	String	{
					"componentCode": "CC_FOI_CROP_VARIETY_NAME",
					"componentType": "FEATURE_OF_INTEREST",
					"selector": "CROP_VARIETY_NAME",
					"value": "ST 4946GLB2"
					}

CC_PARAM_GROWER_NAME	Client who's field is being harvested. This is only available through a separate JD V2 query and must be merged into the JSON payload manually before submitting to the plugin.	CC on ObsColl	String. Treat as Parameter on ObsCollection	String	{ "componentCode": "CC_PARAM_GROWER_NAME", "componentType": "PARAMETER", "selector": "GROWER_NAME", "value": "Big H Farms, Inc." }
CC_FOI_FARM_NAME	Farm being harvested. This is only available through a separate JD V2 query and must be merged into the JSON payload manually before submitting to the plugin.	CC on ObsColl	String. Treat as Feature of Interest on Obs COllection	String	{ "componentCode": "CC_FOI_FARM_NAME", "componentType": "FEATURE_OF_INTEREST", "selector": "FARM_NAME", "value": "Big H Farm 1" }
CC_FOI_FIELD_NAME	Field identification. This is available as a link in the JSON. A GUID is available if needed. This is only available through a separate JD V2 query and must be merged into the JSON payload manually before submitting to the plugin.	CC on ObsColl	String. Treat as Feature of Interest on Obs COllection	String	{ "componentCode": "CC_FOI_FIELD_NAME", "componentType": "FEATURE_OF_INTEREST", "selector": "FIELD_NAME", "value": "Back 40" }
A_YLD_MOISTURE	Moisture content measured by harvester	Obs	Observation. The moisture sensor is in the baling chamber and measures while the machine is operating. Units are "percent moisture content, wet basis (w.b.)" This is measured as a decimal %.	Decimal	"moisture": { "@type": "EventMeasurement", "value": 19.39, "unitId": "prcnt" }
A_YLD_1GOSG_MODULE_DIAMETER	Diameter of the module in centimeters or inches	Obs	Observation. It is the diameter of the end of the cylindrical module created by the machine measured in centimeters (cm) or inches (in), depending on how the Deere API was called. The plugin passes the received unit of measure on to the application data model.	Decimal	"diameter": { "@type": "EventMeasurement", "value": 180, "unitId": "cm" }

CC_FOI_FIELD_NAME	Field identification. This is available as a link in the JSON. A GUID is available if needed.	CC on ObsColl	String. Treat as Feature of Interest on Obs COllection	String	{ "componentCode": "CC_FOI_FIELD_NAME", "componentType": "FEATURE_OF_INTEREST", "selector": "FIELD_NAME", "value": "Back 40" }
A_YLD_WMAS_TOTAL	Weight of the module in kilograms or lbs	Obs	Observation. It is weight in kg (or lb) per module without correction for moisture content. Units: kilograms (or lbs) of seed cotton per module.	Decimal	"weight": { "@type": "EventMeasurement", "value": 5178.65568507, "unitId": "kg" }
M_1GOSG_MODULE_DROP	Event bearing Location where the module was deposited / removed from the machine	Obs	This is when the bale/module was released from the cradle. The key is the Lat/Lon that are encoded as the spatialExtent of the Obs (i.e., not overridden by the ObsColl lat/lon) Since an Obs MUST have a phenTime and this is APPARENTLYunknown, the best we can do is inherit the phenTIme of the ObsColl. NOTE: If the drop time of the module becomes available, THAT should be the phenTime. FInal note: The value of the Obs is a dummy Boolean, always set to TRUE.	Spatial Extent	"dropLocation": { "@Type": "Point", "lat": 43.6187, "lon": 116.2146 }
A_YLD_AREA_PER_BALE	Area of the field harvested for the module associated with this data record in square meters. Hectares ("ha") by default and acres ("ac") if specified in the header.	Obs	Observation. This is the area that was harvested to make the round module in a unit of area that depends on query parameters. [Wet mass divided by this area gives seed cotton yield in kg/lb per ha/ac]. Original column comment: Area of the field harvested	Decimal	

			for the module associated with this data record in square meters. "ha" by default and "ac" if specified in the header.		
M_1GOSG_MODULE_CUMULATIVE_FIELD_AREA	Cumulative area of the field harvested at the time that module was made (square meters). Cumulative area of the field harvested at the time that module was made (square meters). THIS HAS BEEN DEPRECATED IN THE JSON API.	Obs	number	Decimal	5748
M_1GOSG_SEASON_TOTAL_MODULES	Cumulative count of modules for the season. Season total number of modules made by that machine. THIS HAS BEEN DEPRECATED IN THE JSON API.	Obs	number	Numeric	

