Creating ARDI Systems from Spreadsheets

Optrix Pty. Ltd.

ABSTRACT

This guide details the formats and techniques involved in importing your entire ARDI database from engineering spreadsheets.

Overview

What Does This Document Cover?

This document discusses the spreadsheet formats and the various techniques required to import your ARDI database from spreadsheets.

This allows users to rapidly create their ARDI databases based on exported information from other systems.

Assumed Knowledge

This document assumes you are already quite familiar with ARDI administration and have followed the Site Builder Guide.

Copyright

Optrix Pty. Ltd.
10/75 Cygnet Avenue, Shellharbour City Center, NSW, Australia
www.optrix.com.au

Introduction

Why Import from Spreadsheets

Some ARDI systems are very large, with thousands of assets required.

Adding each asset by hand would be an extraordinarily difficult task. But since many large applications already have existing computer-based systems – such as asset registers, SCADA packages etc. – there is data available to allow ARDI to *import* this data.

This changes setting up your ARDI database from an impossible task to a relatively simple one, particularly for those with a working knowledge of spreadsheet tools such as Microsoft Excel.

The Spreadsheets

Spreadsheet Names

ARDI needs quite a bit of data to create its database. Rather than all of the information being in one large file, we split the details over several.

These files are summarised here but shown in greater detail in the following chapters.

File	Content
Relationships	The names of each of your ARDI *relationships.*
Properties	The names, types and default values of each of your *properties*.
Types	Descriptions of your different *types* and what *properties* they use.
Templates	This page describes your *templates*, which act as a basic structure so you can rapidly create assets in the **Assets** file.
Assets	A list of each of your assets and their properties.
I/O List	The I/O list is a file created after you've set up the database – it's used to connect all of your assets to live data.

Interconnections

When using OpenOffice or the desktop version of Microsoft Excel to edit the spreadsheets, you should ensure that you do **not** change the file names.

Many of the sheets contain formulas that look up details in other files to help you rapidly fill in information without risking typing or spelling errors – renaming the files will cause these connections to break and error messages to appear.

Sheet Order

The list above shows the tables in the *order they are expected to be filled in*.

This is because of how they depend on one-another. Relationships simply need a name and some formatting details. However, **properties** can flow down relationships, so there are times you need to know the relationship name to fill in property details, and property names to fill in type details etc.

An alternative approach is to fill in each of your **templates** first, then fill in the other details based on the contents of the templates. This is useful when you're getting feedback from users as part of your requirements analysis.

See Techniques (page 25) for more details.

Blanks

You can get empty export copies of these files from the Import screen – you can find this under **Administration | Utilities | Import/Export Spreadsheets**

Relationships File

The *relationships* file contains a simple list of each of your ARDI relationships.

Relationship Definitions				
Name	**Type**	**Downstream Name**	**Upstream Name**	**Example**
Location	Hierarchy	Contains	Inside	Asset B is inside Asset A, and A contains B.

Above is a basic example of a column in the relationships file – it describes the built-in **Location** relationship.

It consists of the following four columns…

Column Name	Content
Name	The name of the relationship
Type	The type, being one of the below values… **Physical**, **Logical**, **Hierarchical**
Downstream Name	The text that is used when this asset is the **parent** of another.
Upstream Name	The text that is used when this asset is the **child** of another. Note that the word 'is' is always included before this text.

The final column, *Example*, is not imported. It is used as a helpful guide to Microsoft Excel users of how both the upstream and the downstream names are actually applied.

Properties File

The *properties* file contains a list of each of your ARDI properties, including the type and default values.

Basic Attributes

Property Definitions			
Name	For (Media / Type / Application)	ARDI Name	Type

This is the first section of the property spreadsheet, where the basic attributes of the property are defined.

There are four columns.

Column Name	Content
Name	The name of the measurement or piece of information
Media / Type / Application	The ARDI documentation suggests breaking your properties up based on the *media* inside your pipe, or when there's a difference in what the property values really mean. This value is added to the *name* column to form the ARDI Name (below)
ARDI Name	A combination of the property name (from the *name* column) and the media or type (from the *Media / Type / Application* column).
Type	The name of the *property type* for this property. These include **Analogue**, **Digital**, **Enum** etc.

