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and Entrepreneurship Section



PICMET '22

**Portland International Center for
Management of Engineering and Technology**

PICMET '22 Conference
August 7-11, 2022
Portland, Oregon, USA

**Technology
Management and
Leadership in Digital
Transformation –
Looking Ahead to
Post-COVID Era**

PICMET Headquarters

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**CONFERENCE
BULLETIN**

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PICMET '22

Dear PICMET Guests:

We are pleased to welcome you to the PICMET '22 Conference.



The theme of PICMET '22 is “Technology Management and Leadership in Digital Transformation - Looking Ahead to Post-COVID Era.”

Digitization started several decades ago, and gained a tremendous acceleration to transform our lives. It is particularly important now, with increasing uncertainties affecting economic outlook, and massive changes taking place throughout the world in the COVID era. Industry 4.0 is changing every aspect of economy and society. Climate change is an extremely serious issue, worldwide. Supply Chain Management is crucial. Job creation and job loss are both an opportunity and a challenge. The gap between technologically advanced nations and technology-poor nations is growing rapidly. The trend toward globalization seems to be reversing itself due to political considerations. Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), Analytics and Data Science are starting to have a major impact on our lives.

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

The focus of PICMET'22 is on the leadership challenges in managing technology to address critical issues that the world is now facing and will face in the “new normal” conditions after the COVID crisis is over. The theme is woven into the keynote speeches and many of the papers, but the Conference is not limited to it. Every aspect of technology management is addressed in the presentations.

There are eight keynote speeches.

Monday:

Dr. Marie-Elisabeth Paté-Cornell, Stanford University – USA; “Making Engineering Systems Safer and Smarter: Warnings of Cyberattacks and Artificial Intelligence”

Dr. Mel Horwitch, MIT – USA; “Innovation Management and Quest for a More Strategic Society”

Tuesday:

Dr. Henry W. Chesbrough, University of California Berkeley – USA; “Beyond Best Practice: New Developments in Open Innovation”

Dr. Robert A. Burgelman, Stanford University – USA; “A Strategic Leadership Perspective on the 4th Industrial Revolution: Personal, Organizational and Societal Implications”

Wednesday:

Dr. Aaron J. Shenhar, Rutgers University – USA; “Do We Need a New Science of Technology and Its Management?”

Dr. James M. Utterback, MIT – USA; “The Dynamics of Competition and of the Diffusion of Innovation”

Thursday:

Dr. Dietmar Theis, Technical University of Munich – Germany; “Digitalization Mitigates Climate Change and Moves Us to a Sustainable Future”

Mr. John McDougall, Dalcour Innoventures, Ltd. – Canada; “Applying Digital Technologies to Manage Climate Change”

PICMET '22 received 837 submissions from authors representing more than 200 academic institutions, industrial corporations and government agencies in 34 countries. After a double-blind refereeing process, 193 papers have been included in the conference. The referees were from universities, industrial organizations and government agencies from around the world.

The PICMET '22 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 37 sections listed below. Each section contains several papers on the topic.

- **Technology Management Framework**
- **Strategic Management of Technology**
- **Collaborations for Technology Management**
- **Digital Transformation**
- **Leadership**
- **Science and Technology Policy**
- **Science and Technology Communication**
- **Decision Making for Technology Management**
- **Artificial Intelligence for Technology Management**
- **Environmental Issues**
- **Educational Issues**

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- **Global Issues**
- **Sustainability**
- **Emerging Technologies**
- **Internet of Things (IoT)**
- **Social Media**
- **Entrepreneurship/Intrapreneurship**
- **Intellectual Property**
- **Innovation Management**
- **Project/Program Management**
- **R&D Management**
- **New Product Development**
- **System Design**
- **Manufacturing Management**
- **Quality Management**
- **Supply Chain Management**
- **Enterprise Management**
- **Information/Knowledge Management**
- **Information/Communication Technologies**
- **Technological Changes**
- **Technology Forecasting**
- **Technology Roadmapping**
- **Technology Adoption**
- **Technology Management in the Energy Sector**
- **Technology Management in the Health Sector**
- **Technology Management in Biotechnology Industry**
- **Technology Management in Service Industry**

A large number of colleagues around the world contributed to the success of the PICMET '22 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, and formatted the papers for the Proceedings with the assistance of the out-going Executive Director Hakan Kutgun and the new Executive Director Angel Contreras Cruz; Scott Schaffer, as the Legal Counsel, provided continuous legal advice; Tom Gillpatrick as the Treasurer and Sang Ahn as the Chief Accountant handled the finances. 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 Nasir Sheikh was the Director of Student Activities. Caroline Mudavadi managed registrations, Angel Contreras Cruz and Fayeze Alsoubaie 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. Nasir Sheikh chaired the Brad Hosler Outstanding Student Paper Award Committee, whose members Antonie Jetter, Hongyi Chen and Jonathan Ho evaluated the papers nominated for the award.

Timothy Anderson, Kiyoshi Niwa, Dilek Cetindamar Kozanoglu and Harm-Jan Steenhuis conducted the review process for the papers as Associate Editors; 176 colleagues from around the world reviewed the papers. Timothy Anderson did the scheduling of the accepted papers for presentation at the conference. Amir Shaygan was the Editorial Assistant to check and verify that the finalized papers had been revised as recommended by the reviewers.

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

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

The sponsors and supporters of PICMET '22 made this conference possible. We extend special thanks to all of them: Portland State University Department of Engineering and Technology Management, IEEE TEMS (Technology and Engineering Management Society), Portland State University Foundation, PSU Maseeh College of Engineering & Computer Science, Portland State University Office of Information Technology, InFocus, FreeGeek, and WHOVA Event Management.

We believe the PICMET '22 *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.

~ Dunder F. Kocaoglu, President and CEO



PICMET '22

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DEDICATION

*PICMET '22 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.*

EXECUTIVE COMMITTEE

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Scott Schaffer, Schaffer IP Law

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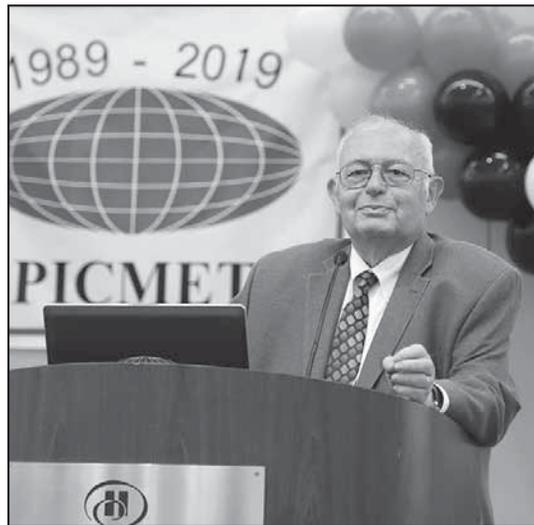
Liono Setiowijoso, Portland State University

Co-director of International Activities

Kiyoshi Niwa, The University of Tokyo - Japan

Co-director of International Activities

Dilek Cetindamar Kozanoglu, University of Technology Sydney



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Nasir J. Sheikh (Chair), Portland State University

Antonie J. Jetter, Portland State University

Hongyi Chen, University of Minnesota, Duluth

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Dilek Cetindamar Kozanoglu, Univ. of Technology Sydney

Kiyoshi Niwa, The University of Tokyo

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Dana Bakry, Portland State University

Bhavana Ramesh, Portland State University

Member at Large

Antonie J. Jetter, Portland State University

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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.

Dr. Adnan Akay, Former Provost, Bilkent University, Turkey

Dr. Bulent Atalay, Professor, University of Mary Washington and the University of Virginia, USA

Dr. Guruduth S. Banavar, CTO, VIOME, USA

Dr. Walter Buchanan, Professor, Texas A&M University, USA

Dr. Robert A. Burgelman, Edmund W. Littlefield Professor of Management, Stanford University, USA

Dr. Curtis R. Carlson, Founder and CEO, The Practice of Innovation, USA

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

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

Dr. Youngrak Choi, S&T Policy Adviser, Korea

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

Dr. Kathleen Eisenhardt, Professor, Stanford University, USA

Dr. Steven Eppinger, Professor, MIT, USA

Dr. Sadik Esener, Director, Knight Early Cancer Detection Center, OHSU, USA

Mr. Pliny Fisk III, Co-Director, Center for Maximum Potential Building Systems, Texas A&M University, USA

Dr. Eliezer Geisler, Professor, Illinois Institute of Technology, USA

Dr. Mel Horwitch, Research Affiliate/Visiting Scholar, MIT, USA

Dr. Jay Lee Professor, University of Cincinnati, USA

Dr. Tom Magnanti, President, Singapore University of Technology and Design, Singapore

Dr. Elicia Maine, Professor, Simon Fraser University, Canada

Dr. Ann Majchrzak, USC Associates Named Chair of Business Administration, University of Southern California, USA

Mr. John McDougall, President, Dalcov Innoventures Ltd., Canada

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

Dr. Elisabeth Pate-Cornell, Professor, Management Science & Engineering, Stanford University, USA

Dr. Alan L. Porter, Professor Emeritus, Georgia Institute of Technology, USA

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

Dr. Melissa Schilling, Professor, New York University, USA

Dr. Aaron Shenhar, Professor (retired), Rutgers University, USA

Dr. Nam P. Suh, Professor, MIT, USA

Dr. Dietmar Theis, Honorary Professor, Technical University of Munich, Germany

Dr. James M. Utterback, Professor, MIT, USA

Dr. Karl Hampton Vesper, Professor Emeritus, University of Washington, USA

Dr. Oliver Yu, Executive in Residence, School of Business, San Jose State University, USA



PICMET '22

PANEL OF REVIEWERS

Papers submitted to PICMET conferences are subjected to a double-blind review process. Each paper included in the PICMET '22 conference was reviewed by two or more members of the Panel of Reviewers to assure a very high quality. This year's panel had 176 members from around the world. They are listed below in alphabetical order by last name.

Mike Adams	Bill Dresselhaus	Gul Kremer	Tippawan Pinvanichkul
Adshariya Agsornintara	Alptekin Durmusoglu	David Kruger	Patravadee Ploykitikoon
Mark Ahn	William (Ike) Eisenhauer	Isak Kruglianskas	Mark Polczynski
John Aje	Kishore Erukulapati	Chung-Huei Kuan	Leon Pretorius
Jose Albors-Garrigos	Judith Estep	Trevor Laine	Marthinus Pretorius
Joe Amadi-Echendu	Clare Farrukh	Tritos Laosirihongthong	Prattana Punnakitikashem
Muhammad Amer	William Flannery	Thomas Lechler	Ruy Quadros
Timothy Anderson	Janice Forrester	Chung-Shing Lee	Vichita Ractham
Jean-Pierre Auffret	Takao Fujiwara	Jaegul Lee	T. Ramayah
Fahad Aldhaban	Nathasit Gerd Sri	Jeong-Dong Lee	Bharat Rao
Fatima Albar	Pisek Gerd Sri	Luciana Lenhari	Samar Saha
Rian Beise-Zee	Tom Gillpatrick	Yan-Ru Li	Ichiro Sakata
Tal Ben-Zvi	Paulo Gomes	Ziqi Liao	Rosine Salman
Frederick Betz	Markus Günther	Dong-Joon Lim	Yuriko Sawatani
Elif Baktir	Cory Hallam	William Limonge	Günther Schuh
Sule Balkan	Robert Harmon	Chien-Hsin Lin	Terry Schumacher
Bridget Barnes	Rainer Hasenauer	Hai-Chen Lin	Lone Seboni
Caroline Benton	Kazuo Hatakeyama	Justin Lin	Takehisa Seino
Jeffrey Butler	Bill Hefley	Chih-Cheng Lo	Shintaro Sengoku
John Byrne	Keith Hollingsworth	Marcelo Machado	Siri-on Setamanit
David Güemes Castorena	Paul Hong	Ochini Madanayake	Gerald Sheblé
Ferhan Cebi	Mel Horwitch	Saku Makinen	Nasir Sheikh
Shann-Bin Chang	Jili Hu	Robert Martin	Kunio Shirahada
Yu-Yu Chang	Jing Hu	Gita Mathur	Nathalie Sick
Chayakrit Charoensiriwath	Stefan Huesig	Christiane Maurer	Nermin Sökmen
Dilek Cetindamar	Lane Inman	Daphney Mayindi	Woodie Spivey
Leong Chan	Nazrul Islam	Mary Mathew	Harm-Jan Steenhuis
Hongyi Chen	Kazuhiko Itaya	Carlos Mena	Frank Steiner
Jin Chen	Takayuki Ito	Whasik Min	Fang-Pei Su
Yufen Chen	Guven Iyigun	Tim Minshall	Yalcin Tanes
Byungchul Choi	Hannu Jaakkola	Yaeko Mitsumori	Attawit Techawiboonwong
Ying-Chyi Chou	Antonie Jetter	Martin Moehrle	Alfred Thal, Jr.
Americo Cunha	Bertha Jimenez	Kirankumar Momaya	Cherie Trumbach
Scott Cunningham	Yuya Kajikawa	David Moore	Yuri Tukoff-Guimaraes
Marina Dabic	Gulgun Kayakutlu	Songphon Munkongsujarit	Andreas Udbye
Antonie de Klerk	Clive Kerr	Nazmun Nahar	Cornelis van Waveren
Ozgun Dedehayir	Ron Khormaei	Steven Nahas	Thanaphol Virasa
Glenn Dietrich	Dundar Kocaoglu	Paulo Nascimento	Wayne Wakeland
Brent Dixon	Alisa Kongthon	Kiyoshi Niwa	Andrew Walters
	Sigal Kordova	Leon Oerlemans	Ming-Yeu Wang
		Toryos Pandejpong	Chun-Hsien Wang
		Wonkoo Park	Yuichi Washida
		Peerasit Patanakul	Charles Weber
		Tero Peltola	David Wilemon
		Gary Perman	Dietmar Winzker
		Phallapa Petison	Nihan Yildirim
		Mariana Pfitzner	Man Hang Yip
		Simon Philbin	Jian Zhan
		Fred Phillips	

PICMET '22

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

PICMET '22

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

2010

HRH Princess Maha Chakri Sirindhorn, Thailand

2011

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

2012

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

2013

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

2014

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

2015

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

2016

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

2017

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

2018

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

2019

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

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

PICMET '22

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 (TÜBİTAK)

2011

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

2013

Dr. Eliezer Geisler, Distinguished Professor, Stuart School of Business, Illinois Institute of Technology, USA
Dr. Hans Georg Gemuenden, Professor, Berlin University of Technology, Germany

2015

Dr. Steven Eppinger, Professor of Management Science and Innovation, Massachusetts Institute of Technology, USA
Dr. Alan L. Porter, Professor Emeritus, Georgia Institute of Technology; and Director of R&D for Search Technology, Inc., USA

2016

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

2017

Mr. Scott Roth, Chief Executive Officer, Jama Software, USA
Dr. Karl Hampton Vesper, Foster School of Business, University of Washington, Seattle, USA

2018

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

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

2019

Dr. Gregory A. Daneke, Professor Emeritus, W.P. Carey School of Business, Arizona State University, USA
Dr. Ann Majchrzak, Associates of USC Business Administration Chair and Professor of Digital Innovation Department of Data Sciences and Operations, Marshall School of Business, University of Southern California, USA
Dr. Melanie Mitchell, Professor of Computer Science, Portland State University, USA

PICMET FELLOWS

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

- 1. Technology Management Research** as demonstrated by the research conducted and supervised, research results published in refereed journals, and research grants received from funding agencies or industry.
- 2. Technology Management Education** as demonstrated by technology management programs/courses developed, taught or managed, PhD students supervised, and new educational initiatives taken.
- 3. Technology Management Implementation** as demonstrated by management of technology-based projects, programs and organizations in industry or government.
- 4. Technology Management Consulting** as demonstrated by consulting activities with high impact on the improvement of technology management practice.
- 5. Technology Management Policy Making** as demonstrated by the role played in policy making levels for effective utilization of technology management concepts and processes.
- 6. Technology Management Leadership** as demonstrated by the book(s) published, journal(s) edited, technology management organization(s) established or managed.

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

2011

Mr. Charles Allcock, PGE, USA

PICMET '22

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 Hambræus, Royal Swedish Academy of Engineering Sciences, Sweden
Dr. Dundar Kocaoglu, Portland State University, USA
Mr. Thomas Lipscomb, The Center for the Digital Future, USA
Dr. Tom Long, Tektronix Vice President, Retired, USA
Mr. John McDougall, Alberta Research Council, Canada
Dr. Graham Mitchell, University of Pennsylvania, USA
Dr. Kiyoshi Niwa, The University of Tokyo, Japan
Dr. Kwan Rim, Samsung Corporation, Korea
Dr. Frederick Rossini, George Mason University, USA
Mr. Terry Rost, The Franchise Group, USA
Dr. Nam Suh, KAIST, Korea
Dr. Nejat Veziroglu, University of Miami, USA
Dr. Eric von Hippel, MIT, USA
Dr. Seiichi Watanabe, Terumo Corporation, Japan
Dr. Rosalie Zobel, European Commission, Belgium

2013

Dr. Klaus Brockhoff, WHU – Otto Beisheim School of Management, Germany
Dr. Antonie de Klerk, University of Pretoria, South Africa

Dr. Norman G. Einspruch, University of Miami, USA
Dr. Joseph P. Martino, Yorktown University, USA
Mr. Terry Oliver, Bonneville Power Administration, USA
Dr. Alan L. Porter, Search Technology, Inc., USA
Dr. Albert H. Rubenstein, Northwestern University, USA
Dr. James C. Spohrer, IBM, USA
Dr. David M. Steele, San Jose State University, USA

2014

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

2015

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

2019

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



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, 2021. 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

Takaharu Jibiki

ADVISOR & CO-AUTHOR

Dr. Shintaro Sengoku

UNIVERSITY

Tokyo Institute of Technology

PAPER TITLE

“Consideration on the Standardization and

Industrialization of Human Microbiome Technologies in Japan”

ABSTRACT

Human microbiome technologies have attracted attention as a new therapeutic modality. However, in order for the technologies to form a new industry, standardizing human microbiome analysis should be the first priority to ensure the reliability and quality of human microbiome data. The objective of this study was to clarify the current situation regarding the standardization of human microbiome analysis and the potential of human microbiome technologies to be industrialized in Japan. This study considered the future prospectives of the standardization of microbiome analysis along with its challenges. In addition, the industrialization of human microbiome technologies was discussed with particular consideration of the situational differences between Japan and the United States. The following challenges were identified: 1) “Innovator’s Dilemma” in human microbiome technologies, 2) obsolescence of consortium-driven standards, 3) fragmentation of microbiome data, 4) insufficient collaborations between organizations, and 5) inadequate government funding for basic research. Further, the following requirements were identified for the industrialization of human microbiome technologies in Japan: 1) facilitation of the microbiome analysis business, 2) development of diagnostic technologies, 3) development of peripheral technologies, 4) improvement in the quality of and access to open data on the human microbiome, and 5) investment in drug discovery research.



LTM AWARD

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

PICMET '22 AWARDEE

Dr. Marie-Elisabeth Paté-Cornell

The Burt and Deedee McMurtry Professor in the School of Engineering Professor and Founding Chair, Department of Management Science and Engineering, Stanford University



Dr. Marie-Elisabeth Paté-Cornell is the Burt and Deedee McMurtry Professor in the School of Engineering and a Senior Fellow (by courtesy) of the Stanford Freeman-Spogli Institute for International Studies. Her specialty is engineering risk analysis, with applications to complex systems (space, medical, offshore oil platforms, cyber security,

etc.). Her work has been based on probabilistic and stochastic models and on Artificial Intelligence. She is a member of the National Academy of Engineering, the French Académie des Technologies, the NASA Advisory

Council, and a Distinguished Visiting Scientist of the Jet Propulsion Lab. She was a member of the President's Foreign Intelligence Advisory Board (2001 to 2008). She holds a BS in Mathematics and Physics, Marseille (France), an Engineering degree (Applied Math/CS) from the Institut Polytechnique de Grenoble (France), an MS in Operations Research (OR) and a PhD in Engineering-Economic Systems (EES), both from Stanford University. She is the author or coauthor of numerous publications including several Best Paper awards. She was awarded the 2002 Distinguished Achievement Award of the Society for Risk Analysis (of which she is a Fellow), the INFORMS Ramsey Medal of Decision Analysis (2010), an Honorary PhD from the University of Strathclyde (2016), and the IEEE Ramo medal for Systems Engineering and Science in 2021.



