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PICMET ’19

Dear PICMET Guests:

We are pleased to welcome you to the PICMET ’19 Conference.

The general theme of PICMET ’19 is “Technology Management in the World of Intelligent Systems.” Artificial intelligence, robotics, autonomous cars, drones, the IoT (Internet of Things), and the applications of these intelligent technologies to nanomaterials, energy, medicine and other industries are rapidly changing the world we live in. The future of society, economy and industry will be radically different from the present. If we manage these transformative technological changes, we can create an unprecedented economic growth, cure the “incurable” diseases and stabilize the environmental ecosystem. If we cannot manage them properly, we could end up being slaves to technology. Proper technology management includes the management of not only the technical system, but also the economic, environmental, social, political, legal, ethical and regulatory aspects of technology.

The theme is woven into the keynote speeches and several papers, but the Conference is not limited to it. Every aspect of technology management is addressed in the presentations.

There are eight keynote speeches:

Monday:
Mr. John R. McDougall, Former President, National Research Council, Canada, “Artificial Intelligence – Confronting the Ethical Dilemmas”

Dr. Melanie Mitchell, Portland State University, USA, “Artificial Intelligence and the Barrier of Meaning”

Tuesday:
Dr. Henry W. Chesbrough, UC Berkeley-Haas School of Business, USA, “Open Innovation Results”

Dr. Ann Majchrzak, University of Southern California, USA, “Open Innovation: How to Use AI to Enhance the Crowd’s Ability to Offer Innovative Strategic Directions for Firms and Society”

Wednesday:
Dr. Tao-ming Cheng, Chaoyang University of Technology (CYUT), Taiwan, “Emerging Trends in Technology Research Management in Taiwan”

Ms. Mandy J. Mock, VP Information Technology Group, Intel Corporation, USA, “Data is Future”

Thursday:
Dr. Bulent Atalay, University of Mary Washington and the University of Virginia, USA, “Polymaths and Accelerated Intelligence”

Dr. Gregory A. Daneke, Professor Emeritus, Arizona State University, USA, “Automacene Rising: Managing the Social & Economics Consequences of Advanced Information Technologies”

PICMET ’19 received 456 submissions from authors representing more than 200 academic institutions, industrial corporations and government agencies in 44 countries. After a double-blind refereeing process, 200 papers were included in the conference. The referees were from around the world.

The PICMET ’19 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 38 sections, listed below. Each section contains several papers on the topic.

- **Technology Management Framework**
- **Strategic Management of Technology**
- **Science and Technology Policy**
- **Science and Technology Communication**
- **Collaborations for Technology Management**
- **Artificial Intelligence for Technology Mgmt.**
- **Environmental Issues**
- **Cultural Issues**
- **Educational Issues**
- **Convergence of Technologies**
- **Decision Making**
- **Emerging Technologies**
- **Internet of Things (IoT)**
- **Social Media**
- **E-Business**
- **Entrepreneurship/Intrapreneurship**
- **Intellectual Property**
- **Social Innovation**
- **Project/Program Management**
- **Innovation Management**
- **R&D Management**

PICMET ’19

- **New Product Development**
- **System Design**
- **Manufacturing Management**
- **Supply Chain Management**
- **Enterprise Management**
- **Information/Knowledge Management**
- **Technology Forecasting**
- **Technology Roadmapping**
- **Technology Assessment and Evaluation**
- **Technology Acquisition and Adoption**
- **Technology Marketing**
- **Technology Transfer**
- **Technology Mgmt. in the Energy Sector**
- **Technology Mgmt. in the Health Sector**
- **Technology Mgmt. in Biotechnology Industry**
- **Technology Mgmt. in Automotive Industry**
- **Technology Mgmt. in Transportation Industry**

A large number of colleagues around the world contributed to the success of the PICMET ’19 Conference.

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

Ann White, as the Executive Director Emeritus, edited the *Bulletin* and prepared the front-end materials; Liono Setiowijoso, as the Director of Operations, designed, maintained and managed the information systems and PICMET web site, with Hakan Kutgun’s assistance, under the guidance of PICMET CIO Bob Martin, and formatted the papers for the *Proceedings*; Byung Sung Yoon, as the former Executive Director and Conference Coordinator, coordinated the overall planning of the conference. Hakan Kutgun, as the new Executive Director, provided support throughout the planning and registration process; Scott Schaffer, as the Legal Counsel, provided continuous legal advice. Timothy Anderson was the Chief Technical Officer, Kiyoshi Niwa and Dilek Cetindamar Kozanoglu were Co-Directors of International Activities, Charles Weber was the Director of Awards, and Antonie Jetter was the Director of Student Activities. Amir Shaygan managed registrations and Songphon Munkongsujarit coordinated on-site activities; Pei Zhang managed documentation and A/V equipment; Ahmed Alibage prepared the signage; and Jeff Birndorf developed graphic arts for the conference. Antonie Jetter chaired the Student Paper Award Committee, whose members Hongyi Chen, Jonathan Ho, Nathasit Gerdsri, and Dong-Joon Lim evaluated more than 30 papers nominated for the award. Hakan Kutgun managed the PICMET page on LinkedIn.

Timothy Anderson, Kiyoshi Niwa, Dilek Cetindamar Kozanoglu and Harm-Jan Steenhuis conducted the review process for the papers as Associate Editors; 100 colleagues from around the world reviewed up to 10 papers each. Papers submitted to PICMET ’19 were reviewed by two or more reviewers to assure high quality. Timothy Anderson did the scheduling of the accepted papers for presentation at the conference. Amir Shaygan, Fayez Alsoubaie, Saeed Alzahrani, Husam Barham, Maoloud Dabab, Abdulhakim Giadedi, Rafaa Khalifa and Pei Zhang were the Editorial Assistants to check and verify that the finalized papers had been revised as recommended by the reviewers.

Elizabeth Aubrey and Sherri Young of IEEE worked with PICMET from the beginning to the end of the conference planning effort. Their 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 International Advisory Council provided advice and counsel for PICMET to provide leadership on addressing the strategic issues and critical directions of Technology Management.

The sponsors and supporters of PICMET ’19 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, Maseeh College of Engineering and Computer Science, Portland State University Office of Information Technology, and WHOVA Event Management.

We believe the PICMET ’19 *Bulletin* and *Proceedings* contain some of the best knowledge available on Technology Management for addressing the challenges and opportunities of technological entrepreneurship. We hope they will contribute to the success of technology managers and emerging technology managers, worldwide.

~ Dundar F. Kocaoglu, President and CEO

PICMET ’19

DEDICATION

PICMET ’19 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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ADVISORY COUNCIL

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

PICMET ’19

PANEL OF REVIEWERS

Papers submitted to PICMET conferences are subjected to a double-blind review process. Each paper included in the PICMET ’19 conference was reviewed by two or more members of the Panel of Reviewers to assure a very high quality. This year’s panel had 100 members from around the world. They are listed below in alphabetical order by last name.

Hitoshi Abe
Mark Ahn
Jose Albors-Garrigos
Fahad Aldhaban
Joe Amadi-Echendu
Masami Asai
Elif Baktir
Sule Balkan
Bridget Barnes
Caroline Benton
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Antonie de Klerk
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Alptekin Durmusoglu
William (Ike) Eisenhauer
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Rainer Hasenauer
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Martin Hoegl
Paul Hong
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Marthinus Pretorius
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Ichiro Sakata
Leonardo Santiago
Yuriko Sawatani
Günther Schuh
Takehisa Seino
Shintaro Sengoku
Wonchul Seo
Marko Seppänen
Nasir Sheikh
Kunio Shirahada
Nathalie Sick
Nermin Sokmen
Woodie Spivey
Frank Steiner
Fang-Pei Su
Yalcin Tanes
Alfred Thal, Jr.
Harald Throne-Holst
Andreas Udbye
Cornelis van Waveren
Thanaphol Virasa
Wayne Wakeland
Ming-Yeu Wang
Yuichi Washida
Charles Weber
Man Hang Yip

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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

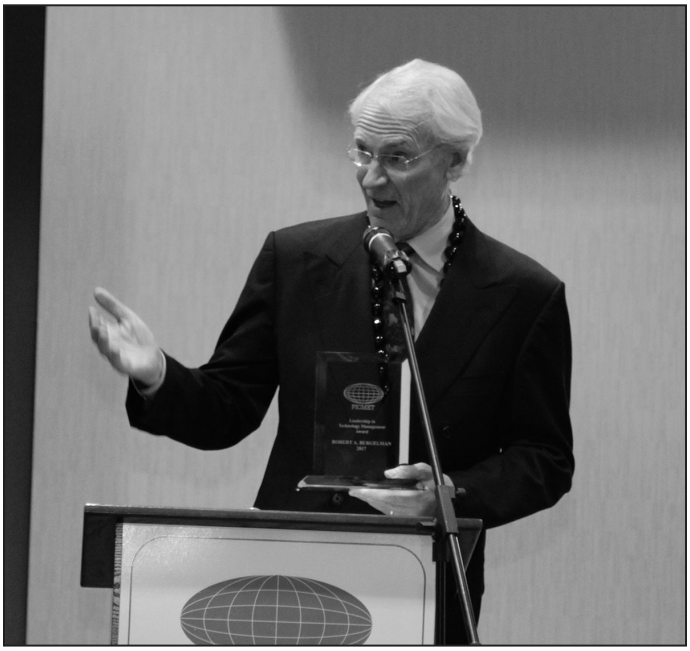
2007
Dr. Harold A. Linstone, Editor-in-chief, Technological Forecasting and Social Change, University Professor Emeritus, Systems Science, Portland State University, USA
Dr. Yoshio Nishi, Director of Research of the Stanford Center for Integrated Systems, Director of the Stanford

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

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

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.

PICMET ’19

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

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

STUDENT PAPER AWARD

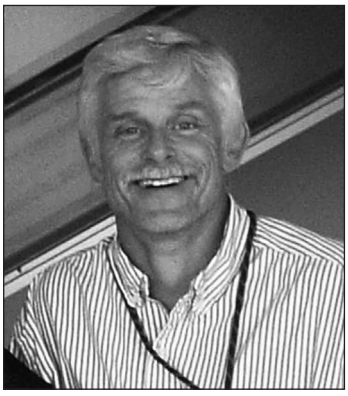
PICMET NAMES ITS OUTSTANDING STUDENT PAPER AWARD

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, 2018. 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.

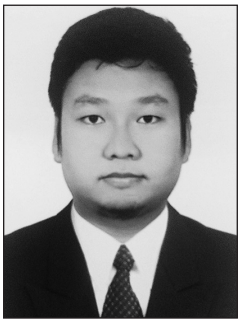
Brad was promoted to Principal Engineer in 2006 and was vested with the informal authority of Chief Technical Officer for the USB Implementers Forum.

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
Wisuwat Wannamakok

ADVISOR & CO-AUTHOR
Dr. Yu-Yu Chang

UNIVERSITY
Southern Taiwan University of Science & Technology

PAPER TITLE
"Understanding Social Entrepreneurial Intentions: Entrepreneurship Education, Academic Major, and Planned Behaviors"

ABSTRACT

This study draws upon the theory of planned behavior to empirically test a model which clarifies the relationships between attitude toward behavior, subjective norm, and perceived behavioral control and university students' social entrepreneurial intentions as well as revealing the moderating role of entrepreneurship education and academic major. Through multiple linear regression analysis, we tested our hypotheses on a sample of 832 college students (342 from three universities in Taiwan and 490 from four universities in Thailand). Results indicate that all aspects of the theory of planned behavior have a positive and significant impact on social entrepreneurial intentions. More interestingly, the positive effects of attitude toward behavior and perceived behavioral control on social entrepreneurship intention are strengthened when students attend entrepreneurship programs at university and have a non-business major. On the basis of three-way interaction analysis, our findings suggest that college students' social entrepreneurship intention is at the highest level when non-business major students have a favorable attitude towards behavior, perceive a strong behavioral control, and receive entrepreneurial education. This paper sheds new lights on the behavioral mechanisms that determine students' intention to engage in social enterprises. The theoretical contributions and practical implications for educational policy are discussed.

Medal of Excellence

Initiated at PICMET '04 in Seoul, Korea, the Medal of Excellence award is given for extraordinary achievements of individuals in any discipline for their outstanding contributions to science, engineering and technology management.

PICMET '19 AWARDEES

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

Dr. Greg Daneke is Professor Emeritus in the W.P. Carey School of Business, Arizona State University, and has also been affiliated with The Centre for Policy Research on Science and Technology at Simon Fraser University in Vancouver, BC. He has held other faculty posts, including Virginia Tech, University of Michigan, and Stanford University. He has also advised government agencies, including the Army Corps of Engineers, Department of Energy, Office of Technology Assessment, and he was a Senior Fellow at General Accounting Office, as well as serving on a White House Task Force. He has been a consultant to multinational as well as start-up firms and has also provided pro bono consulting to various indigenous nations and international NGOs. He is the author of over 100 scholarly publications.

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. Ann Majchrzak is the Associates of USC Chair of Business Administration for the Marshall School of Business at the University of Southern California. She is a Professor of Digital Innovation in the Department of Data Sciences and Operations. She is a Senior Scholar and Fellow of the Association for Information Systems, awarded for "making an outstanding contribution to the I.S. discipline in research, teaching, and service." She has been a member of three National Research Council committees. She publishes in top academic (*Management Science, Organization Science, Information Systems Research, MIS Quarterly*) as well as top practitioner journals (*Harvard Business Review, Sloan Management Review, California Management Review*). She has held concurrent appointments as a research mentor and visiting professor at Esade Business School, Ramon Llull University, Barcelona; Department of Business and Management at LUISS University, Rome, in the areas of Innovation and Organization; and Stevens Institute of Technology. She is also an external expert for the Information Systems and Innovation Group, Department of Management, at the London School of Economics. She has received funding from the National Science Foundation and a range of other agencies. She has published several books, including *Human Side of Factory Automation, Human Side of CAD,* and *Methods for Policy Research*. Her research interests center on ways to improve TOP-integration (where TOP stands for Technology-Organization-People Integration). She is the founder of TOP Integration, Inc., and TOP-Modeler, a decision support tool to help firms design and implement new manufacturing technologies in their facilities. She partners with organizations for all of her research, looking for interesting challenges to TOP integration. She has studied TOP integration for flexible manufacturing cells, computer-aided design, virtual collaboration for innovation, blockchain, and crowd-based collaboration for innovation with a range of companies including Boeing, Rocketdyne, Hyperloop Transportation Technologies, Inc., Digital Equipment Corporation, General Motors, Optum, JPL, HP, Cummins, etc. She has a new book coming out in Fall 2019 currently titled: *Unconstraining Crowds: Innovating Solutions to Wicked Business and Societal Problems*.

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

Dr. Melanie Mitchell is Professor of Computer Science at Portland State University and External Professor and Member of the Science Board at the Santa Fe Institute. She attended Brown University, where she majored in mathematics and did research in astronomy, and the University of Michigan, where she received a Ph.D. in computer science. Her dissertation, in collaboration with her advisor Douglas Hofstadter, was the development of Copycat, a computer program that makes analogies. Dr. Mitchell has held faculty or professional positions at the University of Michigan, the Santa Fe Institute, Los Alamos National Laboratory, the OGI School of Science and Engineering, and Portland State University. She is the author or editor of six books and numerous scholarly papers in the fields of artificial intelligence, cognitive science, and complex systems. Dr. Mitchell's book *Complexity: A Guided Tour* (Oxford University Press) won the 2010 Phi Beta Kappa Science Book Award and was named by Amazon.com as one of the ten best science books of 2009. Her latest book, *Artificial Intelligence: A Guide for Thinking Humans*, will be published by Farrar, Straus, and Giroux in 2019. Dr. Mitchell originated the Santa Fe Institute's Complexity Explorer platform, which offers online courses and other educational resources related to the field of complex systems. Her online course "Introduction to Complexity" has been taken by over 25,000 students and is one of Course Central's "top fifty online courses of all time."

LTM AWARDS

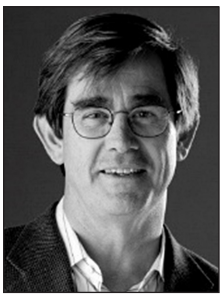
The PICMET Leadership in Technology Management (LTM) Award recognizes and honors individuals who have provided leadership in managing technology by establishing a vision, providing a strategic direction, and facilitating the implementation strategies for that vision.

PICMET '19 AWARDEES

Dr. Tao-ming Cheng
President, Chaoyang University of Technology (CYUT), Taiwan

Dr. Tao-ming Cheng currently is the President of Chaoyang University of Technology (CYUT), Taiwan, and a Professor at the Department of Construction Engineering. He received his Ph.D. in 1996 from the School of Civil Engineering, Purdue University, USA. His research interests include construction ergonomics, construction operations modeling and higher education management. Professor Cheng is the Arbitrator of the Republic of China (ROC). He serves as a Chairman of Accreditation in IEET and is a member of several committees such as Engineering Education Certification; TAC Accreditation; and Higher Education Accreditation and Supervision. Professor Cheng has published more than 100 research articles in indexed journals and conferences in the last decade. He mentors the *International Journal of Applied Science and Technology* (Scopus) and also reviews papers for several SCI journals.

Dr. Henry W. Chesbrough
Professor and Faculty Director, Garwood Center for Corporate Innovation, UC Berkeley-Haas School of Business, USA



Dr. Henry Chesbrough iis best known as "the father of Open Innovation." He is Professor and Faculty Director at Garwood Center for Corporate Innovation and teaches at the Haas School of Business at the University of California-Berkeley. He is also a professor of Information Systems at Esade Business School.

Dr. Chesbrough has written books such as *Open Innovation* (Harvard Business School Press, 2003), *Open Business Model*s (Harvard Business School Press, 2006), and *Open Services Innovation* (Jossey-Bass, 2011). He has been recognized as one of the leading business thinkers by Thinkers50. He received an Innovation Luminary award from the European Commission and Intel in 2014. He also received the Industrial Research Institute Medal of Achievement in 2017 and has two honorary doctorates.

Ms. Mandy J. Mock
VP Information Technology Group, Intel Corporation, USA

Ms. Mandy J. Mock is a vice president in the Information Technology group and serves as the general manager of product engineering solutions at Intel Corporation. She leads the product engineering solutions IT team, which provides Intel's product development teams with innovative IT solutions and support for greater efficiency and faster design and production cycles. Ms. Mock has held leadership positions in Intel's IT group since 2010, capping a two-decade career at the company. Before assuming her current role in 2016, she spent two years as director of financial information systems, leading the team charged with providing IT solutions for Intel's Finance organization. She joined the IT group as director of flex services, a business unit that provides burst capacity resources for software development to Intel's product teams. She joined Intel in 1995 after receiving her bachelor's degree in electrical and computer engineering and French from Carnegie Mellon University. She went on to earn a master's degree in computer science from the Oregon Graduate Institute of Science and Technology and her MBA degree from the Kenan–Flagler Business School at the University of North Carolina at Chapel Hill.

Fellow Awards

The PICMET Fellow award recognizes outstanding contributions to the development and growth of the Engineering and Technology Management discipline.

PICMET '19 AWARDEES

Dr. Barry Bozeman
Regents' Professor and Arizona Centennial Professor, Science and Technology Policy and Public Management, Arizona State University, USA

Dr. Barry Bozeman is Regents' Professor, Arizona Centennial Professor of Public Management and Technology Policy and Director of the Center for Organization Research and Design. Previous positions include Regents' Professor and Ander Crenshaw Endowed Chair of Public Policy, University of Georgia; Regents' Professor of Public Policy at Georgia Tech and Professor of Public Administration, Law and Affiliate Professor of Engineering at Syracuse University where he was founding director of the Maxwell School's founding director of the Center for Technology and Information Policy. Dr. Bozeman has had visiting appointments at University of Michigan, Columbia University, University of Copenhagen, and Universite Marne-La-Valle (Paris Est).

Bozeman's practitioner experience includes a position at the National Science Foundation's Division of Information Technology and a visiting position at the Science and Technology Agency's (Japan) National Institute of Science and Technology Policy. Bozeman has served as a consultant to a variety of federal and state agencies in the United States, including the Internal Revenue Service, the Department of Commerce, the National Science Foundation and the Department of Energy. He has helped in the design and evaluation of the national innovation systems of the Republic of South Africa, Canada, New Zealand, France, Israel, Chile, and Argentina. He is a member of the scientific council of the Institut Francilien Recherche, Innovation et Société (France).

Dr. Dilek Cetindamar Kozanoglu
Associate Professor, School of Information, Systems and Modelling, Faculty of Engineering and IT, University of Technology Sydney, Australia

Dr. Dilek Cetindamar Kozanoglu received her B. S. degree from Industrial Engineering Department at Bogazici University, her M.A degree from Economics Department at BU, and her Ph.D. degree from the Management Department at Istanbul Technical University. Before her appointment to the School of Systems, Management and Leadership in the Faculty of Engineering and IT at the University of Technology Sydney (UTS) in 2017, she worked at Bogazici University, Case Western Reserve University (USA), Portland State University (USA), Chalmers University of Technology (Sweden), and Sabanci University (Turkey). She was at Cambridge University, UK and MIT, USA as a visiting professor in 2008 and 2014 respectively. She participated in many international projects, including UN and EU projects. She has more than 80 publications, including 38 papers published in various international journals and nine books. She received an "encouragement award" from the Turkish Academy of Sciences in 2003 and best book award from International Association for Management of Technology in 2012. Her main interest and research topics are digital transformations, entrepreneurship, and technology and innovation management. She has served in various administrative roles. After being the Director of Competitiveness Center during the period of 2008-11, she became founding Director of the Entrepreneurship Center at Sabanci University, which she directed from 2012-2017. She joined UTS as the director of the Masters of Business and Technology.

Dr. Jonathan D. Linton
Professor and Chair, Operations and Technology Management, University of Sheffield, Sheffield, United Kingdom

Dr. Jonathan D. Linton is best known for his international interdisciplinary work at the interface of engineering, science and management and as the Editor-in-Chief of *Technovation: The Journal of Technological Innovation Entrepreneurship and Technology Management*. Prior to joining Sheffield University Management School, he was the Power Corporation Professor at the University of Ottawa. He is also a former faculty member of the Lally School of Management, Rensselaer Polytechnic University and the Tandon School of Engineering, New York University. Jonathan holds undergraduates in materials engineering and biology from Western University in Ontario and an MBA and PhD from the Schulich School of Business, York University. He is the foreign head of the Science Technology Studies Laboratory at the Higher School of Economics, Moscow, and a registered Professional Engineer.

Dr. Dietmar Theis
Honorary Professor, Flat Panel Display Technology, Technical University Munich, Germany

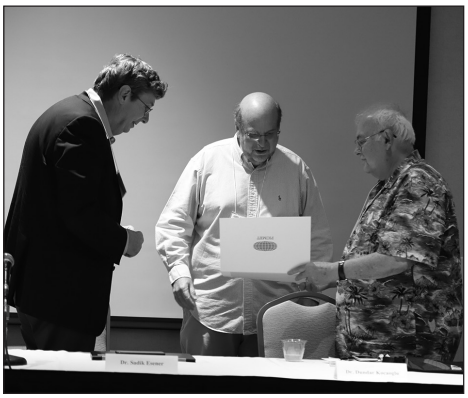
Dr. Dietmar Theis completed his high school education in 1964 at the German High School in Istanbul/Turkey. He subsequently studied physics at TU Berlin, finishing

Fellow Awards

in 1970. Until 1976 he worked as a research assistant at the Institute for Solid State Physics at TU Berlin. During this time, he worked on his doctoral thesis on the optical properties of solids. In 1977 Professor Theis joined the Corporate Research and Development Division of Siemens AG to work on projects in the field of optoelectronics and power electronics. From 1990 until his retirement in 2008 he steadily moved towards management in the areas of research policy, research marketing, international university collaboration and represented Siemens on political science advisory boards. He also advised the Siemens Managing Board on these issues. Together with colleagues from the Corporate Communications Department, he published the *Siemens Research and Innovation* magazine for more than 10 years. He has been lecturing on optoelectronic displays and flat panels at TUM since 1997.

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.



General Information

CONFERENCE FOCUS

Artificial intelligence, robotics, autonomous cars, drones, the Internet of Things (IoT), and the applications of these intelligent technologies to nanomaterials, energy, medicine and other industries are rapidly changing the world we live in. The future of society, economy and industry will be radically different from the present. If we manage these transformative technological changes, we can create an unprecedented economic growth, cure the "incurable" diseases and stabilize the environmental ecosystem. If we cannot manage them properly, we could end up being slaves to technology. Proper technology management includes the management of not only the technical system, but also the economic, environmental, social, political, legal, ethical and regulatory aspects of technology.

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 critical role to play in the proper 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 '19 Conference explores the role of technology management in the world of intelligent systems.

It is our expectation that PICMET will encourage researchers to engage in significant scholarly work in responding to the world's needs for managing effective technological entrepreneurship in the years to come.

WHO SHOULD ATTEND

Following the PICMET tradition, this high-impact conference will set the stage for innovation management for decades to come. The world's leading experts from academic institutions, industrial corporations and government agencies will participate in the discussions. PICMET '19 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
- vStudents 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 '19 program consists of

- Ph.D. Colloquium, "Getting Your PhD….and Beyond: Critical Stages and Career Paths for the Ph.D. Student," Sunday, August 25, 13:00 - 17:00, Galleria III (across from Grand Ballroom on the Ballroom level)
- Plenary sessions by global leaders from industrial corporations, academic institutions and government agencies in the Grand Ballroom I (Ballroom Level)
- Three special meetings:
  1. Panel of Editors Lunch Meeting for the reviewers of papers submitted to PICMET conferences, Monday, August 26, 12:00-14:00, Skyline I Room (23rd Floor)
  2. Country Representatives Lunch Meeting for the current PICMET Country Representatives and those who are interested in becoming Country Representatives, Wednesday, August 28, 12:00-14:00, Skyline I Room (23rd Floor).
  3. PICMET '19 Debriefing and PICMET '20 Planning Session for everybody who would like to discuss strategies for future PICMET conferences, Thursday, August 29, 14:00-15:30, Grand Ballroom I (Ballroom Level).
- 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

There will be two publications at PICMET '19:

- The "Bulletin" containing the conference schedule and abstracts of each presentation

General Information

- The "Proceedings" containing all of the papers on a USB drive.

The publications will be available to PICMET '19 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 the site visit or other events 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 and site visit are 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: Grand Ballroom I 02: Galleria I 03: Galleria II 04: Galleria III 05: Parlor C 06: Parlor B 07: Parlor A 08: Forum 09: Council 10: Directors 11: Studio

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 Parlor C.

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.

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.

General Information

- Allow about five minutes for questions from the audience after your presentation.

AUDIO/VISUAL EQUIPMENT

Boardroom West Room on the 3rd Floor is designated as the Authors' Room. The authors can work there with their laptops anytime they wish to do so.

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 USA electric port if your connection port is different. You can get more information and tips at http://www.usatourist.com/english/traveltips/electric-power-tips.html.

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

WIRELESS ACCESS

Wireless access will be available on the Ballroom level and in the Authors' Room.

PICMET VOLUNTEERS

PICMET Volunteers wearing white 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.

CITY OF ROSES

GETTING AROUND PORTLAND

Portland's public transportation system includes MAX (Metropolitan Area Express) light rail, Tri-Met buses, and the Portland Streetcar. Tickets are interchangeable among the three and can be purchased aboard buses or from ticket machines along the MAX or Streetcar lines. Fares are $2.50, less for seniors ("honored citizens"), the disabled and youths.

Complete information about Portland's public transportation system is available at http://trimet.org.

AIRPORT TRANSPORTATION

The pickup area for taxis and town cars is located at the center section of the airport terminal's lower roadway on the baggage claim and departure level. Most transportation providers serve downtown Portland, which is approximately 20-40 minutes from Portland International Airport, depending on traffic.

If you are traveling light and do not mind walking two blocks, you can board the MAX (Metropolitan Area Express, http://trimet.org) Red Line on the baggage claim level of the Portland International Airport (follow the signs to MAX Light Rail). Get off the train at the Pioneer Square stop (between 6th Ave. and Broadway) in downtown Portland and walk two blocks south on 6th Avenue to the Hilton Portland Downtown (921 SW 6th Ave., Portland, Oregon). Tickets are $2.50 and can be purchased at the ticket machine inside the airport close to the MAX line.

CLIMATE

The temperature in Portland generally varies between 56oF (13o C) in the evening to 80 o F (27o C) during the day in July/August in Portland. The low humidity makes summer months very pleasant and comfortable. You may need a sweater or light jacket in the evening.

GRATUITIES

Informally known as tipping, in the United States gratuities are voluntary. Tips are rewarded for services performed (gratitude) and are a supplement to an employee's income.

Following are recommended gratuities:

- For your hotel stay: housekeeping, $3 to $5 per day; bellman, $2 to $3 per bag; and discretionary for above and beyond services provided for you.
- For a taxi ride: 10 – 15 percent of the fare.
- For restaurant service: 15 – 20 percent of your total bill.

TRAVEL OREGON

Portland, otherwise known as "The City of Roses," is a robust and vibrant city with endless things to see and do. Music, food and art festivals abound throughout the city during the summer months. Museums, art galleries, unique retail shops, and restaurants of all varieties are within walking distance of the Portland Hilton Downtown.

The State of Oregon is famous for its award-winning wineries and golf courses, as well as its breathtaking coastline, rivers and mountains. We hope you will venture out and experience Portland and the surrounding countryside while you are in Oregon.

Following is a sampling of local events and destinations while you are visiting. For a complete list of all that Oregon has to offer, visit www.travelportland.com.

Downtown Portland and the Willamette River

PORTLAND EVENTS

Noon Tunes Summer Concert Series

Since 2002, Pioneer Courthouse Square has celebrated summer with a free lunchtime concert every Tuesday in July and August. The popular Noon Tunes Concert Series showcases the best in regional and local musical talent. On August 27th Soul Impression will perform *(Tuesdays, July & August; Pioneer Courthouse Square, 701 SW 6th Avenue, Portland, Oregon; 12:00-13:00; free)*

Oregon Zoo Summer Concerts

It wouldn't be summer in Oregon without an evening of great music at the zoo's annual summer series. On Sunday, August 25th, Amos Lee will perform. *(Oregon Zoo, 4001 SW Canyon Road, Portland, Oregon; for schedule and ticket prices visit www.zooconcerts.com)*

City of Roses

Portland Farmers Market
This market, located at Portland State University, attracts a large crowd of people seeking the finest and freshest produce from local farmers as well as breads, cheese, flowers and more. *(South Park Blocks between SW Hall & SW Montgomery, Portland, Oregon; 08:30 - 14:00; Saturdays only)*

Portland Saturday Market
Stroll down row upon row of local handcrafted items and homemade foods. The Portland Saturday Market—open Sundays too—is the nation's largest open-air craft market. Talk directly to the artists and learn about their creative styles and products. *(2 SW Naito Parkway, Portland, Oregon; Saturdays 10:00-17:00; Sundays 11:00-16:30; www.portlandsaturdaymarket.com)*

Portland Timbers Soccer
Major League Soccer team the Portland Timbers will host the Seattle Sounders on August 23rd and Real Salt Lake on August 31st at Providence Park. *(Providence Park, 1844 SW Morrison, Portland, Oregon; for schedule and ticket information visit www.portlandtimbers.com)*

Portland Timbers Soccer

PORTLAND ATTRACTIONS

Art Galleries
The Pearl District, loosely bordered by W. Burnside and NW Hoyt, and NW 13th and NW Park, represents a good share of the gallery arena. Galleries can also be found in fairly concentrated numbers in the Skidmore District (roughly between Front and Fourth Aves. from SW Oak to NW Glisan St.) and the city's downtown core.

Lan Su Chinese Garden
Located in Portland's historic Old Town Chinatown, Lan Su ("Garden of Awakening Orchids") Chinese Garden is one of Portland's greatest treasures and most interesting sites to see while visiting Portland. A result of a collaboration between the cities of Portland and Suzhou, our sister city in China's Jiangsu province that is famous for its beautiful Ming Dynasty gardens, Lan Su was built by Chinese artisans from Suzhou and is the most authentic Chinese garden outside of China. Much more than just a beautiful botanical garden, Lan Su is a creative wonder—a powerfully inspiring experience based on a 2,000-year-old Chinese tradition that melds art, architecture, design and nature in perfect harmony. Once inside the garden's walls, you will feel as if you have traveled through time to another era in a faraway world. Lan Su is a window into Chinese culture, history and way of thinking. Ever changing, Lan Su always has something new to offer - by the minute, by the hour, and with the seasons. *(239 NW Everett Street, Portland, Oregon; hours: 10:00—19:00; admission, $12.95; www.lansugarden.org/)*

Lan Su Chinese Garden

Oregon Historical Society
In the heart of Portland's Cultural District, the Oregon Historical Society houses treasures of the Northwest, a priceless collection that tells the story of Oregon from its earliest people to the present day. Exhibits are designed for visitors of all ages, with artwork, artifacts, photographs, audio/visual presentations and hands-on displays for children. The Oregon Historical Society Museum Store is Portland's premier spot for distinctive Northwest gifts, including jewelry, artwork, books and games. *(1200 S.W. Park Avenue, Portland, Oregon; Museum Store: S.W. Broadway at Madison; for hours and admission charge visit www.ohs.org)*

City of Roses

Oregon Museum of Science and Industry (OMSI)
Imagine a place where you can journey to the outer reaches of the galaxy, feel the power of an earthquake, climb aboard a real submarine, uncover a fossil, enter the world of virtual reality, or travel the globe in a five-story high IMAX® domed theater. With more than 200 interactive exhibits and labs, there is something for everyone in the family. Touch, explore, question and discover at the Oregon Museum of Science and Industry (OMSI), located on Portland's waterfront. Open year-round; hours vary. *(1945 S.E. Water Avenue, Portland, Oregon; www.omsi.edu)*

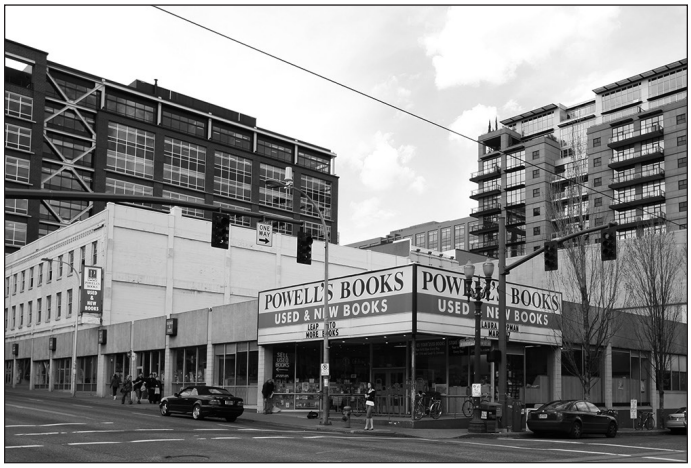
Pittock Mansion
Experience the charm of a lost era as you learn about Henry and Georgiana Pittock and the beautiful estate that symbolizes the growth of Portland. Admire remarkable antique furnishings and fine arts set in a 1914 National Historic Register property. Pack a picnic basket and enjoy a sweeping view of mountains, rivers and the city. *(3229 N.W. Pittock Drive, Portland, Oregon; for hours and admission charge visit www.pittockmansion.org)*

Portland Art Museum
Find out why the oldest museum in the Northwest, the Portland Art Museum, is internationally renowned for exciting art experiences. Located in the heart of downtown's cultural district, the Museum's campus includes an outdoor sculpture court and historical interiors. Tour the world and travel through history in magnificent permanent collection galleries, six stories of modern art and special exhibitions. *(1219 S.W. Park Avenue, Portland, Oregon; phone: 503 226-2811; for hours and admission charge visit www.portlandartmuseum.org)*

Portland Spirit
The Portland Spirit welcomes you aboard the Northwest's premier dining ship. Daily lunch and dinner cruises on the Willamette River offer a perfect opportunity to surround yourself with unmatched views of the Portland skyline. Freshly prepared cuisine, full-service bars and live entertainment complete a river experience unlike any other. *(www.portlandspirit.com)*

Portland Walking Tours
Portland Walking Tours is the #1 ranked attraction and tour in Portland. These fun and award-winning tours explore the excitement, history, food, architecture, neighborhoods, bridges, parks, fountains, artwork, and just plain weird places in Portland, Oregon. Join the award-winning, leisurely walks with no hills and discover what guests and the media are talking about. *(www.portlandwalkingtours.com)*

Powell's City of Books
More than just a bookstore, Powell's is a Portland institution. The largest independently owned bookstore in the country, Powell's has more than one million volumes of new, used, rare and out of print books and covers a city block. Powell's map helps guide browsers from one room to the next. *(1005 W. Burnside; www.powells.com/locations/powells-city-of-books)*



Powell's City of Books

Tom McCall Waterfront Park
It is hard to believe that this stretch along the Willamette River was once a busy expressway. Rather than impatient motorists, the park is now occupied with new types of movers—joggers, bikers and rollerbladers, as well as pedestrians in the mood for nothing more energetic than a stroll. Waterfront Park is taken up during the warmer months with cultural and musical events, as well as overheated folks hoping to cool off in the Salmon Street Springs Fountain at the east end of S.W. Salmon St. *(Naito Parkway between S.W. Harrison St. and N.W. Glisan St., Portland, Oregon)*

Washington Park
Washington Park is not only one of Portland's most beautiful sights, it also contains many of the city's favorite haunts. Lying within the park's expansive boundaries are not only the requisite children's play area, tennis courts and picnic areas, but also wonderful surprises such as the Oregon Zoo, Japanese Garden, World Forestry Center, Hoyt Arboretum and the International Rose Test Gardens. Washington Park has its own MAX (Metropolitan Area Express) stop, which lets you off right at the zoo entrance (at the Pioneer Square stop, take the west-bound Red Line or Blue Line trains marked "Beaverton" or "Hillsboro"). After the train ride, hop on and off the Washington Park

City of Roses

shuttle, which is free and loops around to Park attractions. Read on for more information about these attractions. *(http://explorewashingtonpark.org/#)*

Oregon Zoo
Trek through the tropics amid the sounds of birds, monkeys and other creatures. You're not in West Africa; you're in Portland at the zoo's African Rain Forest exhibit. After you've survived the steamy tropics, dry off in the savanna, where giraffes, rhinos and hippos graze. From the tundras of Alaska to the coastal waters of Peru, travel around the world in an afternoon. Five minutes from downtown on Hwy. 26 West, or take MAX light rail. *(Washington Park, 4001 S.W. Canyon Road, Portland, Oregon; for hours and admission price visit www.oregonzoo.org)*

Japanese Garden
Nestled in the scenic west hills of Portland, the Japanese Garden is a haven of tranquil beauty which has been proclaimed one of the most authentic Japanese gardens outside of Japan. Encompassing five and one-half acres and offering five separate garden styles, the Garden includes an authentic Japanese Tea House, meandering streams, intimate walkways, and an unsurpassed view of Mt. Hood. *(Washington Park, 611 SW Kingston Avenue, Portland, Oregon; for hours and admission price visit www.japanesegarden.com)*

Japanese Garden

World Forestry Center
All new hands-on, interactive exhibits that are fun for the whole family are waiting to be explored at the Discovery Museum. You can get harnessed in and hoisted up 45 feet to see a bird's-eye-view of the forest, or take a wet-free raft ride in Class IV rapids. Climb underneath the forest to see the life below, or try your smoke jumping skills! Round out your adventure with video journeys to Siberia, China, South Africa and Brazil to learn about trees of the world. Come explore, discover and grow at the Discovery Museum! Five minutes from downtown Portland via Hwy. 26 or MAX light rail. *(Washington Park, Washington Park, 4033 S.W. Canyon Road, Portland, Oregon; for hours and admission price, visit www.worldforestry.org)*

Hoyt Arboretum

Hoyt Arboretum
Hoyt Arboretum is a much beloved Portland open space, covering 185 ridge top acres about two miles west of downtown. It is home to a collection of trees representing more than 1,100 species gathered from around the world. Twelve miles of trails wind through this living exhibit. The Visitor Center, at the heart of the Arboretum, offers maps, trail guides, and information. Spiraling up the southwest corner of the arboretum is the Vietnam Veterans' Living Memorial, which honors Oregonians who died or are still missing from that conflict. *(Washington Park, 4000 SW Fairview Blvd., Portland, Oregon; http://www.hoytarboretum.org/)*

International Rose Test Garden
Whether you want to take in spectacular scenery or the luscious smell of fragrant roses, the International Rose Test Garden offers both. Approximately 10,000 plants, among which are more than 400 varieties of roses, flourish high above a breathtaking city view. Established in 1917, the International Rose Test Garden is the oldest

operating test garden in the country. Admission is free year-round.. *(Washington Park, 400 SW Kingston Avenue, Portland, Oregon)*

Willamette Jetboat Excursions
See Portland's waterfront and more aboard the Willamette Jetboats. Enjoy the area's sights, history and scenic beauty while experiencing the fun and excitement found only in a jet boat. See giant ships, bridges, elegant riverfront homes, historic Oregon City and the majestic Willamette Falls. Reservations are highly recommended. *(1945 SE Water Avenue, OMSI Submarine Dock, Portland, Oregon; www.willamettejet.com)*

SHOPPING

From shop-lined streets to expansive malls, you'll find great spots for tax-free shopping all around town.

Downtown Portland
In the heart of downtown, you will find Pioneer Place – four city blocks filled with shopping, dining and entertainment. *(700 SW Fifth Avenue, Portland, Oregon; www.pioneerplace.com)*

Nordstrom department store is adjacent to Pioneer Square, and specialty shops are scattered throughout downtown Portland.

Northwest/Alphabet District
This district's main streets (Northwest 23rd and 21st Avenues) are packed with boutiques selling Portland-designed clothing and housewares.

