

XOData® is a light-weight, practical, easily accessible and generic OData API visualizer / data explorer – that is useful to developers as well as business users, business-process-experts, Architects etc.

- Business Analysts or End-Users can utilize Data Visualization and Explorer for Ad-hoc Self-Service Reporting.
- It assists in verification, testing and documentation of OData APIs.

## How is it helping?

### ❖ Early API Verification / Testing:

**No surprises! Avoid costly re-work and ensure functional testing of APIs to avoid exposing sensitive data accidentally.**

- 3000+ developers/analysts using XOData Online (each month)
- 300+ APIs explored through XOData and added to OData Directory
- 1800+ downloads of XOData Chrome App.
- Recommended in openSAP training by SAP & [www.odata.org](http://www.odata.org)

### ❖ API Awareness : Replace Lengthy Documentation of OData APIs with Interactive XOData:

**Make it easy for others to understand your API.**

**Some example usage as found on web are as below:**

- Time cockpit decided to bet the farm on OData instead of a custom web api. PragmatiQa's XOData shows what you get for free because of time cockpit supporting OData.  
<http://www.timecockpit.com/blog/2014/06/03/Power-of-Standards-Why-OData-Shines-in-Time-Cockpit>
- <http://api-doc.tourinsoft.com/#/syndication-3x#exploitation>
- [http://through-the-interface.typepad.com/through\\_the\\_interface/2015/07/visualizing-the-autocad-io-api.html](http://through-the-interface.typepad.com/through_the_interface/2015/07/visualizing-the-autocad-io-api.html)

### ❖ Self-Service Interactive Data Exploration/Ad-hoc Reporting & Data Visualizations:

**Individual reports for each conceivable scenario is costly and may not be feasible but most Ad-hoc self-service applications require technical knowledge of SQL etc.**

Unlike data-scientists, end-users need simple, interactive and intuitive self-service data visualizations for their ad-hoc requirements.

**ELI LILLY AND COMPANY is an XOData Enterprise customer.**

## Summary of Features

- ❖ **API Visualization:** It provides interactive (filterable / draggable) model-diagram of datasets for API/data-model awareness.
- ❖ **An interactive OData Query Builder:** OData queries can be made through drop-box selection. It's completely dynamic unlike any other OData UI Framework – so even if your API's metadata changes in future, query builder UI will adjust automatically based on the current metadata. Among other features, it also provides support for expand and selection of individual properties from expanded elements too.

It supports all the OData versions (including most of the OData V4 requirements) and formats (ATOM/JSON). Multi/Deep-Expand through Query Builder is supported for up-to OData V3. Deep filtering is supported for all OData Versions provided the OData API supports it.

Support for OData V4 **bounded** entity / function calls is not available through Query Builder UI. Also queries are prepared with 'AND' condition however in some cases, IN operation can be used for 'OR'. Further, manual editing of OData URL is possible for such scenarios.

The result display tables' layout is also generated dynamically with two modes. On click of [Get All Data] button, the application automatically fetches data in chunks – with built-in intelligence to checks for server or client side paging support to get the data-accordingly in batches. If server side paging is not supported by the API then it uses the client side paging with 5000 (default) records at a time.

- **UI mode** is for normal display and navigations to related entity details – it supports the display of complex hierarchical data as well.
- **Data-mode** is for flattening (N:1 and 1:1 relations) and to show the results in an excel like display – so even related entity data from expands can be used for data-visualizations. Please note that 1:N relations can't be flattened however the same outcome can be achieved through reverse-navigation.
- ❖ **In-built interactive Data-visualization module:** User Friendly and Interactive Data Visualizations ( Data Charts, Pivot Table and World Map ) with Filtering and auto-ranking capabilities for aggregated data received through API Queries.
  - Suitable for light-weight visualizations. Volume of data / performance is restricted by the Browser's memory limit. In other words, targeted Query should be build using Query Builder to receive limited / aggregated data-results, suitable for a client side browser based application.
  - Sum/Count/Avg is supported in both Chart and Pivot. Max/Min is not supported for Pivot table.
- ❖ Also, it's possible to extend/customize XOData –An example implementation of XOData as “Open OData Directory” : <http://pragmatiq.com/odatadir/>
- ❖ XOData is a responsive web-application and should work on smaller devices as well e.g. Tablets, Chrome-Book etc. It requires a modern Browser e.g. Recent Chrome/Firefox etc. or IE10+. Chrome App will only work on Google Chrome Environment. Please note that due to the dynamic nature & memory requirements of App, XOData does not support history navigation through Back button of Browser.
- ❖ Some of the latest features which are currently under beta in Chrome App and will be available for Enterprise soon :
  - OData CRUD related features are under progress and as of now only “Create single entity” feature is available in Chrome App. It supports entities with hierarchical complex types & collections.
  - OData API HTTP Request/Response log feature that can be toggled on/off as required.

