The Power of E2E Collaboration & Integrated Thinking

Tips for Improving Outcomes in Your Next Design Project

MINCO

“There’s a way to do it better. Find it.”

For years, that quote hung on the wall of Thomas Edison’s laboratory. The truth is, Edison was highly practical. He believed “innovation” was only worthwhile when it was replicable, economical and applicable to wide ranging problems that needed to be solved. Of course, he did invent the phonograph, the microphone, the light bulb and batteries. He also secured 1,093 U.S. patents. So, he clearly lived by his own advice.

Edison was like many of the best engineers in large corporations today. He was practical, but a creative problem solver at heart. The attributes that made Edison — and others like him — “innovative” were discussed in vague terms for years. But in 2014, a group of three distinguished engineering professors from Purdue University, along with one from Penn State University, conducted a study to identify the characteristics that drove innovators like Edison to find a better way.[1]

Their methodology was simple: they interviewed engineers and simply asked them to be candid about what separated innovative engineers from non-innovative engineers. Their study determined that a mix of innovative and non-innovative engineers was essential to keep things moving in an organization. A better word for “non-innovative,” according to the findings of the study, seems to be “practical.” But while both types of engineers are required, it is the innovators that enable outcomes such as superior performance, increased value and meaningful product differentiation.

Attributes of Innovative Engineers

according to study participants[1]

Challenger	Questions the current way of doing something
Collaborator	Seeks to work with other people or groups in order to achieve something
Persistent	Pushing beyond the usual, expected, or normal
Risk-Taker	Unafraid of failure in terms of trying something to see if it works
Visionary	Ability to think long-term rather than short-term

[1] Purzer, Senay, and Kathryn Jablokow. “Collaborative Research: Identifying and Assessing Key Factors of Engineer-ing Innovativeness.” age 24 (2014): 1.

The Power of Collaboration and the Will to Challenge Convention

From the perspective of a company that designs and manufactures circuits, heaters and sensors, the most intriguing aspects of the innovation model that came from the study are (1) challenging the status quo and (2) collaborating with others outside your immediate circle. While we continually invest in our products and regularly bring new ideas and offerings to the market, a majority of the innovations we drive are discovered while working alongside our customers to find new solutions that push beyond the ordinary.

Through engineer-to-engineer (E2E) conversations, we partner with customers to uncover new ways to improve the performance of commercial aircraft, make life-saving medical devices more reliable and enhance the resilience of satellites and other vehicles that must perform in space. Unexpected challenges — like finding ways to power weather balloons that provide internet service to a country reeling from the effects of a hurricane — drive us to make our products smaller, lighter, more resilient and less costly, all while adding more features.

Almost invariably, the most impactful innovations Minco produces are a result of integration. By applying expertise in thermal modeling, substrate composition, material stability and other disciplines, we're able to integrate heaters, circuits and sensors to create smaller and lighter devices with lower power requirements. Our customers use complete packages that are simpler and faster to install on manufacturing lines. But most important, our customers achieve all of these new levels of spatial ingenuity and operational economy through devices that meet the demands of absolutely-cannot-fail applications.

The next few pages provide examples — showing the result of challenging the status quo and collaborating closely with customers >

Case Study 1:
Solving a New Problem for a Medical Device Manufacturer

A medical device company was looking to create strong differentiation with surgeons and hospitals who are flooded with new product ideas almost every day. The integration challenge was considerable: our customer's engineers wanted to develop a device capable of cauterizing exit wounds in femoral arteries. Wounds caused by the removal of catheters during heart procedures were taking hours to heal with existing technology. This presented serious risk for patients and tremendous liability for both surgeons and hospitals. Engineers working for the medical device manufacturer believed they could close the cauterizing gap to six minutes, instead of hours — but they needed a compact and reliable integration of a flex circuit, heater and sensor.

Minco was challenged to integrate a flex circuit with a heater and sensor to create a highly reliable device that was able to reach a target temperature of 100°C in less than six minutes — then hold that precise temperature while the wound cauterized. Presenting additional challenges, the finished component could be only slightly larger than a catheter — a donut shape with a 4mm (0.16") outer diameter and 1.5mm (0.06") inner diameter.

Minco's engineers designed a flex circuit consisting of an all-polyimide heater. It was created using a special adhesive-free process that allowed for higher temperatures than conventional polyimide heaters. The circuit itself was not only complex in its size, with limited real estate the elements had to be stacked on top of each other. There were also twenty-two 0.08mm micro blind vias for power as well as two 0.15mm blind vias to carry the signal of the surface-mount NTC thermistor that sensed the temperature of the heat sink.

Engineers from Minco and the manufacturer were able to take the product design to a new level and achieve the cauterizing goal by integrating flex circuits, heaters and sensors into a single device. This new configuration achieved the challenging temperature goals, saved space and improved reliability in the field by reducing the number of failure points.