Context Items:

Name	Description	Class	Comments	Data Type	Example
M_JD_1GOSG_MODULE_ID	24 character string encoded on the RFID tag with RFID position (character 15) set to 0. Note this “Module ID” does not conform to the ASABE standard S647	ContexItem	JD Description: Module RFID	string	3500B988061103035A9439F5
M_JD_1GOSG_MODULE_SN	11 digit serial number unique to that module for John Deere based wraps. First two digits equal year wrap manufactured. The last nine characters of the module ID is the hexadecimal form of the serial number.	ContexItem	JD Description: Module Serial Number	string	14404565493
	UTC date	phenTime on ObsColl	Date when the module wrap started (GMT)	UTC date	3/22/2019

	UTC time	phenTime on ObsColl	Time when the module wrap started (GMT)	UTC time	08:48:20Z
(phenTime on ObsColl)	GMT date & time	ObsColl (merge 2 above)	We manually create this in the plugin code.		2018-10-08T15:53:24.000Z
M_JD_1GOSG_HID_MACHINE_PIN	Unique identification nur harvester	ContextItem	Machine PIN	String	PCFVUGALC0067
M_JD_1GOSG_HID_OPERATOR	Person driving harvester	ContextItem	Machine Operator	String	John Doe
M_JD_1GOSG_HID_GIN_ID	Identification for gin cott	ContextItem	Gin ID	String	AB123456
M_JD_1GOSG_HID_PRODUCER_ID	Code for producer name	ContextItem	Producer ID	String	AB123456
M_JD_1GOSG_HID_COMMENT	Text comments	ContextItem		String	
M_JD_1GOSG_HID_TAG_COUNT	Number of tags that are p Number of times RFID Ta Harvester	ContextItem	Number of times the RFID tags were read while the module wrap was being applied	Numeric	5