FELLOW AWARDS

The PICMET Fellow award recognizes outstanding contributions to the development and growth of the Engineering and Technology Management discipline. There are 11 new PICMET Fellows in 2022. They are listed in alphabetical order below.

PICMET '22 AWARDEES

Dr. Adnan Akay

Former Professor and Provost, Bilkent University, Turkey and Lord Professor of Engineering and Head Emeritus of Mechanical Engineering, Carnegie Mellon University, USA



Dr. Adnan Akay is the Lord Professor of Engineering and Head Emeritus of Mechanical Engineering, Carnegie Mellon University, and former Provost of Bilkent University in Turkey. He received his B.S. (Hon), M.M.E and Ph.D. in Mechanical Engineering with Minor in Mathematics from North Carolina State University - Raleigh, North Carolina. Dr.

Akay joined the National Institute of Environmental Health Sciences as a visiting staff fellow, studying the effects of noise on hearing. From 1978 to 1992, he was on the faculty at Wayne State University where he last held the DeVlieg Chair in Engineering until he accepted the position of professor and head of the Mechanical Engineering Department at Carnegie Mellon University in 1992. In 1997, he was awarded the endowed Lord Chair in Engineering. Taking a leave of absence in 2005, he joined the NSF as the Director of Civil and Mechanical Systems, which a year later merged with another Division to become the current Civil Mechanical and Manufacturing Innovation Division. Continuing his leave of absence from CMU, in 2009 he accepted the challenge of starting a new mechanical engineering department at Bilkent University in Ankara, Turkey, where he also served as a Vice President and has been the provost from 2014 until 2022.

Dr. Akay's contributions to education reach beyond the classroom and the university. Working closely with the heads of mechanical engineering departments of the so-called Big-Ten-Plus universities, Dr. Akay initiated and assumed responsibility for organizing a workshop to broaden the basis of mechanical engineering research and education to support and take advantage of developments in bio-, nano-, and information technologies.

As part of his commitment to promoting new educational approaches to the mechanical engineering community, he was asked and served the external advisory boards of Departments of Mechanical Engineering at Michigan State University and Brigham Young University, Department of Aerospace and Mechanical Engineering at the University of Arizona, Department of Mechanical, Materials, and Aerospace Engineering, Illinois Institute of Technology, Department of Mechanical and Aerospace Engineering, North Carolina State University, Mechanical Engineering Department Bogazici University in Istanbul, Turkey, and College of Mechanical Engineering and Textile Engineering, Istanbul Technical University. He has served on program review teams at the University of Maryland, Michigan Technological University, Arizona State University, Southern University, and Brigham Young University, on advisory boards of Chalmers University of Technology, Korea Advanced Institute of Science and Technology (KAIST), where he also serves on the President's Advisory Council and the Advisory Board of NSF-NSC (Taiwan) Summer Institute on Bio-inspired Sensing & Bio-inspired Actuation.

Dr. Robert A. Burgelman

Edmund W. Littlefield Professor of Management of the Stanford University Graduate School of Business, USA



Dr. Robert A. Burgelman is the Edmund W. Littlefield Professor of Management of the Stanford University Graduate School of Business where he has taught since 1981. He obtained a Licenciate degree in Applied Economics from Antwerp University (Belgium), an MA in Sociology and an MPhil and PhD in Management of Organizations from Columbia

University, where he studied with a European doctoral fellowship from the Ford Foundation (US) and one from ICM (Belgium). His research has focused on the role of strategy making in firm evolution. In particular, he has studied the strategy-making processes involved in how companies enter into new businesses and exit from existing ones to secure continued adaptation. In 2003, he received an honorary doctorate from the Copenhagen Business School (Denmark) for his contributions to the study of corporate innovation and entrepreneurship. In 2017, he received an honorary doctorate in economics of the University of St. Gallen (Switzerland), as well as the Leadership in Technology Management Award from the Portland International Center for Engineering and Technology Management (PICMET 2017). He is a Fellow of the Strategic Management Society and a Fellow

FELLOW AWARDS

of the Academy of Management. He has been on the faculty of Antwerp University, New York University, Harvard Business School (as a Marvin Bower Fellow), and Cambridge University (as a Visiting Professor of Marketing Strategy and Innovation at the Judge Business School). He has published many articles in leading academic and professional journals, as well as more than 180 case studies of companies and organizations in many different industries. His books include *Inside Corporate Innovation: Strategy, Structure, and Managerial Skills* (Free Press, 1986); *Research of Technological Innovation, Management and Policy* (JIA Press, Elsevier; Volume 4, 1989, Volume 5, 1993, Volume 6, 1997, and Volume 7, 2001); *Strategy is Destiny: How Strategy-Making Shapes a Company's Future* (Free Press, 2002); *Strategic Dynamics: Concepts and Cases* (McGraw-Hill, 2006); *Strategic Management of Technology and Innovation* (5th edition, McGraw-Hill-Irwin, 2009); and *Becoming Hewlett Packard: Why Strategic Leadership Matters* (Oxford University Press, 2017). He has served as an Associate Editor of the *Strategic Entrepreneurship Journal*, 2007-2013. He has served as the Executive Director of the Stanford Executive Program (SEP) during 1996-2015, and has taught executive programs and led senior and top management seminars for major companies worldwide. He has also served on boards of directors and boards of advisors of several private companies.

Dr. Henry W. Chesbrough

Professor and Faculty Director, Garwood Center for Corporate Innovation, Haas School of Business, University of California-Berkeley, USA



Dr. Henry Chesbrough is best known as “the father of Open Innovation.” He teaches at the Haas School of Business at the University of California-Berkeley, where he is the Faculty Director of the Garwood Center for Corporate Innovation. He is also Maire Tecnimont Professor of Open Innovation and Sustainability at Luiss University in Rome. Previously he was an

Assistant Professor at Harvard Business School. He holds a PhD from UC Berkeley, an MBA from Stanford, and a BA from Yale University.

He has written books such as *Open Innovation* (Harvard Business School Press, 2003), *Open Business Models* (Harvard Business School Press, 2006), *Open Services Innovation* (Jossey-Bass, 2011) and *Open Innovation Results* (Oxford, 2020). His research has been cited more than 100,000 times, according to Google Scholar.

He has been recognized as one of the leading business thinkers by Thinkers50 several times. He received an Innovation Luminary award from the European Commission in 2014. He received the Industrial Research Institute Medal of Achievement in 2017, the Viipuri Prize from Lappeenranta University of Technology in 2022, the Herbert Simon Award of the Rajk College for Advanced Studies in 2022, and holds two honorary doctorates.

Dr. Eliezer Geisler

Distinguished Professor Emeritus, Illinois Institute of Technology, USA



Dr. Eliezer Geisler is Distinguished Professor Emeritus of Business at the Stuart School of Business of the Illinois Institute of Technology. He received his doctorate in organizational behavior from the Kellogg School of Business at Northwestern University. Dr. Geisler is the author of over 180 papers and presentations to learned societies, and 14 books in the areas

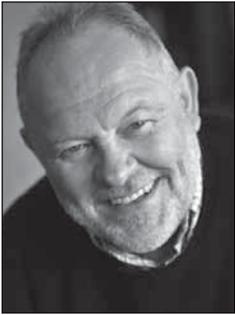
of management and metrics of technology and innovation; management of medical technologies and knowledge management. His current research focuses on the genesis, progress, metrics and evolution of knowledge. He is also working on “Beyond Business Analytics,” a notion consisting of a theoretical space which he developed, between the data collection and analysis (analytics) and the creation of meaning of such data to the decision-maker. He is the recipient of multiple awards, among them: The Medal of Excellence and the title of Fellow award given by PICMET; Honorary Member of the Society of the Advancement of Management of the American Management Association; Research assistantship award from NASA; Blue Key National Honor Fraternity Award; Meritorious Service Award of INFORMS; member of Beta Gamma Sigma Honor Society.

Dr. Hans Georg Gemuenden

Former Professor, Technical University-Berlin, Germany, and BI Norwegian Business School, Norway

Dr. Hans Georg Gemuenden was a Professor of Project Management at BI Norwegian Business School from 2015-2019, a Professor of Technology and Innovation Management at TU Berlin from 2000-2015, and Professor of Corporate Strategy at KIT from 1988-2000. He was the Dean of the Faculty of Economics and Business Administration from 1990-1992.

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He received his “Diplomkaufmann” (equivalent to an MBA) and his Dr. rer. oec. at the University of Saarbrücken, and his habilitation degree at the University of Kiel. The May 9, 2104 Hans Georg Gemuenden was awarded an honorary doctorate (Dr. rerum oeconomicarum et socialium) from the University of Kiel. On October 11, 2015 he was awarded the IPMA Research

Achievement Award. He was Vice Dean of the Faculty for Management and Economics of the University of Technology of Berlin from 2003-2007. From 2004-2007 he was responsible for the Industrial Engineering Program (Wirtschaftsingenieur) and introduced five new Bachelor and nine new Master programs. The Industrial Engineering Program is the largest teaching program at the TU Berlin, involving six of its seven Faculties. From 2013 to 2015 he was a director of the enlarged Academic Senate of TU Berlin.

He was a Founder and a Chairman of the Technology and Innovation Management Division of the Association of University Professors of Management (Verband der Hochschullehrer für Betriebswirtschaftslehre) from 2000-2002 and Chairman of the Scientific Board of the German Innovation Survey of the German Ministry of Technology and Education from 1999 until 2004. He was representative-at-large of the TIM Division of the Academy of Management from 2009 until 2011 and responsible for the best-dissertation award in 2011. He was a member of the Advisory Board of Hauck & Aufhäuser (Private Bank) from 2000-2008. He was a member of the supervisory board (Aufsichtsrat) of ThyssenKrupp Technologies AG (ca. 50,000 employees) from 2006 until this AG was integrated into ThyssenKrupp AG. From 2008 until 2012 he was one of the four principal investigators for Business Administration at Germany’s national science foundation DFG (Deutsche Forschungsgemeinschaft). In 2009 Prof. Gemuenden chaired the Jury of NRW Gruendet. From 2009 until 2012 he was the Chairman of the Advisory Board of EXIST and Deputy Chairman until the end of this Advisory Board. EXIST is a support program of the Federal Ministry of Economics and Technology (BMWi) aimed at improving the entrepreneurial environment at universities and research institutes and at increasing the number of technology and knowledge-based company formations. The EXIST program is part of the German government’s “Hightech Strategy for Germany” and is co-financed by funding of the European Social Fund (ESF). From 2013 to 2017 Hans Georg Gemuenden was the Editor of the *Project Management Journal*, which is

published by the Project Management Institute and Sage.

He has authored or co-authored over 170 peer-reviewed articles, over 200 refereed conference proceedings, over 130 invited chapters, and 4 books in the fields of innovation and technology management, entrepreneurship, project management, business policy and strategy, marketing, human information behaviour and decision making, and accounting. He published in journals such as *Organization Science*, *Research Policy*, *Journal of Product Innovation Management*, *Creativity and Innovation Management*, *International Journal of Research in Marketing*, *Journal of Business Research*, *Management International Review*, *IEEE Transactions on Engineering Management*, *R&D Management*, *International Journal of Project Management*, *Project Management Journal*, *Die Betriebswirtschaft*, *Schmalenbachs Business Review*, *Schmalenbachs Zeitschrift für Betriebswirtschaftliche Forschung*, *Zeitschrift für Betriebswirtschaft*, *Journal für Betriebswirtschaft*, *Die Unternehmung*, and *Projekt Management Aktuell*.

His research focuses on Promoters, Teams and Open Innovation Issues, Management of projects, programs, project portfolios, project networks, project sequences, project careers, and the project-oriented organization with specific consideration of their innovation functions. In contrast to project and program management the management of project portfolios, project sequences, project careers, and the project-oriented organization are not temporary tasks with determined time horizon, rather they ongoing tasks without a determined end, but they are considered as project managing tasks, because they influence the context of projects and programs and provide the critical link with strategies. The management of project networks is often embedded in the network of business networks between the key actors of project networks that work repeatedly together, and share long-term business relationships.

Dr. Charla Griffy-Brown
Professor, Pepperdine University, USA

Dr. Charla Griffy-Brown is a professor at Pepperdine University. She graduated from Harvard University, is a former Fulbright Scholar, and holds a Ph.D. in Technology Management from Griffith University in Queensland, Australia.

Dr. Griffy-Brown served as an associate professor at the Tokyo Institute of Technology, and a Visiting Fellow at Tsinghua University in China and Aoyama Gakuin University in Japan. In 2017, she was a visiting fellow

FELLOW AWARDS



at Jyväskylä University in Finland. She was an invited guest speaker for the US State Department in the area of emerging technologies and development. She has also worked with NASA, the European Commission, and the UN Global Environmental Facility.

As a scholar and leader concerned with sustainability and ethics, she has helped organizations (non-profits, small businesses, and large public companies) manage emerging technologies and risk. She has chaired the Cyber-Secure LA conference since 2018, was a speaker at LA CyberLabs Security Summit, and was given a Congressional Commendation by Representative Maxine Waters for her work in helping non-profits and small-businesses develop a better cyber security posture. She Chairs the Cyber Risk Professional Certification Board at Pepperdine University and has trained hundreds of executives in the areas of business innovation leveraging digital systems and technology management. Charla has worked with business leaders and executives to deploy a risk-based approach in organizations such as Johnson & Johnson, Paramount Pictures, and Nintendo. She currently serves as a director on two Corporate Boards and two non-profit boards including the California Technology Council. She is also the Editor-in-Chief of the international journal *Technology in Society* and she has published extensively in the area of technology and engineering management. A seasoned board member, she has global experience working with executives, speaks Japanese and has extensive experience in the Asia-Pacific region with additional experience in Europe. Her scholarship includes guiding the discourse and framing new approaches for understanding the dynamics between technology and society. The impact of this work includes assisting privately and publicly traded firms to leverage analytics, build cyber risk programs, and deploy technology to achieve greater efficiencies. As a Hispanic/Latinx woman in this field, the *Washington Post* and *Huffington Post* frequently cite her for her advocacy regarding the importance of diversity in decision-making and design when it comes to emerging technologies and risk. She also writes extensively in popular media about emerging technologies, risk, and the importance of diversity for creating agility and a future worth wanting.

At Pepperdine University, Dr. Griffy-Brown chairs the Part-Time MBA Committee, the PGBS Curriculum Committee, and the Advancement of Student Learning Council. She developed the cyber-security classes for the

MBA program as well as the Cyber Risk and Analytics classes for the Masters of Science in Applied Analytics. She teaches in the Executive MBA, Part-Time MBA, Full-Time MBA, and the Masters of Science in Applied Analytics programs as well as the Digital Innovation Concentration. She received the university's top teaching award, The Howard A. White Teaching Award, in 2011, and the same year she was recognized by the International Association of Technology Management as one of their most prolific scholars. She was recognized in 2016 as one of the most cited scholars at the University. In 2019, she was recognized by the Pepperdine Graziadio School with the "George Award" for outstanding scholarship, teaching and service. In 2020, she received Pepperdine University's Excellence in Leadership Award.

Dr. Mel Horwitch

Visiting Scholar/Research Affiliate, MIT-Sloan School, USA, and former University Professor and Dean, Central European University, Hungary



Dr. Mel Horwitch is a Visiting Scholar at the MIT Sloan School of Management. In Budapest, Hungary, he was University Professor at Central European University, CEU Business School Dean, and CEUBS Innovation and Entrepreneurship Project Director. He publishes and teaches extensively on technology strategy, entrepreneurship, and large-scale innovation, most recently concerning analytics/data science and societal challenges. Publications include: *Clipped Wings: The American SST Conflict*, *Technology in the Modern Corporation: A Strategic Perspective* (editor and contributor), *Energy Future* (chapter contributor), and articles in such journals as *Management Science*, *Policy Science*, *MIT Sloan Management Review*, *Technology in Society*, *Journal of Engineering and Technology Management*, and *Journal of High Technology Management Research*, and several cases. At NYU-Poly (now NYU's Tandon School of Engineering), he was Department Chair, Professor of Technology Management, and Institute for Technology and Enterprise Director. He was Dean of Management and Professor at Theseus Institute (now EDHEC) in Sophia Antipolis, France, and served on the MIT Sloan School and Harvard Business School faculties. He was Visiting Scholar at UCSD's Rady School, Hitotsubashi University, and London Business School. He earned an AB from Princeton University and MBA and Doctorate from Harvard Business School. He was a US Peace Corps Volunteer in Thailand.

FELLOW AWARDS

Dr. Edward B. Roberts

David Sarnoff Professor of Management of Technology, MIT, USA



Dr. Edward B. Roberts is the David Sarnoff Professor of Management of Technology, Founder/Chair and former Faculty Director of Martin Trust Center for MIT Entrepreneurship, and Founder and Co-Chair of MIT Entrepreneurship & Innovation MBA Track. He received his S.B. in Electrical Engineering, S.M. in Electrical Engineering, S.M. in Management

and Ph.D. in Economics, all from M.I.T.

He has been on the Board of Directors for Medical Information Technology (co-founder, 1969-), PR Restaurants (1997-), North Country Chamber Players (2004-). Advanced Magnetics (formerly BioClinical Group, now AMAG Pharmaceuticals) (1982-2006), Cannonball (2015-2017, acquired by Google), Carousel Software (co-founder, 1982-1985), Cistran (co-founder, 2002-2003), Cooper Human Systems (co-founder, 2011-2017), Daktari Diagnostics (2009-15), Data Technologies (1967-1968), Digital Products (1993-1996, acquired by Osicom Technologies), DynoMedia (formerly UCAN-TV), Beijing (co-founder, 2006-2014), EdTech Networks (2007-2009), Education & Research Institute (founder, 1968-1995), Environmental Impact Center/EIC (co-founder, 1971-1976), Geodatic (1969-1970), Geophysical Survey Systems (1970-1977), HighPoint Systems (1994-2002), Ibtakar Venture Partners (co-founder, 2000-2007), Informative Computer Services (1968-1970), Interactive Sciences (1968-1970), Interactive Supercomputing (2005-2009, acquired by Microsoft), InTouch Systems (1998-1999, acquired by Comverse Technologies), Inverness Medical Technologies (formerly Superior Sensors, then Selfcare) (1992-2002, acquired by Johnson & Johnson), Laser Science (1987-1996, acquired by Thermo-Electron Group), NetSilicon (1999-2002, acquired by Digi International), OrgSupply (2002-2003), Pegasystems (1996-2005), Phillips Screw (1973-1978, acquired by Rule Industries), Public Sector (co-founder, 1971-1975), Pugh-Roberts Associates (co-founder, CEO, 1963-1990, acquired by PA Consulting Group), SofTech (1969-1974), Sohu.com (Beijing; formerly Internet Technologies China) (co-founder, 1996-2017), Solar Power (1974-1975, acquired by Exxon Enterprises), StarNex (1998-2001), StarSure.com (co-founder, 2000-2001, acquired by ePolicy), Tyco Laboratories (1965-1967, now Tyco

International), University Bank & Trust (1984-1987), Visible Measures (co-founder, 2005-2017, acquired by AdAcuity), Youth Dynamics (1968-1970), Zero Stage Capital Group (including First Stage Capital) (co-founder and General Partner, 1981-2000). He was also a founding angel investor in many startup companies, including Advanced Magnetics, Cover Wallet, HubSpot, Locu, Okta and 3Play Media.

