

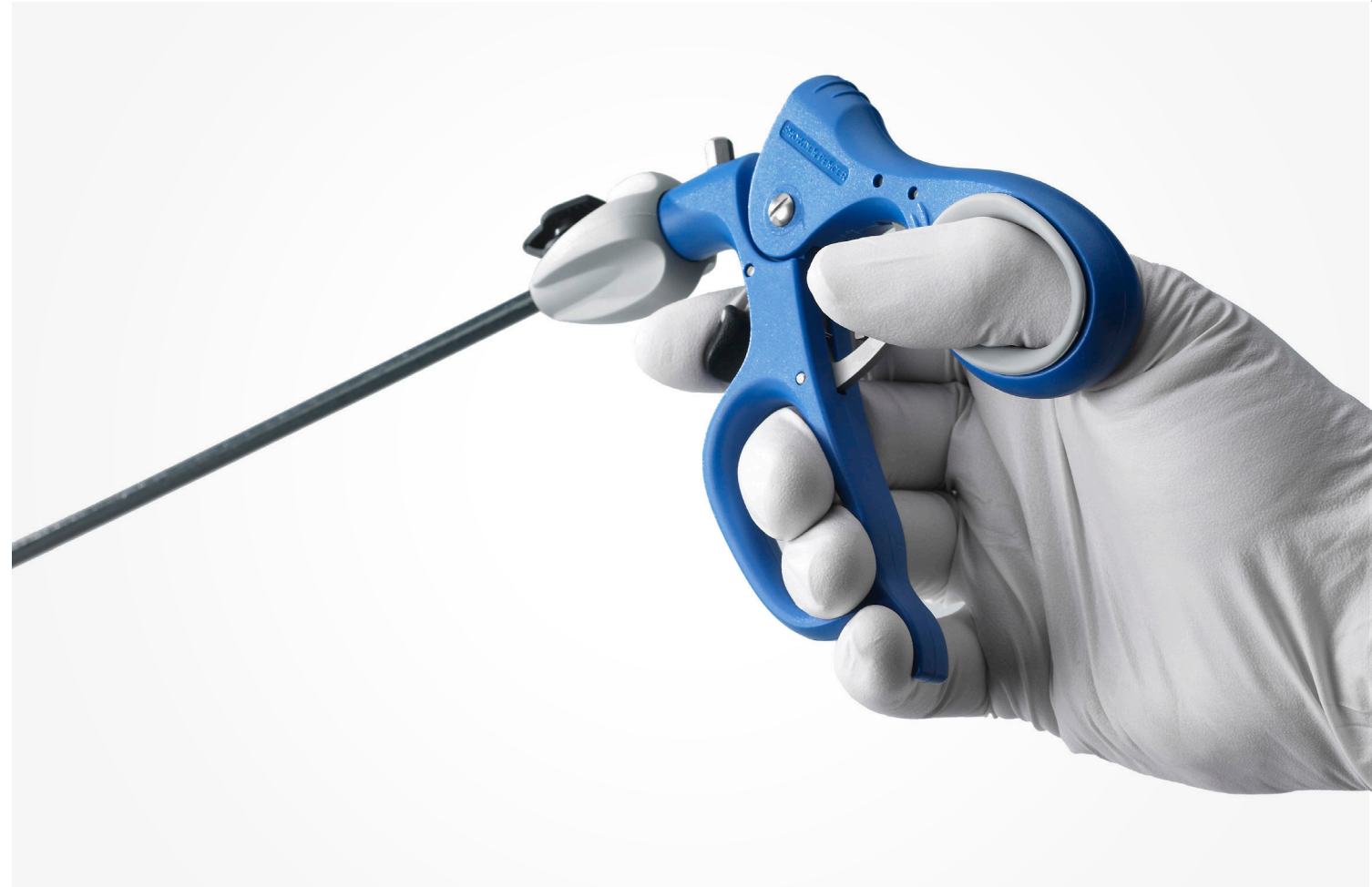
BD

Single-piece Laparoscopic Instrument

Cardinal Health, formerly CareFusion, and later acquired by BD, asked Farm to help develop a universal handle design for a new line of laparoscopic instruments.

Farm began the project with a significant research effort, interviewing 24 surgeons across multiple disciplines to gain an understanding of user needs and competitive product preferences. The data gathered from these interviews were then combined with ethnographic research and observations of live procedures, and led the team to insights that drove the final design and the detailed engineering of the handle.

Our team created a new tool with dramatic improvements in ergonomics. We incorporated a removable insert with better grip characteristics that accommodates a wider range of thumbs. We optimized the handle shaft angle, made the finger openings larger, and improved the force distribution on a user's fingers. The handle design has a more substantial feel while offering improved backlash and rotation-knob performance over previous products. The result? A better user experience for the surgeon performing difficult laparoscopic procedures.





Cook Medical

NavAlign IVC Filter Delivery Device

Pulmonary embolisms (PE) affect thousands of Americans each year, and if left untreated, can kill one out of three individuals. PEs occur when a blood clot becomes dislodged from the vein wall and migrates to the lung, blocking blood flow in the pulmonary artery. To combat this life-threatening condition, surgeons implant IVC filters to trap embolisms before they can cause damage. Cook Medical partnered with Farm to redesign their existing IVC filter delivery system to make it easier to install these life-saving vascular devices.

Farm conducted human factors and usability research, including surgeon interviews and extensive task analysis, to better understand the physical and cognitive steps required to position and deploy a filter. We discovered unnecessary steps in the workflow as well as critical elements of the existing design that contributed to user error and possible misalignment of the filter. The team then created concepts that addressed these issues and tested them with users to compare single or two-handed approaches, as well as to define many ergonomic and cognitive improvements.

Farm's filter delivery system eliminates the effects of pull/push and rotation on the filter, reducing the potential for misalignment. We designed a unique tactile feedback feature into the delivery tool that lets the user feel when the filter is in the correct location. This allows the surgeon to watch the display monitor and eliminates premature deployment. We also reduced the number of steps needed to complete the deployment of the filter, and engineered the product to be more cost-effective to manufacture. The result is a simplified device that features precise control, increased accuracy, and improved device efficacy.

The NavAlign system has exceeded user expectations. It is a totally unique and highly intuitive device that includes features unavailable on any other IVC filter delivery system on the market today.



Cooper Surgical Sensiport Laparoscopic Trocar

When Cooper Surgical came to Farm, it was with the goal of improving the function and reducing the cost of manufacturing of its Sensiport Laparoscopic Entry System. By employing advanced materials and manufacturing processes, including one of the industry's first Titanium Nitride-on-Aluminum combinations, Farm showed Cooper Surgical how the Sensiport System could be manufactured with fewer parts and greater efficiency.

Farm's innovative enhancements allowed Cooper to reduce the production costs of the Sensiport by 50% and reduce its overall weight. This critical weight reduction lets the surgeon more reliably position the trocar within the surgical site and control its operation during surgery.

Farm also improved the existing shield-lock safety mechanism by altering its mechanics. This refined safety mechanism prevents a dramatic increase in the pressure required for surgeons to perforate the patient's tissues, allowing more precise incisions and safer procedures. The result? A better trocar that enhances our client's bottom line.



