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Department of Engineering & Technology Management

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Tecnologico de Monterrey

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PICMET '23

Portland International Center for Management of Engineering and Technology

PICMET '23 Conference
July 23-27, 2023
Monterrey, Mexico

Managing Technology, Engineering and Manufacturing for a Sustainable World

CONFERENCE BULLETIN

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PICMET ’23

Dear PICMET Guests:

We are pleased to welcome you to the PICMET ’23 Conference.

The theme of PICMET ’23 is “Managing Technology, Engineering and Manufacturing for a Sustainable World.”

The COVID-19 pandemic reinforced the critical need for a sustainable world in which human needs are met without causing chronic harm to the environment and without sacrificing the ability of future generations to meet their needs. We recognize more than ever that the long-term survival of humanity depends on our ability to exist and develop without depleting natural resources for the future. Sustainability crosses boundaries in all areas of society, and requires major steps in creating a global environment that functions and prospers without negatively affecting future generations.

Technology cannot solve every problem by itself, but there are very few problems that can be solved without getting technology involved.

The challenge for the Technology Management community is to provide leadership in managing technology to address these issues and to make technology part of the solution, not the problem. We can do this by managing technical, economic, social, political, environmental, legal and ethical systems simultaneously.

PICMET defines the primary role of Technology Management as the management of technologies to assure that they work for the betterment of humankind. Using this definition, technology management has a crucial role in the development and utilization of technology to meet the world’s needs. This is a big challenge for the leaders and future leaders in the Technology Management field. Recognizing this challenge, the PICMET ’23 Conference is focused on the leadership challenges in managing technology to address critical issues in creating a sustainable world. The theme is woven into the keynote speeches and many of the papers, but the Conference is not limited to it. Every aspect of technology management is addressed in the presentations.

There are eight keynote speeches and a welcoming speech in five plenary sessions.

Plenary-1: Monday, July 24; 08:30 - 10:00
Dr. Ricardo Swain, Dean of the School of Engineering and Sciences, Northern Region, Tecnologico de Monterrey – Mexico, welcoming PICMET guests to Monterrey on the 80th anniversary of Tec de Monterrey

Dr. Adnan Akay, Visiting Professor, Sapienza University of Rome - Italy and Professor Emeritus, Carnegie Mellon University – USA; “Managing for a Sustainable World: The Grandest Challenge”

Plenary-2: Monday, July 24, 14:00 - 15:30
Dr. Christopher L. Tucci, Professor, Imperial College, London – UK; “Embracing Digital Disruption”

Dr. Antonio Pita, Director, OIE ITESM and Project Consultant, Cemex Research Center
– Switzerland; “The Imbalance of The Quadruple Helix: Present Paradigms and Shifts in the Making”

Plenary-3: Tuesday, July 25, 08:30 - 10:00
Dr. Bulent Atalay, Professor, Univ. of Mary Washington & Univ. of Virginia – USA; “The Physics of Climate Change”

John McDougall, CEO, SynBioBlox Innovations Ltd and former President, National Research Council – Canada; “Applying Digital Technologies to Manage Climate Change”

Plenary-4: Wednesday, July 26, 08:30 - 10:00
Dr. Gabriela Dutrénit, Distinguished Professor, Universidad Autónoma Metropolitana (UAM) – Mexico; “Innovation Policy, Social Inclusion and Sustainability in Latin American Countries”

Dr. Guillermo José Aguirre Esponda, President, SEFI, ADIAT, Academia de Ingeniería México, Former CTO, Grupo Vitro and Deputy Director of Technology, CONACYT – Mexico; “Towards an Indirect Approach to the Management of Technology, Engineering and Manufacturing”

Plenary-5: Thursday. July 27, 08:30 - 10:00
Dr. Jaime Parada Avila, Former President of CONACYT and National Academy of Engineering – Mexico; “How to Innovate in a Fast Way in Companies of Excellence to Create New Economic Value and Competitive Advantages”

PICMET ’23 received 352 submissions from authors representing 130 academic institutions, industrial corporations, consulting firms, R&D organizations, and government agencies in 33 countries. After a double-blind refereeing process, 136 papers have been included in the conference. The referees were from universities, industrial organizations, and government agencies from around the world.

The PICMET ’23 Conference has two outputs:
This ***Conference Bulletin*** includes an up to 200-word abstract of each paper to enable the participants to select the sessions to attend and the presentations to follow. The Bulletin is intended as a reference book for an overview of the field, in general, and the conference, in particular.

The ***Proceedings*** is a flash drive containing full-length presentations included in the conference. Its purpose is to give full

access to the entire conference for many years after the conference is over. The Proceedings is divided into 34 sections listed below. Each section contains several papers on the topic.

- **Technology Management Framework**
- **Strategic Management of Technology**
- **Collaborations for Technology Management**
- **Competitiveness in Technology Management**
- **Science and Technology Policy**
- **Decision Making for Technology Management**
- **Artificial Intelligence for Technology Management**
- **Sustainability**
- **Environmental Issues**
- **Educational Issues**
- **Emerging Technologies**
- **Disruptive Technologies**
- **E-Business**
- **Entrepreneurship/Intrapreneurship**
- **Intellectual Property**
- **System Design**
- **Technology-Based Organizations and Workforce**
- **Innovation Management**
- **Social Innovation**
- **Project/Program Management**
- **R&D Management**
- **Manufacturing Management**
- **Supply Chain Management**
- **Productivity Management**
- **Quality Management**
- **Enterprise Management**
- **Information Management**
- **Knowledge Management**
- **Information/Communication Technologies**
- **Technology Roadmapping**
- **Technology Planning**
- **Technology Adoption**
- **Technology Transfer and Diffusion**
- **Commercialization of Technology**

A large number of colleagues around the world contributed to the success of the PICMET ’23 Conference.

The PICMET Board of Directors set the strategic direction; the Advisory Council provided guidance for the implementation of the strategies for the conference.

PICMET Honorary Executive Director Ann White edited the Bulletin and prepared the front-end materials; Director of Operations Liono Setiowijoso designed, maintained and managed the information systems and PICMET web site, and formatted the papers for the Proceedings; Executive Director Angel Contreras Cruz managed volunteer teams and crucial interactions with Tecnologico de Monterey, the Monterrey Office of Conventions and Visitors, and the Crowne Plaza Hotel; Legal Counsel Scott Schaffer provided continuous legal advice; Treasurer Tom Gillpatrick and Chief Accountant Sang Ahn handled the finances. Timothy Anderson was the Director of Technical Activities, Kiyoshi Niwa and Dilek Cetindamar Kozanoglu were Co-Directors of International Activities, Charles Weber was the Director of Awards, and Nasir Sheikh was the Director of Student Activities. Caroline Mudavadi managed registrations, Angel Contreras Cruz and Fayez Alsoubaie coordinated on-site activities; Pei Zhang managed documentation and A/V equipment; Ahmed Alibage prepared the signage; and Jeff Birndorf provided graphic design for the conference. Nasir Sheikh chaired the Brad Hosler Outstanding Student Paper Award Committee; Kiyoshi Niwa and Jonathan Ho evaluated the papers nominated for the award.

Associate Editors Timothy Anderson, Kiyoshi Niwa, Dilek Cetindamar Kozanoglu and Harm-Jan Steenhuis conducted the review process for the submissions; 134 members of PICMET’s 397-member Panel of Reviewers reviewed the papers submitted to PICMET ’23.

Timothy Anderson did the scheduling of the accepted papers for presentation at the conference. Amir Shaygan was the Editorial Assistant, checking and verifying that the finalized papers had been revised as recommended by the reviewers.

Christina Zarrello of IEEE worked with PICMET from the beginning to the end of the conference planning effort. Her professionalism and expertise assured the high-quality production of the PICMET Proceedings on schedule.

The Country Representatives, under the leadership of Kiyoshi Niwa and Dilek Cetindamar Kozanoglu, provided linkages between PICMET and the regions they represent.

The sponsors and supporters of PICMET ’23 made this conference possible. We extend special thanks to all of them: Portland State University Department of Engineering and Technology Management, IEEE TEMS (Technology and Engineering Management Society), Portland State University Foundation, PSU Maseeh College of Engineering & Computer Science, Portland State University Office of Information Technology, Tecnologico de Monterrey, Tecnologico de Monterrey School of Engineering and Science, MEM Program at Tecnologico de Monterrey, Office of Conventions and Visitors – Monterrey (OCV), KC Rentas, IEEE Monterrey Section, InFocus, FreeGeek, and WHOVA Event Management.

We believe the PICMET ’23 *Bulletin* and *Proceedings* contain some of the best knowledge available on Technology Management for addressing the challenges and opportunities for a sustainable world. We hope they will contribute to the success of technology managers and emerging technology managers worldwide.

~ Dundar F. Kocaoglu, President and CEO

PICMET ’23

DEDICATION

PICMET ’23 is dedicated to
all researchers, educators and practitioners of Technology Management
who are contributing to the establishment and growth of this field
throughout the world.

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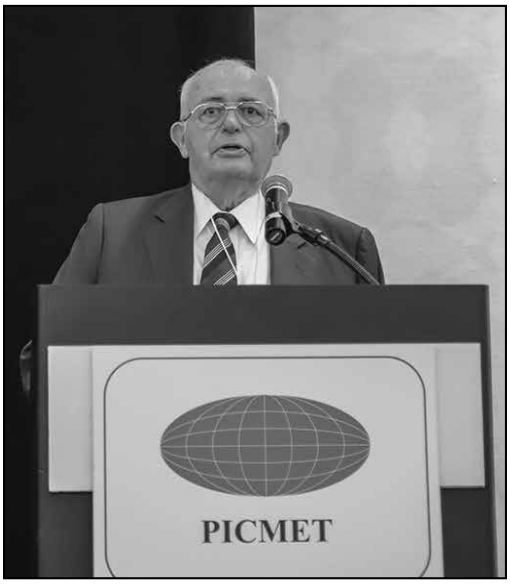

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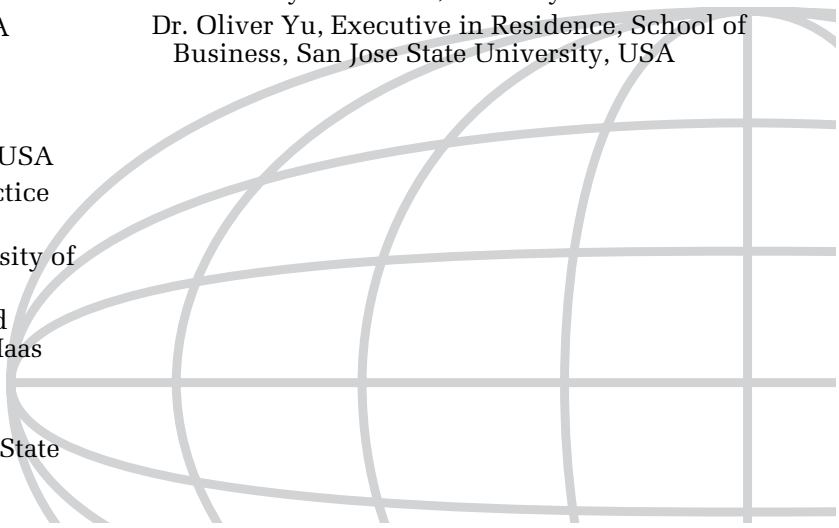
PICMET has an International Advisory Council, which provides advice and counsel on critical issues and strategic directions. The members are listed below.



PICMET ’23

PANEL OF REVIEWERS

Papers submitted to PICMET conferences are subjected to a double-blind review process. Each paper included in the PICMET ’23 conference was reviewed by two or more members of the Panel of Reviewers to assure a very high quality. Members of the Panel are listed below in alphabetical order by last name.

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PICMET LEADERSHIP IN TECHNOLOGY MANAGEMENT (LTM) AWARD RECIPIENTS

The PICMET Leadership in Technology Management (LTM) Award recognizes and honors individuals who have provided leadership in managing technology by establishing a vision, providing a strategic direction, and facilitating the implementation strategies for that vision.

The Award was established in 1991. The recipients with their affiliations and positions at the time of the award are listed below.

1991
Dr. Andrew S. Grove, CEO of Intel, USA

1997
Mr. Norman Augustine, Chairman of Lockheed Martin, USA

1999
Mr. Jack Welch, CEO of General Electric, USA
Dr. Richard M. Cyert, President of Carnegie Mellon University, USA

2001
Dr. Modesto A. Maidique, President of Florida International University, USA
Ms. Carleton S. Fiorina, Chairman and CEO of Hewlett-Packard Co., USA
Ms. Donna Shirley, Manager of the Mars Exploration Program, USA

2003
Mr. Jong-Yong Yun, Vice Chairman and CEO of Samsung Electronics, Inc., Korea
Dr. Joseph Bordogna, Deputy Director of the National Science Foundation (NSF), USA
Dr. Chun-Yen Chang, President of National Chiao Tung University, Taiwan

2004
Dr. Kwan Rim, Chairman of Samsung Advanced Institute of Technology (SAIT), Korea
Dr. Gunnar Hambraeus, member of the Swedish Royal Academy of Science and former President and Chairman, Royal Swedish Academy of Engineering Sciences, Sweden

2005
Dr. Morris Chang, Founding Chairman, Taiwan Semiconductor Manufacturing Company Ltd. (TSMC), Taiwan
Dr. Pairash Thajchayapong, Permanent Secretary, Ministry of Science and Technology, Thailand
Dr. Eric von Hippel, Professor and Head of the Technological Innovation and Entrepreneurship Group, Sloan School of Management, Massachusetts Institute of Technology, USA
Prof. Dr.-Ing. Dr. Sc. h.c. Bacharuddin Jusuf Habibie, former President, Indonesia, and founder and chairman, The Habibie Center, Indonesia

2006
Dr. Youngrak Choi, Chairman, Korea Research Council of Public Science & Technology (KORP), Korea
Dr. Tsuneo Nakahara, Adviser to CEO (past Vice Chairman) of Sumitomo Electric Industries, Ltd., Japan
Dr. Mehmet Nimet Ozdas, Dept. of Mechanical and Control Engineering, Istanbul Technical University, Turkey
Dr. Edward B. Roberts, David Sarnoff Professor of the Management of Technology and Chair, Massachusetts Institute of Technology (MIT) Entrepreneurship Center, USA

2007
Dr. Harold A. Linstone, Editor-in-chief, Technological Forecasting and Social Change, University Professor Emeritus, Systems Science, Portland State University, USA
Dr. Yoshio Nishi, Director of Research of the Stanford Center for Integrated Systems, Director of the Stanford Nanofabrication Facility, and Research Professor in the Department of Electrical Engineering at Stanford University, USA

2008
Mr. William P. Venter, Chairman, Allied Electronics Corporation Limited, South Africa
Dr. Gideon de Wet, Professor Emeritus, University of Pretoria, South Africa

2009
Dr. Klaus Brockhoff, Professor, Otto Beisheim School of Management, Germany
Ms. Anne M. Mulcahy, Chairman and Former CEO, Xerox Corporation, USA

Prof. Muhammad Yunus, Managing Director, Grameen Bank, Bangladesh

2010
HRH Princess Maha Chakri Sirindhorn, Thailand

2011
Dr. David M. Steele, Dean, College of Business and Lucas Graduate School of Business, San Jose State University, USA

2012
Dr. Daniel Berg, Distinguished Research Professor of Engineering, the University of Miami, USA
Dr. Nam P. Suh, President, Korea Advanced Institute of Science and Technology (KAIST), Korea

2013
Dr. Robert JT Morris, VP Global Labs, IBM Research, USA
Dr. James M. Utterback, David J. McGrath jr (1959) Professor of Management and Innovation, MIT Sloan School of Management; and Professor of Engineering Systems, School of Engineering, Massachusetts Institute of Technology, USA

2014
Dr. Hans-Joerg Bullinger, Senator of the Fraunhofer-Gesellschaft, Germany
Mr. Michael Joseph, Director of Mobile Money, Vodafone Group Services Limited, UK; and Fellow, the World Bank
Dr. Thomas L. Magnanti, President, Singapore University of Technology and Design (SUTD), Singapore; and Institute Professor and former Dean of Engineering, Massachusetts Institute of Technology (MIT), USA
Mr. Takeshi Uchiyamada, Chairman of the Board, Toyota Motor Corporation, Japan

2015
Mr. John R. McDougall, President, National Research Council, Canada

2016
Mr. Shinjiro Iwata, Advisor to Hitachi Ltd., Japan

2017
Dr. Guruduth S. Banavar, Viome, USA
Dr. Robert A. Burgelman, Edmund W. Littlefield Professor of Management, Stanford University, USA

2018
Dr. Kathleen Eisenhardt, W. Ascherman Professor, Stanford University, and Co-Director of the Stanford Technology Ventures Program, Stanford University, USA
Dr. Melissa A. Schilling, Professor, Stern School of Business, New York University, New York, USA

2019
Dr. Tao-ming Cheng, President, Chaoyang University of Technology (CYUT), Taiwan
Dr. Henry W. Chesbrough, Professor and Faculty Director, Garwood Center for Corporate Innovation, UC Berkeley-Haas School of Business, USA
Ms. Mandy J. Mock, VP Information Technology Group, Intel Corporation, USA

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PICMET MEDAL OF EXCELLENCE AWARD RECIPIENTS

PICMET's "Medal of Excellence" recognizes extraordinary achievements of individuals in any discipline for their outstanding contributions to science, engineering and technology management.

The award was instituted in 2004. The recipients with their affiliations and positions at the time of the award are listed below.

2004
Dr. Daeje Chin, Minister of Information and Communications, Korea
Dr. Kiyoshi Niwa, Professor in the Department of General Systems Studies at the University of Tokyo, Japan
Dr. Rosalie A. Zobel, Director of Components and Systems in the Information Society and Media Directorate-General of the European Commission

2005
Mr. Bob Colwell, President, R & E Colwell and Associates; and former Fellow, Intel Corporation

2006
Dr. Frederick Betz, Former Program Officer, NSF
Dr. Fariborz Maseeh, Founder and President, The Massiah Foundation
Dr. T. Nejat Veziroglu, Director, Clean Energy Research Institute, University of Miami

2007
Dr. Mihail C. Roco, National Science Foundation (NSF), National Nanotechnology Initiative (NNI), and International Risk Governance Council (IRGC), USA

2009
Dr. Albert H. Rubenstein, Founder and President, International Applied Science and Technology Associates (IASTA); and Professor Emeritus, Industrial

Engineering and Management Sciences, Northwestern University

2010

Ms. Kiran Mazumdar-Shaw, Chairman and Managing Director, Biocon Limited, India

Prof. Dr. Nuket Yetis, President, Scientific and Technological Research Council of Turkey (TÜBITAK)

2011

Mr. Alejandro Cruz, Minister of Science and Technology, Costa Rica

2013

Dr. Eliezer Geisler, Distinguished Professor, Stuart School of Business, Illinois Institute of Technology, USA

Dr. Hans Georg Gemuenden, Professor, Berlin University of Technology, Germany

2015

Dr. Steven Eppinger, Professor of Management Science and Innovation, Massachusetts Institute of Technology, USA

Dr. Alan L. Porter, Professor Emeritus, Georgia Institute of Technology; and Director of R&D for Search Technology, Inc., USA

2016

Dr. Jay Lee, Ohio Eminent Scholar, L.W. Scott Alter Chair, and Distinguished University Professor, University of Cincinnati, USA

2017

Mr. Scott Roth, Chief Executive Officer, Jama Software, USA

Dr. Karl Hampton Vesper, Foster School of Business, University of Washington, Seattle, USA

2018

Dr. Bulent Atalay, Professor, University of Mary Washington and the University of Virginia; Member, Institute for Advanced Study, Princeton, USA

Dr. Sadik Esener, Chair, Biomedical Engineering Department at the School of Medicine, Oregon Health and Sciences University, Portland, Oregon, USA

2019

Dr. Gregory A. Daneke, Professor Emeritus, W.P. Carey School of Business, Arizona State University, USA

Dr. Ann Majchrzak, Associates of USC Business Administration Chair and Professor of Digital Innovation Department of Data Sciences and Operations, Marshall School of Business, University of Southern California, USA

Dr. Melanie Mitchell, Professor of Computer Science, Portland State University, USA

PICMET FELLOWS

The PICMET Fellow Award was established in 2011 to commemorate PICMET's 20th Anniversary. It is bestowed upon those who have excelled in the technology management field by making a significant impact in one or more of the following six areas:

1. **Technology Management Research** as demonstrated by the research conducted and supervised, research results published in refereed journals, and research grants received from funding agencies or industry.

2. **Technology Management Education** as demonstrated by technology management programs/courses developed, taught or managed, PhD students supervised, and new educational initiatives taken.

3. **Technology Management Implementation** as demonstrated by management of technology-based projects, programs and organizations in industry or government.

4. **Technology Management Consulting** as demonstrated by consulting activities with high impact on the improvement of technology management practice.

5. **Technology Management Policy Making** as demonstrated by the role played in policy making levels for effective utilization of technology management concepts and processes.

6. **Technology Management Leadership** as demonstrated by the book(s) published, journal(s) edited, technology management organization(s) established or managed.

The PICMET Fellows with their affiliations at the time of the award are listed below.

PICMET ’23

2011
Mr. Charles Allcock, PGE, USA
Dr. Daniel Berg, Rensselaer Polytechnic Institute (RPI), USA
Dr. Frederick Betz, Portland State University, USA
Dr. Joseph Bordogna, University of Pennsylvania, USA
Dr. Youngrak Choi, Korea University, Korea
Dr. Robert Colwell, DARPA, USA
Dr. Joseph Cox, Distinguished Public Service Professor and Chancellor Emeritus, Oregon University System, USA
Ms. Charmagne Ehrenhaus, Portland Community College, USA
Mr. Les Fahey, Fahey Ventures, USA
Dr. Gunnar Hambraeus, Royal Swedish Academy of Engineering Sciences, Sweden
Dr. Dundar Kocaoglu, Portland State University, USA
Mr. Thomas Lipscomb, The Center for the Digital Future, USA
Dr. Tom Long, Tektronix Vice President, Retired, USA
Mr. John McDougall, Alberta Research Council, Canada
Dr. Graham Mitchell, University of Pennsylvania, USA
Dr. Kiyoshi Niwa, The University of Tokyo, Japan
Dr. Kwan Rim, Samsung Corporation, Korea
Dr. Frederick Rossini, George Mason University, USA
Mr. Terry Rost, The Franchise Group, USA
Dr. Nam Suh, KAIST, Korea
Dr. Nejat Veziroglu, University of Miami, USA
Dr. Eric von Hippel, MIT, USA
Dr. Seiichi Watanabe, Terumo Corporation, Japan
Dr. Rosalie Zobel, European Commission, Belgium

2013
Dr. Klaus Brockhoff, WHU – Otto Beisheim School of Management, Germany
Dr. Antonie de Klerk, University of Pretoria, South Africa
Dr. Norman G. Einspruch, University of Miami, USA
Dr. Joseph P. Martino, Yorktown University, USA
Mr. Terry Oliver, Bonneville Power Administration, USA
Dr. Alan L. Porter, Search Technology, Inc., USA
Dr. Albert H. Rubenstein, Northwestern University, USA
Dr. James C. Spohrer, IBM, USA
Dr. David M. Steele, San Jose State University, USA

2014
Dr. Timothy R. Anderson, Portland State University, USA
Dr. Tugrul U. Daim, Portland State University, USA
Dr. Fred Phillips, Stony Brook - State University of New York, USA
Dr. David Probert, University of Cambridge, UK

2015
Dr. Oliver Yu, President and CEO, The STARS Group; Executive in Residence, Lucas College of Business, San Jose State University, California, USA

2019
Dr. Barry Bozeman, Regents’ Professor and Arizona Centennial Professor, Science and Technology Policy and Public Management, Arizona State University, USA
Dr. Dilek Cetindamar Kozanoglu, Associate Professor, School of Information, Systems and Modelling, Faculty of Engineering and IT, University of Technology Sydney, Australia
Dr. Jonathan D. Linton, Professor and Chair, Operations and Technology Management, University of Sheffield, Sheffield, United Kingdom
Dr. Dietmar Theis, Honorary Professor, Flat Panel Display Technology, Technical University Munich, Germany

2022
Dr. Adnan Akay, Former Professor and Provost, Bilkent University, Turkey and Lord Professor of Engineering and Head Emeritus of Mechanical Engineering, Carnegie Mellon University, USA
Dr. Robert A. Burgelman, Edmund W. Littlefield Professor of Management of the Stanford University Graduate School of Business, USA
Dr. Henry W. Chesbrough, Professor and Faculty Director, Garwood Center for Corporate Innovation, Haas School of Business, University of California-Berkeley, USA
Dr. Eliezer Geisler, Distinguished Professor Emeritus, Illinois Institute of Technology, USA
Dr. Hans Georg Gemuenden, Former Professor, Technical University-Berlin, Germany, and BI Norwegian Business School, Norway
Dr. Charla Griffy-Brown, Professor, Pepperdine University, USA
Dr. Mel Horwitch, Visiting Scholar/Research Affiliate, MIT-Sloan School, USA, and former University Professor and Dean, Central European University, Hungary
Dr. Edward B. Roberts, David Sarnoff Professor of Management of Technology, MIT, USA
Dr. Aaron J. Shenhar, Dr. Aaron Shenhar, Professor of Project Management and Leadership (Ret.), Rutgers University, CEO and Founder, Technological Leadership Institute, LLC (DLI), USA
Dr. James M. Utterback, David J. McGrath jr (1959) Professor of Management and Innovation, Emeritus, MIT Sloan School, USA
Dr. Steven T. Walsh, Distinguished Professor, University of New Mexico, USA

STUDENT PAPER AWARD

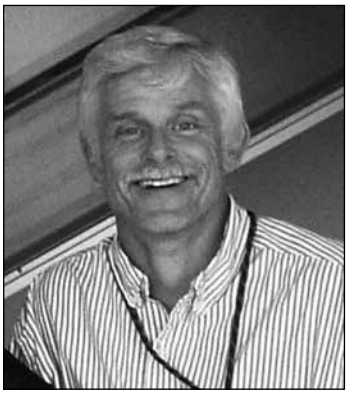
PICMET NAMES ITS OUTSTANDING STUDENT PAPER AWARD

An endowment has been created to name the PICMET Outstanding Student Paper Award after **Brad W. Hosler**, who was a dedicated engineer and technology leader with 25 years of service at Intel, as well as a proud and loving family man. Brad Hosler lived by his motto: "Work hard, play hard."

AWARD CRITERIA

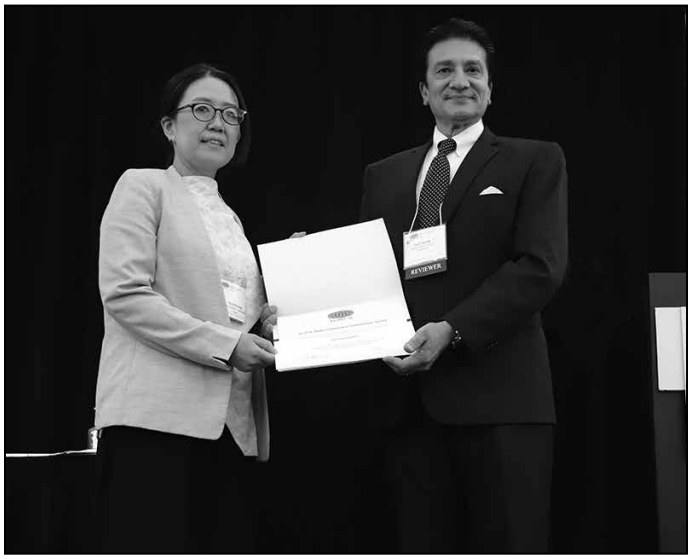
The Brad W. Hosler PICMET Outstanding Student Paper Award is bestowed upon a paper based on the student's research toward a graduate degree in the area of Engineering and Technology Management. Eligibility is restricted to currently enrolled students and those who have received their master's or doctorate degrees after July 31, 2022. The paper is nominated by the advising professor and selected by the Awards Committee. The award consists of $1,000, complimentary conference registration and a certificate for the student, as well as a certificate and complimentary registration for the nominating professor. The winner may not be nominated again for the same award in subsequent years.

ABOUT BRAD W. HOSLER



Brad Hosler passed away on August 31, 2007, at his home in Portland, Oregon, after several years of battling cancer. He received his undergraduate degree from Bucknell University and completed his graduate studies at Carnegie Mellon University. Brad joined Intel in 1980 to work on the architecture and implementation of the I/O subsystem and had key roles in the Plug & Play BIOS definition and its implementation on Intel's first PCI chipset, Saturn. He formed the Compliance Workgroup to establish the PC industry's first multi-vendor I/O compliance program. The innovative methods and practices that he architected and implemented have become the benchmark for the computer industry. Brad was among the pioneers recognized for his industry contributions at the 10-year anniversary of the PCI-SIG, which has a worldwide membership of about 900 companies.

Brad's signature accomplishments are associated with the Universal Serial Bus (USB) family of technologies. He received two Intel Achievement Awards, one in 2003 and another in 2006, for his outstanding work. The success of the USB interface and market of platforms and peripherals that sell in multiple billion units today is a measure of his impact.



Brad was promoted to Principal Engineer in 2006 and was vested with the informal authority of Chief Technical Officer for the USB Implementers Forum.

PICMET is proud to recognize Brad Hosler's accomplishments, as an engineer and a technology leader, by naming the Outstanding Student Paper Award after him.

STUDENT PAPER AWARD

BRAD W. HOSLER OUTSTANDING STUDENT PAPER AWARD

The number of students doing significant research in the area of Engineering and Technology Management was demonstrated by the number of nominations received. The selection of the award winner was difficult because of the excellent quality of all the submissions, but one paper stood out for its contribution to the field of Engineering and Technology Management.

AUTHOR
Dr. Limeng Yu

ADVISOR & CO-AUTHOR
Prof. Chuan-Kai Lee

UNIVERSITY
National Tsing Hua University, Taiwan

PAPER TITLE
"Technological Convergence and Market Creation: Making Connected Cars in China"

ABSTRACT

The fifth generation of mobile technologies known as 5G has been pushing a deep convergence between communication technologies (CT), information technologies (IT) through incorporating and standardizing internet of things (IoT) where the IoT application scenarios using deeply-converging technologies. How do firms respond to such deep technological convergence in 5G era? This study uses Chinese technology firms' making connected cars as a case to explore their roles in the deep convergence driven by 5G. Particularly, the study concerns how firms from information and communication technology (ICT) industry, namely Huawei, Xiaomi and Baidu, seize the opportunities of deep convergence to create connected-car markets under 5G transition. By analyzing the in-depth interviews with industrial experts, and the text analysis of patents, contracts as well as policy documents, it is tentatively found that firms may respond to the convergence through: (a) creating markets through defining and institutionalizing new scenarios; (b) defining the core problem of the new scenarios based on incumbent core technological capabilities; and (c) transferring incumbent core technological capabilities in the defining stage of the new IoT scenarios.

LTM Award

The PICMET Leadership in Technology Management (LTM) Award recognizes and honors individuals who have provided leadership in managing technology by establishing a vision, providing a strategic direction, and facilitating the implementation strategies for that vision.