Dr. Roberts has served as a member of the Editorial Boards of *IEEE Transactions on Engineering Management*, *Industrial Marketing Management*, *Journal of Product Innovation Management*, *Journal of Technological Innovation & Management*, *Research/Technology Management*, *Sloan Management Review*, and *Technological Forecasting & Social Change*.

He is the author or co-author of more than 15 books and monographs, and over 100 papers.

Dr. Aaron J. Shenhar

Dr. Aaron Shenhar, Professor of Project Management and Leadership (Ret.), Rutgers University, CEO and Founder, Technological Leadership Institute, LLC (DLI), USA



Dr. Aaron J. Shenhar is highly regarded as a world-leading expert in technology and project management, innovation, strategy, and leadership. His five academic degrees in engineering and management, including three degrees from Stanford University and two from the Technion in Israel, established a basis for

his later contributions to areas of technology, innovation, projects and leadership in technology-based organizations and academia.

He received many industry and educational rewards, among them, "Engineering Manager of the Year," by IEEE's Engineering Management Society; the first Project Management Institute (PMI) Research Achievement Award, and the International Project Management Association (IPMA) Research Achievement Award. Dr. Shenhar was also nominated as a PMI Fellow and a Fellow of NASA's Science Council of Project Management Research.

His diverse career combined leadership roles in business and academia, which influenced many company practices and future studies. In his business career, he managed

FELLOW AWARDS

projects, innovation, and R&D businesses, and later, as executive, he served as Corporate Vice President, and President of the Electronic Systems Division at Rafael, Advanced Defense Systems.

He served in four universities in the US and Israel. With over 150 publications, six books, and over 15,000 citations, his writings have influenced project and technology management research and education around the world. His Harvard Business School Press book, *Reinventing Project Management*, was selected among the top-five best business books of the year.

As consultant to major corporations, such as 3M, Honeywell, AT&T, Trane, Dow Jones & Co., US Army, NASA, NSA, Lockheed Martin, Merck, Intel, Amdocs, Tata, and Israel Aerospace Industry, he established new methodologies for innovation, project and program management, which greatly improved project delivery goals, as well as company business performances.

Dr. James M. Utterback

David J. McGrath jr (1959) Professor of Management and Innovation, Emeritus, MIT Sloan School, USA



Dr. James M. Utterback holds degrees in Engineering from Northwestern and his PhD (1969) in Management from MIT. He joined MIT in 1974 and the School of Engineering faculty in 1979. In 2001 he was named David J. McGrath jr (1959) Professor of Management and Innovation at MIT Sloan. Dr. Utterback has made foundational contributions to the

systematic study of entrepreneurship and innovation. His book, *Mastering the Dynamics of Innovation* (1994), examined the creative and destructive effects of technological change on the life of firms and industries. Dr. Utterback was elected a foreign member of the Royal Swedish Academy of Engineering Sciences (IVA) in 1999, a fellow of Clare Hall at Cambridge University in 2007, of the AAAS in 2013, and of PICMET in 2021. He holds honorary degrees from Chalmers and KULeuven.

Dr. Steven T. Walsh

Distinguished Professor, University of New Mexico, USA

Dr. Steven T. Walsh received his BS, in Biomedical Engineering (Minor in Economics), MBA in Marketing and New Product Planning and Ph.D. in Strategy with



a specialization in Management of Technology and Entrepreneurship, all from Rensselaer Polytechnic Institute. He is a Distinguished Professor in the Department Finance, International, and Innovation at the Anderson School of Management at the University of New Mexico. Prior to joining UNM, he was an Assistant Professor and a Visiting Professor at New Jersey Institute of Technology. He also holds the Research Professor position in the Joint Research Program between University of Twente and University of Groningen.

He has authored or co-authored 11 books/conference proceedings, 38 book chapters, more than 70 papers in refereed journals and 20 editorials.

Dr. Walsh is the Associate Editor of *Technological Forecasting and Social Change*, *Journal of Small Business Management*, *IEEE Transactions for Engineering Management*, *Journal of Small Business Strategy*, *International Journal of Innovation and Technology Management* and *International Journal of Technology and Intelligence Planning*.

GENERAL INFORMATION

CONFERENCE FOCUS

Digitization started several decades ago, and recently gained a tremendous acceleration to transform our lives. It is particularly important now, when increasing uncertainties are affecting economic outlook, and massive changes are taking place throughout the world. We may, in fact, be at an inflection point. Industry 4.0 is changing every aspect of economy and society. Climate change is an extremely serious issue, worldwide. Job creation and job loss are both an opportunity and a challenge. The gap between technologically advanced nations and technology-poor nations is growing rapidly. The trend toward globalization seems to be reversing itself due to political considerations. Artificial Intelligence (AI), Virtual Reality (VR), Augmented Reality (AR), Analytics and Data Science are starting to have a major impact on our lives.



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

PICMET defines the primary role of Technology Management as the management of technologies to assure that they work for the betterment of humankind. Using this definition, technology management has a critical role to play in the development and utilization of technology to meet the world's needs. This is a big challenge for the leaders and future leaders in the Technology Management field. Recognizing this challenge, the PICMET '22 Conference is focused on the leadership challenges in managing digital transformation to address critical issues that the world is now facing and will face in the

“new normal” conditions after the COVID crisis is over. It is our expectation that this conference will encourage researchers to engage in significant scholarly work in responding to the world's needs.

WHO SHOULD ATTEND

Following the PICMET tradition, this high-impact conference sets the stage for management and leadership in technological innovation in digital transformations for decades to come. The world's leading experts from academic institutions, industrial corporations and government agencies will participate in the discussions. PICMET '22 is essential for:

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

PROGRAM

- Ph.D. Colloquium, “Getting Your Ph.D....and Beyond: Critical Stages and Career Paths for the Ph.D. Student,” Sunday, August 7, 13:00 - 17:00, Adams/Jefferson Rooms
- Plenary sessions by global leaders in technology management in the Multnomah Ballroom.
- Three special meetings:
 1. Panel of Reviewers Lunch Meeting for the reviewers of papers submitted to PICMET conferences, Monday, August 8, 12:00-14:00, Adams/Jefferson Rooms.

GENERAL INFORMATION

- Country Representatives Lunch Meeting for the current PICMET Country Representatives and those who are interested in becoming Country Representatives, Wednesday, August 10, 12:00-14:00, Adams/Jefferson Rooms.
 - PICMET '22 Debriefing and PICMET '23 Planning Session for everybody who would like to discuss strategies for future PICMET conferences, Thursday, August 11, 14:00-15:30, Multnomah Room.
- Research papers by cutting-edge researchers
 - Applications papers by researchers and practitioners working on industry applications
 - Panel discussions with interactions between panelists and the audience

PUBLICATIONS

PICMET '22 has two publications:

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

The publications will be available to PICMET '22 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 is not included in the registration fee. Tickets for these events may be purchased at the registration desk.*

SESSION AND PAPER DESIGNATIONS

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

First digit shows the day	M: Monday
	T: Tuesday
	W: Wednesday
	H: Thursday

Second digit shows the time	A: 08:30-10:00
	B: 10:30-12:00
	C: 12:00-14:00
	D: 14:00-15:30
	E: 16:00-17:30

Third and fourth digits show the room	01: Multnomah
	02: Holladay
	03: Broadway
	04: Weidler
	05: Morrison
	06: Ross Island
	07: Sellwood

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 Morrison.



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.

GENERAL INFORMATION

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

AUTHORS' WORK SPACE

A section of the Lloyd Center Ballroom Foyer near the PICMET registration desk is designated as the Authors' Work Space. The authors can work there with their laptops anytime they wish to do so

AUDIO/VISUAL EQUIPMENT

There will be a computer, a projector and a screen in every break-out room. You can bring your presentation slides on a USB drive and use the computer provided. If you would like to use your own laptop, please be advised the projectors will have both a VGA cable and HDMI cable available to plug into a laptop. If your laptop requires an adapter to accommodate one of these connections you will need to bring the adapter. Also, please make sure that you have an adapter to connect to USA electric port if your connection port is different.

WIRELESS ACCESS

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

PARKING

Complimentary parking is available for PICMET '22 participants in the hotel's parking garage. Please get the white parking ticket when you enter the garage. **If you are staying at the hotel**, you can exit the garage by inserting your room card key into the exit slot. You will have unlimited in and out privileges. **If you are not**



staying at the hotel, but driving to the Conference, ask for a green parking pass at the PICMET registration desk, and when leaving the garage, insert the white ticket first and the green pass after that. The green passes are for one-time use

PICMET VOLUNTEERS

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

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 (\$5 for a daily pass), \$1.25 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 the Portland Lloyd District where the DoubleTree by Hilton Hotel is located. The hotel is approximately 20-40 minutes from the Portland International Airport, depending on traffic.

If you are traveling light and do not mind walking about one-half block, you can board the MAX (Metropolitan Area Express, <https://trimet.org/max/>) 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 Lloyd Center/NE 11th Ave. stop (next to Holladay Park), walk west about one-half block, cross the street and then turn right on NE 11th Ave., walk a few steps and you will see the entrance to the DoubleTree by Hilton Hotel. 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 to 15 percent of the fare.
- For restaurant service: 15 to 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, as well as museums, art galleries, unique retail shops, and restaurants of all varieties.

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.

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 9th Machado Mijiga 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 Friday, August 12th, Jujuba will perform. (*Oregon Zoo, 4001 SW Canyon Road, Portland, Oregon; for schedule and ticket prices visit www.oregonzoo.org/events/category/concerts*)



Jujuba at the Oregon Zoo - August 12th

CITY OF ROSES

PSU 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 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; www.portlandsaturdaymarket.com*)

Portland Timbers Soccer

Major League Soccer team the Portland Timbers will host the FC Dallas on August 6th at Providence Park. (*Providence Park, 1844 SW Morrison, Portland, Oregon; for schedule and ticket information visit www.timbers.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



Lan Su Chinese Garden

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—18:00; admission, \$14; www.lansugarden.org/*)

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)



Oregon Museum of Science and Industry

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; 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, dinner and sightseeing 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)

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. (<https://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 gazelles graze. Visit Elephant Lands to see the Asian elephant residents, and then stop by the Pacific Shores to see the polar bears, penguins, sea otters and harbor seals. Five minutes from downtown Portland 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*)



Oregon Zoo

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*)

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, 4033 S.W. Canyon Road, Portland, Oregon; for hours and admission price, visit www.worldforestry.org*)

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; www.hoytarboretum.org*)



View from the International Rose Test Garden

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.

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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*)



Alphabet District

Northwest/Alphabet District

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

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



Streetcar in the Pearl District

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.travelportland.com/neighborhoods/pearl-district*)

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 mall 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 retail shops, restaurants and an ice rink. (*Bordered by Multnomah and Broadway, 9th and 15th Streets; www.lloydcenter.com*)

Washington Square pulls shoppers into its many specialty shops and restaurants. (*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; www.premiumoutlets.com/outlet/woodburn*)

SOCIAL EVENTS

To facilitate the informal interaction of the participants, several social events have been scheduled during PICMET '22.

WELCOME RECEPTION/BUFFET

DATE: SUNDAY, AUGUST 7
CASH BAR: 18:30 – 22:00, LLOYD CENTER
BALLROOM FOYER
BUFFET: 19:00-22:00
ROOM: MULTNOMAH
DRESS: INFORMAL

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



BUFFET DINNER

DATE: MONDAY, AUGUST 8
CASH BAR: 18:30 – 22:00, PACIFIC
NORTHWEST BALLROOM
FOYER
BUFFET: 19:00-22:00
ROOM: PACIFIC NORTHWEST
BALLROOM
DRESS: INFORMAL

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

AWARDS BANQUET

DATE: TUESDAY, AUGUST 9
CASH BAR: 18:30 – 22:00, LLOYD CENTER
BALLROOM FOYER
BANQUET: 19:00-22:00
ROOM: MULTNOMAH
DRESS: BUSINESS CASUAL (COAT AND
TIE OPTIONAL)

This is the premier social event of the conference. The PICMET '22 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.*

IEEE EVENT

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

DATE: WEDNESDAY, AUGUST 10
TIME: 17:30 - 19:00
ROOM: HAWTHORNE



SPEAKER:
**Paul Menig, Chief Executive
Officer, Business Accelerants**

**“Digitization from the Edge to the
Business Core”**

Paul Menig, founder and CEO of Business Accelerants, has spent his career building businesses. For 35 years, he worked at General Electric,

Eaton Corporation, and Daimler AG. During that time, Mr. Menig gained experience in building new businesses based on high-tech products for multiple industries. These include the military, aerospace, medical equipment, industrial automation, and transportation. He received the BSEE - Electrical/Electronics Engineering from MIT, and the MSEE from Marquette University.

Since establishing Business Accelerants™, Mr. Menig has helped several hundred businesses, including startups, family-owned enterprises, and small-cap public companies. He specializes in guiding leaders on how to develop a long-term strategy to keep them accelerating their profitable growth. Through business consulting, Mr. Menig wants them to generate more revenue from their business and onto their personal balance sheet. He also aims to see company leaders set aside more time for life and spend it with their family and friends.

There is no fee for this event. It is open to all PICMET attendees.



TECHNICAL PROGRAM

PROGRAM OVERVIEW

The PICMET '22 technical program consists of 72 sessions including 4 plenaries, 2 special sessions, 1 panel, 3 tutorials, and 62 paper sessions.

The plenaries are scheduled from 08:30 to 10:00 every morning, Monday, August 8, through Thursday, August 11, in the Multnomah. 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 '22 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 '22.

DAILY SCHEDULES

MONDAY, AUGUST 8, 2022

	01 Multnomah	02 Holladay	03 Broadway	04 Weidler	05 Morrison	06 Ross Island	07 Sellwood
MA 08:30-10:00	Plenary - 1						
MB 10:30-12:00	Social Media-1	Information & Communications Technologies-1	Project & Program Management-1	Technology Management in Service Industry-1	Sustainability-1	R&D Management-1	Technology Management in the Energy Sector
MC 12:00-14:00	LUNCH						
MD 14:00-15:30	Technology Management Framework	Enterprise Management	Project & Program Management-2	New Product Development-1		Decision Making-1	Collaborations-1
ME 16:00-17:30	Innovation Management-1	Information & Knowledge Management-1	Internet of Things-1	Beyond Business Analytics: The Special Case of Technology Management	Leadership	Decision Making-2	Collaborations-2

TUESDAY, AUGUST 9, 2022

	01 Multnomah	02 Holladay	03 Broadway	04 Weidler	05 Morrison	06 Ross Island	07 Sellwood
TA 08:30-10:00	Plenary - 2						
TB 10:30-12:00	Innovation Management-2	Information & Communications Technologies-2	Technological Change	Intellectual Property-1	Artificial Intelligence-1	Global Issues-1	Technology Management in Service Industry-2
TC 12:00-14:00	LUNCH						
TD 14:00-15:30	Innovation Management-3	Information & Knowledge Management-1	Digital Transformation-1	Intellectual Property-2	Artificial Intelligence-2	Improve Your Innovation Odds - Share and Explore Innovation Processes with International Practitioners Who Are Developing ISO Standards for Innovation	S&T Policy-2
TE 16:00-17:30	Innovation Management-4	Meet the Editors	Digital Transformation-2	Intellectual Property-3	Environmental Issues-1	R&D Management-2	S&T Policy-1

DAILY SCHEDULES

WEDNESDAY, AUGUST 10, 2022

	01 Multnomah	02 Holladay	03 Broadway	04 Weidler	05 Morrison	06 Ross Island	07 Sellwood
WA 08:30-10:00	Plenary - 3						
WB 10:30-12:00	Technology Roadmapping-1	Technology Adoption	Technology Management in Biotechnology Industry	Strategic Management of Technology-1	Supply Chain Management	Educational Issues-1	
WC 12:00-14:00	LUNCH						
WD 14:00-15:30	Innovation Management-5	Digital Transformation-3	Information & Knowledge Management-2	Strategic Management of Technology-2	Project & Program Management-3	Technology Management in the Health Sector-1	Quality Management
WE 16:00-17:30	Innovation Management-6	Digital Transformation-4	Information & Knowledge Management-3	The 4Cs: Climate, Covid, Culture, Convergence	Technology Forecasting-1	Emerging Technologies-1	Manufacturing Management-1

THURSDAY, AUGUST 11, 2022

	01 Multnomah	02 Holladay	03 Broadway	04 Weidler	05 Morrison	06 Ross Island	07 Sellwood
HA 08:30-10:00	Plenary - 4						
HB 10:30-12:00	Manufacturing Management-2	Digital Transformation-5	Entrepreneurship & Intrapreneurship-1	Strategic Management of Technology-3	Technology Forecasting-2		
HC 12:00-14:00	LUNCH						
HD 14:00-15:30	PICMET '22 Debrief and Future PICMET Planning						

SCHEDULE OF SESSIONS

SCHEDULE OF SESSIONS BY DATE

MONDAY, AUGUST 8, 2022

Session Number	Day	Time	Room	Session Title
MA 01	Monday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 1"
MB 01	Monday	10:30 - 12:00	Multnomah	"Social Media-1"
MB 02	Monday	10:30 - 12:00	Holladay	"Information & Communications Technologies-1"
MB 03	Monday	10:30 - 12:00	Broadway	"Project & Program Management-1"
MB 04	Monday	10:30 - 12:00	Weidler	"Technology Management in Service Industry-1"
MB 05	Monday	10:30 - 12:00	Morrison	"Sustainability-1"
MB 06	Monday	10:30 - 12:00	Ross Island	"R&D Management-1"
MB 07	Monday	10:30 - 12:00	Sellwood	"Technology Management in the Energy Sector"
MD 01	Monday	14:00 - 15:30	Multnomah	"Technology Management Framework"
MD 02	Monday	14:00 - 15:30	Holladay	"Enterprise Management"
MD 03	Monday	14:00 - 15:30	Broadway	"Project & Program Management-2"
MD 04	Monday	14:00 - 15:30	Weidler	"New Product Development-1"
MD 06	Monday	14:00 - 15:30	Ross Island	"Decision Making-1"
MD 07	Monday	14:00 - 15:30	Sellwood	"Collaborations-1"
ME 01	Monday	16:00 - 17:30	Multnomah	"Innovation Management-1"
ME 02	Monday	16:00 - 17:30	Holladay	"Information & Knowledge Management-1"
ME 03	Monday	16:00 - 17:30	Broadway	"Internet of Things-1"
ME 04	Monday	16:00 - 17:30	Weidler	TUTORIAL: "Beyond Business Analytics: The Special Case of Technology Management"
ME 05	Monday	16:00 - 17:30	Morrison	"Leadership"
ME 06	Monday	16:00 - 17:30	Ross Island	"Decision Making-2"
ME 07	Monday	16:00 - 17:30	Sellwood	"Collaborations-2"

TUESDAY, AUGUST 9, 2022

TA 01	Tuesday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 2"
TB 01	Tuesday	10:30 - 12:00	Multnomah	"Innovation Management-2"
TB 02	Tuesday	10:30 - 12:00	Holladay	"Information & Communications Technologies-2"
TB 03	Tuesday	10:30 - 12:00	Broadway	"Technological Change"
TB 04	Tuesday	10:30 - 12:00	Weidler	"Intellectual Property-1"
TB 05	Tuesday	10:30 - 12:00	Morrison	"Artificial Intelligence-1"
TB 06	Tuesday	10:30 - 12:00	Ross Island	"Global Issues-1"
TB 07	Tuesday	10:30 - 12:00	Sellwood	"Technology Management in Service Industry-2"
TD 01	Tuesday	14:00 - 15:30	Multnomah	"Innovation Management-3"
TD 02	Tuesday	14:00 - 15:30	Holladay	"Information & Knowledge Management-1"
TD 03	Tuesday	14:00 - 15:30	Broadway	"Digital Transformation-1"
TD 04	Tuesday	14:00 - 15:30	Weidler	"Intellectual Property-2"