Property Types

The 'Type' column accepts not only the correct ARDI name for a property, but also a few types that may be more meaningful for process or plant engineers.

Type Name	Content
Measurement / Analogue / Analog	An ARDI measurement property, used to show the value of an analogue value (such as 33.7%)
Digital / Status	An ARDI status property, used to shown the value of a discrete value that only changes between 0 and 1 (such as '1' for On)
Enum / Enumeration	An ARDI enumeration property, used to show a value when have a discrete value that isn't just 0 and 1 (such as when '1' is On and '2' is Starting)
ID	A unique identifying number – these are often used to store what this asset is known as in other systems, such as your SCADA system, historian, maintenance package etc.
Other	Other possibilities include **Text**, **Address**, **Phone Number**, **Email** etc. Certain addons will also provide other options.

Options

Options		
Flows Through	Group	Other

These are the various options that apply to your properties. There are three columns.

Column Name	Content
Flows Through	A list of relationship names (defined in the **Relationships** file) that this property flows through. Note that the property must be a *measurement* (analogue), *status* (digital) or *enumeration* (enum) in order to flow – simple properties such as *text* and *ID* don't flow.
Group	The name of the *group* that you would like this property to appear in. Leave this column blank if most people would like to know this piece of information when looking in ARDI.
Other	The *other* column is used to specify certain flags that may be appropriate for the property. These are detailed below.

Other Values

The *other* column contains codes that describe the property.

These codes are a comma-delimited list of the options shown below…

Other Values	Content
Rate	Marks this property as a measurement taken over time – such as flow rate or current consumption.
Energy	Marks this property as a potentially hazardous source of energy, such as being a pressure or electrical voltage measurement.

Defaults

> *Measurents: Min ; Max ; Units ; Decimals*
> *Enums: {value}={text} ; {value}={text}*

Here is where you specify the **default values** for those properties that are *measurements* (analogues), *statuses* (digitals) or *enumerations* (enums).

Each different type has a different format for the information contained in this column.

Analogue / Measurements

The measurement format is…

```
<minimum> ; <maximum> ; <uom> ; <decimals>
```

For example, to say that the measurement was between 0.0 and 100.0%, you'd write…

```
0 ; 100 ; % ; 1
```

Digitals / Statuses

The digital format is simply….

<zero value> ; <one value>

For example, to say that it is 'Closed' when the value is zero and 'Open' when the value is one, you can write…

```
Closed ; Open
```

Enums / Enumerations

The enumeration format is more complicated when there is more than just zero and one.

<invalue>=<outvalue> ; [repeat]

For example, if you would like to see 'Stopped' when the value is 0, 'Starting' when the value is 1 and 'Running' when the value is 2, you'd use the line below…

```
0=Stopped ; 1=Starting ; 2=Running
```

Examples

Below are some examples of how common properties can be set up…

	Water Pressure	Valve Status	Drive Status
Name	Pressure	Status	Status
Application	Water	Valve	Drive
ARDI Name*	Pressure – Water	Status – Valve	Status – Drive
Type	Analogue	Digital	Enum
Flows Through	Plant Water		
Group			
Other			
Default	0 ; 2000; kPa ; 0	Closed ; Open	0=Stopped ; 1=Started

* This column is automatically updated when working with Microsoft Excel or OpenOffice on desktop.

Types

Types not only group your assets together, they can provide properties, alerts and media to the assets that use them.

In the majority of cases, your assets should get their properties – particularly measurements and other properties that use live data – from a type.

The Types file allows you to set up your list of types, what properties each has and also gives you the ability to set up your type hierarchy.

| Details | | Properties | Alarms | |
Name	Parent(s)	Name	Name	Condition
Equipment		Equipment Tag		
Valve	Equipment / Control	Model		
		Valve Number		
Monitored Valve	Equipment / Control / Valve	Status - Valve	Valve Discrepancy	

Above is an example of a filled-in Type list. It describes three types – *Equipment*, *Valve* and *Monitored Valve*. Each type is separated by a blank line.