Northwest 23rd Ave in the Alphabet District

Pearl District
You can sample haute couture and hot cuisine in Portland's Pearl District, which has quickly become the place to see and be seen. The Pearl is composed of 50 city blocks of industrial warehouses turned into sleek loft apartments, cutting-edge art galleries and vibrant international restaurants. Though the neighborhood features outstanding brewpubs, delicious international cuisine and the world's largest independent bookstore, the soul of the Pearl is in its galleries. *(www.explorethepearl.com)*

Portland's Mall Scene
Bridgeport Village offers an exclusive mix of local, regional and national shops unlike any other shopping experience in Oregon. *(7455 SW Bridgeport Rd., Tigard, Oregon; www.bridgeport-village.com)*

Columbia Gorge Premium Outlets has your favorite brands at significant savings. The center's 45 stores include Adidas, Carter's, Eddie Bauer, G.H. Bass & Co. - Footwear, Gap Outlet, Jones New York, OshKosh B'gosh, Tommy Hilfiger, Van Heusen and more. Columbia Gorge Premium Outlets is located just 15 minutes east of downtown Portland. *(Take I-84 east to Exit 17; 450 NW 257th Way, Troutdale, Oregon; http://shopcolumbiagorgeoutlets.com/)*

The nation's first major mall, Lloyd Center offers some 200 specialty shops in addition to familiar anchors. An ice rink offers entertainment.. *(Bordered by Multnomah and Broadway, 9th and 15th Streets; www.lloydcenter.com)*

Washington Square pulls shoppers into its many specialty shops with the help of several popular anchor stores. *(9585 SW Washington Square Road, Portland, Oregon; www.shopwashingtonsquare.com)*

Woodburn Premium Outlets, Oregon's largest outlet center, features 114 shops including Adidas, Banana Republic Factory Store, Calvin Klein, Eddie Bauer, J. Crew, and Polo Ralph Lauren Factory Store to name a few. *(I-5 South at the Woodburn/Hwy 214 exit; 1001 North Arney Road, Woodburn, Oregon; http://www.factoryoutletstores.info/oregon/woodburn-company-stores.html)*

Social Events

To facilitate the informal interaction of the participants, several social events have been scheduled during PICMET '19.

RECEPTION/BUFFET

DATE: SUNDAY, AUGUST 25
TIME: 19:00-22:00
ROOM: GRAND BALLROOM I, HILTON PORTLAND HOTEL
DRESS: INFORMAL

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

"CULTURAL" DINNER

DATE: MONDAY, AUGUST 26
TIME: 19:00-22:00
ROOM: GRAND BALLROOM I, HILTON PORTLAND HOTEL
DRESS: INFORMAL

Enjoy a savory buffet and a special performance of Brazilian music by Portland's own Bloco Alegria while you mingle and network with colleagues. Included in the regular registration fee.*

AWARDS BANQUET

DATE: TUESDAY, AUGUST 27
TIME: 18:30-19:00
IN THE BALLROOM LOBBY
BANQUET: 19:00-22:00
ROOM: GRAND BALLROOM I, HILTON PORTLAND HOTEL
DRESS: BUSINESS ATTIRE

This is the premier social event of the conference. The PICMET '19 Leadership in Technology Management, Medal of Excellence, Fellow, 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.

Other Events

IEEE – TECHNOLOGY ENGINEERING MANAGEMENT SOCIETY (TEMS) ICE CREAM SOCIAL

DATE: WEDNESDAY, AUGUST 28
TIME: 18:00-19:30
ROOM: GALLERIA II (BALLROOM LEVEL)

SPEAKER:
Dr. Martin Hoegl, Ludwig-Maximilians-Universität München, Germany

"Lost in Collaboration: Making Multi-cultural Teams Work"

Martin Hoegl is professor at Ludwig-Maximilians-Universität München (Munich, Germany), where he heads the Institute for Leadership and Organization. Before joining LMU Munich, he served on the faculties of Washington State Univ. (USA), Bocconi Univ. (Milan, Italy), and WHU (Vallendar, Germany). His main research interests include leadership, collaboration, and innovation in organizations. He has published in the *Academy of Management Journal*, *Decision Sciences*, *Human Relations*, *Human Resource Management*, *Journal of Business Ethics*, *Journal of International Business Studies*, *Journal of Management*, *Journal of Management Studies*, *Journal of Product Innovation Management*, *MIT Sloan Management Review*, *Organization Science*, *Research Policy*, *The Leadership Quarterly*, and other journals.

WALKING TOUR OF PSU AND ETM

DATE: THURSDAY, AUGUST 29
TIME: 15:30
PLACE: MEET AT REGISTRATION DESK

The Portland State University campus and ETM Department is a 1 KM walk from the Hilton. PICMET attendees up for a little walking are invited to take this free, informal walking tour led by Tim Anderson. We will meet immediately after the scheduled end of the PICMET '19 Debrief session at the registration desk area. We will walk through the Portland Park Blocks, past the PSU Bookstore, and visit the ETM Department.

Site Visits

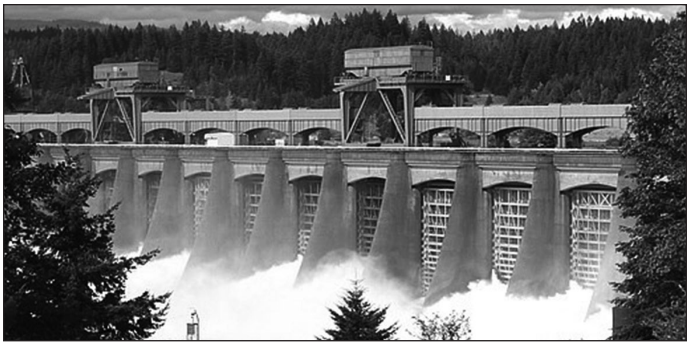
The following site visits are offered during PICMET '19. Seating is limited, so sign up early. The registration fee is $75 for each site visit.

The times below include the commute. The return time is approximate and will depend on traffic.

BONNEVILLE LOCK AND DAM

MONDAY, AUGUST 26, 14:00-17:00

Located in Oregon's Columba River Gorge National Scenic Area 40 miles east of Portland, Bonneville Lock and Dam spans the Columbia River and is designated as a National Historic Landmark. President Franklin D. Roosevelt dedicated Bonneville Lock and Dam in 1937. The U.S. Army Corps of Engineers built this "public works project" during the Great Depression of the 1930s to put people back to work, generate power, and improve navigation on the Columbia River. Soon after, more generators were added to provide energy for building ships and aircraft during World War II.



In later years, the addition of a second powerhouse doubled electrical output. Bonneville can provide the power needs for 900,000 Northwest homes. A second lock replaced the original lock in 1993. Bonneville is part of a series of locks on the Columbia-Snake waterway allowing vessels to transport people and valuable commodities 465 miles (748 km) from the Pacific Ocean to Lewiston, Idaho.

On both sides of the dam you may view the inside of a massive powerhouse. During spring, summer, and fall, view migrating salmon as they swim past windows in the fish ladder. Visitor centers include films and displays about salmon, hydropower, and river navigation.

This site visit includes a guided tour (approximately one hour) providing a full overview of dam operations, including the fish ladders and a walk through of the entire dam. After the tour, attendees will be taken to the Bonneville Fish Hatchery for a self-guided tour (approximately 45 minutes). Bonneville Hatchery was first named "Central Hatchery" and was built in 1909. The hatchery raises 6.6 million fall Chinook, 900,000 spring Chinook, 750,000 Coho, 250,000 summer Steelhead and 60,000 winter Steelhead salmon. Adult salmon begin arriving at the hatchery in September and are then sorted through before spawning begins. Spawning begins during the last week in October and continues until the beginning of December. As part of their natural life cycle, all Pacific Northwest Salmon die after spawning. There are also at least 40 different species of birds to view at Bonneville Fish Hatchery.

It is recommended that you wear comfortable walking shoes for this tour. Purses are permitted during your visit to the dam; however, backpacks must be left on the bus.

More information – Bonneville Lock:
https://www.nwp.usace.army.mil/bonneville/

More information – Bonneville Hatchery:
https://www.dfw.state.or.us/resources/visitors/bonneville_hatchery_more.asp

3D SYSTEMS

WEDNESDAY, AUGUST 28, 14:00-17:00

The 3D Systems Wilsonville, Oregon, site comprises a team of printer development and systems engineers, materials scientists and chemists who were formerly Xerox's respected solid ink engineering and development teams. Joining 3D Systems in 2014, they immediately added significant state-of-the-art development and testing labs

to 3D Systems as well as over 100 engineers and technical support staff to work on the next generation of inkjet-based 3D printers. On this tour you will see work areas along with the above noted labs and prototype build facilities.

For more information: https://www.3dsystems.com/

TECHNICAL PROGRAM

PROGRAM OVERVIEW

The PICMET ’19 technical program consists of 76 sessions including 4 plenaries, 3 special sessions, 1 panel, 1 tutorial, and 67 paper sessions.

The plenaries are scheduled from 08:30 to 10:00 every morning, Monday, August 26, through Thursday, August 29, in Ballroom I on the Ballroom Level. 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 ’19 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 7 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 ’19.

Daily Schedules

MONDAY, AUGUST 26, 2019

	01 Grand Ballroom I	02 Galleria I	03 Galleria II	04 Galleria III	05 Parlor C	06 Parlor B	07 Parlor A
MA 08:30-10:00	Plenary - 1						
MB 10:30-12:00		Entrepreneurship / Intrapreneurship	System Design	Artificial Intelligence for Technology Managment-1	Technology Forecasting	Educational Issues	Social Media
MC 12:00-14:00	**LUNCH**						
MD 14:00-15:30	Strategic Management of Technology-1	E-Business	Convergence of Technologies	Artificial Intelligence for Technology Management-2	Technology Roadmapping-1	Decision Making-1	Cultural Issues-1
ME 16:00-17:30	Strategic Management of Technology-2	Innovation Management-1	Emerging Technologies	New Product Development	Technology Roadmapping-2	Decision Making-2	Cultural Issues-2

TUESDAY, AUGUST 27, 2019

	01 Grand Ballroom I	02 Galleria I	03 Galleria II	04 Galleria III	05 Parlor C	06 Parlor B	07 Parlor A
TA 08:30-10:00	Plenary - 2						
TB 10:30-12:00	Strategic Management of Technology-3	Innovation Management-2	TUTORIAL: Open Source Tools for ETM Teaching and Research	Internet of Things (IoT)	Technology Acquisition & Adoption-1	Intellectual Property-1	Technology Management Framework
TC 12:00-14:00	**LUNCH**						
TD 14:00-15:30	Strategic Management of Technology-4	Information/ Knowledge Management	Technology Management in the Biotechnology Sector-1	Artificial Intelligence for Technology Management-3	Technology Transfer	Intellectual Property-2	Collaborations-1
TE 16:00-17:30	Strategic Management of Technology-5	Innovation Management-3	Technology Management in the Biotechnology Sector-2		Technology Marketing	Intellectual Property-3	Collaborations-2

Daily Schedules

WEDNESDAY, AUGUST 28, 2019

	01 Grand Ballroom I	02 Galleria I	03 Galleria II	04 Galleria III	05 Parlor C	06 Parlor B	07 Parlor A
WA 08:30-10:00	Plenary - 3						
WB 10:30-12:00	Meet the Editors		Technology Management in the Health Sector-1	Artificial Intelligence for Technology Management-4	Technology Assessment & Evaluation-1	Science & Technology Policy-1	Technology Management in the Transportation Sector
WC 12:00-14:00	**LUNCH**						
WD 14:00-15:30	Strategic Management of Technology-6	Innovation Management-4	Technology Management in the Health Sector-2	Social Innovation	Technology Assessment & Evaluation-2	Science & Technology Policy-2	Technology Management in the Automotive Sector-1
WE 16:00-17:30	Strategic Management of Technology-7	R&D Management	Technology Management in the Health Sector-3	Information/ Communication Technologies		Supply Chain Management	Technology Management in the Automotive Sector-2

THURSDAY, AUGUST 29, 2019

	01 Grand Ballroom I	02 Galleria I	03 Galleria II	04 Galleria III	05 Parlor C	06 Parlor B	07 Parlor A
HA 08:30-10:00	Plenary - 4						
HB 10:30-12:00	Sustainability	Enterprise Management	Project / Program Management	Science and Technology Communication	Technology Acquisition & Adoption-3	Science & Technology Policy-3	Technology Management Framework
HC 12:00-14:00	**LUNCH**						
HD 14:00-15:30	PICMET '19 Debrief and Future PICMET Planning						

SCHEDULE OF SESSIONS

SCHEDULE OF SESSIONS BY DATE

MONDAY, AUGUST 26, 2019

Session	Number	Day	Time	Room	Session Title
MA	01	Monday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 1"
MB	02	Monday	10:30 - 12:00	Galleria I	"Entrepreneurship/ Intrapreneurship"
MB	03	Monday	10:30 - 12:00	Galleria II	"System Design"
MB	04	Monday	10:30 - 12:00	Galleria III	"Artificial Intelligence for Technology Management-1"
MB	05	Monday	10:30 - 12:00	Parlor C	"Technology Forecasting"
MB	06	Monday	10:30 - 12:00	Parlor B	"Educational Issues"
MB	07	Monday	10:30 - 12:00	Parlor A	"Social Media"
MD	01	Monday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-1"
MD	02	Monday	14:00 - 15:30	Galleria I	"E-Business"
MD	03	Monday	14:00 - 15:30	Galleria II	"Convergence of Technologies"
MD	04	Monday	14:00 - 15:30	Galleria III	"Artificial Intelligence for Technology Management-2"
MD	05	Monday	14:00 - 15:30	Parlor C	"Technology Roadmapping-1"
MD	06	Monday	14:00 - 15:30	Parlor B	"Decision Making-1"
MD	07	Monday	14:00 - 15:30	Parlor A	"Cultural Issues-1"
ME	01	Monday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-2"
ME	02	Monday	16:00 - 17:30	Galleria I	"Innovation Management-1"
ME	03	Monday	16:00 - 17:30	Galleria II	"Emerging Technologies"
ME	04	Monday	16:00 - 17:30	Galleria III	"New Product Development"
ME	05	Monday	16:00 - 17:30	Parlor C	"Technology Roadmapping-2"
ME	06	Monday	16:00 - 17:30	Parlor B	"Decision Making-2"
ME	07	Monday	16:00 - 17:30	Parlor A	"Cultural Issues-2"

TUESDAY, AUGUST 27, 2019

TA	01	Tuesday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 2"
TB	01	Tuesday	10:30 - 12:00	Grand Ballroom I	"Strategic Management of Technology-3"
TB	02	Tuesday	10:30 - 12:00	Galleria I	"Innovation Management-2"
TB	03	Tuesday	10:30 - 12:00	Galleria II	TUTORIAL: "Open Source Tools for ETM Teaching and Research"
TB	04	Tuesday	10:30 - 12:00	Galleria III	"Internet of Things (IoT)"
TB	05	Tuesday	10:30 - 12:00	Parlor C	"Technology Acquisition & Adoption-1"
TB	06	Tuesday	10:30 - 12:00	Parlor B	"Intellectual Property-1"
TB	07	Tuesday	10:30 - 12:00	Parlor A	"Technology Management Framework"
TD	01	Tuesday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-4"
TD	02	Tuesday	14:00 - 15:30	Galleria I	"Information/ Knowledge Management"
TD	03	Tuesday	14:00 - 15:30	Galleria II	"Technology Management in the Biotechnology Sector-1"

SCHEDULE OF SESSIONS

TD	04	Tuesday	14:00 - 15:30	Galleria III	"Artificial Intelligence for Technology Management-3"
TD	05	Tuesday	14:00 - 15:30	Parlor C	"Technology Transfer"
TD	06	Tuesday	14:00 - 15:30	Parlor B	"Intellectual Property-2"
TD	07	Tuesday	14:00 - 15:30	Parlor A	"Collaborations-1"
TE	01	Tuesday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-5"
TE	02	Tuesday	16:00 - 17:30	Galleria I	"Innovation Management-3"
TE	03	Tuesday	16:00 - 17:30	Galleria II	"Technology Management in the Biotechnology Sector-2"
TE	05	Tuesday	16:00 - 17:30	Parlor C	"Technology Marketing"
TE	06	Tuesday	16:00 - 17:30	Parlor B	"Intellectual Property-3"
TE	07	Tuesday	16:00 - 17:30	Parlor A	"Collaborations-2"

WEDNESDAY, AUGUST 28, 2019

WA	01	Wednesday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 3"
WB	01	Wednesday	10:30 - 12:00	Grand Ballroom I	PANEL: "Meet the Editors"
WB	03	Wednesday	10:30 - 12:00	Galleria II	"Technology Management in the Health Sector-1"
WB	04	Wednesday	10:30 - 12:00	Galleria III	"Artificial Intelligence for Technology Management-4"
WB	05	Wednesday	10:30 - 12:00	Parlor C	"Technology Assessment & Evaluation-1"
WB	06	Wednesday	10:30 - 12:00	Parlor B	"Science & Technology Policy-1"
WB	07	Wednesday	10:30 - 12:00	Parlor A	"Technology Management in the Transportation Sector"
WD	01	Wednesday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-6"
WD	02	Wednesday	14:00 - 15:30	Galleria I	"Innovation Management-4"
WD	03	Wednesday	14:00 - 15:30	Galleria II	"Technology Management in the Health Sector-2"
WD	04	Wednesday	14:00 - 15:30	Galleria III	"Social Innovation"
WD	05	Wednesday	14:00 - 15:30	Parlor C	"Technology Assessment & Evaluation-2"
WD	06	Wednesday	14:00 - 15:30	Parlor B	"Science & Technology Policy-2"
WD	07	Wednesday	14:00 - 15:30	Parlor A	"Technology Management in the Automotive Sector-1"
WE	01	Wednesday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-7"
WE	02	Wednesday	16:00 - 17:30	Galleria I	"R&D Management"
WE	03	Wednesday	16:00 - 17:30	Galleria II	"Technology Management in the Health Sector-3"
WE	04	Wednesday	16:00 - 17:30	Galleria III	"Information/ Communication Technologies"
WE	06	Wednesday	16:00 - 17:30	Parlor B	"Supply Chain Management"
WE	07	Wednesday	16:00 - 17:30	Parlor A	"Technology Management in the Automotive Sector-2"

THURSDAY, AUGUST 29, 2019

HA	01	Thursday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 4"
HB	01	Thursday	10:30 - 12:00	Grand Ballroom I	"Sustainability"
HB	02	Thursday	10:30 - 12:00	Galleria I	"Enterprise Management"

Schedule of Sessions

HB	03	Thursday	10:30 - 12:00	Galleria II	“Project/Program Management”
HB	04	Thursday	10:30 - 12:00	Galleria III	“Science and Technology Communication”
HB	05	Thursday	10:30 - 12:00	Parlor C	“Technology Acquisition & Adoption-3”
HB	06	Thursday	10:30 - 12:00	Parlor B	“Science & Technology Policy-3”
HD	01	Thursday	14:00 - 15:30	Grand Ballroom I	PANEL: “PICMET ’19 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	Grand Ballroom I	PLENARY: "PLENARY - 1"
MD	01	Monday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-1"
ME	01	Monday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-2"
TA	01	Tuesday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 2"
TB	01	Tuesday	10:30 - 12:00	Grand Ballroom I	"Strategic Management of Technology-3"
TD	01	Tuesday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-4"
TE	01	Tuesday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-5"
WA	01	Wednesday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 3"
WB	01	Wednesday	10:30 - 12:00	Grand Ballroom I	PANEL: "Meet the Editors"
WD	01	Wednesday	14:00 - 15:30	Grand Ballroom I	"Strategic Management of Technology-6"
WE	01	Wednesday	16:00 - 17:30	Grand Ballroom I	"Strategic Management of Technology-7"
HA	01	Thursday	08:30 - 10:00	Grand Ballroom I	PLENARY: "PLENARY - 4"
HB	01	Thursday	10:30 - 12:00	Grand Ballroom I	"Sustainability"
HD	01	Thursday	14:00 - 15:30	Grand Ballroom I	PANEL: "PICMET '19 Debrief and Future PICMET Planning"
MB	02	Monday	10:30 - 12:00	Galleria I	"Entrepreneurship/ Intrapreneurship"
MD	02	Monday	14:00 - 15:30	Galleria I	"E-Business"
ME	02	Monday	16:00 - 17:30	Galleria I	"Innovation Management-1"
TB	02	Tuesday	10:30 - 12:00	Galleria I	"Innovation Management-2"
TD	02	Tuesday	14:00 - 15:30	Galleria I	"Information/ Knowledge Management"
TE	02	Tuesday	16:00 - 17:30	Galleria I	"Innovation Management-3"
WD	02	Wednesday	14:00 - 15:30	Galleria I	"Innovation Management-4"
WE	02	Wednesday	16:00 - 17:30	Galleria I	"R&D Management"
HB	02	Thursday	10:30 - 12:00	Galleria I	"Enterprise Management"
MB	03	Monday	10:30 - 12:00	Galleria II	"System Design"
MD	03	Monday	14:00 - 15:30	Galleria II	"Convergence of Technologies"
ME	03	Monday	16:00 - 17:30	Galleria II	"Emerging Technologies"
TB	03	Tuesday	10:30 - 12:00	Galleria II	TUTORIAL: "Open Source Tools for ETM Teaching and Research"
TD	03	Tuesday	14:00 - 15:30	Galleria II	"Technology Management in the Biotechnology Sector-1"
TE	03	Tuesday	16:00 - 17:30	Galleria II	"Technology Management in the Biotechnology Sector-2"
WB	03	Wednesday	10:30 - 12:00	Galleria II	"Technology Management in the Health Sector-1"
WD	03	Wednesday	14:00 - 15:30	Galleria II	"Technology Management in the Health Sector-2"
WE	03	Wednesday	16:00 - 17:30	Galleria II	"Technology Management in the Health Sector-3"
HB	03	Thursday	10:30 - 12:00	Galleria II	"Project/Program Management"

Schedule of Sessions

MB	04	Monday	10:30 - 12:00	Galleria III	“Artificial Intelligence for Technology Management-1”
MD	04	Monday	14:00 - 15:30	Galleria III	“Artificial Intelligence for Technology Management-2”
ME	04	Monday	16:00 - 17:30	Galleria III	“New Product Development”
TB	04	Tuesday	10:30 - 12:00	Galleria III	“Internet of Things (IoT)”
TD	04	Tuesday	14:00 - 15:30	Galleria III	“Artificial Intelligence for Technology Management-3”
WB	04	Wednesday	10:30 - 12:00	Galleria III	“Artificial Intelligence for Technology Management-4”
WD	04	Wednesday	14:00 - 15:30	Galleria III	“Social Innovation”
WE	04	Wednesday	16:00 - 17:30	Galleria III	“Information/ Communication Technologies”
HB	04	Thursday	10:30 - 12:00	Galleria III	“Science and Technology Communication”
MB	05	Monday	10:30 - 12:00	Parlor C	“Technology Forecasting”
MD	05	Monday	14:00 - 15:30	Parlor C	“Technology Roadmapping-1”
ME	05	Monday	16:00 - 17:30	Parlor C	“Technology Roadmapping-2”
TB	05	Tuesday	10:30 - 12:00	Parlor C	“Technology Acquisition & Adoption-1”
TD	05	Tuesday	14:00 - 15:30	Parlor C	“Technology Transfer”
TE	05	Tuesday	16:00 - 17:30	Parlor C	“Technology Marketing”
WB	05	Wednesday	10:30 - 12:00	Parlor C	“Technology Assessment & Evaluation-1”
WD	05	Wednesday	14:00 - 15:30	Parlor C	“Technology Assessment & Evaluation-2”
HB	05	Thursday	10:30 - 12:00	Parlor C	“Technology Acquisition & Adoption-3”
MB	06	Monday	10:30 - 12:00	Parlor B	“Educational Issues”
MD	06	Monday	14:00 - 15:30	Parlor B	“Decision Making-1”
ME	06	Monday	16:00 - 17:30	Parlor B	“Decision Making-2”
TB	06	Tuesday	10:30 - 12:00	Parlor B	“Intellectual Property-1”
TD	06	Tuesday	14:00 - 15:30	Parlor B	“Intellectual Property-2”
TE	06	Tuesday	16:00 - 17:30	Parlor B	“Intellectual Property-3”
WB	06	Wednesday	10:30 - 12:00	Parlor B	“Science & Technology Policy-1”
WD	06	Wednesday	14:00 - 15:30	Parlor B	“Science & Technology Policy-2”
WE	06	Wednesday	16:00 - 17:30	Parlor B	“Supply Chain Management”
HB	06	Thursday	10:30 - 12:00	Parlor B	“Science & Technology Policy-3”
MB	07	Monday	10:30 - 12:00	Parlor A	“Social Media”
MD	07	Monday	14:00 - 15:30	Parlor A	“Cultural Issues-1”
ME	07	Monday	16:00 - 17:30	Parlor A	“Cultural Issues-2”
TB	07	Tuesday	10:30 - 12:00	Parlor A	“Technology Management Framework”
TD	07	Tuesday	14:00 - 15:30	Parlor A	“Collaborations-1”
TE	07	Tuesday	16:00 - 17:30	Parlor A	“Collaborations-2”
WB	07	Wednesday	10:30 - 12:00	Parlor A	“Technology Management in the Transportation Sector”
WD	07	Wednesday	14:00 - 15:30	Parlor A	“Technology Management in the Automotive Sector-1”
WE	07	Wednesday	16:00 - 17:30	Parlor A	“Technology Management in the Automotive Sector-2”

Personal Schedule

	Sunday Aug 25, 2019	Monday Aug 26, 2019	Tuesday Aug 27, 2019	Wednesday Aug 28, 2019	Thursday Aug 29, 2019
08:00 – 08:30 Bright Start (Breakfast)					
08:30 – 10:00 (A)		Plenary - 1 (Grand Ballroom I)	Plenary - 2 (Grand Ballroom I)	Plenary - 3 (Grand Ballroom I)	Plenary - 4 (Grand Ballroom I)
10:00 – 10:30 Coffee Break					
10:30 – 12:00 (B)					
12:00 – 14:00 Lunch Break					
14:00 – 15:30 (D)					PICMET '20 Planning Session (Grand Ballroom I)
15:30 – 16:00 Coffee Break					
16:00 – 17:30 (E)					
19:00 – 22:00	Welcome Reception (Grand Ballroom I)	Dinner (Grand Ballroom I)	Awards Banquet (Grand Ballroom I)		

SPECIAL SESSIONS

PANEL OF EDITORS LUNCH MEETING

DATE: MONDAY, AUGUST 26
TIME: 12:00-14:00
ROOM: SKYLINE I ROOM (23RD FLOOR)

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

Lunch will be provided.

COUNTRY REPRESENTATIVES LUNCH MEETING

DATE: WEDNESDAY, AUGUST 28
TIME: 12:00-14:00
ROOM: SKYLINE I ROOM (23RD FLOOR)

PICMET has 136 Country Representatives in 59 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, Professor Emeritus, The University of Tokyo, and Dr. Dilek Cetindamar Kozanoglu, Professor, 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 '19 DEBRIEFING & '20 PLANNING SESSION

DATE: THURSDAY, AUGUST 29
TIME: 14:00-15:30
ROOM: GRAND BALLROOM I (BALLROOM LEVEL)

This session will provide an opportunity to give feedback on PICMET '19 and to get involved in the planning for the PICMET '20 Conference that will be held in Daejeon, South Korea, August 16-20, 2020, at the Daejeon Convention Center. The theme will be "Technology Management and Leadership in Digital Transformation."

PLENARIES

PLENARY SESSION-1

DATE: MONDAY, AUGUST 26, 2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM 1 – BALLROOM LEVEL

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

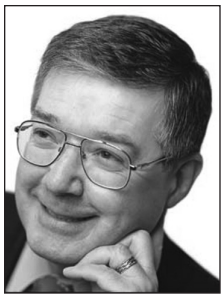
KEYNOTE-1

Mr. John R. McDougall, Fellow, PICMET; Former President, National Research Council, Canada

"Artificial Intelligence – Confronting the Ethical Dilemmas"

We are getting closer to a world in which decision-making is moving beyond our ability to directly oversee it. How will moral and ethical understanding be addressed in AI and machine learning? We can already see the tip of the challenge in driverless vehicles - in collision avoidance for instance, when the AI system confronts alternatives about what should be avoided - hitting another vehicle, striking a pedestrian, going off the side of a bridge or hitting a light standard? Can we train machines to make ethical choices or just objective ones? For example, should an AI decision focus preferentially on its own vehicle, on third parties, or on the overall degree of capital damaged? How will it know what is ethically and morally superior when confronted with choosing between a mother with a young child, an elderly person with a walker, a group of school children or a gasoline tanker truck? Even if we can train a system to develop an ethical framework, whose ethical values should prevail?

In a world of intelligent systems, such choices will be confronted on a continuous basis in a wide range of applications including health care, education, journalism, law, security and personal privacy just to name a few. What limitations will we need to place on our systems? Who should do that? And how will we be able to create an open and constructive environment to have such important but difficult conversations without people simply taking offense? In a world in which values are also in continuous evolution, the need for care is enormous. This presentation is intended to open our minds to some of the challenges we must seriously consider as AI technology applications expand and become more pervasive.



Mr. John McDougall *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 Jubilee Medal.

KEYNOTE-2

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

"Artificial Intelligence and the Barrier of Meaning"

In 1986, the mathematician and philosopher Gian-Carlo Rota wrote, "I wonder whether or when artificial intelligence will ever crash the barrier of meaning." Here, the phrase "barrier of meaning" refers to a belief about

PLENARIES

humans versus machines: Humans are able to "actually understand" the situations they encounter, whereas AI systems (at least current ones) do not possess such understanding. The internal representations learned by (or programmed into) AI systems do not capture the rich "meanings" that humans bring to bear in perception, language and reasoning.

In this talk I will assess the state of the art of artificial intelligence in several domains and describe some of their current limitations and vulnerabilities, which can be accounted for by a lack of true understanding of the domains they work in. I will explore the following questions: (1) To be reliable in human domains, what do AI systems actually need to "understand"? (2) Which domains require human-like understanding? And (3) What does such understanding entail?

Dr. Melanie Mitchell *is Professor of Computer Science at Portland State University and External Professor and Member of the Science Board at the Santa Fe Institute. She attended Brown University, where she majored in mathematics and did research in astronomy, and the University of Michigan, where she received a Ph.D. in computer science. Her dissertation, in collaboration with her advisor Douglas Hofstadter, was the development of Copycat, a computer program that makes analogies. Dr. Mitchell has held faculty or professional positions at the University of Michigan, the Santa Fe Institute, Los Alamos National Laboratory, the OGI School of Science and Engineering, and Portland State University. She is the author or editor of six books and numerous scholarly papers in the fields of artificial intelligence, cognitive science, and complex systems. Dr. Mitchell's book* Complexity: A Guided Tour *(Oxford University Press) won the 2010 Phi Beta Kappa Science Book Award and was named by Amazon.com as one of the ten best science books of 2009. Her latest book,* Artificial Intelligence: A Guide for Thinking Humans*, will be published by Farrar, Straus, and Giroux in 2019. Dr. Mitchell originated the Santa Fe Institute's Complexity Explorer platform, which offers online courses and other educational resources related to the field of complex systems. Her online course "Introduction to Complexity" has been taken by over 25,000 students and is one of Course Central's "top fifty online courses of all time."*

PLENARY SESSION-2

DATE: TUESDAY, AUGUST 27, 2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM 1 – BALLROOM LEVEL

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

KEYNOTE-1

Dr. Henry W. Chesbrough, Professor and Faculty Director, Garwood Center for Corporate Innovation, UC Berkeley-Haas School of Business, USA

"Open Innovation Results"

Dr. Chesbrough will present his research on *Open Innovation Results*, a forthcoming book from Oxford University Press. In this book, he discusses the many challenges presented by open innovation, which often fail to generate the positive results expected. To get open innovation results, we need as much attention inside the firm as we do to the relationships outside the firm. We also need a robust innovation infrastructure to deliver stronger results from innovation. Finally, Dr. Chesbrough will explore the Exponential Paradox, a situation in which rapidly advancing technology does not seem to translate into increased economic productivity.

Dr. Henry Chesbrough *is best known as "the father of Open Innovation." He is Professor and Faculty Director at Garwood Center for Corporate Innovation and teaches at the Haas School of Business at the University of California-Berkeley. He is also a professor of Information Systems at Esade Business School.*

Dr. Chesbrough has written books such as Open Innovation *(Harvard Business School Press, 2003),* Open Business Models *(Harvard Business School Press, 2006), and Open Services Innovation (Jossey-Bass, 2011). He has been recognized as one of the leading business thinkers by Thinkers50. He received an Innovation Luminary award from the European Commission and Intel in 2014. He also received the Industrial Research Institute Medal of Achievement in 2017 and has two honorary doctorates.*

PLENARIES

KEYNOTE-2

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

"Open Innovation: How to Use AI to Enhance the Crowd's Ability to Offer Innovative Strategic Directions for Firms and Society"

Open innovation refers to the use of external agents, such as public crowds, suppliers, alliances, or partners to provide input for new business innovations. Crowdsourcing is one such mechanism in which a publicly solicited crowd is asked to solve a relatively narrowly defined problem, such as a new marketing pitch (for Doritos), a new energy technology (for GE), a new bottle design (for Heineken), new forms of toothpaste (for P&G), new delivery mechanism for a product (Innocentive), or ways to optimize a recommender engine (Netflix) or a space kit (NASA). Such crowdsourcing is based on the notion that the best way to use the "crowd" is to constrain them to narrowly defined problems with clear evaluation criteria, asking them only for their ideas rather than questioning if the problem was defined correctly, and providing significant incentives to participate. With such constraints, the crowd is unable to offer much help to firms, governments, and social organizations in innovating at the systemic, big picture level, such as suggesting new strategic directions for a firm, or ways to solve global warming. We present data demonstrating that, when the constraints are removed, crowds are more innovative than those with the constraints when solving such "ill-structured problems." We then explain how the data shows us what the crowd's innovation process looks like, when left unconstrained. This innovation process is one that can be facilitated by AI.

Dr. Ann Majchrzak *is a scientist, artist, and author. Described by NPR, PBDr. Ann Majchrzak is the Associates of USC Chair of Business Administration for the Marshall School of Business at the University of Southern California. She is a Professor of Digital Innovation in the Department of Data Sciences and Operations. She is a Senior Scholar and Fellow of the Association for Information Systems, awarded for "making an outstanding contribution to the I.S. discipline in research, teaching, and service." She has been a member of three National Research Council Committees. She publishes in top academic (*Management Science*,* Organization Science*,* Information Systems Research, MIS Quarterly*) as well as top practitioner journals (*Harvard Business Review, Sloan Management Review, California Management Review*). She has held concurrent appointments as a research mentor and visiting professor at Esade Business School, Ramon Llull University, Barcelona; Department of Business and Management at LUISS University, Rome, in the areas of Innovation and Organization; and Stevens Institute of Technology. She is also an external expert for the Information Systems and Innovation Group, Department of Management at the London School of Economics. She has received funding from the National Science Foundation and a range of other agencies. She has published several books, including* Human Side of Factory Automation, Human Side of CAD, *and* Methods for Policy Research. *Her research interests center on ways to improve TOP-integration (where TOP stands for Technology-Organization-People Integration). She is the founder of TOP Integration, Inc., and TOP-Modeler, a decision support tool to help firms design and implement new manufacturing technologies in their facilities. She partners with organizations for all of her research, looking for interesting challenges to TOP integration. She has studied TOP integration for flexible manufacturing cells, computer-aided design, virtual collaboration for innovation, blockchain, and crowd-based collaboration for innovation with a range of companies including Boeing, Rocketdyne, Hyperloop Transportation Technologies, Inc., Digital Equipment Corporation, General Motors, Optum, JPL, HP, Cummins, etc. She has a new book coming out in Fall 2019 currently titled:* Unconstraining Crowds: Innovating Solutions to Wicked Business and Societal Problems.

PLENARY SESSION-3

DATE: WEDNESDAY, AUGUST 28, 2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM 1 – BALLROOM LEVEL

Dr. Tugrul Daim, Portland State University

KEYNOTE-1

Dr. Tao-ming Cheng, President, Chaoyang University of Technology (CYUT), Taiwan

"Emerging Trends in Technology Research Management in Taiwan"

PLENARIES

Rapid digital transformation, multi-disciplinary technology research, and innovations are today's hallmark. Taiwan, an island in the Pacific Ocean, too has initiated ample measures to keep the pace of transformation. There exists a renewed thrust on creating a mindset, infrastructure and developing essential cross-discipline intelligent systems to provide universities and enterprises with an innovation-oriented ecosystem, to engage in state-of-the-art R&D, and to enhance industrial competitiveness. Taiwan has a lot going for it with artificial intelligence (AI) research, and the island's prowess in the field continues to grow. Taiwan's tech ecosystem has been built over the decades with support from universities, a tech-centered culture and internet infrastructure. Global players like Google, IBM, and Microsoft have expressed their intentions of developing either AI R&D centers or similar initiatives in Taiwan. Because, companies can hire top-quality engineering talent that has earned a reputation for being more loyal and stable, less likely to be poached, compared to other countries.

The talk will cover an overview of technology research management and recent initiatives in the country. Also, it will uncover the strategies being adopted for Chaoyang University of Technology (CYUT) to become the top 1001+, 301+, 351+ universities in the world, Asia-Pacific region, and emerging economies, respectively, in 2019.

Dr. Tao-ming Cheng *currently is the President of Chaoyang University of Technology (CYUT), Taiwan, and a Professor at the Department of Construction Engineering. He received his Ph.D. in 1996 from the School of Civil Engineering, Purdue University, USA. His research interests include construction ergonomics, construction operations modeling and higher education management. Professor Cheng is the Arbitrator of the Republic of China (ROC). He serves as a Chairman of Accreditation in IEET and is a member of several committees such as Engineering Education Certification; TAC Accreditation; and Higher Education Accreditation and Supervision. Professor Cheng has published more than 100 research articles in indexed journals and conferences in the last decade. He mentors the* International Journal of Applied Science and Technology *(Scopus) and also reviews papers for several SCI journals.*

KEYNOTE-2

Ms. Mandy J. Mock, VP Information Technology Group, Intel Corporation, USA

"Data is Future"

The abundance of data and the compute power to analyze it is changing the world. Business models are being disrupted in all industries and companies must reinvent themselves to take advantage of data. This talk will discuss Intel's journey in Digital Transformation, as well as thoughts on how managers need to prepare for this change.

Ms. Mandy J. Mock *is a vice president in the Information Technology group and serves as the general manager of product engineering solutions at Intel Corporation. She leads the product engineering solutions IT team, which provides Intel's product development teams with innovative IT solutions and support for greater efficiency and faster design and production cycles. Ms. Mock has held leadership positions in Intel's IT group since 2010, capping a two-decade career at the company. Before assuming her current role in 2016, she spent two years as director of financial information systems, leading the team charged with providing IT solutions for Intel's Finance organization. She joined the IT group as director of flex services, a business unit that provides burst capacity resources for software development to Intel's product teams. She joined Intel in 1995 after receiving her bachelor's degree in electrical and computer engineering and French from Carnegie Mellon University. She went on to earn a master's degree in computer science from the Oregon Graduate Institute of Science and Technology and her MBA degree from the Kenan–Flagler Business School at the University of North Carolina at Chapel Hill*

PLENARY SESSION-4

DATE: THURSDAY, AUGUST 29, 2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM 1 – BALLROOM LEVEL

Session Chair: Dr. Dilek Cetindamar Kozanoglu, University of Technology Sydney, Australia

PLENARIES

KEYNOTE-1

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

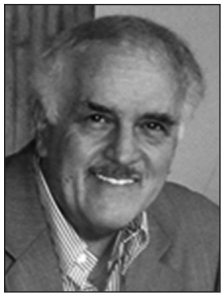
"Polymaths and Accelerated Intelligence"

The Anglo-American expression, "Jack of all trades, master of none," is a dismissive pejorative discrediting the notion of spreading oneself thin. And it has equivalent expressions in most world cultures. A Chinese version reads, "Armed with ten knives, yet none of them sharp." An Estonian version offers a different metaphor, "Nine trades, the tenth hunger." A rare version that has only positive connotations is the Turkish expression, "On parmaginda on marifet" ("Ten skills on ten fingers"), suggesting praise for individuals with a diversity of interests.

In the prevailing model of technology, engineers and innovators specialize in one field or another. But as recent research points out, through the ages most successful innovators have been polymaths. The list includes Archimedes, Brunelleschi, Leonardo, Michelangelo, Galileo, Kepler, Descartes, Huygens, Hooke, Newton, Leibnitz, Darwin, Pasteur, Maxwell, Einstein, and in modern times Bill Gates, Steve Jobs, and Elon Musk.

Drawing on information from different disciplines cannot fail to create fertile grounds for progress. This is the essence of Leonardo's Model. Newton - physicist, mathematician, astronomer, alchemist, inventor, theologian, and natural philosopher - succeeded in showing that the universe was mathematical. And even his preoccupation with alchemy, now discredited as a pseudoscience, helped him to visualize action-at-a-distance and the idea of invisible fields. Shakespeare understood human behavior better than any psychoanalyst and separately he harbored an obsession for history - especially, the histories of England, Scotland, Denmark, Ancient Rome, and medieval Italy. Their settings became the backdrops for his historical plays.

Goethe and Darwin, both impressive polymaths in their own right, were dazzled by the diversity of interests demonstrated by Alexander von Humboldt (1769-1859). The Prussian aristocrat - traveler, essayist, naturalist, botanist, etymologist, ornithologist, geologist, oceanographer, and meteorologist - is still regarded as one of the finest scientific explorers in history. But even von Humboldt does not come close to Leonardo as the "master of all trades." Along with every branch of science and engineering, Leonard also painted...better than anyone else. "The universal genius" and "the greatest genius in history" are frequently invoked in describing the breadth and depth of Leonardo's universe. The artist-scientist's functionally symmetric brain - that magnificent instrument of his effort to satiate an insatiable curiosity - questioned and analyzed relentlessly in inventing the future. Inspired by Leonardo's Model, Virginia Commonwealth University (VCU) created the Da Vinci Center where all projects call for the collaborative endeavors of the departments of engineering, art, and business, together integrating form, function, and economy.