SCHEDULE OF SESSIONS

TD	05	Tuesday	14:00 - 15:30	Morrison	“Artificial Intelligence-2”
TD	06	Tuesday	14:00 - 15:30	Ross Island	TUTORIAL: “Improve Your Innovation Odds - Share and Explore Innovation Processes with International Practitioners Who Are Developing ISO Standards for Innovation”
TD	07	Tuesday	14:00 - 15:30	Sellwood	“S&T Policy-2”
TE	01	Tuesday	16:00 - 17:30	Multnomah	“Innovation Management-4”
TE	02	Tuesday	16:00 - 17:30	Holladay	PANEL: “Meet the Editors”
TE	03	Tuesday	16:00 - 17:30	Broadway	“Digital Transformation-2”
TE	04	Tuesday	16:00 - 17:30	Weidler	“Intellectual Property-3”
TE	05	Tuesday	16:00 - 17:30	Morrison	“Environmental Issues-1”
TE	06	Tuesday	16:00 - 17:30	Ross Island	“R&D Management-2”
TE	07	Tuesday	16:00 - 17:30	Sellwood	“S&T Policy-1”

WEDNESDAY, AUGUST 10, 2022

WA	01	Wednesday	08:30 - 10:00	Multnomah	PLENARY: “Plenary - 3”
WB	01	Wednesday	10:30 - 12:00	Multnomah	“Technology Roadmapping-1”
WB	02	Wednesday	10:30 - 12:00	Holladay	“Technology Adoption”
WB	03	Wednesday	10:30 - 12:00	Broadway	“Technology Management in Biotechnology Industry”
WB	04	Wednesday	10:30 - 12:00	Weidler	“Strategic Management of Technology-1”
WB	05	Wednesday	10:30 - 12:00	Morrison	“Supply Chain Management”
WB	06	Wednesday	10:30 - 12:00	Ross Island	“Educational Issues-1”
WD	01	Wednesday	14:00 - 15:30	Multnomah	“Innovation Management-5”
WD	02	Wednesday	14:00 - 15:30	Holladay	“Digital Transformation-3”
WD	03	Wednesday	14:00 - 15:30	Broadway	“Information & Knowledge Management-2”
WD	04	Wednesday	14:00 - 15:30	Weidler	“Strategic Management of Technology-2”
WD	05	Wednesday	14:00 - 15:30	Morrison	“Project & Program Management-3”
WD	06	Wednesday	14:00 - 15:30	Ross Island	“Technology Management in the Health Sector-1”
WD	07	Wednesday	14:00 - 15:30	Sellwood	“Quality Management”
WE	01	Wednesday	16:00 - 17:30	Multnomah	“Innovation Management-6”
WE	02	Wednesday	16:00 - 17:30	Holladay	“Digital Transformation-4”
WE	03	Wednesday	16:00 - 17:30	Broadway	“Information & Knowledge Management-3”
WE	04	Wednesday	16:00 - 17:30	Weidler	TUTORIAL: “The 4Cs: Climate, Covid, Culture, Convergence”
WE	05	Wednesday	16:00 - 17:30	Morrison	“Technology Forecasting-1”
WE	06	Wednesday	16:00 - 17:30	Ross Island	“Emerging Technologies-1”
WE	07	Wednesday	16:00 - 17:30	Sellwood	“Manufacturing Management-1”

SCHEDULE OF SESSIONS

THURSDAY, AUGUST 11, 2022

HA	01	Thursday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 4"
HB	01	Thursday	10:30 - 12:00	Multnomah	"Manufacturing Management-2"
HB	02	Thursday	10:30 - 12:00	Holladay	"Digital Transformation-5"
HB	03	Thursday	10:30 - 12:00	Broadway	"Entrepreneurship & Intrapreneurship-1"
HB	04	Thursday	10:30 - 12:00	Weidler	"Strategic Management of Technology-3"
HB	05	Thursday	10:30 - 12:00	Morrison	"Technology Forecasting-2"
HD	01	Thursday	14:00 - 15:30	Multnomah	PANEL: "PICMET '22 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	Multnomah	PLENARY: "Plenary - 1"
MB 01	Monday	10:30 - 12:00	Multnomah	"Social Media-1"
MD 01	Monday	14:00 - 15:30	Multnomah	"Technology Management Framework"
ME 01	Monday	16:00 - 17:30	Multnomah	"Innovation Management-1"
TA 01	Tuesday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 2"
TB 01	Tuesday	10:30 - 12:00	Multnomah	"Innovation Management-2"
TD 01	Tuesday	14:00 - 15:30	Multnomah	"Innovation Management-3"
TE 01	Tuesday	16:00 - 17:30	Multnomah	"Innovation Management-4"
WA 01	Wednesday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 3"
WB 01	Wednesday	10:30 - 12:00	Multnomah	"Technology Roadmapping-1"
WD 01	Wednesday	14:00 - 15:30	Multnomah	"Innovation Management-5"
WE 01	Wednesday	16:00 - 17:30	Multnomah	"Innovation Management-6"
HA 01	Thursday	08:30 - 10:00	Multnomah	PLENARY: "Plenary - 4"
HB 01	Thursday	10:30 - 12:00	Multnomah	"Manufacturing Management-2"
HD 01	Thursday	14:00 - 15:30	Multnomah	PANEL: "PICMET '22 Debrief and Future PICMET Planning"
MB 02	Monday	10:30 - 12:00	Holladay	"Information & Communications Technologies-1"
MD 02	Monday	14:00 - 15:30	Holladay	"Enterprise Management"
ME 02	Monday	16:00 - 17:30	Holladay	"Information & Knowledge Management-1"
TB 02	Tuesday	10:30 - 12:00	Holladay	"Information & Communications Technologies-2"
TD 02	Tuesday	14:00 - 15:30	Holladay	"Information & Knowledge Management-1"
TE 02	Tuesday	16:00 - 17:30	Holladay	PANEL: "Meet the Editors"
WB 02	Wednesday	10:30 - 12:00	Holladay	"Technology Adoption"
WD 02	Wednesday	14:00 - 15:30	Holladay	"Digital Transformation-3"
WE 02	Wednesday	16:00 - 17:30	Holladay	"Digital Transformation-4"
HB 02	Thursday	10:30 - 12:00	Holladay	"Digital Transformation-5"
MB 03	Monday	10:30 - 12:00	Broadway	"Project & Program Management-1"
MD 03	Monday	14:00 - 15:30	Broadway	"Project & Program Management-2"
ME 03	Monday	16:00 - 17:30	Broadway	"Internet of Things-1"
TB 03	Tuesday	10:30 - 12:00	Broadway	"Technological Change"
TD 03	Tuesday	14:00 - 15:30	Broadway	"Digital Transformation-1"
TE 03	Tuesday	16:00 - 17:30	Broadway	"Digital Transformation-2"
WB 03	Wednesday	10:30 - 12:00	Broadway	"Technology Management in Biotechnology Industry"
WD 03	Wednesday	14:00 - 15:30	Broadway	"Information & Knowledge Management-2"
WE 03	Wednesday	16:00 - 17:30	Broadway	"Information & Knowledge Management-3"
HB 03	Thursday	10:30 - 12:00	Broadway	"Entrepreneurship & Intrapreneurship-1"

SCHEDULE OF SESSIONS

MB	04	Monday	10:30 - 12:00	Weidler	“Technology Management in Service Industry-1”
MD	04	Monday	14:00 - 15:30	Weidler	“New Product Development-1”
ME	04	Monday	16:00 - 17:30	Weidler	TUTORIAL: “Beyond Business Analytics: The Special Case of Technology Management”
TB	04	Tuesday	10:30 - 12:00	Weidler	“Intellectual Property-1”
TD	04	Tuesday	14:00 - 15:30	Weidler	“Intellectual Property-2”
TE	04	Tuesday	16:00 - 17:30	Weidler	“Intellectual Property-3”
WB	04	Wednesday	10:30 - 12:00	Weidler	“Strategic Management of Technology-1”
WD	04	Wednesday	14:00 - 15:30	Weidler	“Strategic Management of Technology-2”
WE	04	Wednesday	16:00 - 17:30	Weidler	TUTORIAL: “The 4Cs: Climate, Covid, Culture, Convergence”
HB	04	Thursday	10:30 - 12:00	Weidler	“Strategic Management of Technology-3”
MB	05	Monday	10:30 - 12:00	Morrison	“Sustainability-1”
ME	05	Monday	16:00 - 17:30	Morrison	“Leadership”
TB	05	Tuesday	10:30 - 12:00	Morrison	“Artificial Intelligence-1”
TD	05	Tuesday	14:00 - 15:30	Morrison	“Artificial Intelligence-2”
TE	05	Tuesday	16:00 - 17:30	Morrison	“Environmental Issues-1”
WB	05	Wednesday	10:30 - 12:00	Morrison	“Supply Chain Management”
WD	05	Wednesday	14:00 - 15:30	Morrison	“Project & Program Management-3”
WE	05	Wednesday	16:00 - 17:30	Morrison	“Technology Forecasting-1”
HB	05	Thursday	10:30 - 12:00	Morrison	“Technology Forecasting-2”
MB	06	Monday	10:30 - 12:00	Ross Island	“R&D Management-1”
MD	06	Monday	14:00 - 15:30	Ross Island	“Decision Making-1”
ME	06	Monday	16:00 - 17:30	Ross Island	“Decision Making-2”
TB	06	Tuesday	10:30 - 12:00	Ross Island	“Global Issues-1”
TD	06	Tuesday	14:00 - 15:30	Ross Island	TUTORIAL: “Improve Your Innovation Odds - Share and Explore Innovation Processes with International Practitioners Who Are Developing ISO Standards for Innovation”
TE	06	Tuesday	16:00 - 17:30	Ross Island	“R&D Management-2”
WB	06	Wednesday	10:30 - 12:00	Ross Island	“Educational Issues-1”
WD	06	Wednesday	14:00 - 15:30	Ross Island	“Technology Management in the Health Sector-1”
WE	06	Wednesday	16:00 - 17:30	Ross Island	“Emerging Technologies-1”
MB	07	Monday	10:30 - 12:00	Sellwood	“Technology Management in the Energy Sector”
MD	07	Monday	14:00 - 15:30	Sellwood	“Collaborations-1”
ME	07	Monday	16:00 - 17:30	Sellwood	“Collaborations-2”
TB	07	Tuesday	10:30 - 12:00	Sellwood	“Technology Management in Service Industry-2”
TD	07	Tuesday	14:00 - 15:30	Sellwood	“S&T Policy-2”
TE	07	Tuesday	16:00 - 17:30	Sellwood	“S&T Policy-1”
WD	07	Wednesday	14:00 - 15:30	Sellwood	“Quality Management”
WE	07	Wednesday	16:00 - 17:30	Sellwood	“Manufacturing Management-1”

PERSONAL SCHEDULE

	Sunday Aug 7, 2022	Monday Aug 8, 2022	Tuesday Aug 9, 2022	Wednesday Aug 10, 2022	Thursday Aug 11, 2022
08:00 – 08:30 Bright Start (Breakfast)					
08:30 – 10:00 (A)		Plenary - 1 (Multnomah)	Plenary - 2 (Multnomah)	Plenary - 3 (Multnomah)	Plenary - 4 (Multnomah)
10:00 – 10:30 Coffee Break					
10:30 – 12:00 (B)					
12:00 – 14:00 Lunch Break					
14:00 – 15:30 (D)	Ph.D. Colloquium 13:00-17:00 (Adams/Jefferson)				PICMET '23 Planning Session (Multnomah)
15:30 – 16:00 Coffee Break					
16:00 – 17:30 (E)					
19:00 – 22:00	Welcome Reception (Multnomah)	Dinner (Pacific Northwest)	Awards Banquet (Multnomah)		

SPECIAL SESSIONS

PANEL OF EDITORS LUNCH MEETING

DATE: MONDAY, AUGUST 8
TIME: 12:00-14:00
ROOM: ADAMS/JEFFERSON

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 10
TIME: 12:00-14:00
ROOM: ADAMS/JEFFERSON

PICMET has 146 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 '22 DEBRIEFING & '23 PLANNING SESSION

DATE: THURSDAY, AUGUST 11
TIME: 14:00-15:30
ROOM: MULTNOMAH

The hiatus caused by COVID-19 made this year's conference unique. We invite the entire PICMET community to join us for this interactive session. The PICMET organizing committee will be present to hear feedback about this year's conference, discuss lessons learned, and talk about future PICMET conferences.



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PLENARY SESSION-1

DATE: MONDAY, AUGUST 8
TIME: 08:30-10:00
ROOM: MULTNOMAH – FIRST LEVEL

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

KEYNOTE-1

Dr. M. Elisabeth Paté-Cornell, The Burt and Deedee McMurtry Professor in the School of Engineering Professor and Founding Chair, Department of Management Science and Engineering, Stanford University

“Making Engineering Systems Safer and Smarter: Warnings of Cyberattacks and Artificial Intelligence”



AI can address two aspects of the management of the risk of systems' failure: information processing and automatic decisions. In both cases, intelligent as it is, the system may need temporarily at least, human input in addition to what the computer-driven “robot” has learned so far or can access quickly enough. In the case of information, this occurs if new data

are observed that cannot be interpreted automatically based on previous or accessible information. In the case of decisions, they may include preferences, risk attitudes or thresholds that reflect the will of the decision maker(s), especially when facing large uncertainties or large magnitudes of potential outcomes. In such cases, time permitting, one needs a hybrid system involving both an automatic “robot” and a human operator. Dr. Paté-Cornell will present several vignettes of such systems and will then focus on the example of the management of warnings of cyber-attacks for a specific system, and in that case, how one can learn about potential attackers and manage the penetration of a computer system by outside agents, with the goal of protecting its core.

Dr. Marie-Elisabeth Paté-Cornell is the Burt and Deedee McMurtry Professor in the School of Engineering and a Senior Fellow (by courtesy) of the Stanford Freeman-Spogli Institute for International Studies. Her specialty is engineering risk analysis, with applications to complex systems (space, medical, offshore oil platforms, cyber

security, etc.). Her work has been based on probabilistic and stochastic models and on Artificial Intelligence. She is a member of the National Academy of Engineering, the French Académie des Technologies, the NASA Advisory Council, and a Distinguished Visiting Scientist of the Jet Propulsion Lab. She was a member of the President's Foreign Intelligence Advisory Board (2001 to 2008). She holds a BS in Mathematics and Physics, Marseille (France), an Engineering degree (Applied Math/CS) from the Institut Polytechnique de Grenoble (France), an MS in Operations Research (OR) and a PhD in Engineering-Economic Systems (EES), both from Stanford University. She is the author or coauthor of numerous publications including several Best Paper awards. She was awarded the 2002 Distinguished Achievement Award of the Society for Risk Analysis (of which she is a Fellow), the INFORMS Ramsey Medal of Decision Analysis (2010), an Honorary PhD from the University of Strathclyde (2016), and the IEEE Ramo medal for Systems Engineering and Science in 2021.”

KEYNOTE-2

Dr. Mel Horwitch, PICMET Fellow, Visiting Scholar/ Research Affiliate, MIT-Sloan School, and former University Professor and Dean, Central European University

“Innovation Management and Quest for a More Strategic Society”



There is a worldwide need for a more strategic society, which, ideally, exhibits successful forethought and leveraging of knowledge in dealing with societal-scale challenges and promoting societal well-being. Also critical for a more strategic society is effective modern innovation management. This entails more than superior competencies in state-of-the-art technology. Modern innovation management is increasingly multi-faceted and inter-connected. Constituent elements range from entrepreneurial venturing to corporate R&D, with actors often becoming parts of complex ecosystems. Especially important today in achieving a more strategic society is macro-innovation, which refers to involvement and partnering of diverse actors across multiple sectors, with government often playing a more prominent role due to increasing demands to mobilize vast resources. This stands in contrast to previous eras when distinct elements of innovation management captured attention (e.g., global R&D and high-tech entrepreneurialism). This deployment of a

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broad portfolio of innovation-management activities, therefore, constitutes a critical feature of a more strategic society as it confronts such looming challenges as AI, cities, competitiveness, sustainability, security, and health.

Dr. Mel Horwitch is a Visiting Scholar at the MIT Sloan School of Management. In Budapest, Hungary, he was University Professor at Central European University, CEU Business School Dean, and CEUBS Innovation and Entrepreneurship Project Director. He publishes and teaches extensively on technology strategy, entrepreneurship, and large-scale innovation, most recently concerning analytics/data science and societal challenges. Publications include: *Clipped Wings: The American SST Conflict*, *Technology in the Modern Corporation: A Strategic Perspective* (editor and contributor), *Energy Future* (chapter contributor), and articles in such journals as *Management Science*, *Policy Science*, *MIT Sloan Management Review*, *Technology in Society*, *Journal of Engineering and Technology Management*, and *Journal of High Technology Management Research*, and several cases. At NYU-Poly (now NYU's Tandon School of Engineering), he was Department Chair, Professor of Technology Management, and Institute for Technology and Enterprise Director. He was Dean of Management and Professor at Theseus Institute (now EDHEC) in Sophia Antipolis, France, and served on the MIT Sloan School and Harvard Business School faculties. He was Visiting Scholar at UCSD's Rady School, Hitotsubashi University, and London Business School. He earned an AB from Princeton University and MBA and Doctorate from Harvard Business School. He was a US Peace Corps Volunteer in Thailand.

PLENARY SESSION-2

DATE: TUESDAY, AUGUST 9
TIME: 08:30-10:00
ROOM: MULTNOMAH – FIRST LEVEL

Session Chair: Dr. Kiyoshi Niwa, Professor Emeritus, The University of Tokyo, Japan

KEYNOTE-1

Dr. Henry Chesbrough, PICMET Fellow, Professor and Faculty Director, Garwood Center for Corporate Innovation, Haas School of Business, University of California-Berkeley, USA

“Beyond Best Practice: New Developments in Open Innovation”



In this talk, Professor Henry Chesbrough will describe his well-known model of Open Innovation and then outline recent theoretical and empirical research on that model. This new research extends the earlier concept, and also shows certain limits to that model's use in several economic sectors. The result is an understanding

of open innovation that weaves together internal and external flows of knowledge, where each stimulates greater usage of knowledge from the other. Professor Chesbrough will conclude with recent examples of these dynamics at work in innovation.

Dr. Henry Chesbrough Dr. Henry Chesbrough is best known as “the father of Open Innovation.” He teaches at the Haas School of Business at the University of California-Berkeley, where he is the Faculty Director of the Garwood Center for Corporate Innovation. He is also Maire Tecnimont Professor of Open Innovation and Sustainability at Luiss University in Rome. Previously he was an Assistant Professor at Harvard Business School. He holds a PhD from UC Berkeley, an MBA from Stanford, and a BA from Yale University.

He has written books such as *Open Innovation* (Harvard Business School Press, 2003), *Open Business Models* (Harvard Business School Press, 2006), *Open Services Innovation* (Jossey-Bass, 2011) and *Open Innovation Results* (Oxford, 2020). His research has been cited more than 100,000 times, according to Google Scholar.

He has been recognized as one of the leading business thinkers by Thinkers50 several times. He received an Innovation Luminary award from the European Commission in 2014. He received the Industrial Research Institute Medal of Achievement in 2017, the Viipuri Prize from Lappeenranta University of Technology in 2022, the Herbert Simon Award of the Rajk College for Advanced Studies in 2022, and holds two honorary doctorates.

