

DATA VISUALIZATION TOOLS BENCHMARKING WITH A BRIEF USER GUIDE – THE ESRI SUITE

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Introduction



With many tools around to create dashboards, it is not always easy to decide the best one to go for. To help answering this question, this document aims to compare the four existing ESRI products and identify their suitability for a given scenario. This benchmarking is based both on testing and real-life use cases of CartONG and the Global Data Service of the United Nations High Commissioner for Refugees (UNHCR).

The following four types of dashboards from the ESRI suite have been included in this benchmarking¹:

- **ArcGIS Maps for Power BI**
- **ArcGIS Web AppBuilder**
- **ArcGIS Dashboards (formerly Operations Dashboard for ArcGIS)**
- **Insights for ArcGIS**

Although these are all data visualization tools, their functionalities are different and meant to address different scenarios, use cases and user groups. Hence, the **goal** is not to find one good solution for all contexts but to **provide an overview of what tool may be the most suited for a specific task**.

The document will start with an overview and individual review on each of the four tools including their main assets, functionalities and licensing requirements. In contrast, the subsequent summary chapter, including the feature table on pages 9-11 and the decision tree will compare the offerings of each tool against each other.

Annex 1 will provide a walk-through on how to start the dashboard configuration on each tool, starting from the data imports to working on the visualizations. This chapter will provide concrete examples of the strengths and limitations of each tool, with the site mapping data used for testing. Likewise, Annex 2 will bring together existing use cases of visualizing the UNHCR data with each of the ESRI tools.

DEFINITION:

While many definitions of a dashboard exist, very few of them are suitable to the humanitarian and non-profit settings where the focus is on saving and improving human lives rather than maximising the profit. Below is the definition of the Humanitarian Dashboard of [the Inter-Agency Standing Committee \(IASC\) in 2012](#):

"The purpose of the Humanitarian Dashboard is to consolidate and present needs assessment and other core humanitarian information at crisis-level in an accessible format that facilitates analysis and evidence-based decision-making. The Humanitarian Dashboard is intended to:

- Assist the humanitarian country team in **facilitating analysis**, dialogue and strategic programming on **needs, coverage, gaps and priorities**;
- Assist cluster lead agencies in presenting **consolidated assessment information** from within the clusters, and in tracking/highlighting **progress against their targets**;
- Serve as the basis for a process of inter-sectoral analysis, including the discussion of **needs, coverage, gaps and priorities across clusters**;
- Highlight **information gaps** and point out areas to be targeted for further **needs assessment**;
- Support advocacy by illustrating **key issues, bottlenecks, number of people in need, and coverage**."

¹ ESRI ArcGIS Experience Builder, first released in 2020, has been omitted from this benchmarking due to time constraints.

In summary, a dashboard is a way of displaying key performance indicators, such as the needs versus coverage, on a single page. By bringing together the core data, a dashboard is often used as a report, a snapshot of performance or the operational reach.

REQUIREMENTS OF THE UNITED NATIONS HIGH COMMISSIONER FOR REFUGEES (UNHCR):

This comparison will be based on a UNHCR use case of visualizing the camp mapping data. The aim is to **provide the UNHCR Global Data Services team with throughout knowledge, pros, cons and limitations of these tools and to enable them to choose the one best adapted to their context.**

Real-time data visualization of the camp infrastructures stored in UNHCR Camp Mapping database:

- Data source:
 - Reading a feature layer
 - Reading directly a live Database, which is updated on a regular basis through
 - Access to private ArcGIS Online content
- Data visualization:
 - Spatial representation of the infrastructures
 - Graphs, indicators, analysis, both within and outside of the map element

Other requirements taken into account include licensing, the complexity of set-up, degree of IT maintenance required, dashboard sharing capabilities and the embedding options, possibility of offline use, user friendliness and the overall performance of the tool.

The summary table on pages 9-11 displays and compares the types and diversity of the visualization possibilities (including the map element, charts, tables, indicators, option to add pictures) offered by each dashboard tool.

Apart from ArcGIS Maps for Power BI, all the tools featured in this benchmarking are available on ArcGIS Online (AGOL), with the Creator and GIS Professional user types.

1. ESRI tools Comparison



1.1. ArcGIS Maps for Power BI

Microsoft Power BI is a cloud-based business intelligence and analytics service. When connected to all required data sources, Power BI simplifies data evaluation and results dissemination with scalable dashboards, interactive reports, embedded visuals and more.

Documentation: <https://doc.arcgis.com/en/maps-for-powerbi>

Power BI as a stand-alone offers a number of built-in tools for simple geographical visualisation and spatial analysis. With relevance to this document focusing on the tools offered by ESRI, **it is possible to access ArcGIS content with the ArcGIS Maps for Power BI extension.** In this document, our focus is more on the spatial possibilities offered by ArcGIS Maps for Power BI rather than Power BI itself.

Example: Visualization of Kenyan school data by Spatiality

<https://spatiality.co.ke/arcgis-maps-visualizations-microsoft-power-bi/>

A) Licensing

There are two aspects to take into account here: the Power BI license (see [Annex 1.1.A](#)) and the ArcGIS Maps for Power BI add-on license (see [Annex 1.1.B](#)).

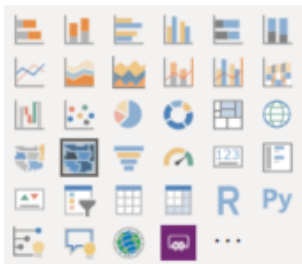
There are three levels of Power BI licenses: free, Pro or Premium, **and three levels of ArcGIS Maps for Power BI license:** free, or the add-on license to an existing organizational ArcGIS account.

B) UNHCR requirements and technical tests

All the steps the user has to follow in order to create a dashboard with Power BI and ArcGIS Maps for Power BI are described in [Annex 1.1.C](#). These tests have been carried out to assess the extent to which the UNHCR requirements could be achieved. These include, for example, accessing real time spatial data, and creating maps using this data. Results of these test are summarized at the section 1.5, pages 9-11, on the summary table.

C) Dashboard visualizations overview

All the visualization possibilities in Power BI are accessible from the Visualizations panel.



However, by clicking on the three dots, you will be able to search for many more options in the Power BI library and add your choices into your Visualization panel.

Visualization types: <https://docs.microsoft.com/en-us/power-bi/visuals/power-bi-visualization-types-for-reports-and-q-and-a>

There are also hundreds of additional visuals that you can download from the App Store besides those already available in Power BI.

Overview of the possible visualization elements:

► **Maps:**

Basic map (point)

Choropleth map (polygons and geolocation only)

Shape map (TopoJSON boundaries possibility)

ArcGIS Maps for Power BI (personal basemaps, personal and public hosted layers and Living Atlas data)

► **Charts:** bar, line, key performance indicators, stacked, multiple, grouped, curve, ribbon, area, cascade, pie, ring, treemap, gauge, funnel, scatter, bubble, waterfall, doughnut, word cloud...

► **Indicators:** cards (single or multiple number)

► **Tables:** table, matrix

► **Images and text:** yes

► **Other:** R element, Python element, Q&A element, slicers (filters)

► **Interactivity:** automatic

1.2. Web AppBuilder (Dashboard theme)

Web AppBuilder for ArcGIS is an intuitive application within ArcGIS Online/ArcGIS Enterprise that allows building map-centered web apps without coding, with the use of the readily available widgets.

Documentation: <https://doc.arcgis.com/en/web-appbuilder>

Example: [UNHCR Presence and People of Concern's Locations](#)

A) License

→ Web AppBuilder (ArcGIS Online or Portal)

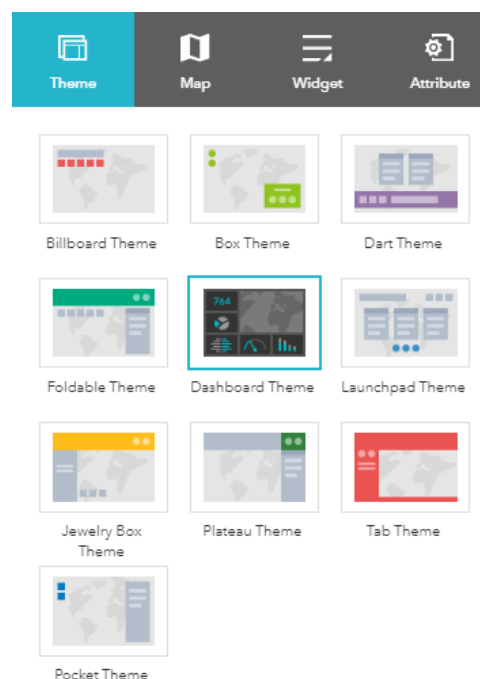
In order to use Web AppBuilder for ArcGIS, you must have a Creator or GIS Professional user type, and privileges to create apps in your ArcGIS organization.

Within ArcGIS Online or your ArcGIS Enterprise portal, you will have to work from a theme that will preconfigure the look and the type of your dashboard. You will be guided through all the steps from start to finish: this includes setting up the maps, widgets, style and more.

→ Web AppBuilder

Web AppBuilder for ArcGIS (Developer edition) requires an ArcGIS for Developer subscription but **allows you to customize your apps**, themes and widgets with the use of simple coding. Likewise, this upgrade allows hosting your apps on your own server (see 1.2).

This solution is, however, more complicated to put into action and is likely to be rejected for its over-performance for the UNHCR needs. Thus, in this document, we are only considering the Web AppBuilder Online / Portal option.



B) UNHCR requirements and technical tests

All the steps the user has to follow in order to create a dashboard with Web AppBuilder for ArcGIS are described in Annex 1, Section 2.

Results of these test are summarized at the section 1.5, pages 10-12, on the Summary table.

C) Dashboard visualizations overview

Web AppBuilder for ArcGIS offers a broad range of visualization possibilities. In Annex 1, Section 2, you will find a list of the most useful and commonly used widgets to display in a dashboard.

Overview of the possible visualization elements

- **Maps:** ArcGIS Online web map (fully configurable) + legend
- **Charts:** "Infographics" widget (indicator, gauge, pie, bar chart, line chart, stacked chart)
- **Indicators:** Info Summary
- **Tables:** Attribute table
- **Images and text:** yes

- **Other:** Swipe, Print, Feedback collector, Analysis tools (aggregate, calculate density, buffers, filter, find nearest, cluster, find similar, join, merge, overlay, summarize within...)
- **Interactivity:** yes

1.3. ArcGIS Dashboard

ArcGIS Dashboard (Operations Dashboard for ArcGIS up until 2020) is a platform for creating, authoring, publishing and sharing dashboards with others. This tool offers an easy user interface and a range of visualization options, and normally, without a requirement to know any coding. However, if required by the user, some of the visualizations can be further extended with simple coding.

Documentation: <https://doc.arcgis.com/fr/operations-dashboard>

Examples and useful resources:

<https://community.esri.com/community/gis/applications/arcgis-dashboards/blog/2019/03/01/operations-dashboard-for-arcgis-useful-links>

LICENSE

In order to use ArcGIS Dashboard, **you must have an organizational ArcGIS Online or Enterprise account with a Creator or GIS Professional user type.**

You can create dashboards from ArcGIS Online or your ArcGIS Enterprise portal.

A) UNHCR requirements and technical tests

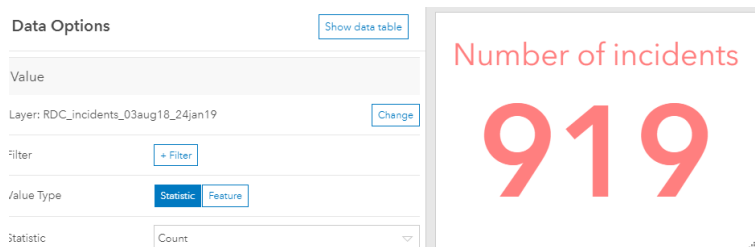
All the steps the user has to follow in order to create a dashboard with ArcGIS Dashboard are described in Annex 1.3.B.

B) Dashboard visualizations overview

The different elements available within ArcGIS Dashboard are as follows:

- **Map:** ArcGIS Online web map
- **Pie charts:** You need to update the color of your pie chart manually since the colours are not linked to the symbolization of the map.
- **Serial chart**
- **Gauge**

- Indicators



- **Rich text**
- **Embedded Content:** images, link to web app
- **List:** You can configure the list and choose the text you want to display for each elements.

- **Selector:** A selector (by category, by value or temporal) can only be created in a Side panel or a Header panel.

There is no possibility to add tables to an operational dashboard, but you can bypass this problem by using an image of your table. However, if connected to live data, the image should be manually updated each time there are changes in the data displayed in the table.

Overview of the possible visualization elements

- **Maps:** ArcGIS Online web map (fully configurable) + legend
- **Charts:** serial chart (point, line, bar), stacked chart, multi chart, gauge, text
- **Indicators:** statistical indicator, feature indicator
- **Tables:** no
- **Images and text:** text, embedded media (image or link to web apps)
- **Other:** category selector, number selector, time selector
- **Interactivity:** manual

1.4. Insights for ArcGIS

Insights for ArcGIS is an app you access through your ArcGIS organizational account, that allows you to perform iterative and exploratory data analysis on various static and live datasets, with or without geography. Unlike the other tools featured in this benchmarking, this tool comes with a built-in “Analysis View” that allows a user to explore the relationship between the database and the different visualizations.

Documentation: <https://doc.arcgis.com/en/insights>

Examples: <https://hub.arcgis.com/datasets/21a0bff04d664ab1bf71e83a982c364f>

A) License

→ Insights analyst

If you have no plan to access other ArcGIS products, you can pay for an access to Insights only.

→ Add Insights to an ArcGIS account

The other paid solution is to add an Insights license to an existing Creator or GIS Professional organizational account (21 day of free trial).

Overview: <https://doc.arcgis.com/en/insights/get-started/insights-overview.htm>

→ Viewer additional license

You can purchase an additional viewer license to ensure secure viewing of internal Insights workbooks.

Pricing: <https://www.esri.com/en-us/arcgis/products/arcgis-insights/pricing>

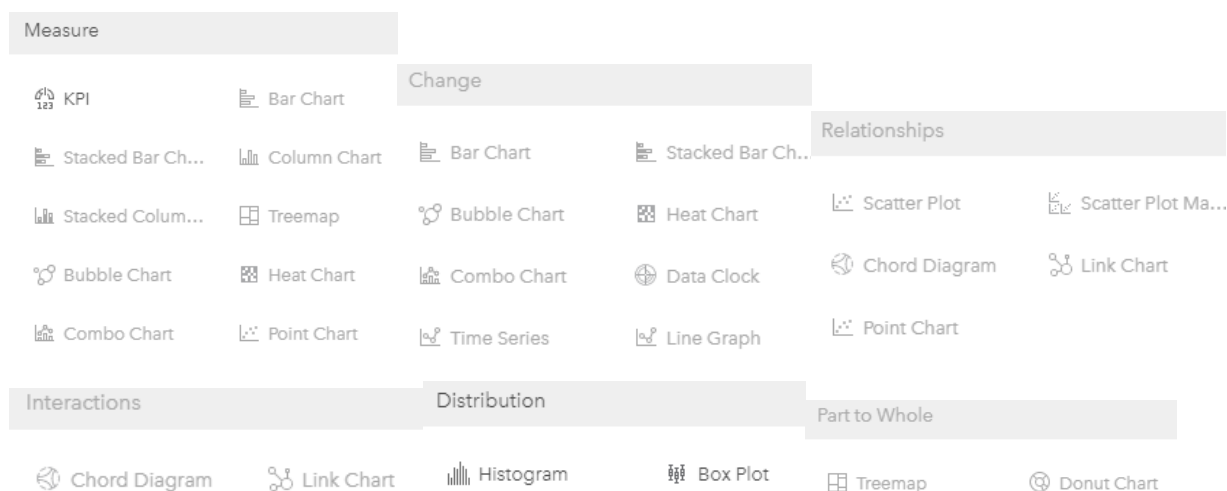
B) UNHCR requirements and technical tests

All the steps the user has to follow in order to create a dashboard with Insights for ArcGIS are described in Annex 8.

