MIT and Insurance & Health Maintenance Organizations

Insurance companies and HMOs are going through a time of great challenge and disruption. Affordability, alternative financing models, and government regulation present interconnected risks. Innovations in genomics, biotechnology, and medical devices present a wide array of opportunity to improve patient care, while electronic health records coupled with big data allow for increased customer focus and engagement based on sophisticated analytics.

The Massachusetts Institute of Technology is perfectly poised to address the spectrum of these challenges, as it plays a leading role in education, research, and public service in many fields, fostering a problem-solving approach that encourages researchers to work together across departments, fields, and institutional boundaries. The resulting collaborations have included thousands of fruitful partnerships with industry and other leading research institutions.

In addition, entrepreneurship and innovation are at the heart of MIT’s mens et manus (mind and hand) practical education and have had significant impact in the world: A 2015 report suggested that 30,000 companies founded by MIT alumni were active as of 2014, employing 4.6 million people and producing annual revenues of $1.9 trillion.

Examples of the deep expertise of MIT’s faculty and multidisciplinary research, which address current challenges in HMOs and the insurance industry include:

- Jonathan Gruber, Professor of Economics, worked with the Obama administration in developing the US Affordable Health care legislation and, earlier, with Governor Mitt Romney, on the development of Massachusetts’ novel healthcare program.
- Amy Finkelstein, Professor of Economics, was one of two principal investigators for the Oregon Health Insurance Experiment (impact of extending Medicaid coverage) and recipient of the American Society of Health Economists’ Medal (2014), awarded to the economist age 40 or under who has made the most significant contributions to the field of health economics.
- Thomas Kochan, Professor of Management and Co-Director of the MIT Institute for Work and Employment Research, is an expert on labor relations and organizational structure in healthcare, as well as manufacturing, airlines, and other areas.
- William Pounds, Professor Emeritus of Management and former Dean of Sloan School, is an expert in corporate governance and operations management and produced seminal work on the role of Boards of Directors.
- The Harvard-MIT Program in Health Sciences and Technology brings together MIT, Harvard Medical School, Harvard University, and Boston-area teaching hospitals in a unique collaboration that integrates science, medicine, and engineering to solve problems in human health.
Entrepreneurship and innovation strengths include the Martin Trust Center for MIT Entrepreneurship, Technology Licensing Office, over 20 student entrepreneurship or innovation clubs and initiatives (e.g., the MIT $100K Entrepreneurship Competition), and over 60 entrepreneurship courses offered during the 2015–16 academic year.

The MIT Startup Exchange, a startup accelerator focused on fostering collaboration between MIT-connected startups (>1,300) and member companies of MIT’s Industrial Liaison Program.

Through the MIT Lab for Innovation Science and Policy, the MIT Innovation Initiative is investigating factors that shape innovation outcomes—including policies, incentives, institutions and infrastructure—at every level.

MIT Initiative on the Digital Economy (IDE) addresses the nature of the workforce of the future and how to accelerate the transformation of institutions, organizations, and human skills to keep up with the quickening pace of digital innovation.

In the following pages, a selection of MIT centers, departments, groups, and labs are presented. These entities are actively involved with research and education related to insurance- and HMO-relevant topics bulleted below.

- Big data/analytics
- Clinical informatics/computational physiology
- Consumer behavior
- Data security, privacy, trust
- Demographics
- Digital economy
- Innovation
- Management
- Marketing
- Medicine, Science, Engineering
- Risk management
- Social networks, collective intelligence
- Wellness / lifestyle issues

For close to 70 years, the Industrial Liaison Program (ILP) has provided expert navigation of MIT’s vast resources. MIT’s ILP can bring the intellectual power of MIT to you by connecting your organization to the expertise, talent, and technologies that can make a difference in your company. For more information about how the ILP can put the resources of MIT to work for you, call us at 1-617-253-2691, e-mail us at liaison@ilp.mit.edu, or visit http://ilp.mit.edu/.

**BIG DATA / ANALYTICS**

**BigData @ CSAIL** researchers are investigating how to transform big data into big insights. The initiative’s approach brings together world leaders in parallel architecture, massive-scale data processing, algorithms, machine learning, visualization, and interfaces to collectively identify and address the fundamental technology challenges faced with Big Data. The approach is focused on the themes of computational platforms; scalable algorithms; machine learning and understanding; and privacy and security.