## XOData for Enterprise Deployment: Important Technical Considerations

### Infrastructure:

XOData® is built as a generic, client side web application – HTML5/JavaScript (using AJAX for API call). It's a \*Single Page Web-Application\* (SPA) so hosting it on any web app server should be easy. PragmatiQa can provide support for this but customer's development team will deploy the application on their platform.

It uses standard OData API to avoid dependency on backend and deliberately avoids any platform specific server side components to reduce considerable overhead of duplicate infrastructure/server & server side components. Further, it exploits recent technical advances in client side (provided by Modern Browsers, HTML5 & JavaScript) with the aim to provide consumer level experience.

### Same Domain Restriction of Browsers:

If you plan to deploy XOData Application on the same system (sub-domain) from where the OData Service is being served then no further consideration is required with regard to same-origin-restriction of Web-Browsers.

However, in case you need to deploy XOData on a separate server and not on your OData Service provider system (i.e. it will not be served from same sub-domain) then it will require a method to avoid the same-origin-restriction of browsers.

- ❖ If you already have any such web applications (JavaScript AJAX/OData API based) working in your landscape then there should be a proxy/web-dispatcher/API Manager in place to mediate and provide access to your APIs from web applications.
- ❖ Implementing CORS support (server and client side both) is another option.

### Authentication Mechanism:

XOData supports basic authentication and can be customized/extended to support other authentication method e.g. OAuth2 implicit. Customer's development team can integrate XOData web application to support desired authentication scheme as per their environment. PragmatiQa can provide support for changes required in XOData application.

### Customization:

- ❖ **Look & Feel:** Bootstrap CSS can be generated as per standard customization <http://getbootstrap.com/customize/> to change color and other aspects of elements. CSS customization is possible to alter the look and feel of HTML elements.
- ❖ As of now XOData is only available with English Text.
- ❖ **OData Service-list:** A Service-list can be setup. This will provide a much simpler option to the users as they can access all the available OData services from Service List drop-down.
  - OData producer system can provide a Service Catalog API that will provide a list of OData APIs for which user is authorized.
  - Alternatively, a JSON config file that is available in "customization" folder as ServiceList.json – example services can be replaced with Name and Metadata URL of your actual OData APIs.

**Getting Started:** (please note that look & feel on some of the screens might be different in latest XOData)

- If you are using XOData Chrome App or XOData for Enterprise then provide the connection details on "Connection Tab". Enter login details (username / password) on "Connection" tab and Press [Use this Setup].

Optional : Service Provider's Service List URL

Service System Type: SAP NW Gateway

Service List URL: https://sapes1.sapdevcenter.com/sap/opu/odata/IWFND/CATALOGSERVICE/ServiceCollection

Specific steps to access OData services from SAP Gateway

1. Follow special steps for SAP Gateway, highlighted in Green.
2. Enter User Name/Password to access the OData Service.
3. Adapt the "Service List URL", e.g. replace the localhost:8000 with your system:port.
4. Press Use this Setup" button. List of all SAP services will be retrieved and pre-populated in service list [selection box at the top Menubar]. Choose a service and start exploring.
5. Build Query on Query Builder Tab. Press [Search] to retrieve Data.

Connection is not required for "File Upload" but only metadata visualization is possible.

Authentication Details

User Name: PO \*\*\*\*

Password: \*\*\*\*\*

Prerequisite: OData Service should be accessible through Basic Authentication.

Remember Details Use this Setup

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- Click on "Choose Access Options" button on the top-bar to select "OData Metadata URL", then enter metadata URL ( e.g. http://system:port/serviceName/\$metadata ) and press [Get Details].
- Please note that the metadata URL is OData service URL added with /\$metadata at the end and it provides an XML document with metadata details. You can also check the URL in a normal browser window to verify that URL is correct and accessible.