Results of these tests are summarized at the section 1.5 Summary table (pages 9-11).

C) Dashboard visualizations overview

As shown below, you can create visuals from a large choice of charts:



Overview of the possible visualization elements

► **Maps:**

ArcGIS Online web map (fully configurable) + legend

OR flat data (CSV, Shapefiles, GeoJSON): simple map (points, polygons...), choropleth...

► **Charts:** gauge, stacked, bar, column, bubble, combo, treemap, heat, point, change chart, relationship chart, scatter plot, chord diagram, link chart, box plot, donut, data clock, scatterplot...

► **Indicators:** no



► **Tables:** yes

► **Text and images:** no

► **Other:** Ability to join data, spatial analysis techniques: Calculate change, calculate ration, spatial filter, enrich data, spatial aggregation, heat map, buffer, calculate density, find nearest, create buffer, drive time, predict variable...

► **Interactivity:** automatic

1.5. Summary Table

| | ArcGIS Maps for Power BI | Web AppBuilder (Dashboard theme) | ArcGIS Dashboard | Insights for ArcGIS |
|--------------------------|---|--|---|---|
| Link | https://doc.arcgis.com/en/maps-for-powerbi | https://doc.arcgis.com/en/web-appbuilder | https://www.esri.com/en-us/arcgis/products/arcgis-dashboards/overview | https://doc.arcgis.com/en/insights |
| Licenses | 3 levels of Power BI license: <ul style="list-style-type: none"> - Power BI (free): free but limited sharing capabilities - Power BI Pro: paid regular use - Power BI Premium: higher performances, no data size limit, unlimited sharing to non-Power BI users 3 levels of ArcGIS Maps for Power BI license: <ul style="list-style-type: none"> - Free license (without an ArcGIS account): limited features - Add-in license with a Viewer or higher user type organizational ArcGIS account. | Only requires a "Creator" or "GIS Professional" user type with your organizational ArcGIS account. Possibility to customize your dashboard and visuals by using the Web AppBuilder (Developer Edition) with an ArcGIS Developer subscription (free limited license or paid full license). | Only requires a "Creator" or "GIS Professional" user type with your organizational ArcGIS account. | 3 levels of license: <ul style="list-style-type: none"> - Insights Analyst (without an ArcGIS account): paid but with no possibility to access to your content from your ArcGIS account - Insights add-on license (to add to an existing Creator or GIS Professional organizational account) - Viewer: additional costs for more secured functionalities |
| Platform used | Power BI Desktop and Power BI online service | ArcGIS online or ArcGIS Enterprise | ArcGIS online or ArcGIS Enterprise | ArcGIS online or ArcGIS Enterprise |
| Access to real time data |  No access to feature services  Connection to a PostgreSQL database possible but only without its spatial component | Yes, access to ArcGIS feature services | Yes, access to ArcGIS feature services | Yes, access to ArcGIS feature services |
| Real time data alert | Yes, but only with limited capacities on Pro/Premium. | No | No | No |
| Complexity of set up | Medium | Easy | Easy | Medium |
| Level of IT maintenance | Medium | Low | Low | Medium |

| | | | | |
|---|--|---|--|---|
| Recognized data sources | <p>Flat files: Excel, Text/CSV, XML, JSON, SharePoint folder...</p> <p>Databases: SQL Server database, PostgreSQL database, Access database, Oracle database, Azure SQL database...</p> <p>Online Services: SharePoint Online list, Facebook, GitHub, Microsoft Exchange Online...</p> <p>Others: R script, Python...</p> <p>⚠ Large choice of non-spatial data sources, BUT without spatial component.</p> <p>⚠ No access to your private ArcGIS Online and Enterprise content. Access to public hosted layers but only as background data.</p> | <p>Shapefiles, GeoJSON, CSV, KML, mxd, dwg, feature service, map service...</p> | <p>Shapefiles, GeoJSON, CSV, KML, mxd, dwg, feature service, map service...</p> | <p>Shapefiles, GeoJSON, CSV, KML, mxd, feature service, map service...</p> |
| Visualization possibilities (see below for details) | <p>There are hundreds of visuals available in the AppStore besides of those already available in Power BI by default.</p> | <p>Large choice of charts, many map-based visualization options.</p> <p>⚠ Requires a clear idea of the dashboard layout and content before starting.</p> | <p>Small choice in widgets, limited to the creating simple dashboards.</p> | <p>Large choice of charts, many map-based visualization options.</p> |
| Maps | <p>Map (point): from lat/long info, limited geolocation by names or addresses, basemaps limited to Bing maps only.</p> <p>Choropleth map (point or polygon): from lat/long info, limited geolocation by names or addresses.</p> <p>Shape map: possibility to add data as TopoJSON (point or polygon) but without a basemap.</p> <p>ArcGIS Maps for Power BI: you can use custom basemaps from your own or publicly available content</p> <p>⚠ Limited mapping options.</p> <p>⚠ No option for web sharing</p> | <p>ArcGIS Online web map (fully configurable).</p> <p>⚠ Your web app will be based on the configuration of the web map on ArcGIS Online. You should be careful about elements such as symbology, popups, bookmarks and labels as these cannot be controlled directly in your web app.</p> | <p>ArcGIS Online web map (fully configurable)</p> <p>⚠ Your web app will be based on how you configure your web map in ArcGIS Online. You should be careful about elements such as symbology, popups, bookmarks and labels that you will not be able to modify or add in your web app.</p> | <p>ArcGIS Online web map (fully configurable) simple map (points, polygons...) choropleth map</p> |

| | | | | |
|-----------------------------------|--|---|---|--|
| Charts | Bar, stacked, histogram, multiple, grouped, curve, ruban, area, cascade, pie, ring, treemap, gauge, funnel, word cloud, bubble chart | "Infographics" widget (indicator, gauge, pie, bar chart, line chart, stacked chart) | Serial chart (point, line, bar), stacked chart, multi chart, gauge, pie chart | Gauge, stacked, bar, column, bubble, combo, treemap, heat, point, change chart, relationship chart, scatter plot, chord diagram, link chart, box plot, donut, data clock, scatterplot... |
| Indicators | Indicator, key indicator... | "Info Summary" | statistical indicator, feature indicator | No |
| Tables | Table, matrices | Only attribute tables, but you can bypass this problem by using an image your table. | There is no possibility to add tables to an operational dashboard, but you can bypass this problem by using an image your table. | Yes |
| Images and texts | Yes | Yes | Text and embedded media (image or link to web apps) | Yes |
| Others | Scripts: R element, Python element, Q&A element | Spatial analysis: swipe, print, feedback collector, Analysis tools (aggregate, calculate density, buffers, filter, find nearest, cluster, find similar, join, merge, overlay, summarize within...) | Selectors: category selector, number selector, time selector | Ability to join data Spatial analysis: Calculate change, calculate ration, spatial filter, enrich data, spatial aggregation, calculate density, find nearest, create buffer, drive time, predict variable... |
| Interactivity | Yes | Yes | Manual set up required for interconnected filter and zoom actions. For example, unless manually set up, selecting a country on a map will not result in zoom and filter to that country by default. | Yes |
| Customization options | Yes | Yes, with Web AppBuilder (Developer Edition): minimum coding skills required. | No | No |
| Mobile mode | Yes, a mobile version of your report can be created and will be automatically adjusted to mobile use. | Yes, the application will automatically adapt to the screen size. | No, but possible to create exclusive versions for desktop and mobile use. | No |
| Responsive to screen sizes | Yes | Yes | No | Yes |

| | | | | |
|--------------------------|--|---|---|---|
| Sharing | <p>With a free license, you can only share your reports as .pbix files, or without the interactivity as excel or jpeg files. You can create reports but no dashboard. With the Pro license, you can create dashboards and share them along your reports, but only to other Pro users.</p> <p>To be able to share to users without a Power BI account, you will need an upgrade to the Premium license.</p> <p> Regardless of the license, online sharing or embedding is never possible with the ArcGIS Maps for Power BI extension.</p> | After making your dashboard available to public, you can share your dashboard to people outside of your organization. | After making your dashboard available to public, you can share your dashboard to people outside of your organization. The link to provide for non-ArcGIS users has to be adapted. | After making your dashboard available to public, you can share your dashboard to people outside of your organization. |
| Embedding | Requires a Pro or Premium license. Not supported ArcGIS Maps for Power BI elements. | Yes | Yes | Yes |
| Offline mode | You can access your reports in offline mode by working locally in Power BI Desktop, or by exporting your reports as pdf or excel files. | Offline possibility with Portal | Offline possibility with Portal | Offline possibility with a combination of Portal, Server and Insights Desktop. |
| Access to ArcGIS content | Only to public hosted features. | Yes | Yes | Yes but only with the appropriate license. |
| User friendly | No | Yes, with ESRI support and documentation available | Yes, with certain limitations. | Yes, with certain limitations. |
| Technical skills | None, unless you want to customize the visuals. | None, unless you want to customize the visuals. | None | None |
| Performance | The report elements and dashboard tiles are slow to react when interacting with the data. The size of data is limited even with a Pro license. | OK | OK | OK |

2. Limits and assets overview

After this presentation of different solutions, the main question is which solution can be most useful for a specific task or a specific context. This depends very much on the needs, type of data source, and knowledge.

2.1. What are the differences

What is the difference between ArcGIS Dashboard, Insights for ArcGIS and Web AppBuilder according to ESRI?

*"Operations Dashboard for ArcGIS is the premier app for creating sophisticated dashboard apps. It **offers precision charting and visualization options** and uses a new "dashboard" item type in ArcGIS Online and ArcGIS Enterprise 10.6.*

*Web AppBuilder for ArcGIS has a 'dashboard' theme layout option, where you can create a dashboard. You can use the Infographic widget to create simple charts and visualizations quickly and easily. You can also incorporate additional functionality such as **editing and geoprocessing in your apps**. Existing Web AppBuilder users will likely choose this option to create dashboards.*

*Insights for ArcGIS is designed for both **spatial and non-spatial analysis and data exploration**. The analysis results are displayed in maps, charts, and tables on a worksheet – these can be interpreted to be a "dashboard", but not in the traditional sense. The distinction here: this app's focus is for data discovery and analysis."*

Esri dashboard solutions: <https://community.esri.com/thread/204746-what-is-the-difference-between-insights-for-arcgis-and>

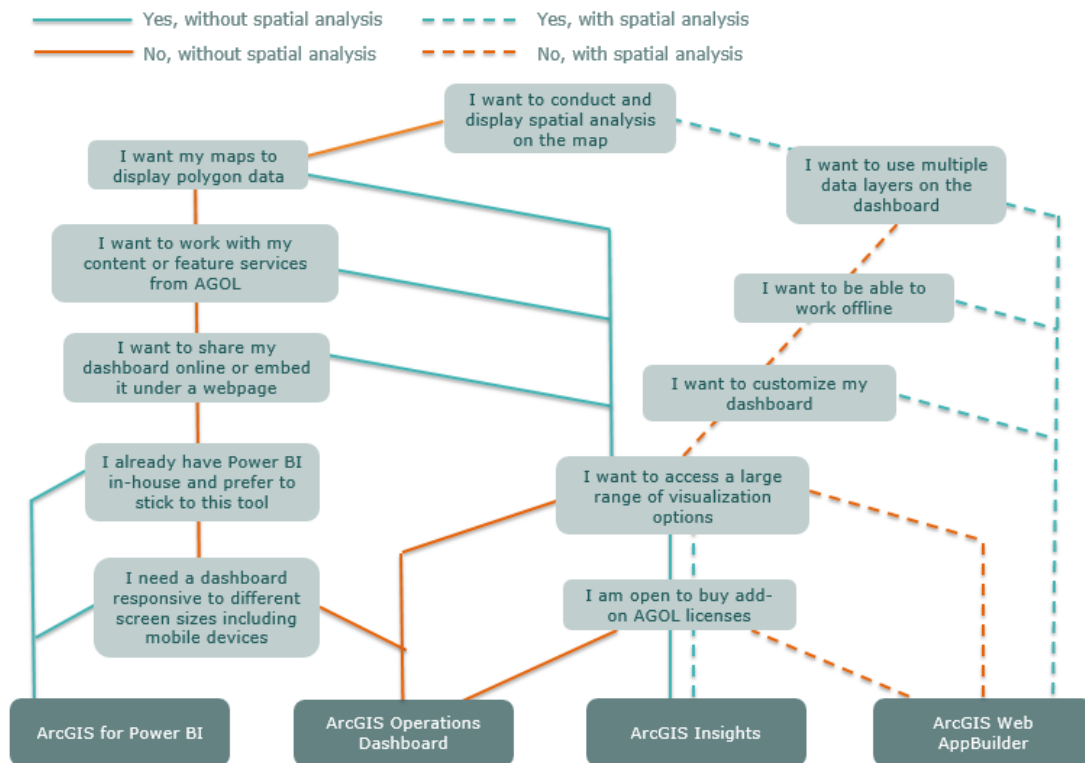
Insights for ArcGIS offers more charting options than ArcGIS Dashboard, but does not have a real "presentation" mode, all of its cards are simply displayed on a worksheet.

2.2. Decision tree

The decision tree in the below figure is intended to give an idea of what should be considered when choosing between these ESRI data visualization solutions.

However, as usual with decision trees, this one is meant to work as a simplified guide for selecting between one or more tools. In the end, many aspects may influence the final decision and hence, creating a readable graphic that includes each special case is almost impossible. When looking at the decision tree please note that in most cases choosing "yes" does not necessarily eliminate other options. For example, it is still possible to use another tool than Operational Dashboard for simple visualization needs. However, because the Operational Dashboard seems to be the easiest to use, it has been identified as the first choice.

Therefore, the decision tree can only give an idea of the options and choices available but should not be the only basis for a decision. A throughout exploration of the possibilities, strengths and weaknesses of each tool is thus highly recommended. The table on pages 10-12 summarizes important points about each of the solutions presented in this document, which allows to directly compare the different options.



2.3. Conclusion

Starting from the licensing perspective, only the ArcGIS Dashboard and the Web AppBuilder for ArcGIS require an ArcGIS organizational account. The two other options, ArcGIS for Power BI and ArcGIS Insights can be purchased both with or without an already existing ArcGIS account. Hence, for users already in possession of an ArcGIS Creator or Professional licenses, the Dashboard and Web AppBuilder would be the easiest options to go for.

In terms of the overall possibilities and capabilities of the software options, the **Web AppBuilder for ArcGIS** and **ArcGIS Insights** stand out as the most exhaustive choices. With the built-in spatial analysis and map-based data visualization options, these are particularly beneficial for handling geospatial data. Likewise, both of these offer a broad range of widget and visualization options both inside and outside of the map element.