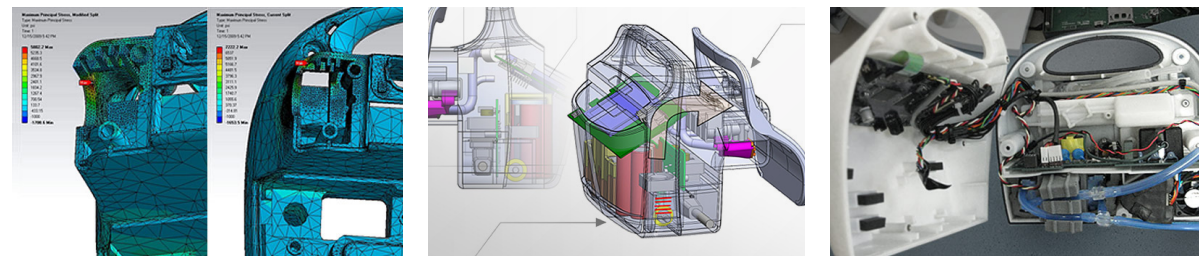
Cardinal Health

Kendall SCD Compression System

Covidien, later acquired by Medtronic, chose Farm for the engineering, human factors, graphical user interface, and design of its compression controller. In 2017 Cardinal Health acquired Medtronic's Deep Vein Thrombosis business. The Kendall SCD Controller, used in conjunction with the Kendall SCD Sequential Compression Comfort Sleeve, helps reduce the incidence of potentially fatal venous thromboembolisms by delivering sequential, gradient, and circumferential compression to the leg.

Farm's team conducted generative research to gain a better understanding of the use environment and the device's elements of interaction with patients and clinicians. Field research uncovered unmet user needs, including the ability to operate the device with one hand, a flexible yet secure method for attaching the device securely to hospital bedrails of varying widths, and a simplified GUI. Instead of using a typical off-the-shelf medical monitor mount, Farm's development team focused on creating concepts that could integrate the bed rail mount and actuation mechanism into the overall form of the device. Prototypes were fabricated for mechanical feasibility and models were created for preference testing, resulting in the selection of a single clip/angled arm design. Multiple refinements were completed to optimize the design based on performance, ergonomics, development risk, cost, reliability, and manufacturability.

Emphasis on early detailed engineering and Finite Element Analysis greatly influenced the component design and reduced development time. Farm also improved the controller by working with sound experts to mitigate pneumatic pump noise by designing and implementing a muffler and foam enclosure to aid in pump vibration isolation. The collaboration between Farm and Covidien brought the new controller from concept to commercialization in just 14 months. The result was a single-handed use device that mounts securely to the various hospital bed rails found on the market today. A large display with strategically placed buttons and animated icons provides users with real-time status feedback, improving controller functionality, ease of use, and overall operation. The Kendall SCD Sequential Compression Comfort Sleeve and the Kendall SCD 700 Series Controller received 510(k) clearance from the U.S. Food and Drug Administration on November 4, 2010.





DJO Global Aircast XP Walking Boot

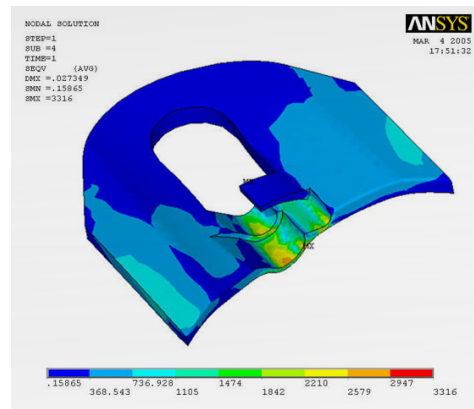
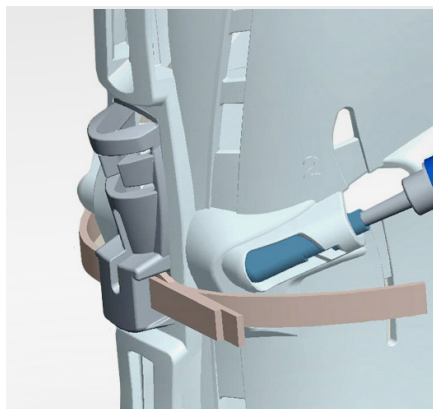
Aircast pioneered the use of graduated pneumatic compression as a way to more comfortably immobilize a patient's foot inside a walking brace. After years of selling the same product into an increasingly crowded category, Aircast recognized a critical need to refresh their primary offering, and asked Farm to create a new signature product.

Our team focused on reducing part cost and weight while increasing comfort and incorporating new features, including a pneumatic pump, better ventilation, and internal geometry derived from the anatomy of the foot. Working closely with Aircast's injection molder and using Finite Element Analysis techniques, Farm engineered highly optimized parts that were 18% lighter than those in the previous product.

At the same time, we succeeded in making the parts stronger while increasing their flexibility and achieving greater part reliability over 90,000 cycles of impact. We incorporated an ergonomic rocker sole made of lightweight composite material that offers enhanced comfort and protection while promoting more natural ambulation, and we made the foot base larger to offer ample room for dressings without sacrificing comfort. Finally, we integrated into the brace a user-adjustable air pump that allows the patient to maintain just the right amount of compressive support throughout the healing process, while maintaining comfort and stability.

Farm succeeded in significantly reducing the weight of the new cast, improved its ergonomics and performance, gave it a bold new aesthetic, and made it more cost-effective to manufacture.

The result? The launch of the new XP Walking Brace gave Aircast a 30% increase in market share.





Echo Therapeutics Prelude SkinPrep System

Echo Therapeutics, a startup company with a prototype skin permeation technology, collaborated with Farm in the development of a safe, painless, and needle-free alternative to traditional drug delivery therapies and non-invasive glucose monitoring. Echo's device allows clinicians to permeate the outermost protective layer of the skin and is intended for use in hospital critical care units.

Farm was responsible for the complete design, systems engineering, and prototyping of the device, including two critical device-to-patient disposables that play an important part in the overall delivery therapy. Operating under Farm's design controls, the systems engineering team conducted a feasibility study of Echo's existing proof-of-concept prototype. Engineers then identified, recorded, and analyzed functional and performance data to help them understand any deficiencies in the existing design and the necessary changes required in order to meet product requirements.

Farm was also responsible for all component selection and for developing and testing a refined system architecture, including software and hardware. Throughout the development process, we built several fully-functional units for engineering evaluation, for verification testing, and for clinical trial use in proving device efficacy.



Hollister

Anchor Fast Oral Endotracheal Tube Fastener

The Anchor Fast Oral Endotracheal Tube Fastener was developed to help clinicians secure oral endotracheal tubes during patient procedures. Farm collaborated with Hollister to redefine the attachment and performance requirements of the fastening system to enhance the unique features of tube stability, smooth repositioning, and skin protection that Hollister is recognized for.

Farm used Finite Element Analysis to help us design concepts that would further increase fastener performance without compromising critical features. As part of that analysis, we tested varying levels of pressure applied to the face in order to achieve the minimal pressure on the upper lip and surrounding tissue. We then researched and tested multiple elasticity and adhesive pad geometry options to optimize the fastener for stability and patient comfort. Because this is a single-use product, Farm integrated key part details into the product geometry to enhance both the DFM and DFA in order to meet cost constraints.

The final product is a much-improved tube fastener with a comfortable, adjustable padded neck band that facilitates trouble-free movement and is easy to secure and reposition, giving clinicians convenient access to the mouth and throat for suctioning and oral care.





