White Paper

Incorporating Data from External Sources with SpatialWorx Mobile Data Adapters

Extend your field data solutions with your own existing data or data from a variety of other sources

Charles Raffensperger

Byers Engineering Company – SpatialAge Solutions Division

February, 2020

SpatialWorx

White Paper

SpatialWorx

Extend your field data solutions with your own existing data or data from a variety of other sources

Abstract

The SpatialWorx system is designed to enable organizations to view, manage, and collect location-based data in the field and use that information to their advantage - whether it's to share with other parties and affiliates, provide rich and informative maps to field personnel, or use it for analysis and reporting to make more informed decisions. In many cases an organization may only have a need to collect raw data, without the need to reference or augment it with data from other existing internal or external sources. Others, however, may have their own existing datasets, in a variety of different formats, which they wish to extend to field users. Still others may want to tap into the vast array of GIS web services (WFS) to provide field users with additional mapping data for reference, such as census information, parcel and land-use overlays, or weather conditions.

To satisfy this essential requirement, for a method to incorporate data from many different data sources, SpatialWorx contains a set of Data Adapters that allow you to easily connect to remote data objects and utilize them natively in your field solution. And although there are many flat file types that can be imported into SpatialWorx from external sources, they are not, by design, processed by the system using Data Adapters. Hence they are not covered explicitly in this document, other than descriptions of them as one of several different data sources that can be utilized in any solution.

This document describes the concept of Data Adapters, what they are used for, how they function in SpatialWorx, and which specific source data types are supported.

SpatialWorx Data Adapters

What are Data Sources?

A data source is an electronically connected source of information typically stored in some sort of collection. Data sources are supplied to field users in the SpatialWorx App via a particular Project (or Projects).

It can represent an external source, such as a database table, Shapefile, or web service, or it can simply represent an internal source via the creation of a new form using the Form Builder tool or selection of a Project Template. A data source is the most fundamental level of data organization in SpatialWorx and the definition of one or more data sources is the first step in the process of building a Project definition. The Web Console interface provides users with an intuitive interface for establishing connections to various data sources or building them from scratch using the Form Builder.

Once a data source is established, it (all or any part of it) is made available to any new Projects that are created or to any Projects that already exist. Part of the Project definition process involves the user following these steps in the web console:

1. Selecting one or more data sources and optionally specifying criteria to filter out only some (a subset) of the data from each source
2. Select the data source into the Project as a map layer that will be distributed to all users on their devices
3. Optionally customize the visual characteristics of the layer (the graphical symbology)
4. Optionally customize which attributes of the data source are available to end users through the layer's form, text labels, etc.

A single data source can also optionally be referenced by one or more Project layers such that multiple Projects can view and work with the same data. For example, you may have a Project that involves inspection of a particular asset such as a power pole. For that Project you're interested in physical characteristics of the pole so you can assess its condition. But you also have a need to track the attachments on the pole and logically want to separate that work out as part of another Project. Both Projects have a need to independently view the same data source and SpatialWorx easily supports both of those solutions natively in its architecture.

Why Data Adapters?

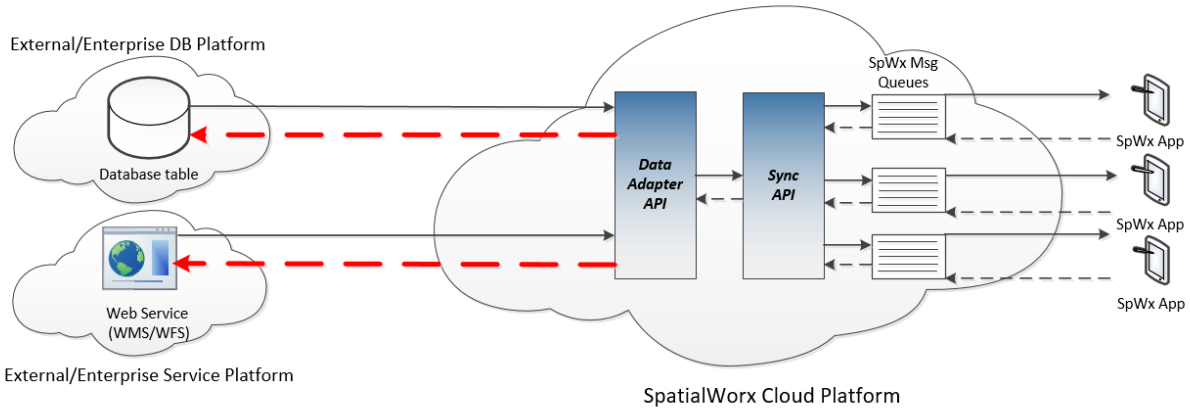
In many scenarios involving raw, location-based data collection the field user starts with a blank map and adds objects (as map features) to represent assets or conditions they encounter as they complete an inspection or survey. In that case there may be no need to augment the field dataset with additional information to use as a reference, or there may not be any other data available for the field user to view

or update. As new data is collected in this manner it is synced up to SpatialWorx's data store in the cloud and distributed to other field users on their devices.