ArcGIS Dashboard, while a powerful, yet simple-use platform, is rather limited in terms of design and data visualization options. As an example, it is particularly difficult to build a dashboard responsive to different screen sizes. Similarly, unlike in Power BI, the dashboard elements are not interconnected by default, thus requiring a manual set-up for any interaction. On the other hand, this can be a positive aspect if the dashboard elements are expected to be independent rather than interconnected.

While **ArcGIS Maps for Power BI** is rich in data visualization options, the application comes with significant limitations, particularly when it goes to the mapping and spatial analysis component. One especially restrictive limitation is the inability to work with feature layers or spatial data files such as shapefiles or GeoJSON files. Hence, the only option remaining is to work with latitude/longitude information or fetching to location names through the Bing name library. While there is a possibility to connect to a PostgreSQL database, the spatial component is not supported. Another challenging aspect with ArcGIS Maps for Power BI is the inability to access your private data from ArcGIS online – only resources available to public can be imported to Power BI. Finally, as a further limitation, dashboards connected to ArcGIS Maps cannot be shared online or embedded on websites.

Annex 1. Walk-throughs with technical tests

1.1. ArcGIS Maps for Power BI

1.1.A. Power BI Licenses

You can either opt for Pro per-user license or a more expensive Premium license. There is also a free license for Power BI with limited possibilities.

Power BI license: <https://docs.microsoft.com/en-us/power-bi/service-features-license-type>

→ Power BI (free)

A free license enables a user to consume content in its workspace and access to some of the features of the Power BI service for their own personal use, without having the possibility to share or publish the dashboard content.

→ Power BI Pro

A Power BI Pro license enables a user to collaborate with other Power BI Pro users. Only users with a paid Power BI Pro license can publish content to app workspaces, share dashboards, and subscribe to dashboards and reports. You can try Power BI Pro for 60 days for free.

On the right, you will find a list features supported by Power BI Pro and the free Power BI license.

| | Free | Pro |
|---|------|-----|
| Connect to 70+ data sources | ✓ | ✓ |
| Publish to Web | ✓ | ✓ |
| Export to PowerPoint, Excel, CSV | ✓ | ✓ |
| Enterprise distribution | | |
| Apps | ✗ | ✓ |
| Email subscriptions | ✗ | ✓ |
| Embed APIs and controls | ✗ | ✓ |
| Collaboration | | |
| Peer-to-peer sharing | ✗ | ✓ |
| Workspaces | ✗ | ✓ |
| Analyze in Excel, analyze in Power BI Desktop | ✗ | ✓ |

Figure 1: Power BI free and Pro licenses comparison

→ Power BI Premium

Power BI Premium provides faster performance and better support large data volumes. Power BI Premium also enables widespread distribution of content by Pro users without requiring the viewers to possess Power BI Pro licenses.

1.1.B. ArcGIS Maps for Power BI licenses

ArcGIS Maps for Power BI can be accessed either with or without an ArcGIS Online account. However, the possibilities within Power BI will not be the same.

→ Without ArcGIS Online or Enterprise – Free

All Power BI users have a direct access to ArcGIS Maps for Power BI. The **basic functionalities are available for free but these** will be restricted to data visualization, basic spatial analysis, and US demographic content. A list of these capabilities is provided on the left side of the following figure.

| Standard (included with Power BI) | With your ArcGIS account |
|---|--|
| Basemaps | |
| 4 basic basemaps | All Esri basemaps plus access to your organization's basemaps, including custom basemaps |
| Geocoding | |
| 3,500 locations per map | 10,000 locations per map |
| 10,000 locations per month | No monthly limit |
| Reference layers | |
| 10 reference layers that contain U.S. demographics | Access to all web maps and layers from your ArcGIS organization |
| Publicly shared feature layers in ArcGIS | Publicly shared feature layers in ArcGIS |
| | Access to ArcGIS Living Atlas of the World maps and layers (feature services) |
| Infographics | |
| Curated gallery of U.S. demographics variables (7 categories) | Full access to the ArcGIS GeoEnrichment data browser, including U.S. and global demographics variables |

→ With an ArcGIS Online or Enterprise account

With an ArcGIS Online or Enterprise organizational account and a user type Viewer (or higher) you have an option to purchase an ArcGIS Maps for Power BI add-on license, enabling an **access to all the features of ArcGIS Maps for Power BI**. This add-on license can be purchased, managed and assigned to the relevant users by your ArcGIS administrator.

ArcGIS Maps for Power BI license: <https://doc.arcgis.com/en/maps-for-powerbi/get-started/arcgis-licensing.htm>

You can also access ArcGIS Maps for Power BI from your ArcGIS Enterprise account.

Enterprise support : https://www.esri.com/arcgis-blog/products/maps-power-bi/mapping/m4pbi_enterprisesupport

Summary of the content that different types of users will be able to see:

| Content type | User |
|---|---|
| Content included with Power BI | All users |
| Publicly shared ArcGIS content | All users |
| Private content from your ArcGIS organization | ArcGIS users in your organization with the required license and privileges |

1.1.C. Walk-through and technical test

Get started: <https://docs.microsoft.com/en-us/power-bi/desktop-getting-started>

1) ADD SOME DATA

The first step is to add data to your workspace.


Power BI allows you to import the following types of data sources:


- Flat files (Excel, Text/CSV, XML, JSON, SharePoint folder)
- Database connection (SQL Server database, PostgreSQL database, Access database, Oracle database, Amazon Redshift, Azure SQL database...)
- Online services (SharePoint Online list, Facebook, GitHub, Microsoft Exchange Online...)
- Other sources (R script, web, Blank Query...)

Power BI data sources:

<https://www.tutorialspoint.com/power-bi/power-bi-supported-data-sources.htm>

As soon as the import process starts, you will see the data appearing in the “Fields” tab in your Power BI workspace. After, you will be able to build visualizations from your data.

 **Power BI does not support geospatial files such as Shapefiles, GeoJSON. You can connect to a spatial database such as a PostgreSQL database, but the spatial component will not be supported.**

 In order for you to work with spatial data, you will have to work with latitude/longitude information, with clearly spelled location names or with addresses. However, this may turn out as a limitation when working with less known place names or with names that have been transliterated from languages using non-Latin script (e.g. Arabic or Persian).

 **There is no possibility to connect to a feature service.**

In order to meet the UNHCR requirements in term of real time display of data, **you will have to create a PostgreSQL database connection.**

To connect Power BI to PostgreSQL, the first step consist of creating the connection in “Get Data > More > PostgreSQL database”.

Base de données PostgreSQL

Serveur

Base de données

Mode de connectivité des données ⓘ

☒ Importer

☐ DirectQuery

> Options avancées

You will be prompted to enter your database information. However, this option is likely to result in an error.

To overcome this issue, you will have to import your data from an ODBC connection instead of a PostgreSQLone . Instructions for this workaround are given in the link below.

Obtenir les données

Tout

- Excel
- Texte/CSV
- XML
- JSON
- Dossier
- PDF
- Dossier SharePoint
- Base de données SQL Server
- Base de données Access
- Base de données SQL Server Analysis Services
- Base de données Oracle
- Base de données IBM Db2
- Base de données IBM Informix (Bêta)
- IBM Netezza
- Base de données MySQL
- Base de données PostgreSQL

Connecteurs certifiés

Se connecter Annuler

PostgreSQL connector issue: <http://niftit.com/connecting-power-bi-to-postgresql>

By choosing a ODBC connection, you will be prompted to enter a connection string in the following format:

Driver={PostgreSQL ANSI};Server=<your server ID>;Port=<your port>;Database=<your database name>;

À partir de ODBC

Nom de source de données

Options avancées

Chaîne de connexion (sans propriétés d'informations d'identification) (facultative) ⓘ

Driver={PostgreSQL ANSI};Server=;Port=;Database=;

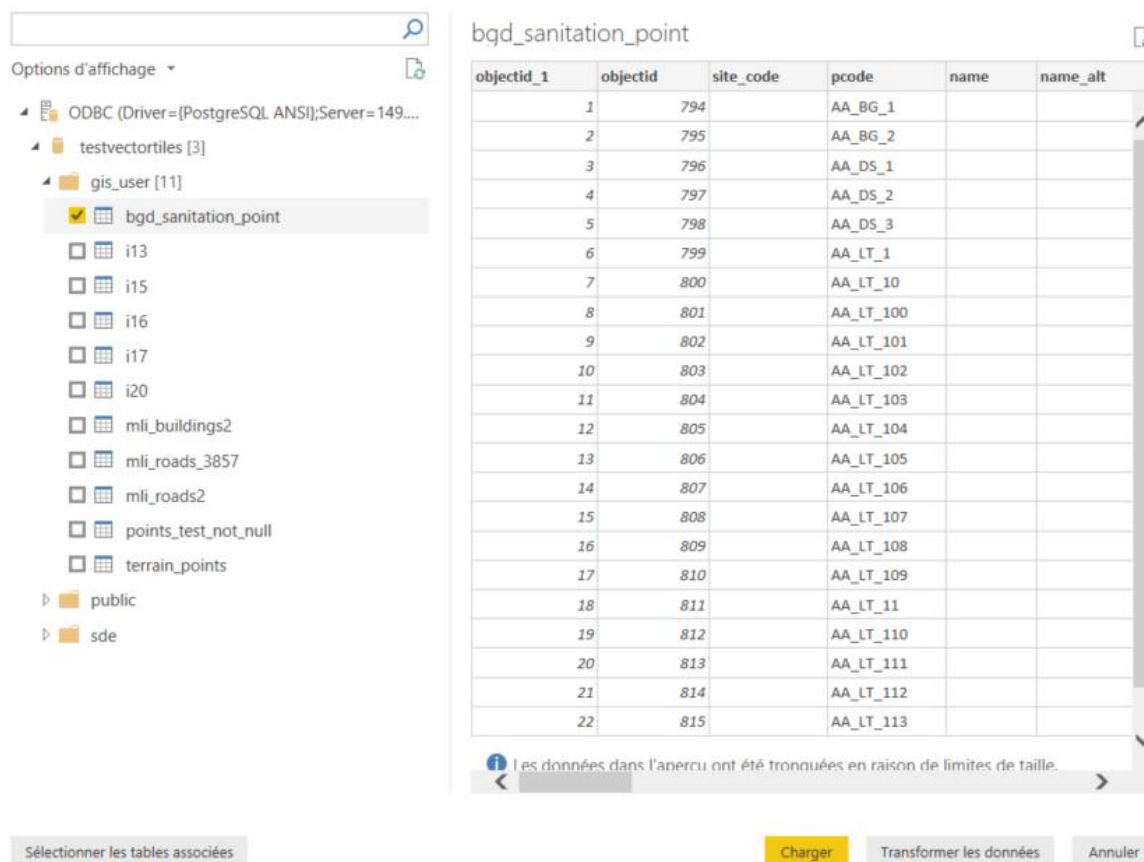
Instruction SQL (facultative)

Clauses de réduction de ligne prises en charge (facultatif)

Détecter

OK Annuler

If the server connection information is correct, a new window will appear, allowing you to preview and select the data you want to work with. Optionally, you can also transform the data before the import to your workspace.



After the import process, you will see the data appearing in your “Fields” tab, accompanying all the other data you may have already imported. Now you will be able to start building your visualizations.

Each visualization will be updated in real time whenever any part of the data is being modified, added or deleted in your database. For example, updates to the data via Collector for ArcGIS or any other mobile data collection tool will be automatically reflected on your Power BI dashboard.

⚠ In the case of the Site mapping database, the UNHCR firewall system prevents Power BI from connecting to the server. In order to be sure that this workflow runs regardless of the VPN issue, we tested and achieved a connection to some non-UNHCR databases.

⚠ You can only connect to the non-spatial component of the PostgreSQL database. Hence, in order to create a map from this database, your data should include latitude/longitude information, localisation names or addresses that can be georeferenced by Power BI.

As a positive point, ESRI time format is not mandatory in Power BI when creating temporal charts: Power BI Desktop works behind the scenes to auto-identify columns with date records. If you wish, you can also change the date representation by modifying the language model settings in your Power BI Desktop.

Date and time in Power BI: <https://docs.microsoft.com/en-us/power-bi/supported-languages-countries-regions#choose-the-language-for-the-model-in-power-bi-desktop>

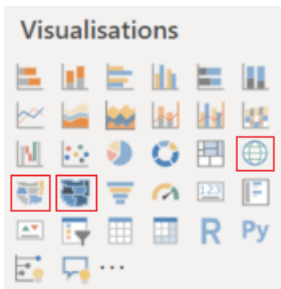
2) CREATING MAPS

This section will cover in two separate parts:

- Basic map features of Power BI standalone, without extensions
- The ArcGIS Maps for Power BI's spatial features, on which this document is specifically focused on.

→ With Power BI basic map features:


There are three available tools for creating map visuals in Power BI



⚠ In all of these three solutions, the only basemaps available are the one from Bing. You can eventually change these basemaps by creating some new ones in Mapbox and calling them with Power BI. More information on the Mapbox connection is provided in the CartONG document [Creating a basemap with MapBox & using it as a visual for Power BI](https://blog.cartong.org/2020/02/14/creating-a-basemap-with-mapbox-using-it-as-a-visual-for-power-bi/): <https://blog.cartong.org/2020/02/14/creating-a-basemap-with-mapbox-using-it-as-a-visual-for-power-bi/>

💡 You can also create basemaps in ArcGIS Online and use **ArcGIS Maps for Power BI** to display your basemaps (see [Creating maps with ArcGIS Maps for Power BI](#)).


Regardless of ArcGIS Maps for Power BI, you can create maps using:

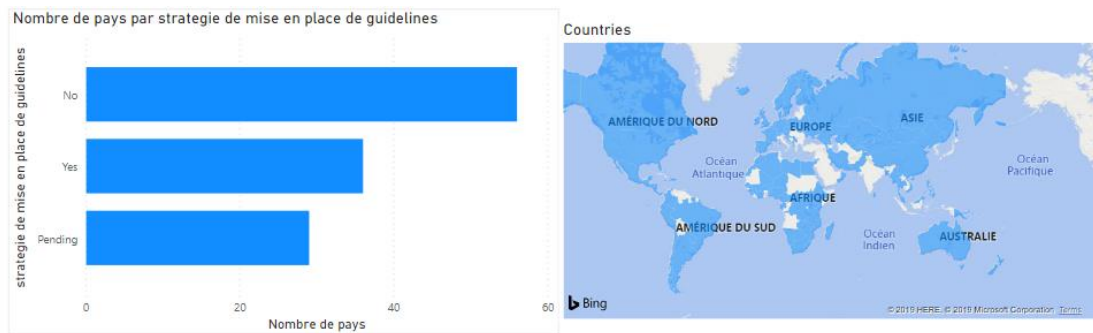
"Map" : your data will be georeferenced as points from addresses information or thanks to latitude/longitude information.



⚠ Based on the testing results, it is difficult to display spatial information as polygons with Power BI mapping tools. Polygon coordinates are not supported in Power BI, whereas point elements can still be displayed, thanks to latitude/longitude information.