The **Computer Science and Artificial Intelligence Laboratory (CSAIL)** researchers have been key movers in developments like time-sharing, massively parallel computers, public key encryption, the mass commercialization of robots, and much of the technology underlying the ARPANet, Internet and the World Wide Web. CSAIL’s approximately 50 research groups are organized into three focus areas: artificial intelligence, systems, and theory. Research is
conducted in almost all aspects of computer science, as well as exploring revolutionary new computational methods for advancing healthcare, manufacturing, energy and human productivity.

The Database Group (DBg) at MIT conducts research on all areas of database systems and information management. Projects range from the design of new user interfaces and query languages to low-level query execution issues, ranging from design of new systems for database analytics and main memory databases to query processing in next generation pervasive and ubiquitous environments, such as sensor networks, wide area information systems, personal databases, and the Web.

The Mathematics Department at MIT is one of the top-ranked mathematics departments in the U.S.—a world center in Pure and Applied Mathematics. In pure mathematics, the department explores exciting current research directions in most of the major fields. The pure math group studies many aspects of algebra, analysis, geometry, mathematical logic and foundations, number theory, probability and statistics, and representation theory. The applied math group focuses on combinatorics, computational biology, computer science, scientific computing, numerical analysis, and areas of physical applied mathematics.

Operations Research Center (ORC) research has led to significant contributions in such areas as health care, education, transportation, manufacturing, and finance. Whether helping a health care company predict future costs and improve medical outcomes or affecting systemic change in how a city assigns students to its public schools, ORC research streamlines business operations and shapes meaningful policies. Research topic examples include health care analytics; machine learning and its interface with optimization; online algorithms; personalized medicine; pricing and revenue management; social networks; supply chain management.

**Clinical Informatics / Computational Physiology**

The Clinical Decision Making Group is a research group dedicated to exploring and furthering the application of technology and artificial intelligence to clinical situations. Because of the vital and crucial nature of medical practice, and the need for accurate and timely information to support clinical decisions, the group is also focused on the gathering, availability, security and use of medical information throughout the human “life cycle” and beyond.

The Computational Physiology and Clinical Inference Group develops and applies computational models of human physiology for clinical monitoring and inference. The group’s research focuses on cardiovascular, cerebrovascular, respiratory and neurological applications. The overarching objectives of the research in the CPCI Group are to enhance patient monitoring, improve clinical decision-making, and better understand physiological and pathophysiological processes. The group develops and uses mathematical models derived from physiology, along with signal processing and estimation methods, to extract relevant information from clinical data.

The Integrative Neuromonitoring and Critical Care Informatics Group leverages data and models to understand the physiology of the injured brain, to improve diagnoses, and to accelerate treatment decisions for the critically ill. The overarching objectives are to improve diagnoses and accelerate treatment decisions for the critically ill and to understand the physiology of the injured brain. To achieve these objectives, critical care data and mathematical
models derived from physiology are leveraged, along with signal processing and estimation methods, to extract relevant information from clinical data. The models provide the constraints that allow readily observable data streams (such as waveforms of ECG, arterial blood pressure) to be related to physiological variables and parameters that are unmeasured but more directly reflective of changes in pathological state.

The **Laboratory for Computational Physiology (LCP)** conducts research on improving health care through new and refined approaches to interpreting data. Some of the researchers have medical backgrounds; others have backgrounds in computer science, electrical engineering, physics, or mathematics; and others have training that spans several of these disciplines. Using modern approaches to modeling, signal processing, pattern recognition, and machine learning, the lab’s researchers develop and refine methods for analyzing data—for example, from patients in intensive care units—and for generating predictive models that will aid in patient care. **MIMIC** is an openly available dataset developed by the MIT LCP, comprising deidentified health data associated with >40,000 critical care patients. It includes demographics, vital signs, laboratory tests, medications, and more.

### Consumer Behavior

The mission of the **MIT Institute for Data, Systems, and Society (IDSS)** is to advance education and research in state-of-the-art, analytical methods in information and decision systems; statistics and data science; and the social sciences, and to apply these methods to address complex societal challenges in a diverse set of areas such as finance, energy systems, urbanization, social networks, and health. IDSS research is rooted in three core disciplines: statistics and data science, information and decision theory, and human and institutional behavior.