Case Study 2:

Solving a Critical Security Challenge in Airports Worldwide

A manufacturer in the airport security market approached Minco with a unique challenge. Most of the devices used to detect explosives, narcotics and other dangerous substances at security gates in airports are large, stationary devices. Agents are required to carry luggage and other items to these devices for sensing — and, up until this point, there had been no device that could be used to detect illicit substances on travelers themselves. The device manufacturer wanted to create a handheld device that was lightweight, reliable and effective. Simply stringing together existing components would not work.

While the customer came to Minco for a flex circuit design and production, the greater challenge was clear: the device had to be small and light enough for agents to carry it through an entire shift. This meant the flex circuit needed to be integrated with a heater — which, in turn, had to deliver more watts per square inch than conventional products had achieved in the past. The integrated package also had to be constructed in a way that would allow for reliable performance, even after months of daily use in environments with tens of thousands of passengers per day. Engineers from Minco and the manufacturer collaborated on a design that saved space by integrating a flex circuit with an all-polyimide heater and sensors. The ultimate design allowed for a rugged and accurate device that's used today to secure air travel around the world.

Case Study 3:

Collaborating on a Challenging Defense Contract Challenge

A defense-industry manufacturer approached Minco to provide flex circuits for the control unit of a modified missile delivery system. Like many defense contracts, the control unit project featured a robust set of certifications and specifications. These requirements always present significant design challenge, but we were able to address them quickly because the manufacturer engaged our flex circuit experts in E2E collaboration at the start of the project.

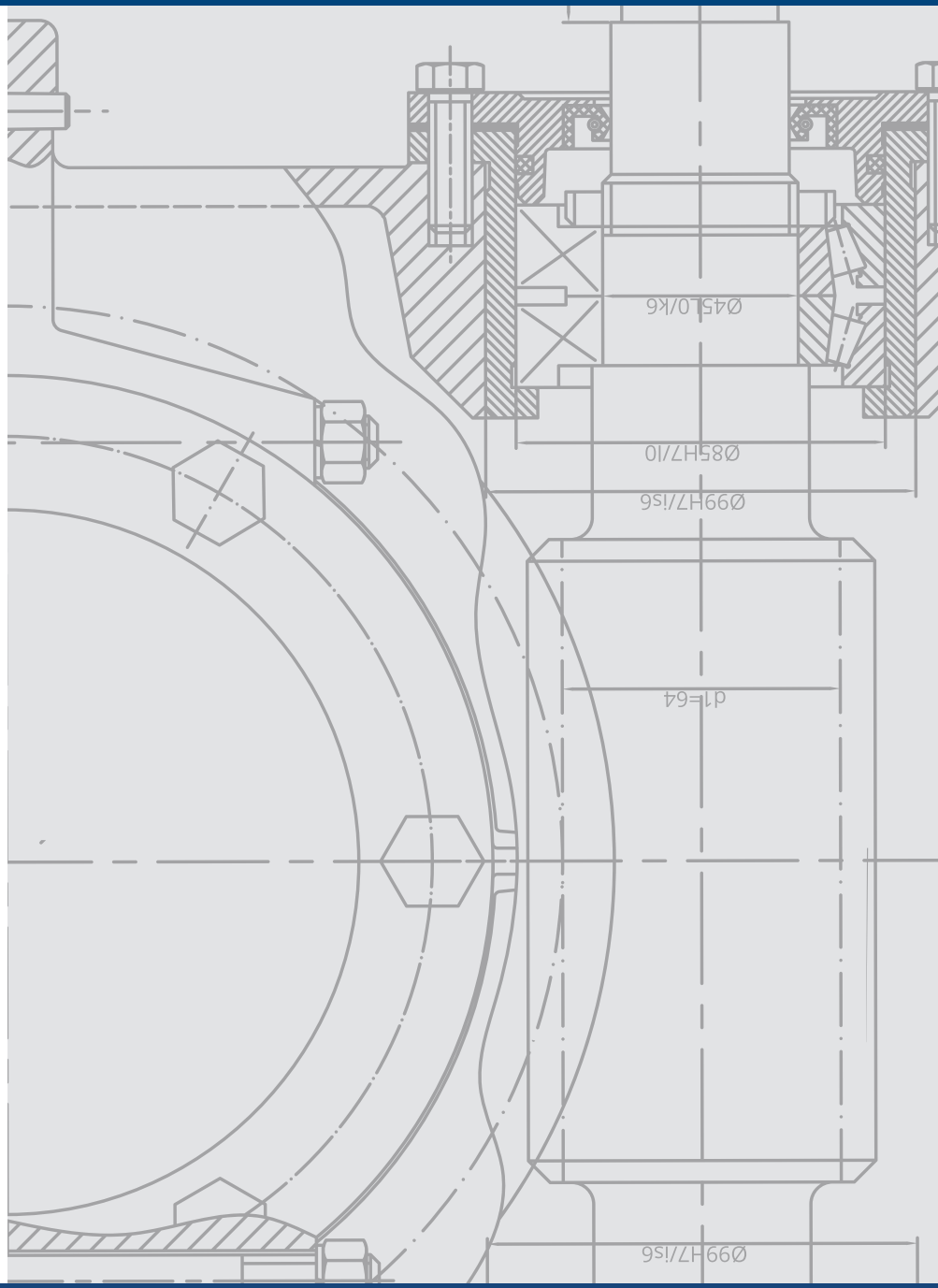
Working as one team, we designed and manufactured a six-layer rigid flex circuit with an extensive subassembly that was able to connect a variety of components throughout the control unit. The Rigid Flex assemblies Minco Manufactured are a combination of rigid areas allowing the use of both through-hole components as well as surface mount components with a package size as small as 0201. The rigid flex design also featured copper shields, which were secured with a pressure-sensitive adhesive. By replacing the existing wiring harness with a flex circuit, the team achieved significant weight and size reductions. The redesigned control unit is 70% smaller, 40% lighter and features a 50% increase in battery life over the previous device.