Note that you can also define your types on individual worksheets if you'd prefer.

There are 5 columns in total.

Column Name	Content
Name	The name of the type.
Parent(s)	A list of this type, separated by the '/' character. For example, *Equipment / Control* says that the this type is a child of 'Control', which is also a child of 'Equipment'.
Property	The name of a *property* (from the properties file) that applies to this type of asset.
Alert Name	The name of the *alert* that applies to this type of asset.
Alert Condition	Leave this blank if the alert information is loaded from a data source. Otherwise, enter the condition in the space provided.
Alert Description	A more detailed description (up to 256 characters) explaining what the alarm represents.

Alert Conditions

Alert conditions are specified using the following syntax…

<Property Name> <Condition> <Value>

Where 'Property Name' is the name of a property from the *Properties* file, *Value* is a numeric value you'd like to compare against, and 'Condition' is one of the values below…

Symbol	Meaning
=	Equal To
<>	Not Equal To
>	Greater Than
<	Less Than

Examples include…

Level > 95 (Alert the user when the level is greater than 95%)

State – Valve=0 (Alert the user when the valve is closed)

Flow Control

Flow control settings can also be set here.

The **Isolation Point**, **Source Point** and **Non-Return Point** properties can be used to adjust your various flow control parameters.

Unlike many other properties, you almost certainly want to specify a *value* for the type – for example, all assets of type 'Air Isolation Valve' are likely to want to control the 'Compressed Air' relationship.

Add a colon after the name of the property, then list all of the relationships that the point applies to.

To use the above 'Air Isolation Valve' example, you could use the following settings…

Details		*Properties*
Name	**Parent(s)**	**Name**
Air Isolation Valve	Equipment / Valves	Isolation Point: Compressed Air

Templates

The templates file contains definitions for each of your *templates* – examples for the different types of assets you will feature in your ARDI database.

A template allows you to roll up a combination of types (and therefore properties and alarms) under a single name.

Unlike the other files, templates are defined on **their own worksheets**. This is to make the *user-focused design* approach easier.

Template Description	
Name	**Types**

There are only really two critical columns when defining a template.

Column Name	Content
Name	The name of the template.
Types	A list of the different *types* that make up the template.

All other columns in the Templates spreadsheet are not read by ARDI, but may be used for your own documentation purposes.

Template Description	
Name	**Types**
Knife-Gate Control Valve	Knife-Gate Valve
	Control Valve
	Equipment

In the example above, the template "Knife-Gate Control Valve" is an easy short-hand for marking an asset with three tags – **Knife-Gate Valve**, **Control Valve** and **Equipment**.

Assets

The Assets table is the largest table of the lot.

It's where each of your actual assets are defined, along with any data about them that might be useful to users.

It's also one of the only spreadsheets where you get to define your own column layout – ARDIs importer uses the column names to tell what you've placed in each column.

As an absolute minimum, you'll require the following columns…

Column Name	Content
Name	The name of the asset.
ERN	The Equipment Reference Number (or unique ID) for the asset.
Types	A comma-delimited list of types this object has (ie, **Knife-Gate Valve, Control Valve**)
Template	The name of the template (from the *Templates* file) to apply to the asset.
Location	A *relationship column* (see below) containing where the asset fits into your location hierarchy.

Apart from these fundamentals, you can also include other columns…

Built-In Columns

The **Description** column can be used to set the description for the ARDI asset.

Relationship Columns

If your column has the same name as one of your *relationships*, ARDI will treat the contents of the column as the names of the *parents* the asset has.

In Hierarchies

For asset hierarchies (such as location), you can enter this as a *path*. For example, if you'd like the asset to appear as part of the *Fire System* on *Unit 1* in *Building 3*, you can use the path….

 Building 3 / Unit 1 / Fire System

Note that you don't have to define these assets individually – if you specify their name in a hierarchy, ARDI will create the corresponding organisational assets for you.