KEYNOTE-2

Dr. Robert A. Burgelman, PICMET Fellow, Edmund W. Littlefield Professor of Management of the Stanford University Graduate School of Business, USA

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“A Strategic Leadership Perspective on the 4th Industrial Revolution: Personal, Organizational and Societal Implications”



Dr. Burgelman will address two high-level questions: 1) What are the implications if the 4th industrial revolution creates algorithms that autonomously develop new knowledge, not embodied in humans? and 2) How can humans maintain control of algorithms that autonomously develop disembodied new knowledge? To address these

two questions, Dr. Burgelman will draw on some of his own frameworks, as well as on social science, poetics, physics and philosophy.

Dr. Robert A. Burgelman is the Edmund W. Littlefield Professor of Management of the Stanford University Graduate School of Business where he has taught since 1981. He obtained a Licentiate degree in Applied Economics from Antwerp University (Belgium), an MA in Sociology and an MPhil and PhD in Management of Organizations from Columbia University, where he studied with a European doctoral fellowship from the Ford Foundation (US) and one from ICM (Belgium). His research has focused on the role of strategy making in firm evolution. In particular, he has studied the strategy-making processes involved in how companies enter into new businesses and exit from existing ones to secure continued adaptation. In 2003, he received an honorary doctorate from the Copenhagen Business School (Denmark) for his contributions to the study of corporate innovation and entrepreneurship. In 2017, he received an honorary doctorate in economics of the University of St. Gallen (Switzerland), as well as the Leadership in Technology Management Award from the Portland International Center for Engineering and Technology Management (PICMET 2017). He is a Fellow of the Strategic Management Society and a Fellow of the Academy of Management. He has been on the faculty of Antwerp University, New York University, Harvard Business School (as a Marvin Bower Fellow), and Cambridge University (as a Visiting Professor of Marketing Strategy and Innovation at the Judge Business School). He has published many articles in leading academic and professional journals, as well as more than 180 case studies of companies and organizations in many different industries. His books include *Inside Corporate Innovation: Strategy, Structure, and Managerial Skills* (Free Press, 1986); *Research of Technological Innovation, Management and Policy* (JIA Press, Elsevier; Volume 4, 1989, Volume 5, 1993, Volume 6, 1997, and Volume 7, 2001); *Strategy is*

Destiny: How Strategy-Making Shapes a Company's Future (Free Press, 2002); *Strategic Dynamics: Concepts and Cases* (McGraw-Hill, 2006); *Strategic Management of Technology and Innovation* (5th edition, McGraw-Hill-Irwin, 2009); and *Becoming Hewlett Packard: Why Strategic Leadership Matters* (Oxford University Press, 2017). He has served as an Associate Editor of the *Strategic Entrepreneurship Journal*, 2007-2013. He has served as the Executive Director of the *Stanford Executive Program (SEP)* during 1996-2015, and has taught executive programs and led senior and top management seminars for major companies worldwide. He has also served on boards of directors and boards of advisors of several private companies.

PLENARY SESSION-3

DATE: WEDNESDAY, AUGUST 10

TIME: 08:30-10:00

ROOM: MULTNOMAH – FIRST LEVEL

Dr. Harm-Jan Steenhuis, Hawaii Pacific University, USA

KEYNOTE-1

Dr. Aaron Shenhar, PICMET Fellow, Professor of Project Management and Leadership (Ret.), Rutgers University, CEO and Founder, Technological Leadership Institute, LLC (DLI), USA

“Do We Need a New Science of Technology and Its Management?”



Yes, we do! At a time when technology is our most powerful driver of growth, prosperity, and life-improvement, there is still no common definition of what exactly is technology, and no common science for studying it or its management. Needless to say, as humanity is facing growing challenges such as climate change, global health hazards, pollution, and cyber and terror attacks, the need for more extensive management studies only intensifies. Dr. Shenhar will claim that society's mounting challenges today require a multidisciplinary approach for integrating distinct technologies, and management, into a unified field. Technology should be seen as the deliberate pursuit of collective creation, that combines the knowledge and the means for doing it. Technology management science

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will emerge as an integrative field, dedicated to studying how modern society generates its complex solutions, and to educating future leaders of such efforts. Since technology is built by people and for people, this science will not only involve STEM graduates, but also graduates of the humanities, fine arts, and social sciences, who would study, among other things, the emotional, risk, and ethical sides of technology, while jointly creating a deeper comprehension of humanity's creative spirits.

Dr. Aaron Shenhar is highly regarded as a world-leading expert in technology and project management, innovation, strategy, and leadership. His five academic degrees in engineering and management, including three degrees from Stanford University and two from the Technion in Israel, established a basis for his later contributions to areas of technology, innovation, projects and leadership in technology-based organizations and academia.

He received many industry and educational rewards, among them, "Engineering Manager of the Year," by IEEE's Engineering Management Society; the first Project Management Institute (PMI) Research Achievement Award, and the International Project Management Association (IPMA) Research Achievement Award. Dr. Shenhar was also nominated as a PMI Fellow and a Fellow of NASA's Science Council of Project Management Research.

His diverse career combined leadership roles in business and academia, which influenced many company practices and future studies. In his business career, he managed projects, innovation, and R&D businesses, and later, as executive, he served as Corporate Vice President, and President of the Electronic Systems Division at Rafael, Advanced Defense Systems.

He served in four universities in the US and Israel. With over 150 publications, six books, and over 15,000 citations, his writings have influenced project and technology management research and education around the world. His Harvard Business School Press book, Reinventing Project Management, was selected among the top-five best business books of the year.

As consultant to major corporations, such as 3M, Honeywell, AT&T, Trane, Dow Jones & Co., US Army, NASA, NSA, Lockheed Martin, Merck, Intel, Amdocs, Tata, and Israel Aerospace Industry, he established new methodologies for innovation, project and program management, which greatly improved project delivery goals, as well as company business performances.

KEYNOTE-2

Dr. James M. Utterback, PICMET Fellow, David J. McGrath jr (1959) Professor of Management and Innovation, Emeritus, MIT Sloan School, USA

"The Dynamics of Competition and of the Diffusion of Innovation"



The purpose of this talk is to briefly review our understanding of the emergence and diffusion of innovation and to provide a new and more nuanced model of diffusion. The point of departure is to abandon the idea that innovation results only in pure competition, or a zero-sum game, between new and established practices. Given evidence from many cases, the authors believe it more likely that at least at the beginning of races between new and older products, processes and services, growth of one will often stimulate growth of the others. We will term this symbiotic competition. Later the interacting technologies may fall into a cyclic state termed predator-prey competition, and finally a zero-sum game of pure competition may ensue. A main contribution is formulation of a general solution for multi-technology, multi-mode competition. The equations derived can be used to model the interaction of any finite number of technologies where the interaction among any pair can either be pure competition, predator-prey or symbiosis. The model allows determination of the mode and strength of the interactions of competing technologies as they evolve. It includes work with Calie Pistorius (Stellenbosch University) and Erdem Yilmaz (MIT SDM 2017).

Dr. James M. Utterback holds degrees in Engineering from Northwestern and his PhD (1969) in Management from MIT. He joined MIT in 1974 and the School of Engineering faculty in 1979. In 2001 he was named David J. McGrath jr (1959) Professor of Management and Innovation at MIT Sloan. Jim has made foundational contributions to the systematic study of entrepreneurship and innovation. His book, Mastering the Dynamics of Innovation (1994), examined the creative and destructive effects of technological change on the life of firms and industries. Dr. Utterback was elected a foreign member of the Royal Swedish Academy of Engineering Sciences (IVA) in 1999, a fellow of Clare Hall at Cambridge University in 2007, of the AAAS in 2013, and of PICMET in 2021. He holds honorary degrees from Chalmers and KULeuven.

PLENARIES

PLENARY SESSION-4

DATE: THURSDAY, AUGUST 11
TIME: 08:30-10:00
ROOM: MULTNOMAH – FIRST LEVEL

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

KEYNOTE-1

**Dr. Dietmar Theis, Honorary Professor, Technical
University of Munich, PICMET Fellow, Germany**

**“Digitalization Mitigates Climate Change and Moves Us
to a Sustainable Future”**



Progress in containing the uncontrolled increase in anthropogenic global warming will depend strongly on enhancing energy efficiency and accelerating decarbonization in all economic sectors. The deployment of the arsenal of the digital revolution offers essential support in this effort. The power sector is at the heart of this digital energy transformation.

The provision of renewable energy like solar and wind power generation must be accelerated, simultaneously digitalization offers innovative business models and provides new ways of system operation. In the past electricity was generated in large power plants, transferred through transmission and distribution networks, and was flowing one-way to end users in all sectors. Digitalization is the enabling tool to cope with the intermittent character of wind and solar power generation, and thus enables efficient, renewable, clean, and multi-directional, distributed energy systems (smart grids). The benefits of digitalization in electrification and transformation of road transport, buildings and industry will be touched briefly. The presentation will highlight some essential features of the symbiosis between digital technologies and mankind's fight against climate change. However, at present there is a painful ambition gap between what needs to be achieved for a sustainable future and the actual commitment of societies and governments.

Dr. Dietmar Theis is an Honorary Professor at the Technical University of Munich, Faculty of Electrical Engineering, where he has been teaching since 1994. He obtained a Master's degree (Diploma) in Physics from

the Technical University Berlin and a Doctoral degree in Solid State Physics from the same University. For his PhD work he was awarded with the Scheel-Prize of the German Physical Society.

In 1977 Dr. Theis joined Siemens' Research Laboratories (Corporate Technology) where he worked on optoelectronics, mainly light emitting diodes and flat panel displays, and on power semiconductors. He published more than 40 technical research papers. Since 1995 he was responsible for R&D marketing communication, R&D policy, and government relations as well as university liaisons. He served as co-editor of Siemens' R&D Journal Pictures of the Future and was involved in the company's technical foresight activities. Dr. Theis was elected as a member of the Engineering Academy of the Czech Republic in 2006 and served as an R&D advisor to the CEO and the Head of the Supervisory Board of Siemens.

In 2008 Dr. Theis retired from Siemens and now continues his professional life as a consultant to several European Scientific and Engineering Associations and as a university lecturer. He keeps contributing to European Foresight Projects and acts as an R&D advisor to companies. In summer 2019 Dr. Theis was elected a PICMET Fellow.

KEYNOTE-2

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

**“Applying Digital Technologies to Manage Climate
Change”**



Arguably, the most serious challenge confronting the world is the rapid rise in greenhouse gas (GHG) emissions. Scientists, engineers and business people are all challenged to address the global GHG challenge in a major way. To make a significant difference, solutions must be scalable to billions of tonnes or more per annum, require no or very low external conventional energy inputs, and be very cost effective. It must not simply push the problem down the road, thereby creating another issue. Solutions will likely be found at the forefront of current scientific capability. Pushing the limits of science to address GHG on such a macro scale pushes us toward biological systems which have demonstrated chemical and physical processes that convert GHG inputs

PLENARIES

(CO₂, CH₄, NO_x, etc.) to useful outputs of various kinds. Biological systems are self-replicating, and under some circumstances demonstrate runaway genetic duplication effects, essentially becoming self-assembling machines at very high rates. GHG solutions will involve capabilities including biology, synthetic biology, bio-engineering techniques which are enabled, developed and knit together with applications of digital technologies and machine learning bio-algorithms. This presentation will explore how that may occur.

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.



TUTORIALS

BEYOND BUSINESS ANALYTICS: THE SPECIAL CASE OF TECHNOLOGY MANAGEMENT

DATE: MONDAY, AUGUST 8
TIME: 16:00 - 17:30
ROOM: WEIDLER

Speaker: Dr. Eliezer Geisler, Distinguished Professor Emeritus, Illinois Institute of Technology, USA



This tutorial is designed to explore the impact of the notion of beyond business analytics on the field of technology management. The notion of Beyond Business Analytics is a complex concept which is composed of two complementary parts, one quantitative and the other cognitive. The first part is the quantity in the space of Analytics which includes

the description of the phenomenon or the notion. The second is the meaning of this quantity to the decision-maker. Analytics is thus the data, whereas beyond analytics is the meaning of the data to the decision maker. This meaning of the data is now extended to the field of technology management.

Decisions made in this field will benefit from beyond business analytics. For example, decisions such as “make or buy” technology will be made after an analysis by using the notion of beyond business analytics. The implications for the analysis of “Big Data” are discussed. Finally, the use of beyond business analytics is also analyzed by the benefits this notion offers the decision-maker.

Dr. Elie Geisler is Distinguished Professor Emeritus of Business at the Stuart School of Business of the Illinois Institute of Technology. He received his doctorate in organizational behavior from the Kellogg School of Business at Northwestern University. Dr. Geisler is the author of over 180 papers and presentations to learned societies, and 14 books in the areas of management and metrics of technology and innovation; management of medical technologies and knowledge management. His current research focuses on the genesis, progress, metrics and evolution of knowledge. He is also working on “Beyond Business Analytics,” a notion consisting of a theoretical space which he developed, between the data collection and analysis (analytics) and the

creation of meaning of such data to the decision-maker. He is the recipient of multiple awards, among them: The Medal of Excellence and the title of Fellow award given by PICMET; Honorary Member of the Society of the Advancement of Management of the American Management Association; Research assistantship award from NASA; Blue Key National Honor Fraternity Award; Meritorious Service Award of INFORMS; member of Beta Gamma Sigma Honor Society.

IMPROVE YOUR INNOVATION ODDS - SHARE AND EXPLORE INNOVATION PROCESSES WITH INTERNATIONAL PRACTITIONERS WHO ARE DEVELOPING ISO STANDARDS FOR INNOVATION

DATE: TUESDAY, AUGUST 9
TIME: 14:00 - 15:30
ROOM: ROSS ISLAND

Speaker: Irene Makar, Director, Dalcov Innoventures Ltd., Innovation Management Advisor, Certified Lead Auditor – ISO 56002 Innovation Management, Canada



Innovation is hard work at best, and managing essential components of innovation, such as IP, is even more of a challenge. Both public and private entities are increasingly concerned about the performance and cost effectiveness of research and development and related innovation investments. At the firm or institutional level, the critical

issues lie with understanding what factors can affect the “Effectiveness and Efficiency” of innovation activities. Everyone involved with innovation is looking for the magic formula.

This tutorial will engage attendees, share experiences, and help participants gain an understanding of a systems and component-approach to innovation. The discussion will also demonstrate the ISO approach to the developing international standards, and how such standardization can contribute to more effective innovation.

The tutorial will facilitate discussion about how participants are managing innovation today, the problems they confront in managing innovation, why innovation standards might be beneficial to them, and

TUTORIALS

how they can participate in the on-going innovation standards development process.

Irene C. Makar, MEd., MSc., MPhil, Innovation Consultant, Director, Dalcov Innoventures Ltd., Director McDougall & Second, Advisory Board EGAS MONIZ Portugal, Advisory Board International Association of Innovation Professionals (IAOIP). Her MOTO is “Never forget, most developed countries compete based on their firms. It’s imperative, that inventions get adopted and diffused, to create value.”

Irene Makar has 25+ years of experience as an executive and/or director in multiple sectors including start-up, ownership, investment, and commercialization from ideation to product concept, scale-up and market entry. Her work internationally in business, academia, and consulting includes expert advisory roles to the European Commission, ISO, the Canadian Government, academic and industry organizations. She has two advanced degrees in science, technology, and innovation (STI) policy from SPRU-UK. Combined with many years of business expertise, she has a full understanding of how innovation, especially process and product innovation, can be used to upgrade knowledge of individual firms and cumulatively the knowledge of the country in which they are domiciled.

THE 4CS: CLIMATE, COVID, CULTURE, CONVERGENCE

DATE: WEDNESDAY, AUGUST 10
TIME: 16:00 - 17:30
ROOM: WEIDLER

Speaker: Charu Nair, CEO, Keys 2DEI Consulting Group LLC, USA



In its purist form, “Technology” is the “art, skill, cunning of hand,” “the science of craft,” simply “applied science.” From a time in the 20th century the term has hardened into being connoted with industrial arts and techniques. Given the truly unprecedented convergence of the emerging technologies and the increasing and widespread

trepidation of people towards the real and perceived future effects, it is critical to revisit, better understand

and incorporate what we as a civilization know all about “culture” and how it manifests in human systems across the globe. Through case studies, interviews, literature review and other analysis, we uncover how a robust understanding of the “technology of culture” is core to us as technology managers and practitioners, so we can make ethical use of this understanding as an ally to our objectives particularly in the fraught oncoming spheres of the convergence of key emerging technologies. As climate surrounds us, Covid assails us, culture embeds us and convergence of emerging technologies threatens us we are peering onto a “convergence” at a new unprecedented level. In this Tutorial, the speaker will take a robust look at the vista of varying scenarios as to how these 4 Cs can intersect and how we, as Technology Managers, can best design for this.

Charu Nair brings three decades of insight and experience in the arenas of industry, education, community, and across private and public sectors, to her work. Whether providing leadership, strategy and diversity initiatives to the Fortune 500; launching the World Trade Center Portland with the executive team, working with almost 400 small to large businesses and leading a five-country trade mission; teaching original curricula as Marylhurst University faculty for a decade, or launching the first laptop in India, foresight is her key. She has made significant and core contributions to several boards over the years, bringing her critically innovative thinking and acclaimed work ethic to the service of each. These have included being a Commissioner of Human Rights in Multnomah County, Commissioner of Civil Rights for the Oregon Bureau of Labor and Industries, Board of Directors for the Urban League, and several other boards including education and all its intersections. Currently she serves as a Board of Trustees on the Oregon Historical Society, Society of Women Engineers, Fulbright Oregon, All Hands Raised among others. In October, her company curated a highly successful five-city equity summit spanning schools, cities and communities, that drew several hundred people to the inaugural launch. With three degrees spanning three countries and travels to 70 more, Ms. Nair’s work is uniquely informed by her significant hands-on local expertise, bridged with her wide-ranging worldwide acumen. Her book on this topic is upcoming.

PHD COLLOQUIUM

GETTING YOUR PHD... AND BEYOND

Critical Stages and Career Paths for the PhD Student

DATE: SUNDAY, AUGUST 7
TIME: 13:00-17:00 (COFFEE BREAK
AT 15:30)
ROOM: ADAMS/JEFFERSON
REGIST: \$40

CHAIR:

Dr. Nasir Sheikh, Visiting Scholar, ETM Dept., Portland State University; and Former Associate Professor, Chair, and PhD Program Director, Technology Management Department, University of Bridgeport, USA

SPEAKERS:

Dr. Charles Weber, Associate Professor, Engineering and Technology Management Department, Portland State University, USA

Dr. Jin Chen, Editor in Chief, *International Journal of Innovation and Technology Management (IJITM)* and Professor, Tsinghua University, China

Dr. Judith Estep, Chief Technology Innovation Officer, Bonneville Power Administration, USA

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



share experiences, and network with scholars from many countries. The invited speakers and the participants will share experiences in the following areas:

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

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

PANEL

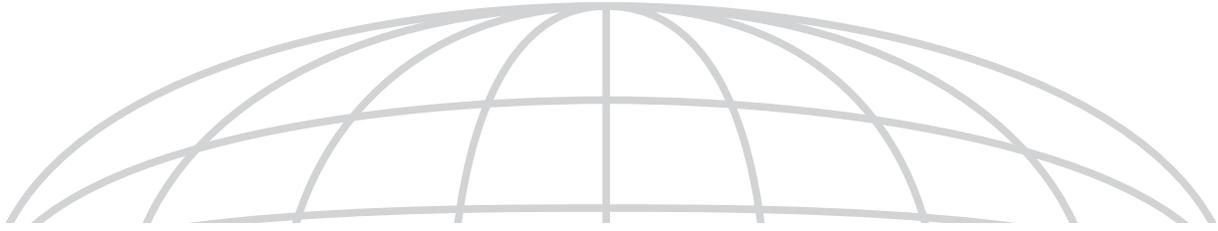
MEET THE EDITORS

DATE: TUESDAY, AUGUST 9
TIME: 16:00 – 17:30
ROOM: HOLLADAY

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.