💡 You can still try to display spatial data as polygons with the "Choropleth map" tool, if you are working with simple administrative boundaries. Bing's geolocalisation system will recognize administrative names such as country or state names, and map your data accordingly. However, this can be problematic when dealing with place names transliterated from languages using non-Latin script (e.g. Arabic or Russian).

- **"Choropleth map"**  : your data will be georeferenced as polygons from localisation information such as administrative boundaries.



⚠ The "Map" and "Choropleth map" tools can be used to create maps only if your data carry latitude/longitude information (point elements only), or localisation names and addresses (point or polygon elements) that can be interpreted by Bing's geolocalisation system. If your data does not carry these types of information (e.g. in the case of non-administrative custom polygons), you can try to work with the "Shape map" option.

⚠ As another limitation, Power BI allows display only one data element on a single map. For example, it is not possible to display point data on top of a choropleth map. In order to display both types of data, you would need to create two separate maps.

- **"Shape map"**  : your data can be geolocalised by importing a custom TopoJSON file instead of using Bing's by default basemap.

⚠ In this case, your data will be displayed using the TopoJSON spatial features, but no background basemap will be visible.

Partner (fixed) Center (mobile) Health specify Clinic Facility

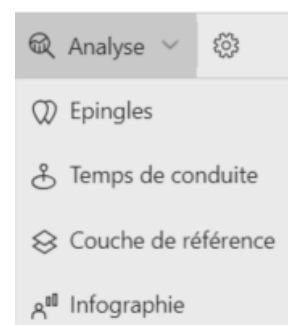


➔ With ArcGIS Maps for Power BI:

In order to work with ArcGIS Maps for Power BI, you will first have to import data from one or more data sources listed above (see [Data sources](#)).

You can then add symbology to your data and use the limited spatial analysis tools, such as:

- Calculating a driving time
- Search for all similar elements from your data
- Add some global demographical data from the ESRI library (including population, age, incomes, education level, family and living condition...)
- Add some reference layers from ArcGIS Online's public hosted layers and the ESRI Living Atlas.



⚠ There is **no possibility to access private hosted layers or maps from your ArcGIS Online**, even when signed in your personal ArcGIS Online account.

⚠ You can only access **hosted layers** from your ArcGIS online account **if they are publicly shared**. As another note, this type of data is available **only as unsymbolized background data** with no possibility of using it for charts, tables, spatial analysis or other types of visualizations.

💡 If you still want to use ArcGIS Maps for Power BI and add spatial background data from your personal ArcGIS Online account, the work-around is to create a basemap corresponding to your needs on ArcGIS Online. After, you can add this map into your report with the "Basemap" tool in ArcGIS Maps for Power BI.

⚠ However, it is not possible to connect to a feature service from your ArcGIS organizational account since it is not a HOSTED feature layer.

CONCLUSION: In order to analyze your private hosted data on ArcGIS Online or Portal, a better option is to use Power BI without the ArcGIS Maps for Power BI extension..

3) SHAPE THE DATA WITH QUERIES (OPTIONAL)

When you connect to a data source, you have a choice to either directly load your data into Power BI, or transform the data with the Power Query Editor (including renaming of columns or tables, removing rows or columns, changing data types, joining data...).

4) CREATE VISUALIZATIONS FOR YOUR REPORT

Power BI offers a large choice of charts and other visualisations that you can use in your report.

If the available choices do not meet your requirements, there is also a possibility to create custom visualizations with the JavaScript programming language.

Custom visuals: <https://powerbi.microsoft.com/en-us/developers/custom-visualization>

5) CREATE A DASHBOARD

A Power BI dashboard is different than a report. It is a single page – sometimes called canvas – that tells a story through data visualizations. The individual visualizations you see on the dashboard are called tiles. You pin tiles to your dashboard from reports. Because the dashboard is limited to one page, a well-designed dashboard contains only the highlights of the report. Readers can view related reports for further details.

Power BI dashboards: <https://docs.microsoft.com/en-us/power-bi/service-dashboards>

You need a Power BI Pro license to create dashboards in workspaces. The ability to create a dashboard requires editing permissions for the report. For that, you need the creator of the report to give you access to its report.

One advantage to use dashboards in addition to reports is the possibility to set alerts when the changes in real-time data exceed the originally set limits for the visualizations. On the other hand, these alerts can only be set on gauges, KPIs, and cards pinned in the dashboard. In addition, other users will not be able to see the alerts you set, even if you have shared your dashboard.

Below is a comparative list of the capabilities supported by reports and dashboards in Power BI.

| Capability | Dashboards | Reports |
|--|---|---|
| Pages | One page | One or more pages |
| Data sources | One or more reports and one or more datasets per dashboard | A single dataset per report |
| Available in Power BI Desktop | No | Yes. Can build and view reports in Power BI Desktop |
| Subscribe | Yes. Can subscribe to a dashboard | Yes. Can subscribe to a report page |
| Filtering | No. Can't filter or slice | Yes. Many different ways to filter, highlight, and slice |
| Featured | Yes. Can set one dashboard as your <i>featured</i> dashboard | No |
| Favorite | Yes. Can set multiple dashboards as <i>favorites</i> | Yes. Can set multiple reports as <i>favorites</i> |
| Set alerts | Yes. Available for dashboard tiles in certain circumstances | No |
| Natural language queries (Q&A) | Yes | Yes, provided you have edit permissions for the report and underlying dataset |
| Can see underlying dataset tables and fields | No. Can export data but can't see tables and fields in the dashboard itself | Yes |

Figure 2: Power BI reports and dashboards capabilities

6) PUBLISH

→ Share:

⚠ Currently, it is not possible to publish or embed to web from Power BI when an ArcGIS Maps for Power BI element is included in the dashboard, even with a Pro license.

With a free license, you will only be able to share your work by exporting your visualisation elements to Excel, or exporting your report to PDF, but with the disadvantage of losing all the interactions. You can also share Power BI Desktop .pbix files like any other files – this would be particularly useful for contexts with low or unreliable internet access. Yet, the most compelling method is to upload the report to the Power BI online service - you will need a Power BI Pro license to do this.

Upgrade to Power BI Pro



This feature is only available to users with a Power BI Pro license. When you upgrade, you get access to collaborate with others and distribute content. Upgrade today or try it free for 60 days. [Learn more](#)

Try Pro for free

Upgrade account

Cancel

⚠ If you have a Power BI Pro account, you will be able to share your work by email or a URL link but only to other Pro license users.

💡 To overcome this sharing issue, you can get a Power BI Premium license, which enables widespread distribution of content without requiring the viewing users to have Power BI Pro licenses.

Share Access

Only users with Power BI Pro will have access to this report. Recipients will have the same access as you unless row-level security on the dataset further restricts them. [Learn more](#)

Grant access to

Enter email addresses

Include an optional message...

- ☒ Allow recipients to share your report
- ☒ Allow users to build new content using the underlying datasets
- ☒ Send email notification to recipients

Report link ⓘ

<https://app.powerbi.com/groups/me/reports/e3d5fdd0-29fe-4d88-a044-f99c87b>

→ Embed a report:

⚠ Currently, it is not possible to publish or embed to web from Power BI when an ArcGIS Maps for Power BI element is included in the dashboard, even with a Pro license.

With the secure Embed option offered by Power BI Pro/Premium, you can easily integrate your report under any internal site that allows embedding with an HTML code snippet or a URL address. However, in order to view the report, you will need to sign into your Power BI Pro, or alternatively the content needs to be located in a workspace created with Power BI Premium capacity.

Embed Power BI reports: <https://powerbi.microsoft.com/en-us/blog/easily-embed-secure-power-bi-reports-in-your-internal-portals-or-websites>

Publish to web: <https://docs.microsoft.com/en-us/power-bi/service-publish-to-web>

→ Share to mobile:

If you wish, you can optimize the display of your reports on mobile by creating a portrait layout where you can reshape or delete your visuals.

The mobile version is published at the same time as the main report. In case there is no mobile-optimized version available, the report opens in an unoptimized landscape view.

Create phone report: <https://docs.microsoft.com/en-us/power-bi/desktop-create-phone-report>

→ Offline mode:


As already mentioned, working in the offline mode is possible when you share your Power BI Desktop .pbix files directly to other Power BI Desktop users. You also have the possibility to export your dashboard in a PDF or Excel format. However, with this option, any interaction with the data will be lost.

1.2. Web AppBuilder for ArcGIS

1.2.A. Walk through and technical tests

Tutorial: <https://doc.arcgis.com/en/web-appbuilder/create-apps/make-first-app.htm>

1. Create a web map (or scene)

 Your web app will be based on the configuration of the web map in ArcGIS Online. Hence, you should be careful with elements such as symbology, popups, bookmarks and labels as you will not be able to modify these in your web app.

2. Create an app

You can open Web AppBuilder directly from your web map in the *Map Viewer*, from the item details of your web map, or from your content page.

To create an app from the item page, view the item details for a map, click “Create Web App”, and choose “Web AppBuilder”.

To create an app from the *My Content* tab of the content page, click “Create” and choose “Web AppBuilder” from the list of options.

3. Choose a theme

Each theme includes a collection of panels, styles, layouts, and preconfigured widgets.

Here we are considering the **Dashboard theme**, which allows you to visualize widgets in the panel directly after launching your app.

Dashboard theme tutorial: <https://downloads.esri.com/learnarcgis/educators/app-builder-dashboard.pdf>

4. Select your web map (or scene)

If you open the Web AppBuilder from the Map Viewer (or Scene Viewer in case of a 3D app) or from the item detail, you will already have your map (or scene) selected. However, you will still be able to change it if you want.

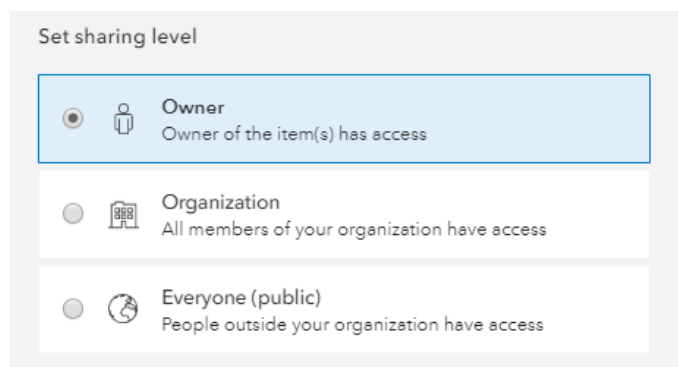
5. Add widgets

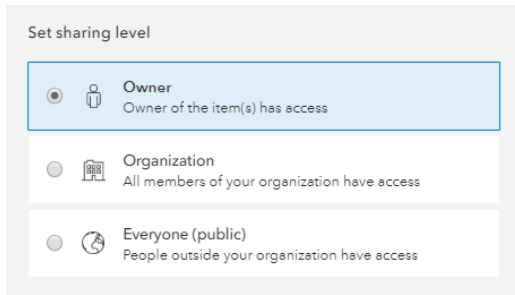
The initial set of widgets vary from theme to theme, as each theme comes with its own preconfigured set of widgets. When building your app, you may add, remove or reorganize your widgets depending on your needs (see **3.3 Analysis and dashboard possibilities**).

6. Save and publish

→ **Share:**

You can make your app available for different user groups and share it with an URL address. For sharing with the wider public, you should set the Sharing level to *Everyone (public)*. With this option, anyone with the link will be able to view your app without logging in to an ArcGIS account.





→ Embed the app:

You can also embed the web app into a web site if it is shared with *Everyone*.

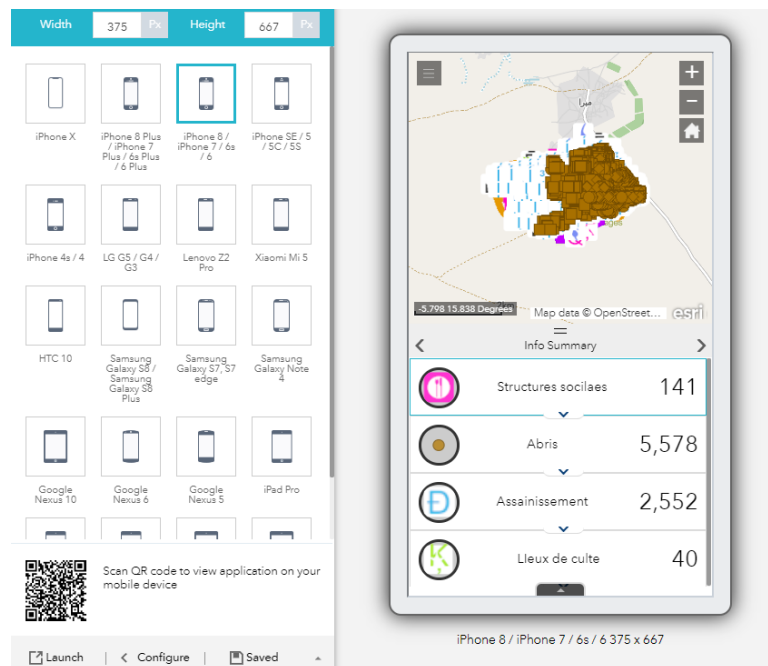
Embed an app: https://doc.arcgis.com/en/arcgis-online/share-maps/embed-maps-groups.htm#ESRI_SECTION1_9B629D885B1D41ECAFFA651CF2D2A849

→ Share to mobile:

You can preview the mobile display of your app before sharing it onwards. In the mobile view, only one widget is displayed at a time, with the lateral arrows allowing a user to switch between the widgets.

→ Offline mode:

If you want to be able to work in offline mode with Web AppBuilder, you will need to configure Web AppBuilder with ArcGIS Portal instead of ArcGIS Online.



1.2.B. Technical possibilities

Widgets are categorized as two types: off-panel and in-panel (see the figure below).

- Off-panel widgets can be turned on and off but cannot be removed from an app.
- In-panel widgets can be added into the widget controllers. The dashboard theme offers five locations for your in-panel widgets. However, if your app needs more than five, you can stack the widgets on top of each other.



Below, you will see some examples of widgets that can be used in the context of Site Mapping. There are many more widgets available but the most relevant to a dashboard are the ones listed below, especially **Infographics**, **Filter**, **Legend**, **Info Summary**, **Analysis** and **About** widgets.

List of available widgets: <https://doc.arcgis.com/en/web-appbuilder/create-apps/widget-overview.htm>



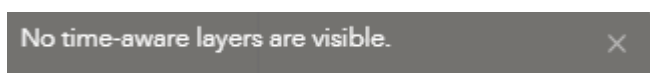
Figure 3: Off and in-panel widgets in Web AppBuilder

→ Off-panel:

Attribute table - Displays a tabular view of operational layers' attributes.

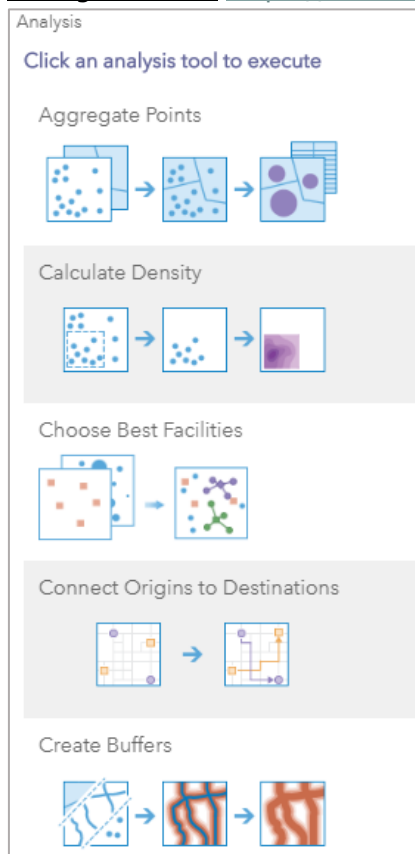
Swipe - Enable the user to swipe between two layers on a map or between your layer and your base map.

