Tecnológico de Monterrey

RESEARCH

EDUCATE INNOVATE TRANSCEND

Research that Transforms Lives

2017

Tecnológico de Monterrey

For Tecnológico de Monterrey research is a strategic activity; it is the engine that generates innovative solutions for the economic, social and environmental development of our country. We are committed to the idea that scientific and applied research should be used to add value to a society in a more rapid, measurable manner. We believe that there are three ways to accomplish this: 1) research to improve education; 2) research to achieve innovation; and 3) research to transform society.

Thus, research is a key cornerstone of education, as there is a need to continuously evolve scientific and technological knowledge in our learning process. The challenge is the use of scientific research to create value to develop a more educated society in a global world, regardless of that society's social and economic reality. We understand that science, technology and innovation will continue to add value to society. An innovation process is a driver for research activities and research is fundamental to innovation.

Therefore, the challenge is to enable a positive connection to bridge knowledge generation with value creation in order to address the most demanding problems humanity is facing: water, energy, environment, food security, global health, education, sustainable growth and poverty. Scientific and applied research should transform society. Open research and innovation models are key to address these challenges with a sense of community, collective knowledge and capacity to act.

At Tecnológico deMonterrey we combine two research approaches with open international collaboration: "knowledge driven creation" and "society driven innovation". Our researchers have a responsibility towards value creation based on our scientific research that addresses society´s demands.

But they also have to advance scientific knowledge to create new concepts, theories, and paradigms to advance the understanding of the world and the universe. We are committed to undertaking research to educate, innovate and transform in order to transcend in this lifetime.

Tecnológico de Monterrey has decided to focus this scientific activity on eight main strategic research areas, encouraging innovation, knowledge generation and knowledge transfer, with the goal of trying to solve México's and worldwide problems. These eight strategic areas include: biotechnology and food; mechatronics and engineering; information technology, sustainability; public policy; business; medicine; and education, the humanities and the social sciences.

This report gives an overview of Tecnológico de Monterrey's scientific and technological activity, offering facts and figures on the impact achieved by our research faculty's work. A general summary of the research and innovation results from 2002 to 2015 is presented, reviewing graduate programs, research areas, international collaboration networks, industrial agreements, patent application results and the institution's standing in the major world university rankings.

These areas are aligned to the eight strategic areas. The scientific work will start, then, from a strategic area that will take concrete form in a discipline and, more precisely, around a theme, where a group of researchers, professors and graduate students meets to generate and transfer new knowledge. To fulfill the scientific objectives, we have created 41 strategic groups that sustain the academic and research activities of the five schools of postgraduate studies and research programs: 1) School of Engineering and Sciences; 2) EGADE Business School; 3) School of Government and Public Transformation; 4) School of Education, Social Sciences and the Humanities; and 5) School of Medicine.

Research at Tecnológico de Monterrey fosters the learning process of our students, underpins the intellectual activities of our professors, and generates knowledge and innovative solutions that address society´s demands.

Arturo Molina, PhD
Vice Rector for Research, and
Technology Transfer

Contents

Introduction	1
Tecnológico de Monterrey	4
Facts & Figures	7
Research Strategy	9
International Collaboration	34
MIT-Tecnológico de Monterrey Research Agreement	35
Strategic Initiatives	37
Industrial Partnership	49
Education Impact	53
Scientific Impact	58
Economic Impact	62
Projects That Transform Mexico	67
Rankings	73

Editor:
Francisco J. Cantú-Ortiz

Editorial Design:
Sandra Yebel Durón
Milton Rodríguez Marín

Text Revision:
Nathalíe Galeano
Susan Fortenbaugh

Information Sources:
Research Reports and Information Systems
at Tecnológico de Monterrey
Héctor Ceballos
Erika Alejandra Juárez

2017

Tecnológico de Monterrey

Tecnológico de Monterrey

- Privately funded,1943
- Non-profit
- Independent
- Non operational support from the government
- 28 non-profit sponsoring organizations
- 542 board of trustees members

Eugenio Garza Sada (1892-1973) was born into a business family, the son of the man who founded the Cuauhtémoc Brewery in Monterrey in 1890. His experience at MIT was the basis for the organization of Tecnológico de Monterrey, which he established along with a group of Monterrey businessmen.
With a prophetic vision,Garza Sada devoted considerable effort to the expansion of the city of Monterrey.
He was a tireless defender of private and free enterprise.
His leadership in Monterrey was very clear and fruitful, both in the field of business, and in education and social welfare.
Both, a successful businessman and an active promoter of community development, Eugenio Garza Sada consistently acted with great simplicity and humanity, focused on the progress of those around him, without distinction. The significance of this great man, industrialist and humanitarian, is undeniable and imperishable.

Tecnológico de Monterrey

MÉXICO

31 Campuses

25 Cities

5 Multi-campus Research & Graduate Schools

16 INTERNATIONAL LIASON OFFICES

FACTS & FIGURES 2016

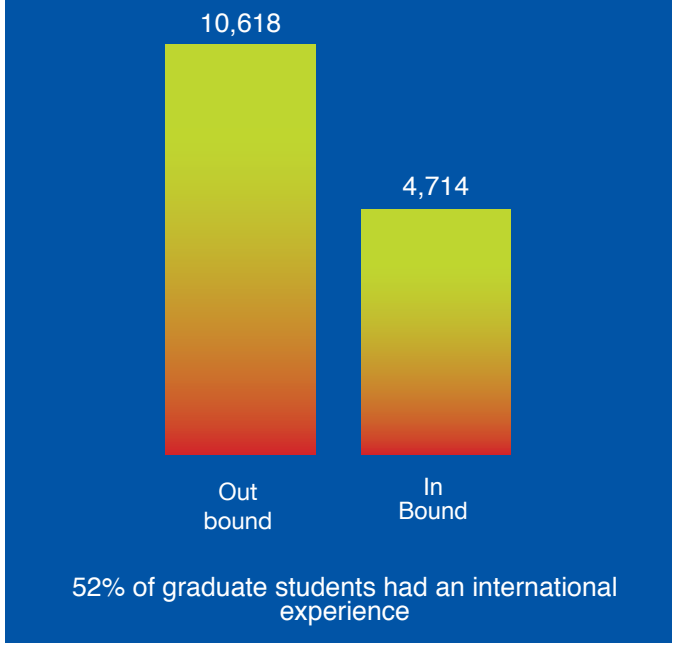
10,117

Professors

89,641

Students

Student mobility



52% of graduate students had an international experience

Alumni

299,273

232,644

undergraduate

66,629

graduate

FACTS & FIGURES 2016

Alumni Associations Worldwide

299,273 alumni distributed in:

Arizona
Austin
Australia
Boston
Calgary
California
Chicago
China
Colombia
Connecticut
Dominican Republic
El Salvador
Florida
France
Germany
Guatemala
Houston
Ireland
Mexico
Michigan
Montreal
New York
New Jersey
Ontario
Panama
Peru
Quebec
San Antonio, Texas
San Francisco Bay Area
Scandinavia
Seattle
Spain
Tijuana-San Diego
Vancouver
Washington DC
Others...

RESEARCH FACTS & FIGURES 2016

PEOPLE

1,435
RESEARCH Faculty

7,819
GRADE STUDENTS

Postdocs **66**

STUDENTS PHD **428**

3,094
Undergrad Students Participating in Research Projects

Research professors in Sistema Nacional de Investigadores
468

RESEARCH FACTS & FIGURES 2012–2016

PUBLICATIONS

3,167

PUBLICATIONS

8,775 Citations

Citations per publication

2.86

International Collaboration

Publications co-authored with institutions in other countries.

44.2%

(Average in Mexico is 39.2%)

Publications in top 10% journals by SNIP

(Source Normalized Impact per Paper)

20.9%

(Average in Mexico is 12.5%)

Academic-Corporate Collaboration

Publications with both academic and corporate affiliations.

1.1%

(Average in Mexico is .8%)

PATENTING FACTS & FIGURES 2010-2016

PATENTS

409

PATENTS

FILED	293
GRANTED	116

	FILED	GRANTED
AMERICA	263	108
EUROPE	3	4
ASIA	4	2
PCT	23	0
OCEANIA	0	2

ENTREPRENEURSHIP 2016

1,727 Companies being incubated in the entrepreneurial ecosystem

68 Incubators in the incubator network

- **24** basic
- **8** high impact
- **36** small companies

956 small companies

4,019 graduated companies since 2002

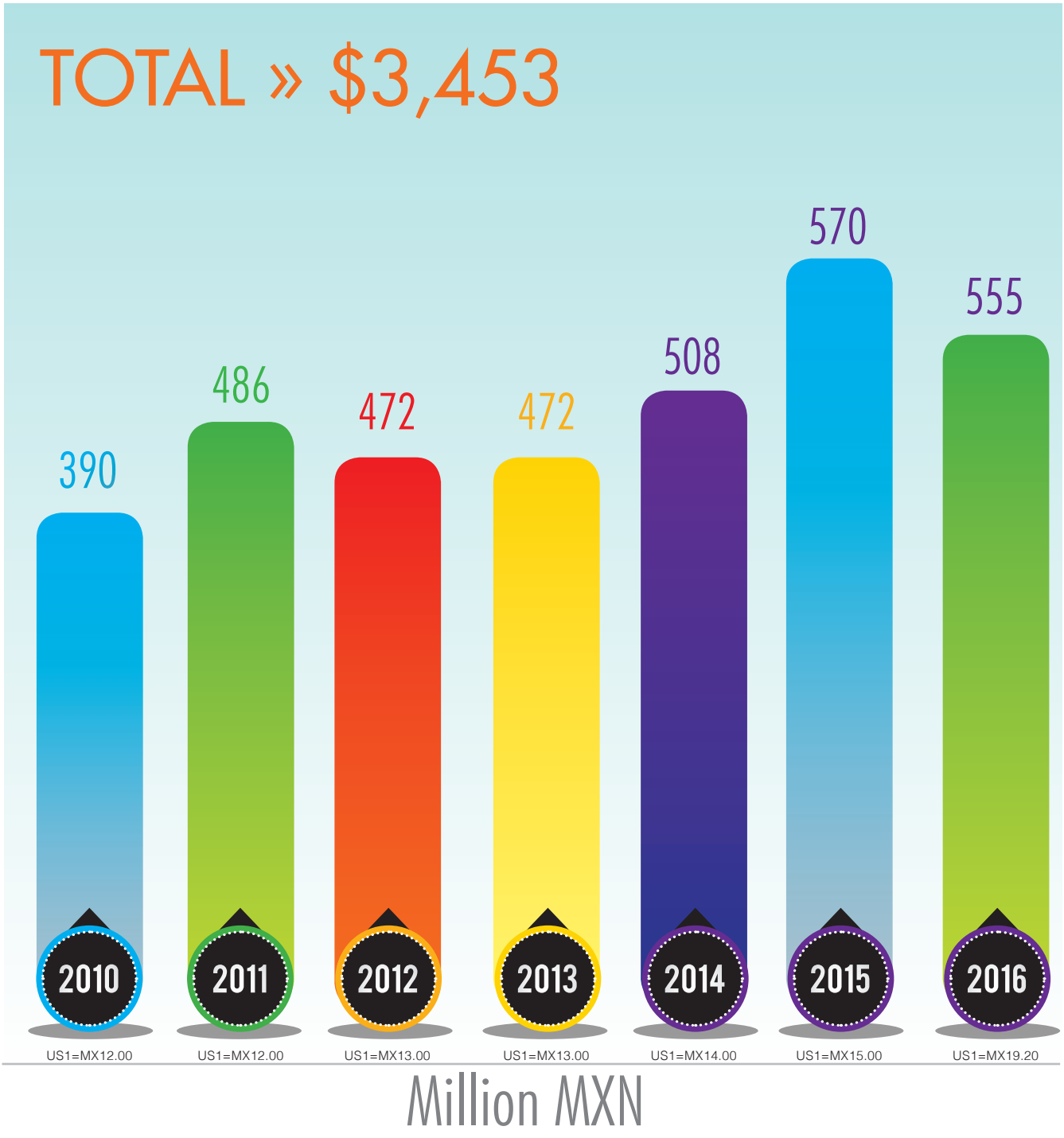
17 business accelerators in the network

14 technology parks

279 companies in technology parks

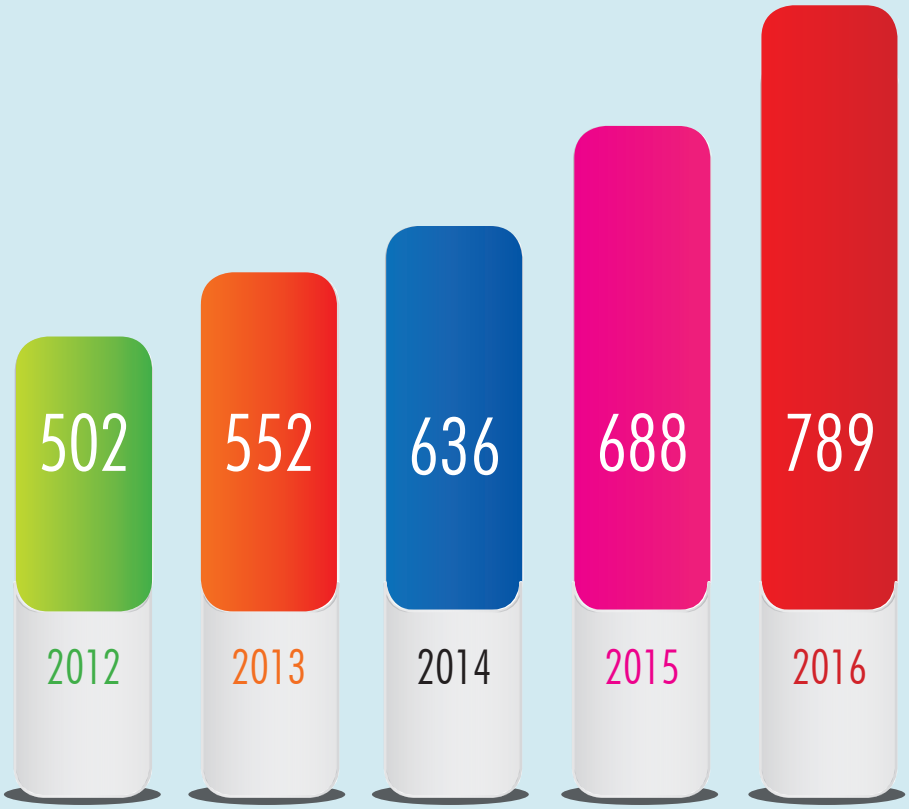
RESEARCH PROJECTS 2016

RESEARCH FUNDING



RESEARCH PRODUCTIVITY: ARTICLES

TOTAL 2012 – 2016: 3,167



GOAL 2016 – 2020: 10,000

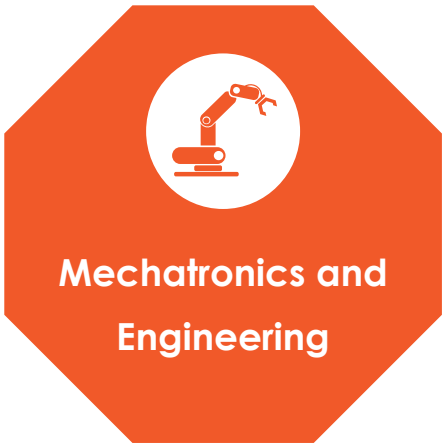
*Scopus

MEXICO
NATIONAL PROGRAM OF SCIENCE, TECHNOLOGY AND INNOVATION
2014–2018

Priority Areas

TECNOLÓGICO DE MONTERREY

RESEARCH AREAS WITH STRATEGIC FOCUS



TECNOLÓGICO DE MONTERREY

RESEARCH GROUPS WITH STRATEGIC FOCUS

Biotechnology
- Bioprocesses and Synthetic Biology
- Cellular and Bioreaction Engineering
- Nutrinomics
- Emerging Technologies and Molecular Nutrition

Mechatronics and Engineering
- Sensors and Devices
- Robotics
- Advanced Manufacturing
- Industrial Engineering and Numerical Methods
- Nanotechnology for Device Design
- Product Innovation
- Nanomaterials
- Automotive Consortium

Information Technologies, Electronics and Communications
- Optics and Lasers
- Machine Learning
- Intelligent Systems
- Networks and Telecommunications

Health
- Cell Therapy
- Bioinformatics, and medical devices
- Molecular Medicine
- Clinical Innovation

Sustainable Development
- Water Science and Technology
- Energy and Climate Change

Education, Humanities and Social Sciences
- Educatio Research and Innovation
- Global Issues
- Industries and Cultural Heritage: Analysis and Trends
- Knowledge Societies
- Social Transformation and Sustainability

Business
- Business Analytics
- Consumer Behavior and Value Creation
- Entrepreneurship and Leadership
- Organizational Strategy and Management in Emerging Economies
- Finance and Macroeconomics
- Social Innovation
- Retail

Public Policy
- Democracy, Institutions, Security and justice
- Regional Development, Energy and Public Economics
- Social Policy and Public Entrepreneurship

STRATEGIC RESEARCH GROUPS

EGADE BUSINESS SCHOOL

Groups in the research areas with strategic focus, working in a collaborative and interdisciplinary manner. Generating knowledge and innovation.

