ack in 1965, Intel Corporation co-founder Gordon E. Moore put forth an observation that over the history of computing hardware, chip performance would double every two years while costs will continue to come down. What has become known as Moore’s Law is, to this day, some 50 years later, gospel in the semiconductor industry. Moore’s Law has subsequently been adopted, in a generic sense, across a variety of industry sectors, and there is no doubt the Colorado bioscience ecosystem is the beneficiary of this logarithmic acceleration of technological innovation.

The rapidly emerging field of HealthIT, leveraging elements such as cloud services and state-of-the-art chips, is the most obvious example of adhering to Moore’s Law. We find many examples of these cutting-edge Colorado companies integrating themselves with more traditional life science enterprises, e.g. in the context of companion diagnostic capabilities of traditional therapeutic development, accelerating the computational analytic power to deliver on the promise of health informatics, and pairing with the medical device field to offer breakthrough advances in the
A cross-disciplinary, collaborative workforce

Colorado bioscience is not only at the cutting edge when it comes to incorporating a diverse array of emerging technologies to drive new industries such as HealthIT. Our talented workforce is taking a similar cross-disciplinary approach towards uncovering new knowledge at the frontiers of science. This excellent work is transpiring at the BioFrontiers Institute at the University of Colorado, where researchers from the life sciences, physical sciences, computer science and engineering collaborate with each other and, when appropriate, also partner with industry to translate discovery into commercial applications.

The BioFrontiers Institute maintains four cores of strength and expertise:

1. Working with large data sets and genomics to surface difficult-to-access information and model biological processes,
2. Using bioimaging to visualize, measure and understand biological processes,
3. Creating new therapeutic paradigms to support the development of new drugs, vaccines and other approaches to improve human health, and
4. Studying regenerative biology to engineer new medical solutions.

Colorado’s own Thomas Cech, PhD, who was awarded the Nobel Prize for his discovery of the principle of RNA catalysis and is the recipient of the National Medal of Science and the Albert Lasker Basic Medical Research Award, directs the Institute. Immediately prior to assuming his leadership role at the BioFrontiers Institute, Cech spent nearly 10 years as president of the Howard Hughes Medical Institute.

Not long ago, Nanoly Bioscience, a startup spinout company incubated within the BioFrontiers Institute, was honored by the San Jose, California, based Tech Museum of Innovation with its prestigious Tech Award. In addition, Nanoly cofounder and MD/PhD candidate Balaji Sridhar traveled to Silicon Valley to accept the Katherine M. Swanson Young Innovator award for his work with the company. Nanoly was one of 10 teams from around the world selected as winners. The company is developing a non-toxic polymer that can be blended with vaccines to prevent spoilage without refrigeration, and then disassembles upon exposure to light so that the vaccine is ready for delivery.
The collaborative nature of Colorado clinicians and researchers is further evidenced by some special work at the Children’s Hospital Colorado. There, the hospital’s Heart Institute has teamed up with the department of bioengineering at the University of Colorado to study three-dimensional imaging and heat-sensitive polymers, creating potential new medical devices to help treat congenital heart defects with minimal surgery. This 3D imaging creates a computer model and then constructs a physical prototype allowing cardiologists to practice procedures virtually or on the physical model. The work is being lead by Robin Shandas, PhD, professor of pediatrics and department chair. His seminal work on heat-sensitive polymers has lead to the spinout startup company EndoShape, whose mission is to commercialize novel medical devices based on proprietary polymer technology and focusing on the coil embolization and occlusion market. The company has received FDA 510(k) clearance for sale of its first product, Medusa® Multicoil, in the US.

Data and its movement have dramatically evolved, thanks in part to the web, Wi-Fi and Bluetooth technologies. Aurora-based Fluonic is a medical device startup pioneering a new generation of infusion devices and information systems powered by a breakthrough microelectromechanical systems (MEMS) flow sensor technology. The Fluonic product precisely monitors and controls drug flow to the patient, instantly detects problems and documents compliance of patients. The flow sensor and regulator measure and control infusion rates with high accuracy and wirelessly communicate this information to HealthIT systems. Fluonic’s initial opportunity is the reimbursed post-operative surgical-site pain infusion market, and the company has already successfully demonstrated that its technology works with the most commonly infused drugs, such as saline, opioids, heparin, serum albumin, antibiotics, insulin and epinephrine.