Alternatively, if you'd like to locate this asset **inside another**, you can use the ERN of the asset. For example, if you'd like the asset to appear as part of asset *YRD-7P,* you simply place the below value in the column…

YRD-7P

Physical and Logical Relationships

When the relationship isn't a hierarchy, you can simply nominate the parent that the asset is connected to, using the parent assets ERN.

For example, if your device took its power from circuit breaker *A43R*, you could write **A43R** in the **AC Power** column.

Examples

Assets			
ERN	**Name**	**Location**	**AC Power**
CV1-24	Main Conveyor Belt	Building 3 / Material Transfer	
ST5-01	Main Conveyor Slippage Monitor	CV1-24	CB220
DB-22	Distribution Board 15	Building 3 / Power Room	
CB220	Circuit Breaker 220	DB-22	

The above table defines four assets.

CV1-24 (the Main Conveyor Belt) is located inside the **Material Transfer** system of **Building 3**. It contains **ST5-01**, the Main Conveyor Slippage Monitor.

DB-22 (Distribution Board 15) is located inside the **Power Room** in **Building 3**. It contains **CB220**, a circuit breaker.

ST5-01, the Main Conveyor Slippage Monitor, is powered by circuit breaker CB220.

These four lines result in the creation of **7 assets**, and **5 relationships** (counting the location relationships between Building 3 and both the Material Transfer section and the Power Room) in ARDI.

Property Columns

If your column has the same name as one of your *properties*, ARDI will treat the contents of the column as the value of that property for the asset.

This allows you to quickly assign properties like ID numbers, equipment references, drawing IDs etc. to your assets from other spreadsheets and data sources.

Assets			
ERN	**Name**	**Serial Number**	**Model**
CV1-24	Main Conveyor Belt	SN99283	AGR-9923
ST5-01	Main Conveyor Slippage Monitor	882993002030	KQ2R-1R-EX2
DB-22	Distribution Board 15		ENC-22-03P
CB220	Circuit Breaker 220	293829938AAR	G-CB-2993-29

Numbered Columns

Some of your properties and relationships may only occur occasionally. In larger applications, this could mean having dozens or even hundreds of columns, making your asset list awkward and unwieldly.

To save on space, ARDI supports *numbered columns*, which makes your spreadsheet much smaller and easier to read.

As well as a name, these columns also include a number and may be repeated several times.

For Properties

Assets			
Property Name 1	**Property Value 1**	**Property Name 2**	**Property Value 2**
Model	AGR-9923	Serial Number	SN99283
Model	KQ2R-1R-EX2	Serial Number	882993002030
Model	ENC-22-03P		
Model	G-CB-2993-29	Serial Number	G-CB-2993-29

Above is an example of a **property numbered column** being used. Here each of the assets have a model number, but only the distribution board doesn't have a serial.

If you have a lot of properties, using numbered columns like this allows you to radically reduce the number of columns in your spreadsheet.

For Relationships

Assets			
Relationship 1	Parent 1	Relationship 2	Parent 2
AC Power	CB220		
Instrument Air	AF-992		
DC Power	PS992	Data	PLC_4992

Above is an example of a **relationship numbered column** being used. Here, different assets are connected to AC power, instrument air, DC power and data.

If you have a lot of relationships, using numbered columns like this allows you to radically reduce the number of columns in your spreadsheet.

For References

References
DT4-273^Temperature
DT4-273^Temperature=Inlet Temperature
DT4-273=Inlet Temperature Sensor

Above is an example of a **reference column**. These add *references*, allowing you to see properties from other assets.

The syntax of the expression in this column is as follows….

<asset ERN or name>^<property name>=<custom name>

All of these elements other than the ERN can be skipped.

Let's look at the examples above to figure out what they are actually doing…

1) Item one adds a reference to the *temperature* of the asset DT4-273.
2) Item two adds a reference to the same temperature, but this time renames it to 'Inlet Temperature'.
3) The last option adds a reference to the **entire asset** DT4-273, not just the temperature property, and renames it 'Inlet Temperature Sensor'.