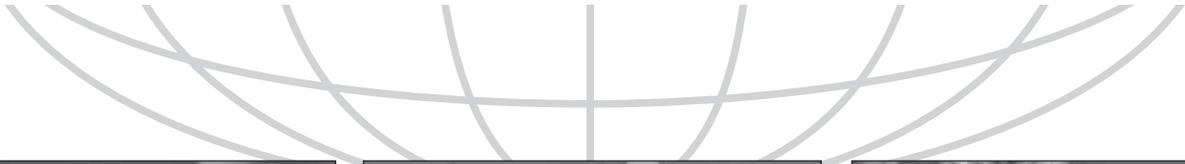


THE PICMET EXPERIENCE



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.*



SESSIONS

MA-01 PLENARY - 1

DATE: MONDAY, 8/8/2022
TIME: 08:30-10:00
ROOM: MULTNOMAH
CHAIR: TIMOTHY R ANDERSON; PORTLAND STATE UNIVERSITY

MA-01.1 [K] • Making Engineering Systems Safer and Smarter: Warnings of Cyberattacks and Artificial Intelligence

Marie-Elisabeth Paté-Cornell; Stanford University, United States

AI can address two aspects of the management of the risk of systems' failure: information processing and automatic decisions. In both cases, intelligent as it is, the system may need temporarily at least, human input in addition to what the computer-driven "robot" has learned so far or can access quickly enough. In the case of information, this occurs if new data are observed that cannot be interpreted automatically based on previous or accessible information. In the case of decisions, they may include preferences, risk attitudes or thresholds that reflect the will of the decision maker(s), especially when facing large uncertainties or large magnitudes of potential outcomes. In such cases, time permitting, one needs a hybrid system involving both an automatic "robot" and a human operator. Dr. Pate-Cornell will present several vignettes of such systems and then will focus on the example of the management of warnings of cyber-attacks for a specific system, and in that case, how one can learn about potential attackers and manage the penetration of a computer system by outside agents, with the goal of protecting its core.

MA-01.2 [K] • Innovation Management and Quest for a More Strategic Society

Mel Horwich; Central European University, United States

There is a worldwide need for a more strategic society, which, ideally, exhibits successful forethought and leveraging of knowledge in dealing with societal-scale challenges and promoting societal well-being. Also critical for a more strategic society is effective modern innovation management. This entails more than superior competencies in state-of-the-art technology. Modern innovation management is increasingly multi-faceted and interconnected. Constituent elements range from entrepreneurial venturing to corporate R&D, with actors often becoming parts of complex ecosystems. Especially important today in achieving a more strategic society is macro-innovation, which refers to involvement and partnering of diverse actors across multiple sectors, with government often playing a more prominent role due to increasing demands to mobilize vast resources. This stands in contrast to previous eras when distinct elements of innovation management captured attention (e.g., global R&D and high-tech entrepreneurialism). This deployment of a broad portfolio of innovation-management activities, therefore, constitutes a critical feature of a more strategic society as it confronts such looming challenges as AI, cities, competitiveness, sustainability, security, and health.

MB-01 Social Media-1

Monday, 8/8/2022, 10:30 - 12:00

Room: Multnomah

Chair(s) Sayaka Tokita; Hitotsubashi University/ Mejiro University

MB-01.1 [R] • Online Customer Review Platform Categorization to Identify Market Needs

Sanghyun Park; Seoul National University, Korea, South
Sungjoo Lee; Ajou University, Korea, South

Today's globalized business environment has made business demands more dynamic and complex than ever. Accordingly, companies have confirmed that customer demands emanate from online customer review platforms, whose importance they have recognized as being

important. There are many studies about extracting market needs from online customer review platforms. However, the research focuses on these processes and is limited to specific platforms. Limitations arise when diverse types of OCR platforms exist, due to processes being limited to a specific platform. Therefore, we categorized these platforms and tested the differences in their underlying market needs information with a quantitative approach. Part-of-speech tagging, named-entity recognition, and lexicon-based sentiment analysis were applied as methodologies. The academic contribution of this study is to suggest that an appropriate data source should be selected according to the market for extracting user review data. A practical contribution of this study is reduced waste of materials and human resources among companies through a basic stage of an optimized analysis process.

MB-01.2 [R] • A Study of Subscription Gifting as Donation on Twitch Social Live Streaming Service under COVID-19 Pandemic Situation

Hisayuki Kunigita; Japan Advanced Institute of Science and Technology, Japan
Yuuji Kohda; Japan Advanced Institute of Science and Technology, Japan

On social live streaming services such as Twitch, live broadcasting by digital game players, or streamers, has become more and more active, and the number of viewers has sharply increased since the spring of 2020 because of the COVID-19 pandemic. Twitch offers subscription gifting as a way for viewers to donate to streamers. A viewer purchases a subscription to a streamer's channel and gifts it to another viewer. The subscription fee is divided between Twitch and the streamer at a specific ratio. Subscription gifting increased sharply for each streamer in the spring of 2020 than before. This paper focuses on the increase in subscription gifting and provides a correlation analysis between subscription gifting and social density in the virtual world during the pandemic in the spring of 2020 using real Twitch data from TwitchTracker.com. We hypothesize that the increase in social density due to the sharp increase in the number of viewers during the pandemic has led to this significant increase in subscription gifting. We anticipate that the results of our analysis can contribute to the design of new services in the post-pandemic new normal with a better understanding of human behavior in emergency situations.

MB-01.3 [R] • Institutional Logics Shaping the Behavior of Actors in C2C Handmade Market

Sayaka Tokita; Hitotsubashi University/ Mejiro University, Japan

In recent years, with the development of ICT, the customer-to-consumer transaction market (C2C market), in which individual consumers sell their own creations to other consumers, has expanded. The emergence of an online platform that mediates transactions between consumers has given them personal trading opportunities. This paper focuses on this C2C market. The goal of this paper is to clarify the institutional logic that exists in the C2C market and shapes the behavior of actors. Interviews with people who are actors in C2C market reveal the existence of four institutional logics: hobby logic, communication logic, commercial logic, anti-profit logic. In particular, the anti-profit logic expresses the seller's aversion to making money from their creations. This institutional logic looks like a mismatch as the institutional logic that exists in the trading market for economic profit. In the way, some of these institutional logics in C2C market are formed by human emotional factors, unlike the rational rules that exist in the business-to-customer (B2C) market. Since both the seller and the buyer in the transaction are human individuals, the institutional logic of the C2C market they form is very complex.

MB-02 Information & Communications Technologies-1

Monday, 8/8/22, 10:30 - 12:00

Room: Holladay

Chair(s) Sergio M Borja; Seoul National University

MB-02.1 [R] • A Framework to Manage a Penetration of Digital Systems into Physical Society

Aki Tomita; Toyo University, Japan

SESSIONS

Today, Internet-connected computers are rapidly penetrated into our lives, making an intricately intertwined digital and physical economy. A digitalized economy should be equally regulated as the traditional physical one because digitalization does not mean being provided with special benefits. Thus, a behavior regulated in the physical world should be also regulated in the virtual world at the same level. However, realities are sometimes different because unseen behaviors of digital systems are difficult to be conscious before they are implemented and work. Thus, regulations tend to fall behind digital innovation. Due to ease of integration of multiple digital systems compared with physical ones, digitalization also causes unexpected side effects. To smoothly integrate a digital system into the traditional physical one without preventing unexpected side effects of digitalization, this paper proposes a framework to grasp behavior of a digital system without depending on physical presence. Also, this paper demonstrates effectiveness of the proposed framework by applying it to a permanent establishment (PE), which is a fundamental concept of the contemporary international tax system, and Facebook's Libra, which brings about integration of cross-border payment system and transfer of personal information.

MB-02.2 [R] • IT Governance Mechanisms, IT Governance Domains, and Their Influence on IT Governance Effectiveness: Empirical Analysis in Colombia

Sergio M Borja; Seoul National University, Korea, South
Younghwan Moon; Seoul National University, Korea, South
Hyenyoung Yoon; Seoul National University, Korea, South
Junseok Hwang; Seoul National University, Korea, South

The pervasive use of IT and its increasing management and governance complexity calls for a better attention about the topic of IT governance. Even though the topic is gaining more attention between practitioners and academics, there is a gap about what mechanisms improve IT governance effectiveness and how they are linked to IT governance domains. This study uses structural equation modelling to evaluate 215 valid surveys that were collected from members of the respective local chapters in Bogotá, Colombia of the following institutions: ISACA and PMI. In addition, members of the Colombian computer science engineers association, ACIS, also participate in answering our survey instrument. This study uses the variable ITG relevant knowledge to divide the dataset in two groups. The first group was labelled "High ITG relevant knowledge" and the second one "Low ITG relevant knowledge". In the first group processes are perceived as the most influential ones on ITG domains. In the second group were processes and relational mechanisms. In the first group, all IT governance domains influence IT governance effectiveness. In the second group, value delivery and resource management were not found as they influence IT governance effectiveness.

MB-02.3 [R] • Mechanisms That Influence IT Governance Effectiveness: Empirical Analysis in Private and Public Sector in Colombia

Sergio M Borja; Seoul National University, Korea, South
Keungoui Kim; Seoul National University, Korea, South
Hyenyoung Yoon; Seoul National University, Korea, South
Junseok Hwang; Seoul National University, Korea, South

The influence of information technology (IT) is visible everywhere. The evolution of IT encourages firms to have more concerns about the role that IT is playing for achieving strategic goals. Worldwide it is known that companies are making huge investments in IT acquisitions and also in how to govern its complexity. As a result, IT governance gains attention among organizations. This study reviews individual IT governance mechanisms and their influence on IT governance effectiveness. The study examines how IT intensity use by firms and IT governance experience influence IT governance effectiveness. The IT governance mechanisms selected were IT strategy committee, IT steering committee, involvement of senior management in IT, corporate performance measurement systems, ethics and culture of compliance, and corporate communication systems. This study uses structural equation modelling to evaluate 293 valid surveys collected from members of the ISACA and PMI in Bogota as well as the Colombian Association of Computer Science

Engineers (ACIS). This study found that corporate communication systems and IT strategy committee have a positive and significant influence on the overall IT governance effectiveness. In firms with less than 10 years of IT governance experience, the influence of IT strategy committee is higher.

MB-03 Project & Program Management-1

Monday, 8/8/22, 10:30 - 12:00

Room: Broadway

Chair(s) Antonie M de Klerk; University of Pretoria

MB-03.1 [A] • Risk Management in the South African Construction Industry

Zain U Abideen; University of Pretoria, South Africa
Antonie M de Klerk; University of Pretoria, South Africa

This descriptive study investigates the risks experienced in the South African construction industry, their probability of occurrence and the impact on project objectives. It also researches the risk management strategies employed and the degree to which they influence firms' performance. The study is based on a questionnaire survey of contractors and project risk managers from a purposely selected sample of 50 construction companies. The questionnaire was designed with four separate sections and tested for reliability. The results indicate that the ten most critical risks faced by the South African construction industry are the following: cash flow problems, effect of time and cost overrun, investment risks, inadequate resources and availability of funds, availability and exchange rate fluctuations, incomplete project closure, no extra-work control, special equipment and materials transshipment delays, inadequate and low-quality procurement of resources, and damage during construction due to negligence. Additionally, ensuring good quality of construction materials through an efficient supply chain, and formal training of construction workers are the strategies which significantly influence the firms' performance. The study also shows that project management, end-product fitness for purpose and reduction in supplier/contractors' defaults drastically improve if risk management strategies are properly implemented.

MB-03.2 [A] • Project Risk Management in a Major Southern Africa Mining Company

Riaan van Rooyen; University of Pretoria, South Africa
Antonie M de Klerk; University of Pretoria, South Africa

The management of risk is essential in engineering projects. This is especially the case in the mining industry where projects, as with other industrial projects, often contain substantial hidden risks and uncertainties that ultimately impact decision-making and project success. The mining industry is, however, seen as among the most complex, uncertain and hazardous industries, requiring careful risk management to ensure success. Within this industry, questions remain on what the typical risk management process, organizational adoption and maturity of risk management are. Barriers to risk management exist, which impact the extent of adoption and application of the risk management process across organizations and even across projects within an organization. A qualitative, theory-application, multi-case study research was performed, focusing on one company within the Southern African mining industry. The analysis of the results reveals that there is general agreement on the barriers to risk management and consensus on the relative importance of these barriers. The study concludes by identifying the most critical barriers to risk management within the company. This work contributes to the understanding of how project risk management is applied and can be used to identify and explore further mechanisms to overcome these barriers and improve overall project success.

MB-03.3 [A] • Risk Management in Construction Projects in the South African Mineral Processing Industry

Fundiswa Y Zitha; University of Pretoria, South Africa
Antonie M de Klerk; University of Pretoria, South Africa

Construction projects in mineral processing plants in South Africa have high failure rates

SESSIONS

despite the availability of many risk management processes, tools and practices to project managers. This industry application paper investigates the effectiveness of risk management in mineral processing projects. The mining and mineral processing industry is one of the world's most uncertain and hazardous industries and in recent years South Africa has experienced its fair share of economic, political and industrial challenges. Despite these challenges, a recent survey revealed that many African mining executives remain focused on the importance of securing new projects to ensure future production and growth. These new projects include new and complex technologies aimed at increasing productivity and efficiencies in the extraction and processing of minerals. South African mining industry risks unique to the region include knowledge and skills shortage, quality of education, prevalence of HIV/AIDS, power outages, political involvement and increased talks on nationalization, insufficient expenditure on R&D projects and increased unionisation. The effective management of risks is essential for project performance especially in this particular industry, due to significant investments required as well as the combination of both construction and mining/mineral processing risks involved. The study uses qualitative research methods to collect and analyse data from project management practitioners involved in construction projects in mineral processing plants. Operational, financial, legal and compliance, political and SHE risks are identified as major risks that need to be effectively managed to reduce project failure. The actions and behaviours of leaders and followers in projects are found to precipitate project failure. These include limited risk knowledge and competence, complacency and poor collaboration with team members. Risk management processes are also noted as a problem as they tend to be complex and impractical. Finally, the lack of comprehensive application of formal risk management along all the stages of the project life cycle is found to have a negative effect on risk management. The study recommends the development of a risk management culture, project team training and the reassessment of the effectiveness of currently used risk management tools in order to improve project success rate.

MB-04 Technology Management in Service Industry-1

Monday, 8/8/22, 10:30 - 12:00

Room: Weidler

Chair(s) Man Hang Yip; University of Cambridge

MB-04.1 [R] • Towards Molecular Representation: How to Depict Relationships within a System for Product-service System Design

Man Hang Yip; University of Cambridge, United Kingdom

The utility of classifying a product-service system (PSS) as a standard diagram that shows the relationship between its product and service portions was demonstrated in an earlier research to clarify design specifications. Ten configuration types were proposed, implying any new PSS could potentially be represented by one of these standard diagrams. From 2016 to 2019, the process of characterizing PSS ideas was tested in business setting across four industries. It was found that the process of building a PSS representation diagram, which was then used to identify its configuration type, was infeasible in business setting. Instead of one overall representation, multiple mini-representation diagrams for key relationships were adopted, which begged the question of how PSS configuration type could be identified. Moreover, the process of identifying PSS configuration type was largely subjective, which diminished the potential of using the configuration type of a PSS to inform development teams about key aspects of the development, such as stakeholder engagement requirements and contingent environmental conditions. This study examines the previously proposed configuration types in light of the usage of mini-representation diagrams. It proposes novel molecular representations that depict the core structures of PSSs. Future research trajectories following the molecular representation proposal conclude this paper.

MB-04.2 [R] • Smart Policing: Ethical Issues & Technology Management of Robocops

Sira Maliphol; SUNY Korea, Korea, South

Clovia Hamilton; Indiana University, United States

The killing of George Floyd in the United States has drawn attention to police brutality worldwide because it was caught on video. The frequency of incidents of police brutality has resulted in mutual distrust and fear between police and citizens. Repeated stories of police violence suggest policing needs a reimagined overhaul that addresses human rights. New ubiquitous technologies point to a need for greater smart policing research, development and technology management. Surveillance cameras and robotics are considered forms of smart policing. Robocops are currently out on patrol in many jurisdictions around the world. Smart technologies have the potential to improve policing and ethical outcomes through technological objectivity. Smart policing can potentially alleviate racial bias through technology management. Many reported incidents of police brutality in the United States involve traffic stops. While there is likely a need for traditional policing in cases such as rape and murder, violent—often fatal—incidents stemming from community policing interactions should be examined. This systemic review finds that there are few studies that address this gap. The “defund the police” movement in relation to minor crimes includes the reallocation of funds toward community services and community policing. This research focuses on how police funds can be better allocated toward social services, community policing and smart policing that results in much needed police reforms.

MB-04.3 [R] • Automation of Frontline Service Encounters: A Script Theory Perspective

Chau Nguyen; Hitotsubashi University, Japan

Technological developments have allowed more frontline service encounters to be automated, but there are still failed attempts, suggesting a gap between technology's ability and customer readiness. This paper discusses factors that affect the substitution of human employees by technology in the frontline from the perspective of script theory. Originating from cognitive psychology, script theory (Abelson, 1976; Schank & Abelson, 1977) states that human minds consist of structures that help make sense of situations and guide behaviors. Technological developments such as improving humanness illustrate attempts to mimic human-to-human interactions, i.e., try to get close to the traditional service scripts. However, customers may still reject these efforts if they cannot adjust their scripts to suit the new service style. Based on a literature review of script theory in the service context, propositions will be developed with the aim to include both technology and customers in the discussion of automated service encounters.

MB-05 Sustainability-1

Monday, 8/8/22, 10:30 - 12:00

Room: Morrison

Chair(s) Ronald Vatananan-Thesenvitz; Bangkok University

MB-05.1 [R] • Digital Leadership for Sustainable Community-based Tourism (CBT)

Murtaza Haider; College of Management, Mahidol University (CMMU), Thailand

Randall Shannon; College of Management, Mahidol University (CMMU), Thailand

Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

Smart tourism aims at the efficient use of resources, better experiences for tourists, and sustainable growth for the population and ecosystem of the destination. To be effective smart tourism may benefit from the use of ICT, mobile communication, cloud computing, artificial intelligence, and virtual reality. The advent of 5G, blockchain, and ultra-broadband will change the way of communication and thus how smart tourism can be achieved. This paper explores the reasons for developing local community leaders at Community-Based Tourism (CBT) destinations to be trained as digital leaders of their communities. An analysis of emerging technologies relevant to smart tourism is conducted in general, and for CBT in particular. An assessment of two locations in Thailand reveals how CBT has reshaped these tourist destinations. The results of the study outline the need to train local community leaders to become digital leaders of their communities, as a means to exploit new technologies for sustainable CBT.

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MB-05.2 [R] • Identification of Fields of Action for the Development of Ecologically Sustainable Products

Michael Riesener; RWTH Aachen University, Germany
Maximilian Kuhn; RWTH Aachen University, Germany
Christina Ruschitzka; RWTH Aachen University, Germany
Daniel Becker; RWTH Aachen University, Germany
Günther Schuh; RWTH Aachen University, Germany

Sustainability is becoming increasingly important, especially for manufacturing companies in the machinery and plant engineering industry. This industry has a particular responsibility as it can significantly influence the overall sustainable development due to its high resource consumption and CO₂ emissions. Companies are already addressing Corporate Social Responsibility or follow the Sustainable Development Goals. Despite such guidance, companies have difficulties in implementing comprehensive sustainability strategies. This is due to the insufficient operationalization of sustainability objectives for corporate functions such as product development. Moreover, there is a high manual effort for the evaluation of the product in terms of ecological measures using existing methods such as the life cycle assessment. In addition, the possibilities for influencing sustainability are not directly apparent. Therefore, this paper introduces a sustainability assessment for machinery and plant engineering products by focusing on ecological criteria in life cycle phases that product development can influence. Based on an assignment of the measured ecological criteria to the product structure, fields of action for the development of ecological improved products can be systematically identified. Sustainability goals are incorporated into the prioritization and evaluation of the fields of action in order to derive more sustainable solutions within product development.

