



## Helping to advance scientific discovery.

CASE STUDY

### Summary

This client returned to Beacon EmbeddedWorks to assist in creating a device that combines chromatography and detection technologies into a single, easy-to-operate instrument. The device would hone precision, simplify, and automate the chemical purification process. This would free chemists from tedious purification so they can focus on conducting scientific discovery.

### Challenge

Chromatography is a technique chemists use to separate mixtures. Chemists often spend hours staging and monitoring chromatography instruments to extract the components that they need to advance scientific discovery. Chromatography can quickly become exorbitantly expensive if a process fails, a sample leaks, or a machine breaks down. In these unfortunate cases, the resulting loss of valuable time and samples add up quickly.

The need for a chromatography option that utilizes cutting-edge technology was exacerbated by the reality that existing machines were unable to accurately detect all compounds. Thus, isolating the desired components sometimes required additional processing steps. As one chemist explained to our team, "Time is of the essence and purification is the chokehold in discovery chemistry." This client sought our teams support through the entire process, from concept development and research, to product lifecycle development. The client trusted our team to bring their product to laboratories around the world quickly and on budget.

### Customer Profile

This client is a global supplier of products for petroleum refineries, industrial applications, food and beverage packaging and commercial and residential construction. The company is well established with operations in more than 40 countries.

### More Information

#### Why choose a Beacon EmbeddedWorks SOM?

See what differentiates our SOMs from the rest.

[beaconembedded.com/system-on-modules/](https://beaconembedded.com/system-on-modules/)

#### About Beacon EmbeddedWorks

Beacon EmbeddedWorks is a full-service provider of innovative System on Modules (SOMs). Backed by a suite of customization, security, and support services, our dependable, pre-certified, and feature-dense embedded solutions serve the most strenuous applications.

## Solution

Having previous success working with our team, this client returned for help with discovery, research, and product development. Our Industrial Design, Mechanical Engineering, Electrical Engineering, Systems Engineering, Embedded Systems and Manufacturing teams collaborated with the client throughout each stage of new product development. We began by establishing a basis of market and user research upon which to develop device concept. To turn the concept into a top-of-the-line device, we engaged in a process of product refinement, including alpha and beta prototyping. Once the design was confirmed our teams brought the device specifications through to production and assembly.



As part of its discovery research, designers from our Industrial Design team traveled to numerous laboratories to observe and interview chemists, their assistants, service technicians and sales people. The design team wanted to understand current methodologies, equipment, tools, and safety measures associated with chromatography. This helped our team to develop an understanding of opportunities, limitations, and normal behaviors associated with laboratory environments. This was essential so that we could comprehensively incorporate user needs.

Our design team quickly learned that space is a premium in laboratories. The integrated product of multiple subsystems managing the RFID, motors, heaters, and the fluidics system had to meet ergonomic requirements while fitting into a single, compact enclosure.

While size was one noteworthy constraint, it was equally important to improve the user experience. Based on our research and collaboration with the client, the team ensured that the new product utilized efficient component layouts, physical geometries, and user interfaces that intuitively guided chemists through each stage of use. This intuitive guidance relied on the software's ability to anticipate user needs, from set up and sample processing to postdocumentation, cleaning, and maintenance.

The team created an aesthetically compelling design that guided the user through product functionality, embodied the client's brand, and communicated their commitment to quality through advanced technology.

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## Solution Continued

Our engineers created 75 custom-developed parts in addition to the fluidics and electronics. We worked with the client to strategically integrate all subsystems and protect the 11 electrical boards from solvents by enclosing it all within an industry-first, compact, ergonomic, design.

We worked with the client to combine more than 30 sensors (including optical, thermal, pressure, and RFID) and over 20 actuators (including 9 motors, 12 valves, a fraction collector, and a complex, gradient valve-based fluidic system) into one cohesive device. Implementation of RFID tags maximized efficiency by recognizing and monitoring the process internally. This allowed for workflow quality assurance, as cartridges, trays, and flow rate could all be auto-populated by the intelligent design. The device even improved on previous models by including the capabilities to collect and analyze previously undetectable compounds. A sophisticated software algorithm integrated multiple detector signals through advanced signal processing to make this advanced detection, collection, and fractioning possible.

System architects took advantage of our System on Module (SOM) technology for increased time-to-market and the ease with which components could be upgraded to the next generation embedded products. We leveraged our extensive experience with multi-processor architectures to create the instrument's graphical user interface (GUI) using the Microsoft, allowing for a system powered by Windows XP. The net platform reduced time and effort in GUI development. An FPGA, using embedded softcore and discrete logic, provided real-time control of all sensors, actuators, pumps, and motors in the system. In addition, the input of results could be automated to eliminate extra steps for technicians by connecting the device directly to the laboratory information management system.

Through close collaboration with engineering and manufacturing teams gave the customer an accurate representation of the product early in the development process. This was possible because we anticipated potential engineering changes and manufacturing refinements. Our concurrent engineering process leveraged new product introduction (NPI) procedures to provide manufacturability assessment early in the development and continuous verification to reduce redesigns.

## Results

The resulting product combined chromatography technologies and an extensive list of product enhancements to give the chemistry community never before seen efficiencies in product verification, purification, and production. Beacon's integrated product development and concurrent engineering reduced risk, time, and cost for the client to launch the first of its kind chromatography product. The product launched in February 2009 and has since received multiple instrument and product innovation awards. Beacon continues to manufacture and support the product today.

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