PragmatiQa Choose Access Option: http://services.odata.org/V3/ODATA/ODATA.svc/\$metadata Get Details

Connect Query Builder XML

OData Metadata XML File Upload

OData Metadata URL

OData Services

SAP Tables:Needs Backend Component

FeaturedProduct

Product

Advertisement

CT\_Address

Street

City

State

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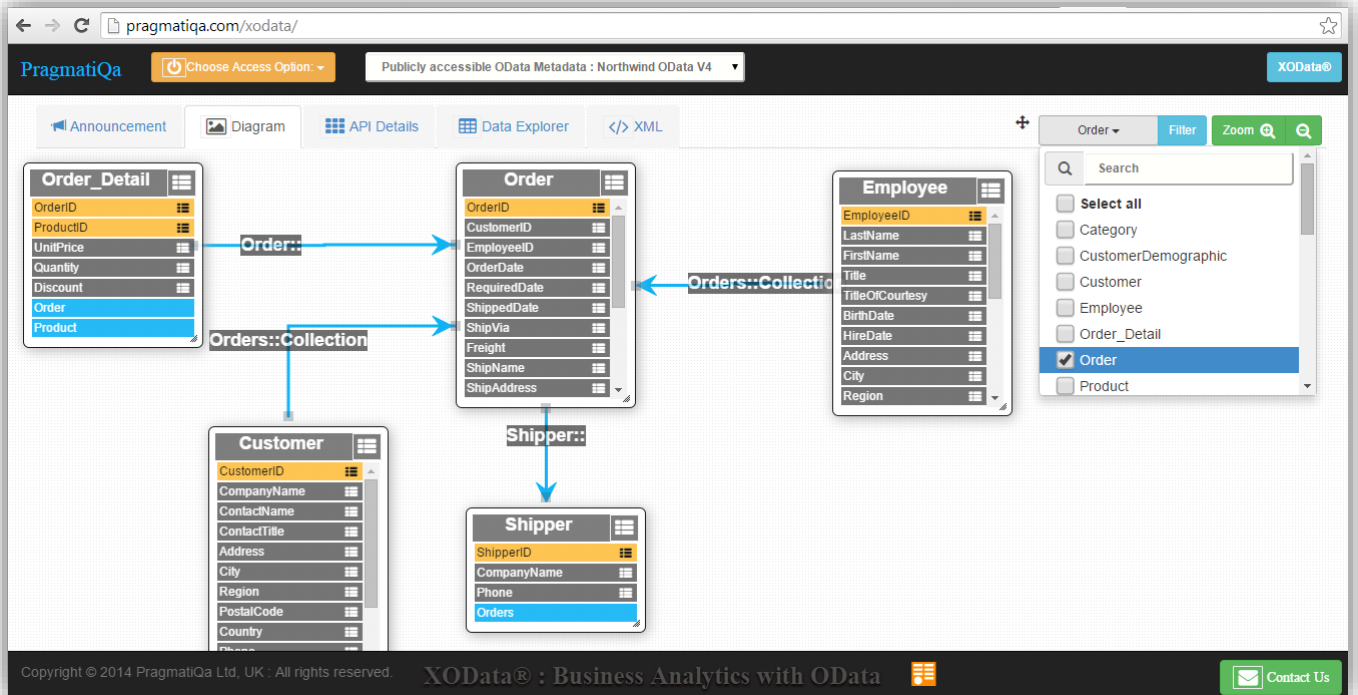
0..1::\*

0..1::0..1

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**Overview of Features with an Example:** In this example we will select Northwind OData V4 API. On selection, Metadata XML document of API is parsed and converted to an interactive relationship diagram – that is also filterable to focus on a particular dataset/entity and its related datasets – e.g. in the screenshot below, we are focusing on Order and related entities only.



Further details about entity/types/attributes/functions etc. can be seen on Details tab.

The screenshot shows the 'API Details' tab for the 'Order' entity. The table below provides the metadata for the entity's attributes:

Entity Order							
name	type	nullable	extensions	StoreGeneratedPattern	maxLength	precision	scale
OrderID	Edm.Int32	false		Identity			
CustomerID	Edm.String				5		
EmployeeID	Edm.Int32						
OrderDate	Edm.DateTimeOffset						
RequiredDate	Edm.DateTimeOffset						
ShippedDate	Edm.DateTimeOffset						
ShipVia	Edm.Int32						
Freight	Edm.Decimal					19	4
ShipName	Edm.String				40		
ShipAddress	Edm.String				60		
ShipCity	Edm.String				15		
ShipRegion	Edm.String				15		
ShipPostalCode	Edm.String				10		
ShipCountry	Edm.String				15		

On the Data Explorer Tab, OData Queries can be made interactively as below and data can be retrieved :

The screenshot shows the PragmatiQa Data Explorer interface. The query is set to 'Order : Orders' with a filter 'Customer : CustomerID equals VINET'. The URL is `http://services.odata.org/V4/Northwind/Northwind.svc/Orders?$top=20&$filter=Customer/CustomerID eq 'VINET'`. The results table shows 4 entries:

Links	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity
▼	10248	VINET	5	1996-07-04T00:00:00.000Z	1996-08-01T00:00:00.000Z	1996-07-16T00:00:00.000Z	3	32.3800	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims
▼	10274	VINET	6	1996-08-06T00:00:00.000Z	1996-09-03T00:00:00.000Z	1996-08-16T00:00:00.000Z	1	6.0100	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims
▼	10295	VINET	2	1996-09-02T00:00:00.000Z	1996-09-30T00:00:00.000Z	1996-09-10T00:00:00.000Z	2	1.1500	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims
▼	10737	VINET	2	1997-11-11T00:00:00.000Z	1997-12-09T00:00:00.000Z	1997-11-18T00:00:00.000Z	2	7.7900	Vins et alcools Chevalier	59 rue de l'Abbaye	Reims

In the results display, related entities can be retrieved by selecting desired Links from drop-down.

The screenshot shows the PragmatiQa Data Explorer interface with the 'Links' column expanded for OrderID 10248. The expanded view shows related entities for the Customer:

Links	CustomerID	CompanyName	ContactName	ContactTitle	Address	City	Regio
▼	VINET	Vins et alcools Chevalier	Paul Henriot	Accounting Manager	59 rue de l'Abbaye	Reims	

Just to add that above requirement can also be handled by simply expanding Customer initially while building the Query itself – example given below:

The screenshot shows the PragmatiQa XOData interface. At the top, there's a navigation bar with 'PragmatiQa', a 'Choose Access Option' dropdown, and 'Publicly accessible OData Metadata : Northwind OData V4'. Below this, the query configuration is shown:

- Where:** Customer (dropdown), CustomerID (dropdown), equals (operator), VINET (value)
- Expand:** Customer (checked), Employee (unchecked), Order\_Details (unchecked), Shipper (unchecked)
- Columns:** (+)
- Order by:** (+)

The query URL is: `http://services.odata.org/V4/Northwind/Northwind.svc/Orders?$top=20&$filter=Customer/CustomerID eq 'VINET'&$expand=Customer`

Buttons: Get Data, Reset, Open URL, Get All Data, Expand.

Links	Customer	OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName
	10248	VINET	5	1996-07-04T00:00:00.000Z	1996-08-01T00:00:00.000Z	1996-07-16T00:00:00.000Z	3	32.3800	Vins et alcools Chevalier	
<b>Customer</b>										
Links	CustomerID	CompanyName	ContactName	ContactTitle	Address	City	Rei			
-- Select --	VINET	Vins et alcools Chevalier	Paul Henriot	Accounting Manager	59 rue de l'Abbaye	Reims				
	10274	VINET	6	1996-08-06T00:00:00.000Z	1996-09-03T00:00:00.000Z	1996-08-16T00:00:00.000Z	1	6.0100	Vins et alcools Chevalier	

Initial selection can be with a restriction of \$top but pressing [GET ALL Data] button will fetch the complete results for the query (without \$top restriction). Also, it's possible to change the table layout to much more data-friendly and excel like display by changing the setting – see button on the top-right corner [ Hide/Show Default Settings then change “Auto Display based on data-size” to “Layout in Data Mode”]

The screenshot shows the 'Data Visualizer and Explorer' interface. At the top, there's a navigation bar with 'PragmatiQa', a 'Choose Access Option' dropdown, and 'Publicly accessible OData Metadata : Northwind OData V4'. Below this, the settings are shown:

- Endpoint:** Publicly accessible OData Metadata : Northwind OData V4, OData Version: 4.0
- Formats:** Default, Input Date Format like 2014-05-25T14:49:52 Default
- Query Settings:** Package of 5000, Layout display in Data Mode (selected), Auto Display based on Data Size, Layout display in UI Mode, Layout display in Data Mode
- Select:** Order : Orders, top 20
- Where:** Customer (dropdown), CustomerID (dropdown), equals (operator), VINET (value)
- Expand:** Customer (checked), Employee (unchecked), Order\_Details (unchecked), Shipper (unchecked)
- Columns:** (+)

Buttons: Hide/Show Default Settings.



..and now after running the query results will be displayed as below : the table has excel like features for selection/copy ( CTRL+A, CTRL+C) etc. Just to mention that data can also be exported to CSV through [Export] Button.