Time slider



⚠ This widget can only be used if your layer has time settings enabled. For hosted feature layer, you can do this in the Settings menu. If using feature services, be aware that you will have to enable use of the time element from the service parameters.

Configure time: <https://doc.arcgis.com/en/arcgis-online/create-maps/configure-time.htm>



Print : Allows a user to print or export the dashboard view in a PDF format

→ In-panel:

About - Provides text information about your app

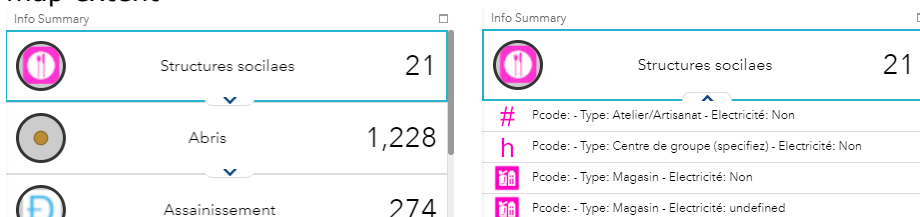
Add Data - Enables end users to add data to the map by using ArcGIS Online or ArcGIS Enterprise content, entering URLs of external content, or uploading files from their own device.

Examples:

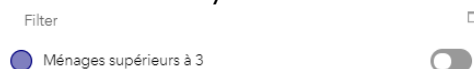
| | |
|--|------------------------|
| Aggregate points | Filter |
| Calculate density | Find hotspots |
| Choose best facilities (e.g. maximize the coverage regarding capacity) | Find nearest |
| Create buffers | Cluster |
| Enrich layers with weather and population data | Find similar locations |
| Extract data | Join |
| | Merge |
| | Overlay |
| | Summarize nearby |
| | Summarize within |

Analysis - Contains a number of tasks that allow you to perform common spatial analyses on your hosted data

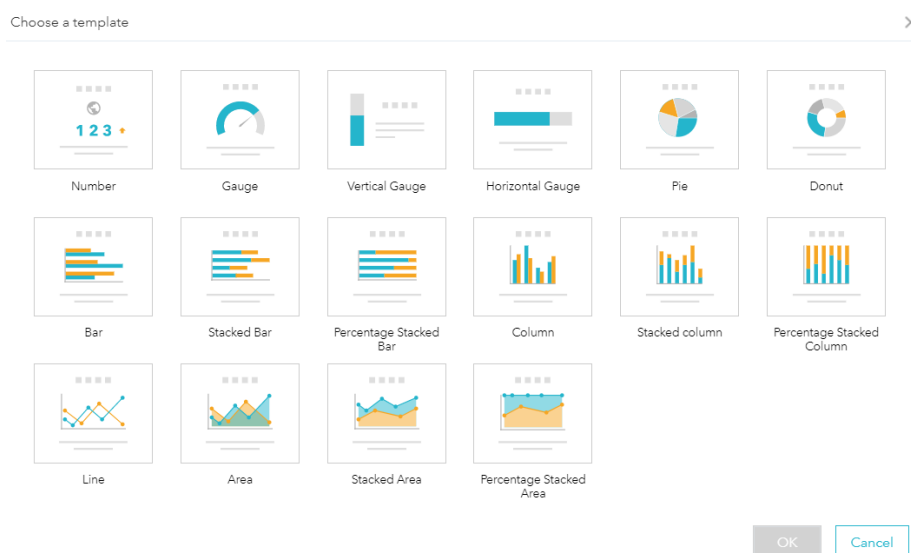
Info Summary - Dynamically summarizes numeric attributes for features depending on the map extent



Filter - Allows you to limit the visibility of features in a layer.



Infographics - provides 16 graphic templates you can use to visualize and monitor attributes and statistical data in the map and from extra data sources.



Near Me - Allows you to find features within a buffer of a defined address or location, view more detailed information about those features, and get directions to the selected feature.

! To use this tool, you have to enable the popups in the web map

Report Feature - Enables you to collect and manage data quality feedback from users. Data quality result statistics can be displayed as infographics by using the **Reviewer Dashboard** widget.

Legend - You can choose to display a legend with all or selected map elements

1.2.C. Developer Edition

Web AppBuilder for ArcGIS (Developer edition) requires an ArcGIS for Developer subscription **allowing customization of your apps, themes and widgets** using a little bit of code. Also, you will be able to host your apps on your own server.

ArcGIS for Developer pricing: <https://developers.arcgis.com/pricing>

Web AppBuilder for ArcGIS (Developer edition): <https://developers.arcgis.com/web-appbuilder>

With an ArcGIS organizational account, **you can get a free ArcGIS for Developer access** with limited but agreeable range of capabilities:

- ✓ ArcGIS Developer Build and deploy unlimited non-revenue-generating apps.
- ✓ Use all of Esri's APIs (application programming interface) or SDKs (software development kit) for web, native, and mobile platforms
- ✓ 1,000,000 basemap and geocode transactions per month
- ✓ Style basemaps and manage your map content
- ✓ Host, query, and analyze your data
- ✓ 10,000 route transactions per month
- ✓ Over 40 GB of tile and data storage

By using Web AppBuilder for ArcGIS (Developer edition), you can build your own widgets and themes instead of using only the preconfigured ones. Additionally, you will be able to share these custom creations to the broader ArcGIS user community.

Web AppBuilder for ArcGIS is built using ArcGIS API for JavaScript. The body of code and the broad technical documentation allows programming new web apps and embedding new functions into the existing ones. Just a little bit of coding is required for customizing your application.

ArcGIS API for JavaScript: <https://developers.arcgis.com/javascript/latest/guide/licensing>

Most of the time, you will work with a sample web app. You will have to link this app to your ArcGIS Online or ArcGIS Enterprise web map, using the web map's unique ID. After, you will be able to customize your app by changing and complementing the code in your sample app.

API Reference: <https://developers.arcgis.com/javascript/latest/api-reference/index.html>

This solution is, however, more complicated to put into action and is likely to be rejected for its over-performance for the UNHCR needs. Thus, in this document, we are only considering the Web AppBuilder online option.

1.3. Dashboard for ArcGIS

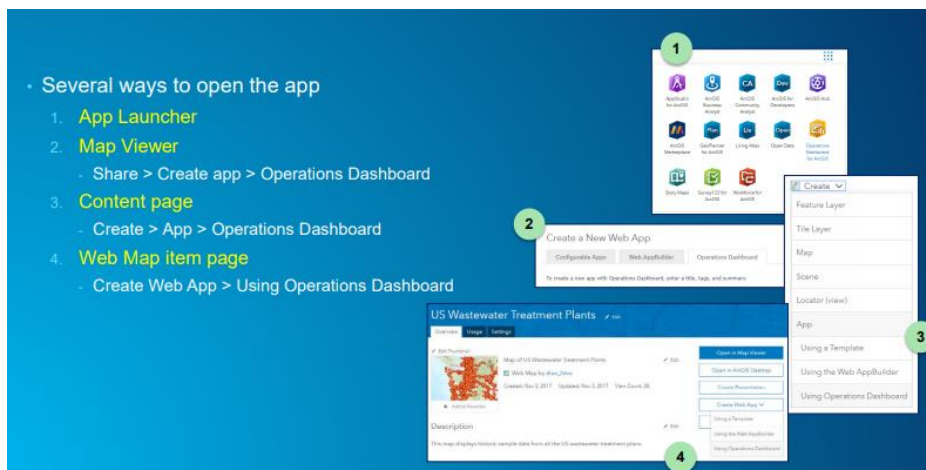
1.3.A. Walk-through and technical test

1. Create a web map

! Your web app will be based on the configuration of your web map in ArcGIS Online. You should be careful about elements such as symbology, popups, bookmarks and labels as you will not be able to control these in your web app.

2. Create an app

You can access the Dashboard for ArcGIS from the *Map Viewer*, from your web map item detail, or from your content page.



3. Select your web map

If you open the Dashboard from Map Viewer, you will already have your map (or scene) selected. However, you can still change the map or scene if you want.

4. Add elements (charts, indicators, rich text...)

All the built-in elements are configurable through the graphical user interface, and no coding is required for building the dashboard.

5. Organize your elements (size, position, and stack)

You will be able to adjust the size and the position of the elements directly on the user interface.

6. Add actions (i.e. interactivity between the different elements)

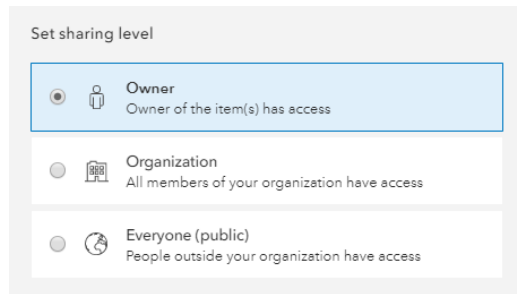
Actions allow the user to select and interact with the various map elements. For example, you can configure your app so that the charts update themselves when a user zooms in the map or selects a particular country from a drop down menu.

! Unlike the Web AppBuilder, the Operations Dashboard does not offer interaction by default. Thus, you will need to set up manually all interaction elements, including filtering the charts according to the zoom level of the map. The same applies to color schemes and other symbology used in the map and accompanying chart(s).

7. Save and publish

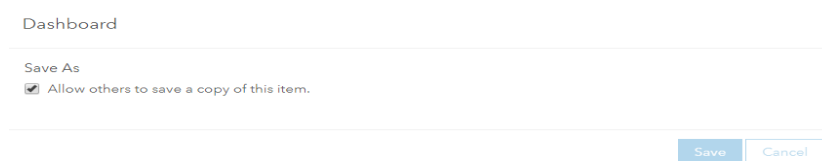
→ Share:

You can make the dashboard available for different user groups and share it with an URL address. For sharing with the wider public, you should set the Sharing level to *Everyone (public)*. With this option, anyone with the link will be able to view the dashboard without logging in to an ArcGIS account.



Share outside of organization: <https://community.esri.com/thread/206753-sharing-operations-dashboard-outside-of-organization>

You can also allow other people to copy and use your dashboard while saving it in your workplace.



→ Embed your app:

You can embed the web app into a web site when the Sharing level is set to *Everyone*.

Embed an app: https://doc.arcgis.com/en/arcgis-online/share-maps/embed-maps-groups.htm#ESRI_SECTION1_9B629D885B1D41ECAFFA651CF2D2A849

→ Share to mobile:

ArcGIS Dashboards are not responsive to screen sizes and thus, not optimized for mobile displays. In case mobile use is necessary for your dashboard, ESRI recommends configuring the dashboard with mobile display in mind. This requires choosing a minimal amount of widgets, and ensuring that your layout fits into the mobile preview.

Dashboards on your mobile: <https://doc.arcgis.com/en/operations-dashboard/help/dashboards-on-your-smartphone.htm>

→ Offline mode:

As is the case with the Web AppBuilder, working in the offline mode requires configuring your ArcGIS Dashboard with Portal instead of ArcGIS Online.

1.3.B. ArcGIS Dashboard Beta Release of March 2020

The walk-through and technical tests above, along with the case study below, are all based on the 2019.3 release of the Dashboard tool. However, in the spring 2020, during the peak of the coronavirus pandemic, ESRI announced the release of a new beta version of the next ArcGIS Dashboard. This version comes with a range of enhancements, including the following:

→ Increased options to use Arcade expressions:

In the past editions, the Arcade expressions were available exclusively for the map pop-up element. However, from 2020 onwards, the use of Arcade expressions allows limited customization also for lists and indicators. The screenshot on the right shows a customised indicator, with an icon accompanying the number element. The icons, along with the number and text parts, can be further customized with the use of Arcade expressions. Likewise, as seen in the bottom left, the expression allows defining the fields and styles for the list visualizations. Before this release, creating of lists was possible only with the first attribute of a dataset.

Indicator Options


Expression Globals Functions Constants

```

1
2
3 return {
4   //textColor: '',
5   //backgroundColor: '',
6   //topText: "School",
7   //topTextColor: '',
8   //topTextOutlineColor: '',
9   //topTextMaxSize: 'medium',
10  topText: "Shelter has a lock",
11  middleText: $datapoint["count"],
12  middleTextColor: '',
13  middleTextOutlineColor: '',
14  middleTextMaxSize: 'large',
15  iconName: 'haslock',
16  //bottomText: '',
17  //bottomTextColor: ''

```

Shelter has a lock



209

Last update: 2 minutes ago

Construction Year:
Shelter Type: Local construction
Has electricity: No
Comment: walls with grass / temporary category

Construction Year:
Shelter Type: Local construction
Has electricity: No
Comment: Grass for walls and roof / temporary

Construction Year:
Shelter Type: Local construction
Has electricity: No
Comment: Grass for walls and roof / temporary

Construction Year: 2,019
Shelter Type: Local construction
Has electricity: No
Comment:

→ Improved “Count” aggregation

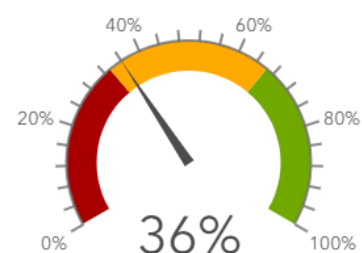
Earlier, the Dashboard did not allow counting of distinct features, resulting in possible duplicate records appearing in the dashboard. Fortunately, in the latest release, this problem can be eliminated with the “Distinct” button, available for indicator, serial and gauge charts.

Another improvement with the “Count” feature is the possibility to count features by their attribute value. For example, in the past versions, each data point was included in the count, regardless of the values. In contrast, the new beta version allows controlling the values to be included and also, filtering out the empty records.

Despite the slight improvements, work-arounds are still required with many visualizations. For example, the new

value-based “Count” feature allowed creating the gauge on the bottom right. However, a work-around was needed to display this type of non-numerical data in percentages rather than absolute values.