MB-05.3 [A] • Investigating Corporate Firms' Awareness and Performance in Promoting Circular Economy in Taiwan's Recycling Industry

Sirirat Lim; National Chiao Tung University, Taiwan
Lamin K Sonko; National Chiao Tung University, Taiwan

In contemporary business practices, the concepts of circular economy entail the adoption of business models that allow companies to create value in their operations that adhere to environmental sustainability. Many firms understand the significance of environmental sustainability practices as evidenced by recycling processes; however, the practicality of circular economy initiative being a business strategy is yet to be holistically understood. This study addresses this gap by investigating how firms develop and incorporate circular economy initiatives into their operations and strategy. The study also identifies factors affecting circular economy initiative implementation in firms. The leading firm in the glass recycling industry in Taiwan, Spring Pool Glass, is chosen for this study because of its significant impact and contributions in the industry. Data were collected through in-depth interviews and secondary data. The study shows that in practice, firms may not fully implement the ideology of circular economy. While sustainable product development practices are highly adopted, stakeholder collaboration for sustainable innovation practices are less practiced. To embrace circular economy initiative and create value, it is vital for firms to overcome bottlenecks that could derail the full realization of the circular economy.

MB-06 R&D Management-1

Monday, 8/8/22, 10:30 - 12:00

Room: Ross Island

Chair(s) Hideki Hayashida; Tokyo University of Agriculture and Technology

MB-06.1 [R] • Organizational Capabilities for the Development of PSS in Business Ecosystems

Philipp Humbeck; University of Stuttgart, Germany
Jonas Rosenfelder; TRUMPF Werkzeugmaschinen GmbH+Co. KG, Germany
Thomas Bauernhansl; Fraunhofer IPA, Germany

Digitalization opens new possibilities for data acquisition and processing as a basis for

forward-looking business models in the mechanical engineering industry. Customer needs are increasingly being met by software solutions and competitors from outside the sector are trying to occupy the digital customer interface. Furthermore, margins in the traditional product business are decreasing due to the commoditization of hardware. Innovative business models are often based on integrated offerings that combine products and services into Product-Service-Systems (PSS). In order to realize these value propositions, companies from different industries and varying sizes form business ecosystems. This enables access to complementary competencies, new markets or a more efficient use of resources. This new form of value creation raises enormous challenges for the actors involved, as 28 qualitative semi-structured interviews and a comprehensive literature research have shown. The aim of this paper is to derive organizational capabilities required for the development of PSS in business ecosystems based on the identified fields of action. Twenty workshops were held with representatives from practice and theory. This work is intended to expand the state of the art in research and to provide managers with a framework for the future development of their organization or their business ecosystem.

MB-06.2 [R] • Business Ecosystem Management: A Model for the Governance, Auditing and Design of Business Ecosystems

Philipp Humbeck; University of Stuttgart, Germany
Heiko Loeffler; TRUMPF Werkzeugmaschinen GmbH + Co. KG, Germany
Thomas Bauernhansl; Fraunhofer IPA, Germany

Current trends such as the increasing commoditization of hardware and the growing generation of customer benefits through software-based services are forcing companies in the mechanical and plant engineering industry to develop innovative Smart Product-Service Systems (PSS) based on new business models. The associated increasing complexity requires the integration of new competencies and resources. This leads to a transformation of individually acting companies to inter-organizational business ecosystems. However, since traditional product-oriented companies in the mechanical and plant engineering industry do not have enough awareness or knowledge about the management of business ecosystems, a management model is required. The goal of this paper is to design a model for the management of business ecosystems within the development of Smart PSS. For this purpose, a comprehensive literature review was conducted in which existing approaches were identified. Subsequently, these were evaluated according to defined criteria and the necessary components were derived, as the basis for the created model. The model should enable orchestrating companies to design, audit and govern the business ecosystem with the help of three modules. The model contains methods for practical application and considers the different characteristics of a business ecosystem over its life cycle.

MB-06.3 [A] • Novel Dynamical Validation Method for the R&D Project Status Visualization: Collaboration with Text Mining and Physics Model

Hideki Hayashida; Tokyo University of Agriculture and Technology, Japan
Hiroki Funashima; Kyushu University, Japan

In this study, a means of clarifying the current state of a research and development (R&D) project was developed by visualization using a magneto-physics model simulation. Similar previous studies on R&D projects have involved either quantitative or qualitative approaches, but combined approaches have not been investigated sufficiently. In this study, the state of an R&D project was considered to be the summation of correlated interactions among various factors. The modified Ising model was used as the magneto-physics model and was applied as the dynamic innovation phase status model to analyze the interactions in the R&D project. The model consists of both quantitative and qualitative components. Although it was previously shown that a project can be analyzed and visualized by combining quantitative and qualitative aspects, the qualitative part was not discussed in sufficient detail. The qualitative elements were the focus of the present research, where qualitative analysis was performed by text mining and was found to be effective. It is likely that these new findings based on quantitative data analysis by text mining can be incorporated into the conventional R&D project evaluation method.

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MB-06.4 [R] • What Are Critical Success Factors for the Winning at New Products?

Jiawei Gao; Hitotsubashi University, Japan

Yuichi Washida; Hitotsubashi University, Japan

Xiuyan Ma; Zhejiang University of Technology, China

Companies have been increasingly opting to utilize project teams to contend with highly turbulent and dynamic conditions while under current uncertainty markets, and stakeholders have tremendous influences on the performance of R&D projects. For example, as a key internal stakeholder, the top manager's decisions including budget, personnel et al. could be vital for a R&D project team. The different interests among different internal and external stakeholders make the problem more complex. In this paper, we utilize the neural network algorithm to simulate the decisions from the top manager. With the data from non-industrial robotic R&D project teams in Japan, a neural network model of the top manager is constructed. Afterwards we design role-play card games to reconstruct the R&D processes of project teams. Two types of cards, stakeholder card and technology card, are randomly allocated to the participants. Participants then decide their R&D strategies and the strategies are evaluated by the neural network model. From the role-play card game simulation, we find that there are some factors which are critical for the success of the R&D project team.

MB-07 Technology Management in the Energy Sector

Monday, 8/8/22, 10:30 - 12:00

Room: Sellwood

Chair(s) Charles M Weber; Portland State University

MB-07.1 [R] • An Analysis on Impacts of Small-scale Hydropower Plants Utilizing Water Supply System: Potential Socioeconomic Impacts on the Local Community

Yaeko Mitsumori; Osaka University, Japan

As a source of renewable energy, hydropower has a history of over 100 years in Japan and has played a key role in Japan's modernization and economic development as 100 percent domestically produced energy. However, most of the economically viable sites for hydropower generation in Japan have already been completely developed. In addition, large hydropower development grows increasingly difficult these days, as people become aware that large-scale development leads to issues such as environmental destruction and the loss of history and culture. Japanese people are having a new look at small hydropower as a source of renewable energy. Small hydropower plants have supplied electricity at the local level for many years, utilize local water resources, and do not require the construction of large-scale dams. This study focused on small hydropower plants utilizing water supply system. The Japanese government recently conducted a survey and found many potential sites for small hydropower plants based on water supply systems. This study analyzed how small hydropower plants utilizing water supply system could contribute to increasing renewable energy utilization in Japan and examined potential socioeconomic impacts on the local community.

MB-07.2 [R] • The Democratization of Energy through Neighborhood Microgrids

Laurence W Corbett; Portland State University, United States

Charles Weber; Portland State University, United States

Tim Anderson; Portland State University, United States

The concept of a microgrid is a relatively recent development and has been applied to high resource facilities with continuous power requirements. The use of microgrids to maintain an electric power supply during adverse events for a neighborhood is novel. This paper outlines some of the considerations for such an undertaking and presents a few techniques which may be useful to produce a successful implementation of a neighborhood microgrid. Putting power generation in the hands of individual households would serve to democratize the energy industry and improve the resilience of the power grid.

MB-07.3 [A] • Study of Distributed Generation Systems that Supplies

Electrical Energy to Distribution Networks

Ana Cecilia C Moreno Alamo; Pontificia Universidad Católica del Perú, Peru

Eduardo Raúl del Rosario Quinteros; Pontificia Universidad Católica del Perú, Peru

Carlos Guillermo Hernández Cenzano; Pontificia Universidad Católica del Perú, Peru

A literature review of current distributed generation technologies, to supply electrical energy to the distribution networks, is performed. Likewise, the operation and behavior of a distributed generator interconnected with the substation, supplying electrical energy to a distribution network, are evaluated. The generation of electrical energy is crucial in the socio-economic development of a nation. Currently, the demand for electric power is growing along with concerns related to environmental issues arising from the installation and use of energy. In an energy market context, for economic reasons and population growth in Peruvian urban areas, electrical power systems (EPS) are increasingly exposed to incremental stress resulting in they are operating closer to their stability limits, increasing the risk of contingencies in the EPSs. In this scenario, the distributed generation (DG) appears to counteract the great environmental impact generated by the large conventional hydroelectric or thermoelectric plants. In Peru, this alternative allows to meet the needs of electricity generation in small urban centers, also contributing in this way with the decentralization of the Peruvian National Interconnected Electrical System (PNIES). The PNIES supplies electricity mainly to the most populated areas of the country. The supply of electrical energy to less populated areas is done through isolated systems (IS) which are not interconnected to PNIES. These systems are not monitored or regulated by the Peruvian National Interconnected Electrical System operations committee, so they do not have a formal mechanism for monitoring and controlling voltage limits, power limits supplied, stability limits, etc. This implies these isolated systems are insecure for operators and the surrounding environment, they are unreliable systems and susceptible to failures that could cause interruptions in the energy supply. On the other hand, these isolated systems are operated in a significant percentage by diesel, toxic and nonrenewable resources. The operation and behavior of a distributed generator interconnected with the substation, both supplying electrical energy to a distribution network are evaluated. This distributed generator is of the rotary type, used in small-hydro. Finally, the voltage profile of the system in a permanent regime is analyzed in several operation points of the distribution network, and different load scenarios. Furthermore, the variations in the distributed generator frequency will be analyzed in several load scenarios. Analysis was carried out in Matlab and Simulink environment which allow simulating electrical power systems.

MD-01 Technology Management Framework

Monday, 8/8/2022, 14:00 - 15:30

Room: Multnomah

Chair(s) Joe Amadi-Echendu; University of Pretoria

MD-01.1 [R] • Application of Smart Concepts for Sustainable Development Goals (SDGs)

Hiroshi Suzuki; Meta-Engineering Research Institute, Japan

Smart is an important concept to realize a smart city, smart community, smart grid, etc. The author applied the meta-engineering concept and defined "smart" as an integrated product of hardware and software. To optimize this smart, the software scale should be three times that of hardware. Recently, Sustainable Development Goals (SDGs), also known as Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet's environment, and ensure that all people enjoy peace and prosperity by 2030. The 17 SDGs are integrated: they recognize that action in one area will affect outcomes in others, and that development must balance social, economic, and environmental sustainability. The author proposes application of the "smart" concept to achieve SDGs. The evaluation methodology of smart is done by smile: a portmanteau of smart and -ile. It can assess areas as agile, mobile, juvenile, flexible, etc. By monitoring the volume of smile provided by smart SDGs, one can evaluate the provided smart capabilities. The author explains two examples: on-demand buses and smart grid.

MD-01.2 [R] • Data Mining Methods to Support C2M Product-service

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Systems Design and Recommendation System Based on User Value

Tzu-Chein Wang; National Taiwan University, Taiwan

Ruey-Shan Guo; National Taiwan University, Taiwan

Chialin Chen; National Taiwan University, Taiwan

In recent years, with the impact of COVID-19 epidemic, Taiwan's food manufacturing industry needs digital transformation. Faced with such a dynamic enterprise environment, the construction of an accurate R&D system becomes very important and urgent. By discussing the market analysis methods and the design of research and development process in literatures, this study further used a combination of natural semantic analysis technology and QFD method to build an integrated model, so as to help food processing companies understand the consumer demand and some issues in product research and development in the terminal market. Proof of Concept (POC) showed that, first, the marketing supervisor or R&D supervisor accurately evaluate the consumer needs of online users on the e-commerce platform, successfully develop products that consumers are satisfied with, and strengthen R&D decisions; second, by analyzing the characteristics of consumer demand through machine learning model, aspects of demands that consumers care about the most could further help to formulate product improvement strategies with application value, which would be extremely helpful to the methodology research of incremental innovation; and third, an integrated model of market and R&D analysis would effectively assist the food industry to develop products on the spot to be successfully delivered to the Amazon platform, in which this methodology could be applied in the entire food manufacturing industry.

MD-01.3 [R] • On Leadership for Sustainable Management of Mobile Telecommunications Systems

Mugisha Philip Bisanda; University of Pretoria, Tanzania

Joe Amadi-Echendu; University of Pretoria, South Africa

The sustainability of technological systems, such as cellular mobile telecommunications networks, is paramount in the current era of Society 5.0 as propelled by fourth industrial revolution technologies. Mobile telecommunications systems pervade all aspects of human endeavor in the sense that they not only facilitate hyper interconnectivity and inter-communicability between individuals but also, telecommunications systems encourage high levels of interdependency between all actors, agents, and man-made elements utilized by society for governance, commerce, and industry. In conjunction with the imperatives of the sustainability paradigm, issues such as rapidly evolving technologies, increasing regulatory concerns, complex business relations and vagarious consumer expectations present serious challenges for the management of mobile telecommunications systems. This paper discusses an empirical examination of the role of leadership as part of an on-going study of sustainable management of mobile telecommunications systems.

MD-01.4 [R] • The 30 Years' Transitions of PICMET Conferences

Shino Iwami; NEC Corporation, Japan

Nobuhiko Sarukura; Osaka University, Japan

People in technology management and industrial engineering learned the mechanism of innovations based on the established theories. We have devised products that will be disruptive innovations, triggered them with open innovation, and aimed at products and services that can win in the market. Meanwhile, in the last 30 years, computer science has been generalized, new technologies such as artificial intelligence have been applied to new products and services, and China and India are growing as emerging players. Don't you feel the gap between textbooks, which let us overview the domain, and studies in the international conferences? We, researchers in technology management, capture the overview with the current topics and indicate new frontiers to business persons.

MD-02 Enterprise Management

Monday, 8/8/2022, 14:00 - 15:30

Room: Holladay

Chair(s) Yuichi Washida; Hitotsubashi University

MD-02.1 [R] • Application of Digital Technology in TQM Business Processes

Chantelle Khwela; University of Johannesburg, South Africa

Arnesh Telukdarie; University of Johannesburg, South Africa

Total Quality Management (TQM) has become global practice in various industries. Recent developments in manufacturing advancement have led to organizations systematically implementing digitization to optimize and improve on their processes to meet customer demand. The research approach includes a framework constituting over all TQM business process integration, process inputs and outputs, engaging from ERP configuration system through to manufacturing systems and that supports functional departments. This research study aims to enhance the business function challenges within the overall organization, incorporating the functional departments and its sub-functions. The proposed results indicated that processes that are interdependent can be configured with effect of variation in reducing processing times within business processes.

MD-02.2 [A] • Methodology for Governance and Management of Enterprise Architectures

Jorge E Barrera Niño; National University of Colombia, Colombia

Sergio M Borja; Seoul National University, Korea, South

Modernity requires organizations to be alert to survival all the time. This means permanent reinvention in terms of products, processes and assets to improve their efficiency, their risk management, their ability to generate value for their customers and for discovering new opportunities. For this, it is necessary to adopt and adapt the digital transformation approach in the architectures of business, data, applications and technological infrastructure. The objective of digital transformation with its different and dynamic architectural modalities such as cloud computing and mobile computing is integrating digital technology with all areas of a company's work by fundamentally changing its way of operating to provide greater value to its customers. To be capable of permanent innovations during and after the Covid-19 pandemic and its massive disruptions, companies need to know themselves effectively in real time; this is only possible through the application of the best governance and management practices of enterprise architectures, within an adequate methodological framework which avoids the risks of technological bias in IT projects. There also has to be an adequate balance of resources between conventional daily operations and the digital transformation projects. The EAM ® or enterprise architectures methodology meets this requirement with an optimal benefit-cost ratio.

MD-02.3 [R] • An Analysis of the Bangladesh Pharmaceutical Industry after Graduation from the Least Developed Country Status

Yaeko Mitsumori; Osaka University, Japan

Hiroshi Kubo; Chiba Institute of Technology, Japan

Due to enforcement of the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), all of the WTO members were required to introduce a TRIPS-compatible patent law (including product patents) in their countries. However, TRIPS granted a grace period to LDCs, including Bangladesh. According to the current scheme, Bangladesh will be exempted from introducing product patents until 2033 due to the TRIPS special treatment of LDCs. Bangladesh has a strong pharmaceutical industry and domestic pharmaceutical companies occupy the majority of its pharmaceutical market, which is unusual for an LDC. This study will analyze what impact the TRIPS special treatment of LDCs will impose on Bangladesh's pharmaceutical industry. Due to the special TRIPS exemption, Bangladesh's pharmaceutical companies are allowed to copy brand-name drugs whose patents are protected in other countries and are allowed to sell these copied drugs in both domestic and overseas markets. Bangladesh's pharmaceutical industry has been enjoying healthy growth over the past three decades; however, it is facing challenges. First, the technology level of most of Bangladesh's pharmaceutical companies is not very high. Only a few Bangladesh firms can export their products to regulated markets. The other more serious issue is that since Bangladesh's economy has been developing so rapidly over the past decades, Bangladesh has cleared the test for graduating from LDC status. Based on quantitative and qualitative analysis, this study will first observe the current status of Bangladesh's pharmaceutical industry and analyze the

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impact of graduation from LDC status on Bangladesh's pharmaceutical industry.

MD-02.4 [R] • Formulation and Verification of Standard Key Performance Indicators for Design Department

Rui Mao; Hitotsubashi University, China

Yuichi Washida; Hitotsubashi University, Japan

Such as the discussion on the impact of dominant design on innovative performance and the introduction of Design Driven Innovation, there has been wide recognition that design plays a strategically crucial role in boosting a firm's competitiveness, which has been changing and evolving beyond traditional roles. In spite of this trend, it was pointed out that the potential of design resources including in-house designers are not sufficiently utilized in Japanese enterprises generally. It is reasonable to assume that this issue stemmed from the visualization of design values. Therefore, this study aims to develop and verify standard key performance indicators that can quantitatively evaluate the activities and outcomes of in-house design teams, which contributes to the effective utilization of design resources. During the study, 465 managers from four large Japanese enterprises responded to a survey by multisource assessment on in-house designer teams' performance. The results of principal component analysis reveal that there are five factors which are product development capabilities, provision of information, brand consistency, output speed and cost contributing to the evaluation of design department performance. Moreover, multiple regression analysis also indicates that the emphasis on KPI for design departments differs between each enterprise.