The screenshot shows the PragmatiQa XOData interface. At the top, there is a navigation bar with the PragmatiQa logo, a 'Choose Access Option' dropdown, and a dropdown menu for 'Publicly accessible OData Metadata : Northwind OData V4'. A search bar contains the URL: `http://services.odata.org/V4/Northwind/Northwind.svc/Orders?$top=20&$filter=Customer/CustomerID eq 'VINET'&$expand=Customer`. Below the search bar are 'Get Data' and 'Reset' buttons. The main area displays a table with 12 columns (A-L) and 6 rows of data. The table has a search bar and buttons for 'Get All Data', 'Graph', and 'Export' above it.

	A	B	C	H	I	J	K	L	M	N	
1	Customer.CustomerID	Customer.CompanyName	Customer.ContactName	Customer.PostalCode	Customer.Country	Customer.Phone	Customer.Fax	OrderID	CustomerID	EmployeeID	OrderL
2	VINET	Vins et alcools Chevalier	Paul Henriot	51100	France	26.47.15.10	26.47.15.11	10248	VINET	5	1996-0
3	VINET	Vins et alcools Chevalier	Paul Henriot	51100	France	26.47.15.10	26.47.15.11	10274	VINET	6	1996-0
4	VINET	Vins et alcools Chevalier	Paul Henriot	51100	France	26.47.15.10	26.47.15.11	10295	VINET	2	1996-0
5	VINET	Vins et alcools Chevalier	Paul Henriot	51100	France	26.47.15.10	26.47.15.11	10737	VINET	2	1997-1
6	VINET	Vins et alcools Chevalier	Paul Henriot	51100	France	26.47.15.10	26.47.15.11	10739	VINET	3	1997-1

Let's try now with a less restricted query to get relatively large set of data in order to show the data visualization features. There are several types of charts as well as world-map available on the chart type and multiple dimensions/measurements can be displayed on charts apart from filtering /ranking. Charts can be resized by dragging from sides and can be exported as PNG image. Filtering is available by clicking on filter sign on each attributes on Pivot table. Also ranks are calculated automatically that can be used to show - top 10 values etc.

In this case we have interactively selected Order entity and expanded (\$expand) with Customer information – also picking just a few relevant attributes (\$select). After pressing [Get All Data], 830 records are received.



The screenshot shows the PragmatiQa XOData interface. At the top, there's a navigation bar with the PragmatiQa logo, a 'Choose Access Option' dropdown, and a 'Publicly accessible OData Metadata : Northwind OData V4' dropdown. Below this is a search bar with a URL: `http://services.odata.org/V4/Northwind/Northwind.svc/Orders?$top=20&$select=CustomerID,OrderID,OrderDate,ShipCity,ShipCountry,Freight&$expand=Customer($select=CompanyName,City,Country)`. There are 'Get Data' and 'Reset' buttons. Below the search bar is a table with columns A through I. The table contains 20 rows of data, including columns for Customer.CompanyName, Customer.City, Customer.Country, OrderID, CustomerID, OrderDate, Freight, ShipCity, and ShipCountry.

	A	B	C	D	E	F	G	H	I
1	Customer.CompanyName	Customer.City	Customer.Country	OrderID	CustomerID	OrderDate	Freight	ShipCity	ShipCountry
817	Hungry Owl All-Night Grocers	Cork	Ireland	11063	HUNGO	1998-04-30T00:00:00	81.7300	Cork	Ireland
818	Save-a-lot Markets	Boise	USA	11064	SAVEA	1998-05-01T00:00:00	30.0900	Boise	USA
819	LILA-Supermercado	Barquisimeto	Venezuela	11065	LILAS	1998-05-01T00:00:00	12.9100	Barquisimeto	Venezuela
820	White Clover Markets	Seattle	USA	11066	WHITC	1998-05-01T00:00:00	44.7200	Seattle	USA
821	Drachenblut Delikatessen	Aachen	Germany	11067	DRACD	1998-05-04T00:00:00	7.9800	Aachen	Germany
822	Queen Cozinha	Sao Paulo	Brazil	11068	QUEEN	1998-05-04T00:00:00	81.7500	Sao Paulo	Brazil
823	Tortuga Restaurante	México D.F.	Mexico	11069	TORTU	1998-05-04T00:00:00	15.6700	México D.F.	Mexico
824	Lehmanns Marktstand	Frankfurt a.M.	Germany	11070	LEHMS	1998-05-05T00:00:00	136.0000	Frankfurt a.M.	Germany
825	LILA-Supermercado	Barquisimeto	Venezuela	11071	LILAS	1998-05-05T00:00:00	0.9300	Barquisimeto	Venezuela
826	Ernst Handel	Graz	Austria	11072	ERNSH	1998-05-05T00:00:00	258.6400	Graz	Austria
827	Pericles Comidas clásicas	México D.F.	Mexico	11073	PERIC	1998-05-05T00:00:00	24.9500	México D.F.	Mexico
828	Simons bistro	Kobenhavn	Denmark	11074	SIMOB	1998-05-06T00:00:00	18.4400	Kobenhavn	Denmark
829	Richter Supermarkt	Genève	Switzerland	11075	RICSU	1998-05-06T00:00:00	6.1900	Genève	Switzerland
830	Bon app'	Marseille	France	11076	BONAP	1998-05-06T00:00:00	38.2800	Marseille	France
831	Rattlesnake Canyon Grocery	Albuquerque	USA	11077	RATTC	1998-05-06T00:00:00	8.5300	Albuquerque	USA