% of shelter units with assessment completed



A full list of the new features in the 2020 beta release is available at ESRI Community:

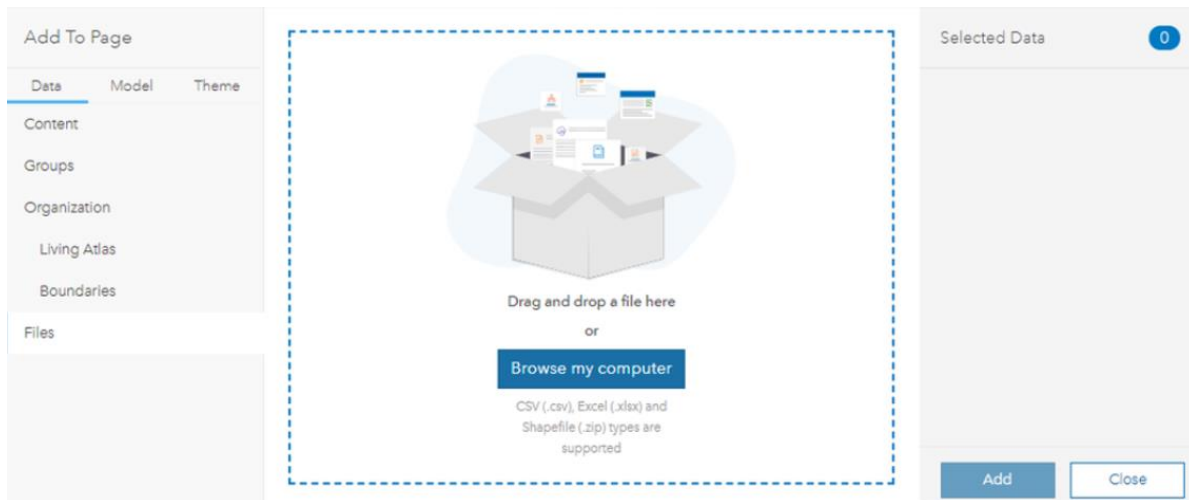
<https://community.esri.com/docs/DOC-14736>

1.4. ArcGIS Insights

1.4.A. Walk-through and technical tests

1. Add a data source

You can choose data from ArcGIS Online, your own ArcGIS Enterprise account (My content, Groups, Organization, Living Atlas...) or upload data from your computer. ArcGIS Insights will read real-time data from your ArcGIS Online content, allowing the use of feature layers from the Site Mapping database. Hence, any updates in the live data sources, such as feature layers, will be automatically reflected in the dashboards created with Insights.



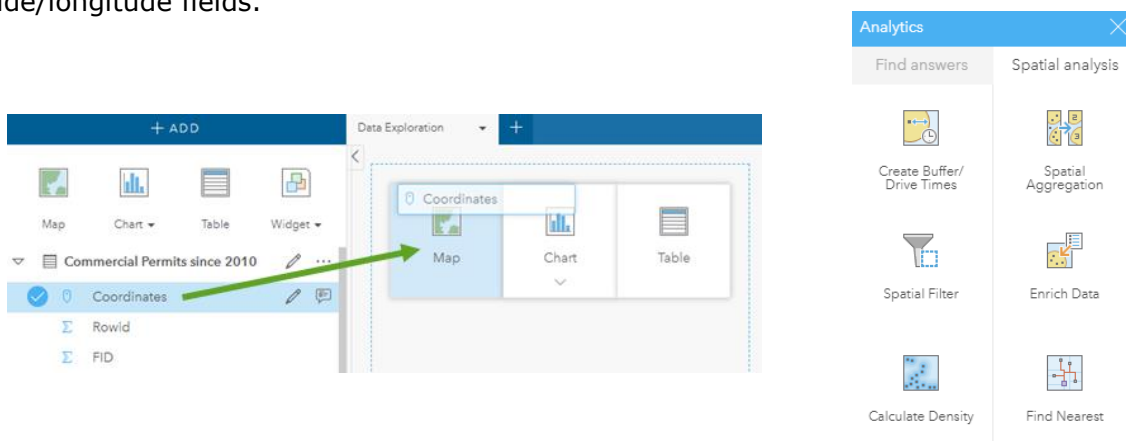
If you want, you can also create relationships between the data sources and thus enrich and interconnect the data displayed in your dashboard. A typical use case is to connect non-spatial data to a spatial dataset, for which you will need at least one shared attribute between the two (or more) datasets.

2. Create cards

You can create visualization elements - called cards in Insights - by dragging data into the workspace and transforming it into a map, a chart or a table.

→ Map:

If you import data from an Excel or a CSV file, you need to enable the location by identifying the latitude/longitude fields.

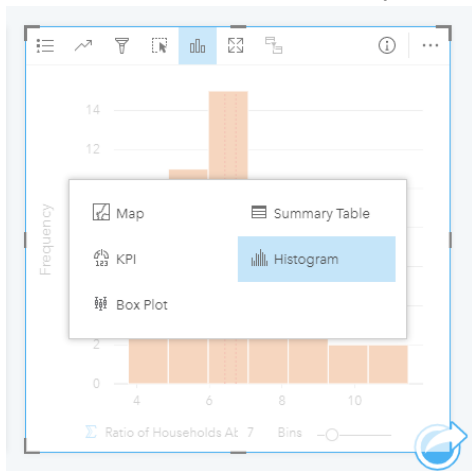


By dragging the coordinates field(s) to the workspace, you can create a map showing the location of your data. You can change the symbology of the map by dragging additional data fields, such as a type field, into your map.

With the built-in options, you are able to filter the data and conduct simple spatial analysis including aggregating your data by location, complementing your map with demographical and population data, creating a heat map or finding the nearest elements near the points of interest.

→ Charts:

Insights offers a wide range of built-in chart options. In addition to the basic bar, line and pie charts, the additional options include a bubble chart or proportional area chart. You have many ways to edit the chart, including: adding more data to the graph, changing the style or color schema, changing the “group by” field, filtering the data or changing the type of the chart. Insights automatically detects the possible options for the chosen data type; for example, numerical data would be required for creating a line chart.



Create charts: <https://doc.arcgis.com/en/insights/create/create-charts.htm>

The different elements you are creating will automatically be linked to each other when you interact with the data.

→ Tables:

By default, the tables aggregate the data by counting the records. However, for numerical data, this can also be changed to sum, average, minimum or maximum.

3. Style your page

You can style your page by changing the background colour, adding some text or media, and reorganizing and resizing the cards within your page.

Styling your page: <https://doc.arcgis.com/en/insights/create/customize-your-page.htm>



Despite the name of the above documentation page, this is not customisation in the traditional sense of the term.

Customize: "To write new code (programs, class files, scripts) to in the software that meets specific requirements."

Configure: "To use tools in the application to meet specific requirements without the use of code."

Customization is by definition much more invasive to the core application because it requires programmers to modify or enhance the application at the code level. Thus, in the case of Insights for ArcGIS, we are only able to configure, rather than customize, the dashboard page.

💡 If you want to customize your dashboard, you can use the Scripting method for extending and customizing your Insights content using Python or R language.

Scripting: <https://doc.arcgis.com/en/insights/reference/scripting-overview.htm>

4. Save and publish

→ Share:

After completing the dashboard configuration, you will be able to share your dashboard to different user groups.



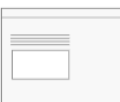
Share as

| | |
|--|--|
| <p>Title</p> <div style="border: 1px solid #ccc; padding: 5px; min-height: 20px;">Enter a title for this item</div> <p>Type</p> <div style="border: 1px solid #ccc; padding: 5px;">Page ▼</div> <p>Description</p> <div style="border: 1px solid #ccc; padding: 5px; min-height: 40px;">Enter a description for this item</div> | <p>Tags</p> <div style="border: 1px solid #ccc; padding: 5px; min-height: 20px;">Add tag(s)</div> <p>Share with:</p> <p><input type="checkbox"/> Everyone (public)</p> <p><input type="checkbox"/> CartONG</p> <p><input type="checkbox"/> These groups:</p> <div style="border: 1px solid #ccc; padding: 5px; min-height: 40px;">No groups available to share with.</div> |
|--|--|

Share your work: <https://doc.arcgis.com/en/insights/share/share-your-work.htm>

When sharing, a window will open and give you all the information needed to: access your page (in View mode only), access a specific page item in your organization workspace (requires you to be logged into your ArcGIS account), or copy the <iframe> to embed the page into a story map or web page.

Page shared successfully!

| | |
|--|--|
| <p>Here's what you can do with your page:</p> <div style="margin-bottom: 10px;">  <div style="border: 1px solid #ccc; padding: 5px;"> View your shared page <div style="border: 1px solid #ccc; padding: 2px; min-height: 15px;"></div> <div style="text-align: right; color: #0070C0;">Go</div> </div> </div> <div style="margin-bottom: 10px;">  <div style="border: 1px solid #ccc; padding: 5px;"> Access your page item <div style="border: 1px solid #ccc; padding: 2px; min-height: 15px;"></div> <div style="text-align: right; color: #0070C0;">Go</div> </div> </div> <div>  <div style="border: 1px solid #ccc; padding: 5px;"> Embed <div style="border: 1px solid #ccc; padding: 2px; min-height: 15px;"> <iframe src= </div> </div> </div> | <p>Shared with:</p> <p>Everyone (public)</p> <p>CartONG</p> |
|--|--|

Who can view your page will depend on who the page is shared with. However, if you share your page with *Everyone*, people will be able to access the page in View mode without having to log in to an ArcGIS account.

Share a page: <https://doc.arcgis.com/en/insights/share/share-page.htm>

→ Embed your dashboard:

You can easily embed your Insights page with <iframe> provided when sharing your dashboard.

→ Share to mobile:

There is no specific information regarding mobile display of reports.

→ Offline mode:

No offline option on the AGOL version. The offline mode requires installation of ArcGIS Enterprise and the Insights desktop application.

1.4.B. ArcGIS Insights in ArcGIS Enterprise

To unlock even more features of ArcGIS Insights, it is possible to install and run the tool in ArcGIS Enterprise. Among the dedicated hosting space and database connections, the Insights Enterprise option, together with the desktop version, allows using of the tool in an offline mode.

Before commencing the installation process, make sure that your organization has both the Portal for ArcGIS and ArcGIS Server up and running.

Full documentation of ArcGIS Insights in ArcGIS Enterprise:

<https://doc.arcgis.com/en/insights/get-started/install-insights.htm>

Annex 2. Case studies with UNHCR data

2.1. Standard Expanded Nutrition Survey (SENS) with Power BI for ArcGIS

2.1.A. Introduction

The Standard Expanded Nutrition Survey (SENS) collects data about the nutrition and food security within selected refugee camps. This survey data is compiled into an Excel file, hosted on the UNHCR OneDrive. The original [SENS dashboard](#), built with Power BI Pro and the Mapbox extension, brings together the key data from the seven operational modules.

It should be noted that the current SENS dashboard does not use the Power BI for ArcGIS extensions. This is because of the following reasons:

- The map element is relatively simple as the dataset contains the latitude and longitude values for each refugee camp location.
- The data visualization needs were covered by the build-in options offered by Power BI Pro and there is no need to “boost” the map with the ArcGIS extension
- It was possible to create a custom basemap with Mapbox. Unlike the ArcGIS extension, Mapbox does not require a license for basic use.
- The dashboard needs to be embedded on the SENS HTML page (as has been done with the current map). This would not be possible with the ArcGIS extension.

CartONG has not yet encountered a real use case of ArcGIS Maps for Power BI. One key reason for that is the end user requirement to share or embed the map online. For the Power BI dashboard with the ArcGIS extension to be usable, the sharing of the dashboard should take place exclusively through internal channels. Another motive to choose the Operations Dashboards and Web AppBuilder over the ArcGIS for Power BI is the priority on fast performance, rather than a large collection of data visualization options.

However, in order to assess the strengths and weaknesses of this tool, CartONG decided to create a replica of the SENS dashboard with the use of the ArcGIS Maps extension. This was based on a hypothetical user case that the existing nutrition data should be compared with the general food security situation within Chad, a host country to over six million refugees and internally displaced persons. Since Power BI standalone allows displaying only one geographical feature on one map, a connection to the ArcGIS Maps would help to solve this problem. At the same time, the team acknowledged that the map would be no longer available for online sharing or embedding.

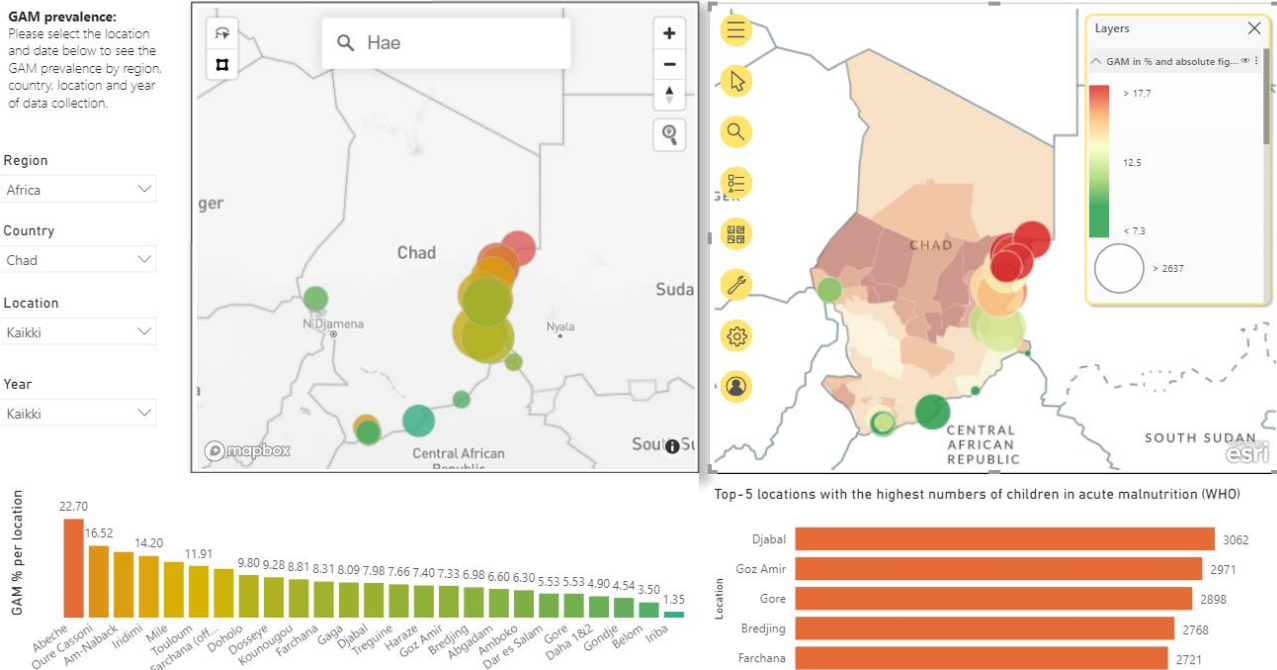
⚠ Before proceeding with ArcGIS for Power BI, it is wise to ensure with all the audiences that there will be no need for online sharing or embedding of the dashboard

2.1.B. User experience

After connecting to the ArcGIS Maps for Power BI, the world is open to millions of public maps and data services shared on AGOL. This use case requires finding a layer about the food security situation in Chad. Hence, in order to achieve a meaningful analysis, the goal is to find a layer with geotagged information about the food security situation. Unfortunately, despite the high number of content, no suitable layers were discovered through AGOL. This was not a big blocker as a suitable web map could be created by styling a World Food Programme (WFP) GeoJSON file on an AGOL map and converting this into a public hosted layer. After, it was possible to import this layer into the ArcGIS Maps for Power BI visualization on the dashboard report.

The screenshot below shows the original SENS web map using a custom UNHCR basemap created and hosted on Mapbox. In contrast, the map on the right has been built with the ArcGIS Maps for Power BI extension. The background map displaying the food security situation at each department is not a polygon layer but in fact, the hosted layer just created on AGOL. Unfortunately, it is not possible to edit the map directly on Power BI but all the modifications to the colors etc. must be carried out on AGOL.