Boulder-based Biodesix was founded to apply the principles of complex data analysis and mass spectrometry to the discovery and development of improved multivariate tests that give physicians better information to understand the patient and their disease. Call it personalized medicine. By better understanding the clinically meaningful information contained within each patient’s molecular profile, these tests function to improve diagnosis and therapeutic intervention combined with the intention of leading to better outcomes. The company has commercialized its first product, VeriStrat®, the first serum proteomic test for advanced, non-small cell lung cancer patients that helps physicians determine if a patient should receive treatment with Tarceva® (erlotinib). The company is not a one-product pony; there is also a platform in place to enable a spectrum of tests.

To enable the reliable use of mass spectrometry for the analysis of patient samples, Biodesix developed ProTS®, a technology platform that harnesses the power of mass spec and provides an unparalleled ability to analyze and compare complex data sets. ProTS enables the rapid discovery and validation of diagnostic tests that answer
a wide range of clinical questions. The company has designed the tests to be non-invasive and require minimal amounts of readily accessible biological fluids such as blood or serum.

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Littleton-based dbMEDx is a wireless medical device company that has developed the world’s smallest wireless 3D ultrasound scan engine with an integrated image analysis. The BBS Revolution™ device wireless probe performs images collection and analysis. The real-time, non-invasive scanning technology combines the power and safety of ultrasound with sophisticated image processing electronics and software to provide simple and fully automated diagnostic measurements. The BBS Revolution™ is an automated bladder volume measurement device, which is an essential component of a comprehensive catheter associated urinary tract infection prevention program, and offers the advantages of rapid and accurate bladder volume measurement, a wireless and lightweight probe, minimal user training and no required aiming. Recently, dbMEDx announced that it received 510(k) clearance from the FDA to market this novel bladder scanner in the US, and sales are expected to begin in 2015.

How big is big data? Boulder-based Flashback Technologies might have something to say about that. The company has developed CipherSensor™, a computational engine that provides predictive decision support solutions to address data analysis needs. Flashback is focusing its efforts on developing algorithms to transform minimally invasive patient monitoring to provide clinicians with new tools to improve outcomes and reduce healthcare costs. CipherSensor™ integrates techniques that include classification, regression, clustering, semi-supervised learning, reinforcement learning and active-ongoing learning, with feature extraction techniques derived from robotics and computer vision. This integration enables the development of models for estimation, prediction and control derived autonomously from extremely large (many terabyte) data sets. As data increases or changes, the product is able to efficiently integrate this new knowledge into existing models without the need for relearning the model form scratch. Healthcare providers are typically unable to continuously monitor multiple vital signs from multiple patients 24 hours a day. Decisions regarding ongoing care and the application of life-saving interventions are historically made from qualitative “snap-shot” observations, without the benefit of observing trends and the dynamic nature of the evolving pathophysiology of illness or injury. Flashback, utilizing CipherSensor™ technology, is building a set of algorithmic solutions to address these unmet needs.

Wearable sensors are all the rage; just ask Tim Cook and Apple, right? Boulder-based Prima-Temp’s new technology provides precise and accurate core body temperature measurements. A reliable and convenient product allows for continuous detection of subtle changes in temperature that is communicated directly to a smartphone. Their first product, Bloom, is a wearable sensor that benefits any woman who wants to effortlessly manage her fertility. Bloom is a self-inserted sensor that detects the subtle changes that occur before ovulation, and then sends an alert to a smartphone indicating when one is most fertile. Bloom pinpoints the window of fertility without having to actively engage in data collection. The company is developing additional products for the obesity and weight loss, sleep disorder and heat exhaustion markets.

Gordon Moore must certainly have a smile on his face. Who would have envisioned 50 years ago that the nascent semiconductor industry would have such a profound impact upon the world of bioscience? But that certainly is the case. Whether a company is developing a wearable device that communicates its data to a variety of sources to improve outcomes, or developing algorithms to surface potentially life-saving insights out of heaps of big data, or leveraging the web to connect cohorts more efficiently (which ultimately can save money for payors and providers), it is the convergence of cross-functional and disciplinary teams comprised of Colorado’s best and brightest minds that is enabling the flourishing HealthIT sector.