PICMET '23 AWARDEE

Dr Gabriela Dutrénit
Distinguished Professor, Universidad Autónoma Metropolitana (UAM) – Mexico

Dr. Gabriela Dutrénit is an economist with a PhD in Science and Technology Research Studies from the Science Policy Research Unit (SPRU), University of Sussex, UK. She is a professor in the Master's and PhD Program in Economics and Innovation Management at the Universidad Autónoma

Metropolitana (UAM), Mexico. Dr Dutrénit is a "Distinguished Professor" of the UAM and a regular member of the Mexican Academy of Science. She is president of the Latin American Chapter of this network, LALICS (Latin American Network for Economics of Learning, Innovation, and Competence Building Systems), and member of the Scientific Board of UNU-MERIT at Maastricht University. Her research interests include: innovation and development; learning and technological capability accumulation at the firm level; university–industry linkages; research and development (R&D), and innovation policy. She has coordinated several evaluations of the Mexican STI policy.

Medal of Excellence

The PICMET Medal of Excellence (MoE) Award recognizes extraordinary achievements of individuals in any discipline for their outstanding contributions to science, engineering and technology management.

PICMET '23 AWARDEE

Dr. Christopher L. Tucci
Professor, Imperial College, London, UK

Dr. Christopher L. Tucci is Professor of Digital Strategy & Innovation at Imperial College Business School, where he directs the Centre for Digital Transformation and is co-Director of I-X, a new campus concept for Imperial College London on AI, data, and digital topics. Professor Tucci held the Chair in Corporate Strategy and Innovation from 2003-2020 at EPFL and was Dean of the College of Management there from 2013-2018. In 2018, he was Visiting Thought Leader at CEIBS in Shanghai, China. He received the degrees of Ph.D. in Management from the Sloan School of Management, MIT; SM (Technology & Policy) from MIT; and BS (Mathematical Sciences), AB

(Music), and MS (Computer Science) from Stanford University. He was an industrial computer scientist involved in developing Internet protocols and applying artificial intelligence tools in the 1980s. Professor Tucci teaches courses in Deep Tech Acceleration, Design Thinking, Digital Strategy, AI Ventures, and Innovation Management. His primary area of interest is in how firms make transitions to new business models, technologies, and organizational forms. He also studies crowdsourcing, Internetworking, and digital innovations. He has published articles in, among others, Academy of Management Review (AMR), SMJ, Management Science, Research Policy, Communications of the ACM, SEJ, Academy of Management Annals, and JPIM. His article with Allan Afuah, "Crowdsourcing as solution to distant search," won the Best Paper of 2012, Best Practice Implications Award of 2019, and the Decade Award of 2022 for AMR. He has served in leadership positions in the Academy of Management and the Strategic Management Society.

General Information

CONFERENCE FOCUS

The COVID-19 pandemic reinforced the critical need for a sustainable world in which human needs are met without causing chronic harm to the environment and without sacrificing the ability of future generations to meet their needs. We recognize more than ever that the long-term survival of humanity depends on our ability to exist and develop without depleting natural resources for the future. Sustainability crosses boundaries in all areas of society, and requires major steps in creating a global environment that functions and prospers without negatively affecting future generations.

Technology cannot solve every problem by itself, but there are very few problems that can be solved without getting technology involved.

The challenge for the Technology Management community is to provide leadership in managing technology to address these issues and to make technology part of the solution, not the problem. We can do this by managing technical, economic, social, political, environmental, legal and ethical systems simultaneously.

PICMET defines the primary role of Technology Management as the management of technologies to assure that they work for the betterment of humankind. Using this definition, technology management has a crucial role in the development and utilization of technology to meet the world's needs. This is a big challenge for the leaders and future leaders in the Technology Management field. Recognizing this challenge, the PICMET '23 Conference is focused on the leadership challenges in managing technology to address critical issues in creating a sustainable world.

WHO SHOULD ATTEND

Following the PICMET tradition, this high-impact conference sets the stage for managing and leading engineering, technology and manufacturing for a sustainable world.

The world's leading experts from academic institutions, industrial corporations and government agencies will participate in the discussions. PICMET '23 is essential for:

- Presidents and CEOs of technology-based corporations
- Vice presidents of engineering, R&D and technology in industrial organizations
- R&D managers
- Engineering, manufacturing, operations, quality and marketing managers in the technology-based organization
- Project and product managers
- Information systems managers in industrial and service organizations
- Technology management researchers
- Educators in engineering management, technology management, manufacturing management, technology marketing, software management, information systems management, project management, and technology-focused MBA programs
- Engineering and technology management program heads
- Students in engineering management, management of technology and related programs
- Government officials responsible for technology policy
- Government officials responsible for science and technology programs
- Engineers and scientists moving from technical specialty to management positions while maintaining their identity in technical fields

PROGRAM

The PICMET '23 program consists of

- Ph.D. Colloquium, "Getting Your PhD….and Beyond: Critical Stages and Career Paths for the Ph.D. Student," Sunday, July 23, 13:00 - 17:00, Chiapas Room
- Plenary sessions by global leaders in technology management in Nuevo Leon 3.
- Three special meetings:
  1. Panel of Reviewers Lunch Meeting for the reviewers of the papers submitted to PICMET conferences, Monday, July 24, 12:00-14:00, Tamaulipas Room
  2. Country Representatives Lunch Meeting for the current PICMET Country Representatives and those who are interested in becoming Country Representatives, Wednesday, July 26, 12:00-14:00, Tamaulipas Room

General Information

3. PICMET ’23 Debriefing and PICMET ’24 Planning Session for everybody who would like to discuss strategies for future PICMET conferences, Thursday, July 27, 14:00-15:30, Nuevo Leon 3

- Research papers by cutting-edge researchers
- Applications papers by researchers and practitioners working on industry applications
- Panel discussions with interactions between panelists and the audience

PUBLICATIONS

PICMET ’23 has two publications:

- The “Bulletin” containing the conference schedule and abstracts of each presentation
- The “Proceedings” containing all of the papers on a USB drive.

The publications will be available to PICMET ’23 attendees at the registration desk.

REGISTRATION POLICY

All PICMET attendees, including speakers and session chairs, must register and pay the registration fee to have access to sessions and other events. The registration fee allows admittance to all technical sessions and social events.*

Name badges must be worn to all PICMET sessions, functions and events. If you attend any event that is not covered by the registration fee, you will be required to pay an additional fee.

**The one-day registration fee does not include the evening social events. The PhD Colloquium is not included in the registration fee. Tickets for these events may be purchased at the registration desk.*

SESSION AND PAPER DESIGNATIONS

The sessions are identified by a four-digit code as follows:

First digit shows the day	M: Monday T: Tuesday W: Wednesday H: Thursday
Second digit shows the time	A: 08:30-10:00 B: 10:30-12:00 C: 12:00-14:00 D: 14:00-15:30 E: 16:00-17:30
Third and fourth digits show the room	01: Nuevo Leon 3 02: Colima 03: Durango 04: Guerrero 05: Jalisco 06: Oaxaca

Presentations in each session are given consecutive numbers following the session number. For example, paper TD-05.2 is the second paper on Tuesday at 14:00-15:30 in Jalisco.

PRESENTATION GUIDELINES

SESSION GUIDELINES

The sessions are 90 minutes long and include two, three, or four papers. Depending on the number of papers in the session, the time should be divided equally for each presentation, allowing about five minutes after each one for questions.

SESSION CHAIR GUIDELINES

If you are chairing a session, please follow the guidelines below:

- Contact the speaker before your session starts.
- Check the equipment in the room. If something does not work or if anything else is needed, contact the PICMET volunteer responsible for your room.
- Introduce each speaker.
- Coordinate the time allocated to each speaker so that each has about equal time, allowing about five minutes for questions from the audience.
- Fill out the Session Summary Form and leave it on the table in the room. The form will be given to the session chair by the PICMET volunteer at the beginning of the session.

General Information

SPEAKER GUIDELINES

If you are presenting a paper, please follow the guidelines below:

- Introduce yourself to your session chair and provide him/her with a brief background statement that he/she can use in introducing you to the audience.
- Divide the 90 minutes by the number of papers in your session so that every speaker in the session has approximately the same length of time.
- Allow about five minutes for questions from the audience after your presentation.

AUTHORS' ROOM

Tabasco Room is designated as the Authors' Room. The authors can work there with their laptops anytime they wish to do so.

AUDIO/VISUAL EQUIPMENT

There will be a computer, a projector and a screen in every break-out room. You can bring your presentation slides on a USB drive and use the computer provided. If you would like to use your own laptop, please be advised that you will need to bring the adapters that will fit into the VGA standard connection as all of our projectors will have the standard VGA port. Also, please make sure that you have an adapter to connect to the standard USA electric port if your connection port is different.

If you need information about anything else concerning the conference, volunteers in the registration area will try to help you.

WIRELESS ACCESS

Free wireless access will be available in the guest rooms, public areas of the hotel, meeting rooms and the PICMET registration area.

PARKING

Parking is complimentary for the guests staying at the hotel.

PICMET VOLUNTEERS

PICMET Volunteers wearing polo shirts with the PICMET logo will assist the participants throughout the conference. If you need help in locating the room where your session will be held or if there are equipment problems, for example, you can contact the PICMET Volunteers. If you need information about anything concerning the conference, a volunteer in the registration area will try to help you.

SAFETY AND SECURITY MEASURES

PICMET's top priority is the safety and security of our guests. Please note the following measures to assure that the PICMET '23 participants will be safe and secure during their stay in Monterrey:

1. Even though the COVID-19 restrictions and mask requirements have been reduced or eliminated in many countries, PICMET will have masks available for guests who want to use them during the Conference.

2. Monterrey is a big city with a population of nearly 6 million people. As in every big city, we recommend our guests to be careful of their environment if they go outside the hotel. Please note that there are two Crowne Plaza Hotels in Monterrey. The PICMET '23 Conference is in the one at downtown location (Address: Constitución Oriente 300, Centro, 64000 Monterrey, N.L., Mexico)

3. Ground transportation from the Monterrey Airport to the city is provided by companies authorized by the airport authority. The certified taxi companies include APR, Casco, Ecofy, Executive Transportation, Golden, Helmet, Suburban, Totsa and TPA. We recommend our guests to use one of these authorized companies. You can call any of them and buy tickets at the taxi kiosk in Monterrey airport where a direct telephone line to the taxi companies is available. An English-speaking driver can also be requested. There is usually a person at the taxi kiosk area to help. The hotel personnel can assist you in calling a safe taxi or Uber for your return from the hotel to the airport.

4. We strongly recommend using bottled water, **not tap water**, for drinking, brushing teeth, etc. Bottled water is available at the hotel's registration desk.

DRESS CODE

The dress code is "Informal" throughout the Conference, except for the Awards Banquet on Tuesday evening, July 25th, when it is "Business Casual."

Informal dress code

For men: Slacks and a regular shirt or polo shirt

For women: Slacks or skirt and a blouse or turtleneck, or a casual dress

Business Casual dress code

For men: Dress slacks, button-down shirt, dress shoes (coat and tie optional)

For women: Dress slacks or skirt and a blouse, or a regular dress

MONTERREY

GROUND TRANSPORTATION

Portland's public transportation system includes MAX Ground transportation from the Monterrey Airport to the city is provided by companies authorized by the airport authority. The certified taxi companies include APR, Casco, Ecofy, Executive Transportation, Golden, Helmet, Suburban, Totsa and TPA. We recommend our guests to use one of these authorized companies. You can call any of them and buy tickets at the taxi kiosk in Monterrey Airport where a direct telephone line to the taxi companies is available. An English-speaking driver can also be requested. There is usually a person at the taxi kiosk area to help. The hotel personnel can assist you in calling a safe taxi or Uber for your return from the hotel to the airport.

TEMPERATURE AND CLIMATE

The average high-temperature in July in Monterrey, Mexico, is 31.5°C (88.7°F), while the average low-temperature is 20.7°C (69.3°F). The average heat index (a.k.a. 'real feel', 'feels like'), which factors the actual air temperature with the relative humidity, in July is appraised at 35°C (95°F).

The average relative humidity in July is 58%.

In Monterrey, during July, the rain falls for 17.1 days and regularly aggregates up to 86mm (3.39") of precipitation.

The following is from the Monterrey Convention and Visitors Bureau.

MONTERREY ATTRACTIONS

Amusement Parks
The little ones will live unforgettable moments in our parks, with numerous attractions and entertaining shows. Among the main ones are Sesame Street Park, with three fun areas: Villasesamo, Aquamundo, and Isla Aventura; Bosque Magico (Magical Forest), with incredible mechanical games for children, family and extreme; and Bioparque Estrella, with its Serengeti Safari where you can see more than 800 animals in the open.

Culture
Monterrey is a destination with outstanding museums such as MARCO (Museum of Contemporary Art), Museum of Mexican History, MUNE, Blast Furnace No. 3 (Horno 3), Children's Kite Museum (Papalote Museo del Niño), and the Mexican Baseball Hall of Fame. These facilities host important events that promote culture among locals and visitors, such as the Santa Lucia International Festival, with free performances.

Downtown Stroll
For those who are visiting Monterrey, a tour of its downtown is a must. We recommend that you start at the Government Palace, and then head towards the Museum of Mexican History, located in an area where you will also find magnificent monuments, such as La Lagartera by the master Francisco Toledo. Before boarding the Paseo Santa Lucia boat that will take you to Foundry Park (Parque Fundidora), learn more about the origin of our beloved regional sweets at the Candy Museum (Museo del Dulce).

Extreme Adventure
For nature and adrenaline lovers, Monterrey offers an endless number of activities. There is Matacanes in Santiago, the best canyoning tour in Mexico; the Vertigo Route in the Huasteca, a via ferrata at more than 700 meters high; and the highest bungee jump in the country in Cola de Caballo (Horse Ponytail Waterfalls), just to mention a few. All of them are operated by certified professionals who will guarantee your fun and maximum safety.

MONTERREY

Icons of the City
Besides the majestic Cerro de la Silla (Saddle Mountain), there are so many other icons in Monterrey that you will want to visit for a photo op. There is the impressive Juan Soriano's dove in MARCO (Museum of Contemporary Art), the imposing structures of the Sopladores (Blowers Hall) in Fundidora Park, the historic building of El Obispado (Bishopric Palace) or the Crisol (Crucible) in the pier of Paseo Santa Lucia.

Incredible Caves
There are two famous caves in the state, one in the nearby municipality of Garcia, and the other in the Magical Town of Bustamante. The Grutas de García, discovered in 1843 and more than 60 million years old, can be reached by cable car. The Grutas del Palmito or Bustamante Caves are the only ones in the country with 100% accessibility for people with motor disabilities.

Magical Towns
Our towns of Santiago, Linares and Bustamante are magical because they treasure all the charm of these northern lands, in their customs, gastronomy, landscapes and hospitality. The wonderful Horse Ponytail waterfalls (Cola de Caballo) is in Santiago. In Bustamante you will find the exquisite bread prepared in a wood oven, and in Linares the so-much liked Glorias, a candy made of caramelized milk with walnuts. Stay a few more days and get to know this great state.

Monterrey Cuisine
In addition to dishes such as cabrito (baby goat), machacado con huevo (dry beef meat with eggs), asado de puerco (red chili pork stew), or the already very famous carnita asada (barbecue), Monterrey stands out nationally for its variety of restaurants of renowned chefs, with exquisite regional, international, and fusion specialties, and a very original mixology. It is also worth mentioning that Monterrey produces award-winning craft beers, which can be enjoyed in bars where you will find different brands and types of beer.

Music Festivals
Monterrey has become the musical capital of Mexico, mainly due to its music festivals such as Pa'l Norte,

Machaca Fest, Live Out, Cabuland, Hellow Festival, WiSH Outdoor and Nortex, where great artists of national and international stature are presented, playing genres as varied as urban, rock, hip hop, pop, electronic and Texan, among others.

Sporting Excitement
Monterrey has great sports teams that have been champions in various tournaments, and boasts the best fans in Mexico. In soccer, there are the Tigres and Rayados teams, for both men and women. In baseball, we have the Sultanes. And in basketball, we have Fuerza Regia. In addition, our sports venues are first-class facilities, where an excellent atmosphere prevails.

Social Events

To facilitate the informal interaction of the participants, several social events have been scheduled during PICMET '23.

WELCOME RECEPTION/BUFFET

DATE: SUNDAY, JULY 23
CASH BAR: 18:30 – 22:00, FOYER OF NUEVO LEON 3
BUFFET: 19:00-22:00
ROOM: NUEVO LEON 3
DRESS: INFORMAL

Meet other conference attendees, renew old acquaintances, and begin new friendships and collaborations at this opening reception/buffet. Included in the regular registration fee.*

BUFFET DINNER

DATE: MONDAY, JULY 24
CASH BAR: 18:30 – 22:00, FOYER OF NUEVO LEON 3
BUFFET: 19:00-22:00
ROOM: NUEVO LEON 3
DRESS: INFORMAL

Enjoy a savory buffet while you mingle and network with colleagues. Included in the regular registration fee.*

AWARDS BANQUET

DATE: TUESDAY, JULY 25
CASH BAR: 18:30 – 22:00, FOYER OF NUEVO LEON 3
BANQUET: 19:00-22:00
ROOM: NUEVO LEON 3
DRESS: BUSINESS CASUAL (COAT AND TIE OPTIONAL)

This is the premier social event of the conference. The PICMET '23 Leadership in Technology Management, Medal of Excellence, and Outstanding Student Paper awards will be presented at the banquet. Included in the registration fee.*

The one-day registration fee does not include the Sunday, Monday, and Tuesday evening social events. Tickets for these events may be purchased at the registration desk.

TECHNICAL PROGRAM

PROGRAM OVERVIEW

The PICMET '23 technical program consists of 54 sessions including 5 plenaries, 3 special sessions, 1 panel, and 45 paper sessions.

The plenaries are scheduled from 08:30 to 10:00 every morning, Monday, July 24, through Thursday, July 27, in Nuevo Leon 3. An afternoon plenary session will be held from 14:00 – 15:30 on Monday, July 24, in Nuevo Leon 3. They are described in the "Plenaries" section of this Bulletin.

THE PAPERS

Research papers and applications-oriented papers are explicitly identified in this conference. Separate evaluation criteria were used, and different referees were selected for each category to make sure that appropriate papers were included in the conference for the "Research" and "Application" categories. We emphasized research methodology, the use of the research literature, the theory behind the paper, the sample size, and the impact on the research community for the "Research Papers." The important evaluation criteria for "Industry Applications" were the usefulness of the application, the importance of the case being discussed, the generalizability of the concepts presented, and the impact of the paper on the users of technology management. The "Research Papers" included in PICMET '23 are listed with an [R] in front of their titles on the following pages; and the "Industry Applications" papers are shown with an [A] in front of their titles. Roughly 85 percent are in the [R] category, and the rest are in the [A] category.

The Research Papers and Industry Applications are mixed in the sessions. This was done intentionally to assure effective exchange of ideas among those presenting research papers and those presenting applications-oriented papers.

THE SCHEDULE

The plenary is the only session in the 08:30-10:00 time slot. After that, there are up to 6 break-out sessions throughout the day, Monday through Thursday.

In order to make the sessions easy to see, we have prepared the schedule listings in three different formats for you.

First, you will find a pictorial display of the sessions for each day. The four pages (one for each day) should help you visualize what session is scheduled in what time slot and in which room each day.

In the second set of schedules, the sessions are listed in chronological in order to give you a breakdown of the sessions by time of day.

The third set contains the same information as the second set, but the sessions are ordered by room. This set is intended to give you a good picture of all the tracks in which the sessions are scheduled. The sessions in a track are kept in the same room as much as possible. By looking at the sessions in each room, you should easily be able to select the tracks which you would like to follow.

Finally, you will find a "Personal Schedule" following the schedule listings. It is a chart for you to make your own schedule. Only the common events are marked up on the personal schedule. You can fill it out as a daily calendar for the sessions you would like to follow, events to attend, and people to meet with.

We hope these will help you to take full advantage of the richness of the technical program at PICMET '23.

Daily Schedules

MONDAY, JULY 24, 2023

	01 Nuevo Leon 3	02 Colima	03 Durango	04 Guerrero	05 Jalisco	06 Oaxaca
MA 08:30-10:00	Plenary - 1					
MB 10:30-12:00	Technology Planning	Enterprise Management-1	Commercialization of Technology	R&D Management	E-Business	Information Communication Technologies
MC 12:00-14:00	**LUNCH**					
MD 14:00-15:30	Plenary - 2					
ME 16:00-17:30	Manufacturing Management		Science and Technology Policy	Technology Based Organizations and Workforce	Entrepreneurship & Intrapreneurship-1	

TUESDAY, JULY 25, 2023

	01 Nuevo Leon 3	02 Colima	03 Durango	04 Guerrero	05 Jalisco	06 Oaxaca
TA 08:30-10:00	Plenary -3					
TB 10:30-12:00	ITechnology Adoption	Decision Making for Technology Management	Social Innovation	AI for Technology Management	Strategic Management of Technology-1	Project & Program Management
TC 12:00-14:00	**LUNCH**					
TD 14:00-15:30	Intellectual Property	Innovation Management-1	System Design	Technology Roadmapping	Strategic Management of Technology-2	Quality Management
TE 16:00-17:30	Meet the Editors	Innovation Management-2	Technology Management Framework	Disruptive Technologies-1	Strategic Management of Technology-3	

Daily Schedules

WEDNESDAY, JULY 26, 2023

	01 Nuevo Leon 3	02 Colima	03 Durango	04 Guerrero
WA 08:30-10:00	Plenary - 4			
WB 10:30-12:00	Educational Issues-1	Innovation Management-3	Sustainability-1	Disruptive Technologies-2
WC 12:00-14:00	**LUNCH**			
WD 14:00-15:30	Enterprise Management-2	Environmental Issues	Sustainability-2	Technology Transfer and Diffusion
WE 16:00-17:30	Knowledge Management-1	Innovation Management-4	Productivity Management	Emerging Technologies

THURSDAY, JULY 27, 2023

	01 Nuevo Leon 3	02 Colima	03 Durango	04 Guerrero	05 Jalisco
HA 08:30-10:00	Plenary - 5				
HB 10:30-12:00	Educational Issues-2	Innovation Management-5		Knowledge Management-2	Entrepreneurship & Intrapreneurship-2
HC 12:00-14:00	**LUNCH**				
HD 14:00-15:30	PICMET '23 Debrief and Future PICMET Planning				

Schedule of Sessions

SCHEDULE OF SESSIONS BY DATE

MONDAY, JULY 24, 2023

Session	Number	Day	Time	Room	Session Title
MA	01	Monday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 1”
MB	01	Monday	10:30 - 12:00	Nuevo Leon 3	“Technology Planning”
MB	02	Monday	10:30 - 12:00	Colima	“Enterprise Management-1”
MB	03	Monday	10:30 - 12:00	Durango	“Commercialization of Technology”
MB	04	Monday	10:30 - 12:00	Guerrero	“R&D Management”
MB	05	Monday	10:30 - 12:00	Jalisco	“E-Business”
MB	06	Monday	10:30 - 12:00	Oaxaca	“Information Communication Technologies”
MD	01	Monday	14:00 - 15:30	Nuevo Leon 3	PLENARY: “Plenary - 2”
ME	01	Monday	16:00 - 17:30	Nuevo Leon 3	“Manufacturing Management”
ME	03	Monday	16:00 - 17:30	Durango	“Science and Technology Policy”
ME	04	Monday	16:00 - 17:30	Guerrero	“Technology Based Organizations and Workforce”
ME	05	Monday	16:00 - 17:30	Jalisco	“Entrepreneurship & Intrapreneurship-1”

TUESDAY, JULY 25, 2023

TA	01	Tuesday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 3”
TB	01	Tuesday	10:30 - 12:00	Nuevo Leon 3	“Technology Adoption”
TB	02	Tuesday	10:30 - 12:00	Colima	“Decision Making for Technology Management”
TB	03	Tuesday	10:30 - 12:00	Durango	“Social Innovation”
TB	04	Tuesday	10:30 - 12:00	Guerrero	“AI for Technology Management”
TB	05	Tuesday	10:30 - 12:00	Jalisco	“Strategic Management of Technology-1”
TB	06	Tuesday	10:30 - 12:00	Oaxaca	“Project & Program Management”
TD	01	Tuesday	14:00 - 15:30	Nuevo Leon 3	“Intellectual Property”
TD	02	Tuesday	14:00 - 15:30	Colima	“Innovation Management-1”
TD	03	Tuesday	14:00 - 15:30	Durango	“System Design”
TD	04	Monday	16:00 - 17:30	Guerrero	“Technology Roadmapping”
TD	05	Tuesday	14:00 - 15:30	Jalisco	“Strategic Management of Technology-2”
TD	06	Tuesday	14:00 - 15:30	Oaxaca	“Quality Management”
TE	01	Tuesday	16:00 - 17:30	Nuevo Leon 3	PANEL: “Meet the Editors”
TE	02	Tuesday	16:00 - 17:30	Colima	“Innovation Management-2”
TE	03	Tuesday	16:00 - 17:30	Durango	“Technology Management Framework”
TE	04	Tuesday	16:00 - 17:30	Guerrero	“Disruptive Technologies-1”
TE	05	Tuesday	16:00 - 17:30	Jalisco	“Strategic Management of Technology-3”

SCHEDULE OF SESSIONS

WEDNESDAY, JULY 26, 2023

WA	01	Wednesday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 4”
WB	01	Wednesday	10:30 - 12:00	Nuevo Leon 3	“Educational Issues-1”
WB	02	Wednesday	10:30 - 12:00	Colima	“Innovation Management-3”
WB	03	Wednesday	10:30 - 12:00	Durango	“Sustainability-1”
WB	04	Wednesday	10:30 - 12:00	Guerrero	“Disruptive Technologies-2”
WD	01	Wednesday	14:00 - 15:30	Nuevo Leon 3	“Enterprise Management-2”
WD	02	Wednesday	14:00 - 15:30	Colima	“Environmental Issues”
WD	03	Wednesday	14:00 - 15:30	Durango	“Sustainability-2”
WD	04	Wednesday	14:00 - 15:30	Guerrero	“Technology Transfer and Diffusion”
WE	01	Wednesday	16:00 - 17:30	Nuevo Leon 3	“Knowledge Management-1”
WE	02	Wednesday	16:00 - 17:30	Colima	“Innovation Management-4”
WE	03	Wednesday	16:00 - 17:30	Durango	“Productivity Management”
WE	04	Wednesday	16:00 - 17:30	Guerrero	“Emerging Technologies”

THURSDAY, JULY 27, 2023

HA	01	Thursday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 5”
HB	01	Thursday	10:30 - 12:00	Nuevo Leon 3	“Educational Issues-2”
HB	02	Thursday	10:30 - 12:00	Colima	“Innovation Management-5”
HB	04	Thursday	10:30 - 12:00	Guerrero	“Knowledge Management-2”
HB	05	Thursday	10:30 - 12:00	Jalisco	“Entrepreneurship & Intrapreneurship-2”
HD	01	Thursday	14:00 - 15:30	Nuevo Leon 3	PANEL: “PICMET ’23 Debrief and Future PICMET Planning”

SCHEDULE OF SESSIONS

SCHEDULE OF SESSIONS BY ROOM

Session	Number	Day	Time	Room	Session Title
MA	01	Monday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 1”
MB	01	Monday	10:30 - 12:00	Nuevo Leon 3	“Technology Planning”
MD	01	Monday	14:00 - 15:30	Nuevo Leon 3	PLENARY: “Plenary - 2”
ME	01	Monday	16:00 - 17:30	Nuevo Leon 3	“Manufacturing Management”
TA	01	Tuesday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 3”
TB	01	Tuesday	10:30 - 12:00	Nuevo Leon 3	“Technology Adoption”
TD	01	Tuesday	14:00 - 15:30	Nuevo Leon 3	“Intellectual Property”
TE	01	Tuesday	16:00 - 17:30	Nuevo Leon 3	PANEL: “Meet the Editors”
WA	01	Wednesday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 4”
WB	01	Wednesday	10:30 - 12:00	Nuevo Leon 3	“Educational Issues-1”
WD	01	Wednesday	14:00 - 15:30	Nuevo Leon 3	“Enterprise Management-2”
WE	01	Wednesday	16:00 - 17:30	Nuevo Leon 3	“Knowledge Management-1”
HA	01	Thursday	08:30 - 10:00	Nuevo Leon 3	PLENARY: “Plenary - 5”
HB	01	Thursday	10:30 - 12:00	Nuevo Leon 3	“Educational Issues-2”
HD	01	Thursday	14:00 - 15:30	Nuevo Leon 3	PANEL: “PICMET ’23 Debrief and Future PICMET Planning”
MB	02	Monday	10:30 - 12:00	Colima	“Enterprise Management-1”
TB	02	Tuesday	10:30 - 12:00	Colima	“Decision Making for Technology Management”
TD	02	Tuesday	14:00 - 15:30	Colima	“Innovation Management-1”
TE	02	Tuesday	16:00 - 17:30	Colima	“Innovation Management-2”
WB	02	Wednesday	10:30 - 12:00	Colima	“Innovation Management-3”
WD	02	Wednesday	14:00 - 15:30	Colima	“Environmental Issues”
WE	02	Wednesday	16:00 - 17:30	Colima	“Innovation Management-4”
HB	02	Thursday	10:30 - 12:00	Colima	“Innovation Management-5”
MB	03	Monday	10:30 - 12:00	Durango	“Commercialization of Technology”
ME	03	Monday	16:00 - 17:30	Durango	“Science and Technology Policy”
TB	03	Tuesday	10:30 - 12:00	Durango	“Social Innovation”
TD	03	Tuesday	14:00 - 15:30	Durango	“System Design”
TE	03	Tuesday	16:00 - 17:30	Durango	“Technology Management Framework”
WB	03	Wednesday	10:30 - 12:00	Durango	“Sustainability-1”
WD	03	Wednesday	14:00 - 15:30	Durango	“Sustainability-2”
WE	03	Wednesday	16:00 - 17:30	Durango	“Productivity Management”
MB	04	Monday	10:30 - 12:00	Guerrero	“R&D Management”
ME	04	Monday	16:00 - 17:30	Guerrero	“Technology Based Organizations and Workforce”
TB	04	Tuesday	10:30 - 12:00	Guerrero	“AI for Technology Management”

Schedule of Sessions

TD	04	Monday	16:00 - 17:30	Guerrero	“Technology Roadmapping”
TE	04	Tuesday	16:00 - 17:30	Guerrero	“Disruptive Technologies-1”
WB	04	Wednesday	10:30 - 12:00	Guerrero	“Disruptive Technologies-2”
WD	04	Wednesday	14:00 - 15:30	Guerrero	“Technology Transfer and Diffusion”
WE	04	Wednesday	16:00 - 17:30	Guerrero	“Emerging Technologies”
HB	04	Thursday	10:30 - 12:00	Guerrero	“Knowledge Management-2”
MB	05	Monday	10:30 - 12:00	Jalisco	“E-Business”
ME	05	Monday	16:00 - 17:30	Jalisco	“Entrepreneurship & Intrapreneurship-1”
TB	05	Tuesday	10:30 - 12:00	Jalisco	“Strategic Management of Technology-1”
TD	05	Tuesday	14:00 - 15:30	Jalisco	“Strategic Management of Technology-2”
TE	05	Tuesday	16:00 - 17:30	Jalisco	“Strategic Management of Technology-3”
HB	05	Thursday	10:30 - 12:00	Jalisco	“Entrepreneurship & Intrapreneurship-2”
MB	06	Monday	10:30 - 12:00	Oaxaca	“Information Communication Technologies”
TB	06	Tuesday	10:30 - 12:00	Oaxaca	“Project & Program Management”
TD	06	Tuesday	14:00 - 15:30	Oaxaca	“Quality Management”

Personal Schedule

	Sunday July 23, 2023	Monday July 24, 2023	Tuesday July 25, 2023	Wednesday July 26, 2023	Thursday July 27, 2023
08:00 – 08:30 Bright Start (Breakfast)					
08:30 – 10:00 (A)		Plenary - 1 (Nuevo Leon 3)	Plenary - 3 (Nuevo Leon 3)	Plenary - 4 (Nuevo Leon 3)	Plenary - 5 (Nuevo Leon 3)
10:00 – 10:30 Coffee Break					
10:30 – 12:00 (B)					
12:00 – 14:00 Lunch Break					
14:00 – 15:30 (D)		Plenary - 2 (Nuevo Leon 3)			PICMET '23 Debrief & Future PICMET planning (Nuevo Leon 3)
15:30 – 16:00 Coffee Break					
16:00 – 17:30 (E)					
19:00 – 22:00	Welcome Reception	Dinner	Awards Banquet		

SPECIAL SESSIONS

PANEL OF REVIEWERS LUNCH MEETING

DATE: MONDAY, JULY 24
TIME: 12:00-14:00
ROOM: TAMAULIPAS

Those who reviewed papers submitted to PICMET conferences are invited to this lunch meeting.