Business Analytics

Leader:
Raúl Francisco Montalvo Corzo
rmontalvo@itesm.mx

Consumer Behavior and Value Creation

We study consumer behavior in order to develop effective business strategies that promote responsible consumption and social welfare.

Leaders:
Raquel Minerva Castaño González
rcastano@itesm.mx

Lorena de la Paz Carrete Lucero
lcarrete@itesm.mx

Entrepreneurship and Leadership

Tecnológico de Monterrey is one of the pioneers in entrepreneurial education in Latin America. Today, the training and development of entrepreneurial leadership continues to be a strategic pillar of our institution. This research group focuses, enhances and disseminates scholarship on entrepreneurship and leadership which strengthen economic and social development in Mexico.

Leaders:
Ajnesh Prasad
prasad@itesm.mx

José Ernesto Amorós Espinosa
amoros@itesm.mx

Finance and Macroeconomics

We contribute to the development of Mexican companies through their integration into national and international financial markets. We promote a better understanding of the relation between companies and global macroeconomic conditions.

Leader:
René Cabral Torres
rcabral@itesm.mx

Retail

This group seeks to develop the retail trade in Mexico in order to achieve international competitiveness by developing strategic thin-king that improves competitiveness through: store experience, operational optimization, use of technology and brand value.

Leaders:
María Elena Vázquez Lira
mevl@itesm.mx

Social Innovation

We engage in basic and applied research aimed at understanding the functioning of corporate social responsibility within the context of both large multinational corporations as well as small and medium-sized enterprises. In addition, we study social, multifaceted entrepreneurship. Furthermore, we evaluate social and ecological costs of doing business in order to identify their causes and find solutions. Finally, we study related phenomenon of current interest such as voluntary environmental programs and the role of the firm in the creation of income inequality.

Leaders:
Bryan William Husted Corregan
bhusted@itesm.mx

Strategy and Management of Organizations in Emerging Economies

In the context of emerging economies, we focus on the research processes and practices related to: strategy development and implementation, organizational capabilities, knowledge transfer, governance and human resources management. We apply strategies and management theories through models and tools designed for decision making and sustainable development for organizations in emerging economies. Theoretical approaches to strategy, institutionalism, culture and stake holdings are the main pillars of our research program.

Leaders:
Anabella del R. Dávila Martínez
anabella.davila@itesm.mx

SCHOOL OF EDUCATION, HUMANITIES AND SOCIAL SCIENCES

Global Issues

This research group consists of scholars working on key contemporary issues of global governance across three main fields: global economic governance, global sustainable development and regional conflicts and cooperation. The research lines of the scholars are complementary, each one addresses important aspects of global governance as well as international cooperation and security. The topics covered are crucial for Mexico and other developing countries that seek solutions to important domestic and foreign policy challenges.

Contact:
Dora Elvira García González
dora.garcia@itesm.mx

Industries and Cultural Heritage: Analysis and Trends

We study the term “cultural industry” from a broad perspective that involves the production of cultural goods and services in a non-restrictive and inclusive manner (from popular manifestations to the so-called “high culture”). Its study covers production generated through traditional sectors such as editorial print, analogue or advertising audiovisual, but also via digital media such as newspapers and online magazines, digital transmission of radio and television programs, social networks, sound and film production, etc. Its contents can be educational, artistic, informative and based on entertainment. These can be considered from the following points of view: emission (authorial democratization), reception (new reading canons, coexistence of different types of receptors and audiences), support (convergent platforms), supporting codes (fragmented, inter-texts favoring), representations (new realities, tempo-spatial breaks) and contexts.

We study these industries as an enabling tool for sustainable development that involves various disciplines such as history, political science, economics, literature, communication, design, marketing, ethics, sociology, education, among others. We use the cultural framework proposed by UNESCO: (1) cultural heritage; (2) printing and literature; (3) music; (4) performing arts; (5) phonographic media; (6) audiovisual media; (7) socio-cultural activities; (8) sports and games and (9) environment and nature.

Leader:
María de la Cruz Castro Ricalde
maricruz.castro@itesm.mx

Education Research and Innovation

This group focuses its research on innovation in education in three main areas: management of educational institutions; sociocultural contexts of the digital technology; and teaching and learning processes for a knowledge-based society in diverse areas with an emphasis on science, mathematics, engineering and technology. Some of the multidisciplinary research projects and topics include: impact of innovation strategies in education (gamification, inverted classroom), resources (virtual and remote laboratories, augmented reality, open resources), educational environments (e-learning, b-Learning, m-learning, 3D virtual environment, MOOC), virtual communities (academic writing, educational leaders), training (teachers, researchers, entrepreneurs), skills development (ethical, civic, critical thinking, problem solving) and impact assessments (Tecnológico de Monterrey Educational Model: Tec21, public policy programs).

Leader:
María Soledad Ramírez Montoya
solramirez@itesm.mx

Knowledge Societies

We study the paradigm shift from the material and monetary base of the industrial culture to intangible concepts (ideas and emotions) of the knowledge culture. This new field relies on several specialized areas of knowledge: ethics, epistemology, history of knowledge, knowledge economics, sociology of knowledge, political science and psychology of knowledge as well as technology –particularly ITC and the digital ecosystem– and law.On these grounds, applications are developed and provided for: studies of science and technology, knowledge and innovation management, scientific and technological intelligence, knowledge economy, knowledge-based development and knowledge cities, cultural and legal aspects of technology, ethics and economic culture.

Leader:
Francisco Javier Carrillo Gamboa
fjcarrillo@itesm.mx

Social Transformation and Sustainability

Through diverse interdisciplinary theoretical perspectives, this group looks for ways and strategies to ensure the continuation of social processes in the future. It studies basic resources such as water, its relation to life in the cities and its general role in sustainability. Social transformation is analyzed from four points of view: a) The theory about social changes; b) Education; c) Local-global linkage; and d) The "trans" criterion of contemporary social phenomena, especially from the trans-national perspective.
Ethical issues, peace and sustainability are studied from an interdisciplinary and trans-disciplinary perspective encompassing philosophy, literature, law and international relations. We also study the relationship between development and sustainability as well as cultures of peace. In economic and social aspects, we focus on: evaluation of governmental programs, elections, poverty and inequality, social responsibility and transparency, migration and remittances as well as sub-national public finance.

Leader:
Dora Elvira García González
dora.garcia@itesm.mx

SCHOOL OF GOVERNMENT AND PUBLIC TRANSFORMATION

Democracy, Institutions, Security and Justice

This group generates research that strengthens democracy and its political and judicial institutions through identification and analysis of the conditions and institutions that promote or limit the consolidation of democracy. The group also supports institutions and public administration processes that improve efficiency and reliability by designing and implementing public policies that promote the constitutional rule of law, especially in the areas of research, administration and justice. As a group we seek to influence the public agenda, improve the quality of democracy, increase the efficiency of the public administration and consolidate the new criminal justice system. These goals are pursued through the interdisciplinary study of economics, international relations, engineering (computer science, processes, industry and robotics), communication and pedagogy.

Regional Development, Energy and Public Economics

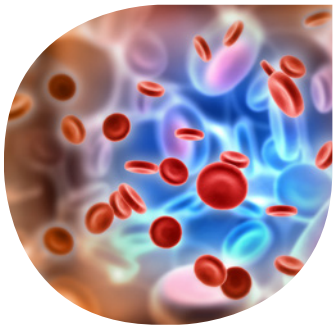
Social Policy and Public Entrepreneurship

SCHOOL OF ENGINEERING AND SCIENCE

Bioprocesses and Synthetic Biology

Our group focuses on the development of technology platforms based on bioprocesses and synthetic biology that generate new applications, new products and new production systems. Our main research lines are: a) Design of bioprocesses, b) novel technologies for bioseparation, c) technologies for measurement and early detection and d) synthetic biology. The bioprocess line focuses primarily on the design, implementation and scaling of unique biotechnological processes for products with commercial potential. The objective of the research line of novel technologies for bioseparation is to generate new strategies for recovery and purification that result in new platforms and products (proteins, enzymes, cells, etc.). The development of technologies for early detection involves the design and use of the micro-devices process for the creation of measurement systems. The research line of synthetic biology focuses on generating unique microbial production systems for obtaining high-value products.

Leader:
Marco Antonio Rito Palomares
mrito@itesm.mx



Cellular and Bioreaction Engineering

The mission of our group is to generate knowledge, new applications, and developments in the area of Pharmaceutical Biotechnology and Biomedicine by combining biological and engineering concepts. Our main research lines are (a) Biopharmaceutical Biotechnology: Production of biopharmaceuticals and recombinant vaccines; (b) Micro- and nanotechnologies for the diagnostic of infectious diseases; (c) Tissue Engineering and stem cell culture; and (d) Engineered biomaterials for biopharmaceutical and biomedical applications. We use reactions mediated by cells and their components (e.g. enzymes and nucleic acids) to generate high-added-value products and applications.

To achieve this purpose effectively, we usually have to engineer the cells and their functions; we use genetic engineering to modify or add new genes to a cell to confer new functions. For example, we engineer bacteria, yeast, and mammalian cells to produce recombinant proteins to diagnose, prevent, or treat global infectious or chronic diseases such as influenza, Ebola, cancer, and rheumatoid arthritis. We also design diagnostic chips to quickly and specifically identify bacteria, virus, or antibodies to tell us whether a person has been exposed to a specific pathogen.

Recently, we entered into the area of biomaterials and tissue engineering. Here we combine concepts of material sciences and technology, microfluidics, genomics, and cell culture in micro-and mini-devices into biomedical applications that could save lives. For instance, we are developing platforms to culture stem cells for tissue repair. We also culture cancer stem cells in continuous-flow microchips to better understand how a tumor grows and how to diagnose or treat a specific type of cancer. For all these applications, we must design and engineer not only the cells but also the systems and environments where we culture them. That is, we also do bioreactor design and engineering.

Leader:
Mario Moisés Alvarez
mario.alvarez@itesm.mx

Emerging Technologies and Molecular Nutrition

Through the convergence of different disciplines (Food Engineering, Biotechnology, Chemistry of Materials, Genomics, Microbiology and Nanotechnology) this group promotes emerging and innovative technologies in order to develop and consolidate its research.

Leader:
Jorge Welti Chanes
jwelti@itesm.mx

NutriOmics

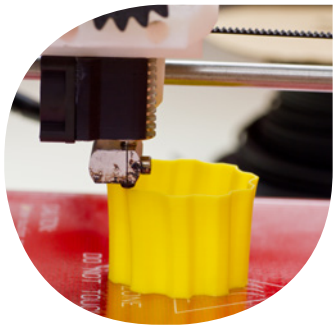
This group performs cutting-edge research in nutrigenomics in order to identify phytochemicals preferably associated with Mexican native plants and foods that have the potential to prevent and treat cancer and chronic degenerative diseases. Important efforts are implemented to extract, identify and isolate phytochemicals, perform in-vitro tests with human and mammalian cells as well as animal tests in laboratory. Additionally, bioprocesses will be developed to obtain tablets, pills and products with nutraceutical and / or pharmacist degrees.

The mechanisms by which phytochemicals prevent or treat chronic-degenerative diseases (diabetes, inflammation, cholesterol and cancer) will be studied by nutrigenomics techniques.

The development of vegetable proteins for food applications, aimed to replace expensive animal proteins, is another important research task of our group. Novel raw materials are being identified, structural modifications of macromolecules are made, novel processes to improve efficiency and functionality of the extraction will be developed as well as the application of proteins in the development of food (dairy, cereals, beverages and other). Biotech also studies the minimization of post-harvest loss of grains and especially molecular markers that increase the nutraceutical capacity of cereals and other grains. This line also studies the processing of the nutraceutical capacity of grain-based foods.

This group will also focus on the creation of a laboratory which processes and does research on the generation of tablets and pills that can be used in clinical studies. This group will do research in the area of genomics.

Leader:
Sergio Román Othón Serna Saldívar
sserna@itesm.mx



Advanced Manufacturing

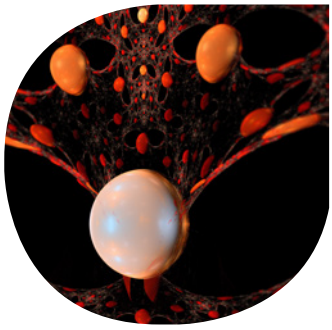
This group focuses on the development of modern transportation systems, particularly associated with the automotive industry. The main research topics of our group are: virtual prototyping, the use of new light materials and multimaterial components in the structure, body and drivetrain of the vehicle to reduce its weight; the development of powertrains equipped with electric motors; the integration of structures and modular systems for vehicle design; vehicle connectivity to the network to enhance its functionality; the development of dynamic, characterization and automotive control systems models; the overall behavior analysis of vehicles to achieve comfort; and the increase in maneuverability and stability using stabilizing devices. Several companies are participating as co-sponsors and users of our research and results.

