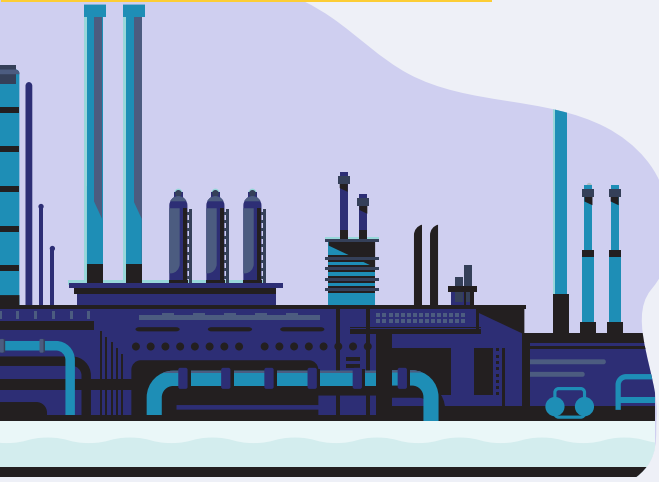
Case Study



COMPRESSED GAS ASSOCIATION

Founded in 1913, the Compressed Gas Association (CGA) is dedicated to the development and promotion of safety standards and safe practices in the gases industry. Their mission is to promote ever-improving safe, secure, and environmentally responsible manufacture, transportation, storage, transfilling, and disposal of industrial, medical, and food gases and their containers.

To better serve their end-users and industry partners—regulators, code developers, and international standards bodies—and to support future growth, CGA modernized their association management system. In addition to governing internal workflows, this system provides an eCommerce store where members and customers can purchase CGA safety publications. The store accounts for 75% of CGA's non-dues revenue, making its usability and stability crucial for CGA, its members, and its customers.

The Need for a Flexible, Modernized System

CGA's association management system was built on two different web applications, four Microsoft (MS) Access databases, and hundreds of reports.

The complexity of the system and the difficulty posed by maintaining it prevented growth and created several challenges:

- Customers struggled to navigate the outdated user interface, often encountered data-driven errors, and were frustrated by the site's limited feature set.
- Staff were required to navigate complex workflows involving six different administrative interfaces to maintain the system, reducing their efficiency and increasing the probability of error.
- Data entry was manual and repetitive. The architecture of the system required the same information to be entered in multiple systems. If done correctly, data errors made it impossible to retrieve reliable, accurate information.
- Some of the underlying software packages were no longer supported by the manufacturer.
- CGA found it extremely difficult to incorporate new features into the system. Attempts frequently led to unanticipated problems and reduced the system's reliability.

CGA chose to partner with Excella to address these challenges and modernize their association management system. The objective was to create a new and better system that would support more product offerings, increase customer satisfaction, and be easier to maintain. We coupled our extensive Agile software development and DevOps knowledge with industry best practices to modernize CGA's legacy system and deliver on their objective.

Resolving Code Complexity and Maintainability

We began by introducing a modern architectural design. To create more stability, reliability, and maintainability, the underlying business logic was separated from the user interface (UI) and rewritten in C#. The dramatic impact of this shift was captured through SilverThread code analysis.

By segmenting the architecture, we were was able to create a comprehensive unit test suite that validated the business logic's functionality. Using a DevOps mindset, the we created build and deployment processes that integrated this test suite with an automated process of deploying all changes—new features and defect fixes—to the production environment. If any tests failed, the build and deployment would also fail, ensuring any preventable defects did not reach production.

Together, these changes introduced by Excella reduced application maintenance costs by 83%. CGA invested the time and effort saved in maintenance and defect fixes into new feature development that benefited from the automated build and deployment process.