Dr. Bulent Atalay *is a scientist, artist, and author. He is described by NPR, PBS, Smithsonian and the* Washington Post *as a "Modern Renaissance Man." He is the author of two best-selling 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. Dr. Atalay'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 has given lectures at Caltech, Princeton, Yale, Harvard, Oxford, NASA, NIST, NIH, and PICMET.*

KEYNOTE-2

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

"Automacene Rising: Managing the Social & Economics Consequences of Advanced Information Technologies"

This second and vastly more consequential stage of the information technology revolution poses a number of unprecedented challenges to the field of technology management. Part of this stems from the fact that much of BIG DATA and AI are still arcane math and science (and more than a bit of hype) in search of technology. Yet challenges are greatly

exacerbated by a number of relatively recent changes in the political economy of technology. Digital information has become a major asset class in and of itself, and politically powerful platform monopolies (which actually retard innovation) have been allowed to operate without the conventional processes we might associate with "adult supervision." Meanwhile, militaristic motives (and funding) still predominate much of the basic as well as applied research. These trends collide with elements embedded within the neural networks and "deep learning" processes that either amplify unrecognized human biases and cultural artifacts or take humans out of the loop altogether - ergo the rise of the "automacene" (which introduces whole new sets of potential socioeconomic dysfunctions). Real, yet often overstated, fears abound of autonomous weapons, a totally redundant workforce, elimination of the few remaining expectations of privacy, and the continued undermining of elections, as well as rampant and rabid anti-social network behavior and armies of bogus bots fueling further fear and hate. Yet many if not most members of the general public are totally unaware of the very real probability of having one's entire life completely "redlined" before one has a change to live it. Highly opaque predictive algorithms are already delimiting access to schools, bank loans, insurance, employment, and government programs for certain artificially collated cohorts - not to mention whether and for how long one might be incarcerated. In the meantime, increased use of AI in risk profiling of increasingly exotic derivative instruments (themselves often algorithmic distortions of erroneous economic theories) and design of prudential regimes virtually insure that the next financial crisis will be even more catastrophic. But it is not all doom and gloom, many steps (some quite promising) are emerging to confront outmoded management models and methods, and they need to be built upon.

Dr. Greg Daneke *is Professor Emeritus in the W.P. Carey School of Business, Arizona State University, and has also been affiliated with The Centre for Policy Research on Science and Technology at Simon Fraser University in Vancouver, BC. He has held other faculty posts, including Virginia Tech, University of Michigan, and Stanford University. He has also advised government agencies, including the Army Corps of Engineers, Department of Energy, Office of Technology Assessment, and he was a Senior Fellow at General Accounting Office, as well as serving on a White House Task Force. He has been a consultant to multinational as well as start-up firms and has also provided pro bono consulting to various indigenous nations and international NGOs. He is the author of over 100 scholarly publications.*

PhD Colloquium

GETTING YOUR PHD… AND BEYOND

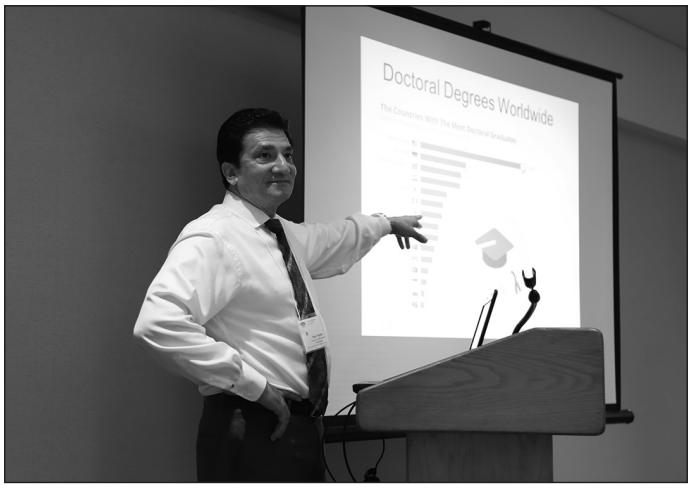
Critical Stages and Career Paths for the PhD Student

DATE: SUNDAY, AUGUST 25
TIME: 13:00-17:00 (COFFEE BREAK AT 15:00)
ROOM: GALLERIA III – BALLROOM LEVEL
REGIST: $40

CHAIR:
Dr. Nasir Sheikh, University of Bridgeport, USA

SPEAKERS:
Dr. Tugrul Daim, Portland State University, USA; and Editor-in-Chief, *IEEE Transactions on Engineering Management*
Dr. Judith Estep, Chief Technology Innovation Officer, Bonneville Power Administration, USA
Dr. Jonathan Linton, University of Sheffield and Director of Emerging Technology Supply Chain Management Research Centre, UK; and Editor-in-Chief, *Technovation*
Mr. Jeffrey London, University of Bridgeport, USA

This interactive session will give PhD candidates an excellent opportunity to learn how to successfully defend their dissertation 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: WEDNESDAY, AUGUST 28
TIME: 10:30-12:00
ROOM: GRAND BALLROOM 1 – BALLROOM LEVEL

PANELISTS: Barry Bozeman, Arizona State University; Tugrul U. Daim, Portland State University; Nathasit Gerdsri, Mahidol University; Martin Hoegl, Ludwig-Maximilians-Universität München; Johathan Linton, University of Sheffield; Fred Y. Phillips, University of New Mexico; Harm-Jan Steenhuis, Hawaii Pacific 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.

The following journals are represented by the panelists:

- ***Journal of Technology Transfer***, Dr. Barry Bozeman, Arizona State University, USA; Editor
- ***IEEE Transactions on Engineering Management***, Dr. Tugrul U. Daim, Portland State University, USA; Editor-in-Chief
- ***International Journal for Innovation & Technology Management***, Dr. Nathasit Gerdsri, Mahidol University, Thailand; Associate Editor
- ***Journal of Product Innovation Management (JPIM)***, Dr. Martin Hoegl, Ludwig-Maximilians-Universität München, Germany; Editorial Review Board
- ***Technovation: The Journal of Technological Innovation Entrepreneurship and Technology Management***, Dr. Johathan Linton, The University of Sheffield, UK; Editor-in-Chief
- ***Technological Forecasting and Social Change***, Dr. Fred Y. Phillips, University of New Mexico; Editor-in-Chief
- ***Journal of Manufacturing Technology Management*** **and** ***International Journal of Information and Operations Management Education***, Dr. Harm-Jan Steenhus, Hawaii Pacific University; Editor-in-Chief
- ***Journal of Small Business Management***, Dr. Steven T. Walsh, University of New Mexico; Associate Editor

SESSIONS

MA-01 PLENARY - 1

DATE: MONDAY, 8/26/2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM 1
CHAIR: TIMOTHY R ANDERSON; PORTLAND STATE UNIVERSITY

MA-01.1 [K] • Artificial Intelligence - Confronting The Ethical Dilemmas

John McDougall; National Research Council, Canada

We are getting closer to a world in which decision-making is moving beyond our ability to directly oversee it. How will moral and ethical understanding be addressed in AI and machine learning? We can already see the tip of the challenge in driverless vehicles - in collision avoidance for instance, when the AI system confronts alternatives about what should be avoided - hitting another vehicle, striking a pedestrian, going off the side of a bridge or hitting a light standard? Can we train machines to make ethical choices or just objective ones? For example, should an AI decision focus preferentially on its own vehicle, on third parties, or on the overall degree of capital damaged? How will it know what is ethically and morally superior when confronted with choosing between a mother with a young child, an elderly person with a walker, a group of school children or a gasoline tanker truck? Even if we can train a system to develop an ethical framework, whose ethical values should prevail? In a world of intelligent systems, such choices will be confronted on a continuous basis in a wide range of applications including health care, education, journalism, law, security and personal privacy just to name a few. What limitations will we need to place on our systems? Who should do that? And how will we be able to create an open and constructive environment to have such important but difficult conversations without people simply taking offense? In a world in which values are also in continuous evolution, the need for care is enormous. This presentation is intended to open our minds to some of the challenges we must seriously consider as AI technology applications expand and become more pervasive.

MA-01.2 [K] • Artificial Intelligence and the Barrier of Meaning

Melanie Mitchell; Portland State University, United States

In 1986, the mathematician and philosopher Gian-Carlo Rota wrote, "I wonder whether or when artificial intelligence will ever crash the barrier of meaning." Here, the phrase "barrier of meaning" refers to a belief about humans versus machines: Humans are able to "actually understand" the situations they encounter, whereas AI systems (at least current ones) do not possess such understanding. The internal representations learned by (or programmed into) AI systems do not capture the rich "meanings" that humans bring to bear in perception, language and reasoning. In this talk I will assess the state of the art of artificial intelligence in several domains and describe some of their current limitations and vulnerabilities, which can be accounted for by a lack of true understanding of the domains they work in. I will explore the following questions: (1) To be reliable in human domains, what do AI systems actually need to "understand"? (2) Which domains require human-like understanding? And (3) What does such understanding entail?

MB-02 Entrepreneurship / Intrapreneurship

Monday, 8/26/2019, 10:30 - 12:00
Room: Galleria I
Chair(s) Caren H Weinberg; Ruppin Academic Center, Israel

MB-02.1 [R] • The Effectiveness of Entrepreneurship Programs to Reduce Unemployment in Developing Countries: The Case of Saudi Arabia

Dana S Bakry; Portland State University, United States
Rafaa Khalifa; Portland State University, United States
Maoloud Dabab; Portland State University, United States

Starting a new business, developing new products and/or services and bringing those to the market may seem deceitfully easy, but in reality, it is a very painful and risky endeavor that can be nearly impossible to undertake without a proper implementation process in place. Several entrepreneurship programs have been established in different regions or countries to make a positive economic change while remaining profitable for both people and the government. Saudi Arabia is a rich country that enjoys high financial potential. In spite of the fact that the country is taking remarkable steps into the entrepreneurship world, there are still unique challenges that inspire or hamper entrepreneurs to engage in the entrepreneur programs' process more fully. In this paper, we explored these challenges and show the transformation of the ecosystem strategy that the Saudi Arabia government has taken to develop the entrepreneurship ecosystem and startup. The study aims to investigate and analyze the relationships between the effectiveness of entrepreneurship programs and unemployment. The paper, however, concludes that the existing entrepreneurship ecosystem still needs development in order to resolve the problem of unemployment in Saudi Arabia. The country should improve the strategies that can support creating an entrepreneurial culture and encourage the youth to be involved in starting new enterprises.

MB-02.2 [A] • Entrepreneurial Ecosystems in Israel: The Changing Role of Government Support: A Historical Perspective

Caren H Weinberg; Ruppin Academic Center, Israel, Israel

Knowing that innovation is considered a driver for economic growth and employment, national innovation and entrepreneurial ecosystems in Germany, the UK and Israel were recently compared for a UK government agency to enhance their understanding. The role of government support was highlighted as having a significant impact on the resilience and robustness of technology infrastructures worldwide - and in Israel specifically. Referred to as the 'Start-up Nation,' Israel and its entrepreneurial success are topics of discussion and reflection across the globe. This work, based on numerous interviews and archival research, provides insights as to how the role of the Israeli government has adapted over time to support this phenomenon. From bi-national marketing agreements to full-blown government-funded incubators and accelerators, programs and government goals have constantly changed to provide a layer of support for technology management and intelligent systems. Funding mechanisms and programing have adapted to shifting populations and target audiences. As opposed to merely summarizing history, this paper breaks events into three distinct time periods to reveal how different government programs were made available, due to changes in expectations and targets that triggered government to adapt their offerings to support changing needs. The final discussion identifies how local and national entities aim to keep pace with ever-changing needs to manage technology as well as intelligent systems to keep abreast of the increased speed of innovation. This includes the introduction of public/private support agencies intended to be more flexible and agile to meet the continuously shifting enterprise, cluster and ecosystem needs of the country and its global outreach.

MB-02.3 [R] • Understanding Social Entrepreneurial Intentions: Entrepreneurship Education, Academic Major, and Planned Behaviors

Yu-Yu Chang; National Cheng Kung University, Taiwan
Wisuwat Wannamakok; Southern Taiwan University of Science & Technology, Taiwan

This study draws upon the theory of planned behavior to empirically test a model which clarifies the relationships between attitude toward behavior, subjective norm, and perceived behavioral control and university students' social entrepreneurial intentions as well as revealing the moderating role of entrepreneurship education and academic major. Through multiple linear regression analysis, we tested our hypotheses on a sample of 832 college students (342 from three universities in Taiwan and 490 from four universities in Thailand). Results indicate that all aspects of the theory of planned behavior have a positive and significant impact on social entrepreneurial intentions. More interestingly, the positive effects of attitude toward behavior and perceived behavioral control on social entrepreneurship intention are strengthened when students attend an entrepreneurship program at university and have a non-business major. On the basis of three-way interaction analysis, our findings suggest that college students' social entrepreneurship intention is at the highest level when non-business major students have a favorable attitude towards behavior, perceive a strong

behavioral control, and receive entrepreneurial education. This paper sheds new light on the behavioral mechanisms that determine students' intention to engage in social enterprises. The theoretical contributions and practical implications for educational policy are discussed.

MB-03 System Design
Monday, 8/26/2019, 10:30 - 12:00
Room: Galleria II
Chair(s) Man Hang Yip; University of Cambridge

MB-03.1 [R] • Contingent Requirements for Artifical Intelligent Systems Development

Gary O Langford; Portland State University, United States
Herman J Migliore; Portland State University, United States

A substantial portion of project failures are due to poorly defined requirements before enough is known about pragmatic end-item product capability, technology maturity, or development strategy. Process models either start with requirements or are weakly structured to elicit and derive actual stakeholder needs and to establish incontrovertible requirements. Existing process models are used acceptably for systems but are wholly inadequate for system and system of systems requirements that involve interactions with humans at a personal level. Problems with products and services are notable when artificial intelligent systems are put into use. Rather than establishing a technology baseline and then working up requirements to advance and then use technology, a set of contingent requirements are posed to be promoted and advanced through a vetting process. From the technology chosen, a requirement is methodically planned to devise a capability, characteristic, or condition as part of the first phase of that vetting. This paper introduces a new form of requirements, termed contingent requirements. A contingent requirement stipulates the conditions for it to be modified according to the way things in fact are (or will be). From scenarios developed systematically by applying the Rand-Stanford method, technology dependencies are postulated, analyzed, and evaluated. The aim for introducing contingent requirements into the lifecycle engineering of artificial intelligent systems (AIS) recognizes that technology should be considered within domains of influences, context(s), and consequences when put into use. Linear, incremental process models do not test for unforeseen consequences. Intelligent systems built on contingent requirements explore those unforeseen consequences by formally testing the intelligent systems in various environments to explore the risks of interactions with individuals and in communities.

MB-03.2 [A] • Digitalization of the Kanban System

Murat Ayabakan; Aisin Otomotiv Parcaları San Tic AS, Turkey
Ersoy Yılmaz; Aisin Otomotiv Parcaları San Tic AS, Turkey

Technologies of the fourth industrial revolution are closing the gap between the physical and virtual world in the manufacturing process, and it will have huge effects on the whole supply chain. The changing paradigm of manufacturing value chain affects tier 1 and 2 suppliers in Turkey as it also affects every country and industry. Definitely, the digitalization of the lines and value chain will bring challenges to these suppliers. They either have to invest in new technologies and competent workers or be open to losing their market proximity advantage to cost-effective competitors. A case study from a tier 1 supplier, Aisin Turkey (which is operating as a supplier to manufacturers like Toyota, Hyundai and Honda), will be shared along with the lessons learned and possible extension strategies for similar companies. In 2017 a dedicated design and manufacturing team was assigned for application of Industry 4.0 technologies and virtual product labors that can communicate with machines, lines and their die changing systems according to orders coming from customers. In this study, details of this digital production management method and the potential impacts of Industry 4.0. or digitalization of manufacturing on tier 1 and 2 automotive suppliers in Turkey will be explored.

MB-03.3 [R] • Managing Value Co-creation: An Integrated Design Framework for Service-Centric Product-Service Systems

Man Hang Yip; University of Cambridge, United Kingdom
Mohd Ahsan Kabir Rizvi; University of Technology Sydney, Australia
Eng K Chew; University of Technology Sydney, Australia

Since the early 2000s, researchers have been advocating service-centric design, which focuses on customer value co-creation as defined in service-dominant logic. However, extant product-service systems (PSS) design methods are often too narrowly scoped to support value co-creation. One difficult aspect is that customers' needs are always evolving, and companies have to continuously adapt their resources and offerings. Moreover, PSS design frameworks that take a broader approach are usually at a business strategy level, leaving out the details of how to operationalize the framework. This research proposes a novel integrated PSS design framework that adopts a lifecycle approach to design - from the gaining of awareness of a need, to soliciting collaboration, co-creating value propositions and generating value-in-use for the actors involved. This framework considers the interactions between actors in the value co-creation process at a strategy level and is integrated with techniques to execute each stage of the framework. Its pilot application in a healthcare case study is discussed in the paper. This paper contributes to the literature of PSS and design research, and the application of actor network theory in supporting the premises of service-dominant logic. It intends to provide guidelines to managers of new PSS development and lifecycle management.

MB-04.1 [R] • Development of a Framework for the Systematic Identification of AI Application Patterns in the Manufacturing Industry

Guenther Schuh; RWTH Aachen University, Germany
Paul F Scholz; Fraunhofer-Institute for Production Technology IPT, Germany

In any industrial sector an increasing number of interconnected objects along with more sensors relying on shortened query rates cause large data volumes that can be utilized for product and process improvement. Methods from the artificial intelligence (AI) technology spectrum have the potential to uncover complex interdependencies in data sets instantly, improve analysis results steadily and adjust to changing external factors dynamically. AI is a heterogeneous technology bundle mainly originating from statistics, advanced analytics and machine learning, which is built up in different layers. Current research is lacking a comprehensive analysis of these different AI technology layers and their corresponding characteristics that can serve as an orientation guideline especially for manufacturing companies. This research derives a nomenclature for the AI technology ecosystem in order to facilitate the discussion of this topic. Moreover, a systematic framework (morphology) is derived in order to classify current AI applications and to identify crucial AI technology composition patterns that might be helpful for future AI application development. Potentially promising scopes for the derivation of AI technology composition patterns are discussed and exemplary settings for employment of the proposed method are evaluated.

MB-04.2 [R] • Research on Financial Performance Evaluation on Artificial Intelligence Listed Companies in China Based on DEA Method

Jili Hu; Jilin University, China
Zhiyuan Nian; Jilin University, China
Xinle Wang; Jilin University, China

China's artificial intelligence (AI) industry has developed rapidly in recent years, with the State Council of China releasing a roadmap in July 2017 with a goal of creating a domestic industry worth 1 trillion Yuan and becoming a global AI powerhouse by 2030. This study evaluates the listed companies in China's AI industry from the perspective of financial performance and analyzes the development status of China's AI industry from a macro perspective. This study selects the more objective and appropriate DEA analysis as the evaluation method according to the characteristics of the AI industry. On the basis of summarizing the development status of the AI industry and AI listed companies, an empirical analysis is carried out. In the data sample, 34 AI listed companies in China's Shanghai and Shenzhen stock markets were selected, and the DEA model with output-orientation model was used to analyze the standard data. The result shows that in the different stock board the efficiency presents different development trends and distribution status.

SESSIONS

MB-05 Technology Forecasting
Monday, 8/26/2019, 10:30 - 12:00
Room: Parlor C
Chair(s) Fred Y Phillips; University of New Mexico

MB-05.1 [R] • Using Patent Analysis to Anticipate Technology Trends: A Case of Coffee Processing Technology in Thailand

Porruthai Boonswasd; Bangkok University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

The technological capability of the coffee industry in Thailand is limited. Coffee manufacturers operate in a red ocean where competition is focused around cost and not differentiation. This paper discusses the insights gained from a study of patents related to coffee processing technologies. The purpose of the study is to identify technology trends and innovative approaches in the coffee industry. PatSnap software is used to conduct a patent analysis of 211 patents from 106 countries in the period of 1999-2018. The analysis aims to reveal the global direction of R&D to forecast technological developments and applications in the coffee industry. The insights gained from the research are used to assist the strategic planning of technological development paths and their possible application in the Thai coffee industry. With a better understanding of the technological landscape, firms operating in the Thai coffee industry are better equipped to make product development decisions.

MB-05.2 [R] • Technological Forecasting of GPU: Uninterrupted Progress for Unquenchable Needs

Dong-Joon Lim; Sungkyunkwan University, Korea, South
Kyu-Won Lee; Sungkyunkwan University, Korea, South
Hyeong-Jun Lee; Sungkyunkwan University, Korea, South

This study conducts an investigation into the technological changes in GPUs over the past 13 years by which strategic development plans can be established for both incumbents and potential entrants to the market. We demonstrate a case where the new entrants would focus on a low-power segment by providing technical specifications required to be competitive considering the rate of technological progress expected. The results show that reference GPUs in the mid-range segment have evolved at a relatively faster rate of progress. Technical specifications to keep pace with the identified technological changes are presented in various development scenarios.

MB-05.3 [R] • Computing Redundancy in Complementary and Supplementary Technologies Using TLC Indicators: A Theoretical Framework

Vimal Kumar; Chaoyang University of Technology, Taiwan
Chien-Yu Lin; Chaoyang University of Technology, Taiwan
Wen-Goang Yang; Chaoyang University of Technology, Taiwan
Kuei-Kuei Lai; Chaoyang University of Technology, Taiwan
Yu-Hsin Chang; Chaoyang University of Technology, Taiwan

Technology redundancy is a powerful concept of strength of similar cord between adjacent technologies; we consider technology redundancy in the form of complementarity and supplementarity. In this research paper, we argue that innovation and technological forecasting are premised on the certain orderliness of its current five life cycle stages. The widespread approach of considering complementary and supplementary technologies and measuring technology life cycle (TLC) stages activities by its indicators, especially patent applications, have yielded to give successful innovations. This current research is based on the TLC and its different TLC stages by finding the indicators of the life cycle of 13 technical indicators from the previous literature. The purpose of this research is to focus on the patentometrics index to identifying the TLC is constructed based on the patent citation network to identify its stages and patent family. We plan to undertake the technology development trajectory at different TLC stages, construct the patentometrics indicators and compute the redundancy among technology complementarity, supplementarity, and knowledge flow to verify the framework given in this paper.

MB-05.4 [A] • Introducing Indigenous Knowledge into Foresight

Thirawut Phichonsatcha; Chulalongkorn University, Thailand
Nathasit Gerdsri; Mahidol University, Thailand
Duanghathai Pentrakoon; Chulalongkorn University, Thailand
Akkharawit Kanjana-opas; Science, Technology and Innovation Policy Office, , Thailand

Foresight has received a great deal of attention in diverse sectors all over the world. To conduct foresight, vital parameters are expert inputs and structured data from various sources, such as academic papers, business reports, trend analysis reports, patent information, etc. Despite the fact that inputs from communities and indigenous knowledge are not well-structured data, they may be as important as structured data. Hence, an indigenous knowledge appears to play an attractive role in foresight, especially in the regions where local wisdom and experience remain valuable. This study aims to explore the possibilities of integrating indigenous knowledge with the foresight process.

MB-06 Educational Issues
Monday, 8/26/2019, 10:30 - 12:00
Room: Parlor B
Chair(s) Guy H Downs; Eastern Michigan University

MB-06.1 [R] • An Exploration of the Relationship Between Personality Type and Satisfaction with Online Learning Environments

Guy H Downs; Eastern Michigan University, United States

Although a considerable amount of research has been conducted that explores the relationship between various student-specific factors and satisfaction with online learning, the body of research that specifically explores the relationship between personality and online learning satisfaction is still emerging. The aim of this paper is to contribute to the literature on this topic by exploring the correlational relationships between those personality traits that are most dominant in undergraduate technology students (i.e., students who have declared a major in the university of interest's College of Technology) and satisfaction with specific aspects of online learning. This paper makes use of self-reported student scores from the NEO-FFI-3, a 60-question inventory that measures personality profiles in the "Big Five" personality traits (openness, conscientiousness, extraversion, agreeableness, neuroticism), and from a survey that measures five unique dimensions of student satisfaction with online learning. Correlations between personality and satisfaction scores are reported, and recommendations are made for how technology educators might best construct their online course curricula to align with the personality profiles of their students.

MB-06.2 [R] • Examining E-Learning Systems Success Continuance Intention User by Integrating TAM and DMIS Model

James K Chen; Asia University, Taiwan
Kuan-Chih Shu; Asia University, Taiwan
Howard H Lee; Asia University, Taiwan

This paper aims to examine e-learning systems' success and predict factors that contribute to the continuance intention of the user. The questionnaire was collected with a survey, and the target samplings were taken from students who used e-learning systems. This study employs multiple regression to test the model, hypotheses, as well as the interactions between constructs. This model helps e-learning providers and decision makers to understand users' point of view so they will continue using the e-learning system as a tool to gain knowledge and learning experience. Enhancing information quality and system quality will improve the users' perception that using e-learning will be useful for them and easy to operate it. Moreover, this research has proven the mediating effect of TAM in the relations of system quality, information quality, and service quality towards learning performance. The results demonstrate that continuance intention is significantly affected by learning performance. The research model provides a new and comprehensive approach for system providers to understand what factors contribute to users continuing to use the e-learning systems.

MB-06.3 [R] • Applying Theory to Practice: Measuring Learning Outcomes from a STEM Doctoral Program

Todd Alexander; Worcester Polytechnic Institute, United States
Lindsay D Lozeau; Worcester Polytechnic Institute, United States
Terri Camesano; Worcester Polytechnic Institute, United States
Frank Hoy; Worcester Polytechnic Institute, United States

In 2013, Morris, Kuratko and Cornwall reported a trend in entrepreneurship education moving from a focus on starting small businesses toward stimulating innovative, growth-oriented ventures. They forecast a broadening of entrepreneurship education leading students to "think and act in entrepreneurial ways in all facets of life, to pursue careers where entrepreneurship can manifest in many different ways, and to apply the entrepreneurial mindset in their personal lives." This approach was adopted at Worcester Polytechnic Institute (WPI) in the design of a Ph.D. program for life science and bioengineering students. The faculty instigators recognized that the majority of STEM doctoral program graduates were not choosing academic careers and were not necessarily being prepared to engage in entrepreneurial behavior either through new venture creation or opportunity seeking within larger organizations. In reviewing the entrepreneurship education literature, it was noted that many programs lacked clear learning objectives and that few provided outcome measures. In this paper, we explain how learning outcomes were developed and implemented for a program selected by the National Science Foundation for its innovativeness and potential for replication, and how results have been and are being evaluated in accordance with Mialaret's theoretical perspective for designing and implementing an education program.

MB-07 Social Media
Monday, 8/26/2019, 10:30 - 12:00
Room: Parlor A
Chair(s) Charles M Weber; Portland State University

MB-07.1 [R] • Do Directionality and Network Size Affect Network Structure in Online Social Networks?

Nitin Mayande; Tellagence Corporation, United States
Charles M Weber; Portland State University, United States

A study of the online social networks of six Twitter conversations about six YouTube product categories reveals that directionality and network size affect the structure of online social networks. Our results indicate that large networks tend to be non-random, regardless of whether they are directional or not, suggesting that structural attributes of the online networks under study are a true reflection of the network's features. Smaller non-directional networks also tend to be non-random, whereas smaller directional networks tend to be random in nature. However, very small networks tend to be random in nature, whether they are directional or not. Our results suggest that larger online networks undergo different generation mechanisms than smaller real-world networks, especially if these networks are directional. Extant theory, which is almost exclusively derived from observation of real-world networks, may thus not adequately describe the behavior of online networks. We propose research to remedy this deficiency at the end of this paper.

MB-07.2 [R] • How to Influence Followers in Social Media: Exploring the Consequences of Opinion Leaders' Living a Calling and P-J fit on Followers' Attitude and Behavior

Chia-Wu Lin; National Dong Hwa University, Taiwan
Chia-Yen Wu; National Dong Hwa University, Taiwan
Li-Ting Chiu; National Dong Hwa University, Taiwan

This study explored the consequential process of opinion leaders' calling under online social media context. We hypothesized two variables, person-job fit and the credibility of opinion leaders mediate the relationship between opinion leaders' calling and the electronic word-of-mouth (eWOM) toward them. Furthermore, we argued that opinion leaders' vanity moderated the relations between the credibility of opinion leaders and the eWOM toward opinion leaders. This research targeted the "YouTuber creator" in Taiwan region as the opinion leaders and their fans as the followers; 31 opinion leaders' questionnaires and 316 followers' questionnaires were collected. The results show that: 1) there is a significant positive relation between living a calling and P-J fit, 2) there is a significant positive relation between P-J fit and the credibility of the opinion leaders, 3) there is a significant positive relation between credibility of the opinion leaders and eWOM, and 4) vanity significantly moderates the relation between source credibility and the eWOM.

MB-07.3 [R] • Research on the Influencing Factors of Enterprise Science Popularization Capability

Li He; China Research Inst. for Science Popularization, China
Rongying Hou; China Research Inst. for Science Popularization, China

Based on the micro-survey data, this paper constructs the index system from the three aspects: the characteristics of management, characteristics of the enterprise and the characteristics of social supervision and incentives. It also establishes a multivariate statistics model to study the influencing factors of enterprise science popularization capability improvement. The results show that the manager's education level and attitude towards science popularization from the characteristics of a manager's aspect have a significant impact on enterprise science capability improvement. Enterprise factors include the enterprise scale, proportion of state-owned assets profitability, the enterprise life cycle, and innovation ability, which from the characteristics of enterprises have a significant impact on enterprise science capability improvement. Factors including government supervision and incentives degree, national science popularization taxation policies, and government supervision degree, which from the characteristics of social supervision and incentives also have a significant impact on enterprise science capability improvement. Based on the above research conclusions, the countermeasures and suggestions for the development of enterprise science popularization capability are put forward.

MD-01 Strategic Management of Technology-1
Monday, 8/26/2019, 14:00 - 15:30
Room: Grand Ballroom I
Chair(s) Deok-Joo Lee; Seoul National University

MD-01.1 [R] • A Game Theoretic Real Option Model for Strategic Decision on R&D and Commercialization Considering Uncertain Technology and Market

Minhyuk Sur; TmaxData, Korea, South
Deok-Joo Lee; Seoul National University, Korea, South
Donghyun An; Seoul National University, Korea, South

In this paper, we analyze the strategic investment decision problem considering the uncertainty of not only technology but also market demand using a two-stage game-theoretic real option model. In the first stage two firms compete with R&D investment by which the firm can enter a new market according to the success or failure of R&D. And then in the second stage, both firms decide whether to enter the market or postpone until the demand uncertainty would be resolved. The payoff functions are formulated by using a binomial real options model to incorporate the technological and market uncertainty. As a result, we found the Bayesian Nash equilibrium which characterizes the optimal investment decision strategies for both companies, which can be used to calculate the optimal level of profits. Numerical experiments with graphical illustrations are presented to demonstrate the optimality of strategies whereby the two firms maximize their own profits. In addition, on the basis of the results of optimal profits and strategies, the present study performs sensitivity analysis with regard to various exogenous variables that could affect the profits and strategies.

MD-01.2 [R] • Planning for Change in the Electric Power Industry: A Primer for Transactive Energy Scenario Development

Joshua Binus; Bonneville Power Administration, United States

The electric power industry and its associated infrastructures (a.k.a. "the grid") are evolv-

ing from centrally planned, organized, and operated networks of players, technologies, and resources to systems of systems that are increasingly digitized and distributed in their operation and innovative capacity. Subsequently, strategic planners and technology managers associated with the electric power industry are faced with a range of scenarios to evaluate, including one that considers the emergence of commercialized transactive energy systems in the coming ten-year time horizon. The crafting of a transactive energy scenario can help inform technology innovation and management efforts that benefit consumers, electricity providers, and society by providing planners with a tool to investigate key drivers of change and a range of desired attributes of future technologies that could be employed to address emerging customer needs, wants, and expectations. This paper introduces readers to key elements associated with the market emergence and adoption of transactive energy systems in order to encourage their inclusion in long-term scenario portfolios being utilized to inform electric power industry planning efforts.

MD-01.3 [A] • University-Industry Collaboration: A Value-Based-View

Wan-Chen Chen; National Taiwan University, Taiwan
Jia-Chi Chang; National Cheng Kung University, Taiwan
Shih-Chieh Fang; National Cheng Kung University, Taiwan

University-industry collaboration refers to the engagement and commercialization activities between university and industry. Academic engagement refers to the inter-organizational collaborations to pursue goals that aim to generate some benefits for both partners. Commercialization refers to the extraction of academic research or invention to obtain financial benefits. A considerable body of work highlights the channels, barriers, and effectiveness of university-industry collaboration (UIC) but has rarely been explored from the perspective of a value-based view. This research presents a case study of a firm that has achieved a successful UIC with the research center of a university, and the process of collaboration is examined from the perspective of value-based view (VBV). Value-based view is composed of three consecutive parts: value creation, value capture and value co-creation. The analysis of the case illustrated the values created and captured by the firms individually and the values co-created together. This research not only reveals the process of UIC, but it also demonstrates the mechanisms of the value co-creation process and conceptualizes the process into three important aspects: shared vision, genuine, and respect. The three conceptualized aspects represent the three important factors that exist in a successful UIC partnership.

MD-02 E-Business
Monday, 8/26/2019, 14:00 - 15:30
Room: Galleria I
Chair(s) Leon Pretorius; University of Pretoria

MD-02.1 [R] • The Rise of Digital Business Models: An Analysis of the Knowledge Base

Amaury Schaller; Bangkok University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand
Nonthapat Pulsri; Bangkok University, Thailand
Arnauld Schaller; Bangkok University, Thailand

This conference paper explores the characteristics of publications related to the topic of digital business models (DBM). In this review, science mapping techniques were applied to review 146 SCOPUS indexed articles and conference papers concerned with the implementation of DBM. Digitization and its rapid evolution are creating new products, changing customer demands and disrupting traditional markets. Hence, the focus of many companies to date has been on the adoption of emergent technologies, such as internet of things (IoT), artificial intelligence, big-data or cloud computing. Yet in order to stay competitive and to avoid disruption by a new market entrant, a firm needs to adapt and even redesign its core business model in the context of the digital age. However, successfully implementing a digital business model remains one of today's most challenging tasks. The aim of this review is to reveal the size, growth trajectory and geographic distribution of the digital business model knowledge base. Moreover, the goal is to detect key journals, authors and publications, as well as to give an overview of the intellectual structure of the literature and possibly highlight actual trends in the domain of DBM. The review attested a modest-sized knowledge base concentrated in Western countries. Furthermore, four "schools of thoughts" were identified and further explained. It is a first attempt of a bibliometric review in this field, and thus shall give guidance for future research and practical implications.

MD-02.2 [R] • A Review of After-sales Service Practice of Chinese Agricultural Machinery in Cross-border E-commerce in Africa

Xiaoshun Qin; University of Pretoria, South Africa
Leon Pretorius; University of Pretoria, South Africa
Dongdong Jiang; University of Pretoria, South Africa

After-sales service (ASS) is an important element after the production has been sold to the end-users and also those who use agricultural machinery. This paper aims to review to some extent the ASS practice of Chinese agricultural machinery in cross-border e-commerce in Africa which has been an active practical and research topic in China, and for that matter globally, since 2000. This review for ASS of agricultural machinery will be shown on the following dimensions: technician/expert, timely repair, spare part, maintenance, training course as well as user information system and service center. By means of previous authors' views, analyses and integration pertaining to the above six aspects of ASS, it is concluded that the ASS of Chinese agricultural machinery is urgently necessary also in Africa. A conceptual framework of risk reduction of after-sales service of agricultural machinery in cross-border e-commerce is designed and presented based on the literature review and inductive reasoning as the final process of this paper. The research method followed in this paper is exploratory based on a literature review as well as aspects of design science research.

MD-02.3 [R] • Research on Consumer's Purchasing Decision Making Process by E-Commerce Platform: Based on Taobao Users

Md Jahir U Khan; Tongji University, China
Yan Shumin; Tongji University, China
Md Zakir H Khan; Tongji University, China

E-commerce market has a different kind of great perspective, mainly the feature of online shopping, but before understanding every move of development, we must know the key factors that control the activity of consumers shopping online. Understanding these impairments can support the development of online shopping. The main objective of this research aims to inspect the decision-making process of online consumption and to evaluate how cultural, social, personal, and environmental factors could have an impact on the customers' online shopping decision, specifically in China's e-commerce market. The research is designed on the perceptions of online consumers' characteristics and environmental motivations. The respondents who have very good online shopping experiences on Taobao e-commerce market for questionnaire were selected from China. A 150 sample was chosen for participation. Research questions were developed on the importance of four factors, while items for each question were designed in terms of sub-factors from main aspects. Consequence verified the impact of factors on customer online shopping behavior and came up with two problems that negatively influence both customers' online shopping decision and online retailers' market.

MD-03 Convergence of Technologies
Monday, 8/26/2019, 14:00 - 15:30
Room: Galleria II
Chair(s) Ilkka D Dongohue; Lappeenranta University Of Technology

MD-03.1 [R] • Explore the Innovative Fulcrums of Patented Technology: A Perspective of Technology Embeddedness

Hung-Chun Huang; National Chi Nan University, Taiwan
Hsin-Ning Su; National Chiao Tung University, Taiwan
Hsin-Yu Shih; National Chi Nan University, Taiwan

Technological interdisciplinarity and integrative development have been issues of academic discourse for some time; several studies have contributed to the investigation of techno-society and technology development. Nevertheless, the interdisciplinary technology present in patents remains insufficiently explored. This study examines a patent interdisciplinary ap-

plication utilizing the USPTO database of patent documents from 2001 to 2014. The findings identify distinctive structural configurations of various technical fields and the ecology of their collaboration. This study presents the interdisciplinary embeddedness of a patent citation network which suggests a technological proximity for incubating innovative capacity. The technological positions of brokerage perform a critical fulcrum for interdisciplinary innovation, which strategizes several innovative capabilities. Meanwhile, technological push and pull promote the process of endogenous, exogenous, and heterogeneous innovation and technology evolution. Thus, this study addresses policy implications for firms and authorities interested in sustaining innovative capabilities.

MD-03.2 [R] • The Value of Digital Twins and IoT Based Services in Creating Lifecycle Value in B2B Manufacturing Companies

Ilkka D Dongohue; Lappeenranta University Of Technology, Finland
Lea Hannola; Lappeenranta-Lahti University of Technology, Finland
Aki Mikkola; Lappeenranta-Lahti University of Technology, Finland

The objective of the ongoing research was to understand, through B2B manufacturing case companies, what role digital twins connected to the real-world asset, using the industrial internet of things, has in innovating asset-based services. The relationship between collected data and digital twin to create lifecycle partnership value between the equipment provider and operator were of interest. The research approach used was design science, and data collection method were semi-structured interviews. The initial results show that the case companies can improve service case management initially when using IoT to collect operational data. However, the challenge is identifying the relevant services to develop and offer to the customer that create a lifecycle value and partnership in the long-term. The value created is difficult to quantify to the customers in the case companies, and this limits the strategic investments. The benefits from data-driven services is seen, but how to connect the collected data into new services is limited. Often the potential benefit was only realized once the services were being used by the customer, and it was typical to pilot these services in the real world. From this ongoing research, the conclusion is that the role of the digital twin is important in verifying these new service offerings and testing them prior to implementation.

MD-03.3 [R] • Detecting Emerging Complex Technological Fields in Robotics

Toshihiro Kose; The University of Tokyo, Japan
Hiroko Yamano; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

Robots are composed of various sophisticated technologies, such as mechanics, control systems, electronics, software, and technology convergence, which could be some of the key factors driving innovation in robotics. In addition, in the era of the Internet of Things, companies are required to take measures to make alliances with possible partners, or undertake mergers and acquisitions as a means of open innovation. However, it is increasingly difficult to identify emerging technological innovation because of the speed of innovation, the uncertainty of the possible combinations that could lead to innovation, and the complex convergence of technologies. Although bibliometrics has enabled us to identify major technologies and the approximate relationship between different fields of technologies, precise methodologies are required that will be able to detect emerging technological fields in detail, especially in the case of complex technologies like robotics. By applying a citation network analysis to both clustering and detecting technology convergence, this paper proposes a methodology to precisely detect emerging complex technological fields. The patents data containing robotics in their titles and abstracts were retrieved from Derwent Innovation, and 65,796 patent citations, from 1974 to 2018, were extracted through the Academic Landscape System. This study contributes to information on decision-making on collaborations or other open innovation measures for organizations.

MD-04 Artificial Intelligence for Technology Management-2

Monday, 8/26/2019, 14:00 - 15:30
Room: Galleria III
Chair(s) Aki Tomita; Toyo University

MD-04.1 [A] • Survey of Artificial Intelligence in Education

Yuzhen Gao; Qingdao University, China
Leong Chan; Pacific Lutheran University, United States
Chung-Shing Lee; Pacific Lutheran University, United States
Hongtao Zhang; Hiretual Inc., United States
Renzhi Cao; Pacific Lutheran University, United States

We are now live in an age that we could easily collect and analyze a huge amount of data instantly by artificial intelligence (AI) technologies. AI is an interdisciplinary and new subject developed by the interpenetration of computer science, psychology, mathematics, business, philosophy, and other disciplines. Education is one of the most important and challenging fields that reshapes our next generation to have a better future world. It also plays an important role in education. Artificial intelligence has brought various influence on education. The literature review method, analysis method, and case study method were studied for the period 2008-2017. Our study for published research papers related to AI and education concludes that there is still a big gap in the education field for integrating AI technology. In this survey, we summarize AI technology and also the business model of AI products in education and deduce the roles of AI in future education.

MD-04.2 [A] • Can AI Tell Emerging Technologies: Evaluating the Importance of Quantitative Features of Technology

Shinwon Seo; KISTI, Korea, South
Jae-Min Lee; KISTI, Korea, South
Heyoung Yang; KISTI, Korea, South
Seonho Kim; KISTI, Korea, South

Many researchers and organizations have been archiving and analyzing vast documents and data for technology evaluations and emerging technology mining. Korea Institute of Science and Technology Information (KISTI), as one of them, has been collecting various technological data from technical literatures, such as patents and papers, and developing techniques to analyze and retrieve various quantitative features from it. Lately, the demand of utilizing our resources, data and technologies for developing an intelligent technology information system in which output is objective, consistent, and explainable has been increasing. By applying the latest advanced artificial intelligent techniques, deep learning, to our data and system, it is possible to improve our capability of evaluating technology and mining future emerging technology. For this reason, it is necessary to investigate and evaluate the effectiveness of each quantitative feature of technology which are retrieved from technical literature analysis. In this paper, we present the results of our study of testing the effectiveness of various quantitative features of technology, which are being referred by human experts in technology evaluation and future emerging technology mining process, in both empirical and statistical ways. In the empirical approach, an artificial intelligent model is built to simulate the human expert group for emerging technology mining, and the change of the performance is observed while the training features are changed. In the statistical approach, the relations between the basic distribution variables of data and the decision making are analyzed.