Leader:
Horacio Ahuett Garza horacio.
ahuett@itesm.mx

Industrial Engineering and Numerical Methods

Our group develops approaches, formulations and solutions to specific industrial engineering problems using a quantitative point of view. We solve production and logistics problems such as planning and production scheduling, facility location, inventory, vehicle routing, territorial design, forest management and port logistics. The approach is quantitative, it provides formulation and solution to problems by designing algorithms that allow us to obtain both exact and approximate solutions.

Contact:
Ricardo Ambrocio Ramírez Mendoza
ricardo.ramirez@itesm.mx

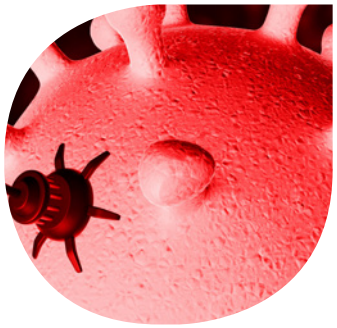


Nanomaterials

This group focuses on the surface engineering by assisted plasma. Main research topics are: Prototype design and construction for the thermochemical treatment of steel parts as well as prototypes for physical vapor deposition (PVD); Nitriding, carbonitriding and oxy-carbonitriding of steels (stainless steels 316L, special steels as “Incaloy”, and titanium based alloys Ti6Al4Va); Thin film coatings on substrates for tribological systems, high performance components and metal dusting improvement that are required for applications in metalworking, automotive, aerospace and biomedical industry; Development of piezoelectric materials used as sensors. The built prototypes allow us to produce multilayer and multicomponent coatings with plasmas generated by DC, RF and microwave fields.

We also develop mathematical representation of kinetics growth in concomitant nitride layers as well as the mathematical representation of the effects in operating parameters related with the characteristics of thin films. We also perform the structural characterization of a wide variety of steels and thin films using scanning electron microscopy, transmission X-ray diffraction as well as micro and nano hardness and bolt testing.

Leader:
Joaquín Esteban Oseguera Peña
joseguer@itesm.mx



Nanotechnology for Device Design

This research group focuses on: a) The development and characterization of intelligent and morphing biocompatible polymeric materials reinforced with carbon nanotubes or nanoparticles, b) the development of cutting edge technology to manufacture devices based on nanostructured materials, c) the prediction of the dynamic response of linear and non-linear systems by using perturbation techniques, nonlinear modal analysis and cutting-edge experimental techniques, d) The computer simulation of engineering components with Finite Element Analysis.

Leader:
Alex Elías Zúñiga
aelias@itesm.mx

Product Innovation

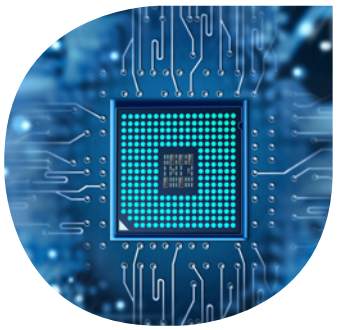
We investigate state of the art concepts and generate significant contributions related to identification of demand from Rapid Growing Markets as well as characterization and application of accelerating technologies for product and process innovations. We also design and create reference models, methodologies and tools for Rapid Product Innovation and Realization. Our group creates and builds conceptual and functional prototypes of products in the areas of advanced manufacturing technologies (micro-machines/micro-factories, 3D printers), sustainable technologies (solar energy, smart grids, green houses) as well as bio-medical devices and intelligent robots.

Leader:
Arturo Molina Gutiérrez
armolina@itesm.mx

Robotics

Our group develops devices in the areas of bio-mechatronics and autonomous vehicles. In the bio-mechatronics area, the objective is to assist the human motion during rehabilitation and to help geriatric people with wearable robotics. In the case of autonomous vehicles (AV's), we focus on the assistance during natural disasters by using teams of heterogeneous robots (air and ground AV's) that interact simultaneously.

Leader:
José Luis Gordillo Moscoso
jlgordillo@itesm.mx



Sensors and Devices

This group develops micro/nanofabrication processes and novel miniaturized sensors and devices, particularly photonic and electrochemical sensors, and micro-labs on a chip. These sensors and devices are fabricated with various materials, such as metals, polymers and carbon, and can integrate ad-hoc microelectronic systems.

The group deals mainly with, but is not limited to: applications related to environmental monitoring, such as sensor networks that monitor groundwater and air pollutants produced by industrial activity; separation and processing of biological materials used for new drugs; the analysis of biological fluids for the prevention, detection and monitoring of diseases; and the development of devices for monitoring and improving cell culture.

The group's experimental facilities include a laboratory for fabrication and characterization of micro/nanostructures and microfluidic devices, a laboratory for prototyping electronic systems and a computer laboratory for multiphysics modeling and microelectronics design.

Leader:
Sergio Omar Martínez Chapa
smart@itesm.mx

Intelligent Systems

This group conducts basic and applied research to develop intelligent systems for solving problems across a wide range of application areas including optimization and logistics, ambient intelligence, web semantics, healthcare, forecasting and business intelligence, among others.

The investigation focuses on the development of innovative heuristic, metaheuristic and hyper-heuristic algorithms based on computational intelligence and other techniques to model and understand the complexity of the interaction between problems and algorithms with the intention to develop an automated and adaptable computational platform to efficiently solve a variety of real-world problems.

The group also explores strategies such as multi-agent systems, web semantics and data mining for integrating models and methodologies to trace a path toward intelligent organizations and more personalized systems.

Leader:
Hugo Terashima Marín
terashima@itesm.mx

Machine Learning

The group is interested in applying computer technology for solving national priority problems. Currently, we focus mainly on issues such as security, business intelligence, education, logistics and bioinformatics.

Leader:
Raúl Monroy Borja
raulm@itesm.mx

Optics and Lasers

This group studies the application of light in micro-manipulation systems, quantum computing and characterization of micro and nanostructured materials including metamaterials. We develop special light profiles using lasers and other incoherent light sources. Lasers are one of the most important areas in scientific and applied research, they have been successfully applied in various fields such as medicine, metrology, telecommunications and biotechnology, among others.

In all these applications, it is very important to control the widening of the beam as it propagates through the air. Several current research in optics are designed to minimize the light beams dispersion. Additionally, the group will explore the potential applications of these rays in the industry (drilling and cutting laser), biotechnology (optical tweezers) and metrology for materials characterization.

Leader:
Julio César Gutiérrez Vega
juliocesar@itesm.mx

Telecomunication and Networks

The group works on signal processing for image processing as well as on the convergence between optical communications networks and wireless networks. The group also does research in the following areas: radio over fiber, photonic crystals, aspects from the levels of physical layer, connectivity, modulation, configurable network architecture and sensors, optimization of optical and wireless networks and several applications such as medical, automotive and biological imaging, among others. Signal processing spans many applications such as images, video, audio, speech, communications codecs, biological systems, geological systems, electric power systems, radar, sonar, automotive, signal integrity in RF, RF filtering, smart antennas, fractal signals, nonlinear systems, optical systems and quantum signal processing, among others. One of our research areas focuses on the understanding and development of mathematical algorithms for potential applications and the efficient implementation of such algorithms in DSP processors, specific software or architecture. It is also evident that telecommunications are developing almost exponentially worldwide in response to the ever-increasing bandwidth demand and transmission distances required in communication networks. The systems fit to cope with this exponential growth are led by optical networks. This group does research in long haul transmission systems, advance optical modulation formats, radio over fiber, convergence of networks, photonic crystals, network security and evolutionary algorithms applied to network optimization and design, evaluation of the performance of all-photonic networks and the application of new technologies as quantum security. The Wireless Communications group currently conducts research to improve essential understanding of the fundamental performance in the areas of wireless communications and networks such as 4G, 5G, cognitive radio, position location techniques, interference engineering and modeling, optimum receivers, ad-hoc and sensor networks, vehicular communications (V2V and V2I modeling), network coding, MIMO/ massive MIMO, channel modeling, coexistence/collaboration/ cooperation in wireless networks, CDMA, multiple access, among others.

Contact:
Ricardo Ambrocio Ramírez Mendoza
ricardo.ramirez@itesm.mx

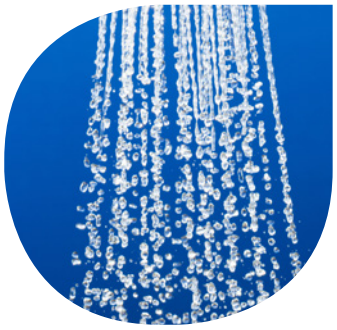
Energy and Climate Change

The Energy and Climate Change (ECC) group consolidates the research interest of the School of Engineering and Sciences in the broad area of sustainable use of energy and environmental resources. The group is composed by faculty members from a host of different engineering disciplines, including mechanical, electrical, chemical, environmental and forest engineering, as well as from the basic sciences, including physics and geophysics. In addition, faculty members

from the EGADE Business School support the issues addressed by the ECC group from the business and economic perspectives.

Three general topics are central for our research: efficient use of energy and clean technologies, renewable energy sources and environmental impact related to the energy sector with particular emphasis on climate change and air resources. The faculty members preferentially conduct applied research in their areas of interest and seek to establish the connections from specific technological solutions to the “big picture” of economic and environmental implications.

Leader:
Alberto Mendoza Domínguez
mendoza.alberto@itesm.mx



Water Science and Technology

This research group implements several activities related to the management of water resources and engineering for sustainable use in the following areas: a) hydrological processes focused on the management of water resources in the area basin; b) environmental process focused on developing biorefineries and new green technologies; c) environmental geoprocesses focused on the study of the environmental impact in the subsoil related to human activities; and d) environmental nanotechnology focused on the development of new and advanced materials.

Leader:
Jürgen Mahlknecht
jurgen@itesm.mx

SCHOOL OF MEDICINE

Molecular Medicine

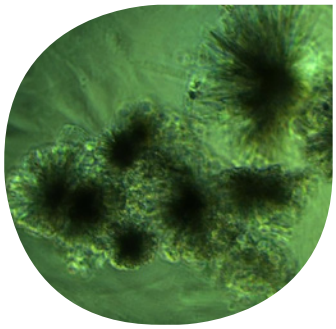
We study molecular and cellular alterations in the development of diseases and their treatments.

Leader:
Inma Castilla de Cortázar Larrea
iccortazar@itesm.mx

Bioinformatics and Medical Devices

This group focuses its research on topics of bioinformatics, genomics, medical imaging and medical devices. In bioinformatics, we focus on: algorithms and experiments for analysis, identification and validation of diagnostic biomarkers and forecasts for diseases (including cancer) and in stem cells differentiation processes. We perform computational trials (ie: Machine Learning, Artificial Intelligence) and experiments (i.e: cuture, RT-PCR, transcriptomics and genomics). In genomics, we focus on the analysis, identification and validation of mutations, genetic and epigenetic alterations in various diseases and in the use of genomic technologies such as next-generation sequencing (NGS). In Medical Imaging, we focus on computer aided diagnosis and detection via analysis, identification and validation of imaging markers in various diseases including cancer. We are interested in algorithms, techniques and computational models for obtaining knowledge and improving clinical medical diagnosis and prognosis. We also focus on correlations between medical imaging and molecular data. In Medical Devices, we research and develop medical technology to promote innovations in diagnosis, treatment, therapy and assistance for people with disabilities, especially in pediatric populations. We study the design of new robotic rehabilitation schemes to lessen the level of disability of patients with sequel of SCI or EVC and enable their inclusion in social and productive activities. All these efforts are based on personalized medicine.

Leader:
Víctor Manuel Treviño Alvarado
vtrevino@itesm.mx



Cell Therapy

We are dedicated to the study, isolation, expansion and characterization of stem cells – from hematopoietic and adipose tissue– for its use in regenerative medicine programs. The group has an extensive experience in the development of differentiation protocols to specific cell lineages. This cells therapy, through autologous transplantation, is used by our group to improve the quality of life of patients suffering chronic degenerative diseases of the nervous system such as amyotrophic lateral sclerosis (ALS) and Parkinson's disease. We are recognized as a world reference in the ALS therapeutic approach. In the near future, preclinical models in animals will be ready to support the use of these cells in diabetes mellitus treatment.

Leader:
Jorge Eugenio Moreno Cuevas
jemoreno@itesm.mx

Clinical Innovation

This group develops activities focused on the diagnosis, treatment and prevention of diseases. We study our country's great challenges from a traslational approach integrating basic and applied research projects that propose solutions needed for the treatment of the people who are at risk. Our research focuses on metabolic syndrome, blindness and surgery as well as maternal and child binomial.

Leader:
Arturo Santos García
arturo.santos@itesm.mx

RESEARCH FACULTY

Dra. Rocío Ortiz López

She graduated in Químico Farmacobiólogo Faculty from Universidad Veracruzana. She had her Masters and PhD in Molecular Biology from Universidad Autónoma de Nuevo León (UANL). She realized a training in molecular diagnosis from Baylor College of Medicine in Houston, Texas. Her expertise areas are the use of Biomarkers in breast cancer and cervix cancer, and the genomic applications in biotechnology. She belongs to National Researchers System (Conacyt), level 3.

Dra. Carmen Hernández Brenes

She an active researcher specializing in emerging technologies for stabilization of essential nutrients: food design based on nutrigenetics. Currently she is a research professor in the Department of Biotechnology and Food Engineering and the Biotechnology-FEMSA Center. In her scientific career, she has published numerous articles in refereed journals, has applied for an international patent and is the author of several book and books chapters. At the undergraduate level, she teaches courses in Human Nutrition, Food Safety (HACCP Certified Alliance) and Sensory Evaluation; and at the postgraduate level, the Enzymology and Biocatalysis course.

Dr. Julio César Gutiérrez Vega

He is a physicist who has done pioneering work in wave propagation of optical fields; specifically, he introduced the Mathieu family of non-diffracting optical beams and the Helmholtz-Gauss beams.
He is the leader of the research group on Optics. His areas of expertise include wave propagation, laser beam shaping and laser cavities. He has authored and co-authored more than 185 articles in international journals, conference proceedings and books. He was the first Mexican to be named senior member of the International Society of Optics and Photonics, serving in this organization as conference chair, editor and student chapter advisor.

Dr. Guillermo Torre Amione

He is the leader of the research group in Molecular Medicine. His research focuses on applied clinical investigation in the areas of heart failure and cardiac transplantation. His lab conducts a variety of clinical research protocols, including multinational studies and investigator-initiated protocols. He is also Chief of the Heart Failure Division, Department of Cardiology at Houston Methodist Hospital, dividing his time between an active clinical practice and research on heart failure. Dr.Torre´s clinical and basic laboratories are committed to the development of better therapies focused on the modulation of immune responses in patients with heart failure and cardiac transplant. He received the SCOUPS Award for the most-highly cited author on medicine in 2012.

Dr. Sergio Román Othón Serna Saldívar

He specializes in food science, and is the leader of the research group in NutriOmics. He has worked and consulted for Mexican and international businesses and agencies, such as the National Food Research Center in Rio de Janeiro, Brazil, SUSTAIN (US Agency for International Development), Gamesa, GIMSA, Química SUMEX, Omega Tech and other organizations related to food and nutrition. He is also the director of the Protein Research and Development Center (Centro de Investigación y Desarrollo de Proteínas-CIDPRO). His research specialties are the processing of cereals and oil-producing seeds, the extraction of phytochemicals for medicinal use and fermentation enzyme biotechnology. He has published seven books, 29 book chapters, 98 articles in peer-reviewed journals, eight encyclopedia articles and holds two patents, and has applications pending for eight more. He also developed a type of winter wheat used in the United States.