Lunch will be provided.

COUNTRY REPRESENTATIVES LUNCH MEETING

DATE: WEDNESDAY, JULY 26
TIME: 12:00-14:00
ROOM: TAMAULIPAS

PICMET has 152 Country Representatives in 60 countries. They provide the linkage between PICMET Headquarters and the different parts of the world by disseminating PICMET information in their regions, proposing locations for future PICMET conferences, and starting PICMET chapters in their countries. Three such chapters, PICMET - Japan, PICMET - Korea, and PICMET - Turkey, are already in operation.

PICMET's co-Directors of International Activities, Dr. Kiyoshi Niwa of The University of Tokyo, and Dr. Dilek Cetindamar Kozanoglu of The University of Technology Sydney, invite the Country Representatives and those who are interested in becoming Country Representatives to a meeting to discuss the roles of the Country Representatives, the procedure to start and organize PICMET Chapters, and the requirements for holding future PICMET conferences in their countries.

Lunch will be provided.

PICMET '23 DEBRIEFING & '24 PLANNING SESSION

DATE: THURSDAY, JULY 27
TIME: 14:00-15:30
ROOM: NUEVO LEON 3

We invite the PICMET community to join us for this interactive session. The PICMET organizing committee will be present to hear feedback about this year's conference, discuss lessons learned, and talk about future PICMET conferences.

PLENARIES

PLENARY SESSION-1

DATE: MONDAY, JULY 24, 2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3

Session Chair: Dr. Timothy R. Anderson, Portland State University, USA

WELCOMING SPEECH

Dr. Ricardo Swain, Dean of the School of Engineering and Sciences, Northern Region, Tecnológico de Monterrey – Mexico, welcoming PICMET guests to Monterrey on the 80th anniversary of Tec de Monterrey

KEYNOTE-1

Dr. Adnan Akay, Visiting Professor, Sapienza University of Rome, Italy; and Emeritus Professor, Carnegie Mellon University, USA

"Managing for a Sustainable World: The Grandest Challenge"

Managing technology and engineering for a sustainable world encompasses social, cultural, economic, human health, and environmental concerns – all of which also drive public policies. Since everything we do influences the sustainability of the planet to a greater or lesser degree, sustainability is best managed as a shared responsibility, at both local and global levels. Globalization of goods, such as food, energy, textiles, electronics, and transportation vehicles, places a responsibility on suppliers, manufacturers, and the consumers as well as on nations. A fundamental challenge to managing sustainability rests on the ability to estimate the long-term consequences of actions taken in the short-run. In many cases, policies have been developed describing goals and indicators. Another challenge relates to the differences in sustainability practices among nations and affordability of trade-offs across different segments of society, different regions of the world and their traditions. Common to all is the need for education and an understanding of the financial implications of environmental stewardship. The presentation will suggest the planet as a system whose equilibrium is being challenged and briefly review proposed metrics and recommendations to sustain it.

Dr. Adnan Akay *is a visiting professor at Sapienza University of Rome and Emeritus Professor at Carnegie Mellon University. Previously he was the provost at Bilkent University in Ankara, Director of the Civil, Mechanical, and Manufacturing Innovation Division at the US National Science Foundation, Lord Professor and Head of Mechanical Engineering at Carnegie Mellon University, and DeVlieg Professor at Wayne State University. He is a recipient of numerous awards including the ASME Per Brüel Gold Medal for Noise Control and Acoustics and Humboldt Research Award. He is a Fellow of PICMET, the American Society of Mechanical Engineers, and the Acoustical Society of America. He was elected as a Distinguished International Member of Institute of Noise Control Engineering of the United States of America. Dr. Akay serves on the advisory boards of several universities and regularly consults with international businesses as a technical advisor."*

PLENARY SESSION-2

DATE: MONDAY, JULY 24, 2023
TIME: 14:00-15:30
ROOM: NUEVO LEON 3

Session Chair: Dr. Kiyoshi Niwa, The University of Tokyo, Japann

KEYNOTE-1

Dr. Christopher L. Tucci, Professor, Imperial College, London, UK

"Embracing Digital Disruption"

igital technologies are everywhere, from generative AI to new mobile telecommunications, drones, cloud computing, 3D printing, Internet of Things, virtual reality, Web3, and maybe someday quantum computing. They are changing the way we live, consume, work, produce things, enjoy entertainment, and much more. Digital technologies are also creating enormous opportunities for organizations across virtually all sectors of the economy. In this presentation, Professor Tucci will take us on a tour of digital "disruption," creative destruction, open innovation, corporate venturing, crowdsourcing, and more. He will also discuss

how innovation management can help organizations of all sizes and in all sectors create and capture value, and what kinds of innovation management cultures, practices, and programs are most effective.

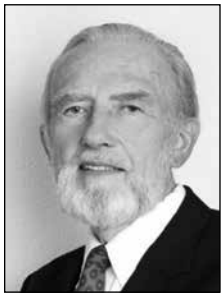
Dr. Christopher L. Tucci *is Professor of Digital Strategy & Innovation at Imperial College Business School, where he directs the Centre for Digital Transformation and is co-Director of I-X, a new campus concept for Imperial College London on AI, data, and digital topics. Professor Tucci held the Chair in Corporate Strategy and Innovation from 2003-2020 at EPFL and was Dean of the College of Management there from 2013-2018. In 2018, he was Visiting Thought Leader at CEIBS in Shanghai, China. He received the degrees of Ph.D. in Management from the Sloan School of Management, MIT; SM (Technology & Policy) from MIT; and BS (Mathematical Sciences), AB (Music), and MS (Computer Science) from Stanford University. He was an industrial computer scientist involved in developing Internet protocols and applying artificial intelligence tools in the 1980s. Professor Tucci teaches courses in Deep Tech Acceleration, Design Thinking, Digital Strategy, AI Ventures, and Innovation Management. His primary area of interest is in how firms make transitions to new business models, technologies, and organizational forms. He also studies crowdsourcing, Internetworking, and digital innovations. He has published articles in, among others, Academy of Management Review (AMR), SMJ, Management Science, Research Policy, Communications of the ACM, SEJ, Academy of Management Annals, and JPIM. His article with Allan Afuah, "Crowdsourcing as solution to distant search," won the Best Paper of 2012, Best Practice Implications Award of 2019, and the Decade Award of 2022 for AMR. He has served in leadership positions in the Academy of Management and the Strategic Management Society.*

KEYNOTE-2

Dr. Antonio Pita Szczesniewski, University Relations and Project Consultant, Cemex Research Center, Switzerland

"The Imbalance of the Quadruple Helix: Present Paradigms and Shifts in the Making"

The notion of the Quadruple Helix expands upon the traditional Triple Helix of innovation, involving the three main actors: government, academia, and the business sector by adding a fourth key actor: civil society in recognition of the importance of citizen participation and the active role of civil society. This approach is based on the idea that collaboration among these four actors is crucial for fostering innovation, competitiveness, and sustainable economic growth in the present 4.0 industrial revolution. Generally, industry is still recognized as the main and leading influential actor due to its ability to drive innovation and the economy. However, there has been a growing recognition of the present imbalance that the other three actors have with industry as well as between themselves due to paradigms that are still being clung to from the third industrial revolution. This situation resembles the typical S-Curve pattern and paradigm influence that follows the evolution of an industry, product, or business model over time, and a review will be made of characteristics of each imbalance as well as the paradigm shifts that are already in the making.



Dr. Antonio Pita Szczesniewski *is currently university relations and project consultant for Cemex's Research Center in Switzerland and is director of the Swiss International Academic Delegation of the Tecnológico de Monterrey. He started his career as a professor in the department of Thermodynamics, Fluid Mechanics and Control Engineering of the Tecnológico de Monterrey, and as director of the Fluid Mechanics Laboratory he received a research grant awarded by the Organization of American States for the Construction of 3D Boundary Layer Wind Tunnel. He then held positions as head of the department of Professional and Scientific Development, Vice-President of Divisional Technology and Director of Vitro's Corporate R&D Center, and later as senior R&D engineer scientist at Vitro's Swiss Research Center. He has published articles in leading journals, holds three US and World Patents on Glass Manufacturing and 50 Special Technical Reports. He is a member of the Mexican Academy of Engineering and was a member of the Scholarship and Grants Committees for the Mexican National Science and Technology Council (CONACYT). Dr. Pita received a PhD in Solid and Fluid Mechanics as well as a master's degree from the University of Iowa and a Bachelor of Science degree from the Johns Hopkins University.*

PLENARIES

PLENARY SESSION-3

DATE: TUESDAY, JULY 25, 2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3

Session Chair: Prof. Harm-Jan Steenhuis, Hawaii Pacific University, USA

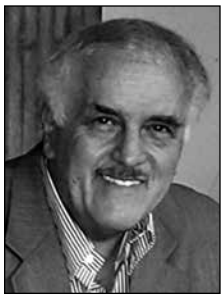
KEYNOTE-1

Dr. Bulent Atalay, Professor, University of Mary Washington and UVA, Fredericksburg, USA

"The Physics of Climate Change"

Energy is the lifeblood of Civilization
This keynote has many legs and is based on a graduate course entitled, "Future Alternate Sources of Energy," taught for nearly two decades by Bulent Atalay at the University of Virginia. The two inseparable aspects of energy are its production and its consumption, and both aspects are ultimately explained by physics and chemistry. Both aspects can have devastating consequences on our planet and these effects must be minimized. The atmosphere is a fine mist, a breathable gaseous blanket overlying the earth. Five-to-nine miles in thickness, it is infinitesimal compared with the 4,000 miles (6400 km) radius of the planet. For the preservation of life on earth, this fragile blanket must be preserved. A maxim gaining popularity globally reads, "There is no planet B!" The underlying physics is not difficult compared with the fundamental physical laws of quantum mechanics and relativity. But it is a messy sort of science, involving mathematical models, and large-number crunching. It creates polarizing domestic and international politics between the owners and the buyers of fossil fuels. And it pits believers of man-made climate change against its deniers. In this discussion of limited length, we will take inventory of many of those "legs" but focus on just two of them: the rudiments of the physics of climate change along with one source of energy production that is clean, virtually inexhaustible, resistant to catastrophic accidents, within reach, but hitherto unattained.

***Dr. Bulent Atalay** — scientist, artist, author, and lecturer — has been described by NPR, PBS, and the Washington Post as a "Modern Renaissance Man." He is the author of two successful books on the intersection of art, science, and mathematics, where Leonardo, the pre-eminent Renaissance man, serves as the focal point. His best-selling book, "Math and the Mona Lisa," (Smithsonian Books, 2004) has*



appeared in 14 languages; and Leonardo's Universe (National Geographic Books, 2009) has appeared in English and Japanese, and was declared, "One of ten must-have books," by the Britannica. Bulent's academic background is in theoretical physics, distilled from work at Georgetown, UCal - Berkeley, Princeton, Oxford, and the Institute for Advanced Study, Princeton. He travels around the world lecturing at academic institutions and on cruise ships on the "A-subjects," art, archaeology, astrophysics, atomic physics, and Ataturk, confessing that he knows much less about the "B-subjects," business, banking, biology, and botany... He recently put the finishing touches on "Beyond Genius," a new book that examines the internal and external factors which produced Leonardo da Vinci, William Shakespeare, Isaac Newton, Ludwig van Beethoven, and Albert Einstein, a pair of pure artists, a pair of pure scientists, and a scientist-artist who straddles the cultures of both. Atalay has given lectures at Caltech, Princeton, Duke, Yale, Harvard, Oxford, NASA, NIST, NIH, Smithsonian, and the National Geographic Society, as well as keynote talks at PICMET '05, '10, '12, '14, '16, '17, and '19. His website appears at www.bulentatalay.com

KEYNOTE-2

John R. McDougall, PICMET Fellow, CEO, SynBioBlox Innovations Ltd and Former President, National Research Council, Canada

"Applying Digital Technologies to Manage Climate Change"

A sustainable world is a world in balance with itself. As humans, we should work seriously not to disrupt this balance. Levels of production, consumption, waste, and emissions all need to become synergistically integrated – designed, manufactured, managed, and recycled in a manner that maintains a global balance. The major question is not if we should transform our activities in this way, but rather how to do so in a manner that is feasible, both technologically and economically; and comprehensive. Food, water, energy, the basics of life, are important aspects to consider. But infrastructure, building materials and consumer products must also be incorporated. Circularity is a "whole system" concept for addressing issues and challenges associated with waste – especially carbon-based waste materials such as GHGs and plastics, and toxic materials associated with resource production and transformation. That means dealing with waste ma-

PLENARIES

terials emitted through stacks and exhausts to the atmosphere, and single use waste materials that currently tend to be discarded rather than collected – by finding ways to collect and repurpose them for reprocessing and/or reuse. This presentation will explore how biomimicry provides a framework for helping this to occur.

John R. McDougall *is currently CEO of SynBioBlox Innovations Ltd. and of the Bio-Conversion Databank Foundation. He has 50 years of experience in 75 countries in the natural resource, IT, manufacturing, consulting, real estate, and investment industries as well as research and development and academia. He retired from Canada's National Research Council after six years as President, a position he accepted after 12 years as CEO of the Alberta Research Council. He was the inaugural Chair in Management for Engineers at the University of Alberta from 1991-97, and he initiated Innoventures Canada Inc. in 2006 to bring together Canada's leading research and technology organizations providing technology development, demonstration and deployment services as centers of excellence for commercialization and research.*

In the private sector, after eight years with a multinational, he managed and founded firms in real estate, investment and development, frontier exploration and logistics, project management, technology development, economics and economic development, financial and business planning, data processing and custom software development and natural gas brokerage. He has also served as an outside director or advisor to several public and private firms.

Mr. McDougall is an active volunteer in business, professional and not-for-profit organizations where holding leadership positions in local, national and international organizations such as The Edmonton Chamber of Commerce and World Trade Centre, Capital Care Foundation, Engineers Canada, St. John's Ambulance, Eureka and the G8 Heads of Research Organizations. He has also served on dozens of academic and government committees and agencies.

He has received medals and recognition including the 2015 PICMET award for Leadership in Technology Management, Honorary membership in the Mexican College of Civil Engineers and the Queen's Gold and Platinum Jubilee Medals.

PLENARY SESSION-4

DATE: WEDNESDAY, JULY 26, 2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3

Session Chair: Dr. Thomas Gillpatrick, Portland State University, USA

KEYNOTE-1

Dr Gabriela Dutrénit, Distinguished Professor, Universidad Autónoma Metropolitana (UAM), Mexico

"Innovation Policy, Social Inclusion and Sustainability in Latin American Countries"

Latin America and the Caribbean countries are characterized by structural heterogeneity (productive, social and environmental) and a strong social inequality. The Science, Technology and Innovation policies prevailing in the region have followed the international trends and combine the three existing analytical frameworks. Different structures coexist in each country, including a modern and innovative, a low productivity, and a traditional knowledge. In this keynote we will explore the types of existing structures and discuss the implications for the design of STI policies. We will particularly question the need to formulate a triple/quadruple STI policy to attend each of the structures. This combination of policy brings challenges for the design of a policy mix that integrates instruments that foster innovation in the different existing structures, with a perspective on inclusion and sustainability.

Dr. Gabriela Dutrénit *is an economist with a PhD in Science and Technology Research Studies from the Science Policy Research Unit (SPRU), University of Sussex, UK. She is a professor in the Master's and PhD Program in Economics and Innovation Management at the Universidad Autónoma Metropolitana (UAM), Mexico. Dr Dutrénit is a "Distinguished Professor" of the UAM and a regular member of the Mexican Academy of Science. She is president of the Latin American Chapter of this network, LALICS (Latin American Network for Economics of Learning, Innovation, and Competence Building Systems), and member of the Scientific Board of UNU-MERIT at Maastricht University. Her research interests include: innovation and*

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development; learning and technological capability accumulation at the firm level; university–industry linkages; research and development (R&D), and innovation policy. She has coordinated several evaluations of the Mexican STI policy.

KEYNOTE-2

Dr. Guillermo José Aguirre Esponda, President, SEFI, ADIAT, Academia de Ingeniería México, Former CTO, Grupo Vitro and Deputy Director of Technology, CONACYT, Mexico

"Towards an Indirect Approach to the Management of Technology, Engineering and Manufacturing"

One of the most important challenges facing those in charge of managing engineering and technology development tasks is to find the right balance between controlling the tasks and maintaining the freedom and creativity of the participants needed for achieving the targets. This keynote presents an indirect approach to the management and control of design and technology development activities resulting from a five-year engineering research program, developed at the University of Cambridge, and applied in the public and private sectors. Dr. Aguirre will present examples and applications of the indirect approach in the industrial sector, federal government, and entrepreneurship.

Dr. Guillermo José Aguirre Esponda *is the creator of the indirect approach to the application and management of engineering, technology and manufacturing, CINDI®, with which he has created leading products in their markets, government programs that multiplied the national investment in technology by more than 10 times, and ventures lauded by Forbes and MIT Technology Review as the most promising in the country. He obtained his Ph.D. from Cambridge University, an M.Sc. from Loughborough University, and a B.Sc. in Engineering from UNAM. He has published more than 100 papers, 7 books and registered 18 patents. He chairs some of the most prestigious engineering and technology organizations in his country and is a visiting professor at MIT. As CTO of Grupo Vitro, one of the largest industrial conglomerates in Mexico (1991-2001), he led the company to obtain the National Technology Award and designed product lines that have been market leaders for more than two decades. As Deputy Director of Technology at CONACYT (2001-2007), he led the country to historic levels of investment in engineering, technology and manufacturing and received the National Business Impulse Award. In his role as a consultant (2007-present), he has helped hundreds of companies and entrepreneurs to grow exponentially and generate billions of dollars in new sales.*

PLENARY SESSION-5

DATE: THURSDAY, JULY 27, 2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3

Session Chair: Dr. David Güemes-Castorena, Tecnológico de Monterrey, Mexico

KEYNOTE-1

Dr. Jaime Parada Avila, Former President of CONACYT and National Academy of Engineering, Mexico

"How to Innovate in a Fast Way in Companies of Excellence to Create New Economic Value and Competitive Advantages"

Based on his recent book, Dr. J. Parada shares his vision about managing the investment in innovation to accelerate the economic growth and competitive advantages. This presentation describes the current innovation situation in Mexico, and the reasons to invest in innovation for developing new products, services, solutions, processes, business models and new businesses with added value for clients and customers. The use of the INNCOM integrated innovation model with 8 components is explained. The 8 components are: (1) Value creation for all stake holders of the company, (2) Strategic plan for medium and long-term, (3) The innovation project portfolio, (4) The critical processes to integrate and execute innovation projects, (5) The core competences for innovation, (6) The organization and the governance, (7) The allocation of resources and investment for innovation, and (8) The creation of culture of innovation in the company. It is important to mention the critical role of the information systems and key indicators and metrics of success to evaluate the profitability of the investment in innovation in the enterprise. The role of open innovation ecosystems is important to reinforce the capabilities of the company to collaborate with external experts, universities, and public research centers.

Dr. Jaime Parada Avila *has over 45 years' experience in the fields of Research, Science and Technology De-*

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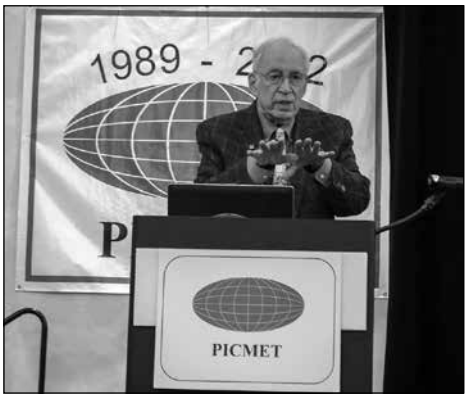
velopment, Innovation and Business Management. He was President of the National Council for Science and Technology (CONACYT); and Chief Technology and Innovation Officer of important industrial groups like Sidermex, Vitro, Whirlpool, and Cydsa. In the State of Nuevo León, he was the General Director of the Institute of Innovation and Technology Transfer, and Director of the Research and Technology Innovation Park (PIIT). He was the President of the Mexican National Academy of Engineering, and he was awarded with two Honoris Causa Doctor degree in engineering by the University of Sheffield in England and by the Autonomous University of Nuevo León. Dr. Parada was professor at the Engineering Faculty of UNAM and a visiting professor at University of Texas in Austin. He was awarded with the order of merit by the government of Germany, and leadership award from the Association of University Research Parks. He has been member and advisor of several important associations, public research centers, companies, governments, and universities, in the field of innovation. As an entrepreneur he provided support and guidance in high tech companies in the fields of advanced materials, software, and innovation services. He is the author of several papers and a recent book: "How to innovate in companies of excellence."

THE PICMET EXPERIENCE

Joining the world's leading technology management experts from academic institutions, industrial corporations and government agencies for discussions on cutting-edge topics.



PhD Colloquium

GETTING YOUR PHD… AND BEYOND

Critical Stages and Career Paths for the PhD Student

DATE: SUNDAY, JULY 23
TIME: 13:00-17:00 (COFFEE BREAK AT 15:00)
ROOM: VERACRUZ
REGIST: $40

CHAIR:
Dr. Nasir Sheikh, Senior Director Analyst, R&D, Emerging Technologies and Trends, Gartner, USA; and Visiting Scholar, Department of Engineering and Technology Management, Portland State University, USA; former Associate Professor, Chair, and PhD Program Director, Technology Management Department, University of Bridgeport, USA

SPEAKERS:
Dr. Charles Weber, Associate Professor, Engineering and Technology Management Department, Portland State University, USA
Dr. Jin Chen, Editor in Chief, *International Journal of Innovation and Technology Management (JITM)* and Professor, Tsinghua University, China
Dr. Hugo Carlos Gomez Guzman, Director, Pepsi Cola, Mexico

This interactive session will give PhD candidates an excellent opportunity to learn how to successfully defend their dissertation, how to publish their research and how to become confident in searching for jobs in academia and industry after obtaining the PhD degree. In addition, the PhD candidates will be able to meet peers and colleagues, share experiences, and network with scholars from many countries.

The invited speakers and the participants will share experiences in the following areas:

- Critical stages in the PhD process and how to successfully master them
- The PhD process and career paths
- Coping with possible challenges while pursuing the PhD degree
- Entering the job market – academia, government, or industry (tips/tools for job searching)
- Publishing PhD research

We encourage research students in all stages of the PhD process, as well as recent graduates, to join this illuminating colloquium.

Panel

MEET THE EDITORS

DATE: TUESDAY, JULY 25
TIME: 16:00 – 17:30
ROOM: NUEVO LEON 3

Meet the editors of the Technology Management related journals. The editors will discuss the philosophies, criteria, and submission processes of their journals and answer questions from prospective authors.

SESSIONS

MA-01 PLENARY: PLENARY-1

DATE: MONDAY, 7/24/2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3
CHAIR: TIMOTHY R ANDERSON; PORTLAND STATE UNIVERSITY

MA-01.1 [K] Managing for a Sustainable World: The Grandest Challenge

Adnan Akay, Sapienza University of Rome, Italy; and Carnegie Mellon University, United States

Managing technology and engineering for a sustainable world encompasses social, cultural, economic, human health, and environmental concerns – all of which also drive public policies. Since everything we do influences the sustainability of the planet to a greater or lesser degree, sustainability is best managed as a shared responsibility, at both local and global levels. Globalization of goods, such as food, energy, textiles, electronics, and transportation vehicles, places a responsibility on suppliers, manufacturers, and the consumers as well as on nations. A fundamental challenge to managing sustainability rests on the ability to estimate the long-term consequences of actions taken in the short-run. In many cases, policies have been developed describing goals and indicators. Another challenge relates to the differences in sustainability practices among nations and affordability of trade-offs across different segments of society, different regions of the world and their traditions. Common to all is the need for education and an understanding of the financial implications of environmental stewardship. The presentation will suggest the planet as a system whose equilibrium is being challenged and briefly review proposed metrics and recommendations to sustain it.

MB-01 Technology Planning
Monday, 7/24/2023, 10:30 - 12:00
Room: Nuevo Leon 3
Chair(s) Charles Weber; Portland State University

MB-01.1 [R] • Bibliometric Analysis on Artificial Intelligence Research to Support National Artificial Intelligence Strategy in Thailand

Alisa Kongthon; King Mongkut's University of Technology Thonburi, Thailand
Nathasit Gerdsri; Mahidol Univeristy, Thailand

Artificial Intelligence (AI) adoption in Thailand is still in the early stages. To expand the adoption of AI in Thailand, the country needs training and expertise in the technology and government support in AI infrastructure which includes a technology and innovation strategy, education, and R&D infrastructure. In 2022, Thailand's National Artificial Intelligence Strategy and Action Plan has been launched with the aim for Thailand to have an effective ecosystem for developing and applying AI to enhance the economy and improve quality of life by 2027. This paper aims to apply bibliometric analysis on AI research publications in Thailand to identify insights such as the current AI experts and their networks, the application areas of AI, and the core technologies. With these insights, policy makers can identify the gaps between current AI research landscape and desired outcomes of the National AI strategy and action plan.

MB-01.2 [R] • Critical Success Factors of Technology Transfer: An Investigation into the Health Sector of Bangladesh Using ISM-DEMATEL Approach

Md Ahsan Uddin Murad; University of Technology Sydney, Australia
Farid Ahmad; Bangladesh University of Engineering & Technology, Bangladesh
Dilek Cetindamar; University of Technology Sydney, Australia

The study aims to observe the critical success factors (CSFs) of the technology transfer (TT) process within a developing country context. Based on a literature review, a list of 15 CSFs is created. Then, these CSFs are examined empirically in the context of technologies transferred into the health sector in Bangladesh. The study uses data collected from 35 experts and adopts two techniques, namely interpretive structural modelling (ISM) and DEcision MAking Trial and Evaluation Laboratory (DEMATEL), in order to understand the causal relationships among CSFs that have influenced TT. The findings show that among the studied factors, 'Management Support', 'Strategy and Goal' and 'Government Regulation' have the most significant impact on the success of TT implementation in the Bangladesh health sector. The paper is one of the rare studies in technology management literature by bringing together ISM and DEMATEL techniques as well as offering an empirical study carried out in the health sector of a developing country context. The findings will enable TT practitioners to select the most appropriate CSFs for successful TT in context of developing countries. The paper ends with a summary and puts forward suggestions for future studies.

MB-01.3 [R] • Leadership for Technology Management in a Volatile, Uncertain, Complex, and Ambiguous (VUCA) World: A Review of the Literature and a Research Agenda

Dahm M Hongchai; Portland State University, United States
Charles M Weber; Portland State University, United States

The organizational environment of the 21st Century is becoming increasingly volatile, uncertain, complex, and ambiguous (VUCA). Leadership practices in technology management are evolving accordingly. A review of the literature on leadership concludes that success in a VUCA world requires approaches that focus on problem solving, relationships, empathy, and motivation (PREM), as well as integrating three traditional perspectives: authentic leadership, servant leadership, and adaptive leadership. Unfortunately, the literature on integrated approaches to leadership in technology management is very sparse. This paper consequently proposes a research agenda from which best practices for leadership in technology management in a VUCA world will hopefully emerge.

MB-02 Enterprise Management-1
Monday, 7/24/2023, 10:30 - 12:00
Room: Colima
Chair(s) Steven T Walsh; University of New Mexico

MB-02.1 [R] • Management of Modular Enterprises

Karoly Nagy; BME-UBT Joint Transformative Research Centre, Kosovo
Edmond Hajrizi; UBT Higher Education Institution, Kosovo
Edrina Gashi; UBT Higher Education Institution, Kosovo

This study summarizes some important results of the theoretical methodological foundation provided by the author of an ongoing virtual economic zone (VEZ) development project. Modular (modularized) enterprises are a new generation "subspecies" of digital enterprises. The framework for modularization and its operations is provided by VEZ, which implies a kind of "service system" running mainly on the base of an Internet of Things "infrastructure". The topic of a VEZ project is concerned with the intersection of cloud computing, big data and the Future of Internet, focusing on the use of IPv6. Modularization and development of VEZ will facilitate the creation of more effective and new qualitative types of enterprises and organizational culture all over the world. In addition, enterprise modularization will increase opportunities for development of the human-technology partnership. In a modular enterprise, the management team has a permanent opportunity to examine the conditions of every module directly if it is necessary. The leaders avoid the danger resulting from the distortions of aggregated reports. At the same time, they face the fact that management of modular enterprises demands a completely different approach from the habitual point of view and requires big data thinking. The future of work at the enterprise modularization will shape the future of technology management and will increase the opportunities for development of the human-technology partnership.

MB-02.2 [R] • Evaluating the Impact of Continous Improvements through the Implementation of Total Preventative Maintenance in Confectionary Manufacturng Plant: A Case Study

Vuyiso Mhlanga; University of Johannesburg, South Africa
Arnesh Telukdarie; University of Johannesburg, South Africa
Tatenda Katsumbe; University of Johannesburg, South Africa

The production of inexpensive consumables is the primary goal of the Fast-Moving Consumer Goods (FMCG) industry. It is seen as one of the largest manufacturing sectors in the world. Emerging markets, where there is a high demand, are presently driving the industry's expansion. This study employs a case study methodology, similar to the one used in a prior study that examined the effects of applying total preventive maintenance (TPM) in a manufacturing company to streamline operations. The approach for implementing TPM was examined in this study, along with related challenges. Due to covid-19, the study had several disruptions that harmed industrial processes, globally. The findings demonstrate that since the company implemented TPM, Overall Equipment Effectiveness (OEE) has improved. The collected data for the financial year 2019, which was a pre-TPM implementation year, reported the lowest OEE of 54.31% compared to the lowest of 68.39% recorded in the financial year 2020, after the TPM's implementation had begun. Machine availability, performance, and quality calculations are important performance metrics that spur innovation or advancements, and they are used to calculate OEE.