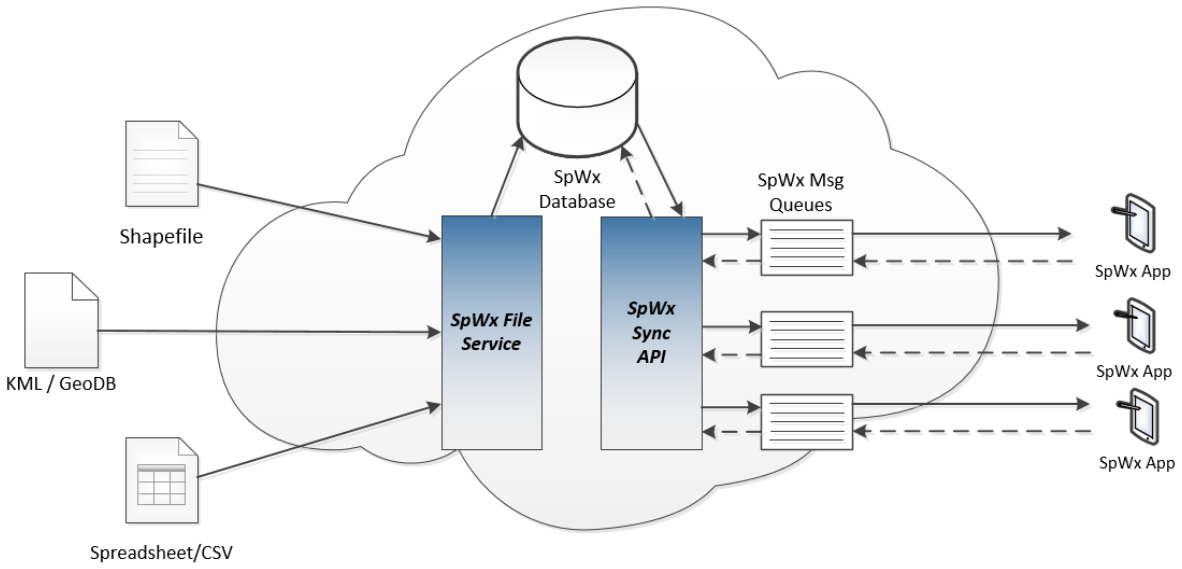
However, in many cases an organization may have their own original dataset(s) that they wish to have taken to the field as references. Or they may have a requirement to pull in data from other external sources. This data may be stored in a standard relational database, in any of several different flat file types (Shapefiles, CSV, KML, etc.), or it may be data from any of a host of different web services or RSS feeds. And while most of the remote data an organization may want to supply to field users is spatial and geo-referenced (so it can be shown on the map in the SpatialWorx App) there may also be a need for non-spatial (tabular) data that can be used in lookup formulas, option lists in data collection forms, or for other purposes. Additionally, you may have other sources of data that *are* spatial but are *not* geo-referenced such as CAD drawings or various raster file formats (including hand drawn maps). While SpatialWorx currently does not provide tools to geo-reference file data of this type there are other tools available to do that prior to bring that data into this system.

The SpatialWorx architecture, at its core, is designed specifically around the concept of providing a platform to aggregate data from many different sources into a single, unified view of all the information of interest so you can realize the maximum benefit from the data you collect and/or manage. Data Adapters are a powerful toolset that offer you incredible flexibility to select and combine data from many different sources and use it to your best advantage.

This simple illustration depicts external source data that SpatialWorx Data Adapters can connect to and feed to all app devices through the OVM Sync API as queued messages.



This simple illustration depicts file based sources whose data is imported directly into the SpatialWorx database and fed to all app devices when requested, using the same Sync API as for non-file based data sources.



SpatialWorx Cloud Platform

That flexibility is also baked into the fabric of the Project model in SpatialWorx, which expands on the versatility that the Data Adapters provide. While that concept will be covered in more detail in another whitepaper, the basic concept is this:

- You set up connections to any desired data sources, whether it's your own data from an accessible relational database, a file you select, or a web service
- All of the data sources you select are made available to *any* Project(s) you create and are available in the maps field users access in the SpatialWorx App
- More than one Project can point to a single data source – so in essence a data source can optionally be shared between different Projects
- Filters can also be optionally defined at the Project level so field users see and work with only a subset of the data from a shared data source

What are Data Adapters?