Dra. Dora Elvira García González

She is the leader of the research group Transformation and Sustainability. She specializes in ethics, political philosophy, hermeneutics and the philosophy of culture. Her research lines include ethics, the culture of peace, human rights, water, and sustainable cities. She investigates strategies, methods and tactics to self-sustain human social processes in the present and in the future. She has been a visiting scholar at the University of Granada, Spain, the National University of Comahue and the University of Barcelona. She also serves as the academic leader of strategic projects in the humanities since 2009 and the coordinator of the UNESCO group in ethics and human rights.

RESEARCH FACULTY

Dra. Raquel Minerva Castaño González

She is the leader of the research group Consumer Behavior. Her research lines include brands and adoption of innovations, marketing strategies, cultural meanings of consumption, responsible consumer behavior and social welfare. Her purpose is to understand the factors that influence consumer behavior in the context of the globalization process to identify market opportunities and develop business strategies based on preferences and consumption patterns. She has participated in consulting and training courses for international companies, such as Cervecería Cuauhtémoc-Moctezuma, Gamesa, Cadena Comercial OXXO, HEB and Whirlpool. She received the best paper award from the American Marketing Association (AMA) for the paper published in 2012 "How Close Brands Are Included in the Self: Psychological and Neural.

Dr. José Florencio Fernández Santillán

He holds two doctorates in political ideas and in political science. He has taught courses, carried out research projects and had fellowships with Harvard University's John F. Kennedy School of Government since 2003 as a specialist in political analysis. He is also a visiting scholar at Georgetown University.
He regularly writes for *El Universal* (a Mexican newspaper); he has been named an electoral advisor for the General Council of the Federal Electoral Institute (Instituto Federal Electoral), as well as for the editorial committee of the journal of the Mexican Senate, and for the magazine *Este País*.

Dr. Carlos Manuel Urzúa Macías

With a Ph.D in economics, he specializes in economic theory and econometrics. He was Secretary of Finance in the Mexico City government (2000 to 2003). He has worked as a consultant to the World Bank, as well as the United Nations Economic Commission for Latin America and the Caribbean, the United Nations Development Programme and the Organisation for Economic Co-operation and Development. He has published eight books on economics, two books on poetry, and written dozens of articlesin various international journals.

Dra. Marisela Rodríguez Salvador

phD on Business Management at the Polytechnic University of Catalonia (1999).
She belongs to the pioneers groups on the field of Competitive Technology Intelligence on Iberoamerica.
In 2001 she established the research area of Competitive Technology Intelligence for Innovation at Tecnológico de Monterrey, campus Monterrey. She has provided consulting services, courses and conferences for more than 100 organizations in Latin America and Europe.
She has published more than 100 articles in top refereed journals and conference proceedings in Europe, USA, and Latin America. And has several national and international awards including Romulo Garza award (2011) and Tec Woman (2014).
She is member of the National System of Researchers (SNI) of México (level 2) and she became the first woman at Tecnológico de Monterrey belonging to the Mexican Academy of Sciences.

Dra. Janet Gutiérrez Uribe

She received her PH.D. in Engineering with specialty in Biotechnology from Tecnológico de Monterrey in 2006, and her Master with specialty in Biotechnology for the same institution in 2003.
She has imparted class in Biotechnology area and coordinated the Biotechnology Research Center.
She has several articles in important journals, such as publish and filed patents.
Her research areas are the identification of substance with antioxidant, anticancer and anticholesterol activities in Mexican food.
Actually she is member of the National Researchers System (CONACYT) in Mexico, level 2, and belongs to Tecnológico de Monterrey NutriOmics Research Group.

Dr. Rajagopal

With a doctoral degree in marketing, he specializes in marketing related topics that include competitor analysis, marketing strategy, consumer behavior, selling systems, international marketing, services marketing, and new product development. He has been teaching in undergraduate, graduate and doctoral programs since 1984 in various management schools of high rank in India and at international destinations. He has a vast number of publications on marketing, including 42 books and more than 125 research papers.

RESEARCH FACULTY

Dr. Mario Moisés Alvarez

Specializing in biopharmaceutical engineering, he is the leader of the research group Cellular and Engineering Biofeedback. His research specialties include design of bio-reactors, transport phenomena and mathematical modeling of biological systems. He has published more than100 articles in prestigious international journals in his field, and given papers in several international forums and conferences. His activities have included the creation of a way to mass-produce a vaccine against the AH1N1 virus during the 2009 outbreak. More recently his group became involved in the design and fabrication of chips capable of producing monoclonal antibodies through anchorage dependent mammalian cell culture.

Dr. Bryan William Husted Corregan

He is the leader of the research group Social Innovation. He has worked at the Instituto de Empresa, Madrid, Military School in Bolivia and School of Business at York University. He currently holds a joint appointment with the Schulich School of Business, York University, where he Is a member of the Haub Chair in Business and Sustainability. His main research interests are in: business and international management business, economics and econometrics, finance, technology and Innovation management, and marketing. He received the SCOUPS Award for the most-highly cited author on Social Sciences in 2011.

Dr. Marco Antonio Rito Palomares

He is the leader of the research group Bioprocesses and Synthetic Biology. He is recognized as one of the most important biotechnologists in Mexico in the recovery and purification of bioproducts. He has been honored with the Jubilee Award 2003 granted by the International Foundation for Science (IFS) and the Rómulo Garza Reasearch Award 2002, at Tecnológico de Monterrey. He is a member of the prestigious Mexican Academy of Sciences and president of the Mexican Society of Biotechnology and Bioengineering, Nuevo León State Section. He has published more than 80 research papers and book chapters and holds five patents.

Dra. María de la Cruz Castro Ricalde

Maricruz Castro Ricalde has taught at the Tecnológico de Monterrey, campus Toluca, since 1987. She received her PH.D. from the Universidad Iberoamericana in 1996 and she also completed another one in the Basque Country University, in Spain, where she specialized in Journalism and Cinema. She had worked on essays about women filmmakers in Mexico and Mexican contemporary Literature, with particular focus on Gender and Cultural Studies.
She belongs to “Diana Moran”, a Mexican researching group centered on Literary Theory and Criticism, since 1998. Since 2006, she coordinates the book collection “Desbordar el canon. Escritoras mexicanas del siglo XX”, awarded by the Fondo Nacional para la Cultura y las Artes (FONCA) in 2006 and 2009. Maricruz is recognized by the highest scientific council in México, belonging to the National Researchers System (S.N.I.), at level 2.

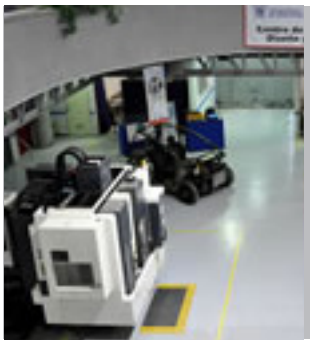
Dra. Anabella del Rosario Dávila Martínez

Dr. Anabella Davila is a full-time professor and the leader of the Strategic Focus Research Group (GIEES) of Strategy and Management of Organizations in Emerging Economies. Previously, she was the Ph.D. in Business Administration Program Director and Research Director at EGADE Business School Monterrey.
Dr. Davila has been a guest professor and invited researcher at several national and international universities, and she is currently an active member of the Academy of Management and of the National Researchers System (CONACYT) in Mexico, Tier II.
Her teaching and research expertise includes institutionalism, labor culture, human resource strategic management, sustainability, and human development.

Dra. María Inmaculada Castilla de Cortázar

Inma Castilla Cortazar Larrea holds a doctorate in medicine from the University of the Basque Country, with postdoc in Marburg (Germany) at the Department of Basic Hepatology.
She has won awards for biomedical research, "Gil-Vernet" of the Royal Academy of Medicine of Catalonia; "Juan Antonio Garcia Torres" of the Royal Academy of Medicine of Granada; Institute of Spain. Currently She is the Director of the Clinical Doctorate of the National School of Medicine at Tecnologico de Monterrey and she is the Group leader of the Molecular Medicine Research Group, where she develops the study of the molecular and cellular alterations in diseases development and treatment. Her research lines are focused on the study of pathophysiology at the cellular and molecular level.

RESEARCH CENTERS



The center focuses on the training of researchers and specialist consultants seeking to participate in the identification and resolution of issues raised by the challenges of globalization of design and product engineering, intelligent manufacturing processes and reconfigurable and logistics systems. CIDyT is based on the use of its intellectual capital, infrastructure and strategic alliances with key technology providers and universities of international prestige for maximum results.

CIDYT

Center for Innovation in Design and Technology

CAALCA

Water Center for Latin America and the Caribbean

The center conducts research and does consulting, providing new knowledge, training and disseminating knowledge for sustainable management and use of water resources in Latin America and the Caribbean.

There are three main areas: bioprocess engineering, food biotechnology and pharmaceutical biotechnology. The research is focused not only on knowledge generation, publication of scientific articles and preparing human resources' level of excellence, but also on the generation of patents, technology solutions for industry, technology transfer and the generation and incubation of new technology-based businesses.

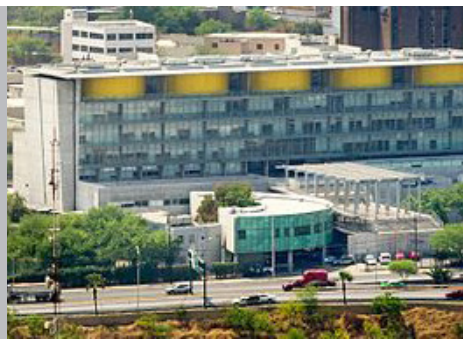
CB-FEMSA

Biotechnology-FEMSA Center

CITES

Center for Innovation and Transfer in Health

Center specialized in research, innovation and transfer in the area of health. The principal lines of investigation include: cardiology, cell therapy, hematology and cancer, ophthalmology, nutrition, health system management.



INTERNATIONAL COLLABORATION

BIOTECHNOLOGY
Cornell University
Texas A&M University
St. Jude Children´s Research Hospital

MECHATRONICS AND ENGINEERING
Massachusetts Institute of Technology
Rice University
University Of California

INFORMATION TECHNOLOGIES, ELECTRONICS AND COMMUNICATIONS
University Of California, Berkeley
Carnegie - Mellon University

SUSTAINABLE DEVELOPMENT
Arizona State University
University of Calgary

PUBLIC POLICY
Princeton University
Fudan University

BUSINESS
Babson College
Northeastern University

HEALTH
Johns Hopkins University
Houston Methodist Leading Medicine
USP Universidade de São Paulo

EDUCATION, HUMANITIES, AND SOCIAL SCIENCES
University Of California, Berkeley
UNESCO

Massachusetts Institute of Technology

Tecnológico de Monterrey

MIT – TECNOLÓGICO DE MONTERREY
Research Agreement

On October 31, 2014 a cooperation agreement was signed with MIT. Collaboration with MIT represents a strategic opportunity to enhance the research initiative with Tecnológico de Monterrey in nanoscience and nanotechnologies.

The possibilities of this cooperation and collaboration agreement include:

- Promotion of student and researcher exchange
- Enhancement of scientific production
- Encouraging creativity and active learning to exploit the most sophisticated technological knowledge network in the world
- Developing superior competencies and capacities to meet growing industrial competitiveness, foster environmental sustainability and improve the quality life of people.

MIT – Tecnológico de Monterrey

Massachusetts Institute of Technology

Tecnológico de Monterrey

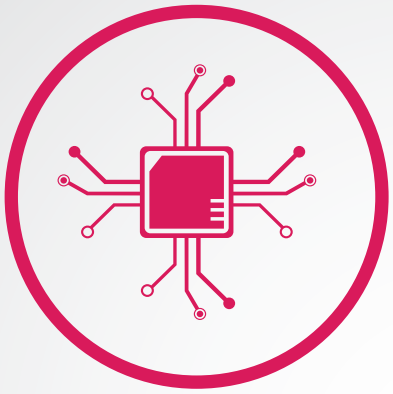
MIT – TECNOLÓGICO DE MONTERREY
Research Agreement

MIT.NANO Research Areas:
Personal Medicine
Energy Systems
Ubiquitous Computing
Multiscale Manufacturing
Sustainable Infrastructure
Quantum Science and Technology

TEC.NANO Research Areas:
Personal Medicine
Energy systems
Multiscale Manufacturing
Quantum Science and Technology

STRATEGIC INITIATIVES

TEC . NANO



ENERGY

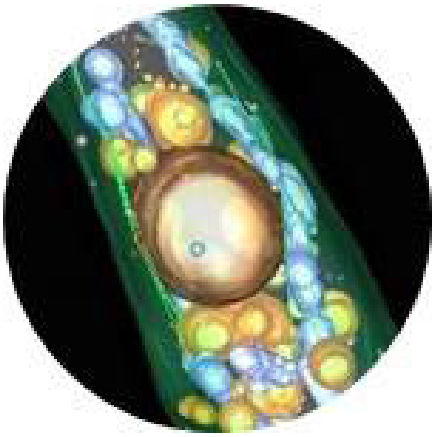
EDUCATION

ENTREPRENEURSHIP

STRATEGIC INITIATIVES: TEC.NANO

Initiative with the aim of supporting research in areas of nanoscience and nanotechnology through interdisciplinary projects in:

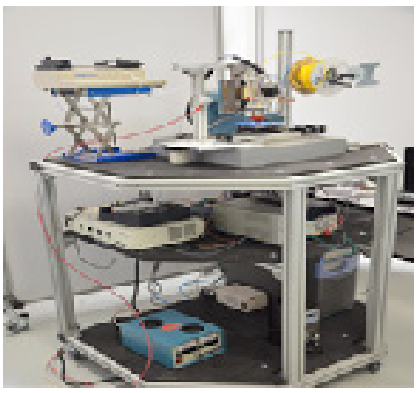
- Biotechnology
- Mechatronics
- Sustainability
- Information and Communication Technologies
- Health
- Education
- Entrepreneurship
- Public Policy

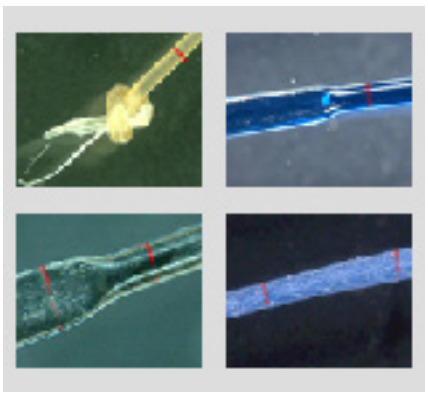


STRATEGIC INITIATIVES: TEC.NANO

Ongoing Projects at Tecnológico de Monterrey

- Chemical and electrochemical synthesis of metallic nanoparticles
- New constitutive models of nanostructured materials
- Intelligent surgical meshes
- 3D printing for scaffolds in tissue engineering
- Surface engineering
- Biomems: C-MEMs, dielectrophoresis, CD-microfluidics
- Micromachines and micro-factories
- Development of micromixers for mass transfer in microfluidic cells
- Nanoelectronics (nanosystems; low-power consumption, statistical circuit theory)
- Quantum information processing
- Design of nanostructures for sensor development
- Design of nanoplatforms for controlled release of genetic material and drugs
- Nano-optics: Interaction of light with nano-systems
- Interactions between nano-optical systems





STRATEGIC INITIATIVES: ENERGY

Our goal is to contribute to the competitive development of the energy sector in Mexico.