Reduction in Code Complexity

	Visual Basic Code	New C# Code	Comparable Benchmarks
File Connections (lower % indicates more dependencies)	18%	96%	80%
Modularity (lower % indicates tighter coupling)	9%	100%	99%
Clusters of Large Cycles (lower % indicates greater complexity)	5%	100%	92%

Improvement in Maintainability

	Visual Basic Code	New C# Code
Overall System Maintainability	27%	99%
Defect Ratio (% of defects introduced per KLOC)	9%	4%
Downstream Risk	7.2%	2.5%

A Need for Improved Usability

With a solid architecture and automated build process in place, we moved on to improve the usability of the system for the benefit of all users, including CGA staff, members, committees, and customers. We took the following steps:

Analyzed the functional and technical architecture of the system to identify effective modernization strategies.

Collected data about the user experience (UX) through interviews and observations, evaluated the UI, and researched options for improved approaches.

Created options for replacing the customer-facing website. Presented these options and their respective tradeoffs to CGA so that they could make an informed, data- driven decision on a way forward.

Ported all MS Access features into a web-based UI and combined existing "web portals" into a single, consistent UI, thereby streamlining user workflows and eliminating redundant data entry.

Established referential integrity within the underlying database to eliminate the need for duplicative data entry and reduce data-related errors.

Through these steps, Excella's reduced the number of administrative interfaces from six down to one. This dramatically improved the usability of the system. Data entry errors were eliminated by rearchitecting the underlying database—normalizing it, removing duplicates, and establishing referential integrity. This work made it much easier to enter data into, retrieve data from, and effectively use the system, both for CGA staff and their end-users.

Our investigation also revealed unnecessary payment processing expenses; CGA was able to reduce the cost of payment processing by 50% while simultaneously simplifying the purchasing processes for members, committees, and customers.

A New Way of Prioritizing New Features

A key objective for CGA was the ability to deliver new features effectively, without compromising system reliability. Excella's architecture and DevOps infrastructure provided the foundation for a new approach. Using Agile software processes, we demonstrated how work could be prioritized by value and impact, delivered in small batches, and continuously improved. Agile uses multiple, integrated, rapid feedback loops to ensure that the most valuable changes are being delivered consistently and that customers—CGA staff and their end-users—are benefiting from those deliveries.

By using Agile, we greatly increased visibility into the ongoing work, enhanced CGA's prioritization decisions, improved the effectiveness of the team, and reduced the time spent on defect fixes.

Accelerated Feature Development

	Visual Basic Code	New C# Code	Comparable Benchmarks
Days per KLOC	**16**	**14**	**N/A**
% Effort (Feature Development)	**75%**	**86%**	**84%**
% Effort (Defect Fixes)	**25%**	**14%**	**16%**

Conclusion

CGA's decision to partner with Excella to modernize their association management system resulted in a series of important benefits:

- By using modern architectural designs, Excella was able to develop a new, streamlined UI, comprehensive business logic, and normalized database that improved usability, eliminated tedious and redundant workflows, and reduced errors.
- By using Agile software development practices, Excella improved the efficiency of development work and accelerated the delivery of new features without compromising system stability.
- By increasing the reliability of the system, CGA saw an 83% reduction in application maintenance cost.

CGA's staff, customers, and members have a new, simplified user interface that provides a richer user experience, more efficient workflows, and fewer defects. The modernized system provides a significant reduction in maintenance costs while simultaneously providing more rapid delivery of changes and improvements, all without any compromise to product quality.

> *CGA has been working with Excella since 2014 to modernize the legacy databases and web-based applications that make up our proprietary association management system. Throughout our project, we have worked with a combination of senior developers and students from Excella's student eXtension Center (XC) in Blacksburg, Virginia. This approach resulted in a substantial cost savings for CGA without any compromise to product quality or timeliness; in fact, the students have been the catalysts for some significant value-added innovations on our project. The senior developers have consistently delivered high quality technical solutions, demonstrated the ability to adapt to our shifting needs, and have been mindful of the project budget. Everyone who we have worked with at Excella has been extremely professional and able to communicate easily with all members of our staff, regardless of their level of technical knowledge related to our systems. We would absolutely recommend Excella to anyone considering their services.*
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> **— Laura Brumsey, CGA acting Product Owner and VP of operations**