MD-04.3 [R] • Integrating AI Capabilities into Existing Technology Platforms: Drones as a Case in Point

Bharat Rao; New York University, United States
Bala Mulloth; University of Virginia, United States
Adam Jay Harrison; New York University, United States

Breakthroughs in artificial intelligence promise to supercharge technology platforms, and give them added capabilities like inference, real-time decision making, contextual awareness, and autonomous operation. In this paper, we explore this phenomenon using the case of drones. Drones have been used for many years in military applications, and have now found their way into the commercial sector. Several industries such as agriculture, construction, industrial infrastructure, security and surveillance, and entertainment, to name a few, operate drones on a regular basis. Using advanced sensors, drones can not only continuously collect and store data, but also send them back to base or the cloud for further analysis, and then act on the insights generated. The combination of large datasets, complex

algorithms, and the ability to access machine learning on powerful cloud servers mean that drones are no longer passive functionaries. In fact, they can act as sophisticated and intelligent machines using advanced AI and respond dynamically to challenges in real time. In this paper, we describe how this newfound capability is being harnessed for new classes of applications and business opportunities. From a strategic perspective, we argue that AI needs to be conceptualized as a meta layer on top of existing technology platforms, that in turn gives the platform new capabilities that were previously out of reach.

MD-05 Technology Roadmapping-1
Monday, 8/26/2019, 14:00 - 15:30
Room: Parlor C
Chair(s) Nasir J Sheikh; University of Bridgeport

MD-05.1 [R] • Development of a Strategic Roadmap Framework for Nonprofit Organizations: Literature Review

Dan Tenney; University of Bridgeport, United States
Nasir Sheikh; University of Bridgeport, United States

Today's small-to-medium nonprofit organizations (SMNOs) are focused on their immediate mission and due to limited resources and capability rarely address long-term strategic planning. A strategic roadmap (SRM) can provide the basis for a long-term strategy for such organizations. The roadmap can also be designed to operationalize the policies and procedures spanning multiple time periods, typically in years. As an initial step in the development of the roadmap framework, a literature review was performed to address: trends and priorities, gaps in research, applied methodologies, and future research requirements of organizations that address societal needs. This review analyzes three primary themes of interest: nonprofit market trends, nonprofit operations management, and roadmapping methodologies. It covers multiple perspectives, including social, technical, economic, environmental, and political (STEEP).

MD-05.2 [R] • Defining the Scope of a Roadmapping Initiative: A Checklist-based Template for Organizational Stakeholders

Clive Kerr; University of Cambridge, United Kingdom
Robert Phaal; University of Cambridge, United Kingdom

Roadmapping has a proven history of supporting organizations in a variety of ways. It has been applied across a spectrum of industrial initiatives, ranging from: simply generating a technology roadmap for a project; to being deployed as a tool to integrate into and enhance existing business processes; to acting as a platform for underpinning and synchronizing corporate-wide management toolkits; through to developing international consensus-based multi-organizational roadmaps. However, the adoption and implementation of roadmapping still remain problematic. A major upfront hurdle for many organizations is to elicit the requirements for a given roadmapping initiative and produce an agreed expression of what is "needed-vs-expected" and what can be "delivered" (in the allotted timeframe and resources available). Requirements elicitation is typically driven by a set of stakeholder perspectives and opinions. In order to align and agree, there should be a reconciling of self-interests versus collective interests, and this should be reflective of the organizational context and realities of the specific situation. In order to help define the scope of a roadmapping initiative, a checklist-based template has been designed which brings together the conceptual dimensions and practical elements that are necessary to deepen and enrichen the understanding of expectations and requirements.

MD-05.3 [R] • Key Principles for Integrating Multiple Roadmaps for Innovation System Foresight: Case Studies of RTOs with Innovation Missions Beyond Just Technology R&D

Jae-Yun Ho; Institute for Manufacturing, Cambridge University, United Kingdom
Eoin O'Sullivan; Institute for Manufacturing, Cambridge University, United Kingdom

Strategy exercises based on roadmapping approaches are increasingly being used to support effective management and foresight of diverse functions of technological innovation systems. In addition to roadmaps for technology development, a set of specialized roadmaps that particularly focus on the development of other functional activities of innovation (such as standardization, education and workforce development, and infrastructure development) are being developed for their timely and effective management in support of innovation. As there are significant relationships and interdependences between these various functions, there may be value in systematic integration and alignment of corresponding roadmaps in order to promote the overall functioning of technological innovation systems. However, evidence shows that they are largely disconnected from each other, increasing potential risks of inefficient use of resources and missed opportunities to capture greater value from technology R&D. In this context, this paper presents case study analyses of recent roadmapping exercises, demonstrating the importance of aligning multiple, interrelated roadmaps focusing on various functions of innovation systems in a coherent and integrated way; it also identifies key guiding principles and practical requirements to support such integration and alignment. Roadmaps developed by Manufacturing USA institutes provide interesting case studies, as they have broad innovation missions including, for example, both technology development as well as education and workforce development. By identifying associated challenges as well as useful activities adopted in practice, the paper offers guidance on how integrated roadmapping processes can be designed for more effective management of diverse functional activities of technological innovation systems. It thus provides an initial stepping stone for developing a more structured process of innovation system foresight, which is increasingly important with the systemic, contextual and evolutionary understanding of innovation.

MD-06 Decision Making-1
Monday, 8/26/2019, 14:00 - 15:30
Room: Parlor B
Chair(s) Nathasit Gerdsri; Mahidol University

MD-06.1 [R] • Using The Hierarchical Decision Model (HDM) to Select a Sustainable Voice over Internet Protocol (VOIP) Provider

Fayez Alsoubaie; Portland State University, United States

The continued technological progression has instituted a modification in communication facets. Consequently, the use of the Voice over Internet Protocol (VoIP) has enhanced and technical researchers believe that this innovation will be at the center stage for future phone engagements. VoIP services are offered by different providers depending on the customer's unique personal or corporate requirement. Therefore, firms should undertake extensive research to determine the most appropriate service providers that would optimize operations and improve productivity. In most cases, the choice of VoIP in a hierarchical organization is influenced by factors such as the number of users within various protocols, the total devices needed to reach a far-reaching link, and the sustainability of the selected broadband technology. Aspects like the cost of acquiring a VoIP and output should also be considered to facilitate a timely return on investment. Getting accustomed to interior networking schemes and current technologies is vital in the quest to establish a useful internet set-up design. While the presence of several inhibiting factors may affect the effectiveness of VoIP, the hierarchical decision model (HDM) provides a decision-making criterion that can be applied to improve its functioning. The approach considers several VoIP options that are drawn and approved by network specialists. Therefore, the HDM is used as software to make a balanced contrast of different tangible factors before they are ranked according to their importance. Finally, an analytical model established to make VoIP coherent consisted of different stages that included the objective, criteria, sub-criteria, and alternatives as the main decision aspects. Groups of telecommunication experts from diverse organizations were invited to help in making a proper judgment regarding the best VoIP option. Google voice emerged as the most viable alternative from the study due to its effectiveness. Therefore, it is evident that embracing accurate inquiry outlooks and standards are essential for attaining successful research outcomes. The research question is: what is the best-chosen service provider through multiple alternatives?

MD-06.2 [R] • Evaluation of the Cryptocurrency Adoption Decision Using Hierarchical Decision Modeling (HDM)

Saeed Alzahrani; Portland State University, United States
Tugrul Daim; Portland State University, United States

In recent years, there has been a massive attention toward cryptocurrency. The development of the blockchain technology has enabled the cryptocurrency to invade the financial industry by providing, to some extent, an alternative banking system with extra benefits such as lower cost of transaction, faster transaction processing, and higher level of privacy. Bitcoin is the first completely decentralized digital currency to exist in the cryptocurrency market. People have adopted cryptocurrency for several reasons. This adoption is a purchasing decision where the users make the adoption decision based on a set of factors that matter to them. This paper aims at evaluating the factors impacting the cryptocurrency adoption decision. To do so, we have identified the factors that the users consider when making the purchasing decision based on a comprehensive review of recent literature and experts' inputs. The objectives of the paper are to: (1) identify the factors impacting the adoption decision, and (2) determine the ranking of these factors based on the quantification of users' judgments. This paper proposes a hierarchical decision model (HDM) to understand the users' decision to adopt cryptocurrency. The model suggests four main perspectives that influence the adoption decision, namely: economic, technical, social, and personal. Every perspective consists of a set of related criteria. We then used the pairwise comparison method to assess the importance of the perspectives and criteria to the overall objective of the model. The findings of this study suggest that users evaluate and make their decision mostly from economic and social perspectives. The top criteria found to influence the cryptocurrency adoption decision are the investment opportunity, subjective norms, businesses acceptance, privacy, and global attention. This paper provides insights into the factors impacting the adoption decision and their importance level. It also helps the cryptocurrency developers to understand the consumers' adoption criteria to encourage cryptocurrency adoption.

MD-06.3 [R] • Evaluating the Selection of Cellular Business Using A Hierarchical Decision Model: The Case of Libya

Maoloud Y Dabab; Portland State University, United States
Rafaa Khalifa; Portland State University, United States
Nader N Beltiaf; Almadar Aljadid Mobile Phone Company, Libya

With all of the changes and challenges in Libya, the country possesses many positive attributes for carefully targeted investment in several sectors and seeks to use the last updated technology to improve public service. The Libyan ministry of telecommunication is interested in long-term investment in the cellular telecom industry. Although the ministry and its national operators have sought to catch up to the fast growth of the technology and provide the best service to the customers, the sector needs some reforms. Therefore, to improve prospects for success, four options (privatization of the companies, licensing a new foreign operator, supporting existing operators, and joint venture) were identified and evaluated based on a multiple perspectives criteria and goals using a hierarchical decision model (HDM) methodology. The judgments of Libyan experts in the telecom sector were used to validate and quantify the model. The final result shows the licensing of a new foreign operator is considered to be the best option in the case of Libya.

MD-07 Cultural Issues-1
Monday, 8/26/2019, 14:00 - 15:30
Room: Parlor A
Chair(s) Joseph Acai; University of Pretoria

MD-07.1 [R] • The Changing Moral Mirror of Society: From Human to Artifical Intelligent Systems

Gary O Langford; Portland State University, United States
Teresa Langford; Portland Community College, United States

Management of technology and its development carry along the responsibility and consequences for interactions between human and artificial intelligent systems (AIS). In spite of all good intentions, the effects and repercussions of conflicts between humans and the systems built with intent to assist humans may be proceeding along the path that will recognize a dismal mistake in judgment. Dreadful and intolerable impositions on human behavior may arise regardless of how AIS is designed. That is not to say progress should cease, but rather to make the case that intensely determined efforts need to delve into the uses and implications of AIS. Heretofore, only the manifestations of goodwill are energizing research and early uses. This paper proposes and outlines the power of applying systems model-based thinking (SMBT) to begin outlining the realms of behavior that society could be aware. Open discussion to facilitate general awareness is deemed essential to a fuller participation in a useful and enlightened future with AIS.

MD-07.2 [R] • The Innovation Management-Civil Society Connection

Mel Horwitch; Central European University (Former), Hungary

This essay examines a hitherto mostly neglected innovation-management-civil society connection. Innovation management scholarship and practitioner approaches generally focus on building capabilities relevant for promoting effective innovation in diverse organizational venues. However, civil society thinking, scholarship, and practitioner lessons are only beginning to take advantage of innovation management's possible contributions. An absence of sufficient dialogue is unfortunate since innovation management capabilities are increasingly required for viable civil society. This is because such capabilities are well-suited for settings characterized by accelerating technology intensity, increasing emphasis on knowledge building, and the placing of greater priority on value-creation skills. Robust civil societies require appropriate innovation management capabilities because (1) innovation management capabilities are essential for competitiveness today, (2) innovation management capabilities are accessible, and (3) innovation management capabilities possess an underlying moral dimension representing bases for optimism and hope for the future. Relevant streams of thought in innovation management and their pertinence for civil society today are discussed, and contributions of innovation management perspectives and practice for today's civil society are identified. Relevant conditions in Central Eastern Europe are presented as a case in point. Finally, by interacting with greater intensity civil society issues also enlarge the discipline and influence of innovation management itself.

MD-07.3 [R] • Understanding the Mechanism of Residents' Behavior in Demolition Projects in an Ethical Approach: The Effects of Moral Disengagement and Perceived Justice

Chenhan Tian; Tianjin University, China
Lianying Zhang; Tianjin University, China
Shanshan Huang; Tianjin University, China

In the process of new-type urbanization construction in China, conflicts between stakeholders have always been sensitive social issues. Although the laws and regulations regarding demolition are increasingly strict, the behavior of local government and developer are increasingly normative. The unethical behavior of relocated residents became increasingly intractable. Previous studies have largely referred to relocated residents as economic man and focused on the interest game relocated residents are involved in, without considering the effect of ethical factors on the behavior of residents. To close this gap, this paper analyzes the interest demand and possible behavior choice of residents in urban demolition projects through literature reviewing. Then, through a questionnaire survey, this paper discusses the influence of relocated residents' moral disengagement on their behavior. Furthermore, this paper discusses the moderating effect of relocated residents' perceived justice on the above effects and analyzes the mechanism of residents' behavior.

ME-01 Strategic Management of Technology-2
Monday, 8/26/2019, 16:00 - 17:30
Room: Grand Ballroom I
Chair(s) Kenji Nagasato; Hitotsubashi University

ME-01.1 [R] • Overseas Expansion of Japanese Multinational Corporations: Knowledge Transfer Management in Taiwan

Kenji Nagasato; Hitotsubashi University, Japan

Transferring knowledge globally is thought to lead to competitive advantage of multinational companies. However, it is not easy to transfer knowledge from the parent company to overseas subsidiaries. In previous research, the "social relationship" is considered to be important for facilitating the transfer of knowledge from the parent company to overseas subsidiaries. In this research, it is not an approach between organizations such as how to construct social relationships between parent companies and overseas subsidiaries, but if they have special conditions that are overseas subsidiaries, it is easy to transfer knowledge from the parent company to the overseas subsidiary. This result provides useful suggestions for multinational companies to select effective destinations.

ME-01.2 [R] • The Impact of Promotion Mechanism on Consumer Adoption of Mobile Payment

Hsin-yi Hu; National United University, Taiwan

Today, due to the booming of the internet and the popularity of mobile phones, transaction payment methods have become more diversified. The mobile payment involves a very complex mechanism and many industries such as the financial industry, information industry, telecommunications industry and service industry. Mobile payment has gradually affected consumer life and industry development. Many shops and restaurants have begun to provide related services. However, compared with other countries, Taiwan's mobile payment usage rate is low. In order to promote the development of new technology services, the Taiwan government has launched many preferential policies and various promotion activities. The operators have also tried to use different cash discount activities to increase usage of mobile payment and improve transaction efficiency. However, because the cooperative banks and contracts of each mobile payment vendor are not the same, people may have doubts about mobile payment. How to use the suitable promotion method to influence the consumers' intention and behavior of using mobile payment is seen as an important issue. This study mainly uses a questionnaire survey to understand the transaction behavior of consumers using new technology. And it further explores the impact of the promotion mechanism of mobile payment on consumers' intention and attitudes to mobile payment.

ME-01.3 [R] • Adapting Market Uncertainty in Digital Innovation Based on Adaptive Capability Configurations

Wei Yang; Hangzhou Dianzi University, China
Qing Zhou; Hangzhou Dianzi University, China
Gang Fang; Hangzhou Dianzi University, China
Chouyong Chen; Hangzhou Dianzi University, China

Digital innovation is crucial for companies surviving and growing in a digital world. The process of adaption is inevitable to deal with uncertainty in digital innovation and management issues. In this paper, adaption is divided into adjustment and abandonment, and the relationship between adaption and multi-dimensional adaptive capability is investigated. We conducted a fuzzy set qualitative comparative analysis using data from 19 digital innovation projects of listed companies in China and identified four configurations: average adjustment, agile adjustment, adrift abandonment, and anticipative abandonment. The results contribute to the research of adaption and its capability-based theory for digital innovation.

ME-02 Innovation Management-1
Monday, 8/26/2019, 16:00 - 17:30
Room: Galleria I
Chair(s) Jonathan Linton; University of Sheffield

ME-02.1 [R] • Innovation Strategy and Technological Catch-Up of Chinese Internet Giants: Evidences Based on Patent Data

Chenghuan Zhang; The University of Tokyo, Japan
Koichi Tsukioka; The University of Tokyo, Japan
Deyun Yin; World Intellectual Property Organization, Switzerland
Kazuyuki Motohashi; The University of Tokyo, Japan

A new generation of information technology (IT), such as artificial intelligence, cloud computing, internet of things, has been transforming production and business across the world profoundly. While Chinese internet companies begin to play an increasingly important role in the global digital economy by pushing forward the technological frontier, existing studies focus on their business models and ignore their rising technological capabilities. Based on natural language processing (NLP) based text mining and network analysis of patent data, this paper examines whether and how IT companies realize technological catch-up through innovation in emerging economies by comparing three leading internet giants in China, namely, Baidu, Alibaba and Tencent with their US counterparts. In particular, it investigates these three technological companies' innovation strategy by analyzing their (1) patent portfolios, technological focus, patenting patterns and trends, and (2) the technological difference between them and their US peers.

ME-02.2 [R] • The Effects of Business Environments on Innovation Activity and Firm Performance: Based on Workplace Panel Survey of South Korea

Do Bum Chung; KISTI, Korea, South
Hye-Jeong Jang; KISTI, Korea, South
Byungil Kim; Andong National University, Korea, South

Until now, innovation activities have been promoted to maintain sustainable competitive advantage by expanding R&D investment or acquiring external knowledge. However, innovation activity may also be one of the strategies for creating new breakthroughs in difficult situations, so it is necessary to analyze the relationship between innovation activity and firm performance more closely. Therefore, this study aims to analyze the effects of business environments on innovation activity and firm performance, using the data of Workplace Panel Survey (WPS) from Korea Labor Institute. The business environments are largely divided into internal and external environments. Internal environments examine the professional management system and the regular/official personnel evaluation system, because organization management can affect innovation activity or firm performance. In addition, in order to determine what situation firms are facing in the market, external environments examine the degree of competition in the domestic market and the degree of market demand. As a result of the analysis, the regular/official personnel evaluation system and the degree of market demand positively influence both innovation activity and firm performance, but the professional management system and the degree of competition in the domestic market are somewhat different. That is, firms should consider the effects of internal and external business environments for innovation activity and firm performance. This study can be used as basic data for planning the innovation strategy of firms.

ME-02.3 [R] • Measurement and Comparison of Patent Quality on Typical Emerging Industries in China

Xiaoli Wang; Beijing Institute of Technology, China
Yun Liu; University of Chinese Academy of Sciences, China
Defang Yang; Beijing Institute of Technology, China
Yihan Xu; Beijing Institute of Technology, China
Meijian Yang; Beijing Institue of Technology, China

We analyzed the concept of patent quality and the status quo of patent quality evaluation, designed the technical classification systems and patent retrieval strategies, and set up a database of patent characteristic information on graphene industry. We constructed the patent quality evaluation system on "three dimensions - whole process" from three dimensions that included technical quality, legal quality and economic quality, and from four forming stages that included patent creation, patent application, patent examination and patent authorization. According to totality, compound growth rate, patented authorizer type, technology subfield, quality sub-dimension, etc., we systematically measured patent quality of the graphene industry in 31 provinces in China and compared different characteristics of patent quality. Our conclusions were including characteristics of patent quality in each region, region classifications based on the patent characteristics, distribution of regions with relatively high patent quality, and distribution of regions with high development potentiality for patent quality. We attempted to provide effective reference and accurate direction for further monitoring the patent quality on the graphene industry in different regions, formulating policies to improve pat-

ent quality and promoting innovative development on related strategic emerging industries.

ME-03 Emerging Technologies
Monday, 8/26/2019, 16:00 - 17:30
Room: Galleria II
Chair(s) Ronald Vatananan-Thesenvitz; Bangkok University

ME-03.1 [R] • The Emergence of the Personalized Medicine Innovation Ecosystem in British Columbia: Selective Revealing, Strategic Timing and Success

Andrew Park; Simon Fraser University, Canada
Elicia Maine; Simon Fraser University, Canada

Personalized medicine is a growing subsector within medicine and biotechnology, having become a new subdomain of research within the traditional biotechnology industry. This study aims to identify, classify and analyze the emergence of the personalized medicine innovation ecosystem in British Columbia in order to inform innovation policy. We draw on and contribute to the innovation ecosystems and the open innovation literatures by examining the emergence of the personalized medicine industry in British Columbia, and the commercialization patterns and strategies of the firms within it. In this paper we identify and study the formation, open innovation mechanisms, financing and value creation of companies with technologies related to personalized medicine. Of the 94 PM firms founded in B.C., 64 are currently active, with 48% in therapeutics, 38% in diagnostics, and 14% in digital health. We find evidence of the importance of the open innovation mechanisms of selective revealing and of strategic timing to value creation by personalized medicine ventures.

ME-03.2 [R] • Applying Dynamic Topic Modeling for Understanding the Evolution of the RFID Technology

Nils Denter; University of Bremen, Germany
Huseyin Caferoglu; University of Bremen, Germany
Martin G Moehrle; University of Bremen, Germany

Radio-frequency identification (RFID) is an enabling technology that diffuses into several application fields, such as logistics, finance and medicine. Knowledge about the diffusion's direction into application fields, which have not yet completely been exploited, may help technology managers and scholars to better understand the evolution of the RFID technology. Recent methods are either characterized by high manual efforts or miss the opportunity to directly identify emerging application fields. This leads to the question, which method is suitable for examining a technology's diffusion in a time-oriented and highly automated manner? In this paper, dynamic topic modeling (DTM) is applied for this purpose. Using the same RFID patent data set as in earlier publications, we create a term-document matrix. Subsequent to this, we carry out DTM and thus retrieve relevant topics which represent application fields. Additionally, we identify dynamic shifts in the application fields. Finally, we make a comparison between DTM and topic modeling in particular. We conclude that DTM is more appropriate for measuring the diffusion of a technology into an application field than earlier methods. Apart from generating an overview of application fields, DTM enables the observation of term dynamics in the application fields and is therefore suitable for managers and scholars interested in technology diffusion.

ME-03.3 [R] • Technological Capabilities of Printed Electronics: Features, Elements and Potentials for Smart Interactive Packaging

Justina Lydekaityte; Aarhus University, Denmark
Torben Tambo; Aarhus University, Denmark

Printed electronics is a fast-developing enabling technology that employs electrically functional inks and traditional printing techniques to revolutionize the fabrication of various electronic devices to add intelligent and interactive features to physical items such as products packaging. Like every emerging technology, printed electronics has been developed for a few decades and moved from the research-oriented to commercially available production. The technology has taken one more step further into innovation by enabling printing on various substrates, such as flexible plastics, thin films, paper and cardboard. As a result, the traditional passive consumer packaging is facing alternatives and more advanced forms of packaging are being introduced to the market. The entire communication system of the enhanced packaging can be enabled by low-cost, light-weight and flexible electronics such as NFC tags, batteries, displays, antennas, etc. Therefore, this paper aims to explore the characteristics of printing electronics and its potential for smart interactive packaging innovation including available printing techniques, conductive materials and substrates. This paper encompasses an extensive literature review and a set of empirical observations from the industry. The key findings provide a list of potential electronics that can be applied onto smart interactive packaging, as well as a value chain of operational activities related to the manufacture of PE-enabled consumer packaging.

ME-04 New Product Development
Monday, 8/26/2019, 16:00 - 17:30
Room: Galleria III
Chair(s) Martin Hoegl; LMU Munich

ME-04.1 [A] • Deploying Natural Language Processing to Extract Key Product Features of Crowdfunding Campaigns: The Case of 3D Printing Technologies on Kickstarter

Nina Chaichi; Portland State University, United States
Timothy R Anderson; Portland State University, United States

In the technology management field, an informal source of information such as social media has been used for technology mining, leader user detection, etc. However, the usually unstructured nature of the informal information introduces some challenges. This study is part of an effort to automate key product features extraction from crowdfunding campaign's textual information in order to analyze the effect of them on the decision-making process of crowdfunding backers. This paper intends to evaluate the performance of UDPipe R package and six keyword extraction techniques on candidate features selection from textual data of 3D printer campaigns on Kickstarter. In the end, it will be discussed which technique captures the 3D printer features better.

ME-04.2 [R] • New Product Development in Platform Business Ecosystems: Evidence from High-Technology Manufacturing Firms

Chun-Hsien Wang; National Chiayi University, Taiwan
Tachia Chin; Zhejiang University of Technology, China

Platform-based new product development (NPD) in a supply chain can offer focal firms and their collaborators the potential for substantial improvements in the new product being designed. We consider firms in the context of their platform-based business ecosystem and explore how around platforms interlinking suppliers, competitors, distributors, and complementors are organized with respect to complementary activities affect their new product development success. These members rely on the business ecosystem utilizing the shared platform for their product development improvement. Consequently, we study the phenomenon of a platform-base business ecosystem in which platform members jointly design and develop the new product in a cocreation process. We specifically develop a theoretical framework to explain how the platform visibility and new product speed to market of business ecosystem may jointly shape the extent to which participating focal firms can sustain their superior new product performance. A survey of 191 high-technology manufacturing firms is undertaken on the new product development embedded in the platform business ecosystem. We found that the combination of high platform visibility and new product speed to market strengthened the new product performance. Our findings shed new light on strategy in emerging platform business ecosystems and provide guidance to managers on operating the ecosystems.

ME-04.3 [A] • UX-centric Design Method for Open Innovation

Tatsuya Suganuma; Japan Advanced Institute of Science and Technology, Japan

Naoshi Uchihira; Japan Advanced Institute of Science and Technology, Japan

To strengthen a company's core competence and to develop new products and services, a collaboration with diverse industries and companies becomes vital in the current global environment of rapid technological innovation. Many studies have thus been conducted on the topic of open innovation, and these have iterated means of creating new product ideas and of executing new product development through the utilization of open innovation. However, only a few research projects have undertaken the task of bridging new product ideas to the actual development of new products through open innovation programs in which a company collaborates with discrete industries. A company's problem joining forces with other enterprises in different sectors seems to vest in the company's lack of adequate knowledge about the technology of other industries. Hence, the company cannot identify requisite specifications. This paper proposes a new method of transitioning from concept to actual development in open innovation drives by detailing a new product designated UX (User Experience) and using it instead of request specifications. This paper describes a case study on the application of the proposed method to a Fast-Moving Consumer Goods company.

ME-05 Technology Roadmapping-2
Monday, 8/26/2019, 16:00 - 17:30
Room: Parlor C
Chair(s) Clive Kerr; University of Cambridge

ME-05.1 [R] • Roadmap Feature Analysis: Viewing 'Roadmaps' As Maps

Man Hang Yip; University of Cambridge, United Kingdom
Robert Phaal; University of Cambridge, United Kingdom

Roadmapping, a versatile strategy development and planning method, produces visual outputs known as "roadmaps." As the roadmapping approach gains popularity, the diversity of roadmap designs grows. This exploratory study examines how roadmap visuals can be analyzed and classified based on their features. In order to analyze hundreds of roadmap visuals, this study proposes a new integrative method that is grounded in qualitative content analysis and analytical approaches used in geographical visualizations. The proposed method treats roadmaps as geographical maps, focusing on noticing, comparing, and interpreting the shapes, lines, arrows, and other features of the representations. The application of the new method in this study has resulted in the proposal of a feature-based four-level classification hierarchy for roadmaps. The classification hierarchy contributes to the understanding of the forms that roadmaps can take, supporting design choices for roadmap development in different contexts. This study has opened up new research directions for communities interested in roadmapping and visual representation for strategy communications in general.

ME-05.2 [R] • Extended Techniques to Enhance Technology Roadmapping: Research Opportunities and Challenges

Pawat Tansurat; Mahidol University, Thailand
Nathasit Gerdsri; Mahidol University, Thailand

Currently, managing technologies is even more challenging than before, particularly under the current business dynamics and market uncertainty. This will make it more difficult for technology managers to set up their technology plan or roadmap. Therefore, the current approaches of technology roadmapping (TRM) should be enhanced by integrating scenario analysis and other analytical tools into the roadmap development process.

ME-06 Decision Making-2
Monday, 8/26/2019, 16:00 - 17:30
Room: Parlor B
Chair(s) Nasir J Sheikh; University of Bridgeport

ME-06.1 [R] • Digital Decision Support Systems for Enhanced Human Based Decision-making at the Shop Floor Management Level

Pernille Clausen; Aarhus University, Denmark

This paper aims at emphasizing the importance of digital decision support systems (DSS) to enhance the human-based decision making at the shop floor management (SFM) level. This paper suggests that there is an increased focus on implementing digital technologies for developing DSSs that are adapted to the current threshold of the Industry 4.0 (I4.0) era. It is believed that there is a call for appliance of digital technologies for decision support, as the complexity of infrastructures at manufacturing facilities increases and the environments are becoming more uncertain. Those companies that do not move rapidly and focus on being responsive will fall behind and lose market share, due to the large competition seen today. This paper suggests that the adaptation of digital DSSs at the SFM level will support the practitioners in their decision-making processes, wherefrom the performance level will increase.

ME-06.2 [R] • Implementing Neural Networks within Portfolio Management to Support Decision-Making Processes

Michael Riesener; WZL of RWTH Aachen University, Germany
Christian Doelle; WZL of RWTH Aachen University, Germany
Guenther Schuh; WZL of RWTH Aachen University, Germany
Wenjia Zhang; Carnegie Mellon University, Germany
Merle-Hendrikje Jank; WZL of RWTH Aachen University, Germany

Faced with rapidly changing technologies, diminishing product life cycles and heightened global competition, portfolio managers across all industries encounter increasing challenges within decision-making processes. While portfolio decisions were based on subjective experience in the last decades, this is no longer sufficient. Nowadays, as complexity grows constantly, sophisticated analytical methods are needed to enable effective decisions in portfolio management. However, when regarding the field of portfolio management, one can detect a deficit in the amount of research concerning the usage of analytical methods. Additionally, there is a gap between a company's capacity to produce analytical results and its ability to apply them effectively to portfolio management issues. This paper promotes a methodology that uses a neural network to model potential correlations among portfolio-relevant corporate key performance indicators and predict future trends for these indicators. This allows companies to anticipate their portfolio's future development and to proactively manage their portfolio. The method is applied using a case study.

ME-06.3 [R] • Option-Games and Bayesian MCMC Analyses on R&D Investment in Eco-system of New Energy Industry in Myanmar

Nyein Nyein Aye; Toyohashi University of Technology, Japan
Takao Fujiwara; Toyohashi University of Technology, Japan

Myanmar is rich in power sources. But with low levels of electrification, demand for power is not adequately met. And it needs advanced technology and more investment in power generation and distribution. Efficient and effective management of energy resources and innovative technology for producing it is inevitable and has become very crucial to solve climate change and meet the increased energy demand in the 21st century. Option-games theory and Bayesian MCMC Analysis will be utilized to analyze the optimal investment strategies for the high-risk energy industry and find the possibility of raising the firm's revenue in order to endure and overcome the "Valley of Death" in a period of negative profit. In more detail, this research will help us in examining a situation of option-games for the assessment of optimizing the firms' equity between flexibility and commitment. And Bayesian MCMC Analysis will be applied to the parameters estimation between the firm's revenue and investment cost in an eco-system for the sustainability of a new energy industry. After focusing on Japan's electric power business and cooperation between Japan and Myanmar, we would like to search the potential of innovative and initiative new technological energy industry for the regional development and ecological sustainability in Myanmar.

ME-07 Cultural Issues-2
Monday, 8/26/2019, 16:00 - 17:30
Room: Parlor A
Chair(s) Mel Horwitch; Central European University (Former)

ME-07.1 [R] • Exploring Entrepreneurship in the Academic Environment

Cagla Seneler; Yeditepe University, Turkey

Marina Dabic; University of Zagreb, Croatia
Abdalilah Owaishiz; Portland State University, United States
Tugrul Daim; Portland State University, United States

The entrepreneurial university has taken a prodigious influence globally, and studies show the expedient value of entrepreneurship in education. Universities are performing various entrepreneurship activities alongside their main objectives of teaching and research. This study evaluates university faculty of different work experiences and positions on their perceptions toward the entrepreneurial university. Analysis of variances (ANOVA) and least significant difference (LSD) comparisons were performed on participants' work experience by evaluating certain factors of the entrepreneurship university. Independent sample t-tests were conducted to reveal faculty's awareness of entrepreneurship in their universities. The results help in understanding the interpersonal dynamics within academic organizations. Universities worldwide are adopting entrepreneurship in education by introducing models, methods, and collaboration on all levels of industry and government to fulfill innovative systems in academia.

ME-07.2 [R] • Research on the Construction of Popular Science Culture in China in the New Era

Rongying Hou; China Research Inst for Science Popularization, China
Zheng Nian; China Research Inst for Science Popularization, China
Yin Lin; China Research Inst for Science Popularization, China
He Li; China Research Inst for Science Popularization, China

In the new era, the fourth wave of science and technology of the new industrial revolution, with the core of intelligence and the technology of artificial intelligence and Internet of Things as its representative, is sweeping in. In this context, the construction of popular science culture in China is particularly important. Popular science culture is different from scientific culture. This paper interprets the core system of popular science culture from the perspective of Williams' cultural theory. Based on constructivism theory, this paper puts forward Chinese policies and development on the construction of popular science culture in the new era from four aspects: context, cooperation, conversation and significance. And this paper also further clarifies the important value of popular science culture.

TA-01 PLENARY - 2

DATE: TUESDAY, 8/27/2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM I
CHAIR: DR. HARM-JAN STEENHUIS, HAWAII PACIFIC UNIVERSITY, USA

TA-01.1 [K] • Open Innovation Results

Henry W Chesbrough; UC Berkeley-Haas School of Business, United States

I will present my research on Open Innovation Results, a forthcoming book from Oxford University Press. In this book, I discuss the many challenges presented by open innovation, which often fail to generate the positive results expected. To get open innovation results, we need as much attention inside the firm as we do to the relationships outside the firm. We also need a robust innovation infrastructure to deliver stronger results from innovation. Finally, I will explore the Exponential Paradox, a situation in which rapidly advancing technology does not seem to translate into increased economic productivity.

TA-01.2 [K] • Open Innovation: How to Use AI to Enhance the Crowd's Ability to Offer Innovative Strategic Directions for Firms and Society

Ann Majchrzak; University of Southern California, United States

Open innovation refers to the use of external agents, such as public crowds, suppliers, alliances, or partners to provide input for new business innovations. Crowdsourcing is one such mechanism in which a publicly solicited crowd is asked to solve a relatively narrowly defined problem, such as a new marketing pitch (for Doritos), a new energy technology (for GE), a new bottle design (for Heineken), new forms of toothpaste (for P&G), new delivery mechanism for a product (Innocentive), or ways to optimize a recommender engine (Netflix) or a space kit (NASA). Such crowdsourcing is based on the notion that the best way to use the "crowd" is to constrain them to narrowly defined problems with clear evaluation criteria, asking them only for their ideas rather than questioning if the problem was defined correctly, and providing significant incentives to participate. With such constraints, the crowd is unable to offer much help to firms, governments, and social organizations in innovating at the systemic, big picture level, such as suggesting new strategic directions for a firm, or ways to solve global warming. We present data demonstrating that, when the constraints are removed, crowds are more innovative than those with the constraints when solving such "ill-structured problems." We then explain how the data shows us what the crowd's innovation process looks like, when left unconstrained. This innovation process is one that can be facilitated by AI.

TB-01 Strategic Management of Technology-3

Tuesday, 8/27/2019, 10:30 - 12:00
Room: Grand Ballroom I
Chair(s) Greg Daneke; Arizona State University

TB-01.1 [R] • Linkages in 3D Printing Ecosystems

Ricarda B Bouncken; University of Bayreuth, Germany
Roman W Barwinski; University of Bayreuth, Germany
Jochen R Pampel; Macromedia, University of Applied Sciences , Germany

3D printing technologies offer rich opportunities for product, service, and organizational innovation to firms in diverse sectors. Additionally, the 3D printing field includes diverse firms in sectors of manufacturing, services, software and design. Knowledge of 3D printing is dispersed among firms in the field. Innovation in the still emerging 3D printing field is strongly based upon the creation and exchange of knowledge among firms that work in business or knowledge ecosystems. While there is huge research about knowledge creation in firms and in dyad alliances, little is known about it in ecosystems. Our qualitative research explores the characteristics of ecosystems in 3D printing and focusses on how knowledge creation and exchange occur among firms in 3D printing ecosystems. We find that local and trans-local connections play an important role for knowledge exchange of two different key forms of knowledge in 3D printing: operational process knowledge and technology potential knowledge.

TB-01.2 [R] • Analysis of the Socioeconomic Impact of a Voluntary License Granted by a Brand Name Manufacturer to Generic Manufacturers in India

Yaeko Mitsumori; Osaka University, Japan

Due to the rapid technological development of medicine, new medicines with extremely high efficacy - but also extremely high prices - are being distributed. An example is Sovaldi (Sofosbuvir), an anti-Hepatitis C medicine. Sovaldi cures the disease (Hepatitis C) almost completely. However, its price is extremely high. In the U.S., the price of Sovaldi is USD 1,000 per tablet. It is clear that ordinary people in developing countries cannot afford this medicine. To solve this problem, Gilead Sciences Inc., the manufacturer of Sovaldi, concluded a voluntary license agreement with generic medicine manufacturers in India. The voluntary license allows Indian pharmaceutical companies to sell Sovaldi at USD 4.29 per tablet in India and also allows them to export the product to other selected developing countries as well. Gilead's voluntary license scheme was praised by the Indian government, patients in India, and international patient support organizations. However, certain international NGOs, including MSF (Doctors Without Borders), criticized the scheme. This study focuses on the voluntary licensing scheme and aims to determine appropriate medicine prices.

TB-01.3 [R] • Research and Technology Organizations and Management Systems: A Systematic Literature Review

Marina G Murta Moreno; Federal University of Sao Carlos (UFSCar), Brazil
Sergio L Silva; Federal University of Sao Carlos, Brazil

Research and technology organizations (RTOs) are significant elements for national innovation systems (NISs) with the potential of articulating different actors for social and technological development. Although not so often identified in innovation ecosystem studies, the RTOs literature reveals managerial difficulties, especially for institutions in developing countries. Thus, the objective of this research is to systematically analyze the literature aiming at a better understanding of the integration between processes and resources of existing management systems for RTOs as an opportunity to identify gaps and to define possible fronts of interventions. It seeks to make explicit, in a broader way, aspects that can contribute to the operationalization of NISs in developing countries. The systematic literature review was carried out from the Web of Science and Scopus databases and relevant contributions were found regarding the dynamics of the systems adopted by RTOs. Despite the unfolding of practices and structures that contribute to the effectiveness of research, development and innovation (RD&I), most are incomplete proposals since they address only specific areas of management, which opens up opportunities for conducting studies that more potentially explore management system of RD&I in RTOs, among other deployments.

TB-01.4 [R] • Latent Pattern Extraction and Factorization of Firm Bankruptcies and Metabolism in Japan

Hiroko Yamano; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

Maintenance and replacement are key elements of transaction management for companies to survive in a highly volatile market. Companies that have too low or too high rates of transactional continuity tend to leave the market, especially in severe times, such as in the aftermath of The Great East Japan Earthquake. In other words, the metabolism of transactions is the key to companies' survival. However, the question is what types of companies were replaced by other companies and disappeared from the partner companies' list? In this study, we focused on business bankruptcies, which affect the structure of partner firms' transaction networks. Using the data of 1,406,690 cumulative companies over the 10 years from 2007 to 2016 in Japan, provided by Tokyo Shoko Research, Ltd., we investigated the features of companies to identify any patterns in the cases of bankruptcy. We analyzed the business status related to bankruptcy, including discontinuance, suspension, merger, and resumption. To illustrate the latent features of bankruptcies with various corporate features, we used tensor factorial analysis, which reduces data complexity and enables a reasonable interpretation. The analysis results of factorization seem to clarify previously hidden knowledge to support transaction management.

TB-02 Innovation Management-2

Tuesday, 8/27/2019, 10:30 - 12:00
Room: Galleria I
Chair(s) Michael Mendl-Heinisch; WZL RWTH Aachen

TB-02.1 [R] • An Innovation Framework for Innovation Management

Terry R Schumacher; RHIT, United States

A review of the innovation literature uncovered more than 20 separate models, each describing facets of innovation. There are few cross references among these publications; they are scattered across marketing, strategy, and operations literatures. This paper summarizes key attributes of some of these models, creating a compendium of key managerial practices and recommendations.

TB-02.2 [R] • Determination of Radical Innovation Types

Guenther Schuh; Lab. for Machine Tools and Product Engineering WZL, Germany
Paul Zeller; Fraunhofer Institute for Production Technology IPT, Germany
Philipp Steinmetz; Fraunhofer Institute for Production Technology IPT, Germany

Due to increasing environmental dynamics, the initiation of fundamental structural change is of great importance for today's companies. Based on their high degree of novelty, radical innovations are vital for initiating such discontinuous change. Thus, radical innovations offer companies the opportunity to secure a sustainable competitive advantage. However, the number of successfully implemented radical innovations is low. The reason for this is not based on a lack of high potential ideas. The challenge rather is within the implementation and commercialization of these ideas. At this, the success potentials of an idea, which can be influenced by the innovator, are not sufficiently focused during their implementation. Consequently, neglecting these success potentials leads to the fact that specific needs of the innovation, such as capital and knowledge, are not adequately promoted. As a result, promising ideas for radical product innovations experience a lack of resource support and, thus, do not reach the execution phase or miss their later market potential. In this regard, a model for the determination of radical innovation types is developed within this paper in order to describe type-specific needs for a successful implementation.

TB-02.3 [R] • Business Model Innovation (BMI) Process: A Systematic Literature Review with Bibliometric Analysis

Amaury Schaller; Bangkok University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

This paper explores the characteristics of publications related to the topic of business model innovation (BMI) process. In this review, a science-mapping technique was applied to assess 362 Scopus-indexed articles and conference papers concerned with the BMI process. Due to technological progress, competitive changes, or governmental and regulatory alterations, the need to develop and adapt a firm's business model has become an important task to sustain any organization. The successful adaptation of an existing business model to a new environment closes the gap between the firm's basis of competitive advantage in the industry and its extant resources and capabilities. However, innovating the business model remains one of today's most challenging tasks. The aim of this review is to reveal the size, growth trajectory and geographic distribution of the BMI process knowledge base. Moreover, the goal is to detect key journals, authors and publications, as well as to give an overview of the intellectual structure of the literature and possibly highlight actual trends in the domain of the BMI process. The review attested a modest-sized knowledge base concentrated in Western countries. Furthermore, three "schools of thoughts" were identified and further explained. It is a first attempt of a bibliometric review for this field, and thus shall give guidance for future research and practical implications.