Research:

• Research in political economy of the Mexican energy reform

• Assessment of social impact, urban risk and strategic opportunities at the local level with energy projects

• Public policy analysis for renewable energy

• Impact analysis of hydraulic fracture technology

Outreach:

• Regional strategic plan for the energy sector

• Capital budgeting in gas & oil

• Identifying business opportunities for the value chain energy sector

Berkeley UNIVERSITY OF CALIFORNIA

ASU ARIZONA STATE UNIVERSITY

RICE

BECI BERKELEY ENERGY & CLIMATE INSTITUTE LBNL & UC BERKELEY

UCDAVIS UNIVERSITY OF CALIFORNIA

RICE UNIVERSITY'S BAKER INSTITUTE FOR PUBLIC POLICY

BI-NATIONAL LABORATORY ON SMART SUSTAINABLE ENERGY MANAGEMENT AND TECHNOLOGY TRAINING

Supported by CONACYT and Energy Sustainability Program to develop:

INFRAESTRUCTURE

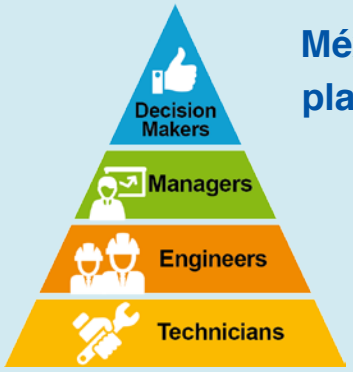
- Decision stage center
- High performance computing platform
- Virtual laboratories
- In site laboratories

RESEARCH

4 Binational research networks

8 Research projects

TRAINING



MéxicoX platform

ACCREDITATIONS

450 Certified and authorized persons

With the participation of companies, institutions and universities in collaboration with Tecnológico de Monterrey

Tecnológico de Monterrey · SEP · TECNOLÓGICO NACIONAL DE MÉXICO · INSTITUTO DE INVESTIGACIONES ELECTRICAS · Berkeley UNIVERSITY OF CALIFORNIA · ASU ARIZONA STATE UNIVERSITY · CFE

RESEARCH PROJECTS:

1 Network — Intelligent decision models for the management of energy sustainability:

1.1	Technology platform for the decision-making
1.2	Interconnection of the Power Systems of the United States and Mexico
1.3	Change of the energy markets in México and evolution of energy markets in the United States

2 Network — Mathematical and knowledge models, optimization, simulation and visualization.

2.1	Bioenergy in Mexico - Comprehensive system for the mapping of feasible energy use routes
2.2	Bioenergy in Mexico - Comprehensive system for the mapping of feasible energy use routes

3 Network — Intelligent technology for the energy value chain

3.1	Advanced technologies to allow high penetration of renewable resources in distribution systems and micro-network
3.2	Technological challenges of integrating the generation of renewable energies to the grid of México
3.3	Restructuring of the market, efficiency and integration of renewable energies to the power sector in México

15 thousand people training in México through 10 MOOC related with the electric energy value chain

450 certified and authorized persons (3% of the MOOC participants)

155 Masters / Specialities

-Energetic Engineering

-Energetic Administration

-Administration of the Energy and his Renewable Sources

29 doctorate students

6

Postdocs

10 SNIs researchers

2 SNIs Instituto de Investigaciones Eléctricas

5 SNIs Tecnológico Nacional de México

3 UC Berkeley researchers

5 ASU researchers

STRATEGIC INITIATIVES: EDUCATION

Serve as a reference for how to educate in order to have an impact on learning processes at different levels:

- Educational policy
- Management of educational institutions
- Curriculum design
- Processes of teaching and learning in the classroom (intensive use of educational technology as a learning mediator)

Projects:

- Assessment for improving external educational evaluation system for public schools with low academic achievement
- Virtual Learning Center
- Center for improvement and educational innovation
- Institutional repository
- Resource Center for Academic Writing
- Culture of legality in primary and secondary schools

CREA
Centro de Recursos para la Escritura Académica del Tecnológico de Monterrey

Centro Virtual de Aprendizaje
IMPULSANDO EL EMPRENDIMIENTO Y LA EMPLEABILIDAD

Cultura de la legalidad en mi escuela

FORMANDO FORMADORES
Centro para la Superación e Innovación Educativa

OBSERVATORY of Educational Innovation Tecnológico de Monterrey

WE IDENTIFY AND ANALYZE THE EDUCATIONAL TRENDS THAT ARE SHAPING THE FUTURE OF LEARNING AND EDUCATION

Observatorio de Innovación Educativa
Esteban Venegas Villanueva

This year, the Observatory of Educational Innovation won the "Open Education Awards for Excellence", category OER Collection.

The Open Education Consortium is a global network of educational institutions, individuals and organizations that support an approach to education based on openness, including collaboration, innovation and collective development and use of open educational materials.

OBSERVE

IDENTIFY AND ANALYZE HIGH-IMPACT EDUCATIONAL TRENDS.

FOSTER

BOOST AND PROMOTE INNOVATION IN THE TECNOLÓGICO DE MONTERREY AND GLOBALLY.

SHARE

COMMUNICATE EFFICIENTLY AND TIMELY WHAT HAPPENS IN EDUCATIONAL INNOVATION.


OBSERVATORIO

Tecnológico de Monterrey

Reporte Semanal de Innovación Educativa

Martes 6 de septiembre de 2016

En esta entrega te compartimos un listado de dieciséis personas que están empleando su pasión y creatividad para cambiar la educación superior en los EE. UU. Por otro lado, la Universidad de Stanford publica un reporte sobre el posible impacto que tendrá la inteligencia artificial en todos los aspectos de la vida en el año 2030.

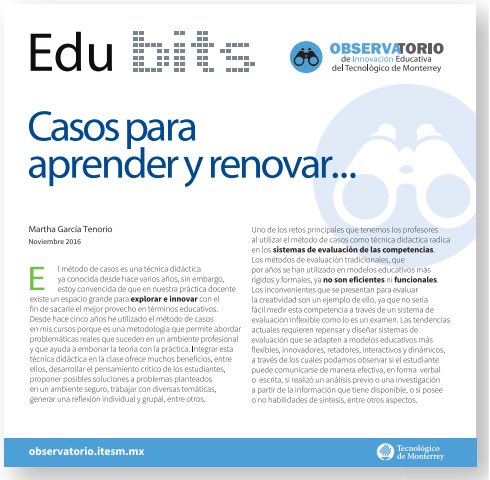
Destacadas

The Sixteen Most Innovative People in Higher Education
Washington Montly

- This list isn't a ranking, and it's by no means exhaustive. Consider it a snapshot of the various overlapping ways in wich creative, passionate people around the U.S.A. are working to make higher education more accesible, affordable, and effective.

WEEKLY REVIEW

Our Weekly Review is a curated media synthesis of the most relevant articles and stories on education technology and innovation.


Edu bits

OBSERVATORIO de Innovación Educativa del Tecnológico de Monterrey

Casos para aprender y renovar...

Martha García Tenorio
Noviembre 2016

El método de casos es una técnica didáctica ya conocida desde hace varios años, sin embargo, estoy convencida de que en nuestra práctica docente existe un espacio grande para **explorar e innovar** con el fin de sacarle el mejor provecho en términos educativos. Desde hace cinco años he utilizado el método de casos en mis cursos porque es una metodología que permite abordar problemáticas reales que suceden en un ambiente profesional y que ayuda a embonar la teoría con la práctica. Integrar esta técnica didáctica en la clase ofrece muchos beneficios, entre ellos, desarrollar el pensamiento crítico de los estudiantes, proponer posibles soluciones a problemas planteados en un ambiente seguro, trabajar con diversas temáticas, generar una reflexión individual y grupal, entre otros.

Uno de los retos principales que tenemos los profesores al utilizar el método de casos como técnica didáctica radica en los **sistemas de evaluación de las competencias**. Los métodos de evaluación tradicionales, que por años se han utilizado en modelos educativos más rígidos y formales, ya **no son eficientes** ni **funcionales**. Los inconvenientes que se presentan para evaluar la creatividad son un ejemplo de ello, ya que no sería fácil medir esta competencia a través de un sistema de evaluación inflexible como lo es un examen. Las tendencias actuales requieren repensar y diseñar sistemas de evaluación que se adapten a modelos educativos más flexibles, innovadores, retadores, interactivos y dinámicos, a través de los cuales podamos observar si el estudiante puede comunicarse de manera efectiva, en forma verbal o escrita, si realizó un análisis previo o una investigación a partir de la información que tiene disponible, o si posee o no habilidades de síntesis, entre otros aspectos.

observatorio.itesm.mx

Tecnológico de Monterrey

EDU BITS

Brief reports on education and innovation issues, events and interviews with key experts and ed leaders.

CEDDIE connection

The Educational Innovation and Teaching Development Center (CEDDIE) support the diffusion, definition, and application of TEC21 Model, with the creation of revolutionary ways of teaching development through research and educational innovation.

The TEC21 initiative is created to align the efforts and modernize, adapt and guarantee the high academic quality standards of Tecnológico de Monterrey.

Some innovation projects of CEDDIE are:

- **The film as didactic resource**
- **"Gamification": a fun approach to learning**
- **Design acting**
- **The life game**


OBSERVATORIO de Innovación Educativa del Tecnológico de Monterrey

Tecnológico de Monterrey

Edu Trends

SEP 2016

50 Puntos
Trabajo en equipo
Avance
Vidas
Banderas

150 Puntos
Trabajo en equipo
Avance
Vidas
Banderas

INICIO

Gamificación

EDU TRENDS

In-depth analysis of trends with the greatest potential to impact on Higher Education.

STRATEGIC INITIATIVES: ENTREPRENEURSHIP

• Fostering the entrepreneurial spirit among students and professors

• The Eugenio Garza Laguera Institute for Entrepreneurship is the largest entrepreneurship ecosystem in Latin America.

• All the entrepreneurship initiatives contribute to generating jobs and to strengthening the national economy by means of knowledge transfer to create wealth and the growth of companies.

• In 2013, we created INC MTY, an entrepreneurship and innovation festival in which Mexican entrepreneurs, innovators and investors participate. INC MTY is the most important celebration of the entrepreneurial spirit.

• Strategic collaboration: Babson College's Global Consortium

BABSON

Instituto de Emprendimiento Eugenio Garza Lagüera

INC mty
INNOVATE.NETWORK.CREATE

GEM Global Entrepreneurship Monitor

737 COLLABORATING INSTITUTIONS

2011–2015

1,430 CO-AUTHORED PUBLICATIONS

2011–2015

Examples of Collaborating Institutions

University	Country	Citations per Publication	Citations	Co-authored publications
Fudan University	China	123	123	1
University of Adelaide	Australia	90	90	1
Swiss Institute of Bioinformatics	Switzerland	70	70	1
University of Michigan	United States	67.3	202	3
Dana-Farber Cancer Institute	United States	64.5	129	2
University of Manchester	United Kingdom	58	290	5
University of Ottawa	Canada	41	82	2
University of Geneva	Switzerland	40.5	81	2
University of Cambridge	United Kingdom	35.5	71	2
Yale University	United States	35	70	2
Stanford University	United States	30	120	4
Johns Hopkins University	United States	26.2	367	14
Harvard University	United States	24.8	447	18
Massachusetts Institute of Technology	United States	14.4	202	14
Secretaria de Salud	Mexico	14.3	129	9
Universidad Nacional Autonoma de Mexico	Mexico	2.1	189	88
Universidad Autonoma de Nuevo Leon	Mexico	2.7	423	156

INDUSTRIAL PARTNERSHIPS

EXAMPLES OF RESEARCH INDUSTRIAL PROJECTS

Navistar

Project: Road Load Data Acquisition
The project has a multi-year horizon and has the primary purpose of developing RLDA (Road Load Data Acquisition) systems that allow collection of information, data and knowledge about the behavior of vehicles on Mexican roads, with the aim of providing feedback to the design process and finding different failure causes in durability and load during operation

Bocar

Is a Company that produce pieces and complex assembles for automotive industry. The research projects related to this area in Tec de Monterrey are:

- Production optimization based in simulation
- On line measurement
- Diagnosis of a high speed mechanized center

Roberto Rocca Research Chair

- Energy efficiency in electric and thermal industrial applications
- Energy conversion and power electronics

EXAMPLES OF RESEARCH INDUSTRIAL PROJECTS

Industrial Consortium in Energy

Companies: Schneider Electric, Ternium, TenarisTamsa, AMI-GE, Cerrey, Prolec-GE, Nutec Bickley, Tenova, Acciona Energy, Diram
Main research areas: Power electronics, design of electrical equipment, optimal dispatch of energy in interconnected power systems, combustion systems, heat transfer and modeling and simulation of industrial processes

Examples of projects:
- Power control optimization of AC electric arc furnaces
- Heat transfer simulation of windings in power transformers for estimation of hot spots
- Compliant mechanisms in miniature circuit breakers

FEMSA

Project: Emerging Contaminant Biodegradation by Enzymatic Processes
This project focuses on the study of the potential use of enzymatic processes for bioremediation of aquatic systems by enzymes extracted from a microorganism obtained from the northwestern region of Mexico, to implement processes of degradation of various compounds. The investigation is focused on kinetics, the major way of degradation of the analysis of interest and toxic by-products.

Metalsa

Project: Design and development of electric propulsion system and semi-active suspension for a light load vehicle
In this project Tecnológico de Monterrey designed a control system for a semi-active suspension in an embedded architecture based on a CAN network. The goal of the algorithm is comfort and individual surface grip on each corner of the car, besides a control system that coordinates each independent corner. The control system is based on the specification and modeling of electrohydraulic dampers, including tolerance to some faults. The system was validated in a commercial vehicle.

Leadership Institute

With the objective of make science in the leadership area, in 2017 is created the new Leadership Institute of Tecnológico de Monterrey, which reinforce the institute commitment to create competitive, transformative, innovates and human sense leaders.

The director of Leadership Institute is Santiago Vázquez Blanco, Phd in Economics by Santiago de Compostela University, and expert in leadership issues, such as positive psychology and happiness science. He is author of “La felicidad en el trabajo… y en la vida”.

EDUCATION IMPACT

Education Model

MODELO EDUCATIVO TEC21

EDUCATION IMPACT

MODELO EDUCATIVO TEC21

EDUCATION IMPACT

Graduate Programs

PhD	12
Master	34
Medical Specialties	16
Specialties	6

68

Busines	8
Public Policy	6
Social Sciences and Humanities	9
Engineering and Science	26
Health	17
Online Business	2

68

EDUCATION IMPACT

Undergraduate Students with Research Experience

Pablo Israel Morales Guzmán, IFI

Materialography, Fractograpgy and Ageing of engineering materials.