The **MIT Sloan Neuroeconomics Lab**’s multidisciplinary research studies problems at the intersection of economics, management, and cognitive neuroscience. The lab’s projects fall into these areas: behavioral economics and consumer behavior; neuroeconomics; and Bayesian truth serum. The group studies behavior that appears anomalous in light of the rational model, focusing especially on financial, medical and consumption choices. Methods include functional MRI, lab experiments, game theory, Bayesian modeling and machine learning.

### Data Security, Privacy, Trust

The **Computer Systems Security Group** researches and builds secure, practical, and flexible systems. The group’s work spans operating systems, computer architecture, distributed systems, programming languages, and web browsers.

The goal of **CyberSecurity@CSAIL** is to identify and develop technologies to address the most significant security issues confronting organizations in the next decade. CyberSecurity@CSAIL aims to provide an integrated and formal approach to the security of systems, combining design and analysis methods from cryptography, software and hardware.

The **Cryptography and Information Security Group (CIS Group)** seeks to develop techniques for securing tomorrow’s global information infrastructure by exploring theoretical foundations, near-term practical applications, and long-range speculative research. The group aims to understand the theoretical power of cryptography and the practical engineering of secure
information systems, from appropriate definitions and proofs of security, through cryptographic algorithm and protocol design, to implementations of real applications with easy-to-use security features. Research examples include: Micropayments; Digital Signatures; Electronic Voting; Private Information Retrieval.

The **MIT Internet Trust Consortium** uses its expertise and knowledgebase to develop new technological building blocks that underlie the emerging personal data ecosystem. These blocks can be combined to address issues like identity management & authentication, authorization & consent management, data security, data mining & privacy-preservation, and digital death & meaningful archiving.

### Demographics

The **MIT AgeLab**’s multidisciplinary research works with business, government, and NGOs to improve the quality of life of older people and those who care for them. The AgeLab applies consumer-centered systems thinking to understand the challenges and opportunities of longevity and emerging generational lifestyles to catalyze innovation across business markets. Work is focused on the impact of disruptive demographics on society, business strategy and innovation, and sits at the intersection of infrastructure, information, and institutions. For instance, what are the implications of disruptive demographics on how businesses engage the consumer, develop products and services, deliver value and see aging as a source of economic opportunity?

### Digital Economy

The **Center for Information Systems Research (CISR)** conducts field-based research related to how companies design themselves and manage for success in the digital economy. CISR aims to develop concepts and frameworks that address the challenges of leading increasingly dynamic, global, and information-intensive organizations. The relevance of CISR’s research is ensured by the active participation of corporate sponsors from a range of industries. Research results are shared with CISR Patron/Sponsor community through working papers, research briefings, an annual conference, and sponsor forums.

The **Department of Economics** faculty is equally committed to graduate and undergraduate education and is at the forefront of both theoretical and applied economics. Its faculty has made pioneering contributions from theory to macroeconomics, to finance, to industrial organization, to international trade, as well as in areas of political economy, labor, and health economics. Student dissertation topics span a wide range of issues in microeconomics and macroeconomics, and include economic theory, data analysis, and econometric methodology.

The **Initiative on the Digital Economy (IDE)** researchers examine how people and businesses work, interact, and will ultimately prosper in a time of rapid digital transformation. The initiative helps organizations understand how the digital transformation is affecting society and everyday life. IDE conducts research in four key areas: Productivity, employment, and inequality; big data and information privacy; new digital business models; social analytics and digital experimentation.

### Innovation
The MIT Innovation Initiative Lab for Innovation Science and Policy was established to help develop the area of ‘innovation science’—an emerging field that can be thought of as applying the scientific method to the practice of innovation. Using a diversity of methods, the lab empirically investigates how innovation occurs, and pioneers more systematic assessments of possible interventions (such as policies, programs or incentives) to achieve desired innovation outcomes (such as the creation of innovation-driven enterprises, and in the longer run, job creation, economic and social impact, and a vibrant innovation economy). Areas of focus on innovation: metrics, policies, programs, boundaries, scale-up.