Tips for Leveraging Integration to Solve Seemingly Impossible Problems

Engineers love challenges. Or as Edison put it, they know there's a better way to accomplish the task at hand — it's just a matter of finding it. From our engineers' experience, creating something new and better typically requires integrating flexible circuits, heaters and sensors into a single package that saves space, cuts costs or improves performance. If you're addressing a new challenge that can't be solved with existing circuits, heaters, and sensors, here are some tips for finding an integration solution that works:

1. Start Simple

In many cases, customers begin by asking Minco to design a flex circuit. Through collaboration, we've discovered that we can integrate a heater and a sensor to create solutions that are lighter, more resilient and more efficient on the production line. For instance, an environment may need to remain thermally stable, so Minco flex engineers collaborate with Minco thermal solution engineers to design a product that exceeds the customer's initial requirements. When Minco engineers familiarize themselves with a project, they can make cost-saving suggestions. One example might be the wires or flex leads connecting the heater to other components in the enclosure. Old-fashioned wiring bundles pose installation difficulties due to their bulk and the possibility of mis-wiring the rig. By combining the various wires into a flat package and adding connector plugs, these challenges are eliminated — it's impossible to connect the plugs the wrong way.



2. Start the Collaboration Process Early

Most performance improvements, space reductions, cost savings and new capabilities that are a result of integration are discovered and tested early in the design process. Engaging flex circuit, heater and sensing experts from the beginning of a project keeps the focus on larger program objectives and provides more runway for new ideas. The most compelling results are almost always a result of collaboration that starts early in the process.

3. Seek a Flex Circuit Supplier with Proven Heater Expertise

Minco engineers can take your flex circuit requirements, apply thermal modeling techniques and integrate a heater to meet your specific needs. E2E discussions can lead to material selection and heater designs that meet specific watt density requirements while still providing high yields. This helps control cost and makes for more predictable delivery schedules. New flexible heater designs offer multiple zones as small as .25” square to as large as 12” x 24”. These designs are 100% customizable and can be adhered to a variety of heat sinks to meet your needs.

4. Explore Ideas that Combine Flexible Circuits with Heaters

Using some of the same substrates utilized in flexible circuitry, you can integrate a flexible heater. Minco engineers can show you new ideas for adding layers that offer lower resistance — and carry power and data signals to other portions of your device. Because Minco engineers are IPC-certified and proficient in IPC 2223 (design standard for flexible circuits), we can help you navigate critical considerations, including material stability, the ability to plate on multiple conductive surfaces, how to drill accurately and cleanly, and the bonding of these various materials.

5. Add Sensing Capabilities for a Full Integration

This can be done through a variety of surface mount off-the-shelf sensors. Both flexible circuits and flexible heaters lend themselves to pick and place technology. Minco engineers are fully up-to-speed on IPC 610 as well as J-STD specifications for soldering, which means we can walk you through every step of the integration process.

Ready to Challenge the Status Quo? Ready for E2E Collaboration?

"You can't solve a problem on the same level that it was created. You have to rise above it to the next level." That quote from Albert Einstein has been cited in engineering classes for decades. But it's true and incredibly relevant today. Engineers in many companies feel they're being judged on their ability to keep production lines moving and products flowing out the door. That's partly true, because every company needs to drive revenue and sustain margins to thrive. But the willingness to change the status quo and find a better way is required to help companies make important leaps in their markets. Just doing the same thing and producing the same products with the same performance characteristics is clearly not sustainable.

If you and your engineering team are ready to take that step and start solving problems on the next level, Minco engineers are ready. Our thermal, flex circuit and sensing experts produce game-changing devices when our customers engage them in E2E conversations. The results are always best when that collaboration occurs early in the design process.

Interested in an E2E conversation? Want our experts to review preliminary designs?

Call Minco at **763.571.3121**
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