MIT and Supply Chain/Logistics/Transportation Industries

The Massachusetts Institute of Technology (MIT) is a leading center of research and education on topics important to the supply chain-logistics and transportation industries such as:

- Supply Chain Management and Logistics
- Transportation Systems and Logistics
- Analytics, Computation, Data, Modeling
- Communications, Networks, Social Networks
- Environmental Impact, Sustainability
- Infrastructure, and City/Urban Science
- Management and Information Technology

Below are brief descriptions of a selection of MIT centers, departments, groups, and labs conducting research and education in these areas. Please note that this is not a comprehensive summary of research being conducted at MIT in the topic areas listed above and the center or lab, etc., may fall into more than one category.

SUPPLY CHAIN MANAGEMENT & LOGISTICS

The MIT Forum for Supply Chain Innovation (the Forum) is a unique community composed of academics and industry members whose support allows Forum researchers to provide customer-focused solutions to design and manage the new supply chain. The Forum has pioneered a deeper understanding of the supply chain and its relationship to corporate strategy and has broad support from a wide cross-section of industry. Research topics have included: multi-agent systems for supply chain innovation; supply contracts; electronics supply chain; dynamic supply chain evolution; supply chain integration; optimizing buy/make decisions; inventory management and dynamic pricing; service supply chains; supply chain strategies; RFID and real-time data in adaptable supply chain management; and distributed interactive simulation.

The MIT Global SCALE (Supply Chain and Logistics Excellence) Network is an international alliance of leading-edge research and education centers. Formed in 2003 with the opening of the Zaragoza Logistics Center (ZLC) in Spain, it expanded in 2008 with the opening of the Center for Latin American Logistics Innovation (CLI) in Colombia, and again in 2011 with the creation of the Malaysia Institute for Supply Chain Innovation in Malaysia. Collectively, the SCALE Network, which includes MIT Center for Transportation and Logistics, spans four continents. The SCALE Network allows faculty, researchers, students, and affiliated companies from all four centers to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications, and help companies to compete in an increasingly complex business environment.

The MIT Megacity Logistics Lab focuses on understanding and transforming the supply chains that interface with sprawling urban centers.

The Supply Chain 2020 (SC2020) Project is a multiyear research effort, launched in 2004, to identify and analyze the factors that are critical to the success of future supply chains. This pioneering project will map out the process innovations that will underpin successful supply chains as far into the future as the year 2020. Initiated by the MIT-Zaragoza Inter-
n national Logistics Program, the global research project involves dozens of faculty, research staff, and students at MIT and institutions around the world. The SC2020 project includes addressing fundamental questions about the structure of supply chain strategy, the nature of strategic alignment, and the logic of future visioning exercises.

The MIT-Zaragoza International Logistics Program is a unique research and education partnership that brings together the supply chain interests of academia, industry and government. The program was established in 2003 by the MIT Center for Transportation and Logistics (CTL), the University of Zaragoza, the Government of Aragón, industry partners, and the PLAZA logistics park in Zaragoza, Spain. The education program offers a master’s degree modeled on MIT Supply Chain Management Program, a doctorate degree, and executive education courses leading to certificates in various logistics-related disciplines. The research program uses the logistics park as a working laboratory to experiment with new logistics processes, concepts and technologies, in active collaboration with leading academic institutions and companies from around the world.

TRANSPORTATION SYSTEMS & LOGISTICS

The MIT AgeLab has assembled a multidisciplinary team of researchers, business partners, universities, and the aging community to design, develop and deploy innovations that touch nearly all aspects of how we will live, work and play tomorrow. AgeLab views ‘successful aging’ for individuals and societies as dependent upon a complex system of three interrelated domains: infrastructure, information and institutions. One theme of the AgeLab’s research addresses transportation safety, impact of health, wellness and medication use on operator performance, personal transportation choices, future travel demand, the promise and trade-offs of new technologies in the automobile, vehicle services and design, and mobility alternatives in the context of livable communities in the United States and around the world.