MIT’s NEW Drug Development ParadIGmS (NEWDIGS) program is a unique collaborative “think and do” tank focused on enhancing the capacity of the global biomedical innovation system to reliably and sustainably deliver new, better, affordable therapeutics to the right patients faster. MIT NEWDIGS takes a systems approach to designing, evaluating and catalyzing important advancements that are so complex and cross-cutting that they cannot be addressed by a single organization or market sector. By bringing together diverse collaborators (manufacturers, regulators, payers, providers, academic researchers, patients) within a safe haven setting, and leveraging MIT expertise in systems and financial engineering, this group informs and enables meaningful high-impact change involving the coordinated evolution of technologies, processes, policies, and people required to achieve its mission.

The MIT Sloan Initiative for Health Systems Innovation (HSI) brings together faculty, researchers, and practitioners from across MIT and around the world to accelerate the creation of high-quality and cost-effective health systems through industry-based research and education. Goal examples: Using data and analytics to balance equity and efficiency to achieve societal welfare goals in allocating limited health resources; developing evidence-based methodologies to evaluate the effectiveness of new health management models, practices and technologies; identify and develop new organizational capabilities and system designs needed to effectively manage and maintain the health of patients in their homes and communities.

The MIT Startup Exchange (STEX) is a web community for the MIT innovation ecosystem, particularly MIT ILP’s members, MIT-connected startups and all MIT employees or alumni who have active startup engagements.

**Management**

MIT Sloan School of Management faculty members are leading economists, public policy experts, entrepreneurs, and executives of companies large and small. Their research is conducted alongside private sector leaders and practitioners with the support and partnership of MIT Sloan students. The Sloan School offers at least ten degree and non-degree programs for undergraduates through experienced executives, and offers 14 and counting action learning labs, including field projects focused on global health, entrepreneurship, and sustainability.

System Design & Management (SDM) is an MIT master’s program in engineering and management offered jointly by MIT’s School of Engineering and the MIT Sloan School of Management. SDM is one of the world’s first graduate programs to integrate engineering, management, and systems thinking. Companies large and small have reaped the benefits of sponsoring employees in MIT’s System Design & Management (SDM) master’s or graduate certificate program or by sponsoring internship and thesis research conducted by self-funded System Design & Management (SDM) fellows.
MARKETING

Members of the MIT Sloan School of Management Marketing group have pioneered research methods, marketing models, and decision-support systems that have enhanced new product development, identified customer desires, predicted customer behavior, and have led to enhanced understanding of marketing strategy. The concept of marketing science, established and popularized at MIT Sloan, remains a critical component of marketing strategy in corporations across the globe.

MEDICINE, SCIENCE, ENGINEERING

The Harvard-MIT Program in Health Sciences and Technology (HST), housed within the Institute for Medical Engineering and Science (IMES), brings together MIT, Harvard Medical School (HMS), Harvard University, and Boston area teaching hospitals in a unique collaboration that integrates science, medicine and engineering to solve problems in human health. Graduate students in science, medicine, and engineering take their training side by side at HST. HST’s faculty members, drawn from a wide range of departments at MIT and Harvard, guide these students into vibrant careers as medical pioneers. HST’s interdisciplinary approach to biomedicine leads to stunning innovations, such as the drug regimen that transformed HIV/AIDS into a treatable disease and the first noninvasive technology for observing the brain in action.

The Institute for Medical Engineering and Science (IMES) is a hub that brings together the community of students, postdoctoral fellows, and faculty who work at the convergence of engineering, science, and translational medicine. IMES aims to accelerate innovation across a spectrum of activities that span discovery, design, and delivery of new medical devices and products. IMES is confronting a variety of clinical challenges by bringing together, and enhancing, MIT strengths in devices, imaging, computation, big data, regenerative medicine, drug delivery, technology transfer, and entrepreneurship. Partnering these strengths with those in local area hospitals/industry is expected to be transformative for advancing human health.

