Rapid Visualization Development Framework

Using “Aardvark” to build custom visualizations for decision-making speed and efficacy
Industrial companies—such as utilities, mining, manufacturing, and oil and gas—are increasingly using custom visualizations to address specific use cases, enhance situational awareness and help employees target the most relevant issues. Think smart grid asset managers being able to monitor equipment in regional service areas, mining operators tracking drilling machines from a centralized control room, or oil and gas site managers inspecting subsea oil wells. In each case, integrating a variety of real-time data sources into a dynamic custom visualization can help these companies increase their agility to more quickly pinpoint and resolve issues. (For more information, see our complementary point of view, “Why Big Data Needs Visualization to Succeed” and related content on Accenture.com.)

Focusing on the example of a smart grid, the custom visualization shown in Figure 1 gives an asset planner detailed information to manage equipment health and to proactively plan for repair or replacement if a substation, transformer or switch shows signs of failure. The global view helps the asset planner to assess the overall health of the smart grid, highlighting the nodes most at risk. A side panel provides details of a selected piece of equipment and allows the asset planner to explore multiple views of the factors used to determine its health, while the map insert narrows down the location of the equipment to within a city block.
Rather than raw data and results, the custom smart grid visualization presents the information in the right context with an appropriate level of detail to help the asset planner make decisions. Survival predictions of the likelihood of equipment failure, for instance, are embedded at various levels: as part of the color assigned to asset health in the overview; as a factor for a particular piece of equipment; and as detailed curves showing the various survival models with different combinations of inputs such as age, load and manufacturer. With a quick glance at the visualization, the asset planner is alerted to potential issues. The employee can hone in on the specific problem, and then decide whether to address it immediately by sending a team out to fix the equipment or wait for the next regular maintenance cycle.

As this example demonstrates, custom visualizations can provide digital businesses with fine-tuned control over the workflow, feel and functionality needed to address highly specific use cases. This makes them an important supplement to existing enterprise business intelligence and data visualization vendor tools. Plus, custom visualizations offer some benefits that out-of-the-box vendor tools may not be able to match.

Powered by a web-focused, open-source technology stack, custom visualizations are more broadly compatible and have fewer constraints than vendor tools. In addition, open-source applications do not have associated licensing costs, which means digital businesses can cost-effectively share custom visualizations among employees in a large department, or even place them on the web for customers to view. (For more information, see Accenture’s “Get Data Insights Out into the Open.”)

Custom visualizations are an important part of the enterprise visual analytics and business intelligence toolkit. Their benefits include greater interactivity, customizability and specificity in targeting functional use cases.

Figure 1: A custom visualization for utilities asset managers. Copyright Accenture.
Limitations of traditional visualization approaches

So why aren’t more industrial companies—and their consumer-facing counterparts in financial services, retail, media and other industries—using custom visualizations in their operations? The short answer: time and money.

Currently, it can be difficult to create custom visualizations that cater to the decision-making process. Traditional development is time and cost-intensive—requiring skillsets in development, design and data engineering. It could take a team several weeks to create just one visualization. And if the result misses the mark, there may be no time or investment left for iteration. This limits the number of possibilities that companies could explore.

Today’s vendor tools for visualization have addressed some of these issues by leveraging configurability for rapid development; however, what they offer in configurability they may lack in customizability. Formats are proprietary and typically cannot be extended or modified. As a result, digital businesses that rely solely on vendor tools may produce visualizations that do not fully support the decision-making process, require more effort to understand or are not usable for the task at hand.
Standardization simplifies visualization production

To make it easier and more cost effective to build custom visualizations, Accenture Technology Labs created a rapid visualization development framework (referred in the following as the Framework). This developer toolkit facilitates and accelerates the production of custom visualizations by abstracting away the complexity of data structures, web applications and organizational sharing. As shown in Figure 2, this standardization helps digital businesses to balance the aspects of custom development and licensing costs while reducing the time to develop, maintain and revise custom visualizations.

Our proprietary Framework is built around a unified workflow with modular processes, which guide developers in choosing which components they need to create the first working prototypes of visualizations that can then be customized. This “liquid approach” makes it quicker and easier for developers to experiment and iterate to reach the final design. The Framework also consists of developer tools, templates, visualization components and a visualization library—all of which rely on standardization based on data type:

- **Developer tools** are command-line tools that assist developers in setting up their development environment to connect the data and cast it into custom visualization. Specifically configured to work with the Framework’s templates and visualization components, these tools enable newly skilled developers with JavaScript familiarity to quickly come to speed and begin developing custom visualizations through configuration.

Figure 2: A comparison of Accenture framework, open source and vendor tooling.
• **Templates** provide the frame needed to fit in custom components. Customizable templates provide ready-to-go web application structures and design styling guidelines. These templates provide the skeleton for client-side application logic as described in Figure 3. Templates can be created in various modern web frameworks, such as React, Angular and Backbone. The standardization of the template across the code backend means that custom visualizations are portable using APIs across a number of technology stacks.