Unlike other coluumns such as relationships, you can specify multiple items in the **same column** by separating them with an OR (|) symbol.

For example, **DT4-273^Temperature=Outlet Temp.|DT4-274^Temperature=Inlet Temp.**

This takes the temperature of an asset and calls it 'Inlet Temp.', and another called 'Outlet Temp.'.

Flow Control Columns

Flow control settings can also be configured using the asset list, and follow a similar scheme to that found in *types*.

The **Isolation Point**, **Source Point** and **Non-Return Point** columns can be added to your spreadsheet. These allow you to specify *what relationships* the asset has an effect on.

For example, if your *Circuit Breaker* asset interrupts electrical power, you can configure it as below…

Assets		
ERN	**Name**	**Isolation Point**
ARN27	Circuit Breaker 7, Box 2.	AC Power, DC Power

Flow control can also be configured in your types.

I/O List

Before importing your I/O list, you should ensure that you've setup your ARDI database already – this not only includes all of your assets, properties and relationships, but also your *data sources*.

The I/O list is a file you should **export** from ARDI before filling it in. ARDI will pre-fill a large amount of information that should allow you to then nominate where ARDI should find the properties for your various assets.

This can also be one of the most technically challenging files to fill in – we suggest connecting one or two items to live and historical data within ARDI before you attempt it, as your downloaded I/O list will then contain some examples of how the linking is done.

Identifying Data

ARDI creates several columns filled with data to help you identify *which* asset you're linking to data. This will include the ERN and name of the asset, as well as the contents of any **ID** or **Text** properties the asset may have.

It also shows the **type** of item you're linking (Property or Alert), the name of that item, and in some cases, the node id (the node id is only required for certain types of property).

ERN	Name	Type	Property/Name	Node/ID	TrackingID	Valve Number
TK7-2	Main Tank	Property	Level			
TK7-2	Main Tank	Property	Temperature			
TK7-2	Main Tank	Property	Agitator Speed			
TK7-2	Main Tank	Property	Agitator Vibration			
TK7-2	Main Tank	Alert	Tank Level Low			

Additional or unknown columns are simply ignored, so if you are preparing the spreadsheet in Excel or OpenOffice and wish to add extra columns to help you automatically generate the link addresses, you can do so.

Links

After that, you'll find the columns that describe how the properties are connected to external data. For each *context*, you'll find columns that allow you to specify…

a) The asset name of the **data source**
b) The **address** of the data in that data source
c) The **transform** to apply to the data to make it human-readable.

In many cases – particularly when working with software rather than hardware – the transform property won't be required.

Actual Live Source	Actual Live Address	Actual Live Transform	Actual History Source	Actual History Address	Actual History Transform
Citect	TK7-2_Level		Citect	TK7-2_Level	
Citect	TK7-2_Temperature		Citect	TK7-2_Temperature	
Citect	TK7-2_Agitator_Speed		Citect	TK7-2_Agitator_Speed	
Citect	TK7-2_Vibration		Citect	TK7-2_Agitator_Vibration	
MSSQL	Alm-TK7-2-Tank-Low		MSSQL	Alm-2254	

The format of the 'Address' columns will vary depending on what driver that particular data source uses. We suggest setting up one or more assets then exporting your I/O list to see an example of the address structure.

The above example is talking to a database and a CITECT server. These have easy-to-read, single addresses. Other drivers – such as **Modbus TCP** – have several different components, such as unit number, register and format.

Media

You can import media into ARDI by uploading a ZIP file containing the files you'd like to import.

ARDI uses the **folder structure** of your ZIP file to determine how to use each of the files you've included.

Here is an example set of folders and files…

Symbols (Folder)

> **Ball Valve.svg**
>
> **Knife-Gate Valve.svg**
>
> **Butterfly Valve.svg**

Types (Folder)

> **Ball Valve Manual.pdf**

ERN (Folder)

> **PT1-42A Manual.pdf**
>
> **PT1-42A Data Sheet.pdf**
>
> **PT1-42AC Isolation Instructions.pdf**
>
> **Specifications – PT1-42A, PT1-42B.pdf**

3D Models (Folder)

> **Ball Valve** (Folder)
>
> > *<contents of model package – model.xml + other files>*

When you upload a complete ZIP file containing those files, ARDI processes them and copies the files to appropriate locations.