TB-02.4 [R] • Building a Socio-Technological Innovation System for African-American Owned Enterprises: Calibrating the Agent-Based Model

Jeffrey O London; University of Bridgeport, United States
Nasir Sheikh; University of Bridgeport, United States

Many surveys reported that African-American enterprises are underrepresented in high-tech innovations and ventures. Inequalities in personal wealth, relatively low levels of enrollment in science and engineering programs, and historically conditioned cultural factors affecting behavior contribute to a lack of African-American high-tech entrepreneurial identity. An agent-based model to simulate African-American high-tech enterprises was developed to identify patterns of successful innovation that could lead to new product development. The goal of this research is to calibrate the agent-based model using case studies. The model includes five types of interactive autonomous agents that comprise a complex innovation system. Through simulation, the causal relationship between elements of the model can be identified to determine factors that lead to the limited representation of African-Americans as owners of high-tech enterprises. By using case studies, the calibration of the model can recommend actions and policies to increase African-American representation in high-tech industries as well as validate the model.

TB-03 TUTORIAL: Open Source Tools for ETM Teaching and Research

Tuesday, 8/27/2019, 10:30 - 12:00
Room: Galleria II
Speaker(s) Timothy R. Anderson; Portland State University
Maoloud Dabab; Portland State University

Dong-Joon Lim; Sungkyunkwan University, Korea, South

This session will demonstrate how we have transitioned a research platform to R for open access and incorporated it into teaching materials, including two open access books and free packages that others are welcome to use.

TB-04 Internet of Things (IoT)
Tuesday, 8/27/2019, 10:30 - 12:00
Room: Galleria III
Chair(s) Vijay Singh Rathore; IIS University, Jaipur

TB-04.1 [R] • Design and Evaluation of an Approach to Generate Cross-Domain Value Scenarios in the Context of the Industrial Internet of Things: A Capability-based Approach

Patrick Weber; Ferdinand-Steinbeis-Institute, Germany
Simon Hiller; Ferdinand-Steinbeis-Institute, Germany
Heiner Lasi; Ferdinand-Steinbeis-Institute, Germany

Smart speakers illustrate how in consumer internet of things physical assets have a digital twin stored on digital platforms. The numerous skills across different vendors in the system of smart speakers are one example of added value in platform-based ecosystems. Based on the three-tier architecture of the Industrial Internet Consortium we illustrate the principles of consumer internet of things and transfer them to the industrial internet of things. With our developed multi-stage approach, enterprises have a guidance for how they can use their business capabilities to generate added value in platform-based ecosystems. Therein, business capabilities create the link between technology and the business model. The developed approach is applied and evaluated in a case study in the context of industrial service. Beyond this paper, the approach is currently applied to other cases outside the industrial sector, such as additive manufacturing and catering.

TB-04.2 [R] • An Intelligent Risk Management Model for Achieving Smart Manufacturing on Internet of Things

Joseph S.M. Yuen; The Hong Kong Polytechnic University, Hong Kong
King-Lun Choy; The Hong Kong Polytechnic University, Hong Kong
H.Y. Lam; The Hong Kong Polytechnic University, Hong Kong
Y.P. Tsang; The Hong Kong Polytechnic University, Hong Kong

To adapt to the ever-changing environment, Internet of Things (IoT) has emerged for supporting manufacturing plants to better manage the quality of products. Since the application of IoT is relatively new to the manufacturing industry, increasing attention has been paid on how to manage the planning and implementation process so as to achieve smart manufacturing. However, IoT applications in each manufacturing plant are varied due to different specifications, such as the product types, product nature, plant layout, production flow, machine and equipment settings. Hence, it is essential to perform risk analysis to ensure that any possible situation and uncertainty is being considered before the implementation process. Risk management plays an important role since disruption can cause significant financial and reputational loss, especially for electronics products, which are environmental-sensitive. In this study, an electronic manufacturing risk management model (EM-RMM) is designed to assess the risk faced by manufacturing plants for IoT applications. By identifying the risks faced by manufacturing plants for IoT applications, the likelihood and consequences of the risks are analyzed by using fuzzy analytical hierarchy process (FAHP) to calculate the weighting of the risks. Through a case study in a plant which manufactures environmental-sensitive electronics products, the results provide a systematic procedure for risk assessment in IoT implementation, with the aim of achieving smart manufacturing.

TB-04.3 [R] • Innovation Design Method for the Internet of Things: Requirements and Perspectives

Naoshi Uchihira; Japan Advanced Institute of Science and Technology, Japan

Innovation in the internet of things (IoT) provides various opportunities for large-, medium-, and small-sized companies; however, its realization is still challenging for these companies. Therefore, an engineering design methodology for IoT innovation is required, especially for non-information and communication technology experts. In this paper, we call the engineering design method for IoT innovation "IoT innovation design method" and discuss its requirements and perspectives with reference to previous studies. Then, this paper proposes a concrete IoT innovation design method with an example. This paper contributes to existing studies not only by proposing a new specific method but also by clarifying the general requirements and perspective (viewpoints) of IoT innovation design methods.

TB-05 Technology Acquisition & Adoption-1
Tuesday, 8/27/2019, 10:30 - 12:00
Room: Parlor C
Chair(s) Tugrul Daim; Portland State University

TB-05.1 [R] • Analysis of the Cryptocurrency Adoption: Literature Review

Saeed Alzahrani; Portland State University, United States
Tugrul Daim; Portland State University, United States

Cryptocurrency is a recent and significant innovation in the financial industry. The goal is to offer a currency that is not tied, created, or backed by a government. Cryptocurrency use the Blockchain technology as the financial platform. Cryptocurrency adoption level has increased, and the market has grown dramatically. There have not been enough literature investigating the adoption and acceptance of the cryptocurrency by users. The aim of this paper is to fill the gap in the current literature by investigating the current cryptocurrency adoption level, adoption-influencing factors, providing an in-depth analysis of these factors and discussing some pitfalls surrounding the cryptocurrency adoption. We believe that despite the difficulty to find out an accurate number of cryptocurrency users, a good estimate can be made by studying the number of cryptocurrency exchange sites' users. In addition, the paper suggests that the main factors driving the adoption decision revealed from the literature review are the investment opportunity cryptocurrency forms, the anonymity of the transactions and privacy, the acceptance by businesses as a payment method, the fast transfer of funds, the low cost of transactions, and technological curiosity. The research findings help researchers, regulators, and cryptocurrency developers to better understand their consumer's intention toward cryptocurrency adoption.

TB-05.2 [R] • Strategic Alliances for Technology Adoption: Alliances and Partnerships for Blockchain Adoption

Anju Babu; Portland State University, India
Charles Weber; Portland State University, United States

This paper aims to study the relevance and importance of strategic alliances for emerging technology adoption. The case researched and discussed here is Blockchain adoption in the semiconductor industry. As a technology, Blockchain has been around for over a decade and is known to provide tremendous value in business transactions. However, the adoption has not gained traction mainly due to the fact that it takes a network to adopt an industrial Blockchain and cannot work in silos. Most companies are shying away from it as they haven't explored what makes a successful strategy for adoption. A literature review was done on the similar technology adoption in the past. The nature of Blockchain and its network dependency were considered. It was clear that strategic alliances are the way to move forward. The various aspects to be considered while forming an alliance, such as understanding the core competencies, finding the right partners, and form of alliances were studied. The research converged in understanding the fact that companies should move away from the transactional business model and have the right expectations and scoping on all sides, standardization, digital integration, and a steady focus on security and privacy.

TB-05.3 [R] • Order or Chaos: The Case of Cryptocurrency Platform

Tsung-Han Ke; National Chi Nan University, Taiwan
Hung-Chun Huang; National Chi Nan University, Taiwan
Hsin-Yu Shih; National Chi Nan University, Taiwan

The purpose of this study is to explore the market maturity of cryptocurrency trading platforms based on the information transmission perspective of financial market price volatility. This study uses the volatility spillovers index proposed by Diebold and Yilmaz and uses the bitcoin trading platform to measure the total price volatility of cryptocurrency trading platforms and the directional spillovers among the trading platforms. The sample period is from January 1, 2015, to September 30, 2018. In the empirical process, each sub-sample is taken every three months. The argument of this research indicated that if the cryptocurrency trading platforms' total spillover effects, with the rolling of the sub-sample period, show the increasing trend, and the trading platform has a staggered spillover effect with each other, indicating that cryptocurrency trading platforms exist the chaotic phenomenon, and the cryptocurrency market is in a stage of low maturity. On the contrary, if the total spillover effects are showing a decreasing trend and the spillover effects are mainly from a certain minority trading platforms, indicating that the cryptocurrency trading platforms present the order phenomenon, and cryptocurrency market is at a stage of high maturity. The contribution of this research is to identify the market maturity of the cryptocurrency trading platform, and to promote policy makers to propose a market-building mechanism for the market situation, so that the cryptocurrency has the opportunity to become a mainstream trading tool.

TB-05.4 [R] • Critical Factors Related to Student Success Technology

Hans VanDerSchaaf; Portland State University, United States
Tugrul Daim; Portland State University, United States

This study examines university students' perspectives on student success technology. Efforts to improve graduation and retention rates for undergraduates (i.e., "student success") and initiatives to enhance the overall student experience are critical for higher education administrators, faculty and staff. These actors are significantly dependent on technology and technology-mediated services. To help understand student perspectives on online services related to student success, this study uses data from a 2016 survey of Portland State University students about the importance and satisfaction that students placed on accomplishing key tasks online (n=1,190 respondents). The main questions in this inquiry are: 1. What, if any, factors, or latent variables, are in the data set? 2. If there are latent variables, what might they tell us about students' perspectives on accomplishing critical online tasks? The study's main findings are that five factors - navigation, tactical, funding, personalization and planning - are present in the data and statistically significant. The findings also suggest that a sixth factor, funding, is not significant. This study contributes to the literature by supporting the notion that there is harmony between the technology that universities utilize to support students and the value that students derive from such tools.

TB-06 Intellectual Property-1
Tuesday, 8/27/2019, 10:30 - 12:00
Room: Parlor B
Chair(s) Yoshikazu Yamaguchi; Chiba Institute of Technology

TB-06.1 [R] • The Alignment between a Patent's Description and Claims: Insights from Semantic Measurement in the Case of Blockchain Technology

Bennet Bruens; University of Bremen, Germany
Martin G Moehrle; University of Bremen, Germany

Patents are a broadly used legal right to protect a company's technology. They comprise two major sections, namely the claim section and the description section. Both sections have to be well prepared and aligned to get the invention granted by the patent office. While the claim section includes the idea of the invention separated in several independent and dependent claims, the description section has to cover a detailed explanation of the invention and should extend it by a proper prior art analysis. A good alignment of the claim section and the description section implies that the claimed content is backed up well by the description. This leads us to our central research question. How well aligned are patents actually? For this purpose, we select blockchain technology as case for our analysis, and apply a basic semantic analysis for a general impression of the patents' alignment. We find three different groups of patents and two weak trends, namely a slight increase of alignment as well as a slight increase of additional information in the description section over the course of time. Additionally, we introduce a new semantic approach, recombining the claim section of a patent to claim elements, to identify precisely how well aligned each part of the claim section actually is. Doing so, we identify two types of claim elements that are not well aligned and discuss possible reasons. For both, managers and researchers, this can help to evaluate patents by a semantic perspective and to see their strengths and weaknesses.

TB-06.2 [R] • Identification of Probable Standard Essential Patents (SEPs) Based on Semantic Analysis Of Patent Claims

Sven Wittfoth; Volkswagen Aktiengesellschaft, Germany

One of the most important tasks in patent analysis is to evaluate a patent in order to identify its financial asset. Patents that are essential for standards, so-called standard essential patents (SEPs), are an especially valuable type of patent because patented products and processes that are essential for standards are primarily designed for the mass market and often generate high royalties. Although several committees publish SEPs by naming the associated standard codes, there are a large number of patents that are likely to be SEPs but have not yet been declared. Market participants are interested in identifying SEPs, and particularly potential SEPs, as these may affect their businesses now and in the future in terms of risk management. In addition to risk issues, opportunities can also be gained through license fees if patents that are suitable as SEPs can be identified within one's own patent portfolio. In this article, the author provides a computer-based method that helps patent holders to determine whether a patent is likely to be declared an SEP and which standards are suitable for potential SEPs, based on a semantic analysis of patent claims using artificial intelligence in the form of the Doc2Vec algorithm.

TB-06.3 [R] • Patent Portfolio Model for Measuring Strategic Technological Strength

Shuying Li; Chinese Academy of Sciences, China
Zhang Xian; Chinese Academy of Sciences, China
Xu Haiyun; Chinese Academy of Sciences, China
Fang Shu; Chinese Academy of Sciences, China
Edwin Garces; Portland State University

As technological innovation plays an important role in today's knowledge economy, organizations are increasingly protecting their inventions by including innovation, entrepreneurship and economic engagement in their strategic planning processes. Intellectual property as the most important output of technological development is valued highly for generating monopoly position in providing payoffs to innovation. Intellectual property management (IPM) helps organizations to identify, enhance and evaluate their technological strength. For patent portfolios are not merely singular super-patents; instead, the inherent diversity created by the aggregation of many different patents offers holders a range of benefits, such as the ability to address the risk and uncertainty fundamental to innovation. A patent portfolio model is built for assessing the advantages and disadvantages of an organization with different technological fields, identifying the opportunities of development potentials and optimal distribution, to support the decision-making for optimizing resource allocation and developing layout for technical field. A three-dimensional model is constructed with technical distribution of patent quantity, depth management of IPR and integrated utilization.

TB-07 Technology Management Framework
Tuesday, 8/27/2019, 10:30 - 12:00
Room: Parlor A
Chair(s) Dilek Cetindamar; University of Technology Sydney

TB-07.1 [R] • A Bibliometric Analysis of Technology Management Research at PICMET for 2009-2018

Dilek Cetindamar; University of Technology Sydney, Australia
Dundar F Kocaoglu; Portland State University, United States
Thorsten Lammers; University of Technology Sydney, Australia

Jose M Merigo Lindahl; University of Technology Sydney, Australia

The Portland International Centre for Management of Engineering and Technology (PICMET) was established in 1989. It has since become one of the leading organizations in the field of management of engineering and technology in the world. PICMET provides a strong platform for academicians, industry professionals and government representatives to exchange new knowledge derived from both research and implementation of technology management. To celebrate its 30-year journey, and to show the trends in technology management research and implementation over the past ten years (2009-2018), this paper presents a bibliometric analysis of the more than 3000 papers accepted for inclusion in PICMET conferences. The study highlights the topics, authors, journals and countries where significant research on technology management is conducted.

TB-07.2 [R] • Machine and Human Is the New Workspace in Emerging Economies: A Phased Approach as the Strategic Framework to Reach Sustainable Economic System Readiness

Rendani Mamphiswana; University of Johannesburg, South Africa
Saurabh Sinha; University of Johannesburg, South Africa

Intelligent technology systems are the new co-workers in the workspace. The wide adoption of these systems in emerging economies, such as South Africa, threatens to worsen unemployment. The expected unprecedented benefits of integrating intelligent technology systems within firms is likely to act as a catalyst for wide, seamless and rapid adoption in emerging economies. This paper proposes a conceptual framework: a phased approach to strategically reach sustainable economic readiness. The proposed conceptual framework defines central mechanisms to guide emerging towards achieving sustainable economic system readiness for human and machine interface in the workspace. An in-depth literature review, on firms' introduction of technologies in the workspace, was conducted, to extract key variables that aided the development of the proposed framework. The research followed a case study approach, where key variables were extracted from literature to compose the proposed framework. The output of this research is envisioned to contribute towards an improved understanding on how emerging economies ought to respond to the coming wave of intelligent technology systems in the workspace. This improved understanding is aimed to be a central enabler in developing suitable policies to manage the impact. The next phase of the research would be to select firms within emerging economies to test for causality among variables composing the proposed conceptual framework.

TB-07.3 [A] • The Influence Factors Analysis of Job Satisfaction of S&T Workers: Based on a National Survey

Kang Li; National Academy of Innovation Strategy, CAST, China
Dasheng Deng; National Academy of Innovation Strategy, CAST, China

China faces serious challenges in mobilizing the enthusiasm of science and technology workers. For this, this paper aimed at measuring job satisfaction and its influence factors. This paper employed the national survey data on Chinese science and technology workers. The assessment structure of S&T workers' job satisfaction in China is composed of 15 dimensions. This paper employed three methods to measure job satisfaction and used regression model to analyze the influence factors. The statistic results show a positive relationship among job satisfaction and working conditions, scientific research results, salary levels, and management system, while gender and administrative post are not statistically significant.

TD-01 Strategic Management of Technology-4

Tuesday, 8/27/2019, 14:00 - 15:30
Room: Grand Ballroom I
Chair(s) Ricarda B Bouncken; University of Bayreuth

TD-01.1 [R] • A Literature Review on Big Data Analytics Capabilities

Baraah Shdifat; University of Technology Sydney, Australia
Dilek Cetindamar; University of Technology Sydney, Australia
Shadi Erfani; University of Technology Sydney, Australia

Many researchers and practitioners are interested in big data due to its transformational potential for achieving competitive advantage. Recent studies indicate that business achieves competitive advantage not only by investments on technology infrastructure but also by creating technological and organizational capabilities. In the light of the Resource-based View theory, this paper aims to find out "what capabilities have been required to build big data analytics?" by conducting an in-depth literature review. We adopted a systematic literature review approach and studied academic articles published between 2010 and 2018. We used Scopus and Web of Science (WoS) databases to find published studies related to big data analytics capabilities, 25 of which met the selection criteria. Results showed capabilities of big data analytics fall into two major categories: human and infrastructure capability.

TD-01.2 [R] • Resilient Technology Strategy in Volatile Environments Derivation of Requirements to Enable Long-Term Strategic Positioning in Times of Volatility, Uncertainty, Complexity and Ambiguity

Guenther Schuh; Fraunhofer-Institute for Production Technology IPT, Germany
Marc Patzwald; Fraunhofer-Institute for Production Technology IPT, Germany
Maria Cristina Imhaeuser Cardoso; Fraunhofer-Institute for Production Technology IPT, Germany

As a result of various influences such as globalization, digitalization or industry convergence, companies are confronted with an increased level of volatility, uncertainty, complexity and ambiguity (VUCA) in their corporate environment. To maintain competitive advantage in this environment, companies, especially in the manufacturing sector, are forced to build up new competences aside their core business to evade commodification. Strategically managing the company's competence- and technology portfolio to build sustainable competitiveness in a long-term technology strategy is heavily impeded by the VUCA environment: Current technology strategy concepts are strongly linked to technology planning, allowing volatility on the planning level to result in strategy changes. As strategic positioning remains a crucial factor for a company's sustainable success, an adjusted concept for technology strategy is required enabling companies to consistently manage their long-term competence- and technology portfolio in a volatile environment. Therefore, the authors discuss the status-quo of technology strategy development in this paper and systematically derive the deficits that arise from a volatile corporate environment. Based on the identified deficits a first attempt is taken to develop requirements for a VUCA-resilient technology strategy development. Adapting technology strategy development to these requirements shall help companies to ensure a consistent long-term corporate development.

TD-01.3 [R] • A Protocol for Replicating a System-Dynamics-based Simulation Models

Armando Elizondo-Noriega; Texas Tech University, Mexico
Naveen Tiruvengadam; Texas Tech University, United States
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Victor G Tercero-Gomez; Tecnologico de Monterrey, Mexico
Mario G Beruvides; Texas Tech University, United States

System dynamics (SD)-based simulation has gained traction in recent times as a technique to study a system's behavior. It has been employed to model diverse complexes, from reactive chemical assemblages to socio-economic systems. However, SD-based simulation models, like models derived from competing simulation techniques, typically suffer the problem of replicability. There are several sources of variation that could afflict any replication attempt such as software idiosyncrasies, floating point errors, and missing data. Adapting to these often intractable limitations will afford the SD-based technique the ability to be used to model problems of higher complexity, which is what this study seeks to do by suggesting an adaptation protocol. This protocol is tested via the replication of a holistic SD-based simulation model to deal with the eventual effects of the interventions in a quality system on a manufacturing organization's profitability. The study also identifies possible avenues for improvement of the protocol for a better fit to diverse SD-based models.

TD-02 Information/ Knowledge Management

SESSIONS

Tuesday, 8/27/2019, 14:00 - 15:30
Room: Galleria I
Chair(s) Haydar Yalcin; Izmir Katip Celebi University

TD-02.1 [R] • Inter-domain Linking of Problems in Science and Technology Through a Bibliometric Approach

Hajime Sasaki; The University of Tokyo, Japan
Satoru Yamamoto; Data Artist Inc., Japan
Amarsanaa Agchbayar; Data Artist Inc., Mongolia
Nyamaa Enkhbayasgalan; Data Artist Inc., Mongolia
Ichiro Sakata; The University of Tokyo, Japan

Science and technology activities are recognized as problem-solving activities. Most solutions are created by tackling problems with previous knowledge, not only in an academic context but also in an industrial context. Scientific papers and patent publications can be regarded as explicit knowledge obtained by problem solving in the academia and industry, respectively. However, approaches toward problem solving do not necessarily match between scientific papers and patentable technology, even in the same field. The research question addressed here is whether scientific problems can be provided insights from technical problems and solutions. In this study, we propose a concept to link problems in inter-domains for knowledge discovery using a linguistic approach. We extracted scientific papers and patent publications related to computer science as datasets in this study. Then, from these datasets, we identified problem sentences and solution sentences by neural probabilistic language model focusing on attention mechanism. Our approach is applied to extract groups of sentences for identifying semantically similar problems in inter-domains. From the results, we extracted several pairs of problem sentences across the domain. The results suggest that scientific problems and industry solutions may be able to give insights for each other. This approach is also recommended not only for corporate activities but also for identifying research trends.

TD-02.2 [R] • The Main Sources for Technology Management Research: A Bibliometric Approach

Tugrul U Daim; Portland State University, United States
Haydar Yalcin; Izmir Katip Celebi University, Turkey

In this study, it is aimed to determine the main sources of the technology management (TM) field. Since there are many bibliographic databases, it is important to identify which journal is the most important in TM, and there are many journals published in this field, it is possible to decide which one is the most important journal for TM. For this purpose, a series of analysis were performed on bibliographic data of the publications indexed in the Web of Science using bibliometrics. The main purpose of the study is to identify and rank the most important journals in the field of TM. In this way, it will be possible to determine the most important publications in the field of TM. To determine the main journal list for the TM area, Bradford law will be used, and citation analysis methods will be used to determine the impact of journals in the field.

TD-02.3 [R] • Reflection of Critical Thinking on the Sustainable Educational Development: A Case Study of the Middle East and North Africa

Dana S Bakry; Portland State University, United States
Maoloud Dabab; Portland State University, United States
Rafaa Khalifa; Portland State University, United States

The development of education through critical thinking is becoming the ultimate goal in developing countries. However, there are numerous factors and challenges in the implementation and adoption of a unique educational system, particularly in the developing countries. Most countries in the Middle East and North Africa have made significant progress toward raising children's school enrollment and completion. However, the quality of education and coherence in content between countries' education systems are still considered as a major issue. To achieve the sustainability of the higher education system, educators must have the knowledge and skills to integrate the critical thinking approach in the development and delivery of the educational curriculum. The purpose of this paper is to simplify the understanding of the importance of critical thinking in the sustainable educational system. Also, this study aims to propose a critical thinking approach that might help to improve the performance and raise the production efficiency of the educational system in Saudi Arabia and Libya. This paper defines both regions in the Middle East and North Africa with cases of Saudi Arabia and Libya, respectively. We focus on determining the educational system needs, its development cycle, and documenting requirements in each country, and we proceed with design synthesis and system validation while considering the complete problem.

TD-02.4 [A] • Improvement of the Production Quality of the Textile Industries in Madagascar by the Knowledge Engineering

Andriamananarivo Rakotozandry Ignace; University of Antananarivo, Madagascar
Mickael Gardoni; Ecole de Technologie Superieure, Canada
Andriakoto Elise Raveloson; University of Antananarivo, Madagascar
Diamondra Razaivaovololoniaina; University of Antananarivo, Madagascar

The textile industry in Madagascar has a very important weight for the Malagasy economic situation. It is the sector that contributes the most to job creation as well as to export. There are two main categories of factories: free zone companies that are moving towards export and small- and medium-sized units who produce for local consumption. The lack of technical competence of the majority of the employees constitutes a common block for the two factories category. The failure is related to the low employee's education level. This gap questions the competitiveness of textile enterprises in Madagascar at the national and global level. Moreover, quality is one of the critical success factors that must be mastered by textile companies to be able to dominate the world of competition. This paper suggests a managerial strategy, the knowledge management, as a lever of quality production improvement. It has as an objective the capitalization, enhancement and improvement of the company's knowledge while placing at the center the human resources. These are the sources of knowledge and the challenge is to formalize and share expert know-how. Nonaka's model has been exploited to achieve knowledge transfer. MASK method is used to rationalize Nonaka's knowledge management cycle. It is recommended that textile companies in Madagascar integrate knowledge management into their management system in order to optimize production quality, productivity and stimulate innovation.

TD-03 Technology Management in the Biotechnology Sector-1
Tuesday, 8/27/2019, 14:00 - 15:30
Room: Galleria II
Chair(s) Hiroshi Kubo; Chiba Institute of Technology

TD-03.1 [R] • Capital Efficiency for Development Stage Biotech-based Firms: An IPO Perspective

Mark J Ahn; Portland State University, United States
Amir Shaygan; Portland State University, United States

Access to multiple tranches of capital is critical for predominantly no revenue development stage biotech firms. While financing needs are monotonically increasing over multiple years in the product development approval cycle, the market for high risk, milestone driven biotech investment is significantly more volatile than the financial markets as a whole. In this paper, we analyzed the role and relative importance of global biotech IPOs, as well as other sources of capital such as strategic alliances, for research and development funding. We also explored and assessed the degree of mismatch between the access to capital, operational efficiencies, and how firms solve the potential unmet capital requirements. Implications for investors, as well as small and large biotech company managers, is discussed.

TD-03.2 [R] • The Productivity of Drug Development: A Systematic Review

Takeshi Akiyama; Tokyo Institute of Technology, Japan
Shintaro Sengoku; Tokyo Institute of Technology, Japan

The evaluation of the productivity of research and development (R&D) is crucial for the management of pharmaceutical businesses, and various methods, indicators, and proposals

for R&D improvement have been investigated; however, there is no consensus on a unified criteria. To resolve this issue, we present a comprehensive review of previous studies on the topic. Publication databases were searched for all relevant studies related to the following: the pharmaceutical industry, R&D, and productivity; a total of 6,357 publications were obtained. Through in-depth screening, 190 publications were selected and subsequently reviewed. As a result, methods for the evaluation of pharmaceutical R&D were classified into four major approaches: R&D cost, regression analysis, ratio analysis and data envelope analysis (DEA). The characteristics of each of these approaches were examined from the following three perspectives: the pharmaceutical industry-level, company-level, and project-level. Furthermore, several elements were identified that explain the significant decrease in pharmaceutical R&D productivity: the sustainability of a business model; increase in R&D expenditure; effectiveness of outsourcing; size of the company; and premiums and amortization with mergers and acquisition (M&A). By forming an intellectual basis for the evaluation procedures, the present study has contributed to the theory of R&D management and to the practices used in the pharmaceutical industry.

TD-03.3 [R] • The Key Success Factors of Biotech Start-Up Firms: Characteristics and Attributes of the Management Teams of High-Performing Biotech Start-Ups

Yoshimi Harada; Tokyo Institute of Technology, Japan
Shintaro Sengoku; Tokyo Institute of Technology, Japan

Biotech start-up firms have become the major originator of innovative products in the pharmaceutical industry. The composition and capability of the management team are key factors in their steady growth and are more elastic than other resources such as the size of capital and number of products. However, the characteristics and dynamics of the management team are not fully understood in Japan, resulting in limited value creation. To address this issue, the present study conducted a systematic review of representative publications on the key success factors of biotech start-up firms. Considering the massive investment and long time before generating revenue with a lower success rate in uncertain situations, we defined firms' success in terms of achieving initial public offering or entering a clinical study (internal factors) and the significance of support from venture capitalists and alliances with large corporations (external factors). Furthermore, we identified the key characteristics of the management team of a start-up firm in terms of its transformation over time, modes of contribution by a seed originator, legitimacy, and scientific understanding.

TD-04 Artificial Intelligence for Technology Management-3

Tuesday, 8/27/2019, 14:00 - 15:30
Room: Galleria III
Chair(s) Heyoung Yang; KISTI

TD-04.1 [R] • An AI-based Approach to Analysis of Medical Innovation: A Case of Ulcerative Colitis Treatment

Kunitoshi Yamasaki; Hitotsubashi University, Japan
Ryuichi Hosoya; Hitotsubashi University, Japan

The role of AI which has been put into practical use recently can be roughly divided into two. One is supplementation of work which human beings have done so far and the other is in areas in which AI outperforms human's work. This paper introduces the process of analyzing the mechanism of occurrence of medical innovation based on natural language processing combined with machine learning techniques, which enables processing a large volume of medical information far more efficiently than a human being. Specifically, with our approach, combined with our dataset, a person can easily understand trends in innovation in the treatment method of an intractable disease. A case study of the analysis of an innovation process for which research efforts had found an effective treatment is discussed.

TD-04.2 [R] • Artificial Intelligence in Healthcare: A New Technology Benefit for Both Patients and Doctors

Le Nguyen; University of Economics and Finance, Vietnam
Thi Thu Ha Do; University of Economics and Finance (UEF), Vietnam

Artificial intelligence (AI) is arguably the most exciting robotics industry and it is recently emerging in healthcare. Most of the researches have been focusing on prediction algorithms of patients' diseases such as cancer, cardiology, breast pathology, etc. Some findings increased computer intelligence as the main application of AI, which is called deep or non-deep machine learning. The gap from previous models is using one function or one type of AI to analyze and forecast diseases rather than helping patients and doctors in surgery. There are rarely white papers using AI for patients approach to training them to know more about their diseases or surgery. Therefore, with developing of more than one function of AI, the paper builds a diagrammatic conceptual model of artificial intelligence on medical app running Blockchain technology as a friendly assistant for both patients and doctors to communicate with them during pre-surgery, surgery and post-surgery. First, AI as an assistant checks free appointment from doctors and patients' available time. Second, AI reminds doctors about their schedule of up-coming surgeries and trains patients before having surgery. Third, deep learning AI analyzes patients' healthcare records and suggests the solutions for patients after surgery under the doctor's review. This paper hopefully will contribute to AI application in healthcare in which not only doctors are using it but also patients, drug companies, insurance companies and hospitals can approach.

TD-04.3 [R] • Cybersecurity Planning for Artificial Intelligent Systems in Space

Gary O Langford; Portland State University, United States
Lucas Beaulieu; United States Air Force, United States
Jeff R Carpenter; Maseeh College of Engineering, United States
Ian Watkins; United States Air Force, 9th Bomb Squadron, United States
Brock Marsh; United States Air Force, United States
Teah Heidorn; United States Air Force, United States
Chris Chase; Portland State University, United States

CubeSats continue to proliferate and are an excellent low-cost method of remote sensing. A key piece of intelligent systems is sensory input, data storage, and data communications. With the continued miniaturization of technology, CubeSats will increase their sensory inputs with future miniaturization and enhance their robustness for autonomous operations if data and communications are secure. These futures inspire an intelligent system solution to on-orbit communications. This paper explores a dual-microprocessor approach to improve hardware cybersecurity of intelligent systems, with a view toward intensional intelligence as a means of adjudicating access to sensitive data onboard the CubeSat. With enhanced cybersecurity, artificial intelligent systems (AIS) will add vital utility to otherwise vulnerable, autonomous systems. Using systems models-based thinking, we shed light on our plan to apply artificial intelligent system concepts to advance CubeSat technology. Managing technology for AIS reduces some of the uncertainties and risks associated with the space environment.

TD-05 Technology Transfer

Tuesday, 8/27/2019, 14:00 - 15:30
Room: Parlor C
Chair(s) Barry Bozeman; Arizona State University

TD-05.1 [A] • A Study on the Performance Factors of the Science and Technology Policy Consultation Project for Developing Countries

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

While the amount of official development assistance (ODA) of Korea has been increasing, there are some criticisms about the effectiveness and management of ODA itself. ODA projects in the area of science, technology and innovation (STI) are also increasing but seem to have many problems too. First, there is not a clearly defined or agreed on definition for STI ODA internationally as well as domestically. Second, the evaluation of the STI ODA performance is not enough. Third, the planning and management capability for an ODA project is

generally lacking. In this background, the performance factors of a STI policy consultation project were analyzed using the case studies and expert interviews. It is concluded that not only STI knowledge transfer capacity but also the absorption capacity are critically important for the success of a STI policy consultation project. In this sense, it is suggested to plan and manage the STI ODA project with the consideration of both transfer capacity and absorption capacity.

TD-05.2 [R] • Absorptive Capacity in Knowledge-Intensive Teams: A Review of Current Literature and Future Tasks

Xiang Yu; Hitotsubashi University, China
Yuichi Washida; Hitotsubashi University, Japan

Companies have been increasingly opting to utilize knowledge-intensive teams to contend with highly turbulent and dynamic conditions as it can promote innovations performance and lead to competitive advantage. Knowledge-intensive teams, just like research teams, product development teams or strategic planning teams, rely on highly qualified individuals to absorb new external knowledge and share it among the entire company to ensure the ability of solving complex tasks. So, knowledge-intensive teams must access a high level of absorptive capacity (hereinafter, ACAP), which has been defined as a set of dynamic organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to assure they can absorb and exploit new external knowledge. In spite of the importance of finding out how to build ACAP for knowledge-intensive teams, few studies in this field disintegrate the ACAP construct into the team level and investigate how to promote ACAP at the team level. Since ACAP is regarded as a kind of multilevel capability and it only can be internally built rather than simply bought from outside as its organization-specific nature, we review important prior studies in this field and state that future research should focus on the combined effects of gatekeepers and combinative capabilities on ACAP.

TD-05.3 [R] • Diffusion of Technological Products from Selected Nigerian Technical and Vocational Colleges

Abiodun I Oyebola; Obafemi Awolowo University, Nigeria
Titilayo Olubunmi Olaposi; Obafemi Awolowo University, Nigeria
O. O Adejuwon; Obafemi Awolowo University, Nigeria
Joshua Babatunde Akarakiri; Obafemi Awolowo University, Nigeria

An important phase of the innovation process is diffusion. Innovations that are not diffused are not useful to the society and cannot contribute to productivity, job creation and the national economy. Findings from studies have shown that various types of technological products are being developed in Nigerian technical colleges. These will amount to wasted efforts if they are not utilized. Therefore, this paper investigated the extent of diffusion of technological products from Nigerian technical colleges. Primary data were collected through the use of a questionnaire from purposively selected 10 technical colleges in Southwestern Nigeria. Two sets of questionnaires were administered to 150 randomly selected students and 150 purposively selected tutors and heads of departments in the technical colleges. Secondary data were sourced from the websites and relevant publications. Data obtained were analyzed using descriptive statistics. The results show that (on a scale of 1 to 5 maximum) the most diffused products were food and beverages (4.84), electronic products (4.01), chemicals and pharmaceuticals (3.64), textile and leather products (3.31), metal fabricated products (3.45), pulp and paper products (3.08), building construction (3.01) and energy/power generation (2.01). The results also show that the extent of diffusion was very low as 80% of the products are not properly disseminated to the public. Although technological products from institutions could be diffused through other effective channels such as specific market, industry and organized private sectors (OPS), spin-off companies, the findings of this study show that no single unit of technological products in the colleges is diffused through these channels.

TD-06 Intellectual Property-2
Tuesday, 8/27/2019, 14:00 - 15:30
Room: Parlor B
Chair(s) Sven Wittfoth; Volkswagen Aktiengesellschaft

TD-06.1 [R] • Analysis of the Factors Influencing Patent Creation and Patent-based Technology Transfer in Universities

Yoshikazu Yamaguchi; Chiba Institute of Technology, Japan
Jun Fujimoto; Chiba Institute of Technology, Japan
Akira Yamazaki; Chiba Institute of Technology, Japan
Takehiko Koshiyama; Chiba Institute of Technology, Japan

It is indispensable for promoting open innovation that technology transfer from universities to private enterprises is performed successfully, and such awareness has been growing in recent years. However, it cannot be said that technology transfer has been actively implemented and has achieved the expected outcomes. It is generally difficult for universities and private enterprises to cooperate with each other. Many studies have pointed out the problems with technology transfer, but further studies are needed. We focused on patent creation and patent-based technology transfer, because universities have already created a lot of patents but have not yet conducted enough patent-based technology transfer corresponding to created patents. This study aims to reveal the factors influencing patent creation, meaning patent applications and patent rights, and patent-based technology transfer, meaning licensing and licensing income for universities. Based on the case of Japanese universities, data on patent creation, patent-based technology transfer, and influencing factors in universities were collected and analyzed. As a result, models explaining patent creation and patent-based technology transfer using influencing factors were derived. In addition, the differences between the models were grasped. Based on the results, improvements in the influencing factors of universities for promoting technology transfer are expected.

TD-06.2 [R] • Intellectual Property Strategy and Competitiveness: A Case Study of an Electrical Engineering Organization

Tanisha Agarwal; Indian Institute of Technology Kharagpur, India
Gouri A Gargate; Indian Institute of Technology Kharagpur, India

Owing to the large competition that large multinational companies face nowadays, which is generated by newer entrants and fewer resources and more flexibility, placing new ideas on the market by varied processes and allowing innovation to occur in a natural manner becomes important. Apart from a well-chalked out strategy, this involves other factors such as a commitment by the employees to stay in line with the business strategy, alignment of internal procedures, cooperation between the finance and legal division, to name a few. Hence, it is important to understand how large innovative companies formulate their strategy towards intellectual property in order to maintain their positions and strive to do even better. In this paper the authors present a detailed anatomy from the electrical and heavy engineering sector of one of the leading companies in the field of innovation, from an intellectual property strategy point of view. The organization is active in extremely diverse technology domains ranging from environmental technology, new energy sources, to artificial intelligence. The study provides an in-depth analysis of the organizational growth, internal and external challenges, and approaches to intellectual property management and future technology trends of the organization. The authors have followed the exploratory case study research methodology.

TD-06.3 [R] • Research on the Classification Evaluation of Patent Quality and Empirical Test

Li Gu; Dalian University of Technology, China
Xi Liang; Dalian University of Technology, China
Xue Han; Dalian University of Technology, China
Liqiang Ren; Dalian University of Technology, China
Kun Ding; Dalian University of Technology, China

Patent quality has a decisive position in a national intellectual property development strategy. Evaluating patent quality objectively and scientifically is important to promote the transfer of patent technology and achievements and enhance the country's independent innovation capability. According to our review of the literature on the evaluation standards of patent quality, we conclude that the current evaluation for the patent quality mainly takes "three characteristics of genetically patent" as the unified standard. However, because the evaluation

standards ignore patent technology to some extent, which is the essential characteristic of a patent, the standard is difficult to accurately measure regarding the level of patent quality. In this study, based on a patent technical perspective, combined with the classification methods in technology and a contemporary system of science and technology, we divide patents into three types: basic-type patent, technological patent and applied-type patent. Next, we further analyze the different evaluation standards of patent quality under these three levels based on the characteristics of three types of patents. Next the scientific nature of the classification evaluation index of patent quality from the perspective of empirical research is investigated, which can provide a certain basis and reference to construct a scientific and reasonable evaluation index system and improve our country's evaluation standard of patent quality.

TD-07 Collaborations-1
Tuesday, 8/27/2019, 14:00 - 15:30
Room: Parlor A
Chair(s) Taryn J Bond-Barnard; GSTM, University of Pretoria

TD-07.1 [R] • LPWA Alliance Strategy: Example of Sigfox Alliance in Japan

Eriko Kasai; Osaka Gakuin University, Japan

While IoT is penetrating into society, the communication method called LPWA (Low Power Wide Area) is rapidly developing. LPWA is a communication method born to automatically and inexpensively collect a lot of small information, and information and communication companies are trying to expand alliances managed by themselves by forming alliances with related companies. LPWA is largely composed of device, network and application, but it is difficult to own all of them on their own, form a business ecosystem, first compete to aim for the de facto standard of each country by each LPWA method. But what kind of mechanism is necessary to expand them? In this paper, we compare the characteristics of alliances managed by companies promoting LPWA and clarify factors necessary for the development of ecosystem. Especially analyzed is the Sigfox alliance in Japan, which is promoting strong cooperation, with securing the freedom to participate and leave. As a result, for creating and expanding business ecosystem, it has become clear that it is important to work closely in human and informational aspects to niche players.

TD-07.2 [R] • Technology Impact Assessment of Coexistence Technology in Mixed Reality

Wonju Hwangbo; Ewha Womans University, Korea, South
Young Il Park; Ewha Womans University, Korea, South

The purpose of this study is to technology impact assessment uncertainties and influences of factors for the coexistence technology in MR (mixed reality) and to derive the ripple effect of the target technology in many different application fields. This survey is to perform technology impact assessment in order to assess the impact of new technologies on the economy, society, culture, ethics and environment in advance and to reflect the results in policy research. This survey is to evaluate the impact of new technologies on the economy, society, culture, ethics and environment in advance and to reflect the results in policy research. The survey is to strengthen the intrinsic intent of technology assessment to strengthen positive impacts and minimize adverse impacts by identifying the various factors affecting society when the coexistence technology in MR (mixed reality) was commercialized as well as by evaluating the positive and negative impacts from a more balanced view. We apply the new theoretical basis elements to this study in order to analyze in advance and improve the method and the results of TA of previous researches. Therefore, it will be meaningful to analyze the difference of the results by analyzing between the results of the TA study designed with the new method and the results of the previous research for the target technology and conducting the demographic characteristics and technology acceptance. For achieving this, we used prior research and the theoretical background about TA, the trends and issues of coexistence technology in MR (mixed reality), the industrial trends and prospect of target technology, the new method designed to better analyze a citizen participation TA survey, conducting TA experts' FGI and reflecting the results, and conducting to survey TA for general citizens in between positive impact and negative impact of demographic, and we will draw conclusions from the above works.