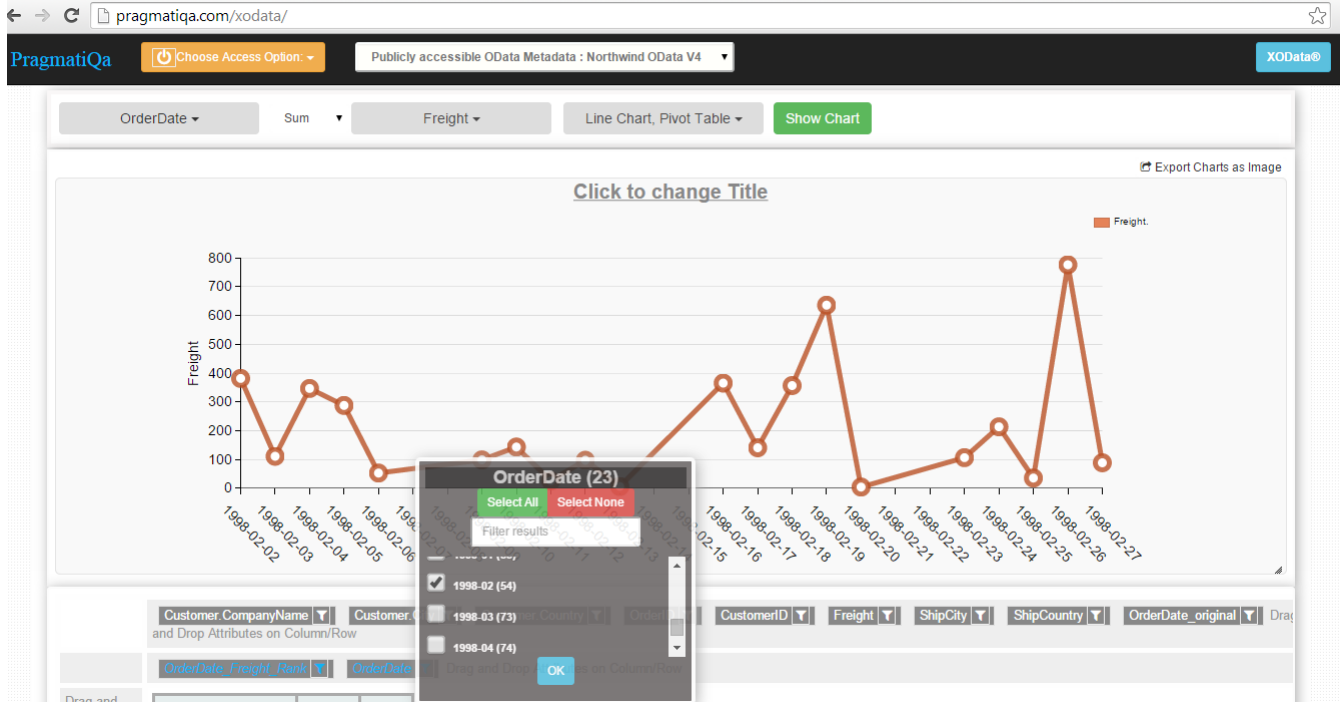
Now pressing on Graph button and then selecting Dimensions and Measurements with operations ( e.g. Count, Sum, Avg. etc. ) from drop-down will create interactive visualizations .

Note that Pivot Table should appear along-side each charts – it can be rearranged by drag and drop of attributes on columns / rows and arranging the sequence of attributes – and will also be used for filtering purpose – see the filter icons on each attribute on Pivot table.