BD

Snowden-Pencer Take-apart Laparoscopic Instrument

Because Farm played a key role in developing Cardinal Health's Diamond-Line of laparoscopic instruments, CareFusion, a Cardinal Health spin-off, chose to collaborate with Farm on a new line of reusable, take-apart laparoscopic tools that support safe cleaning and sterilization protocols for reusable medical devices. In 2015 CareFusion was acquired by BD.

Farm worked closely with Cardinal Health to establish and validate user requirements for the new tools, beginning the project with an international, ethnographic user research program. The resulting data helped Farm design innovative mechanisms for intuitive articulation and verifiable reassembly, and helped the team conduct usability validation testing to ANSI/AAMI ST79:2006 and AORN 2007, standards which ensure that device manufacturers make thoroughly cleanable devices and include instructions for sterilization and handling.

Working from the brand identity and ergonomics of the Diamond-Line, Farm generated several concepts with varying component configurations (hyper-extending thumb bow, breech load, side load, inner pawl, rear lifter) that address the requirements for easy cleaning and sterilization. To prevent accidental part disconnection, Farm developed intuitive tactile and audible snap-in-place parts and markings to help ensure proper assembly. Farm maintained the original multi-dexterous handle and integrated ratchet to give physicians comfortable and intuitive control during surgical procedures. The patented ring-handle design accommodates both precision and palm-style grips while minimizing hand fatigue.

The final design is based on user testing of working prototypes, and its features include three take-apart components that are easy to clean, sterilize, and inspect, creating a more cost-effective alternative to traditional disposable instruments.



Hologic

Selenia Dimensions Mammography System

Farm collaborated with Hologic to develop Selenia Dimensions, their next generation mammography system featuring Tomosynthesis 3D imaging technology. Selenia Dimensions offers more accurate imaging and a better user experience for both the patient and the operating technician.

Farm conducted observational research and one-on-one interviews to better understand the habits and practices of technicians, and the ways in which patients interact with the device. These findings led to the creation of an innovative “flush” form that greatly improves patient comfort by integrating patient interaction areas into the surface of the enclosure. The team then redesigned the device controls to optimize their accessibility and ease of use while strategically locating them to avoid inadvertent contact with the patient and accommodate the rotational movement of the system.

In addition, Farm developed an entirely new workstation with an array of new features, including an enhanced graphical touch screen interface and proprietary x-ray exposure controls that greatly eliminate repetitive joint motion and user fatigue. These ergonomic improvements, integrated with the new design language, leverage Hologic’s brand equity and highlight the new “Tomo” technology as representing a significant leap forward in women’s healthcare.





Abbott

Supera Stent Delivery System

IDEV Technologies, an emerging medical device company and developer of endovascular and interventional applications, developed the first transhepatic biliary wire interwoven nitinol self-expanding stent that offers unsurpassed strength, flexibility, durability, and conformability even with joint flexion.

Farm partnered with IDEV Technologies, later acquired by Abbott, in the development of the SUPERA delivery system. To gain a deeper understanding of technology and usability issues, Farm conducted a competitive audit of existing devices on the market. We then observed multiple procedures and conducted interviews with physicians and technicians. Each step of the process was evaluated (storage, preparation, positioning, deployment, and removal/disposal) for ergonomics and usability optimization. Our analysis of the resulting data led to key recommendations for design development as well as initial architectures focused on simplifying steps, minimizing hand repositioning, and single-hand use. Farm built three interactive device prototypes for the 2008 Vascular Interventional Advances (VIVA) Conference and conducted preference testing with ten physicians to narrow down the control scenarios and ergonomic form. Rapid iterations of 3D models through the subsequent development process helped us verify the ergonomics as well as the industrial design identity of the device. Farm was also responsible for the engineering development, including all control mechanisms and part design. Key improvements included:

- Packaging that allows flushing of the device prior to removal
- Integrated rear flush ports to reduce snagging of bed sheets and improve access
- Reduction of prep, delivery, and removal steps
- Low-profile handle features that won't snag
- Handle form and slider design that mitigates hand and thumb repositioning
- Full single-hand use throughout the procedure

The new device not only allows for more precise stent placement, but gives physicians increased accuracy with fewer steps required for preparation and delivery.



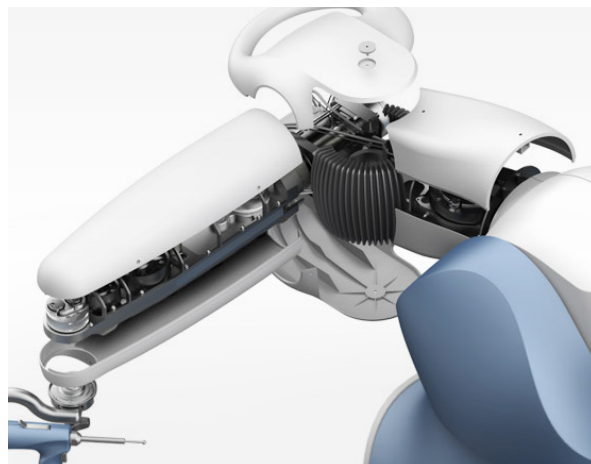
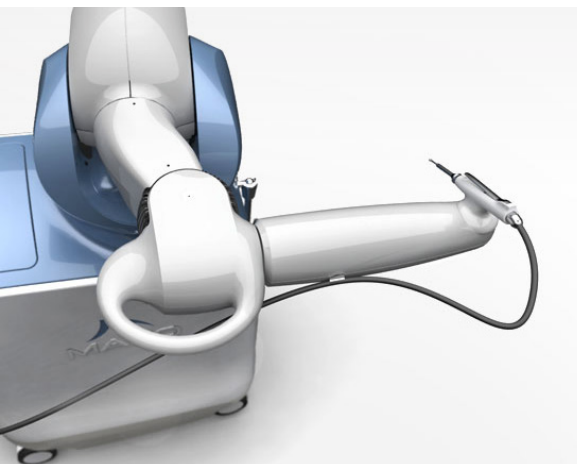
Stryker Mako Robotic System

Farm's collaboration with MAKO Surgical Corp., later acquired by Stryker, helped bring true product innovation to the hands of orthopedic surgeons by introducing a proprietary, interactive robotic surgical system for treating patients living with early to mid-stage osteoarthritis of the knee. The Mako system allows the physician to precisely resurface damaged areas of the knee without compromising the surrounding healthy bone and tissue.

Our team focused Farm's strategic, research-driven process on task analysis by observing live knee replacements and interviewing surgeons in an effort to simplify and refine the procedure. Early-stage mockups and subsequent prototypes then helped the team uncover greater efficiencies in the operating room, including a reduction in the number of procedure steps, while increasing operational accuracy and precision.

Farm's human factors experts helped create an ergonomic design solution that gives the surgeon complete freedom of movement and precise control of the robotic arm. At the same time, the system accommodates the size variations of users as well as patients.

The result? An extraordinary minimally-invasive surgical experience with reproducible precision for every patient. An added benefit—patients can return to an active lifestyle with far less recovery time and a smaller scar compared to total knee arthroplasty procedures.