W. Österle, A.I. Dmitriev, T. Gradt, I. Häusler, B. Hammouri, P.I. Morales Guzman, B. Wetzel, D. Yigit, G. Zhang, Exploring the beneficial role of tribofilms formed from an epoxy-based hybrid nanocomposite, Tribology International, Volume 88, August 2015, Pages 126-134, ISSN 0301-679X, http://dx.doi.org/10.1016/j.triboint.2015.03.006.

Hilda Cecilia Martinez Escobedo, BBE

Effect of Agave americana and Agave salmiana Ripeness on Saponin Content from Aguamiel.

Effect of Agave americana and Agave salmiana Ripeness on Saponin Content from Aguamiel (Agave Sap)
Ana María Leal-Díaz, Liliana Santos-Zea, Hilda Cecilia Martínez-Escobedo, Daniel Guajardo-Flores, Janet Alejandra Gutiérrez-Uribe, and Sergio Othón Serna-Saldivar Journal of Agricultural and Food Chemistry 2015 63 (15), 3924-3930 DOI: 10.1021/acs.jafc.5b00883

Carlos Martínez Vitela, BBE

Validación de bioactividad de peptidos de frijol

Antunes-Ricardo M., Gutiérrez-Uribe J., Martínez-Vitela C., Serna-Saldívar S. (2015) Topical Anti-inflammatory Effects of Isorhamnetin glycosides isolated from Opuntia ficus-indica. BioMed Research International

AWARDS & PRIZES

Wharton University of Pennsylvania

SEI Center for Advanced Studies in Management

QS STARS AWARDS 2016 REIMAGINE EDUCATION

QS Stars Reimagine Education Awards

2016

In this edition, 807 project proposals were received, 520 were evaluated, 156 were selected for shortlisted presentations, and 58 were finalists of almost 30 universities around de world. This contest has 15 participation categories.

Tecnológico de Monterrey participated with 16 projects, 9 of them were elected finalist, and 3 of them were awarded:

Projects Awarded:

"Incubation Cells: Researchers and Entrepreneurs". Project from James Fangmeyer Jr., Francisco Cantú, Silvia Patricia Mora and Nathalíe Galeano, professors from Campus Monterrey. The project consists in the incubation of technological base business, using the patents rights results of thesis of PhD and Masters of Tecnológico de Monterrey alumni. This patents are registered by the students and their professors, with the aim of become them in real business. The Incubation Cells Program role is to provide them business, financial, legal, informatics and marketing advising. Also, this program can provide information about seed capital networks, research resources, and even technological parks office space. This project won **the first place in the Nurturing Employability Award category.**

"Semester i – A new way of learning". Project from Eduardo Bastida Escamilla and Luis Enrique Herrera del Canto, professors from Campus Santa Fe. The project explains the Semestre i methodology, one of the most innovative initiative of competence-based teaching and learning challenge, and part of Modelo Educativo Tec21. This project won **the first place in Hybrid Learning Innovation-Poster in Latam region.**

"Professor Avatar: Telepresence Model". Project from Luis Eduardo Luevano Belmonte and Eduardo López de Lara Díaz, from Campus Zacatecas, and Eduardo González Mendívil from Campus Monterrey. The Project consist in a telepresence model for increase the distance education learning-teaching process, and contribute to the humanization and revaluation of the professor and student's social presence in the distance education model. The project won **second place in Best us of Information and Communication Technology Tools.**

Projects in the final evaluation:

1. **"Semana i: Innovation Challenge Week for Healthcare",** from Silvia Lizett Olivares Olivares, Mildred Vanessa López Cabrera, and Jorge Eugenio Valdez García from Campus Monterrey. The project took part in the Presence Learning Innovation category.
2. **"Faculty Development Program for Clinical Educators",** from Silvia Lizett Olivares Olivares, Mildred Vanessa López Cabrera, Martha Ruth Loyola, and Jorge Eugenio Valdez García from Campus Monterrey. The project took part in the Presence Learning Innovation category.
3. **"Use of Innovative Learning Spaces"**, from Martha Elena Núñez López from Campus Puebla. The project took part in the Presence Learning Innovation category.
4. **"Numerical methods hybrid learning: a STEM Education's bridge"**, from Francisco Javier Delgado Cepeda, from Campus Estado de México. The project took part in the Hybrid Learning Innovation category.
5. **"CONTINUUM: Digital media arts creative hub"**, from Miguel Ángel Nájera Mora, Jacob Bañuelos Capistrán and Juan Carlos Olmedo Estrada, from Campus Ciudad de México. The project took part in the Digital Content category.
6. **"Science Education and Adaptive Evaluation at High School",** from Rodrigo Ponce Díaz, from Campus Eugenio Garza Lagüera. The project took part in the Teaching Delivery category.

SCIENTIFIC IMPACT

RELEVANT PUBLICATIONS (2012-2016)

Interim results from the international trial of second sight's visual prosthesis
Ophthalmology (2012), 119(4) p. 779-788.
Humayun M.S., Dorn J.D., Da Cruz L., Dagnelie G., Sahel J.-A., Stanga P.E., Cideciyan A.V., Duncan J.L., Eliott D., Filley E., Ho A.C., **Santos A.**, Safran A.B., Arditi A., Del Priore L.V., Greenberg R.J.

Transformation of the excited state and photovoltaic efficiency of CH3NH3PbI3 perovskite upon controlled exposure to humidified air
Journal of the American Chemical Society (2015), 137(4) p. 1530-1538.
Christians J.A., **Miranda Herrera P.A.**, Kamat P.V.

Landscape of genomic alterations in cervical carcinomas
Nature (2014), 506(7488) p. 371-375.
Ojesina A.I., Lichtenstein L., Freeman S.S., Pedamallu C.S., Imaz-Rosshandler I., Pugh T.J., Cherniack A.D., Ambrogio L., Cibulskis K., Bertelsen B., Romero-Cordoba S., **Treviño V.**, Vazquez-Santillan K., Guadarrama A.S., Wright A.A., Rosenberg M.W., Duke F., Kaplan B., Wang R., Nickerson E., Walline H.M., Lawrence M.S., Stewart C., Carter S.L., McKenna A., Rodriguez-Sanchez I.P., Espinosa-Castilla M., Woie K., Bjorge L., Wik E., Halle M.K., Hoivik E.A., Krakstad C., Gabiño N.B., Gómez-Macías G.S., Valdez-Chapa L.D., Garza-Rodríguez M.L., Maytorena G., Vazquez J., Rodea C., Cravioto A., Cortes M.L., Greulich H., Crum C.P., Neuberg D.S., Hidalgo-Miranda A., Escareno C.R., Akslen L.A., Carey T.E., Vintermyr O.K., Gabriel S.B., Barrera-Saldaña H.A., Melendez-Zajgla J., Getz G., Salvesen H.B., Meyerson M.

Quantum walks: A comprehensive review
Quantum Information Processing (2012), 11(5) p. 1015-1106.
Venegas-Andraca S.E.

New genetic loci link adipose and insulin biology to body fat distribution
Nature (2015), 518(7538) p. 187-196.
Shungin, D, [**Vallejo**, E.], et al.

Muc5b is required for airway defence
Nature (2014), 505(7483) p. 412-416.
Roy M.G., Livraghi-Butrico A., Fletcher A.A., McElwee M.M., Evans S.E., Boerner R.M., Alexander S.N., Bellinghausen L.K., Song A.S., Petrova Y.M., Tuvim M.J., Adachi R., **Romo I.**, Bordt A.S., Bowden M.G., Sisson J.H., Woodruff P.G., Thornton D.J., Rousseau K., De La Garza M.M., Moghaddam S.J., Karmouty-Quintana H., Blackburn M.R., Drouin S.M., Davis C.W., Terrell K.A., Grubb B.R., O'Neal W.K., Flores S.C., Cota-Gomez A., Lozupone C.A., Donnelly J.M., Watson A.M., Hennessy C.E., Keith R.C., Yang I.V., Barthel L., Henson P.M., Janssen W.J., Schwartz D.A., Boucher R.C., Dickey B.F., Evans C.M.

Declarations for sustainability in higher education: Becoming better leaders, through addressing the university system
Journal of Cleaner Production (2013), 48 p. 10-19.
Lozano R., Lukman R., **Lozano F.J.**, Huisingh D., Lambrechts W.

Inferring tumour purity and stromal and immune cell admixture from expression data
Nature Communications (2013), 4(2612).
Yoshihara K., Shahmoradgoli M., **Martínez E.**, Vegesna R., Kim H., Torres-Garcia W., **Treviño V.**, Shen H., Laird P.W., Levine D.A., Carter S.L., Getz G., Stemke-Hale K., Mills G.B., Verhaak R.G.W.

Bound phenolics in foods, a review
Food Chemistry (2014), 152 p. 46-55.
Acosta-Estrada B.A., Gutiérrez-Uribe J.A., Serna-Saldívar S.O.

SCIENTIFIC IMPACT

RELEVANT PUBLICATIONS

SurvExpress: An Online Biomarker Validation Tool and Database for Cancer Gene Expression Data Using Survival Analysis
PLoS ONE (2013), 8(9) art. e74250.
Aguirre-Gamboa R., Gomez-Rueda H., Martínez-Ledesma E., Martínez-Torteya A., Chacolla-Huaringa R., Rodriguez-Barrientos A., Tamez-Peña J.G., Treviño V.

High temperature latent heat thermal energy storage: Phase change materials, design considerations and performance enhancement techniques
Renewable and Sustainable Energy Reviews (2013), 27 p. 724-737.
Cárdenas B., León N.

World Allergy Organization-McMaster University Guidelines for Allergic Disease Prevention (GLAD-P): Probiotics
World Allergy Organization Journal (2015), 8(1) art. 55.
Fiocchi A., Pawankar R., **Cuello-Garcia C.**, Ahn K., Al-Hammadi S., Agarwal A., Beyer K., Burks W., Canonica G.W., Ebisawa M., Gandhi S., Kamenwa R., Lee B.W., Li H., Prescott S., Riva J.J., Rosenwasser L., Sampson H., Spigler M., Terracciano L., Vereda-Ortiz A., Waserman S., Yepes-Nuñez J.J., Brozek J.L., Schünemann H.J.

Fuzzy self-tuning PID semiglobal regulator for robot manipulators
IEEE Transactions on Industrial Electronics (2012), 59(6) p. 2709-2717.
Meza J.L., Santibáñez V., **Soto R.**, Llama M.A.

A tenant-based resource allocation model for scaling Software-as-a-Service applications over cloud computing infrastructures
Future Generation Computer Systems (2013), 29(1) p. 273-286.
Espadas J., Molina A., Jiménez G., Molina M., Ramírez R., Concha D.

State-of-the-art in downstream processing of monoclonal antibodies: Process trends in design and validation
Biotechnology Progress (2012), 28(4) p. 899-916.
Marichal-Gallardo P.A., Álvarez M.M.

Optimization of cutting parameters for minimizing energy consumption in turning of AISI 6061 T6 using Taguchi methodology and ANOVA
Journal of Cleaner Production (2013), 53 p. 195-203.
Camposeco-Negrete C.

Advancing Higher Education for Sustainable Development: International insights and critical reflections
Journal of Cleaner Production (2013), 48 p. 3-9.
Lozano R., **Lozano F.J.**, Mulder K., Huisingh D., Waas T.

Shaping, organizing, and rethinking service innovation: A multidimensional framework
Journal of Service Management (2012), 23(5) p. 696-715.
Rubalcaba L., Michel S., Sundbo J., Brown S.W., **Reynoso J.**

Synthesis, properties, and biomedical applications of gelatin methacryloyl (GelMA) hydrogels
Biomaterials (2015), 73 p. 254-271.
Yue K., **Trujillo-de Santiago G., Alvarez M.M.**, Tamayol A., Annabi N., Khademhosseini A.

SCIENTIFIC IMPACT

RELEVANT PUBLICATIONS

Long-Term Results from an Epiretinal Prosthesis to Restore Sight to the Blind
Ophthalmology (2015), 122(8) p. 1547-1554.
Ho A.C., Humayun M.S., Dorn J.D., Da Cruz L., Dagnelie G., Handa J., Barale P.-O., Sahel J.-A., Stanga P.E., Hafezi F., Safran A.B., Salzmann J., **Santos A.**, Birch D., Spencer R., Cideciyan A.V., De Juan E., Duncan J.L., Eliott D., Fawzi A., Olmos De Koo L.C., Brown G.C., Haller J.A., Regillo C.D., Del Priore L.V., Arditi A., Geruschat D.R., Greenberg R.J.

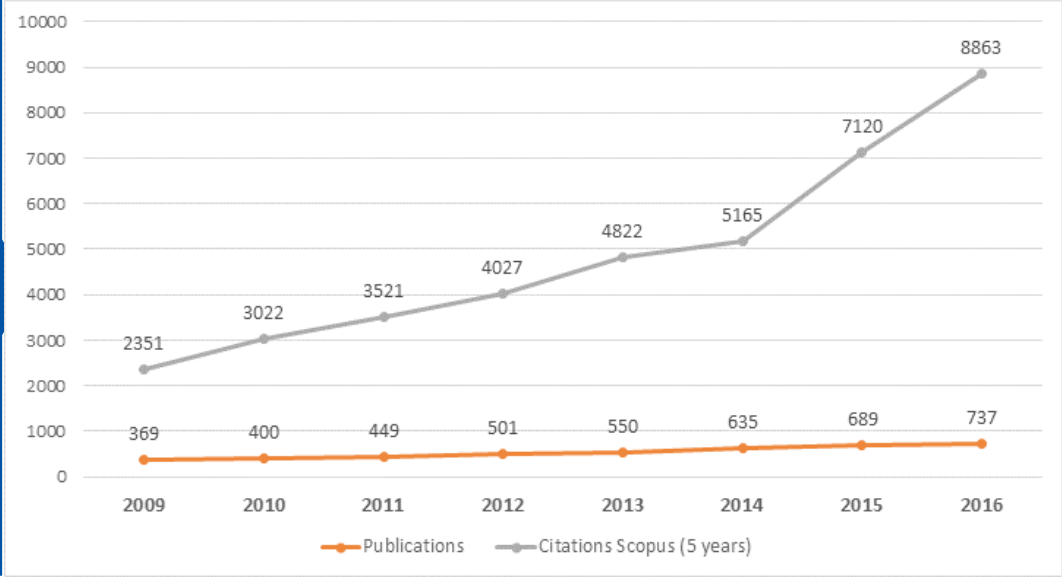
METODOLOGÍA
Las 20 publicaciones más citadas en Scopus con el query:

((AF-ID("Hospital San Jose Tec de Monterrey" 60018640))) OR (AF-ID("Tecnologico de Monterrey" 60007966)) AND (LIMIT-TO(PUBYEAR,2016) OR LIMIT-TO(PUBYEAR,2015) OR LIMIT-TO(PUBYEAR,2014) OR LIMIT-TO(PUBYEAR,2013) OR LIMIT-TO(PUBYEAR,2012))