TE-01 Strategic Management of Technology-5
Tuesday, 8/27/2019, 16:00 - 17:30
Room: Grand Ballroom I
Chair(s) Jonathan Linton; University of Sheffield

TE-01.1 [R] • Business Ecosystem Strategy Using New Hydroponic Culture Method

Hiroshi Kubo; Chiba Institute of Technology, Japan
Kazuki Okoso; Chiba Institute of Technology, Japan

The current, important global issues include "global warming," "population increase," and "food shortage." Japan, however, experiences problems such as "declining birthrate and aging," "declining agricultural workers," and "increasing abandoned cultivation land." In this study, we developed a new "EZ hydroponic culture method" to solve these problems. In this unique flooded agriculture system, many permeable pots with one seedling, together with fertilizer and culture medium, are mounted on a foamed polystyrene plate and floated on the surface of the water. Its characteristics are high profitability, low initial investment amount, low labor load, and low environmental load. However, this new hydroponic cultivation method differs considerably from traditional agricultural systems in terms of not only technical aspects but also management. It becomes even more prominent by collecting big data using internet of things (IoT) technology and drones as well as artificial intelligence (AI). Therefore, the construction of a new business ecosystem strategy becomes increasingly important. In this research, we proposed the "EZ hydroponic cultivation business ecosystem strategy" using the "Five Frameworks for Constructing Keystone Strategy" proposed by PICMET 2018. Furthermore, its effectiveness was confirmed based on three key performance indicators (productivity, robustness, and niche creation).

TE-01.2 [R] • Strategic Technology Planning in Product-Service Systems with Embedded Customer Experience Requirements

Soheil Zarrin; Portland State University, United States
Tugrul Daim; Portland State University, United States

The undeniable impact of artificial intelligence and internet of things on value proposition and offerings of firms drive many strategic initiatives in organizations to design solutions which integrate products and services. Since designing product-service systems inherently introduce a high level of complexity and adding artificial intelligence requirements as one of the influential factors overcomplicate the long-term planning processes, the strategic planners seek effective tools to enable them to manage the level of complexity as well as empower them to communicate the outcomes with the whole organization. In order to achieve this purpose, technology roadmaps provide a structured and flexible means for designing product-service systems which can manage the advanced technologies such as connected and intelligent devices the core factors. This research focuses on designing a new and customized process of technology planning via application of technology roadmapping methodology to design product-service systems. In order to verify the model, a complex product-service system which includes interconnected devices (internet of things) with artificial intelligence enabled capabilities is strategically planned by the proposed model.

TE-01.3 [R] • In Search of Adaptive Capacity: Development of a Strategic Management Model Through a Co-redesign Effort

Adriano Proenca; Federal University, Rio de Janeiro, Brazil
Vinicius C Cardoso; Federal University, Rio de Janeiro, Brazil

The strategic management literature has been for a long time bringing the issue of complexity to its agenda and pointing to the need for organizations to develop their adaptive capacity. However, the design of a management model for the strategic management of established

organizations, so as to replace the traditional strategic management model - the one associated with strategic planning and the follow up and correction framework - still needs to be the object of systematic research & development efforts in the field of management science and engineering. This paper presents an approach in the context of such a design science development effort, where the first redesign process, carried out in partnership with the organization where the practices are to be implemented (i.e., a co-re-design), is described and its results analyzed. It presents a real-world solution for how the traditional model of strategic management can be overcome dialectically - when the initial design proposition is preserved, denied and exceeded at the same time by the adoption of new management practices within and complementary to the standard model as adopted by the organization.

TE-02 Innovation Management-3
Tuesday, 8/27/2019, 16:00 - 17:30
Room: Galleria I
Chair(s) Fuji Xie; Shanghai Jiao Tong University

TE-02.1 [R] • Permeability in Coworking-Spaces as an Innovation Facilitator

Ricarda B Bouncken; University of Bayreuth, Germany
Muhammad M Aslam; University of Bayreuth, Germany
Alexander Brem; Friedrich-Alexander-Universitat, Germany

Contemporary organizations develop porous structures and permeable boundaries to employ external knowledge and resources. On the one hand, permeability in organizations engenders fluidity which increases organizational capabilities through adaptability, diversity, and speed. On the other hand, organizations continuously redefine and reinvent their boundaries to remain stable and to exhibit self-identity. These two competing demands of organizations to simultaneously become fluid as well as stable are evident in modern shared workplaces where organizations share offices with other organizations and professionals. The purpose of this research is to analyze how permeability in shared office spaces influence the internal work structures and processes of members' organizations who have relatively fixed memberships, stable structures, and steep hierarchies. We collected qualitative data based on an inductive research methodology from the providers and users of a coworking-space. Our study concludes that participational autonomy, spatial and virtual connectivity and interrelational heterogeneity determine the level of permeability in a coworking-space. The space level permeability influences the work structures and task processes of members' organizations. Changeability in organizational processes engenders structural differentiation, decentralization, and ad-hoc work processes, which provide autonomy to the organizational employees or independent users to define their work structures, task processes, and work routines. Organizations though maintain their rudimentary structures and permeable boundaries through self-regulatory resources. In this way, permeability enables organizations to leverage the differentiated capabilities of members within and outside of the space and facilitates knowledge exchange across boundaries and hierarchical levels that lead to innovative outcomes.

TE-02.2 [R] • Literature Based Derivation of a Framework to Evaluate Engineering Change Requests

Michael Riesener; WZL RWTH Aachen, Germany
Christian Doelle; WZL RWTH Aachen, Germany
Michael Mendl-Heinisch; WZL RWTH Aachen, Germany
Guenther Schuh; WZL RWTH Aachen, Germany

This paper describes a systematical approach to identify existing methods to evaluate engineering change requests in order to make better decisions on the approval or dismissal of those requests. The motivation to do this research originates in the recognition of practical problems in companies, which are missing suitable methods to evaluate risks and benefits of engineering change requests for their products. The scope of this investigation is focused on the "data-based decision support for engineering change requests," which has been published in academic literature. Therefore, a keyword search is used as a literature review technique. In this context, keywords are defined and complemented by synonyms to identify a higher amount of relevant literature. Different sources are covered within the investigation. The review does not include adjacent areas like organizational change and change management in terms of cultural changes but is focused on technical and design changes to products in all stages of their life cycle. After the identification of current methods, new possibilities of the evaluation of engineering change requests are discussed. Therefore, different requirements which should be fulfilled by new methods are described. In addition, areas for further research are identified. Therefore, a framework which describes the field of actions to improve decisions of engineering change requests is derived from the findings within the literature review.

TE-02.3 [R] • An Internet of Things (IoT)-based Shelf Life Management System in Perishable Food e-Commerce Businesses

Y.P. Tsang; The Hong Kong Polytechnic University, Hong Kong
King-Lun Choy; The Hong Kong Polytechnic University, Hong Kong
C.H. Wu; The Hang Seng University of Hong Kong, Hong Kong
G.T.S. Ho; The Hang Seng University of Hong Kong, Hong Kong
H.Y. Lam; The Hong Kong Polytechnic University, Hong Kong

In recent years, the rapid development of e-commerce businesses has led to an evolution in the perishable food supply chain, such that perishable food e-commerce businesses have been established for covering business-to-business (B2B) and business-to-customer (B2C) transactions. For handling perishable food, accurate shelf life management plays an essential role in estimating product shelf life and in formulating quality degradation model. However, existing methods in shelf life estimation may not be applicable under the e-commerce environment in considering the wide variety of products, fragmented customer orders, and short delivery timeframe. On the other hand, environmental monitoring is another key element for determining ambient environmental conditions, such as temperature and relative humidity, which are used to formulate the quality degradation model. With the emergence of Internet of Things (IoT) technologies, dramatic enhancements in environmental monitoring with improved power efficiency, security and transmission effectiveness are available. In this paper, an Internet of Things based Shelf Life Management System (ISLMS) is proposed which integrates IoT technologies, fuzzy logic and zero-order quality degradation modelling for handling perishable food. Data acquisition throughout the entire e-commerce business can be done automatically in a cost-effective manner. The collected data is then used to adjust the product shelf life and specific rate of quality degradation, with the rate being applied to the quality degradation model. The environmental changes are taken into consideration during the entire supply chain journey, such that the perishable food is handled by all-round shelf life management. As a consequence, with the adoption of ISLMS, perishable food can be safely managed under the e-commerce environment, while information visibility and customer confidence are further enhanced.

TE-02.4 [R] • Integrating Product Innovations for the Aging Population: The Example of Exercise Technology Platforms in an Emerging Economy

Jeff Hamilton; Rangsit University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

The presented research applies a design thinking framework intended to gain meaningful insights about the thoughts, attitudes, and emotions towards exercise and technology within the Thai aging population. A cross-section of 80 elderly in Thailand will be selected to match the demographic profile of the nation and to serve as a paradigm for other emerging economies in the APAC region. In-depth interviews, focus groups and observational analysis are used to guide the creative process in developing integrated product/technology concepts to test with the participants. To produce an interchangeable system, the elderly population is segmented based on three main criteria: (1) physical capabilities, (2) financial situation and (3) technological understanding. The research has yielded a modular product/technology platform concept consisting of low-, medium-, and high-tech solutions to meet the needs of the elderly segments.

TE-03 Technology Management in the Biotechnology Sector-2
Tuesday, 8/27/2019, 16:00 - 17:30

Room: Galleria II
Chair(s) Nathasit Gerdsri; Mahidol University

TE-03.1 [R] • Researchers' 'Startup Readiness' in the Biopharmaceutical Domain Assessed Using Logistic Regression for Features of Their Papers, Patents, Institutes, and Nations

Tomotaka Goji; The University of Tokyo, Japan
Yuki Hayashi; The University of Tokyo, Japan
Hiroko Yamano; The University of Tokyo, Japan
Takanari Matsuda; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

This paper presents a method using logistic regression to predict and detect "startup readiness" of researchers in the biopharmaceutical domain, and to suggest determinants to improve their "startup readiness," using databases of start-up finances, research papers, patents, academic organizations, and national socioeconomics. This method sorts specific industry segments by which financing activities are active, and by which related growing research topics attract increased academic attention. In research domains such as the biopharmaceutical field, which include pursuit of fundamental scientific understanding and applications intended for immediate use, abundant startups with intense scientific linkage have attracted venture capital financing and entrepreneurship for further R&D opportunities and commercialization. We hypothesized that variables composed of several features of papers, patents, research institutes, and nations related to this domain can well reflect researchers' "startup readiness." Our logistic regression model based on our selected and constructed explanatory variables yielded good predictive and classifying performance, with an AUC value of 0.73. Results carried specific implications about what variables and their combinations demand attention, to encourage the "startup readiness" of researchers. More than conventional research methods, our computational approach might provide global, comprehensive, but convenient and real-time understanding of the "start-up readiness" of researchers in user-inspired fundamental research.

TE-03.2 [A] • Overcoming Challenges in Commercializing Bio-tech innovations in India: A Case of Centre for Cellular and Molecular Platforms

Gaurav D Tikas; Indian Institute of Science, India
Taslimarif Saiyed; C-CAMP, Bangalore-India, India
Akhilesh Katte; Indian Institute of Science, Iran

Building capabilities to successfully commercialize biotech research into products or solutions is paramount but challenging to develop, especially in developing ecosystems or countries. Once accomplished, they can turn around the socio-economic condition in such countries and make them self-reliant, at least in the healthcare sector. It may also encourage the incumbent research community to transform their research findings into scientific, entrepreneurial or commercial ventures. However, building such 'innovation ecosystems' in developing countries requires scientific, financial and infrastructural support to overcome their existing barriers. In India, one such government-funded non-profit organization which is trying to overcome the existing barriers and building an ecosystem to encourage biotech innovation and entrepreneurship is the Centre for Cellular and Molecular Platforms (C-CAMP). Since its inception, it has been able to support more than 90 biotech start-ups in funding, mentorship and incubation. In this paper, we start our discussion by understanding some of the major challenges faced by contemporary biotech organizations in India while commercializing their innovations. Subsequently, we attempt to understand how C-CAMP was conceptualized to overcome some of these barriers and how it evolved over the years to become a nodal agency for inspiring biotech innovations and entrepreneurship. This case study highlights some of the best practices followed by C-CAMP in managing biotech innovation and commercialization. Top management teams in biotech-based academia, industry, government or venture capital funding agencies from any country may find these barriers and best practices worth studying and analyzing.

TE-05 Technology Marketing

Tuesday, 8/27/2019, 16:00 - 17:30
Room: Parlor C
Chair(s) Nouri M Beyrouti; Lebanese American University

TE-05.1 [R] • Technology Management and Virtual Consumer Communities: Creative Consumer Technology Perspective

Nouri M Beyrouti; Lebanese American University, Lebanon

Consumers are moving to connected devices by choice to enhance their lives and by necessity, given that it's almost impossible to find a TV that isn't considered "smart" today. The actions and creations of creative consumers tend to be a function of the technology, culture, and government of a particular country. Technology tends to be historically dependent; that is, technologies in different countries evolve along unique trajectories due to inertia rather than because they are the optimal solution. The internet of things (IoT), virtual and augmented reality aims to give consumers access to situations they would otherwise be unable to. But the landscape is rapidly evolving, and it can be tough to know exactly which aspects of IoT and VR and AR consumers are interested in. As the technology has gotten more popular, it has branched out into other industries. Banking is changing rapidly in the digital age as the industry responds to consumers' demands for an approach that mirrors their experiences. While gaming remains the dominant industry using virtual reality, it is gaining popularity in the education sector, healthcare, travel and tourism, retailing business, and smart cities as well. For education, teachers are utilizing virtual reality to showcase subjects like history or geology to their students to give them a more interactive, learn-by-witnessing experience. Virtual reality is making waves in healthcare to give doctors and surgeons a means to train on a new procedure before doing it for real. With VR headsets, travelers can experience the world from the comfort of their homes, and airlines are training pilots using VR. With new uses and improving technology management and marketing for virtual consumer communities. People want to have unique experiences, whether that is through travel or sports or entertainment or even education. But accessibility is a common roadblock to those who don't have the means, geographically, educationally, or economically, to experience the things they can only dream of. But are consumers ready to welcome it into their lives? With the advent of the intelligent technologies, will consumers become even more demanding? How will businesses similar to manufacturing, utilities and healthcare respond to current consumer technology experiencers and influencers? Is this just the start of things to come?

TE-05.2 [A] • Development of the HRTech Market in Japan

Takashi Iwamoto; Keio University, Japan

The 4th industrial revolution is going on and various X-tech businesses using IoT (Internet of Things), bigdata analytics, AI (artificial intelligence), robot, etc., are growing in the world. One of the growing X-tech businesses is HRTech. HR stands for human resources, and various HRTech businesses are being developed in various HR fields such as payroll, talent management, performance management, employee engagement, well-being, etc. Keio Business School started a HR Technology Consortium with various private companies in April 2015, and this became the starting point at which the HRTech market grew rapidly in Japan. The first HR Technology Summit and the first HR Technology Award Conference were held in October 2016, and the Ministry of Economy, Trade and Industry employed HRTech as a tool to accelerate the policy of work style reform in February 2017. This industry-academia-government collaboration accelerated the growth of the HRTech market in Japan.

TE-05.3 [R] • Technology Marketing of Smart Apartments: IOTAS Inc.

Fayez Alsoubaie; Portland State University, United States

This report aims to present a marketing research and plan for the Portland-based company IOTAS. IOTAS is a five-year-old company that provides smart apartment solutions focused on B2B market, and its main goal is to deliver efficient operations management as well as a new revenue streams to property managers and reinvent the tenant experience. The introduction of internet of things (IoT) has enabled the development of multiple new, smart technology applications. Even though the concept behind IOTAS product is not new, its smart home solutions are designed for renters. Partnering with ownership groups, product companies,

and property developers, IOTAS has been successful in creating an adaptive system that not only allows renters to customize and reuse their profiles but also learns from its preferences. This project has a number of contributions. Firstly, it brings relevant information about the company's current performance, size of the market, potential customers and its interests. Secondly, some of the most recognized business planning techniques and marketing tools such as SWOT analysis, competition analysis and customer surveys are used to evaluate IOTAS' likely success to cross the chasm. Thirdly, a marketing strategy is presented so that IOTAS can expand its business and move into the early majority (pragmatists) section of the technology life cycle adoption curve.

TE-06 Intellectual Property-3
Tuesday, 8/27/2019, 16:00 - 17:30
Room: Parlor B
Chair(s) Bennet Bruens; University of Bremen

TE-06.1 [R] • The Market Behaviors of the Patent Transaction

Hung-Chun Huang; National Chi Nan University, Taiwan
Hsin-Yu Shih; National Chi Nan University, Taiwan
Tsung-Han Ke; National Chi Nan University, Taiwan

This investigation reveals several distinctive features of market players in patent transactions. Through transaction network analysis, patent transaction markets have determined that mature markets are informative environments whereby few players create the majority of transactions. Therefore, this market is highly structured, and the distinctive features of market players are characterized. First, market players exhibit different market behaviors in transactional opportunity and capability. Second, the market management of technological transactions is revealed whereby market players can strategize their industrial assets. Consequently, these findings and results not only depict the IPR strategy of leading technology players but also demonstrate the social structure of their competitive advantage. Thus, this study provides insights into the patent transactions market and also addresses management implications for firms and authorities to maintain the value of intellectual properties.

TE-06.2 [R] • How Can a Technology Manager Find a Technological Generality in Its Early Stage: Revisiting Backward-Forward Citation Analysis

Masayuki Hirose; Graduate School, Hitotsubashi University, Japan

This paper is a modest attempt to revisit linkages between backward and forward citations posed by Trajtenberg, Henderson and Jaffe. In their literature known as the leading study, they suggest that more original research, as well as research that draws from far removed technological areas, lead to innovations of wider technological applicability. It is still unclear, however, whether backward citations capture patent importance. Although it is becoming clear that forward citations are a good predictor of important inventions, it is imperative to take quite a wide time window in order to get significant coverage of forward citations, which makes it difficult to count all of the forward citations in the early stage. This problem could be more remarkable in such countries as Japan with examination-on-demand system. On the other hand, patent examination has been accelerated after the Accelerated Examination System (AES) was implemented in Japan. This means that there is a high possibility among applications examined under AES that backward citations cited by such applications are visible in public in the early stage (i.e., at the time of laying-open publication of the applications). This trend can be an important issue for practitioners who use patent information as a tool for innovation research.

TE-06.3 [R] • Legal Fights for Patent Rights: Are the Judicial Concerns of Small Companies Justified?

Juhani Talvela; Lappeenranta University of Technology, Finland
Tuomo Kassi; Lappeenranta University of Technology, Finland

Patents and patenting have been extensively studied in recent years. Large firms are considered more advanced in their management of technology and prosecution of patents, while small firms possess a limited capacity to operate the legal quality of patents. This article deals with concerns expressed by small companies about the legal uncertainties of patents and patenting. We present results from our interviews and subsequently focus on studying patent litigations in Finland. We present the types of parties, court actions, and industries with high litigation activity. Speed and cost of litigation is compared with selected other countries. Data are retrieved from multiple sources, including the Darts-IP database with a global coverage of IPR-related litigation cases. We find that an opposition action is the most frequent type of litigation, followed by infringement and invalidity actions. Combinations of infringement and invalidation actions are not as common in Finland, as seen in other countries. Most litigations are fought by and between large companies. Recommendations are given for technology management in small companies.

TE-07 Collaborations-2
Tuesday, 8/27/2019, 16:00 - 17:30
Room: Parlor A
Chair(s) Wonju Hwangbo; Ewha Womans University

TE-07.1 [R] • Relationship Between Dominant Triple Helix Model and Type of Intermediary Organizations

Petrus T Letaba; NACI, South Africa

Although there is a plethora of studies about the role of triple/ quadruple helix in strengthening the local, national and regional systems of innovation, few of them focus on the relationship between triple helix model type and the intermediary organizations. The intermediary organizations are useful in facilitating knowledge, technology and skills transfer among the collaborating partners. Three main types of triple helix models have been identified within the literature, namely: university-push, government-led and business-driven models. The purpose of this critical literature review study is to characterize the nature of intermediary organizations in each model of triple helix.

TE-07.2 [R] • An Empirical Investigation of the Determinants of Quality Communication in Projects Within The South African Petrochemical Industry

Amina Halifa; GSTM, University of Pretoria, South Africa
Taryn J Bond-Barnard; GSTM, University of Pretoria, South Africa

Quality communication is crucial to be able to synergistically manage costs, schedule and quality deliverables in projects. Yet project team members are often not sure what is the best way to interact and share information, to promote trust, collaboration and project management success. This is especially true for virtual project teams that are involved in projects with high complexity such as in the petrochemical industry. This research investigates the determinants of quality communication in projects within the South African petrochemical industry. Empirical data was gathered from nine project managers and engineers, with an average of 14 years of petrochemical industry experience, and analyzed using thematic analysis. Findings revealed that in addition to good upfront communications planning, the project team needs to be able to effectively: encode and decode messages, use communication technology, vary communication frequency depending on the situation and communicate the right content to the right audience. Furthermore, it was found that these quality communication determinants improve levels of trust, collaboration and perceptions of project management success in South African petrochemical projects.

TE-07.3 [R] • The Community-level Socio-economic Impact of A PFI-based Small Hydropower Plant Construction Project

Yaeko Mitsumori; Osaka University, Japan

In 2017, Higashi Agatsuma Town in Gunma Prefecture constructed a small hydropower plant that utilizes the Hakoshima Spring's water flow. The plant has an output of 170 kW and produces 1.46 GWh of electricity per year, which is equivalent to the annual electricity consumption of 400 households. Higashi Agatsuma Town utilized a Private Finance Initiative (PFI) - a way of creating "public-private partnerships" - to finance this project. A local business called Yamato Co. set up an SPC (special purpose company) which then secured a loan of JPY 410 million from a local bank to construct the small hydropower plant. Yamato sells the electricity

produced by the plant to the local utility company - Tokyo Electric Co. - and pays an annual usage fee of JPY 12 million to Higashi Agatsuma Town. The town is required to pay the annual water usage fee and annual land usage fee. Still the town is able to use the rest of the revenue from the power plant to revitalize the local community, while the SPC still generates a profit of approximately 50 million Yen from the business scheme. This study focuses on Higashi Agatsuma Town's small hydropower plant business and its utilization of PFI. Additionally, the study will analyze the socio-economic impact of the power plant on the community.

WA-01 PLENARY - 3

DATE: WEDNESDAY, 8/28/2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM I
CHAIR: DR. TUGRUL DAIM, PORTLAND STATE UNIVERSITY

WA-01.1 [K] • Emerging Trends in Technology Research Management in Taiwan

Tao-Ming Cheng; Chaoyang University of Technology, Taiwan

Rapid digital transformation, multi-disciplinary technology research, and innovations are today's hallmark. Taiwan, an island in the Pacific Ocean, too has initiated ample measures to keep the pace of transformation. There exists a renewed thrust on creating a mindset, infrastructure and developing essential cross-discipline intelligent systems to provide universities and enterprises with an innovation-oriented ecosystem, to engage in state-of-the-art R&D, and to enhance industrial competitiveness. Taiwan has a lot going for it with artificial intelligence (AI) research, and the island's prowess in the field continues to grow. Taiwan's tech ecosystem has been built over the decades with support from universities, a tech-centered culture and internet infrastructure. Global players like Google, IBM, and Microsoft have expressed their intentions of developing either AI R&D centers or similar initiatives in Taiwan. Because, companies can hire top-quality engineering talent that has earned a reputation for being more loyal and stable, less likely to be poached, compared to other countries. The talk will cover an overview of technology research management and recent initiatives in the country. Also, it will uncover the strategies being adopted for Chaoyang University of Technology (CYUT) to become the top 1001+, 301+, 351+ universities in the world, Asia-Pacific region, and emerging economies, respectively, in 2019.

WA-01.2 [K] • Data is Future

Mandy J Mock; Intel Corporation, United States

The abundance of data and the compute power to analyze it is changing the world. Business models are being disrupted in all industries and companies must reinvent themselves to take advantage of data. This talk will discuss Intel's journey in Digital Transformation, as well as thoughts on how managers need to prepare for this change.

WB-01 PANEL: Meet the Editors
Wednesday, 8/28/2019, 10:30 - 12:00
Room: Grand Ballroom I
Panelist(s) Barry Bozeman; Arizona State University
Tugrul Daim; Portland State University
Nathasit Gerdsri; Mahidol University
Martin Hoegl; LMU Munich
Jonathan Linton; University of Sheffield
Fred Y Phillips; University of New Mexico
Harm-Jan Steenhuis; Hawaii Pacific University
Steven T Walsh; University of New Mexico

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

WB-03 Technology Management in the Health Sector-1
Wednesday, 8/28/2019, 10:30 - 12:00
Room: Galleria II
Chair(s) James K Chen; Asia University

WB-03.1 [A] • Social Assistive Robots for Elderly Care: The New Efficiency in the Context of Triple Bottom Line and Digitization

Irmtraud Ehrenmueller; University of Applied Sciences Upper Austria, Austria
Rainer P Hasenauer; WU-Wien, Austria
Belviso Carlotta; Universita Luigi Bocconi, Italy

Currently, more economically developed countries (MEDCs) are facing a painful shortage of caregivers, while the need for their abilities is growing. The caregivers' capacity bottleneck is aggravated by the counter-directional development in terms of economic efficiency Input (= availability of caregivers' capacity) and Output (= fulfillment of qualitative and quantitative care requirements). It is necessary to introduce a "New Efficiency" concept for social service providers in the eldercare sector. In order to warrant feasibility of process output without cost reduction of the elder care process, this paper focuses on the optimization of process organization and, specifically, analyzes the impact of digitization on services in long-term nursing homes. In this context "New Efficiency" is an enabling paradigm to ensure the attainment of qualitative and quantitative care requirements by optimization of process input. The usefulness of the "New Efficiency" for long-term caring processes is discussed in the context of nutritional care and logistic processes. Taking into consideration that Triple Bottom Line efficiency of service production is a key factor, the research question of how to combine digitized enabling resources (i.e., SAR (Social Assistive Robots), AAL (Ambient Assisted Living), AI (Artificial Intelligence) and IIoT (Industrial Internet of Things) with human resources becomes a vital strategic matter. Therefore, the paper analyzes the organizational issue to partially substitute human workflows through robotic workflows, its productivity and profitability effects as well as the digitization impact on Key Performance Indicators (KPI) of elderly care. Digitization in the context of this paper is the process to convert signals, messages, images from analog to digital format so that computer / robot can receive, store, transform and transmit these data in bit format.

WB-03.2 [A] • Distributed Healthcare and Medicine: Technological Feasibility and Future Scope for Redirecting the Current Centralized Model to Benefit Remote Areas

Seiichi Watanabe; Health Improvement Net Service LLC, Japan
Yasutoshi Komatsu; Health Improvement Net Service, LLC, Japan
Masayuki Ono; Japan Techno-Economics Society, Japan
Kunimasa Katayama; Health Improvement Net Service, LLC, Japan

Distributed healthcare and medicine have been studied to aim for preventive healthcare and early disease discovery, rather than the current system of medical treatment after serious symptoms: Small-scale and flexible distributed systems with minimal investment, rather than the current large and rigid centralized structure. This is described as "the redirection". The study has expanded the scope of our paper at PICMET 2016 on active health improvement through sensor networks to the medical field. It has been demonstrated that this redirection can be realized by flexible distributed systems on Internet of Things (IoT) sensor networks. In this paper, as the first step, the vision for such systems has been clarified and the technological feasibility has been assessed. The conceptual system has been designed by integrating currently available technologies under the principle of self-responsibility, which allows system construction with minimal investment and low-cost management. The IoT sensor networks allow for response at the stage of pre-symptoms or developed symptoms and lead to an effective response with much lower cost, compared with traditional central hospital based rigid systems. The distributed system would greatly benefit remote areas of advanced countries as well as developmental countries. The unique point of the study is new business

creation by activated residents to enhance positive economic cycles in addition to reducing healthcare and medical cost. A social experiment has been planned for a remote village in the west of Tokyo prefecture to be proposed to the local government and residents. The experiment would offer evidence of the advantages of distributed systems under the principle of self-responsibility. The next step is to implement the system in the region and accumulate knowledge to deploy the system to wider areas.

WB-03.3 [R] • Social Impact Bonds: Current Context and Implementation Model in the Healthcare Industry

Shintaro Sengoku; Tokyo Institute of Technology, Japan
Daitaro Misawa; Tokyo Institute of Technology, Japan

A social impact bond (SIB) is a form of contract with the public sector or governing authority, whereby it pays for better social outcomes in certain areas and passes on part of the savings achieved to investors. In recent years, SIBs have been launched in the healthcare sector for the purpose of reducing future medical costs and improving the quality of life of patients. For example, a SIB called "Be Active" launched in Birmingham, England, encouraged people to be healthier through exercise, smoking cessation, etc., which raised an amount equivalent to 464 million GBP. From this point of view, the application of SIB to the healthcare field is social innovation. However, in the healthcare sector, the implementation of SIBs has been limited to only 18 projects, which comprise approximately 17% of the total practices, suggesting the existence of outstanding issues that obstruct the realization of its potential. Considering this situation, in the present study, we conducted an intensive review of scholarly reports of SIB cases in the healthcare sector to date to identify the key factors of their successful implementation and the associated issues in accordance with the current flow of medical economic evaluation, followed by a consideration of a socioeconomic system for the SIB with respect to the theories of medical innovation.

WB-04 Artificial Intelligence for Technology Management-4

Wednesday, 8/28/2019, 10:30 - 12:00
Room: Galleria III
Chair(s) Gary O Langford; Portland State University

WB-04.1 [R] • A Managing Framework for Artificial Intelligence to Supplement Human Workforce in a Digital Economy

Aki Tomita; Toyo University, Japan

Recently artificial intelligence (AI) spring has been brought about by the needs from the aging world as well as advances of the deep learning technologies. Japan is the world's most aged country: 33 percent of its population were aged 60 years or over in 2017. The population aging and population decline contribute to a decline in growth potential. Recalling the growth accounting equation, productivity, neither capital nor labor, is strongly desired to increase. This success depends on how effectively AI makes use of capital and labor, especially labor. AI is expected to supplement human workforce rather than to take place of it. Because AI is not a natural person who has his or her autonomous will, its learning is under control of some natural person. This paper proposes a management framework for AI to supplement human workforce. By looking back at AI history, the proposed management framework integrates statistical knowledge derived from machine learning and deterministic expertise obtained from expert systems. To evaluate the effectiveness of this proposal, this paper analyzes expert system and machine learning applications in auditing. It was confirmed that auditors can be assisted in making decisions on broader areas by integrating the outputs from these two approaches.

WB-04.2 [R] • Domain Process Model Overcome Limitations of Engineering Models for Developing Artificial Intelligent Systems

Gary O Langford; Portland State University, United States
John Green; Naval Postgraduate School, United States
Daniel P Burns; Pacific Northwest National Laboratory, United States
Alexander Keller; United States Air Force Nuclear Command, United States
Dean C Schmidt; Home Port Solutions, LLC, United States

The integrated set of prognostic domains (ISPD) of technology presented here provides a normative means to construct a wholly new process model for guiding technology management of artificial intelligent systems (AIS). Seventeen domains represent all-inclusive stakeholder perspectives that encapsulate lifecycle analyses, evaluations, feasibilities, and tradeoffs with the domain contexts. Following systems model-based thinking (SMBT), a postulated focal point interaction is the entry condition from which each domain is considered and thereafter traversed. Domains are interactive with each other through concurrent, iterative, recursive, and non-recursive processes. This interactive work continues until the completion milestones of each domain are satisfied. Techniques such as agile, progressive, prescriptive, and spiral are used as appropriate to reconcile functional and process requirements, risk, schedule, and budget. An important factor of ISPD is that multiple concepts of operation, widely diverse architectures, and explicitly differentiable designs are inevitable and highly desirable. The entire gamut of interactions of AIS with other posited systems is exposed and examined by the work carried out in each domain. While the ISPD was inspired by the use of SMBT with traditional process models, the essences of ISPD were extracted from developing systems of systems products and services. SMBT was piloted on a one-year project to integrate informational, social, and behavioral exchanges between humans and intelligent systems. This paper introduces SMBT for designing and building AIS by applying ISPD.

WB-04.3 [R] • The Development Status and International Competition Analysis of Machine Learning

Lucheng Huang; Beijing University of Technology, China
Shuang Xue; Beijing University of Technology, China
Xiaoli Wang; Beijing University of Technology, China

As the key technology and basic industry for the Artificial Intelligence,Machine Learning recieves unprecedented attention and rapid development. Based on Derwent innovations index and Web of science database,this paper uses patent statistical analysis, patent text mining, bibliometric analysis and social network analysis methods to analyze competitive situation of this technology field from four aspects: the technology development stage, the technology competition countries, the technology research and development subject and the core and hot technology field identification. The result shows that: machine learning technology is in a period of rapid development, the USA, China and Japan are the main force of technology and market, and the USA has a large number of first-class enterprises;Internet companies are an important driving force for machine learning technology; And the core technology fields and hot technology fields of machine learning focus on recommendations, search,botnet, control and regulation system, data communication system,smart medical diagnostics, speech and image recognition, security devices, educational aids, semiconductor processing,integrated circuit design,and so on.

WB-05 Technology Assessment & Evaluation-1

Wednesday, 8/28/2019, 10:30 - 12:00
Room: Parlor C
Chair(s) Robert Martin; Portland State University

WB-05.1 [R] • Assessment for Commercial Potential of Patent Using Natural Language Programming

Lertchai Khongamnuaisak; Chulalongkorn University, Thailand
Duanghathai Pentrakoon; Chulalongkorn University, Thailand
Sukree Sinthupinyo; Chulalongkorn University, Thailand
Kwanrat Suanpong; Chulalongkorn University, Thailand

According to the World Intellectual Property Organization (2017) report, over 3 million patents exist in the patent database, but only certain numbers have commercial potential. Generally, assessing the commercial potential of a patent consumes time and requires various expertise. Currently, several models have been developed to address this matter, which is to assess using questionnaire tool for portfolios by humans. So that occurs bias any limitation exists that our research will address by artificial intelligence. Hence, this research applies a

natural language programming to assess for commercial potential of a patent consisting of five steps - (i) morphological analysis based on the lexical database, (ii) syntactic analysis of a sentence to check syntax sentence patterns, (iii) sematic analysis to interpret the meaning of words derived from the previous step, (iv) discourse integration from the context of domain together with the main sentence providing more accurate sentence analysis, and (v) pragmatic analysis to ensure the correct meaning of interpretation. Then, the obtained data is used to determine criterion factors and formulate the model for assessing commercial potential of patent using natural language programming. This finding should deliver an alternative effective patent assessment system, which addresses some current deficiency in patent's assessment for commercial potential.

WB-05.2 [A] • Technology and Crime Prevention: Integrating Technologies to Support Community Safety in Tshwane, South Africa

Gerhard le Roux; University of Pretoria, South Africa
Louwrence D Erasmus; Council for Scientific and Industrial Research, South Africa
Leon Pretorius; University of Pretoria, South Africa

With over 2.1 million crimes reported in South Africa annually, the country ranks amongst the highest in the world with regards to the number of crimes reported per annum. The negative economic impact of crime, trauma, reduced quality of life and social implications in South Africa are, to a large extent, immeasurable yet crippling. The high levels of crime in South Africa could be accredited to various elements such as deteriorating moral and ethical standards in society, lack of leadership, social and economic inequalities, poverty, unemployment, deteriorating infrastructure, inadequate systems and ineffective law enforcement. The Tshwane metropolitan area faces all these challenges and is constantly battling to address them in ominous political and economic conditions. One of the mechanisms to prevent crime is effective law enforcement. This includes the availability of resources, reliable information and proper management. These information systems and technologies, if integrated, could provide reliable information which will assist authorities to successfully prevent crime. The question thus arises whether these technologies exist and whether these technologies can be integrated? These questions are answered by means of a literature study, case studies and semi-structured expert interviews. Numerous technologies which can be integrated do exist in Tshwane. Further, given sufficient budgets and proper government policy direction and implementation for collaboration, community safety could drastically be improved.

WB-05.3 [R] • Evaluation of the Effectiveness of the ISO 9001 Quality Management System on Business Processes of Laboratory Information System at a Healthcare Solutions Company

Portia Sejake; Mancosa Graduate School of Business, South Africa
Chipo Mugova; Mancosa Graduate School of Business, South Africa

The purpose of this study was to evaluate the effectiveness of ISO 9001 Quality Management System (QMS) on business processes of a laboratory information system (LIS) of a healthcare solutions company in Johannesburg, South Africa. The evaluation of data obtained from helpdesk records shows that there is a high volume of calls logged related to slowness of the application system that the LIS oversees for the client. It is important that the application system performs optimally at all times due to the critical decision making that contributes to diagnosis of patients. A successfully implemented QMS should be able to highlight problem areas and seek to achieve optimal performance. Therefore, the evaluation of its effectiveness will help identify shortfalls. The qualitative research approach was used, and data was collected by means of interviews using non-probability purposive sampling to select the sample of participants directly involved with the QMS implementation. The findings derived from interviews and review of documentation revealed that a successful ISO 9001 certification seems to be associated with adequate awareness, feedback from customers and measurement of process outputs. It emerged that there is a need to engage all employees from the beginning and to have continuous feedback sessions on the performance of the QMS to derive optimal benefits.

WB-06 Science & Technology Policy-1

Wednesday, 8/28/2019, 10:30 - 12:00
Room: Parlor B
Chair(s) Songphon Munkongsujarit; National Science and Technology Development Agency

WB-06.1 [R] • Enhancing Country's Competitiveness with Innovation Policy Lab - A Case Study of Thailand Innovation Policy Accelerator (THIPA)

Songphon Munkongsujarit; National Science and Technology Development Agency, Thailand

This paper examines the implication of establishing innovation policy accelerator to enhance the effectiveness of implementing, usage as well as scaling-up the innovative public policy in the context of government intervention, especially in developing countries where economic and social demands constantly require the government to come up with innovative policies to tackle the problems and propel the competitiveness of the country in the international arena. Various models of policy and government lab are explored and discussed in detail. The paper primarily investigates the case study of Thailand Innovation Policy Accelerator (THIPA) which was in the early stage and identifies the key success factors as well as limitations in implementing such kinds of programs in Thailand. The paper concludes with the recommendations for moving forward with the innovation policy lab in developing countries.

WB-06.2 [R] • Study on the Implementation of Free Opening Policy for Science and Technology Museums in China

Ting Xia; National Academy of Innovation Strategy, CAST, China
HongWei Wang; Inst. of Quantitative & Technical Economics CASS, China

In 2015, China Association for Science and Technology (CAST) launched the free opening policy on the Science and Technology Museum. In 2016, 123 science and technology museums of CAST have been opened free of charge. Through questionnaire survey and statistical analysis, this paper compares the implementation of the policy in local science and technology museums and the implementation of local supporting policies. On the whole, the policy is effective, but there are still problems, such as: imperfect policy system, weak policy operability, and lack of policy evaluation system. The research suggests that the free opening policy system should be further improved, clarifying the use and management of free opening grant and establishing a monitoring and evaluation system for science and technology museums. The research results provide CAST with a reference for the follow-up of science and technology museum's free opening work.

WB-06.3 [R] • Assessing the Effects of the Chinese State Key Laboratory Scheme

Fangjuan Yang; Tsinghua University, China
Zheng Liang; Tsinghua University, China
Lan Xue; Tsinghua University, China

In order to promote basic research and applied basic research with high quality, China launched the State Key Laboratory Scheme in 1984. After more than 30 years of developments, the Chinese State Key Laboratory has become an important part of China's innovation system. To assess the effect of the implementation of the Chinese State Key Laboratory Scheme, this study focuses on exploring the strategic orientation, operational performance as well as problems and challenges faced by the Chinese State Key Laboratory of the laboratory of academic disciplines as an example. The results of the study show that the Chinese State Key Laboratory has delivered remarkable results in supporting state need, advancing an original innovation, bringing up the talents, promoting discipline development and enhancing scientific cooperation. However, at the same time, there are still some problems to be solved, such as the need to step up financial support, strengthen the evaluation system, and improve top-level design and dynamic adjustment. To address these problems, this study concludes with some exploratory suggestions on funding policies and management.

WB-06.4 [A] • The Effectiveness and Problems of Talent Policy Implementation in China: Taking Major Talent Project as an Example

Jianquan Ma; National Academy of Innovation Strategy, China
Xuan Liu; National Academy of Innovation Strategy, China
HongWei Wang; National Academy of Innovation Strategy, China
YingJie Li; Tsinghua University, China

In 2010, China released the National Medium and Long-Term Talents Development Plan (2010-2020) and proposed 12 major talent projects. Based on the goals of these talent projects, this paper divides 12 major talent projects into 40 sub-tasks and 56 task objectives. Through the logical framework method and statistical analysis, this paper compares the objectives with actual completion, and finds that although the major talent project as a whole is promoted in an orderly manner under the impetus of the ministries and commissions, there are still obstructions in policy implementation such as follows: document implementation, conflict of policies among various departments, lack of systematic design, etc., which means the policy lacks of systematic, persistent and stability features. These reasons lead to the results that the less the leading departments are, the better the projects performed; the less complex the object talents are, the better the projects performed; some of the talent projects are even reduced as political achievement. The implementation of talent projects needs to be further optimized and improved.

WB-07 Technology Management in the Transportation Sector
Wednesday, 8/28/2019, 10:30 - 12:00
Room: Parlor A
Chair(s) Hemaid Alsulami; King Abdulaziz University

WB-07.1 [R] • Benchmarking and Evaluating the Efficiency of Mass Transit Systems Based on Best Practice Using Data Envelopment Analysis

Jacqueline Nayame; Portland State University, United States
Maoloud Dabab; Portland State University, United States
Timothy R Anderson; Portland State University, United States

Public transit systems in the USA have been faced with mounting pressure to decrease their operating costs while at the same time they are expected to increase ridership and meet multiple societal needs. The primary objective of this study is to measure the efficiencies of mass transit agencies based on best practice in the US, identify the influencing factors leading to their efficiencies, and determine how these strategies and policies can be used to improve inefficiency in transit agencies. Using the data envelopment analysis (DEA) method, the study analyzed the mass performance of 334 transit agencies across the US using data from the national transit database (NTD) for five years (2012 to 2016). The results show that public transit agencies operating ridesharing programs such as vanpools and on-demand services are more efficient compared to other agencies as they are able to better utilize their inputs and therefore have a higher overall efficiency.