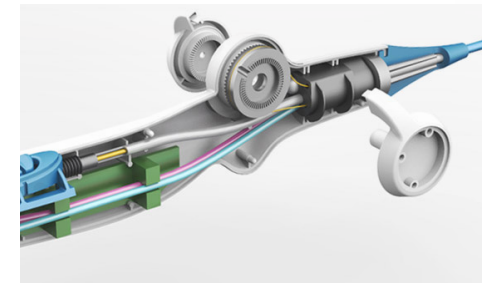
Medtronic

Arctic Front Cryoablation Catheter Device

Farm worked with CryoCath Technologies, later acquired by Medtronic, on FrostByte, the first two-in-one convertible device that incorporates a clamp and a SurgiFrost surgical probe used by interventional cardiologists for minimally invasive cardiac cryoablation procedures, including the treatment of cardiac arrhythmias.

The SurgiFrost probe locks inside the upper jaw of the clamp, providing simplicity and ease of use for the surgeon. The team designed the form factor of FrostByte to be as narrow as possible to ensure that it stays clear of the surgeon's line of vision.

Farm also incorporated an integrated latch that allows the clamp to remain locked; this feature reduces hand fatigue and guarantees that a specific and consistent amount of force will be applied to the cardiac tissue.





TransMedics Organ Care System

Farm collaborated with TransMedics to develop the world's first and only mobile live organ support system that allows a human donor heart or lung to travel for up to 4 hours while supporting the organ's living functions. The Organ Care System (OCS) is designed to maintain organs in a healthy, functioning state outside the human body while allowing real-time, clinical evaluation prior to transplant surgery. The portable, modular cart houses all elements of the system, including an oxygen supply and a perfusion pump that maintains the flow of warm, nutrient-rich blood to the organ. Hot-swappable batteries provide full system power during transport, and are designed to be easily exchanged by an accompanying technician. Since it's critical for the technician to be able to operate the system and assess the health of the organ during transport, Farm incorporated a detachable, wireless LCD monitor to display and control system functions. Finally, we designed the upper, detachable organ containment module to be easily carried by two people, using lightweight carbon fiber to manufacture most of the outer housing.

Farm has helped TransMedics achieve a true breakthrough in organ transplantation technology.



MolecuLight

i:X Handheld Optical Imaging Device

Thousands of people die every year because of infected wounds. A quick diagnosis is critical for prescribing treatment, yet the process currently available for accurately diagnosing a bacterial infection can take several days.

MolecuLight, an early-stage medical imaging company based in Canada, has developed a handheld fluorescence imaging technology platform called i:X. This breakthrough device reveals the presence of bacterial infection in real time.

i:X is brilliantly simple. The clinician aims the device at the wound and presses a button, causing the device to emit a particular wavelength of light while simultaneously capturing an image of the target area. i:X detects and analyzes the intrinsic fluorescence signals emitted by tissues and microbes when illuminated by this light. The presence of bacteria is immediately displayed on the device as a color difference on the wound.

MolecuLight came to Farm with a proof-of-concept prototype and asked us to help their team design and engineer a patient-ready diagnostic device and prepare it for full-scale production.

Farm's primary challenges were to develop an industrial design for the system, package MolecuLight's technology in the appropriate configuration, engineer a mechanism to deploy a proprietary optical filter, and incorporate user-interaction features that would make the product easy to operate.

Throughout the project, our team worked closely with MolecuLight's development team, as well as their contract manufacturer, injection molder, and various suppliers, to ensure a smooth production ramp-up. In late 2015, MolecuLight received its Medical Device License from Health Canada, and in September 2016, MolecuLight was granted CE Mark approval, which enables the commercial distribution of this technology in the European Union. The news has been eagerly received by EU clinicians, with the product being debuted at the World Union of Healing Societies World Congress being held in Italy. In the United States, an FDA de novo approval is pending. On May 18, 2017, MolecuLight announced the execution of an exclusive global distribution agreement with Smith & Nephew to distribute the MolecuLight i:XTM Imaging Device product line.





DJO Global AirSelect Walking Boot

Farm helped DJO become a leader in the category of orthopedic therapy products by developing the innovative Aircast walking cast. In 2013, Farm helped DJO build on that success with the creation of AirSelect, a breakthrough addition to the DJO product family that brings significant improvements in both product performance and user comfort.

Farm's technical team, industrial designers, and human factors engineers developed the new sole design using wearable prototypes, advanced real-time testing, and computerized motion path analysis. The result is a product that helps the patient walk with a more natural gait.

Our engineers collaborated with DJO to design a unique compression pump and manifold system. The system provides easy-to-reach and operate controls and precisely distributes air pressure exactly where it's needed to improve comfort and stability.

The previous Aircast had a sole made of rubber. For the new product, Farm engineers switched to Ethylene-vinyl Acetate (EVA), which makes the part significantly lighter and allowed us to incorporate DJO's proprietary SoftStrike heel cushioning technology. At the same time, Farm strategically designed all of the plastic parts in AirSelect to minimize material use.

Farm created a shell design that supports DJO's long history of combining patient comfort with clinical performance. Part of that success depends on offering a wide range of sizes, creating a challenge in designing multiple shell, sole, and panel components for the various configurations. By creating a flexible and scalable CAD architecture, Farm was able to minimize engineering time for the 15 different size options required by the client.

To maximize the new walker's performance, Farm combined finite element analysis (FEA) with sophisticated rapid prototyping methods. This approach allowed the team to correlate FEA results with actual test data to accurately predict performance in the final molded and assembled product. The success of this approach was verified in testing of the first injection-molded parts.

The new AirSelect weighs 20% less than the previous DJO product, is easier to use, and offers a more comfortable experience for the patient.



Integra Lifesciences

Neuromonitors

Integra, a world leader in the field of surgical tools, consumables, and critical care monitoring devices, came to Farm for help in creating a new family of neurological patient monitors that would reinforce the launch of their new brand identity, while establishing a compelling new visual language to support future product development.

Where the previous generation of Integra's Camino monitor used a small, low-resolution LCD display and membrane-style function buttons, the new generation Camino and Licox monitors would incorporate a large, high resolution, full color touchscreen display designed to be easier for staff to operate and easier to read from a distance. In addition, the new monitors would incorporate onboard battery power, allowing clinical staff to transport the monitors alongside the patient without the inconvenience of power cords.

Farm began the development process by creating a series of component architectures around which the form and interaction experience could be designed. One of the constraints the team had to address was the need to attach Camino and Licor monitors above each other on an instrument pole. This drove the design and placement of the handle and cable attachments as well as the overall aesthetic – our designers wanted the products to look unified when displayed in a pair.

Ultimately, the development process included site visits to 3 hospitals where our R&U team interviewed dozens of key users, an industrial design effort supported by a significant preference testing program, and a mechanical engineering phase that included component architecture, thermal analysis, and a design-for-manufacture effort for every part and assembly in the product. In addition, Farm developed the monitors' graphical user interaction, creating easy-to-use, full color layouts and refining the navigation so clinicians can quickly access critical screens and functions. The result is an elegant, easy-to-operate family of neuromonitors that enhances Integra's brand and adds new depth to the company's product portfolio.