Supported Files

The John Deere import plugin support two unique formats for file import format. The first is the original JD HID flat file, which is the format downloaded from the JD v1.0 HID interface, and is represented as illustrated below in flat file CSV (Comma Separated Value) format.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	3500B988(	16405963848	32.68529	-91.324881	9/15/2017	17:02:49	3	Herrington	Bell	1	312	1N0C690PKH4065095				02:02:49	6975	1	11.1	238	0	32.685252	-91.32589	1	6975	9/16/2017
2	3500B988(	16405963847	32.68681	-91.324777	9/15/2017	19:05:46	2	Herrington	Bell	1	312	1N0C690PKH4065095				04:05:44	12451	2	10.1	226	2208	32.686921	-91.32096	2	5476	9/16/2017
3	3500B988(	16405963846	32.68689	-91.325602	9/15/2017	19:21:41	2	Herrington	Bell	1	312	1N0C690PKH4065095				04:21:40	18867	3	9.5	238	2545	32.687025	-91.32097	3	6416	9/16/2017
4	3500B988(	16405963845	32.6871	-91.327341	9/15/2017	19:29:39	2	Herrington	Bell	1	312	1N0C690PKH4065095				04:29:36	24867	4	9.9	237	2542	32.68734	-91.320969	4	6000	9/16/2017
5	3500B988(	16405963844	32.68759	-91.325131	9/15/2017	19:56:15	3	Herrington	Bell	1	312	1N0C690PKH4065095				04:56:13	30584	5	10	236	2572	32.687526	-91.327111	5	5717	9/16/2017
6	3500B988(	16405963843	32.68782	-91.324358	9/15/2017	20:05:03	2	Herrington	Bell	1	312	1N0C690PKH4065095				05:05:03	36968	6	9.9	239	2521	32.687748	-91.326743	6	6384	9/16/2017
7	3500B988(	16405963842	32.68799	-91.325492	9/15/2017	20:14:08	3	Herrington	Bell	1	312	1N0C690PKH4065095				05:14:07	43717	7	9.9	239	2529	32.68821	-91.321696	7	6749	9/16/2017
8	3500B988(	16405963841	32.68832	-91.324888	9/15/2017	20:22:44	3	Herrington	Bell	1	312	1N0C690PKH4065095				05:22:43	49878	8	10.2	237	2472	32.688391	-91.322565	8	6161	9/16/2017
9	3500B988(	16405963840	32.68839	-91.322477	9/15/2017	20:33:10	3	Herrington	Bell	1	312	1N0C690PKH4065095				05:33:09	54825	9	10.4	214	0	32.688385	-91.322427	9	4947	9/16/2017
10	3500B988(	16405963839	32.72877	-91.317891	9/15/2017	21:21:13	3	Herrington	Bell	2	312	1N0C690PKH4065095				06:21:12	12638	10	0	237	2676	32.728791	-91.316499	1	12638	9/16/2017
11	3500B988(	16405963838	32.72822	-91.319449	9/15/2017	21:34:26	3	Herrington	Bell	2	312	1N0C690PKH4065095				06:34:24	21658	11	0	237	2620	32.728195	-91.321247	2	9020	9/16/2017
12	3500B988(	16405963837	32.72784	-91.316899	9/15/2017	21:48:58	3	Herrington	Bell	2	312	1N0C690PKH4065095				06:48:56	31485	12	0	239	0	32.727823	-91.318119	3	9827	9/16/2017
13	3500B988(	16405963836	32.7275	-91.318863	9/15/2017	22:02:16	4	Herrington	Bell	2	312	1N0C690PKH4065095				07:02:14	40682	13	0	237	2613	32.727528	-91.316975	4	9197	9/16/2017
14	3500B988(	16405963835	32.72732	-91.320524	9/15/2017	22:17:03	3	Herrington	Bell	2	312	1N0C690PKH4065095				07:17:02	49322	14	0	238	0	32.727306	-91.321268	5	8640	9/16/2017
15	3500B988(	16405963834	32.72703	-91.318621	9/15/2017	22:32:02	3	Herrington	Bell	2	312	1N0C690PKH4065095				07:32:00	58421	15	0	239	0	32.727017	-91.319581	6	9099	9/16/2017
16	3500B988(	16405963833	32.72684	-91.317224	9/15/2017	22:50:09	3	Herrington	Bell	2	312	1N0C690PKH4065095				07:50:08	67527	16	0	239	2698	32.726828	-91.318128	7	9106	9/16/2017
17	3500B988(	16405963832	32.72664	-91.317044	9/15/2017	23:09:00	3	Herrington	Bell	2	312	1N0C690PKH4065095				08:08:58	77005	17	0	240	0	32.726623	-91.317981	8	9478	9/16/2017
18	3500B988(	16405963831	32.72643	-91.317167	9/15/2017	23:23:54	3	Herrington	Bell	2	312	1N0C690PKH4065095				08:23:52	86349	18	0	240	0	32.72641	-91.31813	9	9344	9/16/2017
19	3500B988(	16405963830	32.726	-91.317836	9/15/2017	23:38:39	3	Herrington	Bell	2	312	1N0C690PKH4065095				08:38:36	95636	19	0	238	0	32.725978	-91.319033	10	9287	9/16/2017