WB-07.2 [R] • The Effect of Taxi Apps on University Community Transportation Pattern: King Abdulaziz University as a Case Study

Rimal Abu Taha; King Abdulaziz University, Saudi Arabia
Hemaid Alsulami; King Abdulaziz University, Saudi Arabia

The rapid growth of smartphones leads to establishing a huge number of different applications and software that can be downloaded to personal smart phones for free or low prices in order to provide different kinds of services. Many of these applications are for transportation that aim to connect taxi driver and smartphone users who aim to ride or transport from one location to another. These applications help users to find the closet taxi to drive them to their destinations and charge them based on trip time and distance that is measured by the application. Taxi applications are a recent phenomenon, which have an impact on public and private transportation. Recently, many smartphone users in Jeddah, Saudi Arabia, changed their transportation mode and started using taxi applications like working and nonworking people, students, etc. This paper focuses on university students; it aims to study and analyze the impact of these applications on the traditional transportation modes. The paper conducts a survey that scans the situation and describes how taxi applications influence the university student's decisions of transportation and discusses the advantages and disadvantages of taxi applications. The results show that the transportation has changed the pattern of students' decision on choosing their transportation way. Recommendations have been listed to help investors in the transportation sector adapt to the new pattern of the customers.

WB-07.3 [R] • The Evolution of Corporate R&D Strategy in A World Leading Bicycle Company (1972~2016): A Longitudinal Study

Yuan-Chieh Chang; National Tsing Hua University, Taiwan
Po-Hsuan Chen; National Tsing Hua University, Taiwan
Chin-Lai Huang; Giant Manufacturing Co. Ltd., Taiwan

The research and development (R&D) activities are critical to firms' growth, but previous studies provide fewer holistic evidences of aligning corporate strategies with R&D strategies. This study is to investigate how to align corporate strategies with R&D strategies that transform an internationalized company. Moreover, this study also investigated how companies build up their technical capability to transform from a private domestic company to a public and global corporation. A longitudinal study is applied to the world's largest global bicycle company by tracking its history from the beginning establishment to present achievement. Interviews with the CTO and internal documentation are used to analyze the alignment between the corporate strategies and R&D strategies. The results indicate that the co-evolution between corporate strategies and R&D strategies conduces to the process of firms' R&D internationalization. The process of internationalization of this bicycle company provides a referable model for companies who are searching for a way to transform their R&D organizations for the future. The evidences also provide some implications to OEM, ODM, OBM, and R&D transformation in different stages of industrial development of Taiwan.

WD-01 Strategic Management of Technology-6
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Grand Ballroom I
Chair(s) Robert H Martin; Software Management Consulting

WD-01.1 [R] • A System Dynamics-based Technological Archetype to Simulate the Economic Effects of a Six Sigma Project

Armando Elizondo-Noriega; Texas Tech University, Mexico
Naveen Tiruvengadam; Texas Tech University, United States
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Victor G Tercero-Gomez; Tecnologico de Monterrey, Mexico
Mario G Beruvides; Texas Tech University, United States

Six Sigma (SS) is now a well-entrenched methodology for performance improvement and comprises highly sophisticated tools targeted at quality improvement or cost reduction initiatives. However, the application of such tools is often not predicated on a foreknowledge or an informed supposition of the potential effects but is instead autotelic. One approach that has helped managers cope with the uncertainty associated with the implementation of an SS project is a simulation, which helps estimate the performance of critical system variables subjected to diverse what-if analyses. System Dynamics (SD) is a widely used simulation technique based on which no work has been performed to estimate the effects of an SS project in an organization. This work presents a holistic SD-based simulation model for an SS project that is based on a previously established technological archetype. The new model is intended to create a foundational template for future high-fidelity studies on the impact of SS projects in an organization.

WD-01.2 [R] • System Dynamics Modeling of the Effects of the Decision to Purchase Industrial Robots on a Manufacturing Organization

Armando Elizondo-Noriega; Texas Tech University, Mexico
Naveen Tiruvengadam; Texas Tech University, United States
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Victor G Tercero-Gomez; Tecnologico de Monterrey, Mexico
Mario G Beruvides; Texas Tech University, United States

Over time, all industries have adapted to the ever-increasing demand for higher product

quality and throughput by embracing automation and industrial robots. The impact of the purchasing decision of automation equipment such as robots on an organization's profitability needs to be better understood, given the paucity of published empirical data on the topic. One alternative approach to deal with the scarcity of data is simulation, and among the available simulation methods for redressing this issue, system dynamics (SD) has proved to be a reliable alternative. This work presents a SD-based simulation model for the purchasing decision of an industrial robot (purchasing option) within a manufacturing organization that is based on a previously established technological archetype. The intent of this study is to create a suitable simulation environment based on a combination of the two simulation models to study in greater detail the economic effects of purchasing industrial robots.

WD-01.3 [R] • A System Dynamics-based Technological Archetype for the Economics of Leasing Capital-Intensive Industrial Robots

Armando Elizondo-Noriega; Texas Tech University, Mexico
Naveen Tiruvengadam; Texas Tech University, United States
David Guemes-Castorena; Tecnologico de Monterrey, Mexico
Victor G Tercero-Gomez; Tecnologico de Monterrey, Mexico
Mario G Beruvides; Texas Tech University, United States

Over the past decade, leasing, as opposed to purchasing, has gained prominence regarding acquiring capital-intensive industrial robots. Investments in plant automation have seen significant growth over this time given the increasing need for higher productivity and quality. To offset the concomitant rise in automation equipment costs, organizations are increasingly relying on leasing such equipment. The leasing approach allows companies to reduce both the risks associated with and costs of new equipment acquisition. Initial automation efforts typically tend to be experimental, and the leasing of equipment allows organizations to test the efficacy of such efforts before committing to a final leasing/purchasing decision without expending heavily. Despite there being vast extant literature on automation through the use of industrial robots, the dynamics and effects of leasing decisions still need to be understood better. Simulation based on system dynamics (SD) has been used in this study given that it has been demonstrated to be robust to information scarcity, a problem typically associated with data underpinning leasing decisions. A new dynamic archetype based on SD, which is an upgrade of a previously established static technological archetype, modeling the economic effects of leasing an industrial robot for a manufacturing facility is proposed.

WD-02 Innovation Management-4
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Galleria I
Chair(s) Bang-Ning Hwang; National Yunlin University of Science & Technology

WD-02.1 [R] • Identifying Affiliation Effects on Innovation Enhancement

Takahiro Miura; The University of Tokyo, Japan
Kimitaka Asatani; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

Analysis of bibliographic information provides important evidence for identifying scientific innovation and future technological developments. The efficient operation of a research organization requires management of factors that enhance the future publishing of scientists' results. However, existing methodologies such as the use of the Times Higher Education University Rankings does not distinguish the reputation of affiliation from that of its members. Therefore, superior scientists do not perform well because of inferior research environments: so-called Brain Graveyards. As described herein, we propose the Research Productivity Enhancement (RPE) index to quantify affiliation effects on scientists' performance by tracking their scientific publications along with their movements among affiliations. Results show that scientists moving to state-of-the-art institutions do not always achieve enhanced productivity. Rather, some of them collect talented authors. Divided by nationality, many Chinese affiliations show high RPE. Conversely, Japan and Korea give less of a contribution to scientists' productivity. This analysis elucidates scientists' incentives and suggests means by which research organizations can enhance scientific innovation.

WD-02.2 [R] • The Impact of Industry-University-Research Collaboration on Regional Innovative Output

Fuji Xie; Shanghai Jiao Tong University, China

Based on the complex collaboration model and entropy concept in triple helix model, this paper gives out a new concept of collaboration degree of Industry-University-Research, constructs an improved model to measure this degree, and studies collaboration between participators and the innovative environment, trying to understand whether and how these factors influence the regional innovative output. Using the method of regression analysis, this paper examines the influences of collaboration degree of Industry-University-Research and innovative environment on regional innovative output based on Chinese data. The findings show that the effect of collaboration degree is significant. However, with the help of environment, the effect can be quite different. Both political and technology medium environment can reduce these influences, infrastructure environment can strengthen the influence while the humanistic environment has no significant impact. In the end, some suggestions to improve Chinese regional innovative output are put forward.

WD-02.3 [R] • Analysis of the Influencing Factors of Patent Pool Upon the Technological Innovation Based on Network Effects

Jing Hu; China Jiliang University, China
Lijun Zhou; China Jiliang University, China
Yueyi Zhang; China Jiliang University, China

In the context of technical standards highly introducing the technical patents, by obtaining the ownership of patents of technical standards, enterprises influence the expectations of consumers, dominate the leading advantages at the market, improve the entry threshold of technical market and thus get enormous business interests. However, the close connection between technical standards and patents forces the increasing emergence of the "patent thicket" problem, which not only prohibits the promotion of standards and the commercialization of new technologies, but also slows down the innovation motivations of enterprises. As an important tool to promote the technical standards for the enterprises, the patent pool can reduce the transaction costs and lawsuit disputes as well as accelerate the promotion and application of proprietary technologies. Meanwhile, taking advantages of the network effects of technical standards, the patent pool can enlarge the installed base, influence consumers' expectations and reinforce the positive feedback mechanism of technical standards, thus making itself one of the effective paths to resolve the problem of patent thicket and promote the innovation. On the basis of theories regarding the network effects of technical standards, this paper proposes the meanings of network effects for the technical standards and constructs the concept model through which the patent pool influenced the innovation. The questionnaire investigation was conducted, and the analysis was done by the structural equation so as to clarify the factors affecting the innovation of patent tool as well as its acting paths.

WD-02.4 [R] • Critical Consideration Factors Analysis for Open Innovation Implementation: An Empirical Study in a Semiconductor Manufacturer

Bang-Ning Hwang; National Yunlin University of Science & Technology, Taiwan

Traditionally, industrial firms conducted innovation strategies for their own products internally. In recent decades, these strategies have begun to change as firms across industries acquire external technologies to extend their knowledge base, which strengthens the firms' competitive advantages. Despite its growing importance, achieving a successful implementation of open innovation is not an easy task. To this end, this study constructs a decision framework by identifying a comprehensive set of consideration factors of implementing open innovation and groups these factors into an extensive technology-organization-environment (TOE) structure. To further rank the importance of these consideration factors, this study employed the method of analytic hierarchy process (AHP) by surveying a group of experts who have implemented the Open Innovation Platform (OIP) in Taiwan Semiconductor Manufacturing Company (TSMC), the largest semiconductor contracted manufacturer in the world.

In 2008, TSMC launched the OIP as an industry-wide design enablement initiative. To date, the OIP has allowed the entire semiconductor industry to accelerate time-to-market, improve return on design investment and reduce design infrastructure duplication. The contribution of this study lies in not only its providing a structured and comprehensive list of critical consideration factors but also illustrating the application of those critical factors by examples.

WD-03 Technology Management in the Health Sector-2
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Galleria II
Chair(s) Heyoung Yang; Korea Institute of Science Technology Information

WD-03.1 [R] • Patient Empowerment via Mobile Personal Health Records and Mobile Health Applications: A Review of the Current Use

Abdulaziz S Alhomod; OHSU, United States
Saeed Alzahrani; Portland State University, United States

Consumer empowerment has gained a significant attention in the medical field recently, and despite the ambiguity of its definitions, elements and measurement tools, it is apparent that mobile and other communication technology can play a major role in keeping patients informed, involved and empowered. This paper aims to explore methods by which mobile applications contribute to consumer empowerment and allow enhanced patient control over their health.

WD-03.2 [R] • Technology Management Maturity Assessment Model: An Exploratory Multi-criteria Approach for Healthcare Organizations

Amir Shaygan; Portland State University, United States
Tugrul Daim; Portland State University, United States

Maturity models are organizational management tools that have been developed and used for decades as organizations' way of responding to the constant pressure of trying to achieve and maintain competitive advantage through concurrent innovation, quality improvement, and cost reduction. The decision makers in the healthcare industry have been no exception in reaping the benefits of determining the merits and weaknesses of strategies through systematic quality improvement provided by maturity models. Although there are many healthcare maturity models in literature, there is a lack of models that provide managers and decision makers with a systematic, multi-criteria, and quantifiable maturity model. This paper proposes an exploratory model to assess technology management maturity in healthcare organizations by using hierarchical decision model (HDM). The model may help health organizations with pinpointing their strengths and weaknesses in the adoption and implementation of new technologies and technological approaches such as learning health systems (LHS) and their socio-technical infrastructure, while giving them organizational and competitive self-awareness and guiding them in setting their strategies and resource allocation. The model will serve as a much-needed technology management tool for hospitals to assess their technology management maturity for both the public and an organization's advantage in a more effective way.

WD-03.3 [R] • Achieving Sustainable Development Goals for People with Disabilities through Digital Technologies

Nonthapat Pulsri; Bangkok University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand
Kaewkul Tantipisitkul; Space and Universe Company Ltd., Myanmar
Thant H Aung; Space and Universe Company Ltd., Myanmar
Amaury Schaller; Bangkok University, Thailand
Arnauld Schaller; Bangkok University, Thailand
Krip Metanantakul; Bangkok University, Thailand
Randall Shannon; College of Management, Mahidol University (CMMU), Thailand

The world is moving towards an aging society, which causes a rise in the population of people with disabilities. A lot of attention is given to the use of digital technologies that can facilitate activities and solve issues in the daily life of a disabled person. The Sustainable Development Goals (SDGs) initiative launched by the United Nations focuses on the development of a blueprint to achieve a better and more sustainable future for all. In this view, digital technologies are promising to support the development and to help achieve the SDGs. This paper outlines a systematic literature review with bibliometric analysis of scientific publications to provide a connection between digital technologies for persons with disabilities and the SDGs. The results show the clusters of digital technologies and their research collaboration networks. The review intends to provide a knowledge base and evaluation of applications for these technologies. It is the intention of this paper to facilitate the understanding of scientists and policy makers in how digital technologies can address the SDGs and which ones will be most relevant in 2030.

WD-04 Social Innovation
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Galleria III
Chair(s) Kang Li; National Academy of Innovation Strategy, CAST

WD-04.1 [R] • • Research on the Chinese S&T Workers' Perceptions of Academic Environment: Based on the National S&T Workers Condition Survey

Chen Huang; National Academy of Innovation Strategy, China
Martin Bauer; London School of Economics and Political Science, United Kingdom
Dasheng Deng; NAIS, China
Kang Li; NAIS, China

Based on the data of the 4th National S&T Workers Condition Survey, we explored the perceptions of Chinese S&T workers about the academic environment, including the convenience, satisfaction and overall quality of the academic environment. We compared the different perceptions of S&T workers with different attributes and provide research support for the future optimization of the academic environment.

WD-04.2 [R] • A Comparative Study to Explore Different Personality Characteristics of Creativity between Chinese Potential Talents and Normal Adolescents

Guang Yang; China National Academy of Innovation Strategy, China
Mei Li; China National Academy of Innovation Strategy, China
Wen Li; Renmin University of China, China
Xuan Liu; China National Academy of Innovation Strategy, China

Scientific and technological innovation are inseparable from the creativity of scientific and technological talents. As potential scientific and technological talents, adolescents have always been concerned about their creative ability. Qualitative interview research and quantitative questionnaire research are combined to study the creativity personality of adolescents. Data was collected from middle school students in Beijing. Based on whether they received a reward in adolescents' science and technology innovation contest or not, data was divided into two groups: high creativity group (HCG) and the common group (CG). Results show that adolescents of HCG got higher scores than CG in terms of curiosity, internal motivation, openness, and persistence. According to the results, we have carried out some further discussion on improvement of Chinese adolescents' creativity.

WD-05 Technology Assessment & Evaluation-2
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Parlor C
Chair(s) Deok-Joo Lee; Seoul National University

WD-05.1 [A] • An Assessment of the Economic Life of Research Equipment: Korean Case

Jeong-Gi Lee; Seoul National University, Korea, South
Deok-Joo Lee; Seoul National University, Korea, South
Ri Piao; Seoul National University, Korea, South
Kyung-Taek Kim; Korean Institute of Energy Research, Korea, South

Sungjoon Park; Knowledgeworks Co., Korea, South

Recently, as scientific technologies have been modernized and upgraded, medium- and large-sized research equipment have been regarded as a prerequisite condition for the maximization of the outcomes of R&D. The governments of many countries also perceived the importance of research equipment as such and have been making massive investments for research equipment. Given the importance of research equipment, efforts for efficient management of research equipment is required. In particular, the problem of replacing old research equipment has become important because the costs for repairs or maintenances are increased as R&D equipment becomes obsolete. The purpose of this paper is to assess the economic life of R&D equipment empirically using the data gathered from public R&D institutes in Korea which own and operate mid- and large-scale research facilities. We developed a systematic model to apply the traditional engineering economic concept in assessing the economic service life of a research facility owned by research institutes in Korea. Using this model, we estimated the economic service life of research equipment according to the category of facilities with respect to several economic dimensions. Finally, we suggested a policy scheme for efficient replacement of research facilities based on our estimation results.

WD-05.2 [R] • Hospitals' Readiness To Implement Sustainable SmartCare Systems in Addis Ababa, Ethiopia

Getnet B Fanta; University of Pretoria, South Africa
Leon Pretorius; University of Pretoria, South Africa
Louwrence Erasmus; Council for Scientific and Industrial Research, South Africa

The frequent failures of electronic health systems and lack of successful scale-up beyond the pilot phase have been a concern for the implementation of electronic health systems in resource-constrained settings. Despite the challenges, developing countries have increasingly been implementing an electronic medical record system to improve patient care and clinical services. In this multiple case study research, we assess the readiness of 10 hospitals in Addis Ababa, Ethiopia, to implement a sustainable electronic medical record system also known as SmartCare. SmartCare is an integrated electronic medical record system with various models to be used in different departments of a health facility. The assessment adopts a conceptual framework for sustainable eHealth implementation that addresses the technological, social, organizational and economic factors of electronic health systems implementation. Technological readiness, social readiness, organizational readiness, and economic readiness are evaluated to learn hospitals' readiness to implement sustainable SmartCare systems. Sustainable eHealth implementation index is computed from the four factors to evaluate the readiness level of a healthcare organization to implement sustainable eHealth technology. The economic readiness is the lowest of all other factors which highlight the impact of economic factors on the implementation of sustainable SmartCare in Ethiopia. The commitment of top management to support successful SmartCare system in Ethiopia is demonstrated with a high organizational readiness level in most (80%) hospitals. The four categories are closely interrelated so that weakness in the level of readiness in one category may affect other categories. This research project supports the effort of sustainable SmartCare implementation in Ethiopia by identifying the possible gaps in the implementation of sustainable SmartCare systems.

WD-05.3 [R] • Technological Capability Assessment of Rice Processing Industry in Nigeria

Sunday Olufemi Akintelu; Samuel Adegboyega University, Ogwa, Nigeria
Titilayo Olubunmi Olaposi; Obafemi Awolowo University, Nigeria
Joshua Babatunde Akarakiri; Obafemi Awolowo University, Nigeria

The study examined the technological capability of the rice processing industry in Nigeria and assessed the factors that influence it in the industry. It also investigated the rate of development of technological capability development in the industry in a bid to enhance rice processing in Nigeria. Primary and secondary data were collected from 35 rice processing firms in the four geopolitical zones of Nigeria through the use of questionnaires, using Snow balling sampling technique. Data were analyzed using both descriptive and inferential statistics. The result showed that on a Likert rating scale of 5, acquisition capability (3.06) and production capability (3.22) were rated above average while creative (2.85), supportive (2.8) and adaptive (2.86) capabilities were rated low. This indicates that the firms have sufficient capability in the area of acquisition of resources and conversion of technologies, while the capabilities to provide training and improvement of technologies were low. The result further showed that inadequate finance ($r = 0.526$, $p<0.05$) is a constraint towards technological capability development of the firms. Invariably, poor funding strongly influenced technological capability development in the industry. The study concluded that the rice processing operation in Nigeria could be enhanced if proper technological capabilities are in place.

WD-06 Science & Technology Policy-2
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Parlor B
Chair(s) Markus K Westner; OTH Regensburg

WD-06.1 [R] • Blockchain and GDPR: Application Scenarios and Compliance Requirements

Florian Zemler; OTH Regensburg, Germany
Markus K Westner; OTH Regensburg, Germany

Blockchain and the European General Data Protection Regulation (GDPR) are two topics that are currently highly discussed in academia and amongst professionals. The Blockchain technology is claimed to revolutionize how business is being conducted by its way of storing data and sharing it with others. The recently introduced GDPR has a huge impact on processing personal data because it brought major changes to privacy regulation. This might also affect the processing of personal data in Blockchain-based application scenarios. Based on literature analysis, the paper at hand provides an overview of the Blockchain technology, presents a decision model, and introduces two possible Blockchain application scenarios. It analyzes relevant requirements of the GDPR in view of processing personal data and compares these with the fundamental principles of the Blockchain technology. The paper concludes that processing personal data in the Blockchain is violating the GDPR because it conflicts with fundamental specification of this regulation. This finding reveals the need for further research to propose concepts and frameworks for a GDPR-compliant processing of personal data using Blockchain technology.

WD-06.2 [R] • Mitigating High-Skill Brain Drain in Low-Growth Economies: An Examination of Existing Brain-Drain Threats in New Mexico and Strategy and Policy Alternative to Address Them

Aaron T Cowan; University of New Mexico, United States
Kelly R Cowan; Portland State University, United States
Steven T Walsh; University of New Mexico, United States

This study analyzes the challenges faced by struggling or low-growth economies when they lose highly skilled human capital via the process of "brain drain" or "ability drain." Such losses pose severe potential hazards to technology-based economic development. Factors related to these phenomena are characterized and examined via literature review and mixed methodology analysis to compare and contrast potential ways to manage brain drain and even achieve positive "brain gain" through individual and business-oriented strategies and policy alternatives.

WD-06.3 [R] • Analysis of the Effect of Corporate Employment Creation by Government R&D Support

Seunghwan Oh; Science, Technology and Policy Insititute , Korea, South
Jihoon Kim; Science, Technology and Policy Institute, Korea, South
Pilseong Jang; Science, Technology and Policy Institute, Korea, South

Recently, as job creation has become a social issue, discussions about job creation through government R&D support are also actively being discussed. In this study, we tried to analyze empirically the effects of government R&D support of Korea on corporate employment. In this study, National Science and Technology Information Service (NTIS) data is used in order to obtain information on the government R&D support in Korea. NTIS data provides

information on the support of Korean government R&D projects by year. A total of 61,546 R&D projects conducted by the small and medium enterprises (SMEs) from 2011 to 2016 were used for analysis. When analyzing the performance after the government support, it is necessary to distinguish whether the performance is due to the superior characteristics of the enterprise itself or by government support. In this study, the propensity score matching (PSM) method and multivariate matching method are simultaneously used for analysis. As a result of the analysis, government R&D beneficiaries showed an increase in terms of both the number of employees and total wage, which mean the quantity of employment. However, it was confirmed that the wage per employee of the beneficiary company decreased. The wage per employee means the quality of employment. Through this study, the employment creation effect of government R&D support and the necessity that both quantitative and qualitative effects should be considered in employment creation were demonstrated empirically.

WD-06.4 [A] • Technological Capacity Building through the Establishment and Management of Technological Organization in Developing Countries: A Case Study of Nepal Technology Innovation Center in Nepal

Deok S Yim; Science and Technology Policy Institute, Korea, South
Wangdong Kim; Science and Technology Policy Institute, Korea, South
Eun Joo Kim; Science and Technology Policy Institute, Korea, South
Hwang H Cho; Science and Technology Policy Institute, Korea, South
ChiUng Song; Science and Technology Policy Institute, Korea, South

The technological capacity building is one of the critical factors for the national development in developing countries. Especially, the establishment and management of relevant technological organizations are prerequisites for the technological capacity building in one's nation. In developing countries, not like developed countries, there are more factors to consider in the establishment of a technological organization such as governance issues and sustainability. In this paper, the case of National Technology Innovation Center in Katmandu University, which is supported by Korean International Cooperation Agency, is analyzed. In the technology transfer related literature, it is argued that the absorptive capacity and transfer capacity are important in the external technology learning and commercializing process. The case study shows that the absorptive capacity of a developing country and transfer capacity of a donor country are important as noted in the literature. In addition, the willingness to learn from the recipient organization is also critical in utilizing foreign technological aids. Although the study of one country case is not enough, it will give some practical knowledge to understand the establishment of technological infrastructure in the developing countries.

WD-07 Technology Management in the Automotive Sector-1
Wednesday, 8/28/2019, 14:00 - 15:30
Room: Parlor A
Chair(s) Dorothy K McAllen; Eastern Michigan University

WD-07.1 [R] • Autonomous Vehicle Technology Development: A Patent Survey Based on Main Path Analysis

Rico L.T. Cho; National Taiwan University of Science & Technology, Taiwan
John S. Liu; National Taiwan University of Science & Technology, Taiwan
Mei H.C. Ho; National Taiwan University of Science & Technology, Taiwan

This study surveys the patents on autonomous vehicles in a systematic and quantitative manner. Autonomous vehicle has been widely discussed recently due to the fast improvement in the related technologies. Aside from investigating the patent owners who are participating in development of autonomous vehicles, we apply main path analysis to uncover the technology developing trajectory. Three major findings are highlighted for further discussion: communication system will be further developed to pursue vehicle-to-everything, the perception technologies will integrate artificial intelligence, and the vehicle makers will cooperate with ICT companies to develop autonomous vehicle. Monitoring these observations may help companies to evaluate their future directions on R&D management, IP management, and business strategy development for autonomous vehicle.

WD-07.2 [R] • Development of the Conceptual Model and Formulation of a Mathematical Model for Supply Chain in South African Automotive Industry

Babatunde O Aina; Tshwane University of Technology, South Africa
Grace Kanakana; Engineering and Technology UNISA, South Africa
Khumbulani Mpofu; Tshwane University of Technology, South Africa

Effective management of the supply chain structure is crucial in gaining a competitive edge. This work considers the development of the conceptual model as well as the formulation of a mathematical model for the supply chain of the automotive industry. The major players in the conceptual model consists of the primary supplier (Tier 1), intermediary supplier (Tier 2) as well as the original equipment manufacturer (OEM), secondary supplier (dealer) and the end user. Prominent amongst others, constraint is the objective function, which is subjected to the challenges of globalization, mass customization and dynamic changes in demand and supply, product and quality requirements with their associated risk. This resulted in a transportation problem with linear objectives and constraints. The solution provided a simple algorithm for supply chain management. This enhances effective decision-making, improves logistics and information flow with resulting improvement in the overall efficiency of the system at optimum cost.

WD-07.3 [R] • Intelligentization of Automotive Power Steering System Innovation: A Patent Based Analysis

Yu Xiong; Tsinghua University, China
Xianjun Lee; Tsinghua University, China
Donghui Meng; Tsinghua University, China

As safety, comfort and pleasure of driving are concerned, the properties of the steering system as a relevant subsystem of automobiles, as well as an essential interface with the driver, are of great importance. Power steering system, which has the unparalleled advantages in terms of technology, cost and environmental protection, occupies the majority of present automotive steering system market share. However, with the rapid expansion of new energy vehicles and autonomous vehicles, it is still in doubt that the technological innovation of the power steering system is able to meet the future higher requirements. This paper, based on patent portfolio analysis, assesses the innovation of the power steering system. The innovation source and focuses of automotive steering systems are unveiled through the dynamic analysis of patent amounts, major patentees and patent classification codes. The findings show that the research and development of automotive power steering technology focuses on power-assisting mechanisms and monitoring devices, considered as two core technologies. Our analysis also shows that intelligentization, such as the motor control and control algorithm design, is the trend of future technological innovation. We believe that the power steering system is still absolutely competitive. Our study deepens the understanding of the dynamics of automotive power steering system innovation.

WE-01 Strategic Management of Technology-7
Wednesday, 8/28/2019, 16:00 - 17:30
Room: Grand Ballroom I
Chair(s) Ichiro Sakata; University of Tokyo

WE-01.1 [A] • Usage-based Auto Insurance on the Swedish Market: A Case Study

Dan Pettersson; KTH - Royal Institue of Technology, Sweden
Joakim Lillieskold; KTH - Royal Institue of Technology, Sweden
Peter Handel; KTH - Royal Institue of Technology, Sweden
Johan Agerman; Independent, Sweden

The Swedish consumer market for auto insurance is in a process of transformation from traditional insurance to usage-based insurance (UBI) based on telematics. The Swedish market can be characterized as having a high level of diffusion and use of digital technologies, yet while auto UBI is well established in several markets internationally, it has been struggling with the Swedish market. An exploratory case study has been performed covering actors in the Swedish eco system around UBI: incumbent insurance companies, challengers, and tech-

nology providers. Interviews have been carried out with key employees and decision makers to understand which opportunities and challenges they perceive in areas ranging from technology to market and how these influence decisions to engage or not to engage in such innovations. The results indicate among other things that national characteristics influence the establishment of auto UBI; the expected technological development creates a window of opportunity preventing incumbents from engaging; the slowly increasing market penetration by UBI offered by challengers will eventually force incumbents to react; and although the sale of a UBI service is generally not considered profitable for an incumbent, they consider or apply different strategies for self-disruption.

WE-01.2 [R] • A Preliminary Strategic Framework for Enhancing the Sustainability of International Technology Transfer: The Case of Libya

Rafaa I Khalifa; Portland State University, United States
Maoloud Dabab; Portland State University, United States
Husam Barham; Portland State University, United States

International technology transfer (ITT) has played a crucial role not only in the industrial growth of developing countries but also in enhancing the competitiveness of their enterprises in the global market. Libya is a North African country that is currently shifting from a strictly petroleum/mineral based economy to a broad-based economy competing with distinct advantages through selecting, planning, and adopting the right technology for the domestic market. This significant transition requires strategic access to global technology transfer. In this paper, a preliminary strategic framework is designed to enhance the sustainability of the ITT process from international donators to the Country of Libya. The research provides a systematic technology transfer process between the donor and recipient, which focuses on ITT challenges in term of barriers and planning. Two principle research questions are proposed to cover these challenges and help to develop a unique strategic framework: What are the most significant barriers for an international technology transfer between developed and developing countries? Moreover, how should the Country of Libya plan strategically to overcome those barriers and achieve sustainable technology receiving and adoption? In this paper, an in-depth literature investigation is used to answer both questions, leading to the development of a sustainable strategic framework that can help improve the ITT process from international donators to the Country of Libya. Additionally, the research highlights recommendations that can help to improve the quality of the technology transfer process itself in an international context.

WE-01.3 [R] • Analysis of Mergers and Acquisitions Trends in the Semiconductor Industry with the Technology Perspective

Bohua Shao; University of Tokyo, Japan
Kimitaka Asatani; University of Tokyo, Japan
Ichiro Sakata; University of Tokyo, Japan

Technology-driven mergers and acquisitions (M&A) are important for open innovation because they provide companies with external innovation resources. Recently, in the era of Industry 4.0, M&A deals become more and larger for landscape changing in the semiconductor industry. This paper aims at understanding the motivations and trends of this phenomenon from the technology perspective. In this paper, we mainly focus on the semiconductor industries in both the U.S. and Japan because the two countries are famous for the semiconductor. In order to cover the whole situation, we linked the "assignee/applicant" of the Derwent Innovation patent database and company names of a company database for analysis. We achieved this by splitting names into two parts for calculating similarity and matching. With the linkage of the two databases, we dealt data with network science and logistic regression. These practices helped to detect the differences of technology development level between the two countries. Furthermore, with natural language processing, we identified several technology keywords/fields which have influenced M&A in the semiconductor industry recently. Based on these findings, we argue that the future semiconductor industry will meet the diversified needs from society and that in the semiconductor industry, vertical and horizontal M&A prevail alternately.

WE-02 R&D Management

Wednesday, 8/28/2019, 16:00 - 17:30
Room: Galleria I
Chair(s) Xolani S Makhoba; University of Pretoria

WE-02.1 [R] • Competencies of Bridge Managers for Facilitating Global R&D Projects Toward Their Competency Development Framework

Nawarerk Chalarak; Japan Advanced Institute of Science and Technology, Japan
Yasuo Sasaki; Japan Advanced Institute of Science and Technology, Japan
Naoshi Uchihira; Japan Advanced Institute of Science and Technology, Japan

Although globalization provides opportunities for companies to expand their businesses, it brings more challenges to global project management. Collaboration in global research and development (R&D) projects requires competent individuals helping to improve project success. There are liaisons who we call R&D bridge managers (BMs). They facilitate research collaboration in global R&D projects between teams in the home country and the firm's foreign R&D teams. Success in the BM role requires a set of competencies that are related to this job. Competency development frameworks have proven themselves to be effective tools for human resource management. The frameworks identify skills, behaviors, and knowledge that are necessary to ensure job performance. The frameworks have three components: competency list, competency assessment, and competency development method. This study aims to propose a competency list for BMs. This competency list is one component of the BM competency development framework (BMCDF). The competency list is constructed based on a literature survey. It may help BMs to overcome difficulties and challenges in their job. The BMCDF could benefit both BMs to plan for their competency development and organizations to clarify expected job performance. This competency list will be used in the future as part of BMCDF for facilitating global R&D projects.

WE-02.2 [R] • Analysis of R&D Efficiency in South Africa: A Comparison with Other BRICS Countries

Xolani S Makhoba; University of Pretoria, South Africa
Anastassios Pouris; University of Pretoria, South Africa

South Africa is the largest producer of patents and publications in the African continent. This study, considered the country's production of patents and publications in biotechnology and nanotechnology its top priority areas. In addition, the overall publication and patent outputs in all scientific fields compared with the overall investment in R&D as expressed by the gross expenditure on R&D (GERD) as reported yearly in the country's R&D survey is studied. In addition, this overall data is used to compare South Africa's efficiency in all scientific fields to that of other BRICS countries. Data on R&D expenditure is used as input in the R&D process to achieve this comparison. The study found that, within South Africa, nanotechnology has been doing well on both patent and publications efficiency. The efficiency in terms of publications in this field started to fall slightly in 2013 to be equivalent to that of biotechnology. In context of the BRICS countries, it was found that South Africa has the highest R&D efficiency as measured by both patents and publications. This shows that the productivity is not necessarily a function of resources available.

WE-02.3 [R] • Researchers' Ambidexterity: The Duality of Exploratory Orientation and Exploitative Orientation and Its Relationship with Personality and the Impact on Research Performance

Rui Mao; Hitotsubashi University, China
Yuichi Washida; Hitotsubashi University, Japan

This study aims to explore the relationship among researchers' personality, researchers' ambidexterity, and their research performance. Ambidexterity describes someone's ability to use both hands with equal ease. And in the field of management, ambidexterity refers to the ability of organizations to simultaneously explore new capabilities and exploit existing competences. Although this concept has been established as an important antecedent of organizational innovation and performance, it is still unclear how organizational best strive for ambidexterity and even how this concept be best understood. Recently, researchers have

started to argue that ambidexterity is not only essential at the organizational level, but also at the individual level. However, research on individual ambidexterity is still in its infancy. This paper is to explore the relationship between individuals' personality and individuals' ambidexterity. In particular, we identify an individual who is a researcher from a university or private enterprise. Data was collected from 202 researchers in Japan. Then we examined the effect of researchers' personality - captured using FFM's big five factors - on both the researchers' exploratory orientation, exploitative orientation and ambidextrous orientation which is measured in three items each. And we operationalized our dependent variable, research performance, in two different ways: the number of journal publications and amount of research expenses received in one year. We also included several control variables in our analyses like the English ability, years of experience as a researcher, years of research career and the number of members in the research team. We used SEM (structural equation modeling) for our analyses and observe the significant relationship between researchers' personality, researchers' ambidexterity and the impact on research performance.

WE-02.4 [R] • The Budget and Expenditure of the Basic Research: A Comparison between China and the United States

Jie Xu; National Academy of Innovation Strategy, China
Chen Huang; National Academy of Innovation Strategy, China

The innovation performance of China has gradually improved, as the gross amount of R&D input has been growing rapidly in recent years. However, the ratio of China's basic research expenditure to the country's gross R&D expenditure has been stagnating at 5% for years. A relatively low proportion of basic research in R&D expenditure has caused much concern among domestic policy makers and academic researchers in China. This paper analyzes the budget and source of the basic research in comparative perspective mainly between China and the United States. It points out that the level of basic research expenditure in China is not only under the average level of major developed countries, but also incompatible with its current development stage. The main reason for the low proportion of basic research of China is too little investment from Chinese enterprises as the resources for basic research funding rely on the investment from the central government. In the end, this paper makes some policy suggestions to improve the level of China's investment in basic research by using the enlightenment from the American experience.

WE-03 Technology Management in the Health Sector-3
Wednesday, 8/28/2019, 16:00 - 17:30
Room: Galleria II
Chair(s) Seiichi Watanabe; Health Improvement Net Service LLC

WE-03.1 [R] • Save Lives: A Review of Ambulance Technologies in Pre-Hospital Emergency Medical Services

Nonthapat Pulsri; Bangkok University, Thailand
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand
Teera Sirisamutr; National Institute for Emergency Medicine (NIEMS), Thailand
Porntip Wachiradilok; National Institute for Emergency Medicine (NIEMS), Thailand

According to the World Health Organization (WHO), the global population will face many challenges in providing healthcare. The results of the aging society, natural disasters, and global warming are only a few examples. Emergency medical services (EMS) are the backbone of the first responders, emergency medical technicians, paramedics, and medics, to provide vital lifesaving care in an emergency. As part of pre-hospital EMS, ambulances are indispensable in the rapid transit and rescue of patients. Advances in ambulance technologies can enhance the effectiveness and efficiency of EMS personnel and subsequently save lives. Investing in new ambulance technologies is crucial to increase the survival rate and provide better care during the EMS process. However, such investments are costly and depend on the pre-existing EMS system. This paper offers a review of ambulance technologies in pre-hospital EMS between 2014-2018. The review is based on a systematic literature review and bibliometric analysis of publications retrieved from the SCOPUS database. The analysis identified clusters of ambulance technologies in pre-hospital EMS, current ambulance technologies, growth pattern, and direction for the future development. The results of the review are aimed to provide a knowledge base and overview of ambulance technologies for the decision-making process of hospitals and policy makers.

WE-03.2 [A] • Concentration or Diversification: Comparison of the Degree of Concentration for Clinical Trials Among Pharmaceutical Companies

Heyoung Yang; Korea Institute of Science Technology Information, Korea, South

The cost and time required for the clinical trial phase for new drug development are increasing, which is large enough to pose a threat to pharmaceutical companies' survival. This is true for the global mega-sized pharmaceutical companies, but more important for local pharmaceutical companies. Therefore, pharmaceutical companies need a strategy for clinical trials. However, there are few cases in which strategies for clinical trials have been studied. The purpose of this study is to compare strategies for clinical trials of pharmaceutical companies. The strategies of mega-pharmaceutical companies, which have long been global leaders, are analyzed and compared to those of local companies in Korea in order to provide implications for pharmaceutical companies' clinical trial strategy. Diversification, an important concept in corporate strategy, is applied to clinical trials in two aspects. First, this study analyzed how the disease groups are operated by companies in terms of product-diversification or resource-concentration. Second, in terms of risk management through external cooperation, this study analyzed how many collaborators are involved, that is, diversification and concentration in cooperation. A comparison of global mega-pharmaceutical companies with local companies in Korea confirms that there are differences in clinical trial strategies. Global companies have a higher concentration in the disease group of clinical trials than local companies in Korea. In addition, global companies have a higher percentage of collaborations with outside organizations but a higher concentration of collaborators, and this means that there are collaborators in which ties are firmly established with global companies.

WE-03.3 [R] • Health Management Information Systems in Public Hospitals of Tamil Nadu, India: Productivity Analysis Using Malmquist Index

Sri Vidhya Bhavani Munuswamy; Indian Institute of Technology Madras, India
Prakash Sai Lokachari; Indian Institute of Technology Madras, India

The present study analyzes the changes in the total factor productivity index of a state's public district hospitals of India in the period from 2013 to 2017 with the purpose of identifying efficiency patterns for these public district hospitals after the implementation of a health management information system (HMIS). The output-based, variable return to scale (VRS) data envelopment analysis (DEA) Malmquist productivity index was used to estimate productivity change in 31 district headquarter hospitals (DHQH) of Tamil Nadu, India. Results reveal the DHQH's efficiency trends and, therefore, the influence of technology in their organizational functioning of transforming the resources (inputs) to perform their utilities (outputs). They also show the changes experienced in the DHQH's total productivity and its components, namely, the technological change and efficiency change. Positive total productivity factor changes were due to a positive technological efficiency change rather than technical efficiency change. The implementation of HMIS as technology has certainly influenced the performance of DHQH's of Tamil Nadu over time, but it needs to build more administrative capabilities to show a significant increase in the productivity growth as a whole.

WE-04 Information/ Communication Technologies
Wednesday, 8/28/2019, 16:00 - 17:30
Room: Galleria III
Chair(s) Vijay Singh Rathore; IIS University, Jaipur

WE-04.1 [R] • An Annotation Scheme for Developing Prototype Automated Facilitation Software

Naoko Yamaguchi; Nagoya Institute of Technology, Japan
Tomohiro Nishida; Nagoya Institute of Technology, Japan
Takayuki Ito; Nagoya Institute of Technology, Japan

We propose a novel annotation scheme for automatically facilitated online discussions based

on the issue-based information system (IBIS) approach. Automated facilitation of online discussions has advantages such as less influence on participants' relationships and fewer restrictions on time and place. We develop the automated facilitation system as a first step to create a large-scale consensus support system. The discussion data created by our proposed annotation scheme is used for training a machine learning model in the automated facilitation software. The process of defining our annotation scheme is as follows: 1) Human facilitators conducted experimental online discussions on the basis of the IBIS idea. 2) All the discussion data were annotated into six elements. We put ID numbers on all labeled data for indicating posting connections. 3) We tested the facilitator program's ability to judge each element. This process was repeated while improving the annotation definition. The core of our annotation definition was how to distinguish Issue and Con components. We solved this problem by defining Issues as questions able to be answered by ideas. From results of 38 annotations of experimental online discussions, the reliability of agreement between three annotators was Fleiss' kappa=0.66, which means "substantial agreement" among annotators.

WE-04.2 [R] • Spontaneous Webcam Instance for User Attention Tracking

Tarmo Robal; Tallinn University of Technology, Estonia

Eye tracking is one of the solutions applied in human-computer interaction research to study how users interact with user interfaces - where do they focus, what interests them and how do they browse through the content on the page. Eye tracking has also been used to detect user attention and even mind-wandering. Eye tracking is usually carried out by exploiting special hardware - expensive tools that cannot be applied to masses. Thereby, these trackers are only suitable for studies in lab conditions. The latest advancements in technology have enabled use of commercial grade webcams and special software for capturing user eye gaze. However, calibration still remains as a hurdle to overcome. Herein, we explore the applicability of the spontaneous eye gaze tracking approach and its accuracy compared to a professional eye tracking solution in a controlled study. In particular, we focus on the applicability of eye tracking in a user-effortless way for focus area detection in web user interfaces.