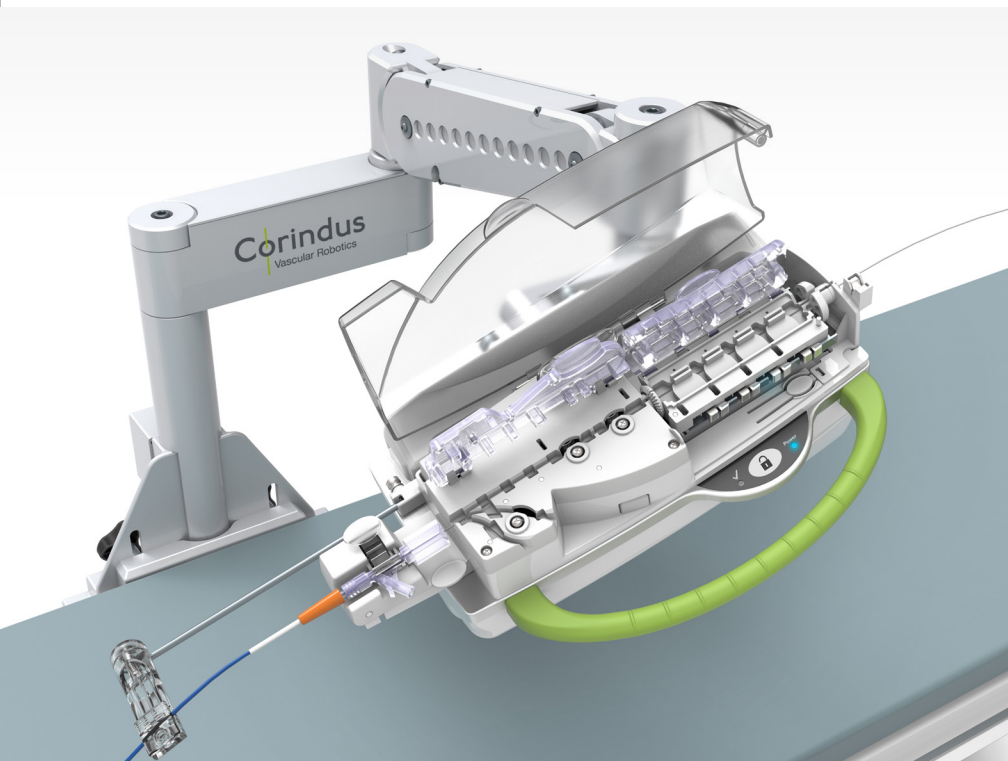
Corindus Vascular Robotics CorPath Guidewire Delivery System

Corindus, a startup company working in the field of catheter lab robotics, challenged Farm to develop and refine their existing percutaneous coronary intervention (PCI) system; used by physicians to robotically control and deliver guidewires and other angioplasty devices to a target lesion deep inside a patient's vascular system with enhanced precision and safety. The system is comprised of a robotically-driven, single-use cassette, robotic drive base, articulating positioning arm, and operator control console. Farm was tasked with completely redesigning the Corindus system to improve its performance, reliability and manufacturability. The result is the CorPath 200 System.

Farm led the systems engineering effort for development of Corpath, including technology and requirements development; human factors, mechanical engineering, software and electronics design. In order to ensure wide clinical acceptance, an open architecture system was developed to support the dozens of guidewire, balloon and stent products currently manufactured by industry leaders. Developing intellectual property to secure competitive advantage in the market was essential for Corindus. To help our client achieve this goal, Farm developed proprietary and patentable technologies for driving and rotating coronary guidewires and devices, converted the durable cassette to single use, and engineered the interface of the cassette to the robotic drive base. To optimize access to the patient and ensure articulation and maneuverability of the catheter inside the body, our Human Factors team determined the impact of varying patient sizes to inform the articulating arm's architecture and required range of motion. The guidewire and device loading process was simplified for users by minimizing steps and allowing easy identification of interaction points including levers and controls. One of the key benefits of the new system is that the physician no longer needs to wear a cumbersome lead apron to protect them from the X-rays that are used during a procedure to "see" inside the patient. When using the Corpath 200, the physician is able to perform PCI procedures while sitting within a lead-shielded control cockpit. The control console was designed to optimize the footprint inside an already crowded catheter lab, and includes an angled touch-screen, joystick and easy to navigate graphical user interface to minimize head, neck, and back strain.

Concurrent to the specification and technology development, our team undertook the effort to commercialize the system. Working under Farm's ISO 13485-certified development controls, we delivered a reliable system architecture; mechanical, software and electronic sub-systems (including a custom, Windows-based single-board computer); single-use cassette design optimized for manufacturability; and fully functioning, pre-clinical prototype devices.

The Corindus CorPath 200 is the only robotic catheterization system to have received FDA 510(k) clearance for use in PCI procedures. In late 2015, they received a clearance for radial access procedures, and more recently, won FDA 510(k) clearance for the CorPath system to be used in peripheral interventions, a year after launching a clinical trial that studied the safety and effectiveness of the CorPath device in peripheral artery disease patients with lower-extremity blockages.





Hologic Affirm Prone Biopsy Table and Patient Support System

Based on the success of its award-winning Selenia Dimensions mammography system, Hologic returned to Farm for help developing the Affirm™ prone biopsy system, the first breast biopsy table to offer integrated 3D tomosynthesis scanning for superior imaging detail. In response, Farm and Hologic designed a breakthrough biopsy system whose next-generation technology is underscored by a more comfortable experience for the patient, a streamlined workflow for technical staff, and an iconic design evolution of Hologic's visual brand.

Farm's design of the Affirm™ prone biopsy system was driven by a comprehensive understanding of the interaction between the patient, the technologist, and the biopsy table. The Farm team observed multiple procedures, followed by one-on-one interviews with both patients and clinical staff, capturing the details of both the patient experience and the operational challenges faced by the technologists. Farm then conducted an ergonomic study of women, mapping how their bodies came into contact with the biopsy table. Guided by this gathered data, dozens of concepts were developed, refined, and fabricated for padding shapes, foam combinations, foot and arm supports, and access inserts. The result was a highly customizable and integrated support system that comfortably cushioned the patient in any position. Fully configurable, the system was designed to address various patient body types and allow complete access to biopsy targets.

The Affirm™ prone biopsy system delivers a new level of design innovation to the Hologic product family, offering better access to challenging lesion locations, a streamlined workflow that makes operation fast and easy, and an integrated support system that greatly increases the patient's comfort.

In April 2016, Hologic announced the U.S. Food and Drug Administration (FDA) clearance and commercial launch of the Affirm™ prone biopsy system, the first dedicated prone biopsy system to offer both 2D and 3D imaging-guided breast biopsies.



NinePoint Medical

NvisionVLE Esophageal Imaging System



Farm collaborated with startup biotech firm NinePoint Medical to develop the NvisionVLE Imaging System, a breakthrough diagnostic tool that allows clinicians to more precisely evaluate the tissue microstructure of the esophagus during a standard endoscopy procedure. NvisionVLE uses advanced optical coherence tomography (OCT), a technology that delivers up to 25x higher resolution than endoscopic ultrasound. OCT allows the NvisionVLE to perform a high-resolution, cross-sectional scan of the esophagus that enables detailed, real-time visualization of tissue layers to a depth of 3mm, helping physicians identify suspicious areas within the tissue and potentially leading to improved biopsy targeting for diagnosis.

To ensure clinicians enjoy an optimal experience when operating the NvisionVLE, and because the device is to be used in conjunction with an endoscope, our usability engineers conducted an exhaustive research phase to experience a wide range of likely use scenarios and clinical environments. Farm conducted site visits, observational research, and one-on-one interviews to better understand the habits and practices of clinicians and how they would interact with both the device and the patient. This phase guided development of the overall product architecture as well as the design of operational features.