Global Acute Malnutrition Prevalence in Refugee Locations



Comparing the maps above, one can see that the ArcGIS for Power BI extension allows “boosting” of the map element with content on AGOL. However, beyond their role as a “background map”, this map and the related data have no other element in the dashboard. Hence, in order to integrate the food security data into the analysis, the GeoJSON file should be imported separately into the Power BI report. Even with this solution, there would not be any built-in interplay between the map and the data. Hence, even though the ArcGIS Maps extension has allowed enriching our map with an additional data element, this applies solely to the map component.

2.1.C. Ideal use case

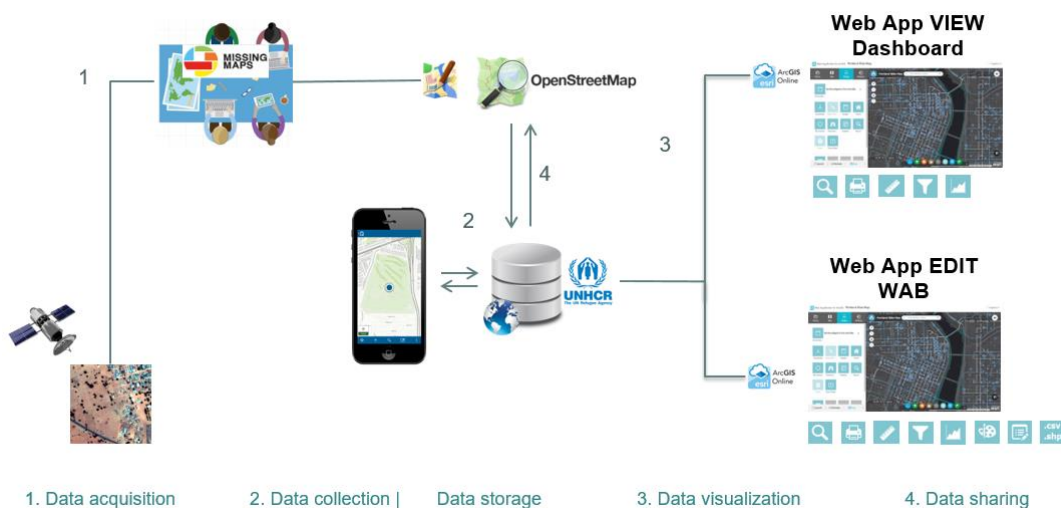
As a conclusion, for an analysis requiring two or more geodata layers, Power BI would not be the best option, even with the ArcGIS Maps for Power BI. However, while inconvenient in our hypothetical use case, this is not to say that the ArcGIS Maps extension would not work for some other scenarios. For example, the Lebanese Red Cross has [previously used an ArcGIS for Power BI dashboard](#) to bring together the field data collected by ArcGIS Survey123 tool. Hence, based on our use case and the user stories from ESRI, ArcGIS for Power BI would be a good tool to go for under the following circumstances:

- ➔ The end user strongly prefers to use Power BI or this is his/her only option available. However, the ArcGIS extension would be required to boost the mapping capacities
- ➔ There is no need to access private feature layers from ArcGIS Online
- ➔ There is no need to use polygon or line data on the map
- ➔ There is no need to share or embed the dashboard online. This could include a case where a dashboard is built with highly confidential data and is thus shared only through internal platforms (e.g. SharePoint or secure email messages)

2.2. Visualization and analysis of the Ethiopia site mapping data with ArcGIS Web AppBuilder

2.2.A. Introduction

Mapping of the existing refugee sites and their infrastructure is crucial for holistic and sustainable site planning. In order to support this effort, the UNHCR Field Information and Coordination Support Section (FICSS, or Global Data Service as of 2020), launched an extensive project for exhaustive mapping of four refugee sites in Ethiopia. The first data collection took place online, with remote mapping sessions, or “mapathons” organised by CartONG. Later in the year, a team of UNHCR and CartONG GIS experts was deployed for on-site mapping in Ethiopia. The goal of the field deployment was to collect data on the infrastructure while training the local teams in mapping of the shelter-specific data. This locally collected data complemented the remote mapping effort with attribute information, including the conditions of shelters and infrastructure, building materials, etc. Both the remotely and locally collected data were compiled in to the UNHCR Site Mapping database.



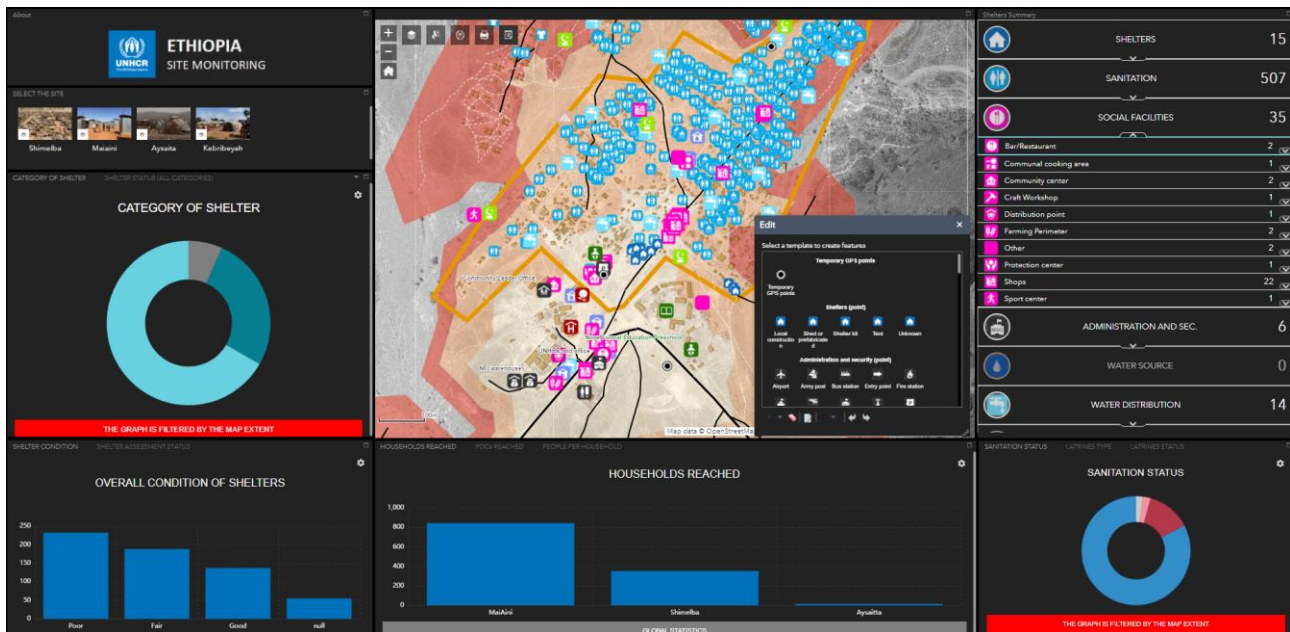
After the completion of the data collection, the next step was to make the data available for the broader UNHCR user groups. The ArcGIS Online Web Map alone offers a good selection of tools for data visualization and spatial analysis. However, the maps and the data were taken to the next level with the extensive chart and widget library of the Web AppBuilder. With the combination of built-in options offered by the Web AppBuilder, UNHCR and CartONG were able to cater for a broad range of different user needs.

While the Ethiopia data has been featured in multiple web apps, in this case study, we will consider the following ones:

- ➔ Ethiopia Site Monitoring: the “View” version
- ➔ Ethiopia Site Monitoring: the “Edit” version

2.2.B. User experience

As usual when using Web AppBuilder, the dashboard building process started with a careful configuration of the AGOL map. The different point, polygon and line data was brought on the map and visualized with the appropriate symbology. In addition to the data collected during the Ethiopia mission of 2019, the dashboard was complemented with other relevant data points, such as [the global boreholes database](#). Also, in order to accommodate user groups from multiple humanitarian sectors, over 25 different data layers were made available in the dashboard. Depending on their needs, each user is able to either view all the layers or select only those relevant for their work.



As shown in the screenshot above, the “Edit” version makes use of the many off-panel and in-panel widget options provided by the Web AppBuilder Dashboard theme. Alongside the different infographics (or charts), the in-panel widgets include a data info summary on the right and image filters for each camp on the top left. With the off-panel widgets, a user has an option to select layers, select features from a map, extract and analyse the data, export the dashboard and add or edit data in the app.

Initially, UNHCR and CartONG had the idea to visualize all the data in one map and give selected users a right to edit the data. However, this one-map approach turned out to be unfeasible as the data was called from two published web services, one with the public and the other with the restricted data. The latter type of data, containing highly sensitive personal information about the refugee communities, was to be made available only to very few users with editing rights. Unfortunately, the Web AppBuilder does not allow differentiation of the data view based on the user status. Hence, two different dashboards were created, one for the restricted users with the editing rights and the other for the broader audience with viewing rights only.

2.2.C. Ideal use case

In a sharp contrast with ArcGIS for Power BI, Web AppBuilder turned out to be an easy and practical application for answering the majority of the user needs. While this tool also comes with certain limitations, the offerings of this tool are significantly broader than the other ESRI options featured in this benchmarking. Accordingly, the Web AppBuilder would be a highly recommended option for use cases centered around visualization and analysis of GIS data. In conclusion, the following scenario would constitute an ideal use case for the Web AppBuilder:

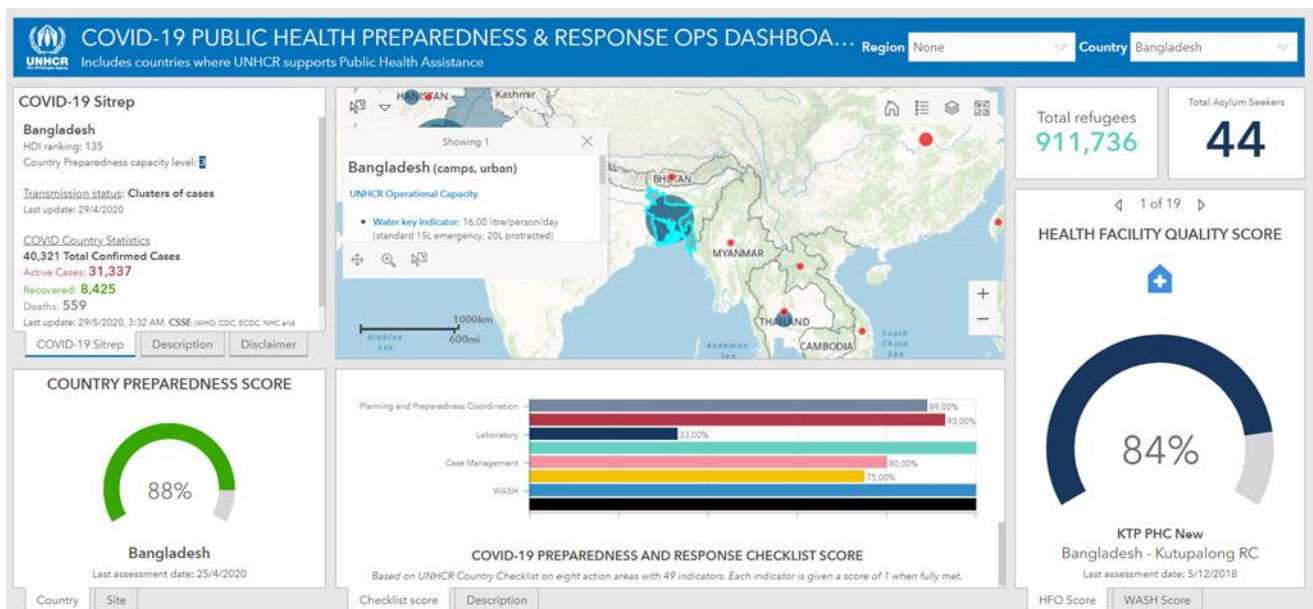
- ➔ The map plays a central role in the dashboard
- ➔ There are multiple geodatasets to be used
- ➔ There is an intention to complement the map with the visualizations and widgets provided by the Web AppBuilder (otherwise, a standalone AGOL map will do the work)
- ➔ There is no rush with the initial set-up of the AGOL web map and the dashboard
- ➔ The charts and other data visualization options are sufficient to meet the user needs

2.3. COVID-19 Public Health Preparedness and Response Dashboard with ArcGIS Operations Dashboard

2.3.A. Introduction

By far the most comprehensive recent use case from the CartONG portfolio for the UNHCR is the COVID-19 monitoring tool created by ArcGIS Operations Dashboard. This visualization brings together data about the public health preparedness situation and response operations in refugee camps. The primary data is collected on three separate KoBo Collector Forms: COVID form on the country level, COVID form on the site level and finally, the Balanced Scorecard forms. Additionally, this data has been joined with COVID-19 case data supplied by Johns Hopkins University.

There were several reasons why ArcGIS Operations Dashboard was chosen for this use case. Firstly, this tool was already available under the ArcGIS license and the Creator user type. Secondly, it was thought that the easy and intuitive user interface would allow a quick delivery of the dashboard. Thirdly, there was no need for a broad range of visualization options, spatial analysis or additional elements provided by the other ArcGIS tools.



2.3.B. User experience

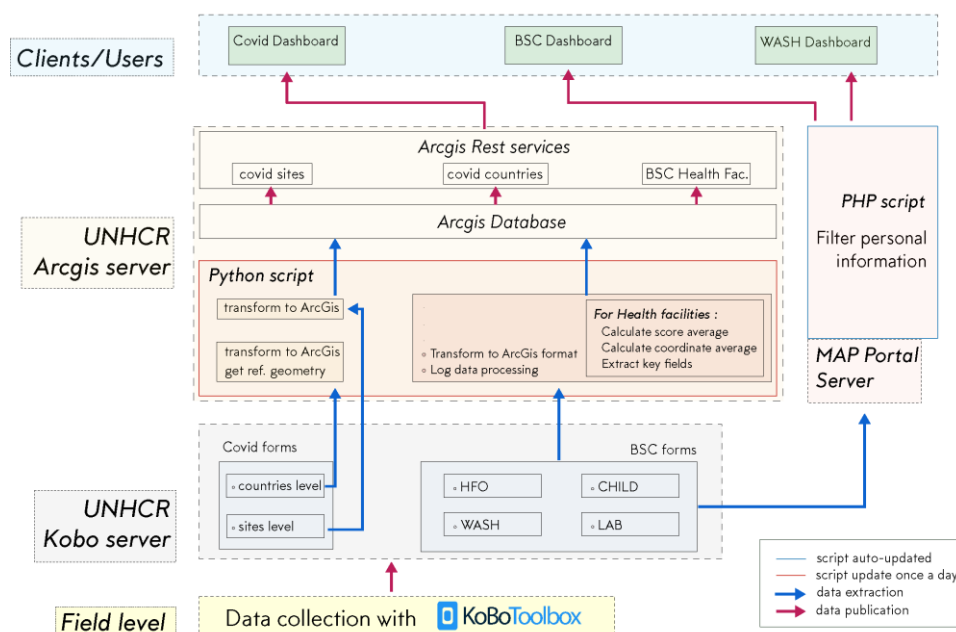
As with the ArcGIS Web AppBuilder, a task with the Operations Dashboard starts with the configuration of the map element. In this use case, the map is used mainly for showing the exact or aggregated locations of the data points (including countries, refugee sites and health sites). Accordingly, the dashboard would be needed to allow throughout visualization and analysis of the data.