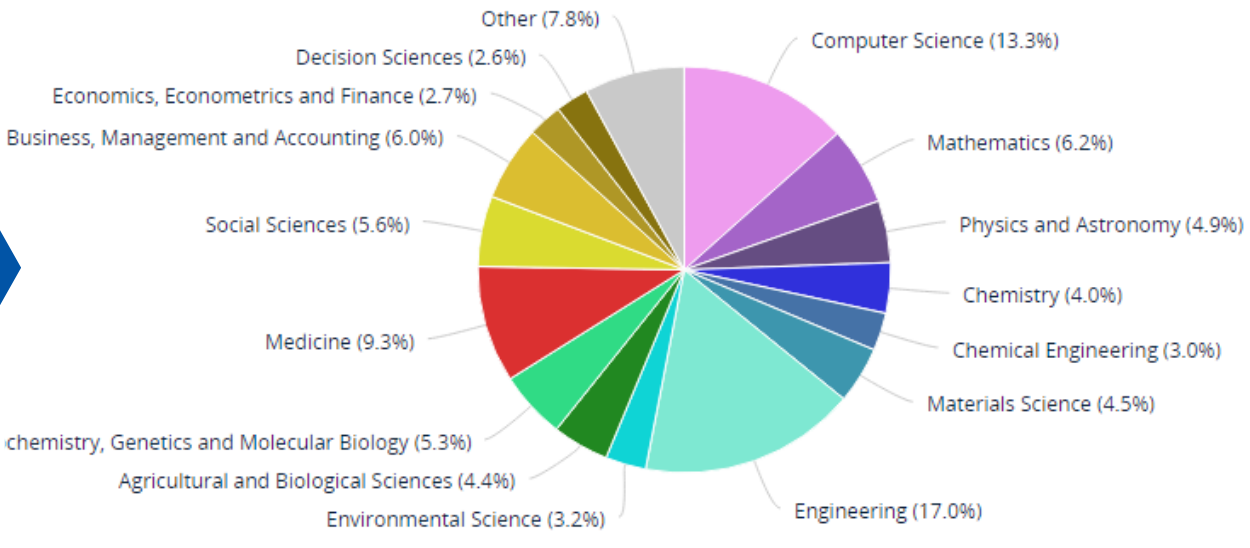
SCIENTIFIC IMPACT

Papers and Citations in Scopus

PAPERS AND CITATIONS IN SCOPUS



PUBLICATION AREAS



ECONOMIC IMPACT

Technology Transfer Office Network

12 P&TTOS

10 Certified P&TTOS

2010 - 2016

PATENT APPLICATIONS IN MEXICO

228

PATENTS GRANTED

92

INDUSTRIAL DESIGNS GRANTED

UTILITY MODELS GRANTED

TRADE MARKS

LICENCING

ECONOMIC IMPACT

Technology-based companies incubated by professors and students per sector

2010 - 2016

ECONOMIC IMPACT

Examples of tech-based companies

Onko Solutions S. de R.L. de C.V.
A high technology company that aims to establish a progressive dynamic for the development and commercialization of technology based on the use of innovative technology in medical devices. At present Onko is commercializing a cervical cancer medical diagnosis device that is reliable, affordable, portable, user-friendly, and minimally intrusive.

EZKATEC S. de R.L. de C.V.
A biotechnology company devoted to innovating, researching and developing probiotic formulations that do not require cold chain for the dairy and pharmaceutical industries. The technology is an integrated high performance process to obtain biomass of probiotic lactic acid bacteria (probiotic), a dairy-based nutritional serum product that improves the quality and health of the general population.

WeaRobot S.A.P.I. de C.V.
Devoted to designing, developing and producing rehabilitation devices.
The use of muscle and brain signals to control robotic rehabilitation can help greatly in the rehabilitation of limbs to supplement control over crucial parameter movement therapy. Aukera Foundation (the social partner of WeaRobot) is an online open innovation platform and crowdfunding offering free prosthetics, orthotics and exoskeletons.

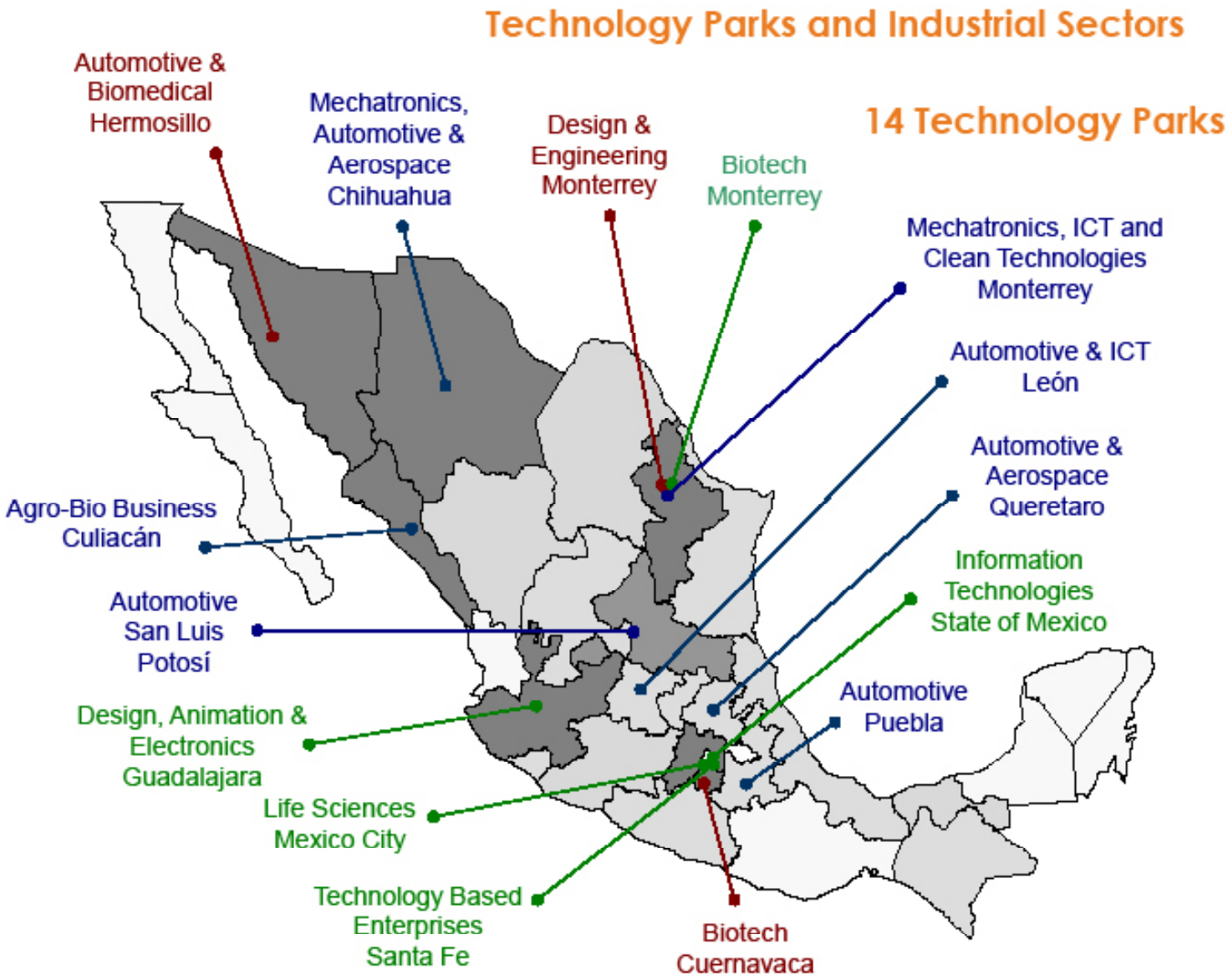
Automatische Technik S.A.P.I. de C.V.
Its the first mexican Company oriented in the production of Delta robotic arms. They can be used to pack, unpack or re-pack any kind of products in small bokes. This company offers solutions oriented to increase production and reduce operation costs, besides, this technology help companies to level up their economies and increase their products quality.

Bio-Recombine Technologies, S. de R. L. de C.V.
A biotechnology company devoted to designing, developing and producing biomolecules of high commercial value (recombinant proteins) to serve the biopharmaceutical market developing vaccines and drugs, and the diagnostic and food sectors through diseasing enzymes with high commercial value.

Global Nano Aditives, S.A. de C.V.
A nanotechnology company devoted to the development of nanofluids for coolants and lubricants. These refrigerants contain nanoparticles dispersed and stabilized to provide better heat conduction properties and wear reduction; applications in electrical transformers, automotive systems, and the metalworking industry in general. This technology was recognized as a TechConnect Global Innovation Awardee at the "TechConnect National Innovation Summit",Washington, D.C., 2014.

ECONOMIC IMPACT

Technology Parks and Industrial Sectors



ECONOMIC IMPACT

Incubator and Accelerator Networks

26 INCUBATORS

16 ACCELERATORS

PROJECTS THAT TRANSFORM MEXICO

Super antioxidants vegetables to improve health

The principal cause of death in México is related with obesity, diabetics, cardiovascular diseases and hypertension caused for lack of prevention strategies. One action to prevent these diseases is increase the ingest of antioxidant compounds that can be present in vitamins and nutritional supplements, but also in their natural state, in the vegetables.

Research professor Daniel Alberto Jacobo Velázquez, and the research group "Bioprocesses and Synthetic Biology" are working in a simple and low cost process that increase the vegetables nutraceuticals compounds concentration. This method is simple and easily done to prevent chronic degenerative diseases.

Acoustics for health

Tinnitus is an ear disease that affects thousands of Mexicans, mostly elders. It´s a constant buzz that affect their quality of life, cause sleep disturbance, reduce their work capacity, and even could cause psychiatric problems. One of the treatments for this disease is the use of acoustics therapies.

Professors Luz María Alonso Valerdi and David Isaac Ibarra Zarate had developed a method to treat this suffering. With this project they are able to evaluate in short and medium term, with an electroencephalogram, the results, the benefits or non-benefits of acoustics therapies, and determinate if that therapy is the best option for them.

Recirculation of water for food production

Rigoberto Engel Ugalde, Aida Malpica Sánchez and Ezequiel Hernández Salas, from Water Science and Technology Research Group developed a process to recirculate water in an indoors agriculture and aquaculture model to increase sustainable development.

They integrate a hydroponic system of aquaculture and biological nitrification in artificial greenhouses of 240 square feet where they can produce vegetables and rise some kind of fish using interconnected systems that reuse and move water from one device to another.

PROJECTS THAT TRANSFORM MEXICO

PRIDE Personal Risk Detection

Recipe help in a risk or danger situation thanks to body and space signs emitted from ourselves isn't science fiction anymore. Research professor Luis A. Trejo Rodríguez and another "Machine Learning" Group professors are developing a mobile device software that generate automatic alerts in a risk or danger situations like kidnappings or natural disasters, and guaranteed a quick response from the in charge authorities.

This device born after another project named ELISA (Emergencia, Localización y Asistencia Inmediata) that operate since 2011 in Tecnológico de Monterrey, Estado de México and JM Sequirity business.

Biofortified Fruits and Vegetables

Human body needs several vitamins and folic acid to improve its functioning. Their deficiency can alter a baby's growth and increase cardiovascular diseases, anemia and even cancer. The lack of this vitamin is also related with depression, cognitive disabilities and Alzheimer.

Research professor Rocío Isabel Díaz de la Garza and their colleagues from Emerging Technologies and Molecular Nutrition Group work with folic acid synthetization. The study case in this project are the plants, they are the principal source of folates and they can produce up to 300% of this vitamin. Whit these project the researchers can significantly improve the health in Mexico.

Sustainable Energy

The research in Tecnológico de Monterrey is oriented in different strategic areas, one of them is Energy. The purpose of educate technicians and experts in México made possible an alliance between Tecnológico de Monterrey, Secretaría de Energía and Conacyt to create a project that improve the education in Energy.

This is the Binational Laboratory for Technological Formation, presented in 2016 by Pedro Joaquín Coldwell, Energy Secretary; Enrique Cabrero, Dean of Conacyt, and David Noel Ramírez, Head dean of Tecnológico de Monterrey. This laboratory integrates infrastructure, development and human resource training to transform energy into a sustainable energy.

PROJECTS THAT TRANSFORM MEXICO

Nanotechnology

Science has learned to control materia in a nanometric scale. Nowadays, researchers can design atoms one by one and make unimaginable things with specific properties, generate devices, materials and new and improved drugs and foods.

Nanotechnology has been able to transform society in a few years, and Tec de Monterrey has been part of it. That's what Ricardo Ramírez Mendoza, dean of this initiative said. Since the collaboration with MIT started in 2014, the Institution has advanced in academic and exchange programs, talent attraction, research collaboration and even a state of the art infrastructure.

Robotics for Physical Impairment

Doctors Ernesto Rodríguez and Rogelio Soto design and develop a series of robotic exoskeletons with the objective of improving the quality of life of people with some type of disability, as well as the reduction or loss of natural mobility of older adults.

Experts expect their final product to have a low-cost modular design that can meet the specific needs of each patient in an integrated manner.The device will be controlled via neuronal signals and will incorporate technology such as augmented reality to deploy 3-D scenarios linked to rehabilitation routines.

Cell regeneration to see again

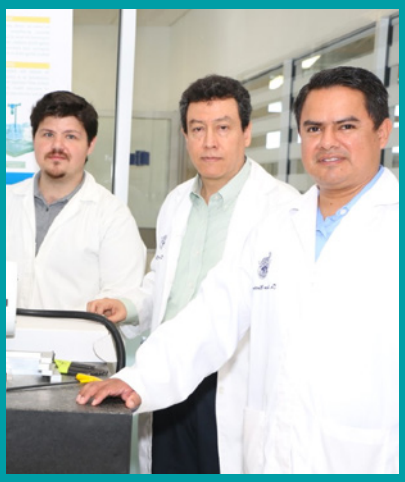
Doctors Jorge Valdez and Judith Zavala lead this corneal cell regeneration project, since in Mexico there are over 7,000 people on the waiting list to receive a transplant of this organ, and their chances of success are minimal since there are never enough donors.

Through this project, with a single artificial biocompatible cornea can benefit up to 10 patients. In order to achieve this, a biomaterial will be generated in which the cells can be deposited to multiply them and thus return the view to thousands of people.

PROJECTS THAT TRANSFORM MEXICO

Mati-Tec: Education for all

Professor Juan Carlos Olmedo developed an app that helps children and young people with limited resources to increase their grades. Mati-Tec is a research project whose purpose is to improve the mathematical skills, literacy and digital processes of public elementary schools.
The application works through a mobile device with internet access. Once inside the platform, users can play with innovative mathematical and Spanish teaching resources. In four years, Mati-Tec has benefited over 6,000 students and hundreds of teachers in 50 schools. The next step is to deliver this platform to the "SEP" to support millions of students across the country.



Nanotechnology

The Nanotechnology project presented by Dr. Alex Elías is focused on four applications of this discipline: the development of a device for the early detection of type 2 diabetes; the creation of an intelligent film, resistant to aggressive environments; a nanometer-mesh for repairing abdominal wall hernias, and nanosensors to identify contaminants in the environment.