Symbols

Symbols are imported from the symbols folder. ARDI scans the folder and looks for a *type* with a matching name.

For example, if you have a type named **Ball Valve**, the symbol **Ball Valve.svg** from the folders above would be assigned to that type.

3D Models

As you would expect, 3D models are loaded from the '3D Models' folder. Like symbols, ARDI scans the folder and looks for a *type* with a matching name.

Unlike symbols, some ARDI models require several files. You give a *folder* the name of your type, and within that folder you place all of the files from the ARDI model archive. This consists of a minimum of one 3D model (in OBJ, FBX or Unity3d format) and the 'Model.xml' file, which describes the model to ARDI.

If you downloaded your 3D model from the Optrix website, you simply need to extract the contents of the file into the folder.

Types

Similar to the above example, ARDI scans the *Types* folder to search for any documentation that it should assign to your types.

This allows you to specify a data-sheet, manual or set of instructions that applies to a wide range of assets.

Properties

All other folders are treated as property names.

ARDI will scan your assets and find those that have a property value that appears in one of your file names.

In the set of folders above, the asset with the ERN **PT1-42A** will be matched with the files **PT1-42A Manual.pdf**, **PT1-42A Data Sheet.pdf** and **Specifications – PT1-42A, PT1-42B.pdf**

Note that it will NOT match with the file that contains the equipment number **PT1-42AC** – this is because a match must not have any other alphabetical or numeric characters on either side. In this case, the match isn't allowed because of the presence of the 'C' in the document name.

Renaming

When ARDI prepares a file to be included, it takes the opportunity to adjust its name.

It removes any occurrences of the key that it matched with – for example, the file **PT1-42A Manual.pdf** would be named simply **Manual** after removing the contents in the example above.

If the filename includes ' – ' (a space, dash and space again), then ARDI assumes that you're using that to separate the *identifiers* from the *name.*

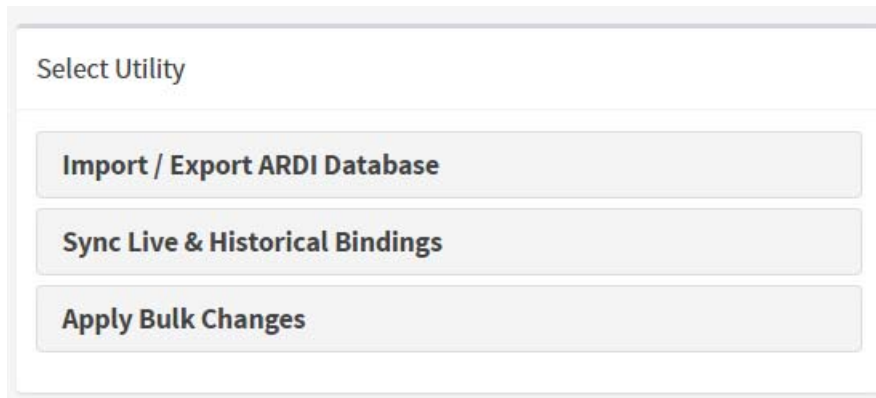The example given includes a file named **Specifications – PT1-42A, PT1-42B.pdf**

In this case, the key (PT1-42A) appears in the second half of the name. ARDI then will choose to keep only the *first* half of the name. This results in a document simply being called **Specification**.

Note that this naming trick also happens in the reverse.

If you had a file named **PT1-42A, PT1-42B - Specifications.pdf**, the key would have been found in the first half of the name, meaning ARDI would chose the *second* half as the document name.