Our designers created an innovative graphical user interface (GUI) that allows the clinician to explore output from the patient in real time as the tiny OCT scanner works inside the esophagus. In order to fully exploit the highly detailed visualization capability of OCT technology, we incorporated into the system a 30" portrait-oriented monitor that can display three different sectional views at the same time and designed a touchscreen control system that allows clinicians to magnify and closely examine a particular area of interest within any of those views.

Farm helped NinePoint Medical go from a concept breadboard to a commercial product in less than a year, creating a device that achieves a new level of precision in tissue visualization.

Integra Lifesciences

Cusa Clarity Ultrasonic Tissue Ablation System

Integra Life Sciences, the leader in ultrasonic tissue ablation, chose Farm to collaborate on developing their next generation ablation system. Used during neuro, liver, and spinal surgery, CUSA Clarity delivers radio frequency energy to the tip of a surgical probe to precisely ablate tissue. Farm designed and engineered two ergonomic handpieces, a smaller and quieter console, and a simplified disposable cartridge for fluid and suction management.

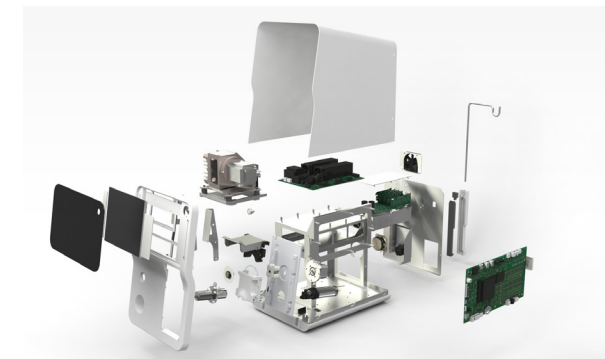
Farm observed live brain tumor procedures at Tufts Medical Center, St. Joseph's Hospital and Medical Center, and Barrow Neurological Institute (BNI) to gain insights into user interface and ergonomic improvements for the handpieces and console.

The team built mockups of the handpieces and various fluid and suction cartridge concepts, and they were tested with users to drive the selection decision. The team then built a full-size functional model of the console with the chosen cartridge and latching scheme for key opinion leaders preference testing. Farm established an intuitive information architecture for the GUI touchscreen, designed new iconography, and created a bold, easy-to-read visual design for the display.

Farm refined the component architecture, sourced critical components, breadboarded mechanical subsystems, and engineered all of the enclosure parts. Farm delivered full production CAD databases to Integra's PDM system and worked with Integra's manufacturing resource in Ireland on design transfer. Electronics and software development were conducted by our development partner, Sunrise Labs.

Key improvements include:

- A re-configurable console system which can be used as both a benchtop and mobile mounted cart.
- Improved workflow with an intuitive Graphical User Interface which controls tip energy, irrigation flow rate, and vacuum level, for a specific surgery.
- Simplified tubing management for faster setup by creating a patented one-handed disposable cartridge for fluid and vacuum tubing management.
- Two integrated handpieces with different frequencies, each with improved handle ergonomics for safety and comfort.
- Significantly reduced the handpiece torque felt by the surgeon compared to previous tubing and cable management schemes.
- Created an ergonomic, disposable nosecone for the handpiece with integrated sealing features to eliminate o-rings.
- Streamlined tip attachment and setup.
- Visual design and brand language that complements Integra Camino/Licox neuromonitors.





Zoll Propaq MD Defibrillator

Farm helped Welch Allyn create the next generation Propaq MD, which was later acquired by Zoll. The rugged, yet highly portable patient monitor and defibrillator designed to meet the rigors of military use while being an effective critical care tool in the cramped interiors of rescue helicopters and transport vehicles.

Farm's team spent time with military and EMS personnel to understand critical and unmet needs. The result was a highly optimized internal component architecture and a product enclosure that minimizes volume and maximizes the functional utility and ergonomics of its use, resulting in a compact, easy-to-use system that's 60% smaller and 40% lighter than any current competitor's device. To enhance the system's operational flexibility, we designed an attachment system that allows the rescue crew to secure the monitor with the patient in any transport situation.

Since its launch, the Propaq MD has been a global success, prompting Zoll to acquire Welch Allyn's defibrillation group as part of an effort to enhance their emergency care product offering.

ConMed

DetachaTip Laparoscopic Instrument

ConMed, a leading manufacturer of surgical devices, asked Farm to help develop an improved version of its popular DetachaTip laparoscopy tool handle. ConMed challenged our team to design and engineer a new reusable (extended-use disposable) handle that would be more comfortable, offer greater control and precision, and address the wide range of hand ergonomics of surgeons' personal working preferences. We had to design the handle ergonomics for female surgeons without compromising the fit for a large male hand, and the controls on the handle had to be accessible for right- or left-handed use. Finally, despite being a limited-use instrument, the device needed to convey high quality and durability with the precise feel of a long-term, reusable device.

Our team carefully observed several laparoscopic procedures and learned that we could create a truly differentiated product if we designed it for the varied approaches that surgeons use for gripping the tool. Surgeons usually hold these devices like scissors, but in order to rest their hands during a long surgery, they often shift to a technique called "palming," where they cradle the tool in the palm of the hand. Yet another common grip approach is used when the surgeon holds the tool almost vertically.

Building on our extensive research, Farm began the process of designing the form of the handle and the tactile interaction points to accommodate surgeon work habits and ergonomic needs. As the overall design evolved, Farm's engineers crafted the part design and internal mechanisms to achieve a highly precise feel in the operation of the product.

The new DetachaTip offers significant improvements designed to help surgeons work more effectively:

- Accommodates all five fingers comfortably when held traditionally or palmed;
- Handle size and range of motion accommodate a wide range of hands, from small female to large male;
- Surfaces have been carefully sculptured to significantly reduce pressure points;
- Interaction area on the bottom of the thumb loop for an additional grip option when operating the handle at a high angle;
- The easy-to-reach tool shaft rotation knob is carefully shaped for precise control by the index finger;
- Tool release button is placed on top where it's easy to see and where there's less chance of accidental activation; and
- No triggers or buttons on handle front, so as not to interfere with the surgeon's natural squeezing motions.



ConMed

Hall Powered Instruments

ConMed and Farm collaborated to create the Hall 50 Powered Instruments System, a new generation of UL approved, autoclavable lithium battery-powered handpieces used by surgeons during large and small bone orthopaedic, trauma, sports medicine, spine, and cardio-thoracic procedures.

ConMed's goal was to create an ergonomic handpiece designed to maximize surgeon comfort and control. At the same time, ConMed wanted a design aesthetic that would express the legacy attributes of their existing powered instrument portfolio and guide the development of future products.

Farm's user-focused design effort was guided by voice-of-the-customer (VOC) research gathered by ConMed over the course of a year. Several concepts were tested with multiple surgeons, in multiple specialties, with multiple glove sizes to find the optimized shape for the handpieces. Data was distilled into a user "wish list" that gave Farm's design and usability team specific interaction touch points that were incorporated into the final design. At the same time, the aesthetic considerations and use of materials were driven by the client's interest in having the tools express ConMed's brand attributes of premium quality, precision, and durability.