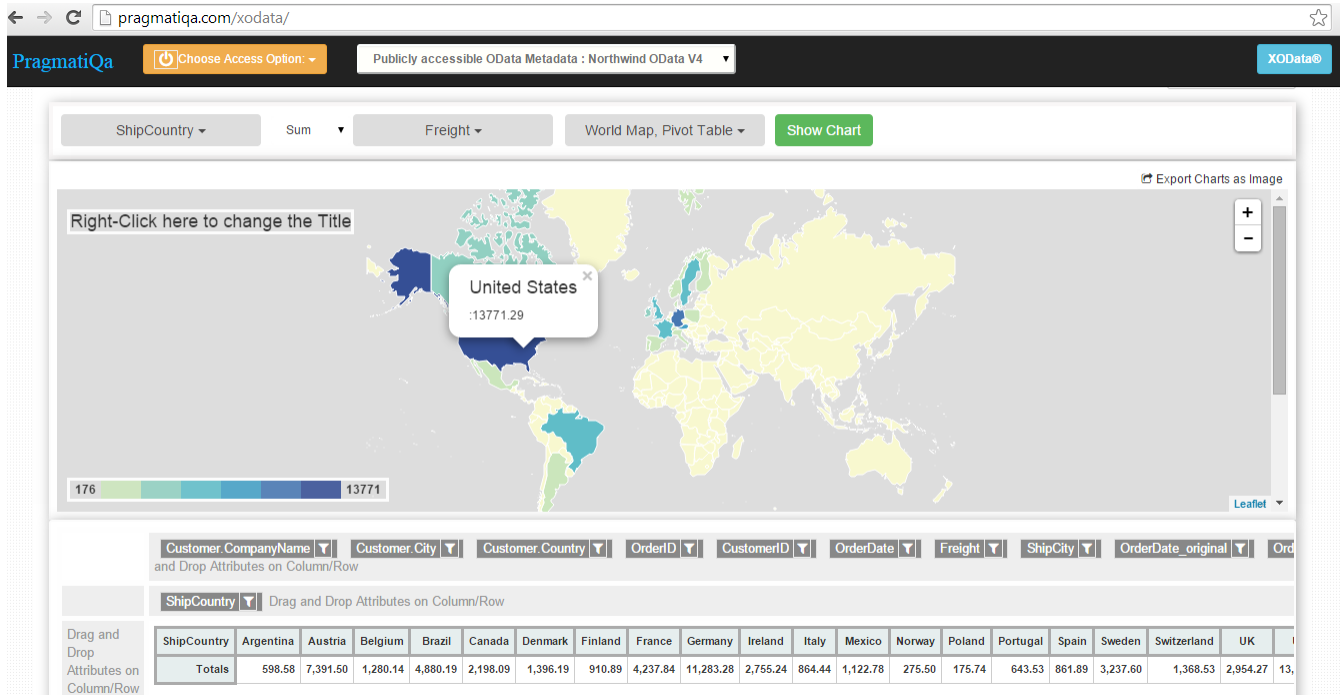
A few examples as below:

The screenshot shows the PragmatiQa XOData interface with a line chart. The chart displays 'Freight' on the y-axis (ranging from 0 to 6.5k) against 'OrderDate' on the x-axis (ranging from 1997-04 to 1998-04). A tooltip is visible over the data point for 1998-01, showing 'Freight: 5.5k'. Below the chart is a filter dropdown menu for 'OrderDate (23)' with options for 1996-07 (22), 1996-08 (25), and 1996-09 (23). The interface also shows a 'Show Chart' button and a 'Click to change Title' prompt.