20	3500B988(	16405963829	32.72571	-91.319274	9/16/2017	00:00:06	3	Herrington	Bell	2	312	1N0C690PKH4065095				09:00:04	105012	20	0	238	0	32.725694	-91.320504	11	9376	9/16/2017
21	3500B988(	16405963828	32.72516	-91.321266	9/16/2017	00:14:23	4	Herrington	Bell	2	312	1N0C690PKH4065095				09:14:22	114653	21	0	238	2716	32.725222	-91.317545	12	9641	9/16/2017
22	3500B988(	16405963827	32.72477	-91.319665	9/16/2017	00:28:49	3	Herrington	Horn	1	312	1N0C690PKH4065095				09:28:46	123871	22	0	237	0	32.724785	-91.318425	13	9218	9/16/2017
23	3500B988(	16405963826	32.72436	-91.319088	9/16/2017	00:41:48	3	Herrington	Horn	2	312	1N0C690PKH4065095				09:41:46	132437	23	0	238	0	32.724375	-91.317986	14	8566	9/16/2017
24	3500B988(	16405963825	32.72308	-91.31836	9/16/2017	00:56:41	3	Herrington	Horn	2	312	1N0C690PKH4065095				09:56:40	141219	24	0	240	0	32.724047	-91.318376	15	8782	9/16/2017
25	3500B988(	16405963824	32.72312	-91.319537	9/16/2017	01:13:48	3	Herrington	Horn	3	312	1N0C690PKH4065095				10:13:46	148952	25	0	236	2793	32.723978	-91.319673	16	7733	9/16/2017
26	3500B988(	16405963823	32.72405	-91.321219	9/16/2017	01:30:38	3	Herrington	Horn	4	312	1N0C690PKH4065095				10:30:36	157450	26	0	240	2891	32.724098	-91.321036	17	8498	9/16/2017
27	3500B988(	16405963822	32.72407	-91.321168	9/16/2017	01:41:21	2	Figura Farms	Cross Creek	1	312	1N0C690PKH4065095				10:41:18	161324	27	0	160	1248	32.724096	-91.318883	18	3874	9/16/2017
28	3500B988(	16405963821	32.75557	-91.218454	9/19/2017	17:25:49	2	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				12:25:48	10928	28	12.5	237	2651	32.755641	-91.210349	1	10928	9/19/2017
29	3500B988(	16405963820	32.75565	-91.21488	9/19/2017	17:34:39	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				12:34:37	17723	29	11.5	238	2608	32.755626	-91.218225	2	6795	9/19/2017
30	3500B988(	16405963819	32.75578	-91.211519	9/19/2017	17:43:43	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				12:43:42	24615	30	11.2	237	2540	32.755727	-91.218237	3	6892	9/19/2017
31	3500B988(	16405963818	32.75582	-91.213237	9/19/2017	17:52:11	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				12:52:10	31207	31	11.4	239	2551	32.755841	-91.210451	4	6592	9/19/2017
32	3500B988(	16405963817	32.75589	-91.216755	9/19/2017	18:03:02	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:03:02	38066	32	11.2	237	2533	32.755938	-91.210463	5	6859	9/19/2017
33	3500B988(	16405963816	32.75594	-91.216389	9/19/2017	18:11:38	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:11:38	44776	33	11.3	239	2600	32.755924	-91.218251	6	6710	9/19/2017
34	3500B988(	16405963815	32.75607	-91.21283	9/19/2017	18:21:03	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:21:02	51625	34	11.2	238	2554	32.756021	-91.218239	7	6849	9/19/2017
35	3500B988(	16405963814	32.75612	-91.211895	9/19/2017	18:29:57	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:29:56	58255	35	10.8	239	2541	32.756135	-91.21046	8	6630	9/19/2017
36	3500B988(	16405963813	32.75619	-91.215868	9/19/2017	18:38:41	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:38:40	64883	36	10.5	238	2529	32.756235	-91.210462	9	6628	9/19/2017
37	3500B988(	16405963812	32.75623	-91.216657	9/19/2017	18:46:48	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:46:48	71260	37	10.4	238	2489	32.756219	-91.218243	10	6377	9/19/2017
38	3500B988(	16405963811	32.75637	-91.212466	9/19/2017	18:55:23	3	Condrey Farms	Hollybrook	hb4	4949	1N0C690PKH4065095				13:55:22	77772	38	10.7	238	2515	32.756319	-91.218263	11	6512	9/19/2017