MB-02.3 [R] • Front-end Planning Reduces Delays in Construction Projects: Systematic Literature Review

Takalani Mashamba; University of South Africa, South Africa
Rendani W Maladzhi; University of South Africa, South Africa
Mukondeleli G Kanakana-Katumba; Tshwane University Of Technology, South Africa

Construction projects entail a substantial investment and effort and are the backbone of both national and global economies. Sadly, many of these projects fail because of inadequate early project planning. Early on in a project, effective project management has been proven to provide significant opportunities for reducing several problems that prevent the achievement of project success. Front-end planning is a crucial step in identifying unidentified project components and creating a clear scope definition and organized approach to the project execution process. In this research, through a systematic literature review, we summarize and analyse the literature on the concept of front-end planning, front-end planning tools and the benefits of implementing front-end planning in construction projects. This paper discusses the published literature related to front-end planning ranging from 2012 to 2022. Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology to conduct a search were used. The results of the literature review confirm that good front-end planning maximizes the probability of project success. The study's findings improve knowledge of front-end planning and will be beneficial to academics and practitioners who wish to do more empirical research on the topic.

MB-03 Commercialization of Technology
Monday, 7/24/2023, 10:30 - 12:00
Room: Durango
Chair(s) Harm-Jan Steenhuis; Hawaii Pacific University

MB-03.1 [R] • Aligning Value Creation and SME Competitiveness in the Export of Maritime Services: Empirical Evidence from Trinidad and Tobago

Leroy F Quildon; The University of the West Indies, Trinidad and Tobago
Kit Fai Pun; The University of the West Indies, Trinidad and Tobago

The multifaceted composition and preponderance of small- and medium-sized enterprises (SMEs) participating in the services sector create unique challenges for specialization, productivity, and innovation, particularly in the export of maritime services. Three issues distilled from the literature are (i) servitization of SMEs, (ii) diversification during periods of uncertainty, and (iii) value creation cluster initiatives as a stimulus for enhancing SME competitiveness, in a circular economy. Aligning value creation and SME competitiveness could drive maritime services export. This paper examines whether SME service-providers could improve competitiveness through value creation and cluster initiatives in the export of maritime services in Trinidad and Tobago (T&T). A survey was conducted in the Leisure Marine Services Cluster. Acquired data on five value creation determinants (namely, repair accuracy, concurrent engineering, quality standard, quality assurance, and quality control) were analyzed using Statistical Package for the Social Sciences (SPSS). Empirical evidence shows that repair accuracy and quality standard had positive estimates, with reliability coefficients above 0.70. The application of cluster initiatives would support the development of a value creation program and enhance SME's competitiveness in T&T.

MB-03.2 [R] • Business Accelerator Success in Hawaii

Harm-Jan Steenhuis; Hawaii Pacific University, United States
Xin Fang; Hawaii Pacific University, United States

This study looks at business accelerators in Hawaii. Hawaii's economy is heavily dependent upon tourism and there are efforts to diversify into more technology-based businesses. Business accelerators can be helpful in this regard. By using a case study methodology four of the main business accelerators on Oahu were studied. It was found that only two of those business accelerators have a main focus on Hawaii-based companies.

MB-03.3 [R] • Assessing and Visualizing Matched-degree of Technology Commercialization in Fulfilling SDGs

Di Liu; Beijing University of Technology, China
Xuan Liu; Soochow University, China
Zihan Lin; The Adelson Educational Campus, United States
Zheng Li; National Academy of Innovation Strategy, CAST, China

The Sustainable Development Goals (SDGs) are some indicators formulated by the United Nations (UN) aiming to solve 17 problems in society, economy, and environment. This paper studied the role of technology innovation management in the fulfillment of these goals and particularly focused on technology commercialization, which is a key concept linking technology innovators, consumers, and governments as a whole. The question was how to utilize public resources to measure degrees of relevance that technology commercialization benefits the SDGs. A concept framework of match-degree assessment and visualization has been established, which integrated three types of existing information including the UN goals, the governmental policies, and the practical data in the provinces of China in 2020. This preliminary study could be a reference to SDGs assessment study and technology management.

MB-04 R&D Management
Monday, 7/24/2023, 10:30 - 12:00
Room: Guerrero
Chair(s) Franck Komi Adjogble; University of Hagen / SMS Group

MB-04.1 [A] • A Framework for Systematic Scientific Research Management

Mohamed Saied; Alexandria University, Egypt
Franck Komi Adjogble; University of Hagen / SMS Group, United States
Shawkat Guirguis; Alexandria University, Egypt
Matthias Hemmje; University of Hagen, Germany
Joachim Warschat; University of Hagen, Germany

Many organizations and research groups have adopted methods, models, and standards to improve their research. However, despite these efforts, they can still find it dificult to put clear planning framework for the research that can be used for both researchers and supervisors. This paper aims to provide a theoretical framework for the researchers who are about to write their research proposal. This paper proposes a systematic framework for planning scientific research. The proposed framework extends is based on the multi-method approach for research developed by Nunamaker et al. The Framework is developed and applied based on a systematic review of existing literature and is complemented with the authors' practical experience. Finally, the framework validation is presented through five real cases studies.

MB-04.2 [A] • Synergy Analysis of Industrial, Research and University

Training Centers Collaboration: A Case Study in Thailand's Eastern Economic Corridor

Udom Lewlomphaisarl; Sustainable Manufacturing Center, Thailand
Ukrit Pungjitwisut; EEC Automation Park, Thailand
Wassana Pullpol; EEC Automation Park, Thailand
Kumpee Suksomboon; National Electronics and Computer TechnologyCenter, Thailand
Arnuphap Dowrueng; National Science and Technology Development Agency, Thailand

The Royal Thai Government has outlined a 20-year strategy to achieve high-income status by 2036. "Thailand 4.0" is guided by the concept of "Industry 4.0", which aims to transform the country into an innovative, value-driven industry, with a focus on 12 areas such as Automation & Robotics, Aviation & Logistics, Biofuel & Biochemicals, and Digital. The development of Eastern Economic Corridor (EEC) lies at the heart of the Thailand 4.0 scheme. The EEC is an area-based development initiative aimed at revitalizing the prestigious East Coast, where numerous business developers have experienced a rewarding investment journey and exceptional success over the past 30 years. This paper introduces a synergy analysis of the 3-phase collaboration approach between the EEC Automation Park located on the campus of Burapha University as the main university in the EEC and the Sustainable Manufacturing Center (SMC) at Automation Robotics and Intelligent System (ARIPOLIS) in Eastern Economic Corridor of Innovation (EECi) with strong partners from industry, e.g., Mitsubishi Electric Factory Automation (Thailand) Limited. This 3-phase approach: 1. Build an island demonstrator, 2. Link production demonstration lines and 3. Transfer to 100 factories in the EEC helps managers realize possible difficulties and systematically prepare solutions in advance.

MB-04.3 [R] • The Impact of the 4th Industrial Revolution on Agricultural Innovation: Perspectives from and a Research Agenda for Southern Africa

Xiaoshun Qin; University of Pretoria, South Africa
John Ouma-Mugabe; University of Pretoria, South Africa

This electronic document is a "live" template and already defines the components of your paper [title, text, heads, etc.] in its style sheet. There is a paucity of academic studies on the role and/or impact of the 4th Industrial Revolution on African agriculture and innovation in agricultural systems. Most of the research has focused on 4IR in industrial production and recently some focus has been given to health systems. This exploratory study lays the ground for future research on the impact of the 4th industrial revolution technologies, for instance, Artificial Intelligence (AI), cloud computing, big data and the Internet of Things (IoT) on agricultural transformation in Southern Africa. The overall questions of this study are: (a) what is the state of preparedness or readiness for 4IR in Southern Africa's agriculture and (b) what kinds of policy measures and instruments that governments in the region should develop and deploy in order to maximize benefits and minimize risks that 4IR technologies may generate in the agricultural sector.

MB-05 E-Business
Monday, 7/24/2023, 10:30 - 12:00
Room: Jalisco
Chair(s) Stefan Huesig; Chemnitz University of Technology

MB-05.1 [R] • Business Patterns and Reverse Innovation Cycles in the Sharing Economy

Anja Herrmann-Fankhaenel; Chemnitz University of Technology, Germany
Stefan Huesig; Chemnitz University of Technology, Germany

In this paper, we analyze the evolution of business patterns of about 1,050 organizations associating themselves with the Sharing Economy from the beginning of the Internet from 1993 onwards. Interestingly, there have been two similar phases of development, one before Web 2.0 between 1993 and 2005 and one from 2005 until today. In both phases, the patterns first focus on access, followed by the selling of products and accompanying services, and finally, enable renting of products. Although the Sharing Economy is no industry itself, we question whether a dominant design develops over time in sectors the Sharing Economy entered and how new services developed according to the reverse innovation cycle. The investigation contributes to the understanding and management of sector-related digital business models, the service innovation process, and Sharing Economy-related business patterns.

MB-05.2 [R] • Standardization vs. Localization of Business Model Design in an International Context: The Case of Online Lending Marketplaces

Sabine Pur; IU International University of Applied Sciences, Germany
Stefan Huesig; Chemnitz University of Technology, Germany
Christoph Schmidhammer; Deutsche Bundesbank University of Applied Science, Germany

Ongoing digitization, cross-industry business model innovations, and global sustainability developments are enabling new business models in the financial industry, with online lending marketplaces as one of the fastest growing areas worldwide. Utterback and Abernathy have shown in many industries that after a ferment and growth phase, a so-called dominant design emerges that serves most of the customer needs and is usually followed by all successful players. This concept is frequently discussed in the literature in a technology-oriented manner but hardly in the context of business models. Thereby, the development of dominant designs in the service industry and the research on platform business models are still underresearched. To address these research gaps, we analyze if an international dominant business model has been established since the emergence of online lending marketplaces in 2005 using a framework that examines the development of a dominant design among two-sided markets. Therefore, we analyze the business models of the respective leading online lending marketplace in the UK, the US and Germany. Based on the results we propose why and how the emergence of international dominant business model could be prevented.

MB-05.3 [A] • Scenario Simulation Enhances Creativity Education - Case Study of Negotiation Curriculum

Ching-Ying Yu; Yuan Ze University, Taiwan

Negotiation is the interaction between people. Understanding a person's behavioral pattern can lead to the best negotiation strategy. If you just stick to your original personality, you won't use the theory of negotiation flexibly. In university, students like acting and expressing themselves. They also like to discuss their ideas with others. Therefore, through the role of scenario simulation, and then broke the original thinking framework in students' minds. This study demonstrated the field experiment with the variable of "scenario simulation teaching method" and "action learning method" to achieve the goal of innovative teaching. Students separated into treatment and control groups. This research conducted four phases in the treatment group: (1) pre-knowledge and problems preview: practicing the five sensory discovery abilities to finding out problems between negotiating parties; (2) instructional teaching: including theoretical explanations and case descriptions with different negotiation theories; (3) scenario simulation role playing: students must simulate characters which come from classical novels based on the results of personal orientation tests; (4) ability to take away: how to write an agreement and how to formulate negotiation strategies. We expect that this innovative teaching method from scenario simulation and action learning can become an evaluation tool for higher education teaching.

MB-06 Information Communication Technologies
Monday, 7/24/2023, 10:30 - 12:00
Room: Oaxaca
Chair(s) Markus K Westner; OTH Regensburg

MB-06.1 [R] • Relation between Edge Computing and the Internet of Things: A Systematic Literature Review

Jonas Schroll; OTH Regensburg, Germany
Markus K Westner; OTH Regensburg, Germany

The Internet of Things (IoT) is an emerging computing paradigm providing new approaches to collect and analyze environmental data. However, as specific challenges arose, the paradigm of Edge Computing with its potential solution capabilities came into place. The combi-

nation of both paradigms is currently highly discussed in industry and research. This paper aims to contribute to this field by conducting a systematic literature review to examine the differences and relation between IoT and Edge Computing on a meta-level. It first investigates conceptual backgrounds, use cases, and implementation types. After that, the differences between the paradigms are highlighted. It becomes clear that the significant distinction is in the architectural composition. However, the scientific consensus reveals that both paradigms have a common historical background, and Edge Computing is perceived as the next step in the evolution of IoT. Furthermore, Edge Computing-based systems can address common IoT challenges identified in the two paradigms' problem-solution space. Ultimately, there is a need for further research in security, edge intelligence, and standardization, with Edge Computing frameworks able to address these in practice.

MB-06.2 [R] • Venture Capital Investment in Artificial Intelligence and Its Performance under the Growing Social Recognition of Artificial Intelligence

Hiroyuki Miyamoto; Tokyo Institute of Technology, Japan
Cristian Mejia; The University of Tokyo, Japan
Yuya Kajikawa; Tokyo Institute of Technology, Japan

Since the 2010s, venture capital (VC) investment in artificial intelligence (AI)-related start-ups has increased rapidly, and numerous startups have achieved exits through Initial Public Offerings (IPOs) and Mergers and Acquisitions (M&As). In this study, we investigate the relationship between the expansion of social recognition of AI (exposure of AI) and the entry of VC investment into this area, and whether VCs that invested earlier in the AI area ("trend leaders") overperformed their peers. As a result, VC entry into AI has expanded with the growth of social recognition. Still, VCs that invested in the AI area earlier and accumulated AI investment experience do not necessarily have a higher probability of achieving an exit. However, early entry into more specific business or technology domains within AI and the accumulated investment experience in these domains increased the likelihood of exit. This study is a new approach to researching VC investments in specific themes. It also provides new insights into existing research on VC performance factors, the value VCs add to their portfolio companies, and the layers of know-how that venture capitalists accumulate.

MB-06.3 [R] • Teleworking Employees' Well-being and Innovativeness: A Bibliometric Analysis of Teleworking Literature

Yousif Elsamani; Tokyo Institute of Technology, Japan
Yuya Kajikawa; Tokyo Institute of Technology, Japan

The field of teleworking has seen significant growth in research and practical implementation in recent years, particularly in response to the COVID-19 pandemic. The increasing adoption of teleworking has had a considerable impact on organizational practices and employees, resulting in a large number of published articles discussing related issues. To understand and navigate this growing body of literature, our study aimed to review existing research on teleworking by utilizing data from the WOS database [1936-2022] and highlighting how researchers have studied and discussed employees' well-being and innovativeness. Our study employed citation network analysis, citation relativity analysis, and data mining techniques to extract comprehensive knowledge from the teleworking literature. Through this analysis, we could trace the field's evolution and observe the impact of the COVID-19 pandemic. We identified emerging research trends and topics, the most influential papers, key researchers, and top journals for each topic. Further, we identified potential gaps and opportunities for further research. This study can aid organizations in regulating and developing adequate teleworking arrangements and improving employee well-being and innovativeness. It can also guide academic researchers in developing new theories and identifying areas of teleworking research that requires further investigation.

MD-01 PLENARY: PLENARY-2

DATE: MONDAY, 7/24/2023
TIME: 14:30-15:30
ROOM: NUEVO LEON 3
CHAIR: KIYOSHI NIWA; THE UNIVERSITY OF TOKYO

MD-01.1 [K] Embracing Digital Disruption

Christopher L Tucci; Imperial College, United Kingdom

Digital technologies are everywhere, from generative AI to new mobile telecommunications, drones, cloud computing, 3D printing, Internet of Things, virtual reality, Web3, and maybe someday quantum computing. They are changing the way we live, consume, work, produce things, enjoy entertainment, and much more. Digital technologies are also creating enormous opportunities for organizations across virtually all sectors of the economy. In this presentation, Professor Tucci will take us on a tour of digital "disruption," creative destruction, open innovation, corporate venturing, crowdsourcing, and more. He will also discuss how innovation management can help organizations of all sizes and in all sectors create and capture value, and what kinds of innovation management cultures, practices, and programs are most effective.

MD-01.2 [K] The Imbalance of the Quadruple Helix: Present Paradigms and Shifts in the Making

Antonio Pita Szczesniewski; Cemex Research Center, Switzerland

The notion of the Quadruple Helix expands upon the traditional Triple Helix of innovation, involving the three main actors: government, academia, and the business sector by adding a fourth key actor: civil society in recognition of the importance of citizen participation and the active role of civil society. This approach is based on the idea that collaboration among these four actors is crucial for fostering innovation, competitiveness, and sustainable economic growth in the present 4.0 industrial revolution. Generally, industry is still recognized as the main and leading influential actor due to its ability to drive innovation and the economy. However, there has been a growing recognition of the present imbalance that the other three actors have with industry as well as between themselves due to paradigms that are still being clung to from the third industrial revolution. This situation resembles the typical S-Curve pattern and paradigm influence that follows the evolution of an industry, product, or business model over time, and a review will be made of characteristics of each imbalance as well as the paradigm shifts that are already in the making.

ME-01 Manufacturing Management

Monday, 7/24/2023, 16:00 - 17:30
Room: Nueva Leon 3
Chair(s) Katri Salminen; Tampere University of Applied Sciences

ME-01.1 [R] • Sustainable Digital Transformation of Manufacturing Industry: Needs for Competences and Services Related to Industry 5.0 Technologies

Katri Salminen; Tampere University of Applied Sciences, Finland
Jere Siivonen; Tampere University of Applied Sciences, Finland
Lasse Hillman; Tampere University of Applied Sciences, Finland
Timo Rainio; Tampere University of Applied Sciences, Finland
Mikko Ukonaho; Tampere University of Applied Sciences, Finland
Mika Ijas; Tampere University of Applied Sciences, Finland
Minna Lantz; Tampere University, Finland
Markus Aho; Tampere University of Applied Sciences, Finland

In the current paper, results of an online survey (n = 74) and follow-up interview (n = 7) are presented. The focus of the study was to gain information on Finnish manufacturing industry's current state in the uptake of advanced and sustainable manufacturing technologies as well as competences and test-bed environments and services needed in the near future (i.e., less than five years). The results showed clear differences in the needs between large com-

panies and small and medium enterprises, but also between different technologies. Further, the results highlight a clear need to develop collaboration between industry and research that provides support to technology management in terms of skills and research. The results are discussed in the context of previous research and existing test-bed facilities (FieldLab and RoboLab Tampere).

ME-01.2 [R] • Manufacturing Maturity Level Diagnosis for Operational Excellence

David Güemes-Castorena; Tecnologico de Monterrey, Mexico
Carlos Chee González; Tecnologico de Monterrey, Mexico
Heriberto García-Reyes; Tecnologico de Monterrey, Mexico
Daniel Zavala-Río; Tecnologico de Monterrey, Mexico
Imelda Loera Hernández; Tecnologico de Monterrey, Mexico
Juan J Hinojosa Cavazos; Tecnologico de Monterrey, Mexico

Manufacturing organizations usually operate and improve their processes continuously; however, they lack a long-term vision of their capabilities and how to achieve operational excellence. This paper presents the case of an organization with different business units that needed to benchmark their manufacturing purposes and diagnose their maturity level. This research article designed a manufacturing maturity method for operational excellence. The operational dimensions evaluated were: (i) people competencies, (ii) process control, (iii) reliability and excellence, (iv) continuous improvement, (v) leadership and culture, and (vi) their integration. Three concepts were evaluated in each dimension of the method: (i) the development level of the process, (ii) process systematization, and (iii) the tools used in each dimension. These concepts were evaluated considering the organization's three levels of application and benefits: output, outcome, and impact. A team of experts utilized the Manufacturing Maturity Level Diagnosis to benchmark the organization. The results were satisfactory since they provided a high-level analysis diagnosis, and the comparison was straightforward. Also, the next steps for the organization were direct since they were dictated by the tool to reach the next level of maturity.

ME-01.3 [R] • Advanced Intelligent Manufacturing in Process Industry Using Industrial Artificial Intelligence

Franck Komi Adjogble; University of Hagen / SMS Group, United States
Joachim Warschat; University of Hagen, Germany
Matthias Hemmje; University of Hagen, Germany

In this paper, we propose a new smart manufacturing model for the process industry that incorporates the industrial Internet, industrial intelligence system, industrial artificial intelligence, and process industry. The model aims to maximize performance, optimize product value, and increase profitability through intelligent optimization systems that implement true cost modeling, production planning optimization, energy design, manufacturing event forensics, predictive maintenance planning, product quality management, and autonomous systems for sustainable production. We also address scientific issues such as human-machine collaborative optimal decision-making, dynamic system modeling and deep learning for control of complex operating states, 5G-based multi-source information transmission, intelligent modeling of complex industrial systems, digital twin technology and visualization, and prediction and traceability of key process parameters. The proposal concludes with a discussion of production indicators, intelligent autonomous control technology, and human-machine collaborative intelligent optimization decision-making, as well as industrial artificial intelligence algorithm collaborative implementation technology. The use of computer vision technology for mobile monitoring of the dynamic performance of decision-making processes is also presented as a key aspect of implementing intelligent manufacturing in process industries.

ME-01.4 [A] • Impact of Digital Twin Technology Utilization in Manufacturing on Sustainability: An Industrial Case Study

Fırat Ünal; University of California, United States
Özlem Albayrak; TEKNOPAR, Turkey
Perin Ünal; TEKNOPAR, Turkey

Parallel to the advancements in technologies that form the core of Industry 4.0, there is an accelerated use of digital twins in many industries. Digital twin utilization aims at various objectives including but not limited to increasing overall equipment efficiency, minimizing energy consumption, enabling predictive maintenance, process optimization, condition monitoring, and waste minimization. Being one of the essential components in contemporary technology management, digital twins positively impact economic and environmental sustainability. This study briefs the management and development phases of a cognitive digital twin implemented as an H2020 Research and Development project for a steel pipe manufacturing factory. The study also presents literature review results related to the impact of digital twins on sustainability, with a special emphasis on energy consumption. The study explains the experiences and the lessons learned, during the digital twin project. Based on the observed experiences, the authors state that in the use of the digital twin technology, the evidenced benefit of technology is a major reason for the technology utilization. The developed digital twin enabled a 10% decrease in energy consumption of the production line and resulted in a reduction in carbon footprint.

ME-03 Science and Technology Policy
Monday, 7/24/2023, 16:00 - 17:30
Room: Durango
Chair(s) Deok S Yim; Science and Technology Policy Institute

ME-03.2 [R] • An Institutional Analysis of the Electrical Vehicle Transition

Scott Cunningham; University of Strathclyde, United Kingdom
Mei-Chih Hu; National Tsing-Hua University, Taiwan
Wenyao Zhang; Qilin University of Technology, China

The adoption of sustainable technologies demands that we create effective designs, supportive infrastructure, and capable institutions. This paper examines the state of play of electrical vehicle provision in Scotland. Electrical vehicles, and their attendant infrastructure, constitute an emerging technology which is rapidly spreading in society. Through an exploration of this case the paper advances the theory of technology delivery systems in a manner which may be reapplied to other technologies, political contexts, regions, and eras of change. This theory describes technologies as mixed assemblages of technological artefacts and human organisation, an approach which is particularly conducive to understanding the management of an emerging technology.

ME-03.3 [A] • The Development Strategy for Indonesia Digital Center PIDI 4.0 toward Digital Transformation

Deok S Yim; Science and Technology Policy Institute, Korea, South
Wangdong Kim; Science and Technology Policy Institute, Korea, South
Shinae Kang; Science and Technology Policy Institute, Korea, South
Eun Joo Kim; Science and Technology Policy Institute, Korea, South

The Indonesian government has been pursuing the conversion of its agriculture-based, traditional economy into a knowledge-based one with the strategy for the fourth industrial revolution. It includes the development of information technology and its application in industry and society. Especially the Ministry of Industry has established "Indonesia Digital Center: PIDI 4.0" and is trying to use it as the promotion agency for the digital transformation of industry. This research analyzed the contextual background and current status of "Digital Center: PIDI 4.0" and suggested operational strategies. First, it is recommended that the center pursue leveraging its internal resource and making strategic collaborations with external partners. The shortage of internal resources and capacity can be overcome with input from external partners. Second, in the beginning, the business of the center needs to be focused more on education and training rather than the development of technologies. Third, the development of internal human resources is a high priority. It is critical to secure the workforce to understand the industry as well as digital technology.

ME-03.4 [A] • Theoretical Analysis of Innovation Commons: The Institutional Code of Economic Growth

Fei Li; Zhejiang University, China

Jia Wei; ZheJiang University, China
Yuedi Zhai; Zhejiang University, China

Innovation was first proposed by Schumpeter. After a series of various development and evolution, it has become an important theoretical basis in economics. This research traces the cornerstone of the theory from the perspective of innovation economics, explores the main factors that promote economic growth, and concludes that innovation and institutions are important factors driving economic growth. Under the background of knowledge economy, there is also an institutional arrangement that is similar to the commons in the process of innovation to create public knowledge resources, promote the diffusion of resources and the cooperation of various innovation subjects, providing more opportunities for innovation. Therefore, this research starts from the concept of Commons, summarizes the common attributes of Commons and the concept of Commons by summarizing the studies on different Commons in the academic circle, then proposes the concept of innovation Commons, summarizes its target functions and characteristics in the operation process, and explores the theoretical logic behind innovation Commons as the institutional code of promoting economic growth to provide a theoretical basis for subsequent studies.

ME-04 Technology Based Organizations and Workforce

Monday, 7/24/2023, 16:00 - 17:30
Room: Guerrero
Chair(s) Harm-Jan Steenhuis; Hawaii Pacific University

ME-04.1 [R] • Analyzing the Role of 'Women in Technology' for Digitally Transformed Organizations

Julia Breßler; Technische Universität Chemnitz, Germany
Lisa Hegemann; Technische Universität Chemnitz, Germany
Stefan Huesig; Technische Universitaet Chemnitz, Germany

Digitization is increasingly recognized as a powerful force in social and economic life. This requires special skills and role models in companies and the society. Yet despite the extensive stream of research on technology and technical skills, we know little about female workers in technology management and in digital processes. In this study, we investigate the roles of female workers in the technology workforce. We also explore the definition of women in technology. Our findings highlight that female tech workers exist currently in all roles and levels in technology workforces. However, the results also show that there are differences in the distribution according to organizational types and hierarchical levels. Our work constitutes a step forward to a more "realistic" picture of female workers in technology management and in technology industries.

ME-04.2 [R] • Decentralized Blockchain Governance and Transaction Costs in Digital Transformation: The Case of the DAO Revisited

Jan-Peter Schmitten; Chemnitz University of Technology, Germany
Gustav Augart; Mittweida Innovativ GmbH, Germany
Stefan Huesig; Chemnitz University of Technology, Germany

The aim of this study is to examine the efficiency of decentralized autonomous organizations (DAOs) derived from differences in corporate governance structures and transaction costs compared to traditional organizations. Core assumptions on these differences from academic and grey literature are integrated into a model of the governance layers of the innovative socio-technical arrangement that is a DAO. We test this model against the case of "The DAO", an early experiment in decentralized autonomous organization, which was forced to be stopped after a hacker stole around 50 million USD in ETH tokens in 2016. The case history and its effects on actors in and outside "The DAO" highlight important aspects to be considered in judging the efficiency of governance structures of DAOs and related transaction costs. Results indicate that especially in situations of crisis, transaction costs rise again and that people are not as far at the margins of the corporate governance as the concept of a DAO proposes.

ME-04.3 [R] • Lean IT: A Review and Comparative Analysis of Practitioner and Academic Literature

Markus K Westner; OTH Regensburg, Germany
Patrick Hillebrand; OTH Regensburg, Germany

Companies have applied Lean Management and its methods in their production functions for several decades. They also increasingly use Lean Management to improve service delivery, for example, in their IT organizations, which is referred to as "Lean IT". Lean IT finds widespread recognition in business practice, but corresponding academic research is still scarce. The paper at hand intends to shed light on the current perspectives of Lean IT from an academic point and a practitioner point of view. The paper applies an innovative quantitative approach of literature analysis using semantic entity annotator and a keyword analysis to systematically identify and compare topics academics and practitioners deem relevant in context of Lean IT. We analyze practitioner media and scholarly articles published from January 2014 to June 2019. The analysis shows that research does not seem to adequately address the topics that are highly relevant for practitioners when it comes to Lean IT, e.g., issues pertinent to Automation, DevOps, role of the CIO, IT Service Management or Scrum in context of Lean IT are under-researched. Our analysis further shows that interest in Lean IT as a field is rising in both groups. Our study can help to guide further research activities.

ME-05 Entrepreneurship & Intrapreneurship-1

Monday, 7/24/2023, 16:00 - 17:30
Room: Jalisco
Chair(s) Charles E Eesley; Stanford University

ME-05.1 [R] • Impacts of Accelerator Cohort Composition on Startup Performance

JungYun Han; National Taiwan University, Taiwan
Charles E Eesley; Stanford University, United States

How does cohort composition affect the outcomes of accelerator participants? Literature on inter-firm and peer learning in entrepreneurship provides mixed predictions: seeking diverse knowledge and being different vs. pursuing fast learning via similar peers. To reconcile the arguments, we investigate the key contingencies, types of knowledge transferred (market knowledge vs. technology) and the unique nature of competition in each knowledge type. Using data from accelerators and their participants during 2005-2018, we find an inverted-U-shaped relationship between market knowledge similarity in a cohort and post-accelerator performance and a positive relationship between technology similarity and performance. Our study reveals a peer learning mechanism in accelerators and provides a nuanced understanding of the effect of knowledge diversity on startup performance.

ME-05.2 [A] • Strategies to Battle Non-consumption in Technology-based Startups

María Teresa Pedraza; Tec de Monterrey, Mexico
Azael Capetillo; Tec de Monterrey, Mexico

Non-consumption is a phenomenon that describes a market segment or entity (person or organization) whose needs are not being met by the current products available because current options could be expensive, complex, or non-existent. There is a space in the market where non-consumption is not being taken into consideration, this opens opportunities to develop a strategy or a set of strategies that can be of use to battle this phenomenon in technology-based products, considering that these types of products are part of new-market creating innovations, which is the market where non-consumption exists. To verify the relevance of battling non-consumption a canvas will be developed and tested with Mexican startups to determine which areas are the most relevant to study, this will give the necessary tools for a final version of the canvas that can later be used as a methodology to analyze a product and create a strategy for a better fit towards the market and or product.

ME-05.3 [R] • Idealized Design for Technology Deployment in Micro-retailers

Andres E Acero; Tecnologico de Monterrey, Mexico
Brian X Cazares; Universidad de Guadalajara, Mexico

Implementing digital technologies in businesses presents significant challenges, including knowledge barriers, a lack of shared vision regarding the business need, and a focus on short-term benefits. These challenges are especially pronounced in micro-retailers, businesses with between 2 and 10 employees, who often opt to ignore or exclude technology from their business model due to these difficulties. Moreover, traditional implementation models for information systems are based on assumptions and tools that may not be accessible to these types of businesses. To address these issues, the authors developed a methodology based on Russell Ackoff's idealized design. The authors surveyed 124 micro-retailers in Puebla, Mexico, and applied the methodology to four different business models. This article presents the results of this process, as well as the lessons learned from the experience.

