

Objective Control Cuts Development Time, Enhances Customer Communication and Increases Component Re-use with I-Logix' Rhapsody

Objective Control Ltd., based in Ohio, provides consulting and mentoring services in the area of industrial process control and Object-Oriented Analysis and Design for application to real-time systems. Objective Control focuses on major process control suppliers within North America, as well as process industry control users worldwide.

Objective Control, in collaboration with Corson Manufacturing Consulting, Ltd. in Columbus, Ohio, selected and began using the Rhapsody® Unified Modeling Language™ (UML™) based visual application development platform in 2000. Rhapsody was selected for the development of an advanced Coating Weight Control System for Steel Galvanizing. Developing and deploying their application on Windows, Objective Control used Rhapsody to develop a system that controls the zinc coating applied to steel in a continuous galvanizing process. Their initial release focuses on improving quality and uniformity of the coating on "hot-dip" lines, where the continuous strip of steel is immersed in a bath of molten zinc, and the excess is wiped off with a jet of air or nitrogen from "air knives." Improved uniformity permits the steelmaker to produce material of higher quality while using less zinc. There is high value associated with improved control with realized savings of \$1,000/day or more in zinc, as well as reductions in scrap or the need to downgrade off-spec material.

Objective Control used object-oriented languages for the development of real-time systems for over 18 years. Like many other companies, prior to object-oriented methods being published, Objective Control developed their own design methods. "We were in close touch with the object-oriented community during that time, and learned what others like Rumbaugh, Booch, Jacobson, and Harel were doing from early papers, conference presentations, and personal discussions well before their methods became mainstream," said Bob Wilhelm, Partner at Objective Control. "As a result, much of our previous design work could be expressed directly in Rhapsody. For example, our first object-oriented project in the 1980s was a complete redesign of a scanning measurement system for sheetmaking processes such as paper and metals. The coating weight system we interface with in our galvanizing application is very similar, so the design of our interfacing logic borrowed much from the earlier measurement system design."

With Rhapsody, Objective Control is able to develop their application graphically utilizing the standard UML. Having long adhered to the Jacobson's Use-Case method for requirements analysis, Objective Control

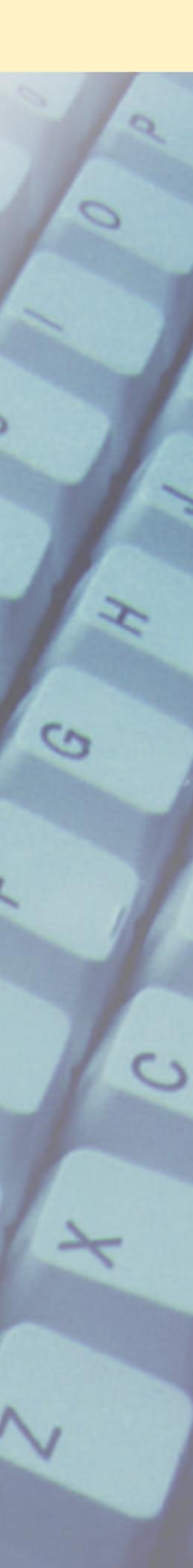
makes substantial use of Use-Case diagrams and Sequence Diagrams to formalize the requirements for the system. Acting as the primary input mechanism, Use Cases allow for the description of major function points within the system. Once those functions are defined, Sequence Diagrams are then used to detail specification of system requirements and collaboration between objects over time. During the early phases, Objective Control rigorously avoided assumptions about the internal design of the system, treating it as a black box, and focusing strictly on its interactions with external systems and human users.

"As the requirements became well-understood, Objective Control shifted focus to Object Model Diagrams and Statecharts to define how the required functionality was partitioned within the system, and elaborated the Sequence Diagrams to define the required interactions among the key objects," said Wilhelm. "The resultant requirements model then becomes the direct basis for the implementation model."

Some of the key benefits of using Rhapsody are the open framework and ability to execute models. Objective Control is able to generate code, targeted for different real-time embedded environments, at the push of a button. As Objective Control graphically develops their system, they are able to debug their application throughout the development cycle. Rhapsody turns the UML designs into verifiable executable models. Once the generated application is run, Rhapsody provides dynamic feedback to the Objective Control developers. The Rhapsody generated code is provided as an executable, and can be run on the host or target environment. "We very much like the open framework, the flexibility and customizability of the code generation. We consider executable models to be essential, and the ability to monitor and interact with the target system by way of an animated model is invaluable," said Wilhelm.

According to Wilhelm, "Our system communicates with other process computers and programmable logic controllers (PLCs) using OPC (OLE, object linking and embedding for Process Control), which is an increasingly important standard protocol for helping to unify communication among process control systems. We had





to develop the code to make our system an "OPC client" following this standard. Using Rhapsody to import a COM/DCOM interface and synthesize Object Model Diagrams made our job significantly easier."

"One of the unique and powerful things about our architecture is that we have integrated The Mathworks' MATLAB® math library, which allows us to do very complex matrix mathematical operations much more easily than we could do using C++ alone, and also provides powerful graphics capabilities," said Wilhelm. "We expect Rhapsody's open framework to become even more essential to our productivity over time, as we refine the level of integration with various tools."

In addition to the value that automatic code generation, the MATLAB integration and the COM/DCOM interface provide, Objective Control benefits from Rhapsody's ability to automatically produce documentation from the model. Wilhelm noted that, "Our initial customer for the galvanizing system was impressed enough with the development environment that they purchased a copy of Rhapsody for their own use. They have been very pleased with the documentation Rhapsody has helped us produce for the system, and we've used diagrams and reports from Rhapsody to support customer communication during all phases of the project."

The user interface, developed by Objective Control's partner, Corson Manufacturing Consulting, was built using Iconics Genesis-32, a commercial off-the-shelf package that is also OPC-based. Although this package has allowed them to begin the development process, some of their graphics requirements could not be met by off-the-shelf components, so they had to develop some special handshaking with an Active-X control within the GUI. "Once again, Rhapsody's ability to import the interface and abstract it into an object model came to our rescue," said Wilhelm. "Rhapsody has certainly paid for itself in reduced development time during the project."

Looking forward, Objective Control's goal is to develop a control system architecture that differentiates itself from traditional process control systems by being "process-centric." The intelligence to control the process will be placed within the framework of an object model of the process itself. This type of architecture will be easier to understand and maintain, and because its modularity matches that of the process better than that of traditional process control software, it is easier to adapt to variations between processes or modifications to an existing process.

"We expect to meet the needs of many different galvanizing configurations with this system. Beyond

that, however, we feel we've developed a general framework for many sheetmaking and sheet processing applications. This is a relatively specialized area of process control with many unique requirements not well-served by conventional process control systems," said Wilhelm. "Many of the components we've developed can be readily applied to other sheet processes, including papermaking, plastic extrusion, and coating/treating, such as for adhesive and abrasive products. The ability to reuse these components will provide significant time and man power savings on future projects."

Objective Control Ltd. integrated Rhapsody into their development process in 2000. By implementing Rhapsody, Objective Control was able to pull previous design elements from earlier real-time object-oriented projects into Rhapsody, and continue development with a UML-based development environment. They were able to graphically develop their system using various UML views, automatically generate production-quality code, execute, test and debug their application and then automatically create documentation. Objective Control is now able to re-use components for future projects, ensuring that the components are bug-free and precious time invested is not repeated. Through Rhapsody, Objective Control has substantially reduced development time and improved maintainability.

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