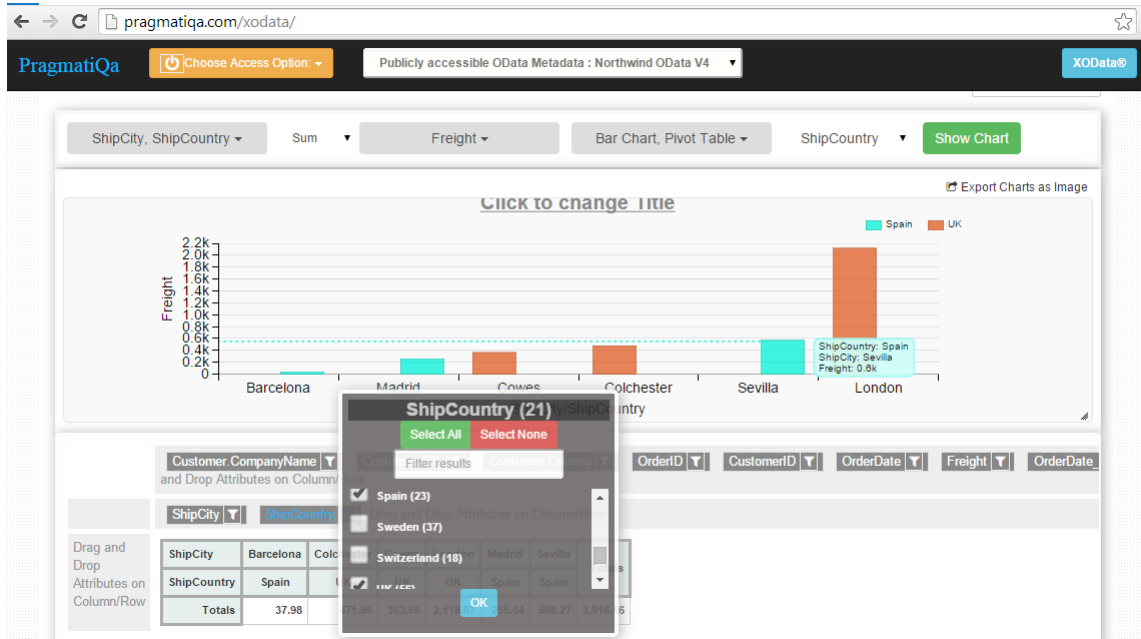
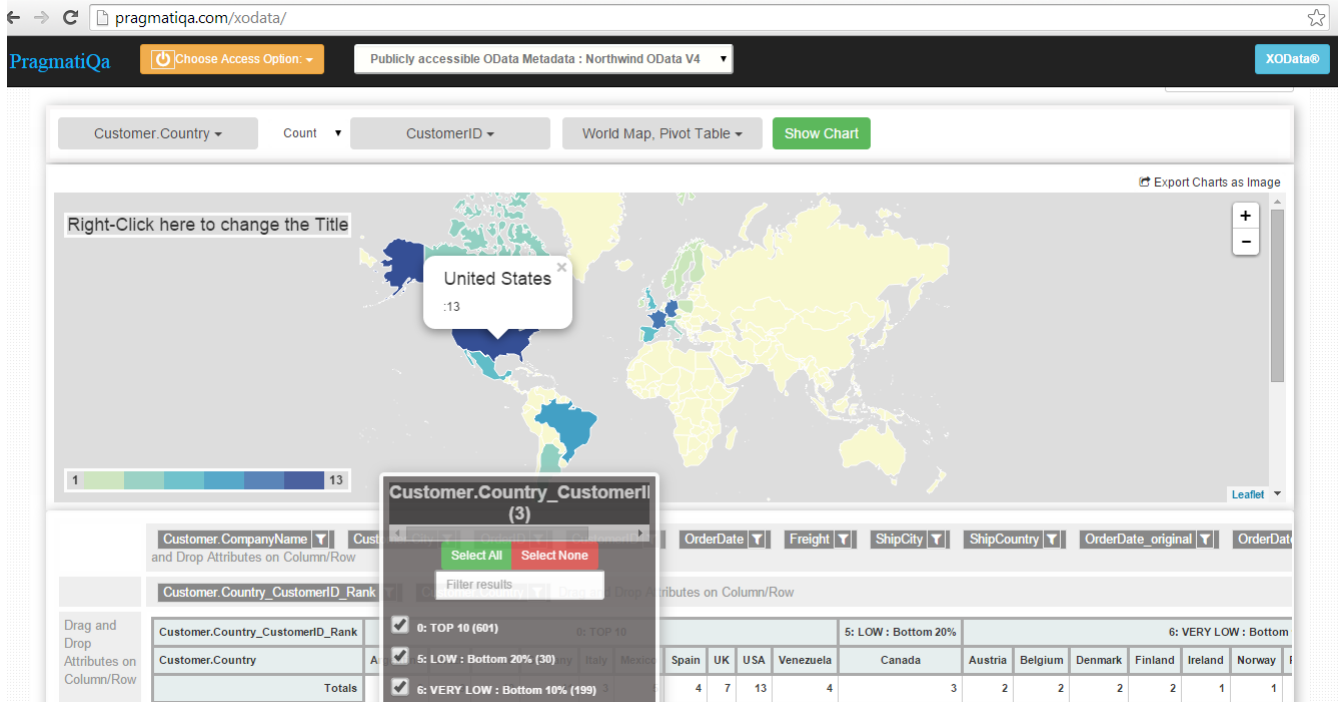
Drill down by selecting just one month:



Country-wise freight: ( Please remove filters, if required )



Count of customers in each country:



One more example using Invoice entity (different OData query) to show multiple measurements (e.g. Invoice value & Freight charges for top 10 customers) on same graph :