TA-01 PLENARY: PLENARY-3

DATE: TUESDAY, 7/25/2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3
CHAIR: HARM-JAN STEENHUIS; HAWAII PACIFIC UNIVERSITY

TA-01.1 [K] The Physics of Climate Change

Bulent Atalay; Scientist, Artist and Author, United States

Energy is the lifeblood of Civilization This keynote has many legs and is based on a graduate course entitled, "Future Alternate Sources of Energy," taught for nearly two decades by Bulent Atalay at the University of Virginia. The two inseparable aspects of energy are its production and its consumption, and both aspects are ultimately explained by physics and chemistry. Both aspects can have devastating consequences on our planet and these effects must be minimized. The atmosphere is a fine mist, a breathable gaseous blanket overlying the earth. Five-to-nine miles in thickness, it is infinitesimal compared with the 4,000 miles (6400 km) radius of the planet. For the preservation of life on earth, this fragile blanket must be preserved. A maxim gaining popularity globally reads, "There is no planet B!" The underlying physics is not difficult compared with the fundamental physical laws of quantum mechanics and relativity. But it is a messy sort of science, involving mathematical models, and large-number crunching. It creates polarizing domestic and international politics between the owners and the buyers of fossil fuels. And it pits believers of man-made climate change against its deniers. In this discussion of limited length, we will take inventory of many of those "legs" but focus on just two of them: the rudiments of the physics of climate change along with one source of energy production that is clean, virtually inexhaustible, resistant to catastrophic accidents, within reach, but hitherto unattained.

TA-01.2 [K] Applying Digital Technologies to Manage Climate Change

John McDougall; National Research Council, Canada

A sustainable world is a world in balance with itself. As humans, we should work seriously not to disrupt this balance. Levels of production, consumption, waste, and emissions all need to become synergistically integrated - designed, manufactured, managed, and recycled in a manner that maintains a global balance. The major question is not if we should transform our activities in this way, but rather how to do so in a manner that is feasible, both technologically and economically; and comprehensive. Food, water, energy, the basics of life, are important aspects to consider. But infrastructure, building materials and consumer products must also be incorporated. Circularity is a "whole system" concept for addressing issues and challenges associated with waste - especially carbon-based waste materials such as GHGs and plastics, and toxic materials associated with resource production and transformation. That means dealing with waste materials emitted through stacks and exhausts to the atmosphere, and single-use waste materials that currently tend to be discarded rather than collected - by finding ways to collect and repurpose them for reprocessing and/or reuse. This presentation will explore how biomimicry provides a framework for helping this to occur.

TB-01 Technology Adoption
Tuesday, 7/25/2023, 10:30 - 12:00
Room: Nuevo Leon 3
Chair(s) Alisa Kongthon; King Mongkut's University of Technology Thonburi

TB-01.1 [R] Sustainable Tourism Management in the Galapagos Islands: A Scenario Analysis of Key Factors for Digital Adoption

Juan Vasconez; Portland State University, United States
Charles M Weber; Portland State University, United States

This paper presents an empirical study that evaluates the digital transformation of the socio-ecological tourism ecosystem in the Galapagos Islands. The study addresses issues that impact the sustainable management of tourism, particularly in the post-pandemic era. The qualitative research methodology includes interviews with local operators, academic experts, and technology providers. A simulation method, based on cognitive maps, explores the effects of digital technologies on the community's current goals for sustainable development, barriers, and needs. The study considers five perspectives: social, political, economic, environmental, and managerial. The research findings suggest that digital technologies can be used as a mechanism for socioeconomic inclusion, as supported by local experts. The study further examines the link between these emerging technologies and factors that can enhance the island's resilience, while also identifying obstacles to be addressed. The methodology proposed in this study has the potential to be replicated in remote and secondary destinations across the Americas, providing a framework for technology assessment. Furthermore, it can serve as a tool for identifying community needs that can be transformed into innovative and smart solutions for fragile tourist locations.

TB-01.2 [R] • An Overview of Quality 4.0: A Systematic Literature Review

Aluwani Y Magodi; University of South Africa, South Africa
Takalani Mashamba; University of South Africa, South Africa
Thobela Mohono; University of South Africa, South Africa

Industry has advanced continuously during the last century. In line with this evolution, quality concepts have also gradually evolved. Companies use quality management practices extensively to gain competitive advantage. Implementation of quality management is crucial for products to thrive in the market nowadays. Questions on how quality management systems might advance and change in the age of digital technology arise in light of emerging production paradigms like Industry 4.0. This study focuses on an overview of quality 4.0. This paper reviews the published literature on quality 4.0 ranging from 2012-2022.This paper involves the study review of papers related to the implementation of Quality 4.0 of known database search, including Science direct, Scopus library and Google Scholar. This literature review contains results from a variety of different perspectives. The perspectives include the focus of the number of distributions by country, the focus of the year of publication, and the number of publishers. The results of the literature point out that there is a clear focus on the implications of digital technology for Quality. The results also reveal an increasing interest in Quality 4.0.

TB-01.3 [A] • Electric Vehicle Charging Stations in Hawaii

Harm-Jan Steenhuis; Hawaii Pacific University, United States

This study looks at electric vehicle charging stations in Hawaii. It is a practical application using existing theories and available information about Hawaii to determine the need for public charging stations. The perspective taken is that of capacity and the use of that capacity. It is determined that 679 public charging ports are required to meet the demand. This is lower than the currently 781 available electric vehicle chargers. This translates into each port serving 21 electric vehicles.

TB-02 Decision Making for Technology Management
Tuesday, 7/25/2023, 10:30 - 12:00
Room: Colima

Note: [R] = Research Paper; [A] = Industry Application; [K] = Keynote

Chair(s) Momtaj Khanam; St. Mary's University

TB-02.1 [A] • Subject Matter Expert (SME) Management Strategy for Multi-criteria Decision Making (MCDM): A Case Study of Hierarchical Decision Model (HDM)

Momtaj Khanam; St. Mary's University, United States

Subject Matter Experts (SMEs) have been filling the void of the knowledge gap since ancient times through their skills and expertise in one or more fields. Multicriteria Decision Making (MCDM) is a research tool that relies on expert judgment and allows one to take a decision when the final decision depends on various criteria and sub-criteria, many of which could be at odds. The ultimate success of the MCDM tool is contingent to a large extent on the management of SMEs that may involve preparing for communication with research subjects, finding SMEs, taking consent for participation, selecting and organizing panels, interacting and collaborating for validation, disagreement, inconsistency, developing desirability curves, evaluating technologies in terms of desirability curves, and finally, triangulation. The research discusses the process of managing SMEs considering the case of the Hierarchical Decision Model (HDM) used for assessing the Market Diffusion Potential (MDP) of Energy-Efficient (EE) technologies. Each section describes the process of managing SMEs from a theoretical perspective and discusses how it is implemented in practice considering the case of HDM for MDP assessment. Throughout the process, experts are consulted in every single step to make the outcome credible, valid, reliable, and authentic. It is a one-stop reference and guide for managing SMEs in MCDM.

TB-02.2 [R] • Mechanisms for Improving Investment Efficiency through Continuous Delivery in Internet Services

Masayoshi Oshima; Recruit Co., Ltd, Japan
Naoshi Uchihira; Japan Advanced Institute of Science and Technology, Japan

Many Internet service companies are working to speed up the delivery of new functions in order to gain a competitive advantage. One method that is gaining attention is Continuous Delivery (CD). Shorter delivery cycles are considered better. Inspired by the case of software development at Recruit Co., Ltd., this research proposes a new computational model that expresses delivery cycles in terms of time and profitability. We then show that profitability can be improved by shortening the CD cycle term and dividing development items. We show that this improvement occurs by minimizing opportunity losses. These results provide important implications for the implementation of CD and suggest directions for future research.

TB-02.3 [R] • Can Enterprise Resource Planning Improve Balance Scorecard Reporting?

Lebogang Seemise; University of Johannesburg, South Africa
Arnesh Telukdarie; University of Johannesburg, South Africa
Tatenda Katsumbe; University of Johannesburg, South Africa

The purpose of this study is to examine whether Enterprise Resource Planning (ERP) system can enhance Balance Scorecard (BSC) reporting in order to enable senior management to take informed decisions that advances the company's strategy. The case study focuses on a metallurgical mining company which produces calcium fluoride. An ERP system is a software used by a mining company to manage and integrate its daily business activities. The system is able to automate and integrate Core Operational Functions (CoF) which enables synchronization of process data. BSC on the other hand is a method used to assess the mine's strategic objectives and goals. The method drives and communicates the mine's strategy across CoF. The BSC comprises of four perspectives. These perspectives assist in selecting relevant Key Performance Indicators (KPIs) to measure in order to understand the performance state of each of the mine's CoF. To determine whether ERP system is able to improve BSC reporting, a quantitative desktop research is followed. Performance of each CoF is measured and analysed to obtain finds. A model is then developed to understand the impact ERP system has on BSC reporting. The results obtained show that indeed ERP system is able to improve BSC reporting.

TB-03 Social Innovation

Tuesday, 7/25/2023, 10:30 - 12:00
Room: Durango
Chair(s) Sara S Grobbelaar; Stellenbosch University

TB-03.1 [R] • The Process of Social Innovations in Social Service Organizations

Anja Herrmann-Fankhaenel; Chemnitz University of Technology, Germany

The social innovations process of social service organizations is in the focus of this study consisting of a theoretical framing, secondary data analysis, and expert interviews. By investigating the viewpoints of the third or welfare sector, the innovation system for social innovations is described in the case of Saxony, Germany. Therefore, the theoretical concepts of the innovation system and the social innovation processes aided in structuring the relevant aspects that need consideration. With a systemic focus, the findings reveal an adapted social innovation process of social service organizations and inner-organization, inter-organization, and system-wide interrelation and challenges. Such challenges are, for instance, the requirement of collaboration between new and traditional actors in the third sector, internal challenges in resources for innovations, collaboration with universities and funding institutions.

TB-03.2 [R] • The Development of a Maturity Model for Business Model Innovation in Social Enterprises

Welekazi Ntloko; Stellenbosch University, South Africa
Sune Schoonwinkel; Stellenbosch University, South Africa
Sara S Grobbelaar; Stellenbosch University, South Africa

Social Enterprises (SEs) aim to create social value without complete dependence on the government by pursuing economic goals that guide the implementation of commercial activities, which is crucial to fund their missions. These revenue-generating activities have a long-term purpose and are a fundamental part of the essence of their business model. Hybridity tensions arise when the pursuit of commercial and social value creation compete for the enterprise's limited resources and causes misalignment in the missions. The fields of sustainable business models, hybrid organising, and business model innovation investigate how organisations use and alter their business architecture to include sustainability in their value creation. Thus, a process model is needed to reinvent the existing business model structure, and adjust and reconfigure the SE's activities to increase the ability to be sustainable and scalable.

TB-03.3 [A] • Assessing the Impact of Laymen Agro Venture's-Vilfresh

Muralidhara G V; ICFAI Business School, Bangalore, India
Aruna Balammal; ICFAI Business School, Bangalore, India

Impact assessment helps in outcome led adaptive thinking and in understanding the meaningful and sustainable change organizations create in the society. This case study assesses the impact on the livelihoods, standard of living and environment created on multiple stakeholders by Laymen Agro Ventures-Vilfresh, a social venture based in Coimbatore, India. Vilfresh has three priorities: Enriching farmers, empowering rural youth, and exciting urban consumers with farm fresh products. Based on a win-win business model, using an aggregator model and use of technology, the venture provides farmers an alternate and profitable distribution channel for their Agri-products; provides agricultural inputs to farmers at wholesale prices by creating an efficient supply chain; creates jobs to rural youth in distributing the products to urban consumers; and makes available fresh, unadulterated milk and other food items to urban consumers at their doorstep. The venture aims at benefitting three major stakeholders: farmers, village youth and urban consumers. The impact is assessed with multi-dimensional, multi-level and multi-stakeholder perspective using Department for International Developments' (DFID) sustainable livelihood (SL) framework. Vilfresh exemplifies effective use of technology for sustainability.

TB-04 AI for Technology Management

Tuesday, 7/25/2023, 10:30 - 12:00
Room: Guerrero
Chair(s) Timothy Anderson; Portland State University

TB-04.1 [A] • Artificial Intelligence Innovation Assistant

Arturo Atl A Rodriguez de la Torre; ITESO AC, Mexico
Gabriela Calvario; Jesuit University of Guadalajara, Mexico

Innovation management (IM) practices are a key element to engage the fast pace of technological momentum. Firms look to keep competitive advantages ultimately to achieve their strategic objectives. Consequently, enhancing and reinventing such practices is fundamental in order to exploit the disruptive capabilities of the emerging artificial intelligence (AI) era. We introduce AIIA (artificial intelligence innovation assistant) as a tool capable to implement artificial intelligence insights into some of the most widely adopted organizational IM processes. As a system of systems model, AIIA depicts a simple yet powerful proposition to integrate state of the art data processing algorithms and management practices. Unlike other current IM models, AIIA embraces innovation from a holistic and cohesive perspective for enterprises and entrepreneurs who seek to incorporate AI into their regular IM activities. Despite AIIA's novelty, future research is required to tackle numerous limitations of this model. Nevertheless, evidence shows AIIA serves as a platform to allow the automated manipulation of data during innovation management processes in a structured and flexible way. Most importantly, this model supports firms and companies as a facilitator to introduce and launch a new stage of technological innovation management capabilities.

TB-04.2 [R] • AI Meets Risk Management: A Literature Review on Methodologies and Application Fields

Niklas Holtz; Volkswagen AG, Germany
Sven Wittfoth; Volkswagen AG, Germany
Jorge Marx Gómez; University of Oldenburg, Germany

Over the years, various publications have been made in risk management application areas, many of which have addressed the use of artificial intelligence (AI) tools. Given the increasing importance of sustainability in society and in business, risk management has enjoyed significant popularity in this area in recent years. This paper comprehensively reviews the existing literature of recent years and synthesizes it in a two-step approach. As a first step, unified definitions of the diverse terms in risk research are introduced, which are derived from related work to setup a basic ground line. Following up on this, the established methods and techniques of risk management are presented, which are primarily reduced to proven manual approaches. For this purpose, sustainability risks are given special consideration with attention to risk management techniques in this field. In the second step of this paper, the relevance of the application of AI in risk management is considered by outlining the different areas of application focusing on this combination. Arising from these application areas, the approaches that have made use of AI tools are reviewed along with exploring potential research gaps. Finally, theoretical implications and the future work within risk research combined with AI tools are derived.

TB-04.3 [R] • An Explorative Study on the Social Media Content Popularity of Taiwanese Public News Media Using Text Mining Techniques

Szu Chuang Li; National Taipei University of Business, Taiwan
Yi-Wen Chen; National Taipei University of Business, Taiwan
Szu Chuang Li; National Taipei University of Business, Taiwan

According to the latest surveys by the Reuters Institute for the Study of Journalism, social media has become the primary source of news for most. Traditional news providers, such as newspapers and TV channels, have been leveraging social media to communicate with their audiences. Public media often provides more neutral news content compared to private-owned media. However, public media are usually less popular for the same reason, as careful word choice and the emphasis on a neutral perspective do not translate well to content popularity. In this study, we try to approach the problem of public media's social media content popularity using text-mining techniques. We collected social media posts from Taiwanese public media and analyzed their content. Performance indicators for individual social media posts were also collected, including likes, comments, and shares. The two findings of the current study are as follows. First, the engagement from social media users seems to be related to the topic of content. The social media editor can strategically select appropriate topics for posting to induce different kinds of engagements. Second, the current results support that the three kinds of engagements are different not just in the magnitude of involvement, but also in the ways to motivate the audience to engage. For the news agencies that still follow traditional news writing style, it is still possible to improve the audiences' social media engagement by choosing suitable topics.

TB-04.4 [R] • The Copyright System Response Under the Artificial Intelligence Technology Paradigm

Li Gu; Dalian University of Technology, China
Xue Han; Dalian University of Technology, China
Xinci Yang; Dalian University of Technology, China
Xi Liang; Dalian University of Technology, China
Kun Ding; Dalian University of Technology, China

Faced with the rapid development of artificial intelligence (AI) technology and the impact of artificial intelligence products, the intellectual property system, especially the copyright system, should respond. Based on the analysis of the technical characteristics of AI, this paper demonstrates if AI products can have copyright in terms of the copyright protection system, analyzes the copyright subject of the products of artificial intelligence, and judges the essential elements that affect the copyright grant. In the aspect of the copyright infringement system, it briefly expounds the potential infringement subject and the identification of infringement facts. Finally, the design of other copyright systems in AI is discussed, aiming at responding to the impact of the copyright system under AI technology paradigm, in order to provide some advice and suggestions for the innovation of the copyright system in China.

TB-05 Strategic Management of Technology-1
Tuesday, 7/25/2023, 10:30 - 12:00
Room: Jalisco
Chair(s) Petrus T Letaba; University of Pretoria

TB-05.1 [R] • Analysis of the Relationship between Technology Foresighting Generations and Tools

Petrus T Letaba; University of Pretoria, South Africa
Rendani Mamphiswana; Nafasi Water and University of Johannesburg, South Africa

Technological change has increased drastically over the years, resulting with the shorter technology lifecycles and frequent disruption of established technologies, products and business models. As a result, the technology foresighting technique as a future anticipation tool has also evolved over time, now with reported six generations. These generations represent the various design, focus and purpose of a technology foresighting exercise at the global, regional, national and local levels. With time, the foresighting tools are getting more complex as more data and sophisticated analytical tools become more available. The improved technology is also enabling improved participation of the foresight exercise stakeholders. Through the use of bibliometrics, this study links various technology foresighting tools with the various foresighting generations. This is important in providing a guidance to the technology foresighting practitioners on appropriate tools to choose for a specific foresighting exercise. It is shown that the sixth-generation technology foresighting, through its more advanced tools, addresses some of the weaknesses in the preceding foresighting generations but also brings back some of their unique strengths.

TB-05.2 [R] • A Survey on the Use and Effects of Goal Hierarchies in Digitalization Efforts

Sinan S. Tanilkan; Simula Metropolitan Center for Digital Engineering, Norway
Leif Knutsen; Simula Metropolitan Center for Digital Engineering, Norway
J. David Paton-Romero; SimulaMet, Norway

Jo E. Hannay; Simula Metropolitan Center for Digital Engineering, Norway

Digitalization has become a primary goal for organizations. Successfully adopting the digital context both in daily operations and in business management and strategy entails great benefits at different levels (organizational, economic, social, environmental…). Thus, it is very important that practitioners have clear conceptions of the goals in this regard and that those goals are "alive" in organizations. For this reason, in this study we present a survey that we performed among practitioners related to the management of Information Technology (IT) from both the private and public sectors in Norway. Through this survey we have tried to find out how organizations understand and translate the current context of digitalization from different goal levels. For that, we asked respondents to relate to one of three goal hierarchies: A) a classical governance approach; B) an organizational tier approach; and C) an effects-based approach. Among the results obtained we found that the first two are the most used and the goal achievement is slightly higher for the classical governance approach than for the organizational tier approach. Likewise, we identified that while top-level management has a good understanding of the goals, this understanding deteriorates as one moves down the organizational hierarchy.

TB-05.3 [R] • Big Data Analytics Capability and Sustainability: A Systematic Literature Review

Md Ahsan Uddin Murad; University of Technology Sydney, Australia
Dilek Cetindamar; University of Technology Sydney, Australia
Subrata Chakraborty; University of New England, Australia

Big data analytics capabilities (BDAC) have been considered a pivotal means of transforming business data into valuable business insights to bring a competitive advantage. This paper aims to provide a systematic literature review to demonstrate the existing empirical investigations on the impact of BDAC on sustainability. The search strategy resulted in 289 studies, of which 59 were shortlisted for review through a stringent quality rubric. The findings indicate that BDAC research is still in its early stage, and there is no consensus on a list of capabilities required to form BDAC. The study also reveals that existing BDAC investigations were mainly conducted in a developed country context, and the impact of BDAC on sustainability is largely unexplored. The main BDAC research interests are focused on firm's performance, innovation, and supply chain competitiveness. The study proposes several research gaps.

TB-06 Project & Program Management
Tuesday, 7/25/2023, 10:30 - 12:00
Room: Oaxaca
Chair(s) Shuto Miyashita; Tokyo Institute of Technology

TB-06.1 [R] • A Literature Review of Simulation-based Approaches to Train Managers in Waterfall and Agile Project Management

Mario A Negrete Rodríguez; Tecnologico de Monterrey, Mexico
Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico
Naveen Tiruvengadam; Kettering University, United States
Mirna A Muñoz-Mata; CIMAT, Mexico
David Guemes-Castorena; Tecnologico de Monterrey, Mexico

The use of specific knowledge, skills, tools, and techniques to manage, control and track a project to deliver value to the customer is known as Project Management (PM). Managers with little to no prior PM experience or training have been known to struggle managing projects, especially those of a high monetary value with their attendant pressures. Given the increasing projectification of work in the modern workplace, projects of various sizes come with an intrinsic risk of failures such as cost overruns and project cancellation. Also, an inability to deliver a project on time and within budget could have serious consequences for the organization and the manager responsible for it. PM training that goes beyond just the tools of PM and focuses on enabling students to view the consequences of their choices as project managers is therefore required. This paper applies State-of-the-Art Matrix (SAM) analysis in combination with the PRISMA-P protocol to understand the trends in simulation-based approaches to training managers and identify opportunity areas for further research.

TB-06.2 [R] • Program and Project Management of Publicly Funded Research and Development: A Structural Viewpoint

Shuto Miyashita; Tokyo Institute of Technology, Japan
Shogo Katoh; Tokyo Institute of Technology, Japan
Tomohiro Anzai; Kawasaki Institute of Industrial Promotion, Japan
Shintaro Sengoku; Tokyo Institute of Technology, Japan

To accelerate innovation, forming consortia for collaborative research and development (R&D) is encouraged. Therefore, the government has funded some programs for large-scale R&D projects. The present study investigates the program and project structures to promote collaborative R&D across multiple disciplines and sectors. As a case for empirical study, the Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST) in Japan was selected. A series of analyses at the program level (n=30 projects) show that factors that promote academic outcomes (e.g., scientific publications) and facilitate activities toward industrialization (e.g., creating intellectual property) are separated. Moreover, the results suggest that the number of researchers explains the number of publications, whereas the number of patent applications does not justify the number of registrations. An analysis at the project level (i.e., one of the projects subsidized by the FIRST Program) was performed as a case study. The results of the case study imply that a strong relationship between actors accelerates the R&D cycle by sharing common knowledge, while a weak relationship ensures trans-disciplinarity or sectoral diversity by transferring domain-specific knowledge. Further, these results indicate that different mechanisms could exist at the program and project levels.

TB-06.3 [R] • Measuring Efficiency and Effectiveness of Municipal Infrastructure Projects

Arik Sadeh; HIT Holon Institute of Technology, Israel
David Guemes-Castorena; Tecnologico de Monterrey, Mexico

Project management goals often lead the project to an ideal quality, standing budget and schedule, and achieving customer satisfaction. Project management in municipal infrastructure deals with accompanying the developer (municipal authority), planning management, approving budgets with relevant regulators, viewing, and removing bureaucratic barriers, coordinating stakeholders, and controlling the contractor until project delivery to the client. In this paper, we examine the performance of municipal projects and the degree of stakeholder involvement; the analysis focused on 50 municipal infrastructure projects completed in the last two years and carried out in Israel. We used Data Envelopment Analysis (DEA) to examine the relative efficiency of project implementation. The analysis is according to the projects' success and characteristics and criteria such as schedule overrun, stakeholder involvement, residents' complaints, risks, and uncertainty at the beginning of the project. Preliminary results indicate the contribution of stakeholders, residents and their degree of involvement in the relative efficiency of projects. Therefore, this research will contribute to the success of municipal infrastructure projects by establishing a policy of allocating resources to municipal infrastructure projects following the level of decision-makers and their impact.

TD-01 Intellectual Property
Tuesday, 7/25/2023, 14:00 - 15:30
Room: Nuevo Leon 3
Chair(s) Liying Wang; Zhejiang University of Technology

TD-01.1 [A] • The Combo Effect of Trade Barrier Prohibition and Intellectual Property Protection on Export Trade Structure

Yuan Lou; Yiwu Industrial & Commercial College, China
Chunmiao Zhao; Jiaxing University, China
Liying Wang; Zhejiang University of Technology, China
Lingxiang Cai; University of Illinois Urbana-Champaign, United States

A trade agreement is a vital link for today's economy. Countries are trying to develop deeper

provisions on technical trade measures by signing free trade agreements, making the standards an essential part of the FTA negotiations. Therefore, it is of profound significance to understand the characteristics and impacts of the provisions of technical trade measures in the Asia-Pacific region. The study measured the 62 FTA technical trade provisions signed by the Asia-Pacific countries through lateral measurement. Based on the measured results, a gravitational model is built to empirically analyze the impact of eliminating technical barriers to trade in FTAs on the exports of bilateral high-tech industries. Eventually, this paper finds out that the signing and entry into force of free trade agreements containing provisions on technical trade measures can significantly change the ratio of IP-intensive products but have no significant impact on the total export.

TD-01.2 [R] • An Analysis of the Introduction of Product Patents in the Pharmaceutical Industry: A Comparison Study of Indian, Mega- and Japanese Pharmaceutical Firms

Yaeko Mitsumori; Osaka University, Japan
Hiroshi Kato; Nihon University, Japan
Akiko Kato; Nihon University, Japan
Koichi Kamijo; International Professional Univ. of Technology, Japan

Just after India won an independence from Great Britain in 1947, there was almost no pharmaceutical industry in India. Under the Patents Act 1970 which did not have any product patent protection, the Indian pharmaceutical industry rapidly developed. Today, the Indian pharmaceutical market ranks the 3rd in volume and 14th in values. Meanwhile, due to TRIPS, India re-introduced product patent in 2005 in the pharmaceutical field. Foreseeing a product patent era, large Indian firms started engaging in NCE development in around 2000. However, not many NCEs have been developed by Indian pharmaceutical firms so far. This study analyzed new drug development activities of Indian pharmaceutical companies by using database. The database analysis found that large Indian pharmaceutical companies have been expanding their R&D investment and engaged in NCE development; however, the amount of R&D investment is still much smaller compared to Mega pharma and leading Japanese pharmaceutical firms. The number of product patents applied by Indian pharmaceutical companies is limited and as a result, NCE development activities are strictly limited in India.

TD-01.3 [R] • Drug Approval Prediction Using Patents

Koichi Kamijo; Int'l Professional Univ. of Technolog in Tokyo, Japan
Yaeko Mitsumori; Osaka university, Japan
Hiroshi Kato; Nihon university, Japan
Akiko Kato; Nihon university, Japan

New drugs require a considerable amount of time and money from development to approval. For example, it may take nearly 15 years to produce a single drug, and some of them may cost as much as $3 billion to develop. Meanwhile, the success rate of new drugs is very small. For instance, it is reported that approximately one percent of all the drugs from initial development are approved. Therefore, realizing the feasibility of the futuristic approval of a new drug at an early development stage would greatly benefit drug marketers and users. In this paper, we develop a machine learning model to predict if a new drug will be approved or not, using the patent specifications for the drug filed in the early development stage. Specifically, we analyze each patent, focusing on product patents, via natural language processing. To achieve this, we use the abstract, claims, and description of the patent specification, as well as other information, including number of claims, inventors, and cited/citing references. Overall, our experimental results prove that we can predict drug approval with a high score of F1-score=0.944.

TD-02 Innovation Management-1
Tuesday, 7/25/2023, 14:00 - 15:30
Room: Colima
Chair(s) Alexander Keuper; WZL of RWTH Aachen University

TD-02.1 [R] • Framework for the Implementation of Continuous Innovation for Technical Products

Michael Riesener; WZL of RWTH Aachen University, Germany
Maximilian Kuhn; WZL of RWTH Aachen University, Germany
Stefan Perau; WZL of RWTH Aachen University, Germany
Thilo Walter; WZL of RWTH Aachen University, Germany
Alexander Keuper; WZL of RWTH Aachen University, Germany
Guenther Schuh; WZL of RWTH Aachen University, Germany

In order to face current challenges of dynamic market environments, customer-specific requirements and shorter development cycles, manufacturing companies need to focus on new innovation approaches like continuous innovation (CI). Thereby, the approach CI focuses on the ability of a company to continuously improve or renew products or features during the product usage phase. Although manufacturing companies are aware of the opportunities to ensure their own competitiveness through CI, the implementation is not successful. In particular, there is a lack of a process model that illustrates the relevant aspects in the dimensions business models, processes and products, which are required for the realization of continuous innovations. This paper attempts to close this gap by introducing a framework for the implementation of CI for technical products in the usage phase. The framework consists of 12 process steps and respective implementation activities in order to realize CI. Furthermore, influencing factors on the implementation process are identified and enable the transformation of the generic framework into a company-specific implementation guide. Thus, the framework supports manufacturing companies in the operative realization and implementation of continuous innovation.

TD-02.2 [R] • Characterizing ELSI/RRI/RI Frameworks and their Links to Innovation Management Theory

Alfonso Avila Robinson; Tecnológico de Monterrey, Mexico
Shuto Miyashita; Tokyo Institute of Technology, Japan
Shintaro Sengoku; Tokyo Institute of Technology, Japan

The concepts of ethical, legal, and societal issues (ELSI), responsible research and innovation (RRI), and responsible innovation (RI) are recognized and encouraged in the current research and development activities. However, there is a lack of understanding of how these concepts are formed and deepened. Considering this issue, we extracted precedented literature on ELSI, RI, and RRI and conducted a bibliometric investigation from geographical, intellectual, technological, and cognitive perspectives. We then operationalized a dataset of prior literature on innovation research and investigated how these concepts interrelate with other innovation research topics. These findings and a proposed conceptual framework provide a basis for a deeper understanding of the historical development process of research on ELSI, RI, and RRI, as well as suggestions on how these are positioned and mutually developed in technology and innovation management research.

TD-03 System Design
Tuesday, 7/25/2023, 14:00 - 15:30
Room: Durango
Chair(s) Ngaka N Mosia; University of South Africa

TD-03.1 [R] • Lean Systems Process Implementation in Healthcare

Ngaka N Mosia; University of South Africa, South Africa

Where do we start with the Lean-healthcare journey, is one of the most common questions practitioners asked throughout the Lean-healthcare journey. In practice, Lean Healthcare is full of interruptions, slow climbs, periods of pause and sudden leaps forward. Implementation efforts are intermittent, while the aim is to attain a frequent, regular, continuous and without an end process. Thus, Lean implementation is not an event but a continuous improvement initiative. A common method for the lean implementation approach is a top-down. This approach is the main cause of interruptions and periods of pause. In the top-down implementation approach, management is trained first on the concept and practices of Lean. Notwithstanding the fact that Lean practice and application in healthcare is at the Gemba, meaning, where the action is. This implies that a true implementation of Lean will only start

when the workers have been comprehensively trained. This research adopts a qualitative research approach to explore and explain why a top-down lean implementation approach fails and why the people site of lean system implementation is a preferred bottom-up implementation method. The research will also prove that one of the main discontinuous development milestones of Lean healthcare transformation is the adoption of an non-integrated approach.