Each of these utilities is the subject of study of a team composed of research professors Joaquín Oseguera, Nancy Ornelas, Flavio Contreras, Marco Antonio Rito-Palmares and Alex Elías.

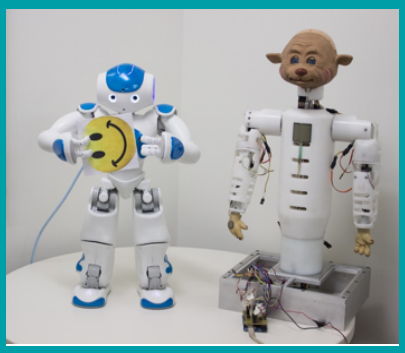
Biotechnology for food security

The field has long lags and requires sustainable technological modernization. That is why the "Centro Internacional de Mejoramiento de Maíz y Trigo" (CIMMYT) and Tecnológico de Monterrey work together on the MasAgro project. The person responsible for this initiative is Dr. Silverio García, who assures that a great majority of Mexicans live in monetary and food poverty, reason why their project is directed to the base of the pyramid of production. Together with experts from more than 50 institutions, this initiative seeks new technologies that improve the processes of planting and growing food, in particular maize. One of its advances is the development of a maize species that is resistant to pests and is beneficial for health.

PROJECTS THAT TRANSFORM MEXICO

Life options for vulnerable communities

Dr. Carlos Brambila and his team have the talent to intervene in rural communities with low levels of agricultural productivity so that, with the help of science and technology, they can improve community development. In Ahuátlan, Puebla, for example, they have found different varieties of plant species that can be exploited in a sustainable way thanks to a vehicle that has two food processing plants: one for peanut products and another for fruit. Dr. Brambila points out that poverty in Mexico is at the same levels of 25 years ago, so its initiative aims to influence the poorest communities through technological processes.



Mechatronics at the service of society

Research professor Pedro Ponce and his project, Robot Teco, are examples of the applications that robotics can have in areas such as health, education and productivity. This android works as a tool for the treatment of children with autism. Teco helps patients express their emotions, improve their social skills and understand the expressions of others.

Another initiative of his work group is a wheelchair with artificial intelligence that through algorithms allows an autonomous navigation. It has different modes of operation and a control system via head movements and voice control.

Building a fair and secure country

After recognizing, that a few years ago our country suffered an escalation of violence, Dr. Pedro Torres of the School of Social Sciences and Government, considered that the Tecnológico de Monterrey had to do something and for that reason developed a security protocol to support in the delivery of justice and security to public ministries and police. He emphasized that his team made the decision to take the research from the cubicles and put it into practice, to meet later with local authorities and governments, and the results are in sight.

PROJECTS THAT TRANSFORM MEXICO

A culture of sustainability

Researchers Alberto Mendoza, Gerardo Lozano Fernandez, Bryan Husted Corregan and Roberto Morelos want to have a sustainable Tec. To achieve this, they are working on the creation of the 2016-2030 Technological Sustainability Plan, which is supported by three main axes: environment, energy and health.

This program seeks to position the Institution in the first place in Latin America and be among the top ten in the world in terms of sustainability. Therefore, it is divided

into a focus group on energy and climate change, as well as another dedicated to the social innovation strategy.

Technology-based entrepreneurship

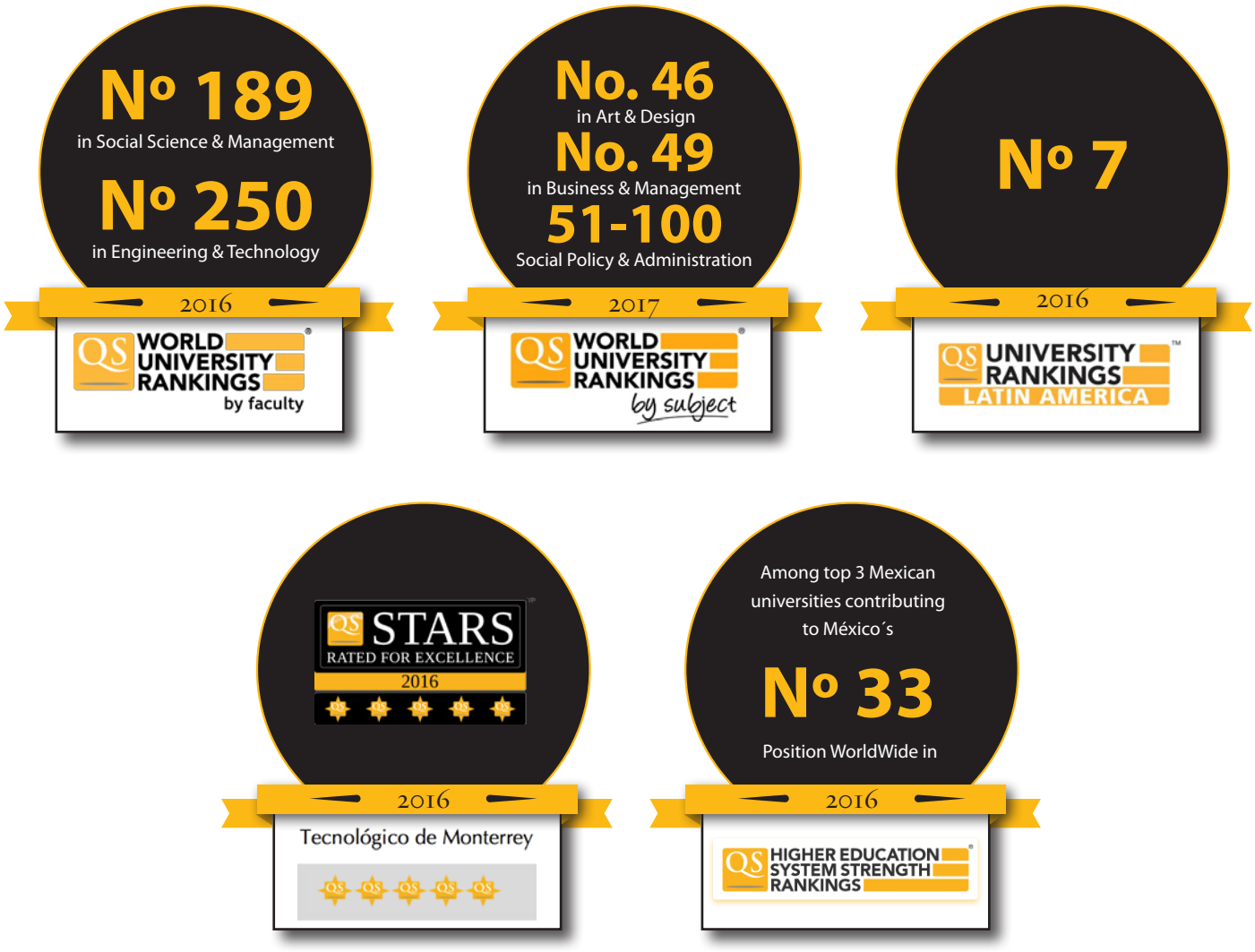
Daniel Moska, Juan Arriaga and Patricia Mora develop a joint project of entrepreneurship to transform research ideas that can be turned into technology-based companies, thanks to the adequate supports that consist of three main factors: the management and simplification of the project, the Training and knowledge of the entrepreneurial environment and finally the approach with the appropriate industry.

Rankings


Nº 1
in México in Employer Reputation
Nº 56
in Employer Reputation WorldWide
Nº 206
Global WorldWide
2016 - 2017
QS WORLD UNIVERSITY RANKINGS


Nº 1
in México
Nº 1
in Latin America
Nº40
WorldWide
2016 - 2017
QS GRADUATE EMPLOYABILITY RANKINGS


Nº 19
Employer-Student Conections
Nº 22
Alumni Outcomes WorldWide
Nº 11
Graduate Employment rate WorldWide
2016 - 2017
QS GRADUATE EMPLOYABILITY RANKINGS


Nº 189
in Social Science & Management
Nº 250
in Engineering & Technology
2016
QS WORLD UNIVERSITY RANKINGS
by faculty
No. 46
in Art & Design
No. 49
in Business & Management
51-100
Social Policy & Administration
2017
QS WORLD UNIVERSITY RANKINGS
by subject
Nº 7
2016
QS UNIVERSITY RANKINGS
LATIN AMERICA
QS STARS
RATED FOR EXCELLENCE
2016
2016
Tecnológico de Monterrey
Among top 3 Mexican
universities contributing
to México´s
Nº 33
Position WorldWide in
2016
QS HIGHER EDUCATION
SYSTEM STRENGTH
RANKINGS


Nº 36
Brics & EE
2015 - 2016
THE BRICS & EMERGING ECONOMIES RANKINGS


501 - 600
WorldWide
2015 - 2016
THE WORLD UNIVERSITY RANKINGS


Nº 1
in México
Nº 8
in Latin America
2016
THE WORLD UNIVERSITY RANKINGS LATIN AMERICA


Nº 4
Universities the top attractor hire from the most frequently
2016
Linked in
Top Attractors


Nº 23
in the TOP 25 Entrepreneurship Undergraduate Schools Ranking in the USA
2016
TOP 25 UNDERGRAD ENTREPRENEURSHIP PROGRAMS OF 2016


501-800
WorldWide
2014
ACADEMIC RANKING OF WORLD UNIVERSITIES


Nº 11
in Student Mobility
Worldwide
2016
multirank
Universities compared. Your way.


Nº 5
in México
Nº 30
in Latin America
Nº 777
WorldWide
2016
RANKING WEB
OF UNIVERSITIES

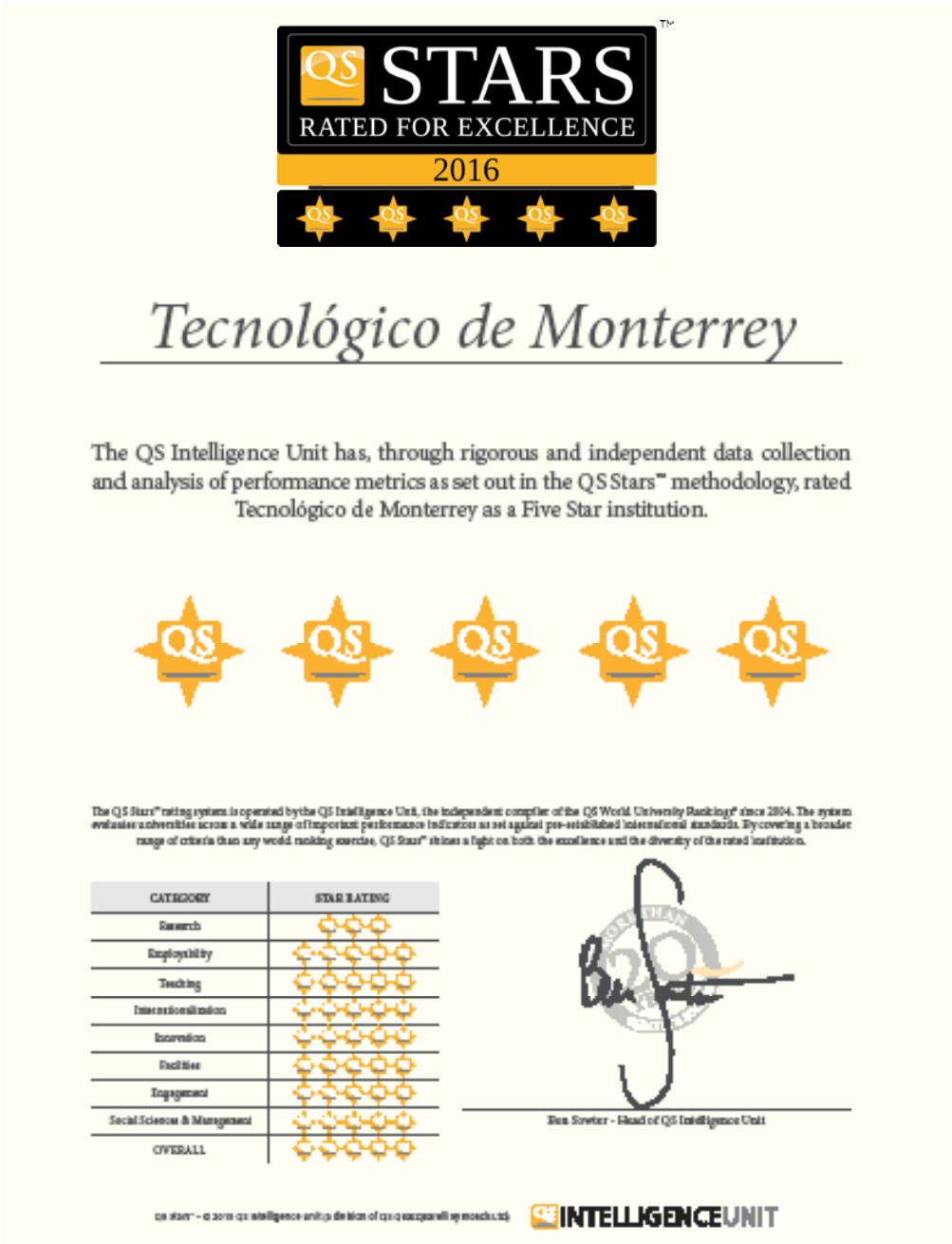

Nº 1
Scientific leadership in México
2016
SCIMAGO
INSTITUTIONS
RANKINGS


Nº 1
Best Business Schools
in Latin America
2016
América
economía


Nº 1
Maestría en Administración
Empresarial (On Line) at
Tecnológico de Monterrey
2016
FSO
Ranking de Instituciones de
Formación Superior Online
de Habla Hispana


Nº 1
Latin America
2014 - 2015
QS Global 200 Business Schools
Nº 1
Most innovative Business School in Latin America
2014 - 2015
Forbes México
Nº 1
MBA in Latin America
Financial Times
2014 - 2015
FT
Nº 1
Business School in Latin America, Eduniversal
2008 - 2015
eduniversal
Nº 1
Master in Financial in Latin America, Eduniversal
2015 - 2016
eduniversal
Nº 1
Executive MBA in Latin America, The Economist
2013 - 2015
The Economist
Nº 1
MBA
in Latin America
América Economía
2014 - 2016
América economía

QS STARS


QS STARS
RATED FOR EXCELLENCE
2016
Tecnológico de Monterrey
The QS Intelligence Unit has, through rigorous and independent data collection and analysis of performance metrics as set out in the QS Stars™ methodology, rated Tecnológico de Monterrey as a Five Star institution.
CATEGORY
STAR RATING
Research
Employability
Teaching
Internationalisation
Innovation
Facilities
Engagement
Social Sciences & Management
OVERALL
Ben Sowter - Head of QS Intelligence Unit
INTELLIGENCEUNIT

TIMES HIGHER EDUCATION

THE BRICS & EMERGING ECONOMIES RANKINGS

BRICS and Emerging Economies 2016/2017

36

The New York Times

Employer Reputation 2016/2017

110

Tecnológico
de Monterrey

research.mty@servicios.itesm.mx

www.itesm.mx