A Data Adapter is a web service in SpatialWorx that acts as a proxy to remote data sources such as relational tables from various RDBMS, legacy system interfaces, application APIs, web services (WFS, ArcGIS), and GeoRSS feeds. Data Adapters allow for the retrieval of data from remote sources so it can be provisioned in Project packages and distributed to field users in the SpatialWorx App. The import capability of file-based external data sources, while also an important feature of the system, is handled by a different mechanism than Data Adapters and as such is not explicitly detailed in this document.

Data Adapters pull data directly from the external data source into the SpatialWorx system where it is packaged for Project downloads to individual devices. They also monitor the external data source for changes (adds, updates, deletes) and propagate those changes out to all devices.

Although Data Adapters work behind the scenes, the SpatialWorx Console provides an interface that allows you to select a data source and make a connection to it via a proxy. Once the initial connection is made, the data is made available to field users seamlessly.

How do Data Adapters Work?

Data Adapter's are web services in SpatialWorx that allows you to establish a connection to an external data source, and for sources other than files acts as a proxy to that remote data. What that means more specifically, for non-file based sources, is that it makes a connection to the external data and maps to it as a substitute for having to import all of that source data into SpatialWorx's database. This effectively provides dynamic access to external source data while bypassing the need to host all of that data in the SpatialWorx database.

The architecture that facilitates this product feature, for source data other than file-based, involves Views that the web service (Data Adapter) creates and maintains in the SpatialWorx database. These Views are essentially SQL- filtered subsets of data from both the external data source and a table in the SpatialWorx database that is created specifically as a control for an external data source (or sources).

Let's break this down…

Data Storage Structures in SpatialWorx

For every external data source, regardless of its type or origin, the system creates a new table in the SpatialWorx database. This includes data sources that represent "new" data to be collected when none currently exists, tables created to store external file data imported into SpatialWorx's database, and tables created as a proxy for external data that will ***remain*** remote and will ***not*** be imported into SpatialWorx's database.

For all data sources, the tables created contain a set of standard "control" columns that the system uses to manage the data as part of many of the base functions of the system. Examples of these would be columns such as:

- Unique ID (UID)
- Created By
- Created Date
- Last Updated Date
- Last Updated By

In addition to the control columns in these tables, additional columns can optionally be added for data to be captured in the field. User defined columns such as these are added through the Form Builder interface in the SpatialWorx Web Console. Examples would be columns in a table (and its corresponding form) created for a simple Pole Inspection Project, such as:

- Height
- Class
- Year
- Condition

When connecting to an external, non-file based, data source the system creates a View that essentially acts as a virtual table with a definition (SQL filtered query) that combines all columns from the control table created in the SpatialWorx database along with a subset of some, or all, columns in the external table or web service source. In addition it adds the column representing the primary key in the external table as a new column in the SpatialWorx control table – this primary key then becomes the key to link the external and internal tables in the new View.

The following table illustrates how the View for an external data source is comprised of columns from three different data objects.

SpatialWorx Control Table Columns	External Source (Table / Web Service) Columns	Additional Columns Added in SpatialWorx (optional)	SpatialWorx View (created by Data Adapter)
Primary Key	*Primary Key*	----------	**Primary Key**
UID	----------	----------	**Uid**
Created_by	----------	----------	**Created_by**
Created_dt	----------	----------	**Created_dt**
Last_upd_dt	----------	----------	**Last_upd_dt**
Last_upd_by	----------	----------	**Last_upd_by**
----------	Height	----------	**Height**
----------	Class	----------	**Class**
----------	Year	----------	**Year**
----------	----------	Condition	**Condition**
----------	----------	Signature	**Signature**

Making the Connection

Connections to non-file based data sources are established via a user interface in the SpatialWorx Web Console. After selection of the desired data source (Oracle, for example) the system displays a dialog that allows the user to enter the appropriate connection and authorization credentials for that source.

The system then attempts to make a connection to the external source, using the connection specifications and credentials supplied by the user. Upon establishment of a successful connection the Data Adapter calls an API that interrogates the source to return a list of tables or data objects that are available for selection in the SpatialWorx Web Console. Selection of a table or data object issues another API call that returns a list of column (attribute) names and the datatype of each. The user can then optionally select any or all of the columns in the source for inclusion into SpatialWorx. The system then creates a new table in the SpatialWorx database with all of the necessary control columns. The system next establishes a View whose SQL filter points to both the column set selected from the external data source and the control set contained in the SpatialWorx database table. For any column definitions in the new table, or query definitions in the View, the system detects the datatype for each source column and uses that in all of its create statements.