TD-03.2 [R] • Behavioural System Dynamics: Conceptual Integration of Critical Bias Variables into Circular Economy Stakeholder Phases

Leandi van der Linde; University of Pretoria, South Africa
Leon Pretorius; University of Pretoria, South Africa
Rudolph Oosthuizen; University of Pretoria, South Africa

System Dynamics (SD) is a powerful lever to understand the influence of biases on sustainable decisions. This paper describes modelling methods that shed light on the level of rationality of stakeholders in the Circular Economy (CE). The main aim of the paper is to explore how complex systems, such as mental models of consumers in the CE, can be evaluated with Behavioural system dynamics (BehSD). This is done using a causal loop (CLD) and stock and flow diagrams (SFD). The model builds on the need to improve sustainable activities by better understanding biases. The paper concludes with a simulation using pseudo-random data to showcase that efforts to reduce biases can influence consumer behaviour effectively. It is important to note that rebound effects and policy decisions are significant amongst many other external influences that need further evaluation.

TD-03.3 [R] • Quantum Science and Technology to Support of Technology Management in Combating Technological Singularity

Karoly Nagy; BME-UBT Joint Transformative Research Centre, Kosovo
Edmond Hajrizi; UBT Higher Education Institution, Kosovo

We agree with Jan Naude that technological singularity and material monism could lead to the end of humanity as we know it and usher in the age of transhumanism. We must finally wake up to the fact that Nietzsche's consciousness of the "construction of the superman (übermensch)" is being brought to life by the flagships of technological singularity and transhumanism - Ray Kurzweil and others. Digital Frankensteins are marching out of the purple fog of the future. Technology management now has a key responsibility in avoiding the trap of transhumanism. Originally, technology management was about getting people and technologies to work together and to do what people expect. In the age of technological singularity, the line between people and technology is blurring. In our view, the main task now is to develop and apply management principles and methods that make this boundary sharply visibly distinguishable, but in a way that maximizes both technological capabilities and the many potential natural human capabilities. According to our research, the achievements of quantum science and technology provide effective tools for this purpose. In our study, we present direct and indirect opportunities and debunk false promises and beliefs. We believe that technology management has a role and responsibility in all areas involving technology, whether nanotechnology, quantum technology, or any other type of technology.

TD-04 Technology Roadmapping
Monday, 7/24/2023, 16:00 - 17:30
Room: Colima
Chair(s) Kunio Shirahada; Japan Advanced Institute of Science and Technology

TD-04.1 [R] • Mining 4.0: A Digital Transformation Approach to Mining Sector

Yannick P Carrasco; Pontificia Universidad Catolica del Peru, Peru

The mining sector remains as the principal in the Peruvian industry; its considerable contribution to GDP, its exploration and integration projects with other sectors, determine its attractiveness. With the consolidation of the Digital Transformation discipline to industry, the term of Mining 4.0 gets attention. Thus, an important element in the understanding of this sector is the characterization of its Digital Transformation involving mainly at the level of convergence. The present work is aimed at employing the benchmark of Digital Transformation into the companies and the Mining 4.0 concept to investigate the convergence in the mining sector of Peru. The methodology of the investigation is descriptive and qualitative, based on a case study on seven companies in the mining sector. The unit of study analysis is the Digital Transformation leverage in Peruvian mining. The main research questions are: In what way the Digital transformation has been implemented in the mining firms? What kind of Mining 4.0 principles have been involved during that transition process? At what level of convergence has been developed? As a result, it must be most companies managed Digital Transformation to restarts the operation control systems, incorporating remote control principles of Mining 4.0.

TD-04.2 [R] • Situational Assessment of XaaS Roadmap for Decarbonization Society Using System Dynamics

Porruthai Boonswasd; Japan Advanced Institute of Science and Technology, Japan
Rujira Chaysiri; Sirindhorn International Institute of Technology, Thailand
Kunio Shirahada; Japan Advanced Institute of Science and Technology, Japan

The Sustainable Development Goals (SDGs) were established in response to the numerous types of environmental deterioration caused by today's rapid economic expansion. Researchers have collaborated with social infrastructure-related industrial organizations to develop a service roadmap for decarbonization by linking consumption-based CO2 emissions through the development of a service model based on the concept of XaaS: Everything as a Service. To establish a development strategy for an innovative service, it is necessary to examine the opportunities of success as well as the circumstances that may happen in various situations. The purpose of this study is to examine the consequences of alternative approaches of executing the scenario service roadmap using System Dynamics. We determined possible scenarios and are implementing a SD model in accordance with the service roadmap, referred to in this study as the XaaS roadmap. The findings can be used to support operational planning.

TD-05 Strategic Management of Technology-2
Tuesday, 7/25/2023, 14:00 - 15:30
Room: Jalisco
Chair(s) Kazuo Hatakeyama; IPB - Consultant

TD-05.1 [R] • A Critical Review of the Development of Technology Maturity Research and State-of-the-art Approaches

Tabea Huellen; Volkswagen AG, Germany
Sven Wittfoth; Volkswagen AG, Germany
Thomas Kneib; Georg-August-University Göttingen, Germany

Measuring a technology's maturity is a topic that has been present in academic research for more than three decades, but regarding sustainability, it is more current than ever before. In order to reach the 1.5° goal, there is no room for mistimed investments into promising technologies. Therefore, reliable measuring instruments are needed to accurately model a technology's maturity and its expected development. But which fact-based approaches within the scope of technology maturity should be used to guide managerial decisions? This paper revisits the historical development of qualitative and quantitative approaches to measuring technology maturity. By conducting a content analysis of more than 500 research documents from 2015-2022, the paper outlines the most recent developments of the research area. Moreover, it critically examines practically established expert-based and bibliometrical approaches and uncovers the shortcomings and research gaps that have not been resolved by either side. Theoretical implications are provided by outlining possible extensions for quantitative approaches regarding expert-validated search strings, the use of additional data sources, indicators beyond the number of publications and future predictions of maturity values. Managerial implications resulting from incorporating these suggestions into further research instruments include improved decision quality regarding the development of and investment in promising sustainable technologies.

TD-05.2 [A] • Scrum Customization to Manage Product Design Modifications in a White Line Manufacturing Company

Bianca M Costa; Federal University of Technology of Parana, Brazil
Isabela B Rocha; Federal University of Technology of Parana, Brazil
Carla A Estorilio; Federal University of Technology of Parana, Brazil
Adriano A Lima; Federal University of Technology of Parana, Brazil
Kazuo Hatakeyama; Polytechnic Institute of Bahia, Brazil

Investing in project management tools has become a strategic concern for companies in dynamic markets such as domestic appliances in white goods. Agile methodologies, particularly Scrum, have gained popularity due to their ability to reduce bureaucracy, help customer collaboration, and empower employees. However, the lack of clarity in the definition of agility and the challenges of adopting this management method can hinder its effective implementation. The aim of this study is to propose a customized version of the Scrum method and its implementation for managing product design changes in a white-line manufacturing company. To achieve this goal, a comprehensive literature review was conducted to explore the operational and conceptual aspects of traditional project management (PMBOK) and agile management methods (Scrum) and the methods for implementing them. To customize Scrum to the company's specific needs, data collection was conducted together with those involved in the sector activities and these data to identify were exhibited through a flowchart. The representation was used to identify the work packages that needed to be managed and considered in the Scrum customization. The proposed Scrum configuration was then evaluated in the field to evaluate its performance in managing project changes. By customizing Scrum to the company's unique requirements, this study provides practical insights into the implementation of agile project management in a white-line industry context. The proposed methodology was applied to enhance project modification management and improve the outcomes of these procedures.

TD-06 Quality Management
Tuesday, 7/25/2023, 14:00 - 15:30
Room: Oaxaca
Chair(s) David Guemes-Castorena; Tecnologico de Monterrey

TD-06.1 [R] • Evaluation of Decentralized Manufacturing via System Dynamics Simulation: A Review of the State-of-the-art

Esteban E Rodriguez-Garcia; Tecnologico de Monterrey, Mexico
Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico
Naveen Tiruvengadam; Kettering University, United States
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Marisela Rodriguez-Salvador; Tecnológico de Monterrey, Mexico

The global economy is undergoing radical and accelerated transformation owing to technological, social, economic, environmental, and political forces. To adapt to a constantly changing business landscape, especially in mature and emerging economies, one alternative available to producers of tangible goods is decentralized manufacturing. When the cost, quality, logistics, and risk factors permit, organizations could spread out, aka decentralize, their production processes locally and/or closer to the customer's location thereby servicing customer expectations better through, among other things, quicker order fulfillment. Given its ostensible potential benefits, Decentralized Manufacturing needs to be evaluated more, but given its relative recency, data on its adoption and impact is correspondingly scarce. System Dynamics (SD) simulation offers a robust method to transcend data scarcity issues to evaluate a system holistically. This study provides a review of the state-of-the-art of the intersection of Decentralized Manufacturing and SD that we hope will lay the foundations for further studies on a deeper understanding of Decentralized Manufacturing and its large-scale adoption.

TD-06.2 [R] • Sensitizing Rules for Change Point Detection in Phase I Analysis with Nonparametric Shewhart-type Control Charts

Guillermo Hernandez Zamudio; Texas Tech University, United States
Victor G Tercero Gomez; ITESM, Mexico
Mario G Beruvides; Texas Tech University, United States

The use of run rules alongside traditional control limits as a sensitizing method has been suggested in the literature in order to increment the power of control charts. Assessments on the effect of combining different run rules with Phase II control charts have been carried out both in parametric and nonparametric approaches with good results, although some controversy exists when using run rules in combination with Phase II monitoring statistics. However, the effect of such enhancing methods has been barely explored within Phase I stages, where nonparametric approaches have a key role due to the high levels of uncertainty on the data model. To address this gap, this paper proposes a thorough examination on the state-of-the-art of the implementation of run rules in Shewhart-type nonparametric Phase I control charts. The latter offers sensitivity to large and isolated changes, whereas the former rules improve the assessment of different forms of drifts and change-points. Readers will find guides on the use of run rules, different types of implementations, a discussion on their controversy, and suggestions for future research.

TD-06.3 [R] • Serialization and Data Management of Bioreactors through Digitization: Bioprocessing 4.0 a Systematic Review

Esteban E Rodriguez-Garcia; Tecnologico de Monterrey, Mexico
Adrián Soto-Mendoza; Tecnológico de Monterrey Campus Monterrey, Mexico
Daniel Guajardo; Tecnológico de Monterrey Campus Monterrey, Mexico

Industry 4.0 has revolutionized the way companies manufacture; however, the bioprocessing industry has struggled due to the nature of the bioreactors design, and the particularities of each bio culture's features. Bioprocessing offers a sustainable and safe way to produce bio compounds for the food, cosmetic and pharmaceutical industries, thus optimizing and enhancing the control methods for bioreactors is crucial for enabling their serialization at a large scale. The compatibility between the different hardware and software of each bioreactor infrastructure during the scaling up process is difficult to achieve, due to a lack of consensus or standards for data management and software integration. Digitization, novel sensors, data management systems and algorithms used in other mature manufacturing processes have been recently used in bioprocesses which have proved to be crucial for accelerating their development state into large-scale productions. Examples of such technologies include the use of Digital Twins and Neural Networks, that adapt to the parameters of each individual process and facilitate the automatic control of processes. Therefore, this review aims to consolidate the state of the art and the next steps available through a systematic analysis of the digitization and integration of different bioreactor technologies for better monitored, controlled, and optimized bioprocesses.

TD-06.4 [R] • Quality Performance Improvement through Robotic Process Automation in Rail Manufacturing

Marvin Sithole; University of Johannesburg, South Africa
Arnesh Telukdarie; University of Johannesburg, South Africa
Tatenda Katsumbe; University of Johannesburg, South Africa

Sustainable quality performance is key to railway manufacturing success. The paper investigates the relationship between quality Defect Per Unit (DPU) generated from a non-automated production process, vs. the same but partially automated (conceptual) production system built around Robotic Process Automation (RPA) principles, focusing on local South African railway manufacturer Company AB. Desktop literature speaks to a positive correlation between process automation and project quality performance. DPU data from South African Company AB, captured across a sample size of 20 locomotives over a 2-to-3-year period, is dissected quantitatively to establish (a) quality performance (DPU based per unit) without RPA and (b) the theoretical quality performance of the same manufacturing system after the incorporation of RPA. Process automation design and limitation of the value chain is derived from a conservative automation scale approximation assumption (benchmarking of automated process industries). The paper finds that a conceptual automation model of Company

AB's value chain yields quality performance improvements of up to 65%, along with a reduction of the Cost of Non-Quality (CONQ) from 4.1 to 1.21 million ZAR. In addition, downtime is reduced from 58 to 16 days before and after RPA respectively. The result reinforces historic sentiments where RPA is generally accepted as a vehicle to accelerate process efficiency and improve overall product quality.

TE-01 PANEL: Meet the Editors
Tuesday, 7/25/2023, 16:00 - 17:30
Room: Nuevo Leon 3
Moderator(s) Timothy R Anderson; Portland State University
Panelist(s) Harm-Jan Steenhuis; Hawaii Pacific University
Gabriela Dutrenit; Arizona State University
Scott W Cunningham; University of Strathclyde
Nazrul Islam; University of East London
Chen Jin; Tsinghua University
Steven T Walsh; University of New Mexico

Meet the editors of the Technology Management related journals. The editors will discuss the philosophies, criteria, and submission processes of their journals and answer questions from prospective authors.

TE-02 Innovation Management-2
Tuesday, 7/25/2023, 16:00 - 17:30
Room: Colima
Chair(s) Karoly Nagy; BME-UBT Joint Transformative Research Centre

TE-02.1 [R] • Some Specifics of the Management of Responsible Innovation

Karoly Nagy; BME-UBT Joint Transformative Research Centre, Kosovo
Edmond Hajrizi; UBT Higher Education Institution, Kosovo
Muhamet Gervala; University for Business and Technology, Kosovo

We have developed a new, responsible innovation model. We use the sign "new" because our model is different from all previous models of responsible innovation. The responsible innovation we have developed has several distinctive features that justify the development of a new approach to innovation management. One of these features is that responsible innovation is essentially a "research-driven" innovation. This in itself would not cause a management problem, but the "driver" is transformative research. As defined by Dr. Arden L. Bement, Jr, Director of NSF, "transformative research is the artistry and alchemy of 21st century". We go further and use the following definition: "Transformative research is a scientific approach to catching the winds moved by transcendent forces in the sails of the ark of human progress." When working with this approach, we are confronted with the fact that there are no ready-made solutions in the equally rich habitat of traditional innovation management. Another difficulty arises from the fact that we have managed to integrate the two streams of responsible innovation together with transformative research into a unified system. The complexity of this distributed process exceeds the limits of "computation". This leads to incredible difficulties for management.

TE-02.2 [R] • Concept for Product Modularization in the Context of Circular Economy

Michael Riesener; WZL of RWTH Aachen University, Germany
Maximilian Kuhn; WZL of RWTH Aachen University, Germany
Alexander Keuper; WZL of RWTH Aachen University, Germany
Frederike Hellwig; WZL of RWTH Aachen University, Germany
Guenther Schuh; WZL of RWTH Aachen University, Germany

In the past decades industrialization increased productivity drastically and it became feasible to overproduce goods in order to lower production cost. This overproduction favored a linear form of value creation, in which raw materials are transformed into finished products. After the usage phase products are disposed, creating the demand for new products. However, resources are limited and considering not only economic but also ecological effects of this linear form of value creation, a fundamental change will be necessary in the future. One possible approach is a circular value creation, in which products, components and materials serve as the base for new value creation cycles after their use. The challenge is that due to their structure and architecture, current products make economically viable circular value creation difficult. New concepts and methodological approaches are necessary for dealing with the question of how product architectures must be designed and modularized in order to realize circular economy in a feasible way. This paper evaluates the latest scientific approaches for the creation of circular products and deducts a concept for modularization in the context of circular economy, which helps applicants to design feasible product architectures and divide products into suitable modules from both an economic and a circular economy point of view.

TE-02.3 [R] • Functional Dynamics of Innovation for Inclusive Development Projects: Event History Analysis of the Stock Visibility System (SVS) in South Africa

Berno Maarsingh; Stellenbosch University, South Africa
Sara S Grobbelaar; Stellenbosch University, South Africa
Marlien Herselman; Stellenbosch University, South Africa

Innovation is an essential factor in stimulating economic growth. However, despite the positive effect of innovation, it is often focused on high-income groups, excluding marginalized individuals and groups, possibly worsening inequality as a consequence. In response, the Innovation for Inclusive Development (I4ID) model has been introduced, drawing on the theory of the conventional Innovation Systems (IS) perspective to help the marginalized benefit from innovation. In this article, we use the Event History Analysis (EHA) research method and causal loop diagrams (CLDs) as an analytical approach to explore the dynamics of the Stock Visibility System, which was implemented in 3300 clinics in South Africa. The study's findings present the analysis of the core dynamics and motors of innovation that led to the project's success.

TE-03 Technology Management Framework-2
Tuesday, 7/25/2023, 16:00 - 17:30
Room: Durango
Chair(s) Samuel A Ajila; Carleton University

TE-03.1 [R] • Environmental Analysis of the Influences on Engineering Identity Formation in Technical Management Environments

Annika Sprung; Texas Tech University, United States
Mario G Beruvides; Texas Tech University, United States
Jennifer G Cross; Texas Tech University, United States
Kelli Cargile-Cook; Texas Tech University, United States

The formation of a professional identity has become an area of both technical management research and practice. Current societal concerns on the issues of identity and identity formation have permeated all aspect of modern society, and the area of technical management is not immune to these concerns. The concerns are not simply a reflection of societal angst. The concerns raised by technical managers, and thus technical management researchers who explore and investigate the current issues plaguing the practice of management, are manifold but center around several issues. Identification with the profession has been generally found to be correlated to technical performance. This alone is of much value to working professionals that look to continuously improve their organizational performance. Other issues such as employee retention and quality of work-life also are affected by identification with an individual's profession. This paper explores and evaluates the current state of the art in professional identity formation, specifically engineering identity formation in the workplace. As indicated in the open technical literature, a variety of approaches to measure professional identity maturity have been attempted. An identification and classification of these approaches, and a subsequent analysis of the strengths and weaknesses of these techniques, are provided in this study to better assist technical managers and technical management researchers in this developing field of study.

TE-03.2 [R] • A Pre and Post Covid-19 Trend Analyses of Mobile Telecommunications Systems

Mugisha Philip Bisanda; University of Pretoria, Tanzania
Joe Amadi-Echendu; University of Pretoria, South Africa

The era of Society 5.0 is characterized by rapid technological evolutions as well as volatile, uncertain, complex, and ambiguous stressors arising from the effects of unprecedented events such as geopolitical tensions and socio-economic transitions, further exacerbated by climate change, global warming, and pandemics. It is apparent that the resilience and sustainability of mobile telecommunications systems have become paramount consequent upon the Covid-19 pandemic. Discourse in extant literature acknowledges that resiliency is a pre-condition for the sustainability, especially of mobile telecommunications systems. This paper is based on an empirical study of several mobile telecommunications firms in developing and developed economies. The paper describes trend analyses of a dozen firms, pre- and post-Covid-19 pandemic. The results of the study provide some insights regarding the resiliency and sustainability of mobile telecommunications systems and businesses.

TE-03.3 [R] • Have the Factors Affecting Software New Product Development (S-NPD) Changed in the Age of Mobile Apps and Agile Methods?

Samuel A Ajila; Carleton University, Canada

It has been long recognized that Time-to-Market, Cost-of-Delay, and Uncertainty are the three major factors that can impact New Product Development (NPD) process. Software New Product Development (S-NPD) process is even more notorious with delay and cost overrun. The goal of this position paper is to examine the three factors: Time-to-Market, Cost-of-Delay and Uncertainty through "observation" vis-à-vis software Apps development process and the use of Agile methods in order to see if something has changed over the years. In addition, a controlled group interview is conducted to support the observation method. The questions this paper seeks to answer are: Are we getting to market on time? Are we delivering software product on budget? Do we have reduced uncertainty when it comes to Apps development and the use of Agile method? The results obtained show that the use of Agile approach in developing Apps can take the product to the market quicker compared to using the rigid linear process, in our case the waterfall V-model. Also, the "product introduction delay" as part of product performance was measured on the assumption that there is no budget or cost overrun. In this case, the Agile method performs better than the linear approach. Lastly, in terms of technological uncertainty, the Agile development approach does not necessarily bring the expected commercial success, and in fact, for the situation where the development of Apps is involved, rapid development could result in failure if a proper plan is not in place for the evolution of the product.

TE-04 Disruptive Technologies-1

Tuesday, 7/25/2023, 16:00 - 17:30
Room: Guerrero
Chair(s) Xin Li; Beijing University of Technology

TE-04.1 [R] • Identifying Transformative Technologies on Emerging Stage: Monitoring Dynamic Evolution of Weak Signals

Qianqian Xie; Leiden University, Netherlands
Wenya Ma; Beijing University of Technology, China
Xin Li; Beijing University of Technology, China

Transformative technologies have the potential to significantly alter existing technological paths and business models, accelerating the industrial change process. Identifying and monitoring transformative technologies early are critical for both corporate investment decisions and government research & development (R&D) strategy. Current studies on identifying and monitoring transformative technologies have primarily focused on technologies in the ascent phase. Little research has been performed on those in the emerging stage. Given gaps in current research, this paper proposes an early identifying framework for transformative technologies based on their dynamic evolution process. First, we discover weak signals of transformative technology using Subject-Action-Objective (SAO) semantic mining and an outlier detection algorithm based on discontinuity features. After identifying weak signals, our research methodology involves monitoring the developing trends from two different perspectives. Firstly, we scrutinize whether research on weak signals has progressed from marginal to core research over time using an outlier detection algorithm. Secondly, we investigate the convergence of weak signals with respect to both the overall technology landscape and research content within technology levels. This is achieved through the utilization of the Latent Dirichlet Allocation (LDA) and Dynamic topic models (DTM). We take research into All-Solid-State Battery (ASSBs) as a case study. The results present the ASSLBs exhibit characteristics from edge to core study. Also, it develops two primary technology tracks: All-solid-state lithium-ion batteries (ASSLIBs) and All-solid-state lithium metal batteries. These two domain technologies display a development pattern from divergence to convergence research. The case verifies the feasibility and validity of the proposed framework. Our work contributes to provide new insights into identifying disruptive technologies in the emerging stage.

TE-04.2 [R] • Early Identification of Potential Disruptive Technologies Using Machine Learning and Text Mining

Xin Li; Beijing University of Technology, China
Xiaodi Ma; Beijing University of Technology, China

Early identification of potential disruptive technologies is critical to corporate R&D investment decisions and government R&D strategy decisions. However, how early identifying potential disruptive technologies has been the focus of academic community. Therefore, in this paper, we propose a framework for early identification of potential disruptive technologies based on machine learning and text mining. In the framework, we firstly obtain relationships pattern between the characteristics of highly cited papers and their citation trends by using machine learning models. Then, we use the relationships pattern to identify potential highly cited papers, solving the time lag problem of using citation analysis to identify potential highly cited papers. Secondly, we construct a breakthrough index based on breakthrough research characteristics to identify breakthrough papers from potential highly cited papers. Finally, we use text mining methods to obtain breakthrough research topics from breakthrough papers, and identify potential disruptive technologies by analyzing and evaluating breakthrough research topics. An empirical study was conducted in the field of chemistry discipline to verify the framework's feasibility and effectiveness. This paper provides a new perspective for the early identification of potential disruptive technologies and lessons for breakthrough research identification and evaluation.

TE-04.3 [R] • Technological Convergence and Market Creation: Making Connected Cars in China

Chuan-Kai Lee; National Tsing Hua University, Taiwan
Limeng Yu; National Tsing Hua University, China
Pao-Lien Chen; National Sun Yat-sen University, Taiwan
Mei-Chih Hu; National Tsing Hua University, Taiwan

The fifth generation of mobile technologies known as 5G has been pushing a deep convergence between communication technologies (CT), information technologies (IT) through incorporating and standardizing internet of things (IoT) where the IoT application scenarios using deeply-converging technologies. How do firms respond to such deep technological convergence in 5G era? This study uses Chinese technology firms' making connected cars as a case to explore their roles in the deep convergence driven by 5G. Particularly, the study concerns how firms from information and communication technology (ICT) industry, namely Huawei, Xiaomi and Baidu, seize the opportunities of deep convergence to create connected-car markets under 5G transition. By analyzing the in-depth interviews with industrial experts, and the text analysis of patents, contracts as well as policy documents, it is tentatively found that firms may respond to the convergence through: (a) creating markets through defining and institutionalizing new scenarios; (b) defining the core problem of the new scenarios based on incumbent core technological capabilities; and (c) transferring incumbent core technological capabilities in the defining stage of the new IoT scenarios.

TE-05 Strategic Management of Technology-3
Tuesday, 7/25/2023, 16:00 - 17:30
Room: Jalisco
Chair(s) Nasir Sheikh; Portland State University

TE-05.1 [R] • A Paper-to-digital Communication Case Study in a Life Insurance Company in South Africa: Strategy Formulation, Strategy Implementation, Evaluation and Outcomes

Thabo T Moloi; Management College of Southern Africa (Mancosa), South Africa
Antoine F Mulaba-Bafubiandi; University of Johannesburg, South Africa

The drive to reduce costs, generate revenue, enhance client experience and adhere to regulatory requirements within the life insurance industry has increased over recent years. This drive has necessitated digital technologies to improve the pace and quantum of change in how life insurance companies communicate with their clients, specifically in moving from paper-based printing and postage to digital communication. Although the rate of digital communication in the South African life insurance industry has been slow compared to the rest of the world, there has been a significant uptake in the recent past. In South Africa, the pain points in the value chain of life insurance companies have been, amongst many others, higher costs and less-than-optimal client experience related to (1) paper-based application forms, (2) paper-based new business policy documents generation, and (3) post-sales paper-based client communication. The implementation and impact of digital communication in the value chain require in-depth understanding and investigation. While the strategy and a step-by-step implementation in a specific life insurance company are discussed and recommended, this paper mainly focuses on the new business policy documents generation. This paper aims to review the implementation of digital communication to clients who have taken out new policies and/or upgraded their existing policies. The research methodology is based on a practical understanding of the environment in a specific life insurance company and an in-depth study of the insurance industry. The discussion points are focused on the value chain of the life insurance company, the strategy development and implementation, the processes, systems and technologies used to shift from paper-based to digital communication and the impact of digital communication on clients, financial advisors and employees.

TE-05.2 [R] • A Case Analysis of Coopetition Triggered by a Regulation Definition

Takashi Yamada; Tokyo Institute of Technology, Japan
Taro Sugihara; Tokyo Institute of Technology, Japan
Masako Ikegami; Tokyo Institute of Technology, Japan

This study investigates how organizations compete and cooperate simultaneously (i.e., coopetition) to define regulations in an industry that is legally controlled and composed of multiple types of sub-industries. We focused on a case in the automotive industry in Japan in the 2010s, where automatic emergency brake systems (AEBS) were getting rapidly popular and regularized. We coded the competitive, cooperative actions as well as actions for a regulation definition of firms, the government, and industrial organizations that were obtained from newspaper articles, magazine articles, and meeting minutes of public-private joint discussions. Time series analysis was applied to the coded actions around a bus accident. As a result, we found that the accident that might have been avoided if AEBS was implemented in a bus seemed to trigger increasing regulation-defining and competitive actions between firms within the next two years after the accident. This result can be an example of a method to find a case where regulation changes coopetitive actions. With the results, we discuss how regulation affects a state of coopetition in the industry or sub-industry.

WA-01 PLENARY: PLENARY-4

DATE: WEDNESDAY, 7/26/2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3

CHAIR: TOM GILLPATRICK; PORTLAND STATE UNIVERSITY

WA-01.1 [K] Innovation Policy, Social Inclusion and Sustainability in Latin American Countries

Gabriela Dutrénit; Universidad Autónoma Metropolitana (UAM), Mexico

Latin America and the Caribbean countries are characterized by structural heterogeneity (productive, social and environmental) and a strong social inequality. The Science, Technology and Innovation policies prevailing in the region have followed the international trends and combine the three existing analytical frameworks. Different structures coexist in each country, including a modern and innovative; a low productivity, and a traditional knowledge. In this keynote we will explore the types of existing structures and discuss the implications for the design of STI policies. We will particularly question the need to formulate a triple/quadruple STI policy to attend each of the structures. This combination of policy brings challenges for the design of a policy mix that integrates instruments that foster innovation in the different existing structures, with a perspective on inclusion and sustainability.

WA-01.2 [K] Towards an Indirect Approach to the Management of Technology, Engineering and Manufacturing

Guillermo José Aguirre Esponda; SEFI, ADIAT, Academia de Ingeniería México, Mexico

One of the most important challenges facing those in charge of managing engineering and technology development tasks is to find the right balance between controlling the tasks and maintaining the freedom and creativity of the participants needed for achieving the targets. This keynote presents an indirect approach to the management and control of design and technology development activities resulting from a five-year engineering research program, developed at the University of Cambridge, and applied in the public and private sectors. Dr. Aguirre will present examples and applications of the indirect approach in the industrial sector, federal government, and entrepreneurship.

WB-01 Educational Issues-1
Wednesday, 7/26/2023, 10:30 - 12:00
Room: Nuevo Leon 3
Chair(s) Nazrul Islam; University of East London

WB-01.1 [R] • Faculty Development: Understanding New Models of Training in Manufacturing and Sustainability

Enrique Diaz de Leon; Tecnologico de Monterrey, Mexico

This paper presents the development of competencies for teachers in several state-of-the-art topics, related to manufacturing and sustainability, for example, Industry 4.0. The term Industry 4.0 originates in Germany as a means of capturing the essence of a trend that saw the digitalization of industrial processes. Given the pace of technological change, the challenge was to reach the highest number of individuals in the shortest possible time. The program was divided into three stages. In the first one, professors from different Tecnologico de Monterrey (Tec) campuses were selected to take an Industry 4.0 course that was adapted from existing courses at RWTH Aachen. In the second stage, the Tec teachers designed a course for other instructors that was adapted to the conditions in Mexico. In the third stage, two more groups of professors were trained. ("Developing the Workforce for Next-Generation Smart ... - ResearchGate") To facilitate dissemination, we created a series of videos to facilitate asynchronous learning. The course was delivered using CANVAS. A laboratory session complemented the activities, and selected participants developed a project as part of their coursework. This work describes the design and implementation of the program. In all, this program has helped 68 professors develop competencies related to the needs of Industry 4.0.