RISK MANAGEMENT

The MIT Golub Center for Finance and Policy (GCFP) serves as a catalyst for innovative, cross-disciplinary and non-partisan research and educational initiatives that address the unique challenges facing governments in their role as financial institutions and as regulators of the financial system. A primary goal of the GCFP is to provide greater access to the tools of modern financial analysis to current and future regulators, policymakers, and other public-sector stakeholders. Initiatives supported by the GCFP are organized into three main tracks: Evaluation and management of government financial institutions; regulation of financial markets and institutions; measurement and control of systemic risk.

The MIT Laboratory for Financial Engineering (LFE) is a research center created as a partnership between academia and industry, designed to support and promote research in financial engineering and computational finance. The goal of LFE is not only to spur academic advances in financial engineering, but also to reach out to students, industry professionals, regulators, and policymakers to support their applications of financial technology in practical settings. LFE research projects fall into five distinct subject areas: Risk Management and
Social Networks, Collective Intelligence, Mobility

The MIT Center for Collective Intelligence (CCI) conducts research on how people and computers can be connected so that—collectively—they act more intelligently than any person, group, or computer has ever done before. CCI brings together faculty from across MIT to conduct research. Projects range from Combining Human and Machine Intelligence for Making Predictions, to the Climate CoLab, to the Deliberatorium, to Nonlinear Negotiation.

MIT Connection Science aims to revolutionize technology-mediated human networks through analysis, prediction, data-driven design, and evaluation. Examples of such networks range from Facebook to the energy grid, managing behavior in modalities such as financial transactions, human health, urbanization and other trends influencing and influenced by society. As more of our personal and public lives become infused and shaped by data from sensors and computing devices, the lines between the digital and the physical have become increasingly blurred.

The Human Dynamics Group is exploring how social networks can influence our lives in business, health, governance, and technology adoption and diffusion. The group uses Reality Mining to ask how to use this data to better organize companies, public health, and governance, by better understanding how social networks influence people when they make decisions, transmit information, adopt new technologies, or change behaviors.

The Macro Connections group focuses on the development of analytical tools that can help improve our understanding of the world’s macro structures in all of their complexity. By developing methods to analyze and represent networks—such as the networks connecting countries to the products they export, or historical characters to their peers—Macro Connections research combines data, visualization techniques, statistical methods, and theoretical insights to help improve our understanding of the world.

The MIT Mobile Experience Lab seeks to reinvent and creatively design connections between people, information and places. Using cutting-edge information and mobile technology, the lab seeks to improve people’s lives through the careful design of meaningful experiences. The multidisciplinary team designs new technologies, carefully considering their impact on societies, spaces and communities. Project area examples: Banking; health; product design; digital platforms; responsive environments.

Wellness/Lifestyle Issues

The Media Lab’s Advancing Wellbeing initiative addresses the role of technology in shaping our health, and explores new approaches and solutions to wellbeing. The program is built around education and student mentoring; prototyping tools and technologies that support physical, mental, social, and emotional wellbeing; and community initiatives.

The Affective Computing group aims to bridge the gap between human emotions and computational technology. The group’s research combines engineering and computer science with psychology, cognitive science, neuroscience, sociology, education, psychophysiology, value-centered design, ethics, and more toward restoring a proper balance between emotion
and cognition in the design of technologies for addressing human needs. Projects are diverse: from inventing ways to help people who face communication and emotion regulation challenges; to enabling customers to give rich emotional feedback; to quantifying patterns of autonomic activity (core emotional physiology) during seizures, stress-related disorders, and sleep.

The vision of the Medical Electronic Device Realization Center (MEDRC) is to transform the medical electronic device industries: to revolutionize medical diagnostics and treatments, bringing health care directly to the individual; and to create enabling technology for the future information-driven healthcare system. Specific areas that show promise are wearable or minimally invasive monitoring devices, medical imaging, laboratory instrumentation, and the data communication from these devices and instruments to healthcare providers and caregivers.

The mission of the Massachusetts Institute of Technology is to advance knowledge and educate students and others in science, technology, and additional areas of scholarship. MIT is committed to generating, disseminating and preserving knowledge and to working to bring this knowledge to bear on the world’s great challenges. As part of its mission, MIT maintains relationships with industrial organizations that enable the exchange of ideas in the context of real-world problems and demonstrate how principles studied at MIT are applied to generate practical benefits for industry and society. MIT’s Industrial Liaison Program helps develop these relationships by facilitating industry’s access to MIT and its vast resources.