In principle, the dashboard visualizations are quick and easy to set up. However, the first shortcoming was the requirement to manually harmonize the colors and symbols between the different visualizations. While a relatively easy task in this use case, the next challenge was the lack of automatic interaction between the different dashboard elements. Likewise, with the map pop-ups, Arcade expressions were used to customize the appearance of the text component. Unfortunately, these expressions are not currently available for the gauge charts, tables or other visualizations featured in this dashboard.

Moving on, as another significant obstacle, the Operations Dashboard does not allow interactions across different data layers. Thus, in order to achieve a fully interconnected dashboard, all the data should be compiled into one dataset. To overcome this issue, several Python scripts were

set up to connect the multi-sourced data into an ArcGIS Rest web service, hosted on the UNHCR GIS database. A full illustration of all the data flows is given in the illustration below.

Kobo data integration *from the field to a dashboard*



Finally, except for the map element, there is no possibility to display data from more than one layer in each visualization. Hence, as with the interaction part, overcoming this problem requires connecting the datasets outside of the dashboard (e.g. by a Python script). Likewise, limitations with the chart options resulting a repetition of the gauge chart and extensive use of text elements. The gauge chart was used for two indicators as this is the only non-textual option to visualize a “reach from a target” data type.

2.3.C. Ideal use case

With all the work and workarounds encountered during the dashboard configuration, the UNHCR and CartONG pushed the ArcGIS Operations Dashboard to its limits. As described above, one of the main challenges with this tool was the limited built-in interconnectivity between different data sources. Without a presence of a database expert, it would have been impossible to configure. Also, the small catalogue of data visualization options required repeating the gauge chart and the text elements.

Still, in spite of the limitations, the Operations Dashboard was still the most suitable from all the tools featured in this benchmarking. Based on this user experience and the lessons learned, an ideal use case would meet the following conditions:

- ➔ The priority is in a quick set-up process
- ➔ All the data would be in one dataset or there is a clear procedure for connecting the different data sources.
- ➔ No need for a high variety of visualization options
- ➔ No need for
- ➔ All or most of the key data is in a number format (integer or decimal) – aside of the text indicators, there are no built-in options to display non-numerical data.

2.4. Visualization and analysis of the Ethiopia site mapping data with Insights for ArcGIS

2.4.A. Introduction

As is the case of ArcGIS Maps for Power BI, CartONG is yet to encounter a real use case with Insights for ArcGIS. One reason for this is the requirement of an extra license that comes at 940 US dollars per year (as of 2020). In contrast, the Operations Dashboard and Web AppBuilder come as integrated components of ArcGIS Creator or GIS Professional user types, thus not requiring investment in additional licenses. Moreover, none of the requests so far has required the extra offerings of Insights for ArcGIS, including multi-page dashboards, special visualizations or map-based business intelligence tools.

However, in order to assess the usability, strengths and weaknesses of Insights, the CartONG team decided to test the tool with a hypothetical use case. In real life, CartONG and UNHCR have created dashboards on the Ethiopia site mapping data with both the ArcGIS Web AppBuilder and the Operations Dashboard. What would be the possible added value of using the Insights instead? Would the broad range of data visualization options both inside and outside of the map reveal new insights about the Ethiopia data?

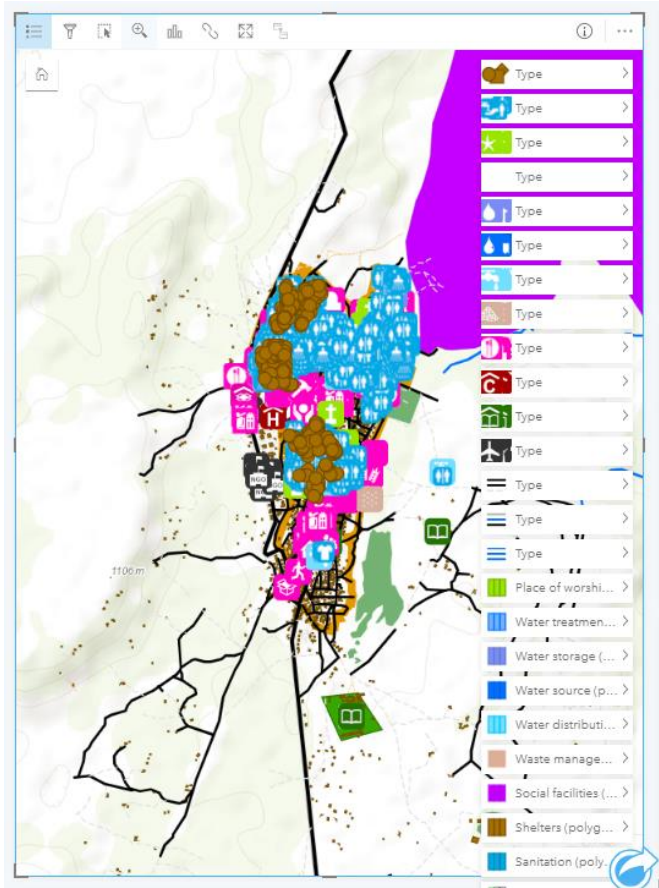
⚠ Due to licensing reasons, this test was conducted outside of the UNHCR ArcGIS Online instance, with a remote connection to the UNHCR data server.

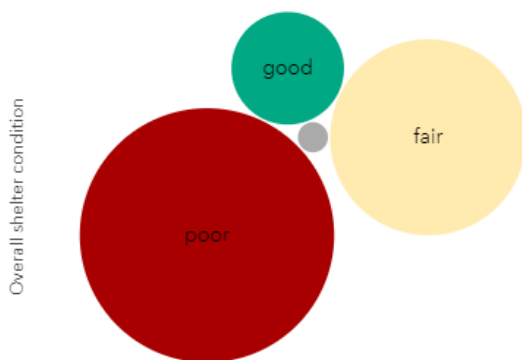
2.4.B. User experience

While it is not possible to add existing ArcGIS Online web maps into your Insights working space, hosted layers can be imported in the data section. As a positive point the high number (over 100,000) of records in the Shimelba case study did not seem to affect the data import of the feature rendering speed. This was despite the appearance of the warning icon ⚠ indicates that the map is not displaying all of the features from the dataset.

After the import process, an appropriate legend icon was assigned to each data point, as per the [instructions of ArcGIS](#). However, as a serious limitation the map legend comes in one size and with little possibility to control the legend captions. In this use case, the legend box turns out to be longer than the height of a regular web page. A workaround is to add the legend into a separate page – however, this needs to be done manually for each layer.

As the next step, filters would be needed to make the map easier to read and use. Despite the [range of filtering options](#), most of these were unsuitable for using with multiple data layers. Hence, the last resort was to manually create predefined filters using the field “Site_code” which is present across all the data layers. Yet, even this filter comes with its drawbacks – for example, this filter will not work on layers with no data. This limitation is highly inconvenient for the dynamic and regularly changing site mapping data.





The step was to test the visualization capacities of Insights. In addition to the regular pie, bar and line charts, the Insights data visualization library also contains some unusual options, including bubble and tree map charts. These are especially helpful for visualizing non-numerical categorical data, as seen in the below example on shelter conditions. Yet, as a setback, this visualization does not allow using figures as part of the labels – hence, an additional visualization would be required for presenting the figures behind the bubbles.

Moving on, Insights offers a range of spatial business intelligence tools and map-based visualization options. In the Ethiopia site mapping use case, the special interest was to assess the compliance with the [humanitarian SPHERE standards](#) requiring maximum 500 meter distance from a shelter to a water point. In practice, a buffer around each water point would allow calculating the proportion of shelters within and outside the 500-meter threshold. Unfortunately, this calculation resulted in a “something went wrong” error. Most likely, this operation failed because of the large size of the datasets containing the shelter and waterpoint data.



2.4.C. Ideal use case

While Insights for ArcGIS has a lot to offer, especially in terms of data visualization options, it was very clear from the beginning that the Ethiopia site mapping data is too heavy and multifaceted for this tool. Many of the core offerings of Insights, including the filters and spatial analysis, cannot operate with large, remotely hosted datasets.

Based on this user experience, Insights for ArcGIS would be an ideal and interesting tool to use when the following conditions have been met:

- ➔ All the data is in a small number of locally hosted dataset
- ➔ The data is complete, static (rather than dynamic) and well structured
- ➔ The goal of the dashboard is not in mapping but for data exploration and analytics with the business intelligence tools
- ➔ There is no need to customize the cards or the visuals

2.4.D. Extra: Idealizing the Ethiopia use case

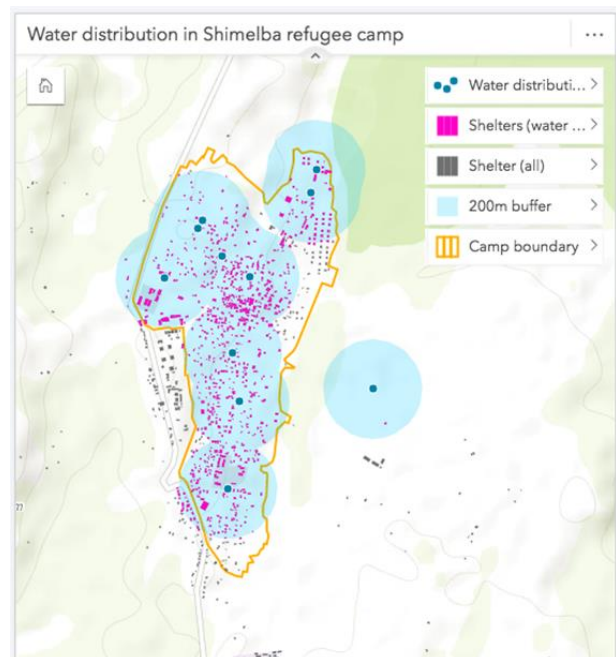
As proved by the hypothetical use case above, working with the entire Ethiopia site mapping database over a remote connection turned out to be too heavy for Insights for ArcGIS. The limitations with the analysis features were particularly disappointing as these would have been especially useful for the site planning effort.

In order to work within the limitations of ArcGIS, the CartONG team gave a second try with a locally hosted data extract, filtered to the extent of the Shimelba refugee camp. This data extract consisted of the following layers, all hosted on ArcGIS Online and called by Insights:

- shelter polygons
- water distribution points
- camp boundary

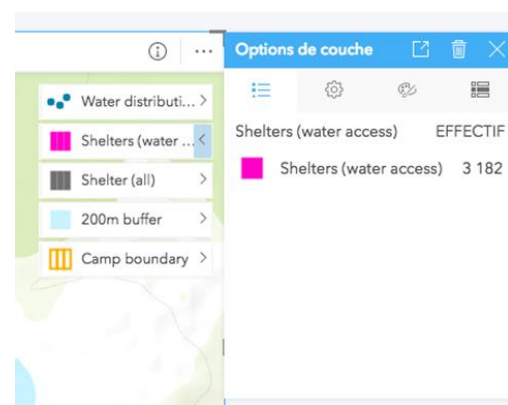
Similarly as in the failed first test, the aim was to calculate the distances around the water points and find out, how many shelters are within and outside the 200 meter threshold. The analysis consisted of the following steps, all illustrated in the figure on the right:

- Creation of a 200 meter buffer zone around water points and adding this as a new data layer to the map (symbolised in light blue)
- Spatial filter of the shelters intersecting the buffer zone and adding this as a new layer to the map (symbolized in pink)
- Creation of two key performance indicators (KPIs) displaying the number of total shelters in Shimelba and the number of shelters intersecting the buffer zone



The results of the analysis are provided in the table below: 3,182 shelters are located within the 200-meter threshold and 980 outside of this limit. Additionally, these numbers are displayed by default in the map legend, upon a click on the arrow next to the layer of interest. Hence, this part of the testing turned out to be a success, unlike in the first testing round with the whole Ethiopia site mapping data set over a remote connection.

| Number of shelter: | |
|---|-----|
| - with access to a water point within a 200m buffer distance | ... |
| 3 182 | |
| Nombre de Shelters (water access) | |
| - without access to a water point within a 200m buffer distance | ... |
| 980 | |
| Nombre de Shelter (no intersection) | |

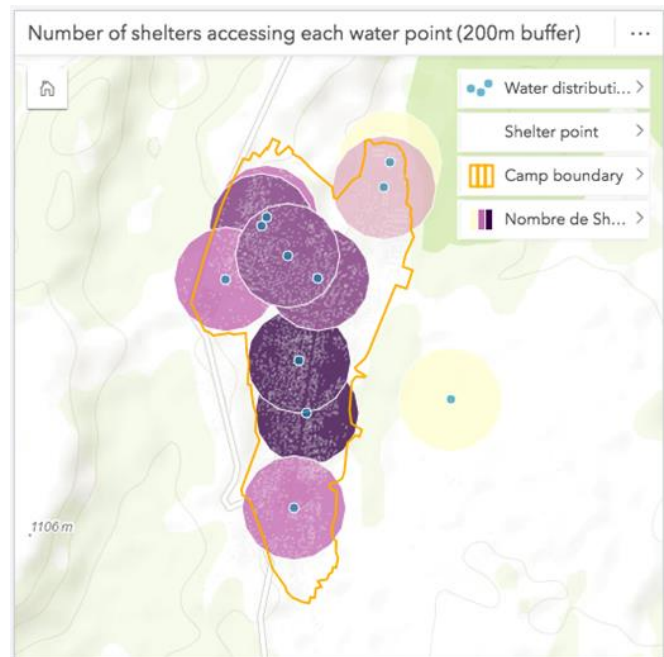


The second analytical test would be about calculating, how many shelters each water point is serving, and this is to be achieved with the following steps:

- Creation of a 200m buffer zone around water points (as distinct polygons)
- Creation of shelter points by calculating the centroids of the shelter polygon layer
- Calculating the number of shelter points falling into each buffer

As seen already in the previous round, the creation of buffers is a routine task on Insights. However, as a drawback, the polygon centroids cannot be calculated directly on Insights but needs to be executed on a desktop application, such as ArcGIS Pro. The resulting centroids data must be hosted in ArcGIS Online and called in ArcGIS Insights, just as the initial data layer.

After the import process, the shelter points layer was intersected with the buffers around the water points, returning the number of shelters using each water point. The next step was to symbolize each buffer polygon according to the number of shelter points falling within the area. As seen in the screenshot on the top right, the darker the colour, the higher the number of shelters around the water point. Additionally, the number of shelters in each buffer zone will appear in a pop-up when hovering a mouse over the buffer zones.



In conclusion, our second test with the data extract also yielded a successful result. Both of the analysis generated could be useful for assessing which parts of the camp have the highest need for additional water points.

Was this an ideal use case for Insights for ArcGIS?

In many ways, the analysis on the extracted Shimelba dataset met the criteria of an ideal Insights use case. With only three, relatively small data layers in the play, the analysis and visualization tools produced the expected results. With the site mapping dataset, there is also a potential of using additional offerings of Insight, including the relationship analysis (as seen in the screenshot on the right).

Of course, even in the “idealized” use case, certain limitations were detected, including the inability to create polygon centroids directly on the Insights interface. Accordingly, to get most out of the Insights, the use should be accompanied with map-centered ESRI tools including AGOL Map and ArcMap/ArcGIS Pro. With a well-prepared data, it is thus possible to explore the data insights with Insights.