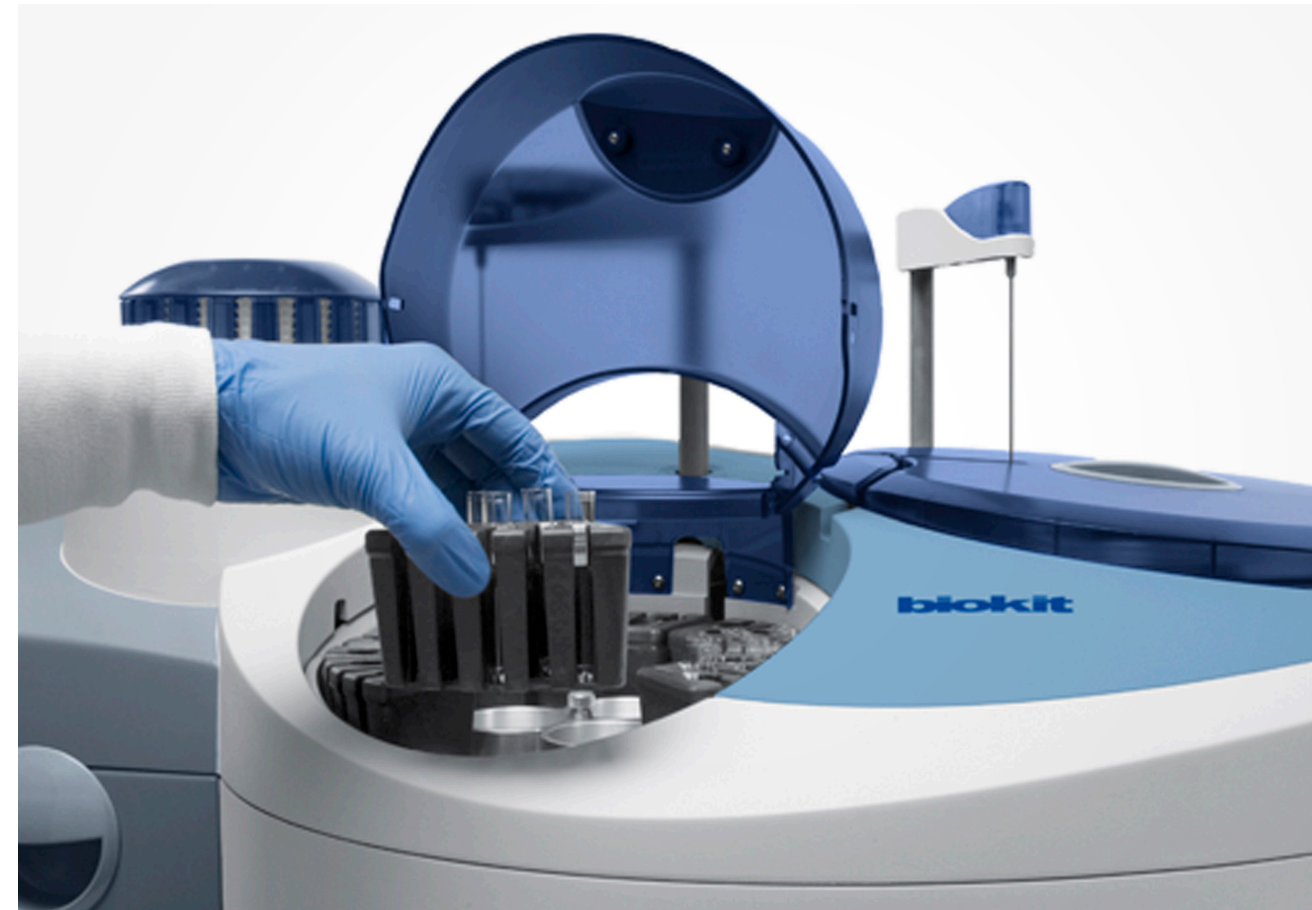
ConMed's new Hall 50 System combines dramatic improvements in ergonomics with precise performance, a standardized modular architecture, reliable, state-of-the-art battery power and convenient sterilization - all in a solution that delivers unmatched value for hospitals, surgeons and operating room staff.



Inova Diagnostics

Chemiluminescent Immunoassay Analyzer

Farm collaborated with BioKit, now an Inova Diagnostics company, to help launch its first proprietary clinical analysis device, a chemiluminescent immunoassay analyzer designed to establish and enhance BioKit's brand identity. Our usability group began the project with a thorough domestic and international research phase, resulting in the discovery of several critical user needs. Concurrent usability studies led our designers to incorporate features like the "User Pods," plug-and-play-cartridges that improve user access and visibility for both reagents and patient samples. The quick-access User Pods also support the system's continuous-use capability, which allows the system to run for three hours with a full inventory, yielding a high test throughput. In addition to designing and engineering the device, Farm developed an easy-to-use universal graphical interface for system control. We created an International icon set and animated, color-coded screen graphics that allow a user to easily determine, from across the room and in real time, the status and location of each sample being analyzed. From superior human factors and ergonomics to an intuitive graphical user interface, Farm's team propelled BioKit into clinical chemical laboratories worldwide.



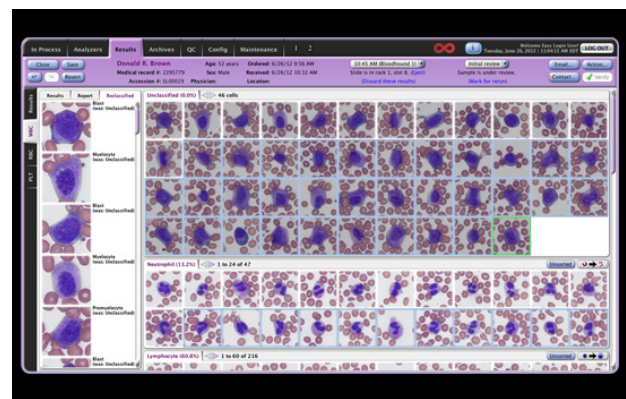
Roche Diagnostics Integrated Hematology Analyzer