The Center for Ocean Engineering has significant research efforts in fluid mechanics and hydrodynamics, acoustics, offshore mechanics, marine robotics and sensors, and ocean sensing and forecasting. In addition, the Naval Construction program provides advanced graduate education on the design of naval ships and vehicles. Center faculty and staff address a number of ocean-related activities, including: observation and exploration of the ocean; naval construction and engineering; ocean resource development; shipping and transportation; ocean energy; ocean acoustics; the role of the ocean in the global environment and in climate change; oceanographic engineering; marine robotics; and biomimetics.

The Center for Transportation & Logistics (CTL) is widely recognized as an international leader in the field of transportation and logistics. Along with basic contributions to the understanding of transportation system planning, operations and management, its efforts include significant contributions to logistics modeling and supply chain management for shippers; to technology and policy analysis for government; and to management, planning and operations for trucking, railroad, air and ocean carriers.

The Global Airline Industry Program is comprised of a multidisciplinary team of faculty, staff and graduate students to study the global airline industry. The goal of the program is to develop a body of knowledge for understanding development, growth and competitive advantage in this industry, which is one of the most diverse, dynamic and perplexing of the world. The Program includes work addressing aspects of the economics, management and operations of air carriers. The scope also includes interactions with airline companies, aircraft and engine manufacturers, airports, air traffic control and regulatory or supervisory agencies such as the Federal Aviation Administration and the International Civil Aviation Organization.

The Intelligent Transportation Research Center (ITRC) focuses on the key intelligent transportation systems technologies, including an integrated network of transportation information, automatic crash and incident detection, notification and response, advanced crash avoidance technology, advanced transportation monitoring and management, etc., in order to improve the safety, security, efficiency, mobile access, and environment. There are two areas of emphasis for research conducted in the center: the integration of component technology research and system design research, and the integration of technical possibilities and social needs.

The Intelligent Transportation Systems (ITS) Program unites researchers from a variety of departments, centers, and laboratories—including the Center for Transportation and Logistics, the departments of Civil and Environmental Engineering, Mechanical Engineering, Electrical Engineering & Computer Science, and the Sloan School of Management—to conduct multi-disciplinary research on the applications of modern information technologies to transportation systems. Efforts have focused on the conceptual design of intelligent transportation systems and on the development of computer tools for design and evaluation of ITS services.

The International Motor Vehicle Program (IMVP) is the oldest and largest international research consortium aimed at understanding the challenges facing the global automotive industry. IMVP, founded at MIT in 1979, has mapped lean methodologies, established benchmarking standards, and probed the entire automotive value chain. IMVP research focuses on
management issues including production systems, technology, and sustainability issues. Sponsors, researchers, and IMVP management determine the research agenda collaboratively. Some of the main IMVP research topics include managing the extended enterprise; the web-enabled automotive; and visions of a sustainable future.

The Operations Research Center (ORC) provides educational and research opportunities for students and faculty interested in the interdisciplinary field of operations research, which draws upon ideas from engineering, management, mathematics, and psychology to apply scientific methods to decision-making. The MIT ORC draws faculty from 8 different departments at MIT, including members from each school. ORC faculty contribute to a wide range of application domains such as flexible manufacturing systems; financial engineering services; air traffic control; transportation systems; public services, such as urban emergency systems; safety and risk analysis in air transportation; and more.

Transportation @ MIT is a coordinated effort to address one of civilization’s most pressing challenges: the environmental impact of the world’s ever-increasing demand for transportation. Hundreds of MIT faculty members work in areas related to transportation, from motor vehicles to urban infrastructure planning to aviation efficiency to adaptive technologies and their influence on personal behavior. The Transportation @ MIT initiative knits together the wide-ranging, robust research already under way at the Institute and creates new opportunities for education and innovation.

ANALYTICS, COMPUTATION, DATA, MODELING

The Accenture and MIT Alliance in Business Analytics conducts research and develops new business analytics solutions to help organizations make more informed decisions, solving some of the most challenging problems faced by today’s global companies. The alliance advisory board selected six ideas for the first round of projects, focused on the themes of big data or decision science: unstructured data; machine learning; visualization; system dynamics; and decision process.