Passing External Data to Field Users

When a new Project is created in the Web Console and it includes at least one external, non-file based data source, a new View is generated as described above to facilitate a proxy in the SpatialWorx database.

To move data down to the App the Sync service creates a packet of Project data, which is a complete set of data, forms, and other controls all packaged into a single file object and moved to the client device. In this regard the system treats the external source no differently than it would a native table and the filter is used to fetch all the records of interest.

Handling Deltas

Another job of the Data Adapter is to monitor the remote source for changes (adds, updates, deletes) at a customer defined interval and submit messages to SpatialWorx Sync so it can distribute those changes to the local Project datasets on all affected mobile devices. This enables field users to have access to data that is close to a real time match with data still maintained in the original external source. The SpatialWorx Web Console allows users to set the time intervals at which this monitoring and update activity occurs.

Updating Source Data

External database tables and web services pose a challenge for direct updating from SpatialWorx due to unknown structures and relationships in the foreign source such as different types of referential

constraints and other rules. Although this may be a valid requirement for some solutions, and is certainly feasible, implementation of a communication mechanism for updates requires specific knowledge of the complete environment on both sides and a specialized approach that is beyond the scope of the standard configuration and Project model in SpatialWorx. Therefore, this capability is not provided in the system by default. However, customized support for this alternative can be arranged with the SpatialWorx team.

Which Data Source Formats are Supported?

Consumable data sources allow you to import or connect to your own source data and include ESRI ArcGIS Server, GeoJSON, WFS, WFS-T, and any SQL database. SpatialWorx Data Adapters currently support the following formats (plans are to expand the supported formats in future releases). We can also work with you to define custom interfaces to data sources and formats that are not included in the packaged set of Data Adapters.

Relational Database Table

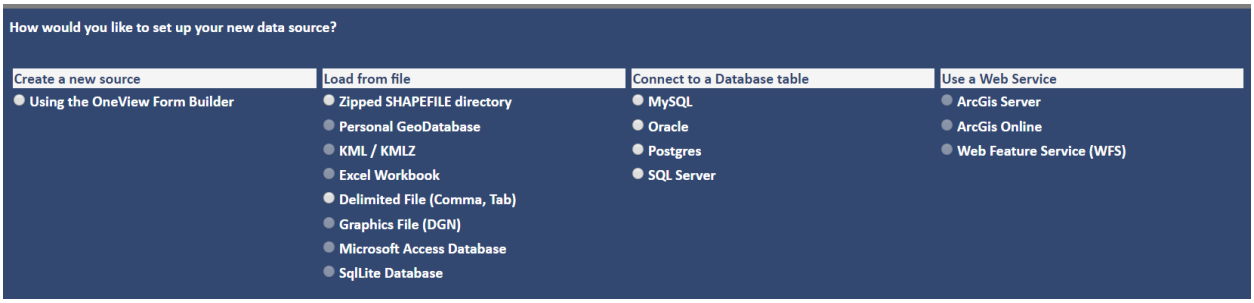
- MySQL
- Oracle
- SQL Server
- PostgreSQL

Web Service

- ArcGIS Server
- ArcGIS Online
- Web Feature Service (WFS)
- Web Feature Service Transaction (WFS-T)

The SpatialWorx web console includes a page that allows you to easily select an external data source. Selection of a data source walks you through the specific settings you need to enter to make a database connection or retrieve data from a web service.

Alternately, you can elect to bypass connections to external data if you don't have any, or it simply isn't a requirement for your Project or solution, and simply create your own from scratch using the Form Builder in SpatialWorx, in which case Data Adapters are not necessary.



Bring Your Complex Data Together for Simple Visualization & Meaningful Analysis

The real power of SpatialWorx lies in its ability to collect and aggregate data from many different sources and expose it to field users through the flexible Project model architecture. Data Adapters facilitate an unlimited versatility to pull together all the data you need in myriad different ways to ensure your field users have access to everything they need and you have the ability to drill deeper into the data you collect and maintain to perform detailed analysis and produce meaningful conclusions. And future releases will serve to extend those capabilities to cover an ever larger range of different source data types/formats.

Whatever your needs, SpatialWorx Data Adapters are a comprehensive solution to organizational needs that vary from complex enterprises with extensive data requirements to simple entities that have more modest requirements and external data needs.