• **Visualization components** are interactive building blocks that populate our Framework’s custom visualization templates. Created using a patent-pending specification, the Framework abstracts different types of data structures for flexible configuration, including tabular, geospatial, network, hierarchical and time-series data types as shown in Figure 4.

**Figure 3:** Framework components scaffold the client-side application logic of the technology stack.

- **Visualizations & User Interface**
  - Component 1
  - Component 2
  - Component 3
  - Layout Styling
- **Application Logic**
  - Data Filters & Interactions
  - Web Application Structure
- **Client-side Server-side**
  - API
  - Database

**Figure 4:** Examples of data structures addressed by the Framework.

- **Tabular**
- **Geospatial**
- **Network**
- **Time Series**
- **Hierarchical**

- **Seconds**
Once data is structured into a standardized specification, changing the visualization requires just a few tweaks. Figure 5 shows network formats of the same data made within a few seconds by changing the component configuration. Colors, dimensions and data source are easily configurable with similar adjustments. And since the code is standard JavaScript, additional customization is possible.

By abstracting away these complex data structures, the Framework's visualization blocks decrease code complexity, focusing on configurability and reusability. Compared to a monolithic application, our visualizations can be more flexibly altered and updated due to their modularity.

- A visualization library curates the standardized visualization components and indexes them by metadata such as industry, data types and use case to help developers choose appropriate designs. Domain-specific visualizations, such as a human body for healthcare use cases, are also available in the library. Components from other open-source frameworks like D3 and Dimple.js can be harvested using the Framework's specification and added to the library for even greater choice. The Framework's standardization and leveraging of prebuilt components decreases the amount of time needed to prototype, build and maintain a custom visualization.

Figure 5: The developer can cast the same data in different formats within seconds.

Figure 6: A gauge component from the smart grid custom visualization is indexed in the Framework's visualization library. It can be discovered and reused by other developers. Copyright Accenture.
The Accenture Technology Labs rapid visualization development framework facilitates and accelerates the production of custom visualizations by abstracting away the complexity of data structures, web applications and organizational sharing.
Agility enables higher-quality visualizations

As shown in Accenture’s pilots with various clients, industrial companies can accelerate custom visualization development from months to just weeks. While this time could be used to save engineering costs, it could also provide an opportunity for investment in more rounds of iterative development. Reducing initial development time enables greater opportunity for iteration to reach a higher-quality product.

An iterative development process, according to researchers, improves the quality and functionality of a design. This methodology involves cycles of prototyping, testing and refinement, with collaboration between groups such as development, design and product. The modularity of the Framework’s templates and components enables this process because changes can be made quickly. Visualization components can be swapped in and out, as well as configured to match a specific look-and-feel without significant investments of engineering time. This encourages user and stakeholder feedback, avoids serious misunderstandings of requirements, and enables more innovative designs to be explored.

“Aardvark” framework built with open source code

Accenture’s rapid visualization development framework (ARVDF) was renamed in a collaborative and spirited effort by the Accenture project team to “Aardvark.” The framework uses a web-focused, open-source technology to accelerate and optimize the production of custom visualizations, which have broader compatibility and fewer associated licensing costs than some vendor tools.
Conclusion

Accenture’s rapid visualization development framework harnesses the creativity and cost-effectiveness of open-source technology to accelerate and optimize the production of custom visualizations. By reducing the complexity of building visualizations through a unified developer toolkit, the Framework decreases the time to value, enables a liquid design and development process, and produces a high-quality visualization that is easier to revise and maintain. These benefits empower digital businesses to make more informed business decisions from the right visualizations.
About Accenture Labs

Accenture Labs invents the future for Accenture, our clients and the market. Focused on solving critical business problems with advanced technology, Accenture Labs brings fresh insights and innovations to our clients, helping them capitalize on dramatic changes in technology, business and society. Our dedicated team of technologists and researchers work with leaders across the company to invest in, incubate and deliver breakthrough ideas and solutions that help our clients create new sources of business advantage.

Accenture Labs is located in seven key research hubs around the world: Silicon Valley, CA; Sophia Antipolis, France; Arlington, Virginia; Beijing, China; Bangalore, India; Herzilya, Israel and Dublin, Ireland. The Labs collaborates extensively with Accenture’s network of nearly 400 innovation centers, studios and centers of excellence located in 92 cities and 35 countries globally to deliver cutting-edge research, insights and solutions to clients where they operate and live.

About Accenture

Accenture is a leading global professional services company, providing a broad range of services and solutions in strategy, consulting, digital, technology and operations. Combining unmatched experience and specialized skills across more than 40 industries and all business functions—underpinned by the world’s largest delivery network—Accenture works at the intersection of business and technology to help clients improve their performance and create sustainable value for their stakeholders. With more than 375,000 people serving clients in more than 120 countries, Accenture drives innovation to improve the way the world works and lives. Visit us at www.accenture.com.

Contributors

Teresa Tung
teresa.tung@accenture.com

Jeff Catania
jeffrey.catania@accenture.com

References


Acknowledgement

We would like to thank Tiffany Dharma for contributing to this paper.