BigData @ CSAIL aims to enable people to truly leverage big data by developing platforms that are reusable, scalable, and easy to deploy across multiple application domains. The approach includes two key aspects: To collaborate closely with industry to provide real-world applications and drive impact; to view the big data problem as fundamentally multidisciplinary. The team includes faculty and researchers across many related technology areas, including algorithms, architecture, data management, machine learning, privacy and security, user interfaces, and visualization, as well as domain experts in finance, medical, smart infrastructure, education, and science.

The Center for Computational Engineering is comprised of faculty and research partners from across the School of Engineering, as well as other departments and units involved in computational engineering education and research around the Institute. The Center’s focus is on the development of new computational tools that are more efficient, more robust, or more capable; and the informed application of existing computational tools—in concert with modeling, experimental, and “analytical” approaches—to address particular engineering problems and questions. Research projects are focused on several major methodology themes, and several major applications themes, including, among others, materials & manufacturing; infrastructure systems & services; and transportation. And site remediation are now a major focus of the field, as are problems related to resource extraction, including engineered geothermal systems.

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 MIT Geospatial Data Center (GDC) is dedicated to large-scale simulation, cyber-physical security, big data, and holistic system data visualization. In 2010, the MIT Auto-ID Lab (including MIT GeoNumerics Group), MIT Center for Grid Computing, and MIT Intelligent Engineering Systems Lab were integrated, so as to be more responsive and to provide greater value-add to various engineering computation projects.

The research efforts of the Human Mobility and Networks Lab pursue understanding statistical laws in the context of technological applications rooted in human behavior analysis. More specifically, the Lab’s research approach is based on complex network models, data mining, and other statistical physics methods. The Lab’s key activities cover human mobility and network research at various scales and can be grouped in four categories: modeling trip lengths, city in motion, individual activity patterns, and spreading dynamics.

MIT Partnership for a Systems Approach to Safety (PSAS) endeavors to create new tools and processes that implement a systems approach to safety. PSAS multi-disciplinary affiliates are working on safety in aviation (aircraft and air transportation systems), spacecraft, medical devices and healthcare, automobiles, railroads, nuclear power, defense systems, energy, and large manufacturing/process facilities (such as oil
COMMUNICATIONS, NETWORKS, SOCIAL NETWORKS

The Auto-ID Labs (at MIT) are the leading global network of academic research laboratories in the field of networked RFID. The labs comprise seven of the world’s most renowned research universities located on four different continents. These institutions were chosen by the Auto-ID Center to architect the Internet of Things together with EPCglobal.

CarTel at CSAIL combines mobile computing and sensing, wireless networking, and data-intensive algorithms running on servers in the cloud to address these challenges. CarTel is a distributed, mobile sensing and computing system using phones and custom-built on-board telematics devices; one may think of it as a “vehicular cyber-physical system.” CarTel helps applications easily collect, process, deliver, analyze, and visualize data from sensors located on mobile units (mobile phones and in-car embedded devices).

The Communications Futures Program conducts research on industry dynamics, technology opportunities, and regulatory issues that form the basis for communications endeavors of all kinds, from telephony to RFID tags. The program operates through a series of working groups led jointly by MIT researchers and industry collaborators. It is highly participatory, and its agenda reflects the interests of member companies that include both traditional stakeholders and innovators. Industry partners include companies across the entire communications value chain.

Connection Science and Engineering is a union of network theory, operations research, control and systems theory computer science, economics, behavioral science, and social media. The group’s goal is to forge the foundations of an integrated framework for understanding the connected world we live in. This requires a multidisciplinary, interdepartmental effort that leverages and supports existing disciplinary network projects. Research areas include modeling social network flows; social data; theory of network computation; network mechanism design; and social architectures.

The Human Dynamics Group studies how social networks can influence people’s lives in business, health, and governance, as well as technology adoption and diffusion. Today people leave digital breadcrumbs wherever they go, through smart phones, RFIDs, and more. The Human Dynamics group uses reality mining to ask how this data can be used 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 group’s projects have already demonstrated the potential to dramatically improve the competitiveness of companies, and hint at the ability to revolutionize social environments.

The Laboratory for Information and Decision Systems (LIDS) is an interdepartmental research center committed to advancing research and education in the analytical information and decision sciences, specifically: Systems and control; communications and networks; and inference and statistical data processing. LIDS research relies on the analytical foundations provided by various mathematical disciplines, such as probability and statistics, dynamic systems, and optimization and decision theory. It also strives to advance these foundations along new directions, relevant to emerging engineering problems. Example application areas include coordination of unmanned autonomous systems; energy information systems; network scheduling and routing; and communication technologies.