WB-01.2 [A] • Protocol for Using Nintendo Switch in an Engineering Class: A Literature Review

Armando Guerrero-Serrano; Linde, Mexico

Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico
Naveen Tiruvengadam; Kettering University, United States
Luis C Felix-Herran; Tecnologico de Monterrey, Mexico
María R Forte-Celaya; Tecnologico de Monterrey, Mexico
Fernando Ruiz-Méndez; Tecnologico de Monterrey, Mexico
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Luis A Taba-Lozano; Tecnologico de Monterrey, Mexico
Álvaro A Castillo-Paz; Tecnologico de Monterrey, Mexico
María S Ramírez-Montoya; Tecnologico de Monterrey, Mexico

The rapid pace of technological advancement means accelerated emergence of new hardware and software options, which speaks to not only the intellectual capabilities of their designers but also to the immense latent potential of these technologies to be used in education to unlock human intellectual capital and train the human capital of the future. That being stated, emergent, experimentative technologies can also have barriers to accessibility; for example, they could be cost prohibitive and/or require potential users to have prior software programming capabilities. The portability of technology could also be a barrier to accessibility. For instance, most game consoles require a screen, which then limits their portability. The Nintendo Switch offers an interesting alternative for use in education in that it overcomes the three accessibility barriers of cost, programming, and portability. It also has the potential to teach video game design to students with no programming skills. Our work is intended to shed light on how the Nintendo Switch has been used previously by educators and technology managers.

WB-01.3 [R] • Use of a Visual Programming Language to Gamify Statistics Instruction for Undergraduate Students: A Literature Review and the Path Forward

Luis C Felix-Herran; Tecnologico de Monterrey, Mexico
Armando Guerrero-Serrano; Linde, Mexico
Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico
Naveen Tiruvengadam; Kettering University, United States
José L Ceciliano-Meza; Tecnologico de Monterrey, Mexico
Fernando Ruiz-Méndez; Tecnologico de Monterrey, Mexico
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Maria Meléndez-Alfaro; Tecnologico de Monterrey, Mexico
Abraham N Aldaco-Gastélum; Iowa State University, United States
Álvaro A Castillo-Paz; Tecnologico de Monterrey, Mexico
María S Ramírez-Montoya; Tecnologico de Monterrey, Mexico

Teaching statistics can be a challenging endeavor. Gamification possesses immense potential to improve acquisition and retention of knowledge in general by way of making learning fun and offering the ability to embed and contextualize concepts in the game design and simulation. The breadth of technology available today presents the possibility of designing, developing, using, and/or adapting existing technologies to tailor budget-friendly gamified simulations to meet curricular needs. This research work proposes to complement the gamification approach with the design and implementation of the video game by the participating students. The Game Builder Garage (GBG) is a programming game intended for the video game tablet console called Nintendo Switch. The GBG is a visual programming language that uses characters that are controlled using the console, and as such, is intuitive and does not require a programming background. This study presents a literature review of the use of gamification in an educational setting with the intent of providing a way forward on its incorporation into a statistics course. Besides, the degree of motivation and the knowledge acquired will be measured with a Motivated Strategies for Learning Questionnaire (MSLQ), and a standardized exam, respectively. Furthermore, including the design of educational video games in the learning of statistics could improve motivation, engagement and, consequently, performance, and be an option to be implemented in other engineering courses.

WB-02 Innovation Management-3
Wednesday, 7/26/2023, 10:30 - 12:00

Room: Colima
Chair(s) Takashi Iwamoto; Keio University

WB-02.1 [A] • Study on Experiences to Enhance Design Thinking Skills

Takashi Iwamoto; Keio University, Japan
Masaru Matsumoto; VISITS Technologies, Japan
Minoru Kuriyama; VISITS Technologies, Japan
Ryoji Minami; VISITS Technologies, Japan
Kazuma Murao; VISITS Technologies, Japan

Design thinking is associated with prescriptions for the innovation of products and services with business and social contexts and one of the important topics in the technology management field. The Design Thinking Test (DTT) was developed by VISITS Technologies Inc. and was released to the market in 2019. The DTT is an assessment tool for measuring creativity and judgment ability which reflect methodology of design thinking, and design thinking scores are calculated as an output of the DTT. In this study, what kind of experiences of university students enhance design thinking skills was examined using the data of 11,040 university students who took the DTT. Regression analyses using data of design thinking scores and experiences of 11,040 university students were executed. It was found that long-term intern or work at firms, business contests, and work experiences such as business planning enhanced design thinking scores of university students. Among these three kinds of experiences, long-term intern or work at firms is the most effective, business contests are the second most effective, and work experiences such as business planning is the third most effective to enhance design thinking skills of university students.

WB-02.2 [R] • Examining the Role of Actors in an Emerging Technological System: The Case of POC Devices

Alfonso Avila Robinson; EGADE Business School, Tecnologico de Monterrey, Mexico
Nazrul Islam; University of East London, United Kingdom
Shintaro Sengoku; Tokyo Institute of Technology, Japan
Kumiko Miyazaki; Asia Pacific Ritsumeikan University, Japan

This paper examines the role of actors in an emerging technological innovation system (TIS) - micro/nanofluidic-based point-of-care (mnPOC) devices. We hypothesize that the evolution of formative innovation systems can be inferred from the changes experienced by actors and the knowledge networks they build. Compared with other studies, we enhanced our discussions with multiple data sources that integrate scientific publications, patents, regulatory approvals, and news. We study the impact of the types of actors on the scientific, technological, and market performances of the TIS mnPOC by examining general technology trends, characterize relevant actors, and analyze knowledge networks. Our findings illustrate how the initial phases of TIS mnPOC closely follow the typical patterns of emerging technologies: increasing scientific and technological research efforts, growing number of new entrant firms, heavy scientific weight, high geographical concentration, and domination by small- and medium-sized enterprises. We also observed unique features, such as the significant influence of large firms considering their roles as intermediary organizations in R&D collaborations, novelty originators through spinoff creation, and innovation support through mergers and acquisitions. Collaboration networks are sparse, reflecting their complementarities in innovation value chains. Our results inform researchers and practitioners about the necessity of understanding the specificities and heterogeneities of emerging TIS for the development of effective system interventions.

WB-02.3 [R] • How to Promote New Product Development through Networked and Embedded Innovation? Based on the Perspective of Digital Transformation

Mengyu Zhuang; Beijing University of Posts and Telecommunications, China
Guanhua Ye; The University of Queensland, Australia
Yawen Li; Beijing University of Posts and Telecommunications, China
Jinyi Zhou; University of Science and Technology Beijing, China

Although current studies indicated that embedded innovation is a crucial addition to the cooperative innovation and the process is often accompanied by digital transformation, few have declared the action path or long-term effects. The effects of networked and embedded innovation on new product development are discussed in a unified theoretical framework in this study. Drawing upon network embeddedness and resource orchestration theories, we propose that: (1) networked innovation promotes new product development performance, and this effect is fully mediated by digital transformation; (2) there exists an inverted U-shaped relationship between embedded innovation and new product development performance, where digital transformation plays the role of complementary partial mediation. Unbalanced panel data made up of 245 firms operating in China's A-share computer communication industry from 2007 to 2020 has been used to test the theoretical model. We aim to emphasize that based on loosely coupled innovation enhancement and power aggregated conflict mitigation mechanisms, digital transformation has a mediating effect in the relationship between the two paradigms of cooperative innovation and new product development, respectively. According to the findings of our study, a future fit innovation strategy is suggested for technology firms.

WB-03 Sustainability-1
Wednesday, 7/26/2023, 10:30 - 12:00
Room: Durango
Chair(s) Aki Tomita; Toyo University

WB-03.1 [R] • Smart Value Chain Tool for the Sustainability of the Food and Beverage Sector

Arnesh Telukdarie; University of Johannesburg, South Africa
Megashnee Munsamy; University of Johannesburg, South Africa
Xolani Maphisa; University of Johannesburg, South Africa
Tatenda Katsumbe; University of Johannesburg, South Africa

The world of business demands continuous evolution, including delivering on global competitiveness, and environmental sustainability by migrating to evolving technologies. Companies find it difficult to capacitate with the appropriate skills to drive financial, environmental, and technological evolution. The onset of the Fourth Industrial revolution indicates that appropriate business processes, including identifying and selecting technological and environmental substitutions, can be digitalized. This research paper reviews current digital strategies for automation of business processes associated with technological and environmental substitution. The South African food and beverage sector is adopted to develop a digital framework to test digitalisation of technological and environmental substitution. The researchers mature the framework into a python enabled toolset that screens in process centric technologies for substitution in the selected food and beverage company. The identification of relevant technologies is identified using a combination of natural language processing and graphical user interfaces for data filtering. The paper culminates in providing outputs of the toolset developed with details of the new technologies and impacts thereof.

WB-03.2 [R] • Promoting Data-driven Technology Transition for a Sustainable World through ESG Entrepreneurship

Aki Tomita; Toyo University, Japan

In 2015, more than 150 world leaders formally approved the plan called Transforming Our World: 2030 Agenda for Sustainable Development until 2030. Climate action is a global goal for our lives to be sustainable. For responsible investors, public companies are to be required to disclose the information based on the Task Force on Climate-related Financial Disclosures (TCFD) framework, strongly focusing on risks and opportunities related to the transition to a lower-carbon economy. To promote adaptation and mitigation for climate change, not merely depending on voluntary efforts by companies, an entrepreneur's creative ideas should be leveraged. ESG entrepreneurs, who are augmented by digital technologies, are expected to challenge other SDGs such as biodiversity in addition to deriving the energy source transition. To encourage social entrepreneurship, this paper proposes a data-driven framework for entrepreneurs executing technology transition. In this framework, the sustainability-related disclosed information, which is mainly targeted at investors, is integrated with complementary information unique to local communities. This paper analyses the benefits of this proposal by applying it to a previous renewable energy field project which faced difficulties in improving profitability.

WB-04 Disruptive Technologies-2
Wednesday, 7/26/2023, 10:30 - 12:00
Room: Guerrero
Chair(s) Marcelo A Machado; Kwantlen Polytechnic University

WB-04.1 [R] • Digital Transformation as an Enabler of Sustainability in Supply Chain and Logistics: Evidence from the Field

Marcelo A Machado; Kwantlen Polytechnic University, Canada
Kazuo Hatakeyama; Polytechnic Institute of Bahia, Brazil

Digital transformation (DT), represented by technology trends like Artificial Intelligence (AI), Big Data (BD), and the Internet of Things (IoT), is a reality for most businesses. Most companies are implementing DT strategies, and the Global Pandemic may have accelerated the digitization of businesses. Concurrently, another set of trends focus on the need for improving the sustainability of business processes. It is now widely accepted that the Earth cannot tolerate a continued, average increase in global temperatures at the rate it is currently experiencing. Governments committed to carbon emission goals have tightened environment regulations. Moreover, customers and even investors who have shifted their mindset and sustainability related performance indicators are now part of the decision of doing business with a company or not. Lastly, an increasing number of business leaders are implementing principled leadership approaches, including social and environmental issues, in their agenda. To make the matters worse, new technology developments like AI have the reputation of being power hungry, requiring increasingly large amounts of energy to run. It is arguable that DT may be further worsening the environmental crisis. As a sign of hope, there are multiple industry cases of the application of digital technologies, notably AI supported by BD, as enablers of sustainable business practices have emerged in recent years. The main objective of this research is to conduct an analysis of select industry examples to investigate the potential of DT as an enabler of sustainable business processes instead of an additional cause of concern. This research will more specifically focus on studying DT as an enabler sustainability in supply chain and logistics since upstream and downstream carbon emissions correspond on average to 70% of a company's carbon emissions not directly related to their primary processes.

WB-04.2 [R] • Evaluation of Agility in Innovative Projects in the Manufacturing Industry

Gustavo L Nascimento; UNISOCIESC, University Center of Santa Catarina, Brazil
Marco A Oliveira; UNISOCIESC, University Center of Santa Catarina, Brazil
Andre H Futami; UDESC - State University of Santa Catarina, Brazil
Kazuo Hatakeyama; Polytechnic Institute of Bahia, Brazil

Studies confirm that companies in sectors that produce physical products when developing innovative projects seek agility by adopting methods and practices from agile project management (APM) theory. The APM, designed by the software industry, recognized the power to bring rapid results to projects performed in environments with high volatility, uncertainty, complexity, and ambiguity, typical of innovative challenge tasks. In this context, studies carried out in the region with a diversified manufacturing park would benefit from understanding how to make its creative projects agile. Besides, this region is a representative sample to confirm the assumption that the combination of administrative aspects and practices can lead to greater agility. The research aims to evaluate the agile practices, the organizational factors, and their contribution to agility performance in the innovation projects of the manufacturing industry. Several methods were developed to evaluate the agility in project management, so a systematic bibliometrics review was performed. The results analysis involved the use of the quantitative approach. Expect to have results highlighting the favorable aspects and barriers

to implementing agility in this sector, besides reinforcing the assumption of the interdependence mentioned above among practices, context, and project performance.

WD-01 Enterprise Management-2
Wednesday, 7/26/2023, 14:00 - 15:30
Room: Nuevo Leon 3
Chair(s) Leon Pretorius ; University of Pretoria

WD-01.1 [R] • The Impact of Underinvestment in Rail and Power Infrastructure on the Mining Value Chain in the Northern Cape

George T Maluleke; University of Pretoria, South Africa
Leon Pretorius; University of Pretoria, South Africa

Mining remains the primary driver of human and economic development in South Africa. The effectiveness of the Manganese mining in the Northern Cape depends on the efficiencies in the use of technology inputs such as power and logistics. The paper reviews the impact of underinvestment in economic infrastructure on the ability of the Manganese Mining Value Chain to unlock development potential in the metalliferous mineral's rich Northern Cape. The paper argues that the dynamic equation based on the development of rail and the expansion of electricity generation capacity, their use in the Manganese beneficiation value chain has direct causality towards growth. Power and logistics variables are endogenous to the dynamic structure of the Manganese value chain and its ability to thrive is dependent on its own internal structure. We take system dynamics view that only elements within the boundary of a system such as the Manganese value chain determines its dynamic behavior. The evaluation of the impact of power and rail logistics on the development in the Northern Cape over a 10-year period, a multi-variate simulation is done in a system dynamics environment, acknowledging that the impact is more likely to be due to several variables acting against each other.

WD-01.2 [R] • Research on the Relationship between Stability, Heterogeneity of Top Management Team and Enterprise Technological Innovation Performance

Ziyan Xu; Zhejiang University, China
Fei Li; Zhejiang University, China

In recent years, the Chinese market has been one of the most innovative markets in the world. We know that China implements an economic system in which public ownership is the mainstay and multiple ownerships develop together. The impact of differences in corporate ownership structures on corporate technological innovation capabilities has always been controversial. In fact, economic theory does not support the impact of ownership structure differences on technological innovation performance. Entrepreneurs should be the reason for the differences in technological innovation capabilities among enterprises, because in the technological innovation practices of Chinese enterprises that emphasize collective leadership, the impact of entrepreneurial factors on technological innovation performance is not very prominent. Therefore, based on the context of Chinese corporate technological innovation, we explain its relationship with corporate technological innovation performance from the perspective of corporate executive team stability and heterogeneity. We try to take an empirical approach to explore what characteristics of the top management team will be conducive to the improvement of corporate technological innovation performance, which will provide theoretical guidance for the construction of corporate top management teams that promote technological innovation.

WD-01.3 [R] • Applying Patent Analysis to Identify Potential Collaborators for Battery Electric Vehicles

Madhur Srivastava; Indian Institute of Technology, Bombay, India, India
Karuna Jain; Indian Institute of Technology, Bombay, India , India

With more than 16.5?million electric vehicles on global roads and their introduction in India, it is pertinent to understand the global and jurisdiction-specific focal areas of technological development in the Battery Electric Vehicles (BEV) industry. Each of the main subsystems of a BEV has several converging and interdependent technologies amongst various stakeholders. We aim to quantify the existing technological knowledge gap based on the concept of technology base scope and the revealed technological advantage. Patents provide robust evidence-based developments in the global and domestic sectors. Hence, we employ patent analysis-based computation of the technological knowledge gap to assess the technological development from an online global database using International Patent Classification (IPC) codes to identify the potential sources for future technological collaborations to build interdependent technical knowledge within the emergent global network. We found outstanding leadership of US-based assignees in BEV core technologies, closely followed by Chinese.

WD-02 Environmental Issues
Wednesday, 7/26/2023, 14:00 - 15:30
Room: Colima
Chair(s) Martin Flegl; Tecnologico de Monterrey

WD-02.1 [A] • Water Shortages in Monterrey: Analysis and Technological Solutions

Armando Martinez; Instituto Tecnologico Superior de Coatzacoalcos, Mexico

Environmental Science and Technology Management could work together to solve real-world problems such as pollution and energy demand. This research area is associated with my previous professional and educational experience where I studied the quality of wastewater and monitored water pollutants in sewage treatment plants. Water is an important and valuable resource necessary in our lives, due to climate change there have been different cities around the world affected by droughts, there is a big demand for clean water and electricity in the world and considering that not all wastewater produced in the world is treated. Resolving this issue (water crisis) necessitates the construction of new water treatment plants, equipped with the latest technology, such as IoT sensors, cloud data storage, and data analysis in order to forecast or easily identify pollutants in the residual water, additionally, it could be reincorporated it in the thermal power generation process. Involving different technological approaches to increase wastewater recycling is a perfect example of a real application to resolve this problem and benefit the local habitats while also caring for the sustainability of nature, life, and technology development.

WD-02.2 [R] • Towards More Efficient Water Management System in Mexico to Prevent Water Scarcity

Martin Flegl; Tecnologico de Monterrey, Mexico
David Güemes-Castorena; Tecnologico de Monterrey, Mexico
Aldo I. Ramírez; Tecnologico de Monterrey, Mexico
Marien Morán-Valencia; Tecnologico de Monterrey, Mexico

Mexico has recently faced severe water scarcity problems, resulting in harsh criticism of the public water system management. Water governance in the country is inefficient because of corruption, the lack of transparency in water policies, and the resistance to change in how the resource is managed among the responsible authorities. This article investigates a state-level public water management system's efficiency and evolution over the last three years. For this, a two-stage Data Envelopment Analysis (DEA) model was constructed using data from the 2019 and 2021 Economic Censuses. DEA identifies the best-performing states and the opportunity areas for each state; therefore, state-policy makers could design plans to boost sustainable water management by identifying current deficiencies in the water system. This paper's findings help to benchmark the adoption and implementation of innovative water governance practices among responsible water authorities.

WD-02.3 [R] • Understanding Organizations' Experiences with Green Certification: The Case of the U.S. EPA Safer Choice Standard

Angel Contreras-Cruz; Portland State University - ETM, United States
Naveen Tiruvengadam; Department of Business - Kettering University, United States
Armando Elizondo-Noriega; ITESM, Mexico

David Güemes-Castorena; School of Engineering and Sciences, ITESM, Mexico

Organizations often encounter a series of barriers when attempting to obtain a certification. Then, having a comprehensive view of the guidelines helps organizations to overcome those challenges on time while increasing the probability to become a certified organization. This study focuses on the U.S. Environmental Protection Agency's (EPA) Safer Choice standard, a certification program that validates specific cleaning products. All Safer Choice products can carry its label, which means the certified product is safe for human use and environmentally friendly (EPA, 2021). Overall, the Safer Choice certification helps companies to reduce and prevent pollution by integrating the standard in the manufacturing and supply chain process. One of the expectations of this research is to fill the gaps identified in the literature review by combining a theoretical road-mapping approach while implementing a green certification. Our results suggest that a road-mapping approach can be useful for stakeholders to understand the Safer Choice certification and provide insight to pursue any other green certification.

WD-03 Sustainability-2
Wednesday, 7/26/2023, 14:00 - 15:30
Room: Durango
Chair(s) Joe E Amadi-Echendu; University of Pretoria

WD-03.1 [R] • A Framework for Integrating Digital Technologies to Improve Water Supply Systems Efficiency in Buildings

Pedro Cortez-Lara; Tecnologico de Monterrey, Mexico
Romeo Ballinas-Gonzalez; Tecnologico de Monterrey, Mexico
Benjamin Sanchez; Tecnologico de Monterrey, Mexico

Current "Blue" BIM (Building Information Modeling) focuses on green building rating systems (e.g., LEED, BREAM) and on 3D modeling of plumbing systems. A reduced group of tools works on specific applications, such as safety of the systems, evaluation of stormwater runoff, and rainwater harvesting. Most of the studies mentioned only provide assumptions or partial efficiency simulation analysis, thus implementing of "Blue" BIM has remained limited. The aim of this study is to develop a framework for integrating water efficiency in supply systems with BIM in design and operation phases of the project. The proposed framework will help to better understand the dynamic inside water efficiency in buildings and the key role of BIM in integrating digital technologies to achieve sustainability.

WD-03.2 [R] • An Approach to Operationalise Resiliency towards Sustainable Futures

Joe Amadi-Echendu; University of Pretoria, South Africa

There is abundant discourse on resilience and sustainability; however, the ongoing challenge remains how to operationalize resiliency towards achieving the inextricably interwoven (i) precepts of circular economy, with (ii) the imperatives of sustainability, and (iii) the human-centered ideals of the era of Society 5.0. Consequent upon increasing concerns for unprecedented and adverse effects of climate change, paradoxically, a significant proportion of extant literature and discourse on resiliency tends to focus on the vulnerabilities of commercial, environmental, governance, industrial and societal systems to stressors inherent within natural hazards. Unwittingly, the convention emphasizes protection from the unprecedented effects of climate change stressors, even though global, national, physical, regional and sectoral delineations of these systems are also susceptible to other volatile, uncertain, ambiguous and complex (VUCA) stressors arising from the interactions and tensions between commercial, governance, industrial and societal endeavour. The content of this paper includes discourse on the classification of VUCA events into four domains, as well as the description of a generic, logically consistent, and coherent framework for operationalizing resiliency towards sustainable futures.

WD-03.3 [R] • A Systematic Review of Digital Skills and Sustainable Development

Sira Maliphol; SUNY Korea, Korea, South
Sonja Walter; Korea Development Institute, Korea, South

The digital transformation of an economy is not only seen as a means to develop economically but also as a way to achieve sustainable development, especially for developing countries. Increased efficiency gains from digitalization of economic activities can provide capabilities to leapfrog over more carbon intensive activities. The new digital economy demands new technological capabilities of workers and for digital processes. Yet, the requisite digital skills required to achieve a sustainable development path have not been identified. This study aims to fill this gap by reviewing the literature on digitalization of skills and on sustainable development. This study will adopt recent methods of reviewing literature that have been made more thorough by applying systematic or structural approaches. The results will provide research agenda and strategies for researchers seeking to fulfill the multi-pronged goals of sustainable development through digital technology transformation and human resource development.

WD-03.4 [R] • Supply Chain for Change (SC4C): A System Dynamics Analysis for the Potato SC at the Wholesale Market of Lima, Peru

Maria de Fatima Leon Jimenez; Massachusetts Institute of Technology, United States
Sabrina Sadalla Collese; Massachusetts Institute of Technology, United States
Tiago Pirez Horvath; Massachusetts Institute of Technology, United States
Christopher Mejia Argueta; Massachusetts Institute of Technology, United States
Sara S Grobbelaar; Stellenbosch University, South Africa

Food insecurity is a critical problem worldwide, and wholesale markets play a fundamental role in guaranteeing the availability and accessibility of food - for this paper, potatoes - to final customers in Lima, Peru. Wholesale markets have been understudied in food environments from a Systems Dynamics (SD) perspective. The present research aims to explore how the Great Wholesale Market of Lima (GWML), the principal wholesale market in Peru, affects the accessibility and availability of the potato value chain in Lima. We use the SD approach to understand the role of the wholesale market by identifying dynamics and the major system archetypes. The results show that investment in knowledge and proper tools could decrease costs, reduce waste and increase productivity, growing food accessibility and sales. We argue that this may lay the foundation for a future modeling study where systems and technology improvements in the wholesale market may be tested.

WD-04 Technology Transfer and Diffusion
Wednesday, 7/26/2023, 14:00 - 15:30
Room: Guerrero
Chair(s) Kiyoshi Niwa; The University of Tokyo

WD-04.1 [R] • Study on Suitable Management Organizations to Promote Usage of Measurement Instruments Produced by University Research

Miyako Iritani; Tokyo University of Agriculture and Technology, Japan
Manabu Eto; Hitotsubashi University, Japan
Tagui Ichikawa; Hitotsubashi University, Japan
Kazuhiko Misawa; Tokyo University of Agriculture and Technology, Japan

There are the following three steps to increase users of cutting-edge measurement instruments produced by university research: (1) providing information on their use at scientific conferences, (2) conducting collaborative research between the developers and users of the instruments, and (3) providing a contract measurement service to researchers wanting to use the instruments as needed. This research study aims to determine the criteria for selecting suitable operating organization handling contract measurement service above when it is located within or outside the university. As model cases, we investigated the following two types of businesses that operate university-owned instruments to provide measurement results: shared-use facilities for industry-academia collaborations operated by universities (university organizations) and university-launched companies (companies) performing out-

sourced services under an instrument-use agreement with the universities. We interviewed three university organizations and three companies about their challenges and success points in managing their organizations. A comparison of the interviews revealed that "maintenance of the organization," "hiring human resources," and "expanding customer base" are the criteria for selecting the two types of businesses.

WD-04.2 [R] • IP Evaluation and Technology Transfer

Priyadarshini Singh; Indian Institute of Technology Kharagpur, India
Gouri Gargate; Indian Institute of Technology Kharagpur, India

Technology has paved the way for tremendous growth. With the invention of Industry 4.0, technology has no bounds. This boon of technological advancement seems boundless and hence diverse to manage. Academic institutions are the hub of technological development. These institutes rigorously work towards bringing intellectual property (IP) and inventions that would contribute to society's development. Academic institute being the source of technology birth, needs to be prioritized, concerning challenges faced in the management of technology. Various processes like intellectual property due diligence, IP audit, and IP valuation affect the technology and its impact on the economic, social, political, and managerial and technical aspects. Academic institutes which have efficient IP management systems produce excellent results and technology transfer is on the higher threshold. In this paper, the process of IP management at an academic institute level is demonstrated by applying the IP audit model. Further various parameters would be mentioned for IP evaluation, which would be intrinsic for evaluating technology and facilitating technology transfer. This study focuses on technology management at an academic institute level, one of the milestones of research and development concerning technology.

WD-04.3 [R] • Smart City Accelerator

Leonardo D Nahle; Ibero Torreon, Mexico

The purpose and goal/objective are to present the concept of the Social-Technological Accelerator oriented to the training and developing technologies that promote and change cities into Smart Cities. The learning paradigm is our battlefield, and by structuring models, we will set up hybrid learning approaches. We would assemble a new learning model, critical social constructs, and organizations in the Innovation Ecosystems. Specifically, the concept is be developed and articulated in strategies to develop strategic competencies, knowledge, skills, and behaviors, the sectors identified with opportunities laid in four key concepts: 1. Innovation Ecosystems and Networks; 2. High Impact Skills for Smart Cities, 3. Smart City Focus; and 4. Innovative Learning; making the Cone of plausibility very useful to addresses the dynamics. The Smart City Acceleration is a concept under development; this report is part of a series of reports on the result of the praxis of this model, whose purpose is to boost and increase the response of the program's terminal efficiency BTIRM of the experiment in this article. Obtained results or anticipated outcomes of the study can help build a Bathtub of Skills for the Smart City Accelerator to be used in the future since this body of knowledge can trigger creativity, innovation, and discipline. Furthermore, the experiment processes the critical element that integrates the outcomes. Therefore, SCA can be used for specific groups of people.

WE-01 Knowledge Management-1

Wednesday, 7/26/2023, 16:00 - 17:30
Room: Nuevo Leon 3
Chair(s) Naoshi Uchihira; Japan Advanced Institute of Science and Technology

WE-01.1 [R] • Comparative Study of Roadmapping and Sci-fi Prototyping Methods to Develop a Knowledge Management Framework

Miwa Nishinaka; Kagawa university, Japan
Kunio Shirahada; Japan Advanced Institute of Science and Technology, Japan
Yusuke Kishita; The University of Tokyo, Japan
Hisashi Masuda; Kyoto University of Foreign Studies, Japan
Hideaki Takeda; National Institute of Informatics, Japan
Dohjin Miyamoto; The University of Tokyo, Japan
Hirotaka Osawa; Keio university, Japan

Roadmapping is a structured, logic-based method to support strategic planning for organizations and governments. However, it is not necessarily effective to produce destructive changes in the era of uncertainty. Specifically, roadmapping is useful for visualizing ideas for better communication among stakeholders but has limitations when creating unconventional knowledge through abduction. Additionally, it lacks the ability to create knowledge considering humanity and well-being to respond to current and future uncertain social situations. Therefore, this study aims to explore the key factors for incorporating the science-fiction (sci-fi) prototyping method into roadmapping, based on the literature review. Roadmapping is a logic-consistent, face-to-face workshop-based method, whereas sci-fi prototyping is a workshop-based method that utilizes fiction in a distributed virtual system. Both methods are used to conceptualize future innovative technologies and policy recommendations. Though they have similar objectives, the resulting future concepts are exactly the opposite. To integrate the two methods effectively, we break them down into modules and consider reconstructing them. After conducting comparative studies based on previous research, we propose a cooperative base of the two methods.

WE-01.2 [R] • Impediments to Knowledge Transfer Behavior of IT Professionals: An Integrative Framework

Tadahiro Imada; Japan Advanced Institute of Science and Technology, Japan
Kunio Shirahada; Japan Advanced Institute of Science and Technology, Japan

Technical knowledge transfer within an organization is expected to enhance organizational innovation capability. These activities seem to be influenced by organizational climate, individual knowledge-hiding behaviors, psychological ownership of knowledge, and trust and organizational time pressure. However, few studies examine in an integrated manner the impact of these factors on the individual's technical knowledge transfer activities. This study focuses on IT professionals and analyzes this influence using the Theory of Planned Behavior to set the research framework. A questionnaire survey was administered to 399 IT professionals. Based on the results of a structural equation modeling analysis, we show how factors related to knowledge transfer behavior, namely communications and internal and external company rules, can enhance a creative climate, reduce the potential of knowledge-hiding behavior and instead, promote knowledge transfer.

WE-01.3 [R] • The Rebirth of Knowledge Management in the Era of Technological Singularity

Karoly Nagy; BME-UBT Joint Transformative Research Centre, Kosovo
Edmond Hajrizi; UBT Higher Education Institution, Kosovo
Edrina Gashi; UBT Higher Education Institution, Kosovo

A special knowledge center model created by the author about 20 years ago and published at the PICMET '01 (2001) conference, among others, was based on the following definition: "Knowledge is when one can effectively use the information and theoretical knowledge at his disposal to solve practical problems". As it is written in the concept of the Japanese Society 5.0 program, currently we are in the Information Society, where information is the key factor. However, creation of knowledge from information is still accomplished by humans. Yet in the fifth stage of human society, this will be done by machines, by AI. Accordingly, we need to turn to not just our higher education system, but our whole knowledge management approach, which teaches to transfer information to knowledge, into the development of effective and secure collaboration ability with AI. We assume that in the future, university students, but others, will be increasingly involved in the "deep learning" processes that were originally developed for the teaching of robots. This paper summarizes the theoretical and methodological findings that underpin the construction of a new knowledge management model based on secure human and AI collaboration, and that avoids the dangers of technological singularity.