The second file format is in JSON format and is created by interacting with the new JD HID v2.0 rest interfaces to retrieve the data required for the historical business information payload. There are multiple interfaces required to hit, in order to collect the data in the following JSON format. Documentation for querying information using the new HID v2.0 rest interfaces can be found at John Deere's developer website.

```
{
  "links": [
    {
      "rel": "self",
      "uri": "https://sandboxapi.deere.com/platform/organizations/913523/harvestIdentificationModules"
    }
  ],
  "total": 2,
  "values": [
    {
      "links": [
        {
          "rel": "self",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523/harvestIdentificationModules/14404565493"
        },
        {
          "rel": "org",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523"
        },
        {
          "rel": "field",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523/fields/e48a7dd0-9af2-44e1-81b4-435d494f7cd5"
        }
      ],
      "moduleSerialNumber": 14404565493,
      "moduleId": "3500B988061103035A9439F5",
      "wrapLocation": {
        "@Type": "Point",
        "lat": 43.6187,
        "lon": 116.2146
      },
      "wrapDateTime": "2019-03-22T08:48:20Z",
      "localWrapDateTime": "2019-03-22T08:48:20",
      "dataIngestionDate": "2019-03-22T08:48:20Z",
      "tagCount": 5,
      "varietyName": "Cotton ABC",
      "machinePin": "PCFVUGALC0067",
      "operator": "John Doe",
      "ginId": "AB123456",
      "producerId": "AB123456",
      "moisture": {
        "@type": "EventMeasurement",
```

```
        "value": 0,
        "unitId": "gal1ac-1."
      },
      "diameter": {
        "@type": "EventMeasurement",
        "value": 0,
        "unitId": "gal1ac-1."
      },
      "weight": {
        "@type": "EventMeasurement",
        "value": 0,
        "unitId": "gal1ac-1."
      },
      "dropLocation": {
        "@Type": "Point",
        "lat": 43.6187,
        "lon": 116.2146
      },
      "incrementalArea": {
        "@type": "EventMeasurement",
        "value": 0,
        "unitId": "gal1ac-1."
      },
      "comment": "Here is a comment"
    },
    {
      "links": [
        {
          "rel": "self",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523/harv
estIdentificationModules/14404565493"
        },
        {
          "rel": "org",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523"
        },
        {
          "rel": "field",
          "uri": "https://sandboxapi.deere.com/platform/organizations/913523/fiel
ds/e48a7dd0-9af2-44e1-81b4-435d494f7cd5"
        }
      ],
      "moduleSerialNumber": 14404565493,
      "moduleId": "3500B988061103035A9439F5",
      "wrapLocation": {
```

```
        "@Type": "Point",
        "lat": 43.6187,
        "lon": 116.2146
      },
      "wrapDateTime": "2019-03-22T08:48:20Z",
      "localWrapDateTime": "2019-03-22T08:48:20",
      "dataIngestionDate": "2019-03-22T08:48:20Z",
      "tagCount": 5,
      "varietyName": "Cotton ABC",
      "machinePin": "PCFVUGALC0067",
      "operator": "John Doe",
      "ginId": "AB123456",
      "producerId": "AB123456",
      "moisture": {
        "@type": "EventMeasurement",
        "value": 0,
        "unitId": "gal1ac-1."
      },
      "diameter": {
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Conclusion

This plugin is part of a larger project effort to unify data collected between the farm, field, gin and farm management information system for the cotton industry. This initiative also builds on an industry history of providing material property data to cotton textile customers. This is an ongoing digital transformation project for the cotton industry at large, unifying data collected throughout the cotton harvest and ginning process. Users of this plugin will benefit from the alignment of data from the cotton classing database with other information collected during the cotton harvest and refinement process and can utilize this information later in time during reporting and data analysis.

By leveraging ADAPT (with which farm management information systems ("FMIS") companies have multiple motivations to integrate), FMIS can provide growers with a user-friendly framework to evaluate and improve the sustainability of their operations.

A great deal of data is now automatically collected by agricultural and ginning machinery. Additionally, the ability to add automated measurement such as processing rate and energy use is possible with minimal costs and modification to the gin. There are also emerging needs to share data to support sustainability and traceability programs.

Cotton Incorporated has sponsored the development of this ADAPT "plug-in" for cotton classing data to make it easier for ag software providers to support cotton specific data.