Importing / Exporting

Administrators can export and/or import their spreadsheet data from the **Administration | Utilities | Import/Export Spreadsheets** button.
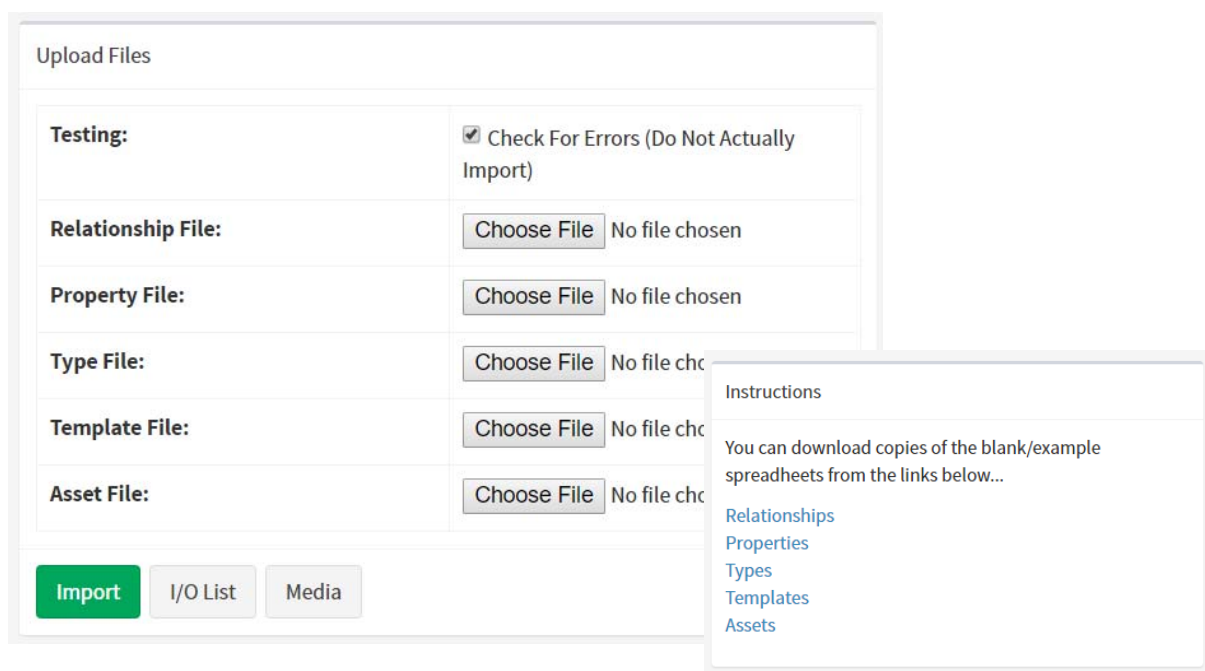

Once you've arrived at the Import/Export page, you'll be able to select the files you'd like to import.

To get blank copies or an export of your ARDI database, use the links on the right to download each of the required files.

You can choose between the Asset, I/O List and Media pages by using the buttons at the bottom of the form.

Techniques

There are two main philosophies when producing your spreadsheets – building them **Ground Up** or **Templates First.**

Ground Up

This technique basically involves starting with your list of relationships and moving forward through your various files – moving from **Relationships** to **Properties**, **Types** and **Templates** before finishing with your **Assets**.

It's suitable if you want to prepare a working system first, before going to your users and further refining their needs, as each of your assets will end up containing the bare minimum of data.

However, this approach may result in you going back over your assets quite a few times, making adjustments to suit user requirements or errors in understanding.

Templates First

If you've looked at the example spreadsheet files, you may have noticed that the spreadsheet for templates contains a large number of unused columns.

These are there to help with the *Templates First* approach.

In this technique, you go to your users and ask them what they want to see when looking at particular pieces of equipment. You use this information to fill in the template documentation – showing what properties, alarms, relationships and references you'd expect to see in an example of that asset.

As you define your **Templates**, you also fill in the required **Properties**, **Relationships** and **Types** you'll need.

This approach is more responsive to user requirements will often result in less need to make changes later. Although both are valid, we suggest the Templates First approach when you have close contact with the end-users of the system.