ENVIRONMENTAL IMPACT, SUSTAINABILITY

The Carbon-Efficient Supply Chains initiative in the Center for Transportation and Logistics addresses three challenges in developing carbon-efficient strategies for supply chains: Measurement—how do you calculate the carbon footprint of a supply chain? Where do you start and stop? What do you include?; Strategy & Decision Making—what are the right strategies to reduce the energy and carbon emissions through out the supply chain? How do you prioritize technology investments based on your current footprint and supply chain strategy?; and, Labeling & Reporting—how do you communicate the carbon footprint to consumers and stakeholders? How do you communicate carbon information within the supply chain?

The MIT Laboratory for Aviation and the Environment is working to increase the fundamental understanding of the environmental impacts of aircraft and fuels on a lifecycle basis, and to develop tools that policy-makers, researchers, and designers use to assess the environmental and economic implications of aviation policy and engineering decisions.

The Materials Systems Laboratory (MSL) studies the strategic implications of materials and materials processing choices. MSL research seeks to understand the competitive position of materials in specific applications, such as assessment of different candidate materials, assessment of process technologies, and evaluation of both the economic and non-economic consequences of each alternative. The MSL develops quantitative tools whenever possible to address direct manufacturing costs of each alternative and total lifecycle costs, and sustainability factors. MSL methodologies include technical cost modeling,
lifecycle cost and emissions tracking, decision analysis techniques, systems dynamics modeling, and system cost modeling.

PARTNER—the Partnership for AiR Transportation Noise and Emissions Reduction—is a leading aviation cooperative research organization. An FAA Center of Excellence, PARTNER research fosters advances in alternative fuels, emissions, noise, operations, aircraft technologies, and science and decision-making for the betterment of mobility, economy, national security, and the environment.

The Renewable Energy Delivery (RED) project in the Center for Transportation & Logistics (CTL) collaborates with key organizations across the renewable energy space (e.g. generators, technology providers, and electric grid operators) to design new supply chain systems for cost-effective renewable energy delivery to end consumers. The project researchers aim to develop insights and tools for problems ranging from daily operations management to strategic planning for the phased deployment of renewable energy generation and transmission.

Research at the Sloan Automotive Laboratory is in the areas of internal combustion engines and fuels, fundamental fluid/thermal/combustion studies, and assessment of advanced propulsion and vehicle technologies, and especially their energy consumption and environmental impacts. The Lab has a number of broad research focuses: engine efficiency improvements to increase power and/or performance; improve alternative fuel operation; advance the fundamental understanding of engine, technology and transportation policy processes; and vehicle life-cycle CO2 emissions reductions.

INFRASTRUCTURE, CITY/URBAN SCIENCE

The City Science Initiative is a unique network of research groups experienced in the design of technology and infrastructure, the analysis of big data, and the development of rigorous scientific theories. Leveraging advances in data analysis, sensor technologies, and urban experiments, City Science will provide new insights into creating a data-driven approach to urban design and planning. To build the cities that the world needs, a scientific understanding of cities is needed that considers the built environments and the people who inhabit them. The aim is to develop targeted research projects and living lab deployments around the themes of urban design, mobility-on-demand, energy, big data, responsive technologies, and integrated live-work environments.

The goal of the Future Urban Mobility project is to develop, in and beyond Singapore, a new paradigm for the planning, design, and operation of future urban mobility systems. Such systems, aimed at both passengers and freight, will materially enhance sustainability and societal well-being on a global scale. This is a particularly opportune time to address this topic due to a confluence of relevant developments: advances in computing, communications, and sensing technologies; the great progress that has been made in recent years in our ability to model, evaluate and optimize urban mobility systems; the growing importance of environmental sustainability issues; the aging of physical infrastructure in developed countries and the need for massive new infrastructure in less developed ones; and the vast economic stimulus that can be provided by the modernization and renewal of urban mobility systems worldwide.