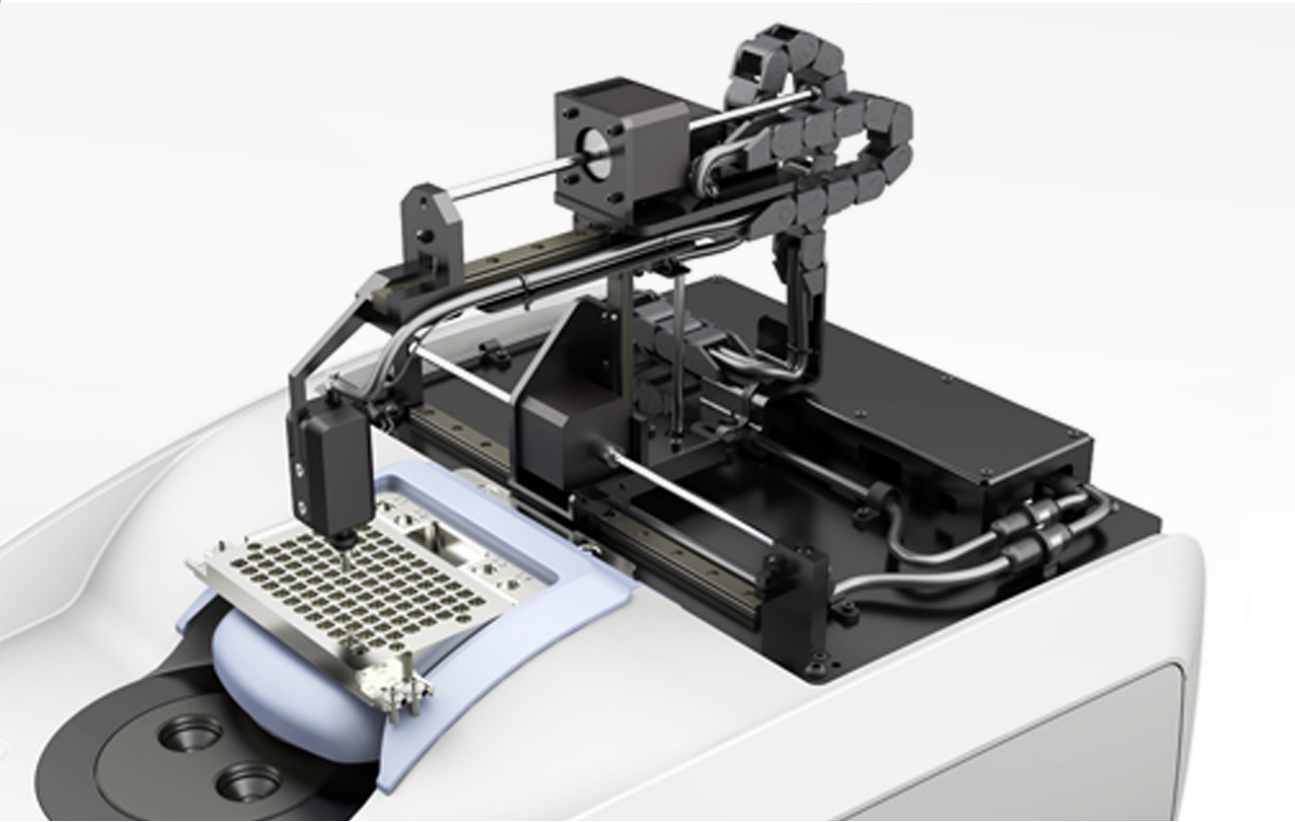
Farm collaborated with Constitution Medical, Inc. (CMI), which was acquired by Roche Diagnostics in 2013, to launch the world's first all-in-one, integrated hematology system for blood analysis that can count, identify, isolate and categorize white and red blood cells, platelets and reticulocytes. The new system performs a comprehensive array of analyses using fewer reagents than the typical flow-based hematology analyzers found on the market today, and offers the unique capability of making and staining its own slides. The system is designed to provide faster and more accurate diagnosis of blood-related diseases, thereby improving patient care.

In order to ensure that the development process was based on rigorous, user focused-design, our research team visited several clinical facilities to understand use environments, analyze laboratory workflows, interview clinical staff and observe user interactions with existing hematology analyzers. This discovery phase helped our design and engineering team identify ways to optimize the user experience around sample tube rack loading, sample preparation, system access, data imaging, reagent storage, and waste management.

Farm built three full-size simulation prototypes for user preference testing that featured articulating doors, drawers and functional interaction features. Based on the feedback from this testing process, the team recognized the need to incorporate into the system a large standalone viewing station with a high resolution monitor and attached keyboard that would provide users with better imaging quality, full data input flexibility and enhanced analysis capability. Our Graphical User Interface developers then used advanced task analysis methods to match the display with a powerful, user-friendly GUI that effectively highlights the system's ability to analyze each cell's morphology, and helps medical technologists focus their attention on particular cells of interest.

Farm was responsible for all subsystem design and engineering, including the component architecture, GUI, outer skins, material selection and the sourcing and final assembly of over 200 subcomponents. Our engineers performed tolerance and FEA analysis on all critical access features and created a custom fluidics drawer to optimize space for reagent storage. Farm then built high fidelity appearance models for CMI to introduce the system at the American Association for Clinical Chemistry's annual meeting in 2011. Roche Diagnostics announced in 2013 that it had purchased CMI for \$220 million.





Perkin Elmer Differential Scanning Calorimeter

Perkin Elmer, an innovator in analytical chemistry, collaborated with Farm in the development of a new line of high-performance differential scanning calorimeters; devices that are used to measure material properties through thermal analysis. The goal was to create a motion control system that was more sensitive, more accurate, and more precise in order to improve efficiency, increase throughput, and minimize user interaction.

Farm accomplished these goals and optimized the unit for manufacturability, serviceability and reliability. Our systems engineering team developed an entirely new robotic system that features our proprietary mechanisms, software and electronic design. Multiple prototypes were fabricated and debugged and critical tolerance analysis was completed throughout the program to deliver a highly optimized solution. Farm's engineering team also assembled multiple pilot units and completed verification testing and agency prequalification to confirm reliability and safety. Key features include:

- Electronic calibration and motion control system that ensured sampling precision and positional accuracy within 0.006”.
- An “intelligent” recovery system comprised of a sensing head and proprietary software with the ability to anticipate possible faults in the system and formulate solutions to maintain throughput and minimize user interaction. Contaminated tips are replaced, foreign objects are relocated and furnace damage is eliminated.
- All components can be easily removed, replaced, installed and upgraded in the field with no preventive maintenance required for the life of the unit.

The collaboration between Farm and Perkin Elmer was a total product development success that pushed performance, precision, accuracy, and reliability to entirely new levels.





Perkin Elmer **Liquid Chromatography System**

For Perkin Elmer, Farm's Industrial Design team blended a comprehensive range of new liquid chromatography products into a cohesive and integrated product offering with a single brand voice. The Flexar™ system is a model of efficiency and flexibility in liquid chromatography analysis. The Flexar™ line offers an array of interchangeable products designed to meet the needs of a variety of users and applications. Each component is designed with a fixed outer dimension and consistent materials that in any configuration maintain a solid, integrated appearance when grouped with other devices from the product family. Other unique design innovations include a system of sub-bezels and tubing management features that accommodate all possible configurations, and provide consistent operation and improved usability across any combination of products.

INTEGRA Biosciences

Viaflo Vision Pipettor

Viaflo, now an INTEGRA Biosciences company, challenged Farm to help them develop a new pipetting device whose visual design would differentiate itself from the competition as well as support a reimagined Viaflo brand. Farm developed various concepts focusing on issues and opportunities discovered through its more than 20 years of experience in the pipetting industry. By focusing on three areas; User Interface, Ergonomics and Visual Identity, Farm's innovation team helped create the industry's first pipette that features a full-color display and a unique Touch Wheel user interface. The Vision Electronic Pipette provides a precise and easy-to-use solution for liquid handling and the fastest volume selection among competitive products.





Waters

ACQUITY UPLC System

Farm developed Waters' ACQUITY UPLC System to match the performance needs of innovative column chemistries with a vigorous, easy-to-use, open and reliable system. The modular architecture optimizes how each unit works together; from fluidics, to sample management, to detection, while improving user interface accessibility. Our team integrated shelves into the sample organizer which are accessible through the swing door and that slide into slots for easy sample handling. Farm also incorporated windows that enable chemists to check interior operation without having to open doors. In addition, an internal drainage system was developed for simple detection and diagnosis of leaks. The new appearance of the ACQUITY UPLC System established a visual image reflecting the advanced features of the burgeoning proteomics market and have become the foundation for Waters' future liquid chromatography products.