WE-02 Innovation Management-4

Wednesday, 7/26/2023, 16:00 - 17:30

Room: Colima
Chair(s) Shuto Miyashita; Tokyo Institute of Technology

WE-02.1 [R] • Utilization of Tangible and Intangible Assets of Science Parks to Lead Innovation in a Deep Tech Sector

Haruka I Hibino; Tokyo Institute of Technology, Japan
Shuto Miyashita; Tokyo Institute of Technology, Japan
Shintaro Sengoku; Tokyo Institute of Technology, Japan

A science park (SP) is an open innovation center where universities and companies from related fields are concentrated in a limited parcel equipped with research facilities to form an innovation ecosystem. In the deep tech field, where scientific discoveries and technological innovations create new products or services, SPs can provide value by utilizing tangible assets such as facilities and intangible assets such as networks, know-how, and expert human resources. In this respect, SPs are considered to have different added value and revenue structures than business parks and virtual open innovation networks. However, there have been few studies that have consistently organized the sequence of events in recent SP businesses, from resource utilization to impact creation. In this study, to depict an entire flow of SP business, previous studies on SPs were revived and organized using a logic model. Relevant findings from research streams other than SPs, such as anchor tenant theory and network orchestrator theory, were also incorporated, and a theoretical foundation for how recent SPs are leveraging their assets to provide values in the field of deep tech was attempted to be built.

WE-02.2 [R] • Managing Public Service and Technology Innovations for Sustainable Development in Mexico: Energy, Water, Agroforestry, and Biocultural Cases

Leonel Corona-Trevino; National University of Mexico UNAM, Mexico

The objective is to select some Public Services Innovations (PSI) focused on sustainable strategies implemented in Mexico from 2019 to 2022. Eight PSI are highlighted and englobed into four cases of public strategies regarding energy sustainability, water, agroforestry, and biocultural. These cases are analyzed, focusing on their characteristics: diagnosis, solutions, agents involved, impacts on public value, and user value. An in-depth analysis of each innovation's process and considering the INDICO index (Innovation Diffusion Co-value) measures the capacity of each PSI and its impact on sustainability considering three axes: time, organization, and the behavior of the agents involved. The findings indicate that technical management and innovations have a favorable impact on sustainability. However, if environmental degradation is higher, longer-term approaches and more complex solutions seem necessary. While these may have uncertain consequences, they seem to provide elements to deter agents' behaviors toward environmental degradation.

WE-02.3 [A] • Models for Creating a Sustainable Shipping Infrastructure via Decarbonization: Opportunities & Challenges

Carlos Bertrand; Texas A&M University at Galveston, United States
Alok K Verma; Texas A&M University at Galveston, United States
Cassia Galvao; Texas A&M University at Galveston, United States
Nima Fathi; Texas A&M University at Galveston, United States

This research consists of an analysis of selected industry-relevant models proposed by major maritime industry stakeholders as a pathway to achieve more sustainable global shipping by decarbonizing the shipping industry. The analysis presented here aimed particularly at discussing the opportunities and challenges in implementing these models within the given timeline defined by the IMO (International Maritime Organization). The models' selection criteria were based on their relevance to the maritime shipping business, mainly attributed to their roles in ship classification and registry. We have employed a multi-method analysis of secondary data publicly available by the models' proponents, focusing on the models' effects on opportunities and challenges for decarbonizing the maritime shipping sector. Our preliminary findings indicate that the success of these models will depend upon various factors related to technology readiness, including supply chain robustness; infrastructure preparedness; financial conditions; and most acutely acceptance of new foundational technologies by the maritime industry professionals and leaders.

WE-03 Productivity Management
Wednesday, 7/26/2023, 16:00 - 17:30
Room: Durango
Chair(s) Timothy R Anderson; Portland State University

WE-03.1 [R] • Adaptations to Leveled-DEA: A Technique for Non-homogeneous DMU Comparison

Naveen Tiruvengadam; Kettering University, United States
Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Sonia V Aviles-Sacoto; Universidad San Francisco de Quito, Ecuador

Leveled-Data Envelopment Analysis (L-DEA) is an adaptation of traditional Data Envelopment Analysis (DEA) in that it affords a limited comparison of heterogeneous Decision-Making Units (DMUs). In other words, while traditional DEA is intended for comparison and benchmarking of homogeneous DMUs (e.g., comparing hospitals only against other hospitals), L-DEA allows for a rather narrow-in-scope comparison of DMUs across industries (hospitals against banks). In theory, L-DEA affords technology managers the ability to build external context against which to evaluate internal efficiencies. The L-DEA method as originally proposed was computed using a parametric method that was computationally slow. This paper provides an applied computational alternative that remains true to mathematics undergirding L-DEA whilst speeding up its computation considerably. In addition, and importantly, L-DEA's ability to remain functional with adaptations and perform against another dataset are both evaluated, in order to explore its capacity for further use.

WE-03.2 [R] • Application of Attainable Regions Method in Productivity Improvement

Ngaka N Mosia; University of South Africa, South Africa

Productivity Improvement is a ratio of output over input. It is achieved by increasing output while reducing inputs or increasing output without changing inputs. It is also attained by maintaining a stable output while reducing inputs. There are numerous permutations that can be designed, that result in productivity improvement. Industrial and production engineers have always been challenged by an unanswered question with regards to Productivity Improvement. The question is, how do we know if the Productivity Improvement design applied is the best for the situation. Is the combination of Productivity Improvement variable optimum, is the Productivity improvement configuration optimized. Thus, these questions allude to a fact that there is a possibility that a new design can be engineered, that might produce better productivity outcomes. This paper adopts a qualitative research approach to explore and explain the process of establishing better productivity improvement design that applies performance targeting in Productivity Improvement initiatives. The paper reports on the application of Attainable Regions method in production and establishes why attainable regions designs are the best productivity improvement designs achieved through a comparison of results achieved through the application of generic productivity improvement methods and results achieved through the application of attainable regions method.

WE-03.3 [R] • Using Linear Programming to Improve Productivity and Profitability with Six-sigma in the Fast-moving Consumer Goods Industry

Herman M Moloto; University of Johannesburg, South Africa
Leon Pretorius; University of Pretoria, South Africa
Jan-Harm C Pretorius; University of Johannesburg, South Africa

This paper investigates the suitability of linear programming techniques to optimize profitability and productivity in the fast-moving consumer goods (FMCG) industry. The impact of six-sigma implementation on the dual objective function problem is also explored. A mixed integer linear programming (MILP) model suitable for the FMCG industry is selected with reference to the classification of lot sizing models found in literature, the classification is based

on the type of problem that the model intends to solve. Two literature derived case studies that are representative of the FMCG industry are used to answer the research question in this work through a simulation research approach in the General Algebraic Modelling System (GAMS) software. The study found that linear programming can be used as an optimization technique in the FMCG industry with the lot-sizing concept. The implementation of six-sigma has a big impact on profitability and productivity as it reduces number of defects and failures, thus improving quality of products and maximizing the output with minimal re-work. This research in engineering management can be used to build a business case for resources to be directed at implementing six-sigma as it provides an alternative way to show the benefits of six sigma implementation.

WE-03.4 [R] • Setting Goals for an Innovation District Using Data Envelopment Analysis

Jaime E Alarcón-Martínez; Tecnologico de Monterrey, Mexico
David Güemes-Castorena; Tecnologico de Monterrey, Mexico
Martin Flégl; Tecnologico de Monterrey, Mexico

This study aims to provide targets for companies to be attracted to a nascent university-led innovation district initiative, to reach a high-efficiency level. To do so, the Data Envelopment Analysis and the Bootstrap method to estimate statistics from a population were utilized to benchmark the best innovation districts in the United States. The results determine the sales from innovation per employee and the percentage of innovation of sales that the companies - to be established in the district - must have to be comparable to the analyzed districts. Furthermore, the study considers the Mexican and regional context as essential in customizing such metrics to make the goals "realistic." A recommendation to the university leading this effort is to apply a strategy that consists of these elements: the organization of group research, the creation of research with commercial potential, the development of organizational mechanisms to move commercializable research beyond the academic borders, and the integration of academic and non-academic organizations in the innovation district.

WE-04 Emerging Technologies
Wednesday, 7/26/2023, 16:00 - 17:30
Room: Guerrero
Chair(s) Oludare Olorunniwo; Obafemi Awolowo University

WE-04.1 [R] • Analogue Reality or Digital Alias Revolution?: The Legacy of GNSS Signal Availability

Oludare Olorunniwo; Obafemi Awolowo University, Nigeria

The evolution of GNSS signals and additional navigational signals to the radiofrequency (RF) spectrum have spun innovative downstream user-end devices, thriving OEM and navigation receiver market, and reconfiguration of the upstream satellite communication boundaries. The emergence of recently repopulated GNSS constellations-GPS, Galileo, GLONASS, and BeiDou give credence to this fact. Major attributions to these developments include upgraded operational control systems, payload capacity building, and modernization programs designed to support interoperability at the space, control and user segments. However, not to be overlooked are the novel signal transforms and convolutional algorithms that have aided conversion of these signals. Yet, common autocorrelation functions and multiplex binary offset carrier (MBOC) platforms in GNSS signal acquisition, have not resolved some compatibility and interchangeability issues in challenging environments. Therefore, this research present:(1) observed trends and milestones in the development of legacy and modernized GNSS signals, (2) various modulation platforms that have fostered compatibility amongst satellite systems, and (3) the dynamic and measurement models of the Kalman filter (KF) and Extended Kalman filter (EKF) of acquired positioning signals in a difficult terrain. The performance assessments and available test results demonstrate the socio-economic benefits of location-based services (LBS) in the global inventure cycle.

WE-04.2 [R] • Virtualization as a Strategy to Develop Sustainable Technology: Path Planning Generator Problem as a Case Study

Javier Maldonado-Romo; Tecnologico de Monterrey, Mexico
Luis Montesinos; Tecnologico de Monterrey, Mexico
Pedro Ponce-Cruz; Tecnologico de Monterrey, Mexico

The insufficiency of resources to satisfy the requirements of the world's population and global circumstances that impact the availability of resources cause significant disruptions in the manufacturing industry worldwide and, consequently, the global economy. For instance, the shortage of raw materials increases production costs (e.g., the increase in the cost of microprocessors produced by the shortage of silicon). Small and medium manufacturing enterprises are more vulnerable to this problem, demonstrating their need for innovative solutions. Therefore, the authors propose expanding the virtualization concept as an alternative. In this case, the extended concept of virtualization seeks to employ devices with limited features to replace physical elements. This work presents a sustainable solution to the problem of a path generator (PG) that generates a safe path in controlled environments. PG comprises two primary modules, perception and planning, which require intensive resources to generate a real-time response. On the other hand, virtualization reduces the number of PG elements, making it feasible to run it on embedded systems with limited capabilities. Therefore, a general-purpose architecture is replaced by a virtual representation for specific use. In this proposal, the authors use a generative network to connect two uncoupled modules to suggest the best virtual path. This way, costs and implementation times are reduced, and safety is approximate to physical elements in controlled environments. Furthermore, it opens an opportunity to implement a circular economy model, such as obsolete smartphones that can be reused in manufacturing applications.

WE-04.3 [A] • CMMI-DEV Industrial Maturity Assessment Model Adaptation for Tangible Products Industries

Ederson C Fernandes; Federal University of Technology of Parana, Brazil
Carla A Estorilio; Federal University of Technology of Parana, Brazil
Kazuo Hatakeyama; Polytechnic Institute of Bahia, Brazil

High industrial performance means a high level of maturity and a strong potential for continuous improvement. Among the models for measuring maturity, CMMI is considered one of the most influential, despite being created only for information technology. Regarding the demand for this type of evaluation by other industries and the lack of alternative models, this work develops the CMMI adaptation for the industry of tangible industrial products. Thus, a questionnaire composed of CMMI terms was submitted to 19 manufacturing practitioners and two academics so that it was possible to identify the terms that would require adaptation. The adaptation process required an extensive literature review, identification of non-comprehensible terms, glossary review, analysis of mind maps, and assistance from experts. Among the results, the paper presents a strategy for adapting a maturity model and a new model under the industrial terminology for manufacturing tangible products.

HA-01 PLENARY: PLENARY-5

DATE: THURSDAY, 7/27/2023
TIME: 08:30-10:00
ROOM: NUEVO LEON 3
CHAIR: DAVID GUEMES-CASTORENA; TECNOLOGICO DE MONTERREY

HA-01.1 [K] How to Innovate in a Fast Way in Companies of Excellence to Create New Economic Value and Competitive Advantages

Jaime Parada Avila; Former President of CONACYT, Mexico

Based on his recent book, Dr. J. Parada shares his vision about managing the investment in innovation to accelerate the economic growth and competitive advantages. This presentation describes the current innovation situation in Mexico, and the reasons to invest in innova-

Note: [R] = Research Paper; [A] = Industry Application; [K] = Keynote

tion for developing new products, services, solutions, processes, business models and new businesses with added value for clients and customers. The use of the INNCOM integrated innovation model with 8 components is explained. The 8 components are: (1) Value creation for all stake holders of the company, (2) Strategic plan for medium and long-term, (3) The innovation project portfolio, (4) The critical processes to integrate and execute innovation projects, (5) The core competences for innovation, (6) The organization and the governance, (7) The allocation of resources and investment for innovation, and (8) The creation of culture of innovation in the company. It is important to mention the critical role of the information systems and key indicators and metrics of success to evaluate the profitability of the investment in innovation in the enterprise. The role of open innovation ecosystems is important to reinforce the capabilities of the company to collaborate with external experts, universities, and public research centers.

HB-01 Educational Issues-2
Thursday, 7/27/2023, 10:30 - 12:00
Room: Nuevo Leon 3
Chair(s) Andres E Acero; Tecnologico de Monterrey

HB-01.1 [R] • Challenges in Establishing and Conducting International Research Endeavors: Issues to Administrative International Research Management

Mario G Beruvides; Texas Tech University, United States
Elizabeth Trejos-Castillo; Texas Tech University, United States

The importance of international research programs or formal dedicated endeavors to international research at the university, corporate, or governmental levels is rarely questioned. Research in the sciences, humanities, medicine, law, and social sciences rarely has borders. The issues on these matters do not pertain to problems of the value and validity of the research or the desire to conduct such international research ventures. Problems arise in the multitude and multifaceted barriers that conducting and managing such research creates. The open literature is flooded with articles on this subject from a plethora of research areas as diverse as nursing to atmospheric sciences and virtually any other subject imaginable. These challenges have been and are currently overcome at the individual project level. The problems compound when institutional plans to establish and coordinate international research endeavors are desired and established. Many universities understand the value of conducting international research and actively promote such ventures but find themselves at a loss on how best to establish, run and manage university-wide efforts. This research looks at the state-of-the-art review of the literature in focused institutional research endeavors and the challenges, barriers, best practices, and management opportunities to address this growing issue confronted by the modern research university.

HB-01.2 [R] • The Role of Public Universities as Determinants of Economic Growth in Mexico

Moises Alejandro Alarcon Osuna; Universidad de Guadalajara, Mexico

In this work, the patents generated and applied by public universities are studied as a determinant of economic growth. Although the growth economic models contemplate the generation of knowledge as a determinant of growth, it is also true that not all public universities have a vocation as generators of knowledge codified in patents, utility models or industrial designs. On the other hand, it is important to point out that there are different productive vocations in the different states, which could represent a differentiated effect of the innovative efforts of public universities. To study this phenomenon, the "Google Patents" patent database is used, in which the patents of Mexican public universities are searched for the period 2010-2020. These patent data are fed into a growth model, with accumulated effects. The results show a positive effect of the generation of patents on economic growth, without no conclusive evidence on the effect of university patents on economic growth. The results suggest that patent registration should be promoted as an essential activity of public universities, since this has long-term economic impacts on the well-being of the population.

HB-01.3 [A] • The Challenges of Augmented Reality for Higher Education in Spanish-speaking Countries

Regina de la Caridad Agramonte Rosell; Universidad Cientifica del Sur, Perú
Angie G Terrones Acosta; Universidad Científica del Sur, Peru
Kelly N Esteban Manco; Universidad Cientifica del Sur, Peru
Jesus L Ángel Oriundo; Universidad Cientifica del Sur, Peru

This systematic review of augmented reality in higher education answers the following question: What are the challenges of augmented reality in higher education in Spanish-speaking countries? The general objective is to identify the current challenges of augmented reality in higher education in Spanish-speaking countries. A bibliographic research method was carried out using the following keywords: augmented reality, higher education, AR; as well as Boolean search operators AND and OR. A total of 96 sources published in Scielo, Scopus, and WOS-indexed journals between 2018 and 2022 in English and Spanish were analyzed. It is concluded that augmented reality contributes to the achievement of learning outcomes and consequently, to the improvement of the quality of educational processes in higher education. However, there are different challenges, such as curricular, technological infrastructure, financial, and training challenges, among others, that require a change in institutional stance in order to improve teaching and learning processes in universities.

HB-02 Innovation Management-5
Thursday, 7/27/2023, 10:30 - 12:00
Room: Colima
Chair(s) Abraham Tijerina-Priego; Tecnologico de Monterrey

HB-02.1 [R] • Innovation Patterns: Lessons from the Mexican National Technology and Innovation Award

Alejandro Preciado Rábago; Qurio, Mexico
David Güemes-Castorena; Tecnologico de Monterrey, Mexico
Pedro García del Valle y Durán; Qurio, Mexico
Abraham Tijerina-Priego; Tecnologico de Monterrey, Mexico

The Mexican National Technology and Innovation Award was created in 1999 and was the best award of its kind in Mexico until 2020. This paper analyzes data from 500 organizations that participated in the Award to identify patterns. Four analyses were performed: (i) the lowest and highest average scores per indicator, (ii) the ranking of the indicators by the level of evaluation and impact on the overall rating; (iii) the ranking of the indicators with the greatest and the least differences in their score, and (iv) the ranking of the indicators with the most significant influence over the others. Each analysis presents differences and similarities between the global data, the organization, and the type of innovation. This study offers some critical insights into innovation motivators; for example, some indicators with the lowest score were environmental impact, own development, the integration of the management of technology system, and technology planning. In contrast, some indicators with the highest score were technological contribution, novelty, and differentiation. This study contributes to advancing the understanding of innovation practices.

HB-02.2 [R] • Domestically Interacted Scientists Drive Nanocarbon Applied Research in China

Noriyuki Higashide; University of Tokyo, Japan
Kimitaka Asatani; University of Tokyo, Japan
Ichiro Sakata; University of Tokyo, Japan

Scientific research generally progresses from basic to applied. Quantitatively identifying the stages of progression helps policymakers build consensus on funding in basic research by discovering the trend of research fields with high potential for practical use. Previously, quantitative evaluation of progression revealed that the nanocarbon applied research is flourishing especially in China post-2010. However, factors that can explain this progression still need to be determined. Here we elucidate the characteristics of the Chinese researchers involved in applied research. Using the large-scale article data, we calculated the share of nationalities of organizations to which scientist groups belonged pre- and post-2010 for

Chinese, U.S., and Japanese scientists. It is found that Chinese applied scientists have been conducting applied research domestically since pre-2010. The paper productivity, number of citations, and quantitative scores of "appliedness" for each scientist are also compared by country, suggesting that Chinese applied scientists are less active in academic achievement. As factors behind China's rapid progress in applied research, the presence of scientists who have been working in a specific applied field for a long time and their strong interest in industry rather than academic achievement are suggested. These peculiarities of China's research environment extracted from large-scale data can help policymakers design the environments to progress in specific science and technology fields.

HB-02.3 [R] • Application of Big Data Strategies for Process Improvement in Healthcare

Ngaka N Mosia; University of South Africa, South Africa

Public health care delivery is dynamic due to the growth in health care science and research in health care delivery systems. The rise in the application of the Internet of Things devices led to an unprecedented increase in data generated. The level of data produced within a healthcare system is insurmountably very high and large and that has generated a greater need to begin applying big data analytics strategies and methods to establish data and information quality. Process optimization and productivity improvement in healthcare service delivery pivots prominently on the quality of information available within the system. Thus, in a process of increasing throughput and reducing patient cycle time throughout the patient journey in a hospital, there is a desperate need for the application of intelligent tools for accuracy and believability assurance in information generated for management decision making. This paper describes a process improvement event achieved through the application of big data strategies in the patient affairs and data management faculty of a public hospital. In the research a data-driven approach to patient information management is adopted and data capturing is transformed from a paper-based to paper-less system. A qualitative research approach is adopted in the case study.

HB-04 Knowledge Management-2
Thursday, 7/27/2023, 10:30 - 12:00
Room: Guerrero
Chair(s) Charles Weber; Portland State University

HB-04.1 [R] • Talent Management and Organizational Learning within the Knowledge Transfer Process of Human Space Technology Development

Kouichi Morimoto; Tokyo Institute of Technology, Japan
Masako Ikegami; Tokyo Institute of Technology, Japan
Taro Sugihara; Tokyo Institute of Technology, Japan

In terms of space development, Japan established its national space agency about 10 years after NASA in the U.S., and has long been engaged in catch-up type research and development (R&D). This paper provides a qualitative case study of the difficulties in knowledge transfer from the U.S. to Japan within the field of human space technology. Additionally, this paper covers how the national space agency overcame these difficulties and further improved its R&D capabilities by internalizing knowledge, and it also examines the process from two perspectives: the learnings of the organization and those of the individual researchers and engineers. This study focused on human factors from human space technologies and knowledge transfer between organizations. It was conceivable that establishing a knowledge transfer practice in a public research institute would be possible, and there are few research cases. Practical research in terms of human resource deployment and organizational learning was also conducted. As a result, a characteristic knowledge transfer relationship was found between knowledge intermediaries and a unique appointment pattern of professionals in public research institutions.

HB-04.2 [R] • Innovating Together: What Influences the Willingness to Share Specific Knowledge as a Member of an Innovation Team?

Diana Heinbucher; Chemnitz University of Technology, Germany

Based on the finding that the higher the quality of Shared Mental Models (SMM) is, the higher the team's innovativeness, this study aims to research which individual constructs affect the willingness to share and exchange special knowledge and specific information during the team creativity process. In a quantitative setting (N=11 teams, 57 master class students), the correlation of creative self-efficacy and creative personal identity [1; 2], collective self-esteem [3; 4], team identification [5; 6] and the willingness to contribute specific knowledge during the team process is researched. In the end, a structural equation model (SEM) shows the correlation of the mentioned constructs. The SEM shows that the used constructs influence the willingness to bring in one's specific knowledge into the team process. Team Identification shows the most decisive influence on Knowledge Exchange and from Knowledge Exchange to SMM. This study focuses on knowledge management in the light of creativity and innovation, elaborating that knowledge sharing is essential for the team's success in finding an innovative solution through creative solution processes and that the characteristics of SMM affect teamwork, team creativity, and team processes. Consequently, an appropriate interaction within the team is needed to promote knowledge-sharing and creative processes and foster the rise of collective self-esteem at the individual level and team identification.

HB-04.3 [R] • Human-centric Digital Twin Focused on 'Gen-Ba' Knowledge: Conceptual Model and Examples by Smart Voice Messaging System

Naoshi Uchihira; Japan Advanced Institute of Science and Technology, Japan
Takuichi Nishimura; Japan Advanced Institute of Science and Technology, Japan
Koki Ijuin; Japan Advanced Institute of Science and Technology, Japan

In recent years, companies and society have undergone a rapid digital transformation, and "digital twin" is the key technology for utilizing various information and knowledge in both physical and cyber spaces. However, sensor data that can be collected by IoT (Internet of Things) is only a small aspect of physical space. In particular, in on-site human working fields, such as nursing care, agriculture, manufacturing, maintenance, and inspection (we call them "Gen-Ba"), there exists a vast amount of knowledge ("Gen-Ba knowledge") that humans possess and cannot be captured by IoT sensors. Since Gen-Ba knowledge includes not only explicit but also latent and tacit knowledge, it has been difficult to utilize it in cyberspace, and there is still a large gap between the two spaces in the digital twin. This study aims to make it possible to capture, systematize, and utilize the vast amount of Gen-Ba knowledge in the human-centric digital twin. The smart voice messaging system (SVM), which has been used for ten years in actual fields, can be used to capture Gen-Ba knowledge. This study proposes a conceptual model of a human-centric digital twin with a focus on Gen-Ba knowledge according to several experiments of real-world applications of SVM.

HB-05 Entrepreneurship & Intrapreneurship-2
Thursday, 7/27/2023, 10:30 - 12:00
Room: Jalisco
Chair(s) Ching-Yan Wu; National Tsing Hua University

HB-05.1 [R] • Growth of Startups: A Complex Adaptive System View

Ching-Yan Wu; National Tsing Hua University, Taiwan
Che-Yu Hsu; National Tsing Hua University, Taiwan

The importance of entrepreneurs' contributions to society and economy has attracted many extensive researches on entrepreneurship-related issues. Although scholars have studied the startups in all respects, they have mostly inspected them from a single-level perspective. Therefore, this study intends to take a holistic view; it adopts the Complex Adaptive System theory to explore the whole picture of the evolvement of startups. Semi-structured interviews were conducted to the case studies of three types of startups: market-based, technology-based, and laboratory-based, as well as the entrepreneurial intermediary organizations (accelerators). The study reports five major findings. First, the motivation to start a venture often comes from the entrepreneurs' ability to find a space in the market. Second, in the process of growth, both individuals and teams of startups will continue to self-organize and evolve with the environment. Third, the startups and the accelerators will have the effects of recycling and recirculating resources. Fourth, there will be a "tagging" behavior among the startup teams,

the accelerators, and the investors. Finally, regardless of the type of startups, the interaction with the environment is a complex process of adaptation that varies according to their own circumstances.

HB-05.2 [R] • A Technological Landscape for Frugal Inventions in China

Andre Herzberg; University of Bremen, Germany
Fynn Hildebrand; University of Bremen, Germany
Martin G. Moehrle; University of Bremen, Germany

Today frugal innovations play an important role especially for Asian countries like China or India. These innovations are characterized by the concentration on a product´s core functions, thereby lowering production costs. Frugal innovations are preceded by frugal inventions, which can be identified in patents. Particularly in the wake of China's major initiative to stimulate patenting, there is a chance to obtain a significant number of hits in the search for such patents. In order to map the technological landscape of frugal inventions in China, we make use of an already tested frugal thesaurus for the search. Our results show that frugal inventions focus on the improvement of everyday living conditions, being concentrated in areas such as heating or agriculture. Furthermore, patent applicants are primarily individuals residing in China and searching for protection of their inventions in that country. From this, two consequences arise for patenting companies from outside China: First, they need to perform a thorough patent search before entering the Chinese market. Second, it is possible for them to use Chinese inventions abroad without paying license fees.

HD-01 PANEL: PICMET '23 Debrief and Future PICMET Planning
Thursday, 7/27/2023, 14:00 - 15:30
Room: Nuevo Leon 3
Panelist(s) Fayez Alsoubaie; Portland State University
Timothy R Anderson; Portland State University
Angel Contreras-Cruz; Portland State University
David Guemes-Castorena; Tecnologico de Monterrey
Dundar F Kocaoglu; Portland State University
Nasir Sheikh; Portland State University
Charles M Weber; Portland State University

We invite the entire PICMET community to join us for this interactive session. The PICMET Organizing Committee will be present to hear feedback about this year's conference and discuss future PICMET conferences.

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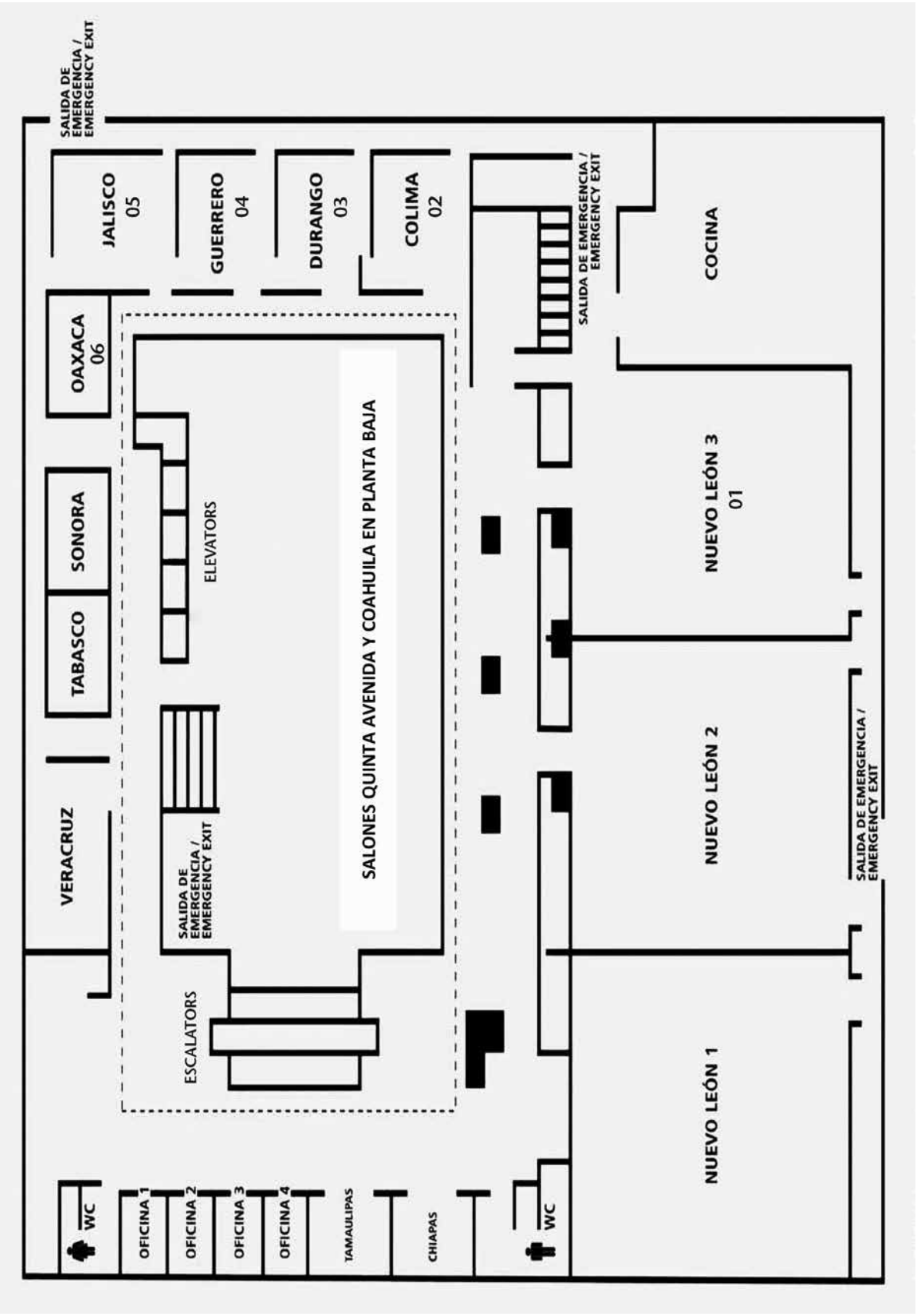
Hotel Floor Layout



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Thursday, July 27, 2023
14:00-15:30
Nuevo Leon 3

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