WE-04.3 [R] • Policy Evolution Analysis: A Case Study of China's Information Technology Policy

Chao Yang; Tsinghua University, China
Cui Huang; Zhejiang University, China
Jun Su; Tsinghua University, China

Policy documents are the carriers of policy and provide a channel for researchers to observe the main contents of a policy and the policy process. However, the relationship among policy documents is complicated. In this paper, we propose a new bibliometric method for detecting the changes of policy topics based on policy documents. We identified policy targets implied in policy documents and built a policy target network. Then, based on the eigenvector centrality features of network nodes, we identified the core policy targets and their evolution in the target field. A case study of China's information technology policy was used to demonstrate the reliability of our method, and the results reflect the practical value of this method in quantitative analysis on policy documents.

WE-06 Supply Chain Management
Wednesday, 8/28/2019, 16:00 - 17:30
Room: Parlor B
Chair(s) Dilek Cetindamar; University of Technology Sydney

WE-06.1 [A] • Application of Agile/Lean to Supply Chains in a Small, Medium and Micro Enterprise (SMME) in South Africa: A Case Study

David J Kruger; University of South Africa, South Africa

Managing an organization's manufacturing and supply chain capabilities remains a challenge at the best of times; in the highly competitive small, medium and micro enterprise (SMME) sector, it is even more important. It is no different in South Africa. Senior management and owners of organizations should treat the issue as a strategic imperative in their organizations. Failure to do so might render an enterprise uncompetitive, with the result that its market share starts diminishing within the sector. The planners in an enterprise must recognize that each of the products manufactured will require a different strategy to compete with competitors' products. Various factors influence the capabilities of an enterprise in the SMME sector, the most important being supply and demand insecurity, life cycle of products and capacity. It could have a detrimental effect on an organization's competitiveness. Awareness of the strategic importance of agile/lean supply chain management is essential if an enterprise within the SMME sector is to remain competitive. Consequently, planners in the sector must achieve the correct balance between the competing factors described above. Implementation of agile/lean strategies for supply chain management within the enterprise concerned would enable it to deal with any fluctuations it might experience. The paper will attempt to illustrate the applicability of a hybrid agile/lean approach in the enterprise concerned.

WE-06.2 [R] • Towards a Novel Framework of Barriers and Drivers for Digital Transformation in Industrial Supply Chains

Thorsten Lammers; University of Technology Sydney, Australia
Laura Tomidei; University of Technology Sydney, Australia
Andrea Trianni; University of Technology Sydney, Australia

Businesses across all sectors are facing the complexity of an increasingly digital economy. Digital transformation offers vast opportunities to businesses and entire supply chains. While many investments are targeted at the organization level, the supply chain perspective can lead to even greater impacts on business performance. However, as supply chains involve interconnections between multiple actors, comprehensive digitalization initiatives at this level are very complex. Several strategic factors affect decision-making around digital investments. For this reason, a framework that categorizes all these factors is needed in order to help managers build digitalization strategies for their supply chains. In this paper, based on a review of existing literature, we give indications for a framework encompassing barriers to and drivers for digital transformation in the context of industrial supply chains. Our framework preliminarily allocates these factors by using two dimensions. The first one classifies them using several categories: financial, knowledge and skills, regulatory, technological, market, organizational, and cultural. The second dimension classifies determinants at the level on which actions can be made, i.e., market, supply chain, or organization. The framework can support organizations to exploit the opportunities provided by digitalization of supply chains and will help managers understand the complexity involved.

WE-06.3 [R] • Operationalising Ambidexterity: The Role of 'Better' Management Practices in High-Variety, Low-Volume Manufacturing

Mile Katic; University of Technology Sydney, Australia
Dilek Cetindamar; University of Technology Sydney, Australia
Renu Agarwal; UTS Business, Management Discipline Group, Australia
Nathalie Sick; University of Technology Sydney, Australia

Innovation and change are fundamental to the long-term sustainability of any organization. Whilst it is important to improve operating efficiency in the bid to become more cost competitive, there is still an underlying need to venture out of the norm and explore new opportunities. Though a great deal of research has emerged regarding the achievement of ambidexterity, there remains a gap in understanding how this is actually operationalized in organizations. This paper takes aim at this problem in the context of SME manufacturers that produce a high variety of customized products at low volumes (HVLV). Under such circumstances, ambidexterity appears intuitively easier to achieve given the manufacturer is designed to be as flexible as possible in the first place - though, it would seem this may be to their detriment. Based on a literature review and drawing from ambidexterity and organizational theory, our contribution is geared towards investigating the underlying mechanisms that make HVLV manufacturers ambidextrous in the first place. In particular, we concern ourselves with exploring how ambidexterity is enacted through what are deemed "better" management practices that result in innovative organizations. By better understanding the more latent characteristics of HVLV manufacturers, we shed some light on the interactions between external and internal influences affecting the impact of ambidexterity under such an environment. Further theoretical and managerial implications are discussed.

WE-06.4 [R] • Digital Transformation Technologies and Capabilities of Technology Utilization: Case Study of Japanese Firms

YoungWon Park; Saitama University and University of Tokyo, Japan
Paul Hong; University of Toledo, United States
Geon-Cheol Shin; Kyunghee University, Korea, South

The digital transformation megatrend is fundamentally disrupting and changing every industry, business and most jobs at a rapid pace. In particular, most Japanese firms utilize diverse digital technologies to sustain their competitive advantages. However, too often the return of investment on digital technologies is not as high as expected. This paper presents a research model between digital transformation technologies and capabilities of digital technology utilization. We hypothesize that higher capabilities of digital transformation technologies utilization contribute to performance of digital technologies utilization. With several case studies of Japanese firms, we find that higher capabilities of digital technologies have a positive impact on the performance of digital transformation technologies. Lessons and implications are discussed.

WE-07 Technology Management in the Automotive Sector-2
Wednesday, 8/28/2019, 16:00 - 17:30
Room: Parlor A
Chair(s) Grace Kanakana; Engineering and Technology UNISA

WE-07.1 [R] • A Study of Factors in the U.S. Automotive Industry That Influence Use and Procurement Outcomes for Electronic Supply Chain Management (eSCM)

Joseph Joyce; Michigan State University, United States
Dorothy K McAllen; Eastern Michigan University, United States
Abubaker Haddud; Southwest Minnesota State University, United States

The U.S. automotive industry is a critical component of the nation's economic growth because of its use of innovative technologies that provide strategic advantages for business and operational practices. This study focused on electronic supply chain management (e-SCM) in the automotive industry and used two factors, ease of system use (EOU) and perception of organizational usefulness (PU), to investigate its impact on procurement outcomes and the organization's decision to use e-SCM. An online survey was used to gather responses from 144 people employed in supply chain management within the U.S. automotive industry regarding perceptions based on the technology acceptance model (TAM). The results found that two variables, perceptions of organizational usefulness and ease of use, affected the final adoption of e-SCM systems within organizations. The study also found that individual experience and educational level were significant in predicting work outcomes, which are important for supporting continued innovation, sustainability, and industry success. Recommendations for future research include studies in alternative industries, such as agriculture, textiles, pharmaceutical and electronics, using a similar research model and survey instrument, as well as research in automotive industries in other countries looking for similarities and differences with the U.S. based findings.

WE-07.2 [A] • An Assessment of the Factors Influencing the Selection of the Best Carsharing Alternative in Portland Area Using Hierarchical Decision Modeling (HDM)

Saeed Alzahrani; Portland State University, United States
Ahmed Alzahrani; Portland State University, United States
Xuran Dai; Portland State University, United States
Wei-Chen Hsu; Portland State University, United States
Rashi Tiwari; Portland State University, United States

Carsharing is a business model of car rentals that allows consumers to benefit from a private vehicle for short periods while being relieved of the costs of the purchase and maintenance. Carsharing is a growing industry and some players are trying to get a hold in the already competitive market. The current transportation market offers consumers many options for buying a vehicle, but fewer practical options for using a vehicle occasionally. Carsharing provides the benefits of allowing easy access to vehicles spread across the city that are rented per an hour or day. It is an increasingly common option for locals and tourists who want to get from one place to another without spending too much time on public transports. These have the added benefit of convenience and comfort of four-wheelers without paying much extra, as in the case of conventional rental cars, taxi, or cabs. This paper uses hierarchical decision model (HDM) to evaluate the factors influencing the selection of the best carsharing alternatives around the Portland area by analyzing different perspectives and criteria that influence the selection. This paper addresses which criteria are most important to renters and provides recommendations for renters and carsharing businesses. The findings suggest that the most essential criteria for the consumers are insurance coverage, reliability, rental cost, drop-off options, and gas cost.

WE-07.3 [R] • The Impact of a Firm's Ownership Structure on Its Technological Innovation Performance

Jinglun Wang; Tsinghua University, China
Jiaxin Shi; Tsinghua University, China
Xianjun Li; Tsinghua University, China

Existing research shows that a company's ownership structure affects its technological innovation performance (TIP). However, the perspective of this research is relatively unilateral and only focuses on the influence of a certain component of company ownership on TIP, without considering the influence of multiple kinds of company ownership structures. This paper selected 23 automotive companies in China as the research sample, and it uses a two-stage data envelopment analysis (DEA) method to measure the companies' TIP and a Tobit panel regression to explore the relationships among different ownership components - state-owned, private, foreign, and the institutional - and their impact on TIP. Our research finds that, among all of the components of ownership of Chinese automotive companies, both state-owned and private ownership structures have a significant impact on TIP, but the positive effect of private ownership is greater than that of state-owned ownership. By contrast, the foreign capital and institutional ownership components were found to have no significant impact on TIP.

HA-01 PLENARY - 4

DATE: THURSDAY, 8/29/2019
TIME: 08:30-10:00
ROOM: GRAND BALLROOM I
CHAIR: DILEK CETINDAMAR; UNIVERSITY OF TECHNOLOGY SYDNEY

HA-01.1 [K] • Polymaths and Accelerated Intelligence

Bulent Atalay; Scientist, Artist and Author, United States

The Anglo-American expression, "Jack of all trades, master of none," is a dismissive pejorative discrediting the notion of spreading oneself thin. And it has equivalent expressions in most world cultures. A Chinese version reads, "Armed with ten knives, yet none of them sharp." An Estonian version offers a different metaphor, "Nine trades, the tenth hunger." A rare version that has only positive connotations is the Turkish expression, "On parmaginda on marifet" ("Ten skills on ten fingers"), suggesting praise for individuals with a diversity of interests. In the prevailing model of technology, engineers and innovators specialize in one field or another. But as recent research points out, through the ages most successful innovators have been polymaths. The list includes Archimedes, Brunelleschi, Leonardo, Michelangelo, Galileo, Kepler, Descartes, Huygens, Hooke, Newton, Leibnitz, Darwin, Pasteur, Maxwell, Einstein, and in modern times Bill Gates, Steve Jobs, and Elon Musk. Drawing on information from different disciplines cannot fail to create fertile grounds for progress. This is the essence of Leonardo's Model. Newton, physicist, mathematician, astronomer, alchemist, inventor, theologian, and natural philosopher, succeeded in showing that the universe was mathematical. And even his preoccupation with alchemy, now discredited as a

pseudoscience, helped him to visualize action-at-a-distance and the idea of invisible fields. Shakespeare understood human behavior better than any psychoanalyst and separately he harbored an obsession for history - especially, the histories of England, Scotland, Denmark, Ancient Rome, and medieval Italy. Their settings became the backdrops for his historical plays. Goethe and Darwin, both impressive polymaths in their own right, were dazzled by the diversity of interests demonstrated by Alexander von Humboldt (1769-1859). The Prussian aristocrat - traveler, essayist, naturalist, botanist, etymologist, ornithologist, geologist, oceanographer, and meteorologist - is still regarded as one of the finest scientific explorers in history. But even von Humboldt does not come close to Leonardo as the "master of all trades." Along with every branch of science and engineering, Leonard also painted...better than anyone else. "The universal genius" and "the greatest genius in history" are frequently invoked in describing the breadth and depth of Leonardo's universe. The artist-scientist's functionally symmetric brain - that magnificent instrument of his effort to satiate an insatiable curiosity - questioned and analyzed relentlessly in inventing the future. Inspired by Leonardo's Model, Virginia Commonwealth University (VCU) created the Da Vinci Center where all projects call for the collaborative endeavors of the departments of engineering, art, and business, together integrating form, function, and economy.

HA-01.2 [K] • Automacene Rising: Managing the Social & Economics Consequences of Advanced Information Technologies

Gregory A Daneke; Arizona State University, United States

This second and vastly more consequential stage of the information technology revolution poses a number of unprecedented challenges to the field of technology management. Part of this stems from the fact that much of BIG DATA and AI are still arcane math and science (and more than a bit of hype) in search of technology. Yet challenges are greatly exacerbated by a number of relatively recent changes in the political economy of technology. Digital information has become a major asset class in and of itself, and politically powerful platform monopolies (which actually retard innovation) have been allowed to operate without the conventional processes we might associate with "adult supervision." Meanwhile, militaristic motives (and funding) still predominate much of the basic as well as applied research. These trends collide with elements embedded within the neural networks and "deep learning" processes that either amplify unrecognized human biases and cultural artifacts or take humans out of the loop altogether - ergo the rise of the "automacene" (which introduces whole new sets of potential socioeconomic dysfunctions). Real, yet often overstated, fears abound of autonomous weapons, a totally redundant workforce, elimination of the few remaining expectations of privacy, and the continued undermining of elections, as well as rampant and rabid anti-social network behavior and armies of bogus bots fueling further fear and hate. Yet many if not most members of the general public are totally unaware of the very real probability of having one's entire life completely "redlined" before one has a change to live it. Highly opaque predictive algorithms are already delimiting access to schools, bank loans, insurance, employment, and government programs for certain artificially collated cohorts - not to mention whether and for how long one might be incarcerated. In the meantime, increased use of AI in risk profiling of increasingly exotic derivative instruments (themselves often algorithmic distortions of erroneous economic theories) and design of prudential regimes virtually insure that the next financial crisis will be even more catastrophic. But it is not all doom and gloom, many steps (some quite promising) are emerging to confront outmoded management models and methods, and they need to be built upon.

HB-01 Sustainability

Thursday, 8/29/2019, 10:30 - 12:00
Room: Grand Ballroom I
Chair(s) Joseph Acai; University of Pretoria

HB-01.1 [R] • The Promise of UN SDGs for Technological Business Development through Collaborations

MJ. Ni. ilknur Tekin; UC Berkeley Haas School of Business, United States

The United Nations General Assembly declared that a "revitalized" Global Partnership for Sustainable Development framework is of crucial importance, supported by the solid policies and actions as outlined in the Addis Ababa Action Agenda of July 2015, as an integral part of the 2030 Agenda for Sustainable Development. The UN Statistical Commission created the Inter-Agency and Expert Group on Sustainable Development Goal (SDG) indicators (IAEG-SDG), which is composed of member states and regional and international agencies as observers. IAEG-SDG developed the indicator framework for the goals with the clarified 232 unique indicators aligned with the UN SDGs, their 169 targets and also the targets of the 2030 agenda to be implemented. The Global Indicator framework was agreed upon in March 2017 and adopted by the General Assembly on July 6, 2017. As they are, the 17 Sustainable Development Goals sets out a vast amount of collaboration opportunities and requirements for governments, NGOs, companies and universities to contribute to the improvement of economic and social welfare of societies, countries and regions in global standards. This paper presents an assessment on the potential of the UN SDG framework for technological development through collaborations.

HB-01.2 [R] • A Review of the Technologies towards Sustainability Assessment of Pavement Infrastructure

Joseph Acai; University of Pretoria, South Africa
Joe Amadi-Echendu; University of Pretoria, South Africa
Isaac Mutenyo; Ministry of Lands, Housing and Urban Development, Uganda

The adoption of the Sustainable Development Goals (SDGs) by member states of the United Nations in September 2015 now demand countries to align their development agenda towards sustainability based on country specific priorities. For developing countries, progress towards sustainable road infrastructure has generally been sluggish, despite the availability of pertinent technologies to support sustainable development of pavement infrastructure. These technologies incorporate sustainability parameters across the entire pavement lifecycle (design/materials, construction, use, maintenance, and end-of-life). This paper examines the applicability of the road pavement technologies against the sustainability indicators in the context of a developing country.

HB-01.3 [R] • The Effects of Environmental Regulations on the Adoption of Managerial and Technical Environmental Practices

Yao Fu; Radboud University, Netherlands
Robert Kok; Radboud University, Netherlands
Paul Ligthart; Radboud University, Netherlands
Allard van Riel; Hasselt University, Belgium
Ben Dankbaar; Radboud University, Netherlands

With the aim to better understand the conditions under which firms respond to environmental regulations, we investigate how regulatory uncertainty and information transparency influence the effectiveness of environmental regulations on the adoption of managerial and technical sustainable practices. Combining evolutionary and institutional theory, we hypothesized that regulatory uncertainty has a negative and information transparency has a positive effect on the effectiveness of environmental regulations. The hypotheses are tested using survey data of 603 Chinese and 155 Dutch manufacturing firms. Our results show that policy awareness is significantly related to technical sustainable practices, while policy enforcement is significantly related to both managerial and technical sustainable practices. Regulatory uncertainty negatively moderates both the relationship between policy awareness and managerial sustainable practices and the relationship between policy enforcement and technical sustainable practices. Information transparency only positively moderates the effect of policy enforcement on technical sustainable practices. This paper explains the underlying mechanism of the impact of environmental regulations on firms' sustainable behavior, emphasizing the importance of not only the policy itself but also the regulatory context. It contributes to institutional theory suggesting heterogeneous response conditions towards institutional pressures and contributes to organizational sustainable behavior studies by testing effects on both managerial and technical sustainable practices.

HB-01.4 [R] • A Study of Factors Contributing to High Raw Material Wastage

in Manufacturing Organisations: The Case of an Automation Company in KZN, South Africa

Alfred K Mashishi; Mancosa Graduate School of Business, South Africa
Chipo Mugova; Mancosa Graduate School of Business, South Africa

From a business perspective, maximum efficiency leads to maximum profits, hence the reason many businesses seek methods to minimize material wastage. This study aimed to identify the factors contributing to high material wastage in a Durban-based automation company in South Africa. The study sought to evaluate the effectiveness of current waste minimization strategies and the challenges experienced to identify possible solutions for recommendation to address material wastage in the manufacturing sector. The study used the quantitative research methodology using structured surveys to collect data from a sample of 100 individuals who are directly linked to and employed by the automation company, selected using simple random probability sampling. Data gathered from the questionnaires was analyzed using Excel spreadsheets and the SPSS data analysis software package to determine critical and significant patterns. The results revealed that the high material wastage at the automation company is a result of low skill levels, little years of experience, low staff retention, poor-quality material, and inefficient manufacturing processes and techniques used. Recommendations presented to management consist of skills development in the factory, training and monitoring of staff, implementation of staff retention strategies and the implementation of advanced manufacturing processes to improve production efficiency.

HB-02 Enterprise Management
Thursday, 8/29/2019, 10:30 - 12:00
Room: Galleria I
Chair(s) Thorsten Lammers; University of Technology Sydney

HB-02.1 [R] • Building a Sustainable Business Model through Technology Entrepreneurship: An Analysis of Business Models from a System and a System of Systems Perspective

Gary O Langford; Portland State University, United States
Teresa Langford; Portland Community College, United States

Case study methods are used to identify key elements of business models in highly competitive environments. Small businesses, in particular, must rely on entrepreneurial prowess and innovation, adapt to their environment, have sufficient resources, and skillfully manage project outcomes in entrepreneurial start-up situations. This research hypothesized that a problem faced by entrepreneurial organizations is due to the fundamental flaws and poor adaptability of their business models to satisfy needs of customers and prospective customers. The problem is that the flow of value from business to customer was different from the flow of value from business to user. Two kinds of business models were examined - for-profit and non-profit. Each business model is expressed and compared in terms of their inherent systemic nature as both a system and as a system of systems. A systems approach is used to identify the essential requirements for building a sustainable business model through a mix of technology innovations for products and services. This paper reveals why sustainable entrepreneurial businesses can be built regardless of given their status as for-profit or non-profit. The advantages and disadvantages of for-profit and non-profit businesses are discussed.

HB-02.2 [A] • Framework Development for Information Security: Case of a Pharmaceutical Company

Zeynep Ocak; Yeditepe University, Turkey
Ayfer Ekiz; Yeditepe University, Turkey

Information security is the protection of information from threats in order to ensure business continuity by reducing business risks, and maximizing return on investments and business opportunities. In today's world, information is exposed to a growing number of threats. Some important reasons for this growth are: increase in electronic applications in businesses as well as in daily life, sharing information on network systems, being able to access information from multiple points, threat of losing information, and increase in personal and corporate loss of money and reputation. Thus, ensuring the information security is vital for today's interconnected business environment. Information security policies are the basis for a reliable information security scheme and are critical to protect the organization's information system (IS) resources and data. ISO 27001:2005 provides a widely accepted information security management guideline for establishing, implementing, operating, monitoring, maintaining and improving an information security management system (ISMS). Although it is suitable for all kinds of organizations, there is a lack of a comprehensive framework, supporting process model, and methodology that can enable an enterprise to implement and effectively manage information security. Thus, the purpose of this study is to examine a pharmaceutical firm's information security management system, and to develop an appropriate framework and methodology to ensure integration of information security management with other enterprise business processes.

HB-02.3 [R] • The Impact of Consumption Values on Green Purchase Intention and Green Purchase Behavior: The Moderating Role of Product Category

Hong Wang; Beijing Institute of Technology, China
Wenwen Bi; Yan'an University, China
Xiaoyang Shi; Beijing Institute of Technology, China
Meijian Yang; Beijing Institute of Technology, China
Na Li; Beijing Institute of Technology, China

With the rise of green consumption, green products have become a part of people's life. Based on the theory of consumption values, this paper designs an empirical study about the different role of shopping goods and convenience goods in the effect of consumption values on green purchase intention and green purchase behavior. To verify the assumptions of this study, questionnaires were carried out among the respondents who have purchased green products, and statistics of 239 people were taken as the valid samples. By the multiple regression contraposed different group of product, it is found that there is a significant difference in the effect of consumption values on green purchase intention and green purchase behavior between these two groups. For convenience goods, functional value and conditional value have a significant effect on green purchase intention, and only conditional value has a significant effect on green purchase behavior. For shopping goods, epistemic value has a significant effect on green purchase intention, and functional value and epistemic value have a significant effect on green purchase behavior. In marketing practice, this study provides marketing strategies for enterprises to promote green purchase intention and green purchase behavior.

HB-03 Project/Program Management
Thursday, 8/29/2019, 10:30 - 12:00
Room: Galleria II
Chair(s) Terry Schumacher; Rose-Hulman Institute of Technology

HB-03.1 [R] • Organizational Support as an Efficient Mechanism for Enhancing High Risk Projects Success

Arik Sadeh; HIT Holon Institute of Technology, Israel
Ofer Zwikel; The Australian National University, Australia
Dov Dvir; Ben-Gurion University of the Negev, Israel

Organizational support from senior executives enhances success. Literature has identified organizational support as an effective process that enhances success. However, the effect of risk is underemphasized. This study is aimed to understand the comprehensive role of risk in the organizational support - project performance relationship and identify the most effective support processes for various levels of risk. Results from an analysis of 280 projects show that organizational support mediates the relationship between risk and project performance. High-risk level attracts senior executives to stronger support of project managers in "organizational projects quality management," which not only mitigates the negative impact of risk but also may switch the disadvantage of risk to an advantage. The paper narrows down the

gap between the organization and project environments in the presence of risk.

HB-03.2 [R] • The Construction of a Crowdsourcing-based Logistics Network in Rural China

Huaqiong Liu; University of Pretoria, South Africa
Leon Pretorius; University of Pretoria, South Africa
Dongdong Jiang; University of Pretoria, South Africa

Based on an analysis of the status and restrictions of logistics in rural China, this paper finds that a key to the sustainable development of a rural economy in China is to improve the rural logistics network. Therefore, it proposes making full use of the untapped human capital in rural areas and giving full play to the role of crowdsourcing logistics in the rural logistics network. This paper employs the analytic hierarchy process (AHP) and fuzzy comprehensive evaluation as part of the research method to analyze the feasibility of the innovative mode of rural crowdsourcing logistics. Furthermore, from the perspective of the crowdsourcing-based rural logistics network design, the paper presents a concept that focuses on the last-mile delivery method in rural logistics, the establishment of crowdsourcing information platforms in rural areas, the design of the distribution process, and crowdsourcing platform management suggestions. The research method is exploratory and based on aspects of an appropriate literature review of logistics networks and crowdsourcing.

HB-03.3 [R] • A Hierarchical Technology Element Decomposition for Co-design Works

Nobuaki Minato; Ritsumeikan University, Japan
Chiho Shimoida; Ristumeikan University, Japan
Kenji Hirata; Ristumeikan University, Japan
Nobuyuki Fujishima; Ristumeikan University, Japan
Takeshi Kamiya; Japan Aerospace Exploration Agency, Japan
Takashi Takeda; Japan Aerospace Exploration Agency, Japan
Kenji Yamagata; Japan Aerospace Exploration Agency, Japan

This paper introduces a method of technology element decomposition (TED), which can be used for co-design works. The method originated with the Japan Aerospace Exploration Agency (JAXA) and has been used to support product innovation through transfer of space technology, promotion of industry-university collaborations, and so on. Through the MOT Practicum conducted between JAXA and Ritsumeikan University, the method has been adapted for general use. TED consists of three phases. First, a product is conceptually decomposed into hierarchical layers (scenario, purposes, functions and measures), allowing everyone to understand its structural relations at a glance. Second, multiple scenarios (combinations of Who, Where, When, and What) are generated, assuming the product's application to new use contexts. Finally, necessary and unnecessary purposes, functions, and measures are added to or removed from the structure to conceptualize a new product. We conducted workshops to examine the effectiveness of the method for group-oriented product design activities. The method particularly benefits understanding of both the global picture and the product details among non-engineers, which facilitates co-design activities without the need for specialized technical knowledge. We believe the method to be useful for collaborations among technical experts and sales teams as well, promoting innovation through diversified viewpoints.

HB-04 Science and Technology Communication
Thursday, 8/29/2019, 10:30 - 12:00
Room: Galleria III
Chair(s) Petrus T Letaba; NACI

HB-04.1 [R] • Research-Industry Collaboration: A Review of the Literature on Evaluation Methods and Motivations

Anastasiya Magazinik; Tampere University, Finland
Saku Makinen; Tampere University, Finland
Nuria Catalan Lasheras; CERN, Switzerland
Joel Sauza Bedolla; CERN, Switzerland
Ulla Saari; Tampere University, Finland

Relationships and collaborations between scientific research and industry play an essential role in sustaining innovation development in society. Therefore, different types of models have been developed to refer to a set of interaction channels, mechanism and forms of linkage between academia and industry. The studies highlight enhancing and diminishing factors of collaboration management, practices on knowledge interactions and collaborative relationships on various levels depending on considered industrial sectors. This review establishes the state of current knowledge in the field and classifies key metrics and indicators for evaluation of scientific research-industry collaboration linkages.

HB-04.2 [A] • Research on the Development Approach of the Science Popularization Industry in China under the Perspective of Sharing Economy

Xuan Liu; National Academy of Innovation Strategy, China
Jianquan Ma; National Academy of Innovation Strategy, China
FuJun Ren; National Academy of Innovation Strategy, China

Sharing economy is a new form of economic and social innovation by integrating the massive, decentralized and idle resources of the society, platforming and synergistically gathering, reusing and matching supply and demand. At present, it is developing rapidly in China and exerts a favorable mitigation effect on the social contradiction between increasing resource deficiency and idleness. As innovation drives development and the public's scientific literacy improves, the science popularization industry is booming; however, public science popularization service is in a sharp shortage of supply. In this context, this paper explores the development approach integrating science popularization industry with the sharing economy from policy environment, development mode and enterprise cultivation under sharing economy with a combination of a depth analysis on the existing problems in the science popularization industry through summarizing the concept, characteristics and development mode of sharing economy.

HB-04.3 [A] • Science and Technology Innovation Team Engagement with Popular Science: Model and Implementation

Xuan Liu; National Academy of Innovation Strategy, China
Yan Li; National Academy of Innovation Strategy, China
Hongwei Wang; Institute of Quantitive and Technical Economics, China
Weiyu Yang; National Academy of Innovation Strategy, China

A complete science communication work is a communication chain that involves different subjects of communication. There are differences in the mode and path of different science communication guidance. In this study, case study is used to sort out and analyze the science popularization work carried out by the State Key Laboratories, and to explore their synergistic relationship and transformation paths. The research shows that the current model of scientific research teams participating in science popularization is shifting from task-based passive communication to responsibility-based active communication. Meanwhile, due to the significant differences in the core values, cost structure, collaborative subject and IT application of the scientific research teams, it is possible to adopt the reconstructed science popularization transformation path and the progressive popular science transformation path in the process of transformation. The research results provide a clear model and reference for the government to guide scientific research teams in conducting science popularization works in an orderly manner.

HB-05 Technology Acquisition & Adoption-3
Thursday, 8/29/2019, 10:30 - 12:00
Room: Parlor C
Chair(s) Steven T Walsh; University of New Mexico

HB-05.1 [R] • Why People Resist Innovation: Study of Resistance to Music Streaming Service

Che-Wei Chang; National Central University, Taiwan
Shiu-Wan Hung; National Central University, Taiwan

Min-Jhih Cheng; National Central University, Taiwan
Her-Her Tsai; National Central University/Hsing Wu University, Taiwan
Chen-En Hou; National Central University, Taiwan
Chiung-Chi Chiang; National Central University, Taiwan

Emergence of online music streaming services transformed the music market. Music streaming services offered on-demand music with an affordable monthly fee, and created a win-win situation for everyone, as music lovers get more options via various streaming systems, and musician receive royalties from the service, while the service provider profits from monthly fees and commercial advertisement. However, some users still prefer incumbent systems even with the superior advantages of the new systems. This study investigates the factors that influence user resistance attitude and intention to music streaming services and proposes a research framework from the perspective of benefit-cost, social norms and habit of using incumbent music systems. An online questionnaire survey was conducted, and 296 valid samples were analyzed through structural equation modeling (SEM). Results revealed that uncertainty costs do not cause user resistance, but habit with incumbent system, transition costs and loss of performance costs, relative benefits, and social norms significantly influence users' resistant attitudes, indicating that users have confidence in the music streaming services, while habit and relative benefits are the primary factors influencing user resistance. This study demonstrates that benefits and costs must be simultaneously considered in investigating users' resistance intentions against new information systems.

HB-05.2 [A] • Why Do Older Adults Use Wearable Devices: A Case Study Adopting the Senior Technology Acceptance Model (STAM)

Yu Huei Chu; Yuan Ze University, Taiwan
Ja-Shen Chen; Yuan Ze University, Taiwan
Ming-Chao Wang; Yuan Ze University, Taiwan

Previous studies have focused much attention on the adoption of technology products; however, research on the adoption of wearable devices for older people is sparse. This study applied the Senior Technology Acceptance Model (STAM) and investigated the factors influencing the acceptance of new technology by focusing on smart watch and bracelet adoption among the elderly. A case study method was adopted, and a group of 15 older adults and 15 younger participants (e.g., their children) were interviewed in Taiwan regarding their use of wearable devices. Several questions were raised: What factors influence the elderly in adopting wearable devices? What are the differences between the opinions and attitudes of the elderly and younger generations in the adaption of wearable devices? Based on the results, we concluded that the healthcare and alert functions are the main factors that enhance the use of wearable devices by the elderly. Also, besides their fashionable design and style, older people are more concerned about the practical and efficiency aspects of wearable devices. Finally, information is lacking for the elderly to learn about the advantages of using wearable devices. A revised STAM model considering these learning and culture issues is suggested.

HB-05.3 [R] • Adoption of Health and Fitness Apps by Smartphone Users: Interactive Qualitative Analysis

Gopinath Krishnan; Indian Institute of Technology Madras, India
Prakash Sai Lokachari; Indian Institute of Technology Madras, India

Mobile health (mHealth) technology enables real-time monitoring and tracking of health and fitness parameters. Despite the rapid proliferation of health and fitness apps, their adoption by smartphone users has been sparsely studied. The present study uses interactive qualitative analysis (IQA), a systems method, to investigate the factors influencing the adoption of health and fitness mobile apps. Following the IQA protocol, focus group discussions were conducted with select participants to identify influential factors (affinities) and relationships. Semi-structured interviews were conducted with another set of select participants with the aim of methodically coding their experiences while exploring the affinities. Subsequent analysis of the coded information led to the formulation of the mental model of the factors that have a bearing on the adoption of the apps. Our findings indicated that technical features, data accuracy and value for money were the primary drivers influencing the adoption of health and fitness mobile apps. Further, our research provided insights into the drivers that played a catalytic role in possibly enhancing consumer acceptance of mHealth applications.

HB-05.4 [A] • Preventive Control to the Transient Stability Problem in Electrical Power Systems

Ana Cecilia Moreno Alamo; Pontificia Universidad Catolica del Peru, Peru
Carlos Guillermo Hernandez Cenzano; Pontificia Universidad Catolica del Peru, Peru
Eduardo Raul del Rosario Quinteros; Pontificia Universidad Catolica del Peru, Peru

A technology watching study based bibliometric analysis and in patent analysis of current technologies and study of methods for preventive control to solve transient stability problems in electrical power systems (EPS) is made. Likewise, current systems used for real-time operation that guarantee safe operation in electrical power systems are analyzed. In the study of current technologies, we look for solutions based on the application of direct methods to guarantee secure operation for different contingency scenarios of the EPS. This study allows formulation of the preventive control as an optimal power flow (OPF) problem with transient stability constraints formulated through direct methods with the target to accelerate the computational process. This formulation will be applied in an electrical power system, having a reduced number of control variables.

HB-06 Science & Technology Policy-3
Thursday, 8/29/2019, 10:30 - 12:00
Room: Parlor B
Chair(s) Chunping Liu; NAIS,CAST

HB-06.1 [R] • Technology, Demand and Innovation Capability of Indian MSMEs

Shrisha Srinivasan; National Institute of Technology, Karnataka, India
Kiran Kunjangad; National Institute of Technology, Karnataka, India

The micro, small and medium enterprises (MSMEs) today constitute a very important segment of the Indian economy. The growth of this sector came about largely due to the vision of government policies framed right after Indian Independence. The MSME sector has emerged as an energetic and vibrant sector of the economy. As per the fourth census of MSMEs report published in 2012, the total numbers of MSMEs in India are 36 million employing over 80 million people. It is the second largest employer after agriculture accounting for 72% services and 28% manufacturing jobs. It also accounts for 45% of total industrial production, 40% of total exports and contributes very significantly to the GDP. The manufacturing segment within the MSME contributes to 7.09% of GDP. The benefits of MSMEs have created a special status and importance in the Five-Year Plans right from its inception. In recent years, the MSME sector has a consistent higher growth rate compared to the overall industrial sector. Despite its commendable contribution to the country's economy, the MSME sector is not getting the required support and faces numerous dilemmas. This is a research paper which aims at developing a framework taking into account efficient demand marketing and innovation strategy performances. The paper also presents the results of the pilot study undertaken.

HB-06.2 [R] • Organizational Innovation of Sci-Tech Societies in the Era of Intelligence: A Case Study in China

Chunping Liu; National Academy of Innovation Strategy, CAST, China
Zheng Li; National Academy of Innovation Strategy, CAST, China
Daya Zhou; National Academy of Innovation Strategy, CAST, China
Yunyan Shi; National Academy of Innovation Strategy, CAST, China

Three foreseeable trends are becoming so important in the coming world of intelligence: continuing emergences of new knowledge, more obscure boundaries of disciplines, and high integrations of sciences and technologies (sci-tech). How to make a sci-tech breakthrough by promoting the intersection and convergence of disciplines has become a vital national strategy. However, interdisciplinary research in China is still at an early stage and discipline construction, including artificial intelligence, has developed slowly, which results in a shortage of intelligent technologies and human resources. It is good to know that some Chinese sci-tech societies have initiatively attempted to promote and to some extent achieved

discipline integration and intelligence innovation through building alliances characterized as openness, hub, and platform, connecting universities, institutions, enterprises and other agencies. By using the method of qualitative data analysis, this paper studied the cases of six alliances comprised by over 70 sci-tech societies in China, such as Alliance of Intelligent Manufacturing Societies and Alliance of Information Technology Societies and verified the findings by the interviews of several managers of the alliances. The result showed the models and paths of organizational innovation of the societies in terms of cross-discipline exploration, technology management optimization, and talent growing-up promotion.

HB-06.3 [R] • The Policy Diffusion of China's National Indigenous Innovation Demonstration Zones: A Case Study on Zhongguancun

Xuanting Ye; Beijing Institute of Technology, China
Defang Yang; Beijing Institute of Technology, China
Yun Liu; University of Chinese Academy of Sciences, China
Zhenwei Zhang; Beijing Institute of Technology, China
Jian Zhang; Central University of Finance and Economics, China

In order to promote the development of national indigenous innovation demonstration zones, the Chinese government has set out a series of policies which intend to improve the institutional system of science and technology innovation, develop the strategic emerging industries, and accelerate the transformation of the economic development mode. This paper raises the analysis on the relevant policies of 17 of China's national indigenous innovation demonstration zones. The paper delineates the status quo and the classification of the policies. By using the method of policy document analysis, the paper explores the characteristics of the policy tool and the paths of policy diffusion. Based on the aforesaid research, the paper intends to investigate the policy diffusion of Zhongguancun national indigenous innovation demonstration zones and to propose the suggestions to promote the development of these zones.

HD-01 PANEL: PICMET '19 Debrief and Future PICMET Planning
Thursday, 8/29/2019, 14:00 - 15:30
Room: Grand Ballroom I
Panelist(s)

Timothy R Anderson; Portland State University
Dilek Cetindamar; University of Technology Sydney
Tugrul Daim; Portland State University
Antonie Jetter; Portland State University
Dundar F Kocaoglu; Portland State University
Hakan Kutgun; Portland State University
Robert H Martin; Software Management Consulting
Liono Setiowijoso; Portland State University
Amir Shaygan; Portland State University
Harm-Jan Steenhuis; Hawaii Pacific University
Charles M Weber; Portland State University
Ann White; Portland State University

Please join us for this debrief session to discuss what you found helpful from this year's conference, what we can do better, and provide input on making PICMET 2020 even better!

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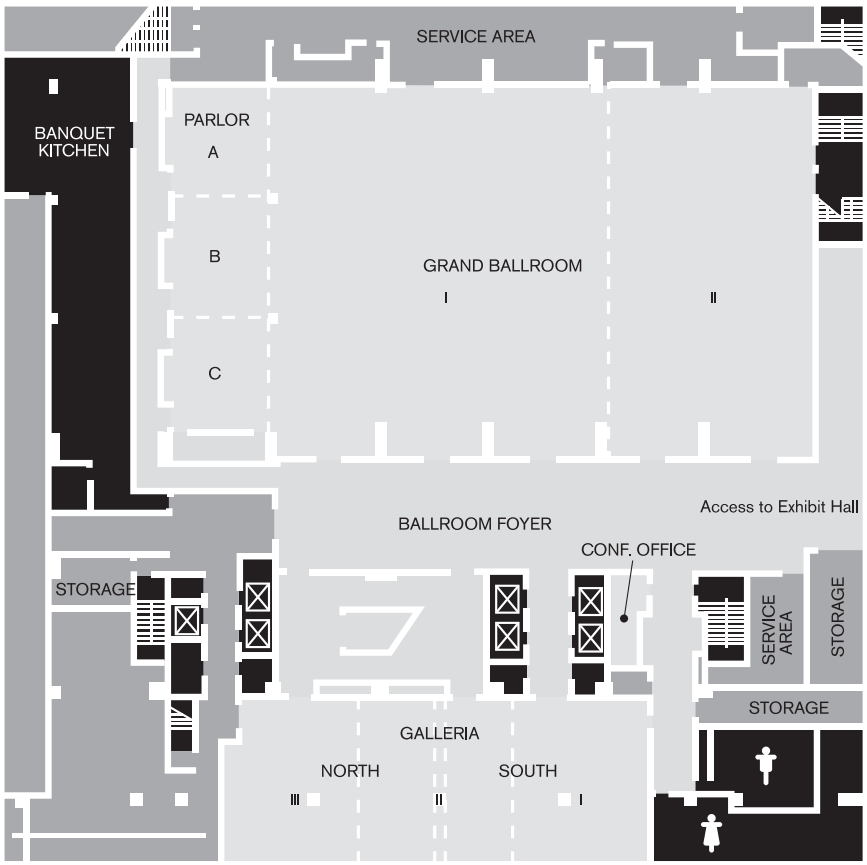
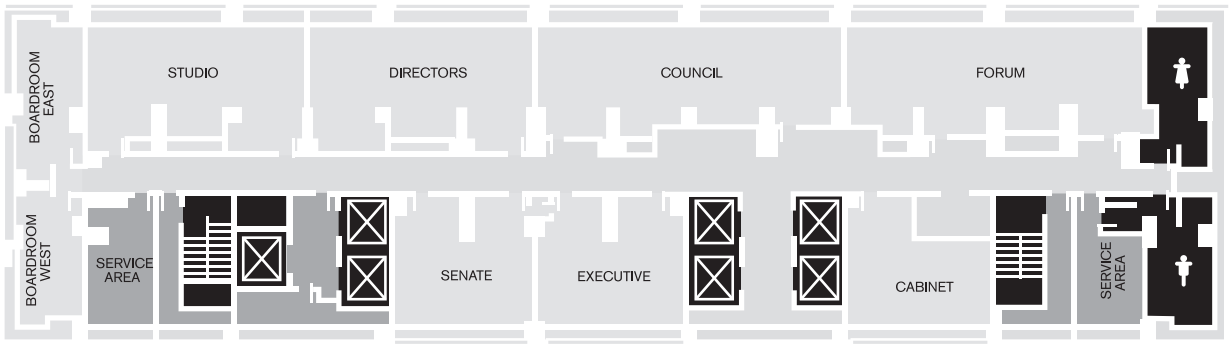
Hilton Floor Layout

Ballroom Level



Hilton
PORTLAND DOWNTOWN

3rd Floor Conference Level



23rd Floor Skyline Level