The goal of the International Center for Air Transportation (ICAT) is to improve the safety, efficiency, and capacity of domestic and international air transportation and its infrastructure, utilizing information technology and human centered systems analysis. Areas of research include: Air Traffic Management; Air Transportation Infrastructure and Economics; Aviation Safety and Weather; Airline Management and Operations; Human Factors; Flight Instrumentation; and Environmental Impact of Aviation. ICAT, and its predecessors, the Aeronautical Systems Laboratory and Flight Transportation Laboratory, pioneered concepts in air traffic management and flight deck automation and displays that are now in common use.

The SENSEable City Laboratory: The increasing deployment of sensors and hand-held electronics in recent years is allowing a new approach to the study of the built environment. The way cities are described and understood is being radically transformed, alongside the tools used to design them and impact their physical structure. Studying these changes from a critical point of view and anticipating them is the goal of the SENSEable City Laboratory.

The Department of Civil & Environmental Engineering (CEE) Transportation Group has provided leadership in the field of transportation research for many years by emphasizing an interdisciplinary systems approach incorporating engineering, urban planning, transport system management and public policy. This interdisciplinary approach is being applied to the concept of sustainable transportation to address the critical issues confronting the world. The scope of the group’s research includes consideration of the interactions of transportation infrastructure and operation, urban spatial structure and land use, economic growth, resource and energy use, and environmental impacts at various spatial and temporal scales. Research encompasses the following areas: Emission standards; new technologies; transportation modes and regional planning; equity; and infrastructure renewal.
The Department of Urban Studies and Planning (DUSP) is comprised of four specialization areas: City Design and Development; Environmental Policy and Planning; Housing, Community and Economic Development; and the International Development Group. There are also three cross-cutting areas of study: Transportation Planning and Policy, Urban Information Systems (UIS), and Multi-Regional Systems Planning. The department is one of the largest – and most diverse – urban planning programs in the United States.

MANAGEMENT AND INFORMATION TECHNOLOGY

The MIT Center for Digital Business is focused on being the leading source of innovation, knowledge creation, dissemination and utilization, in management theory and practice for digital business. The Center has established a large-scale research program to investigate the latest trends and techniques in digital business and has worked with more than 50 corporate sponsors. The core of this program is the custom matching of sponsor companies with MIT faculty to form research teams that address issues that are relevant to both industry and academia. Broad areas of focus include digital marketing, digital productivity, digital services, and the cloud.

The Center for Information Systems Research (CISR) conducts field-based research on issues related to the management and use of information technology in complex organizations. CISR’s mission is to develop concepts and frameworks to help executives address the IT-related challenges of leading increasingly dynamic, global, and information-intensive organizations. Research results are disseminated primarily through working papers, research briefings, an annual conference, and sponsor forums.

The Industrial Performance Center’s (IPC) interdisciplinary teams observe, analyze, debate, and report on strategic, technological, and organizational developments in a broad range of industries and examine the implications for society and the global economy. The IPC often convenes key actors from the public, private and non-profit sectors to discuss the challenges and opportunities facing firms, industries, regions and countries in an increasingly dynamic, competitive, and global economy. The center’s research program is organized around the following themes: energy, globalization, innovation, and production.

The Leaders for Global Operations (LGO) program is a collaboration among MIT Sloan School of Management, MIT School of Engineering, and industry partners. LGO program students receive two degrees in two years: either an MBA or an MS in Management degree from MIT Sloan School of Management, and an MS degree from one of eight departments in the School of Engineering. The program gives students a solid background in critical areas of manufacturing, including manufacturing processes, design and development, operations management, information technology, teamwork, leadership, change management, and systems thinking.

The MIT Sloan School of Management is one of the world’s leading business schools — conducting cutting-edge research and providing management education to top students from more than 60 countries. The mission of the Sloan School is to develop principled, innovative leaders who improve the world and to generate ideas that advance management practice. MIT Sloan offers undergraduate, master’s, PhD, executive education and non-degree programs together with special seminars, conferences, and programs for alumni. The MIT Sloan faculty includes 108 full-time professors along with adjunct or visiting faculty; the student body consists of more than 1,100 graduates and undergraduates. MIT Sloan has 20,000 alumni, residing in 90 countries. More than 650 companies have been founded by MIT Sloan alumni.