MD-03 Project & Program Management-2

Monday, 8/8/2022, 14:00 - 15:30

Room: Broadway

Chair(s) Antonie M de Klerk; University of Pretoria

MD-03.1 [R] • Project Success and Project Manager Competency

Suzaan Pretorius; University of Pretoria, South Africa

Herman Steyn; University of Pretoria, South Africa

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

J. Jordaan; University of Pretoria, South Africa

An increased interest in project management over the last decade resulted in a greater adoption of international standards, increased academic research, and in training on project management concepts. However, studies continue to show lower than satisfactory project success rates. The aim of this paper is to determine the current levels of project success in Africa, as well as the extent that project manager competency influences project success. Six hundred survey responses, reporting on 9,389 projects executed in various Southern African countries, were analyzed statistically. The results indicate a success rate of 70 percent and suggest that organizations with more competent project managers produce more successful projects. The article bridges the current gap between theoretical insights into this topic and the managerial reality in Africa today. It also stresses the need for investment in training and development of project managers in Africa.

MD-03.2 [R] • The Role of Emotional Intelligence in Agile Project Management

Lily Fitzpatrick; PSU, United States

This paper is one skeptical look at the role of emotional intelligence in project success and whether emotional intelligence can be measured. The emotional intelligence framework defined by Daniel Goleman and behavioral neuroscience is the base of the analysis. One study shows the self-assessment measurement of emotional intelligence. Three studies show patterns and correlation of emotional intelligence "people-factors" to the success of agile projects. The "accidental technical project managers" practitioners may find interesting areas and opportunities for better practices to enhance their emotional intelligence to become more resilient and compassionate, especially in the challenging pandemic times.

MD-04 New Product Development-1

Monday, 8/8/2022, 14:00 - 15:30

Room: Weidler

Chair(s) Lennart Hildebrandt; Helmut-Schmidt-University

MD-04.1 [R] • Integrating Internet of Things and Adaptive Neuro Fuzzy Inference System for New Product Demand Forecasting in Electronics Manufacturing

S.M. Li; The Hong Kong Polytechnic University, Hong Kong

F.T.S. Chan; Macau University of Science and Technology, Macao

P. Tsang; Pacific Business Machine Limited, Hong Kong

Under the fiercely competitive business environment, launching new products with optimal profitability and responsive production management is becoming more difficult and challenging than in the past. In addition, product life cycles have now become shorter since customers' purchasing behavior has changed in regard to electronics devices and appliances. This leads to higher uncertainties in the new product development (NPD) process in the electronics manufacturing industry, resulting in inappropriate budgeting and production planning for new products. To address the above concerns, demand forecasting is a key approach for understanding the market potential and sales performance for NPD in electronics manufacturing. In this study, an intelligent new products demand forecasting model (INPDFM), which integrates Internet of Things (IoT) and Adaptive Neuro Fuzzy Inference System (ANFIS), is used to formulate new product demand forecasting (NPDF). The manufacturing process parameters are collected by means of IoT technology, and, together with the product information, a set of input parameters can be determined for the deployment of ANFIS. Subsequently, the Sugeno-type fuzzy inference system can be used to formulate the demand forecasting functionality using a set of training data, in which comparative analysis of the forecasting results is then conducted for evaluating forecasting errors. Consequently, the practicality and adaptability of demand forecasting in the NPD process can be enhanced, and smart manufacturing can be achieved.

MD-04.3 [R] • Open Source Hardware and Decentralized Urban Production for Urgently Needed Products During the COVID-19 Pandemic

Lennart Hildebrandt; Helmut-Schmidt-University, Germany

Manuel Moritz; Helmut-Schmidt-University, Germany

Tobias Redlich; Helmut-Schmidt-University, Germany

Jens P. Wulfsberg; Helmut-Schmidt-University, Germany

The COVID-19 pandemic has highlighted the importance of a local, resource-efficient and open(-source) production infrastructure for the rapid manufacturing of urgently needed products. Decentralized, networked and open production sites (Fab Lab, Makerspace) in urban areas, equipped with modern, low-threshold digital production technology, have been collaboratively used during the pandemic by the civil society to produce personal protective equipment (PPE). A key element for this resilient production and local improvement of the supply situation was open-source hardware, whose product data were collaboratively developed and shared around the globe and could therefore subsequently be manufactured, modified and sold in conjunction with Fab Labs and Makerspaces. The authors have also developed a face shield based on an open-source design, adapted it and provided it for the local market. In this paper, we show in a holistic single case study not only the development and production of the face shields, but also the future relevance of an open(-source) production infrastructure and a production planning and control system (PPC) in case of crises or local need in which new participatory value creation patterns result in innovative products.

MD-04.4 [A] • Design Thinking Framework for the Development of Innovative Product-Service-Systems in Patient Physical Rehabilitation

Jeff Hamilton; Faculty of Engineering, Mahidol University, Thailand

Ronald Vatananan-Theservitz; Bangkok University, Thailand

Tanmoy Kumar Das; Asian Institute of Technology (AIT), Thailand

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Arunya P Senadeera; Asian Institute of Technology (AIT), Thailand

Innovation is a crucial catalyst for a patient's self-sufficiency during their rehabilitation process. The project outlined in this paper aims to create better patient outcomes through effective home-based care with a predominately self-managed physical rehabilitation system by developing innovative product-service systems (PSS). Innovative PSS improves patient outcomes and benefits doctors, hospitals, and the overall productivity of a nation's healthcare system. Furthermore, adopting such PSS enhances the cooperation among patients and healthcare professionals (HCPs) by creating better access and availability. In addition, the PSS effectively enhances the patients' recovery process and overall hospital operations, making access to healthcare more convenient and affordable. This paper reports on an ongoing research project in Bangkok, Thailand that assesses the current systems and analyzes how new technologies, products, and services can upgrade existing physical rehabilitation systems and approaches. The researchers used desk research, field research, and in-depth interviews of patients and stakeholders to identify issues in the current system to develop and then test minimum viable products (MVP) and their essential functions to deliver a satisfying and robust end product.

MD-06 Decision Making-1

Monday, 8/8/2022, 14:00 - 15:30

Room: Ross Island

Chair(s) Mike Freiling; Conceptrics AG

MD-06.1 [A] • Multiperspective Assessment of Enterprise Data Storage

Systems: Literature Review

Luja Shrestha; University of Bridgeport, United States

Nasir J Sheikh; Portland State University, United States

Data-driven strategies powered by big data and analytics will become an increasingly important point of competitive differentiation. Such approaches rely on the storage of a massive amount of data accumulated over time. Besides computing and the network, data storage is a critical component of information technology (IT) infrastructure. Assessment of enterprise data storage systems (EDSS) for selecting the one that provides a comprehensive solution requires not only the consideration of technical performance and economic feasibility but also other perspectives such as strategic, operational, and regulatory. As an initial phase of developing a framework for the assessment and selection of storage solutions such as storage area networks (SAN), network-attached storage (NAS), and purpose-built backup appliance (PBBA), we completed a literature review. The purpose was to gain an understanding of the emerging technologies, their use cases, and market trends. Gaps were analyzed in the literature to formulate multiperspective assessment criteria. The results presented can be used for building a comprehensive decision model for the selection of enterprise data storage systems.

MD-06.2 [R] • Technical, Organizational, and Process Impacts of Business Intelligence Implementation Failure

Randy A Williams; University of Bridgeport, United States

Nasir J Sheikh; Portland State University, United States

Business intelligence (BI) software applications enable rapid decision making in an environment of vastly expanding amounts of data and constantly evolving market dynamics. However, literature suggests that about 70 percent of BI implementation efforts fail to deliver productive outcomes for the decision makers. For a comprehensive assessment of BI implementation failures, this research considers three perspectives: technical, organizational, and process (TOP) and the significant criteria that comprise them. These represent failures as well the absence of success factors. A literature review was performed to determine the criteria that are the elements of the TOP perspectives. A taxonomy of perspectives, criteria, and sub-criteria was developed representing the TOP impacts of BI implementation failures. It included detailed definitions of each element. This is a critical stage in building a decision model for the assessment of successful types of BI implementations.

MD-06.3 [R] • Re-envisioning the Corporation as an Embedded Community

Maoloud Y Dabab; Portland State University, United States

Mike Freiling; Conceptrics AG, United States

Daniel Sagalowicz; Portland State University, United States

The traditional approach of viewing a corporation as a stand-alone entity operating on its own terms is no longer valid or viable. Changing circumstances force us to re-envision the corporation as an embedded community, operating in harmony with other communities and even eco-systems, and especially with itself. The character of decision-making changes radically in this view, as previous notions of individual discrete decisions, criteria, influence, and authority become broader and more diffuse. Notions of making optimal single decisions must give way to an emphasis on win-win relationships over time. In this paper, we discuss the forces that motivate this re-envisioning of the corporation and articulate an Embedded Community Model that provides guidance in meeting the challenges required to be successful in this new environment. We discuss how this framework helps to explain the successes as well as the failures experienced in securing support for COVID-19 vaccination. Applications to technology planning and decision making are also discussed.

MD-07 Collaborations-1

Monday, 8/8/2022, 14:00 - 15:30

Room: Sellwood

Chair(s) Nathasit Gedsri; Mahidol University

MD-07.1 [R] • Systematic Approach Driving toward Effective University-Industry Collaboration (UIC)

Nisit Manotungvorapun; Mahidol University, Thailand

Nathasit Gedsri; Mahidol University, Thailand

Universities are widely perceived as a source of state-of-the-art scientific knowledge and firms opt to work with them to advance their competitive advantages in innovation development. However, collaborations often meet unproductive performance and unsmooth interactions due to gaps in research capability, goals, and working protocols. To reduce the risks of deterioration in collaboration, executives need to foresee possible gaps in advance so that relevant solutions can be planned. This paper introduces the 3-phase analytical approach to manage the university-industry collaboration (UIC). The first phase involves assessing the matching quality of university partners. Next, the assessment result is diagnosed to detect the matching quality gaps. Then, the third phase applies the assessment results to 1.) position university partners into the proper mode of collaboration; Orchestrated collaboration, Assistive collaboration, Attentive collaboration and Mismatched collaboration, according to their complementarities and compatibilities and 2.) craft a strategic roadmap guiding the relationship development toward effective UIC with selected partners. This 3-phase approach helps managers realize possible difficulties and systematically prepare solutions in advance.

MD-07.2 [R] • Mars Terraforming: A New Plan for the Red Planet

Nonthapat Pulsiri; IKI-SEA, Bangkok University, Thailand

Damani Proctor; Space and Universe, Myanmar

Richard B Cathcart; GEOGRAPHOS, United States

Jorge O Buteler; Space and Universe, Myanmar

In the space frontier, space community aims to build Mars habitat. However, Martian atmosphere is toxic to human being with approximately 95 percent of carbon dioxide. In addition, its atmosphere is very thin and there are no trees as on the Earth. Therefore, it is essential to develop and manage an atmosphere on Mars to sustainably live there. In this paper, a new human 5-phased plan for terraforming Mars is proposed: 1) moon stabilization 2) planetary shield 3) carbon harvesting 4) atmospheric conversion and 5) human-focused habitability. The essential plan requires creating an artificial Van Allen belt and the formation of an anthropogenic atmosphere on this Red Planet. Moon stabilization of Phobos and Deimos orbits provides the constant rotating mass to support the terraforming macro-project proposed. Also, the project applies Paleo reactors to power a series of HAARP arrays placed on the modified surfaces of Phobos and Deimos. Therefore, the generating field will

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thicken up Mars atmosphere and affect the amplified weather mass fronts. Low-cost carbon splitters will be applied to pull off carbon from the Martian atmosphere to be stored as fuel for grounded settlements. Moreover, faux trees will support conversion of Martian aerial gases into a breathable medium ("air"). Finally, Mars habitat is complete with soil and natural tree plantations.

MD-07.3 [A] • Firm Collaboration for Innovation in Brazil: An Analysis Based on the Brazilian Innovation Surveys

Caroline G Araújo; Universidade Estadual de Campinas, Brazil
Rosângela Ballini; Universidade Estadual de Campinas, Brazil
Ruy Quadros; Universidade Estadual de Campinas, Brazil

In the past two decades, there has been a growing literature on open innovation and global value chains in Brazil. However, most of them are based on case studies or sectoral surveys. At the level of the population of innovative firms located in Brazil, little is known about the features of firm collaboration for innovation, particularly international collaboration. What are the characteristics or patterns of global innovation networks operating in Brazil, regarding the type of partner and object of collaboration? Is international collaboration relevant to Brazilian innovation? This paper addresses such a gap, by exploring data of the Brazilian Innovation Survey (PINTEC) editions of 2014. Besides, the paper uses bibliometric analysis to comprehend and link themes related to open innovation, collaboration to innovation, global innovation network and/or global value chain, and innovation surveys. This methodology is a way to address the discussion and the relevant variable to analyze patterns of collaboration from a sectoral perspective in Brazil.

ME-01 Innovation Management-1

Monday, 8/8/2022, 16:00 - 17:30

Room: Multnomah

Chair(s) Kaori Shinozaki; Jissen Women's University

ME-01.1 [A] • An Assessment of Patent Scoring Using Natural Language Programming

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

Patent has been an increasingly important role in the world because it is not only significant to protect the invention of the company's business but also to generate revenue from the commercialization. WIPO (2018) reports that the repository has many patents so, to assess patent, it consumes time and requires various expertise. Generally, several models have been developed to address this matter, which assess using a questionnaire tool for portfolios by human. Perhaps, there is not precise because it is assessed based on personal bias or previous experience of expertise. So that, occurs bias any limitation exists that our research will address by artificial intelligence. Thus, this research applies a Natural Language Programming to assess for commercial of the patent. Then, the obtained data is used to assigned factors and calculate the model for assessing the commercialization of patent. This finding should deliver an alternative effective patent assessment, which is a tool that addresses some current deficiency in patent assessment for commercialization.

ME-01.2 [R] • How Acquisitions Change Organizational Structures, Product Portfolio, and Market Positions: Findings from a Case of a Japanese Monitor Manufacturer

Kaori Shinozaki; Jissen Women's University, Japan
Akiya Nagata; Kyusyu University, Japan

This study applies the product architecture positioning perspective to the case of a Japanese visual technology company which made a series of acquisitions to shed some light on how effective management of the acquired resources may be realized. We describe the processes of internalization of the acquisition targets and expansion of the product architecture, examine

the different organizational structures used, and discuss how the concurrent changes in the product architecture and organizational design have contributed to profitability in the new business field. Acquisitions are shown to enable firms to change the product architecture from open modular to closed modular, by exploiting the acquirer's and target's resources when they are complementary.

ME-01.3 [R] • Transforming Innovation Management: Implications of Digitalization for the Organization and Management of Innovation in Leading Brazilian Incumbents

Ruy Quadros; UNICAMP - State University of Campinas, Brazil
Glicia Vieira; UFES - Federal University of Espirito Santo, Brazil
Matheus Franco; Universidade Estadual de Campinas/ UNICAMP, Brazil
Carla Kitsuta; Universidade Estadual de Campinas/ UNICAMP, Brazil
Vinicius Minatogawa; Pontificia Universidad Catolica de Valparaiso, Chile

The digitalization of businesses is a pervasive tide of innovation whose challenges the literature increasingly addresses. Nevertheless, management research has given much less attention to the implications of digital transformation (DT) for the innovation process and its management. This paper aims to contribute to the debate by exploring the implications of DT for the organization and management of innovation in five leading, innovative Brazilian incumbents. In-depth multiple case studies have been carried out in 2020/21 to produce empirical data on the diffusion of DT and how it has affected innovation strategy, organization, and management practices. Our findings suggest that innovative incumbent firms face a considerable challenge. Competition in their markets continues to require proprietary solutions, technologies, products, and processes as the basis of the current or new business models. So, they must perform both business model innovation and product/service innovation under the diffusion of digitalization. However, the attainment of each of these innovation goals is attributed to distinctive organizational units, which seldom are organically integrated. The companies investigated face the emergence of two poles of innovation, whose orchestration is not trivial.

ME-01.4 [R] • The Mechanism and Path of the Cross-market Innovation for Catching-up Firms: A Case Study on New Chinese Electric Vehicle OEMs

Lewis Wei Liu; Tsinghua University, China
Xianjun Li; Tsinghua University, China

Mainstream technology catching-up literature only focuses on how latecomers to assimilate the acquired technology from the markets of the developed countries, which emphasize the latecomers' innovation activities only focusing on their domestic markets, paying little attention to their R&D and innovation activities in the markets of the developed countries, and to reverse back to markets of their home countries. This study discovers the mechanism and path of cross-market innovation based on multiple case analysis on the Chinese new electric vehicle (EV) OEMs. These new EV players directly go to the USA to innovate on top of acquiring new technologies and overcoming the latecomer disadvantage, quickly to become technologically leading position in some new technology innovations, such as drive motor control units, battery management systems, autonomous drive, connected vehicle, big data analytics, V2X and share based business model, in the EV space. The phenomenon of innovative paths by these EV OEMs provides the base to explore the underlined innovation model for latecomers, Cross-Market Innovation (CMI), to catch up and even to lead in both home country and developed country.

ME-02 Information & Knowledge Management-1

Monday, 8/8/2022, 16:00 - 17:30

Room: Holladay

Chair(s) Caren H Weinberg; Ruppin Academic Center

ME-02.1 [R] • Navigating the Trade-offs between Independence and Collaboration: A Network Analytic Method and Case Study

Yi Zhang; University of Technology Sydney, Australia

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Mengjia Wu; *University of Technology Sydney, Australia*
Ximeng Wang; *University of Technology Sydney, Australia*
Hongshu Chen; *Beijing Institute of Technology, China*

Research independence emphasizes the ability to conduct individual work, while collaboration highlights establishing academic connections for team-based activities. Since the two dimensions have become crucial indicators for individual-based research evaluation, how to handle the trade-offs between research independence and collaboration diversity is raised. This paper exploits network analytics to investigate the two indicators via an integrated network that includes an author-term network and a co-authorship network. Specifically, a diffusion-based network analytic model is proposed to evaluate independence by considering the uniqueness of the use of terms, and, in parallel, collaboration diversity is quantified by the strength and breadth of a researcher's co-authorships. We applied the proposed method to a dataset with 19,612 information science-related articles. The observed results not only well demonstrate the reliability of the proposed method but also empirically uncover a balancing threshold between the two indicators, providing references for researchers and decision-makers in the discipline.

ME-02.2 [R] • A Delphi Investigation of Key Factors Used as Primary Criteria to Determine Environmental Velocity in the Thai Healthcare Industry

Krip Metanantakul; *Bangkok University, Thailand*
Ronald Vatananan-Thesenvitz; *Bangkok University, Thailand*

The pace of changes in the external environment has evolved rapidly, which affects every organization. To survive in a changing environment, organizations need to properly prepare their internal and external capabilities to address changes and adjust core capability along with the changes. Therefore, they need to evaluate their business environment and build an effective strategic plan. Decision-makers inside the organization can also gain more insights by monitoring and evaluating external changes that might disrupt their organization. Based on environmental velocity theory, environmental changes can be categorized into low, medium, and high. However, there are still many debates about the element of the measurement model. This study explains the previous models built on the rate of change and direction of change. Thus, there are five main criteria in the model: technology, demand, competition, regulation, and product. According to the main attributes and criteria for determining industry velocity, the list of key factors used as the main criteria to assess an industry velocity is still vague and varied depending on each researcher's perspective. Thus, this paper investigates critical elements for measuring an environmental velocity, including main attributes, main criteria, and respective sub-criteria. The investigation process is conducted through the Delphi technique, which specifies in the medical and healthcare industry. Based on previous studies, the concept of environmental velocity can comprise both the rate and direction of change. The researchers surveyed the management team of a large hospital chain in Thailand to investigate each dimension's essential criteria and effects on the industry's environmental velocity. Also, the results can offer a new strategic plan for the management to prepare for future changes. This study can be further developed with multiple case studies for generalizing the model.

ME-02.3 [A] • Knowledge Creation at Manufacturing Sites by Utilizing SECI Models

Koichi Akagi; *Mitsubishi Hitachi Power Systems, Ltd., Japan*
Manabu Sawaguchi; *Ritsumeikan University, Japan*

In recent years, there is a strong need to reconstruct a new "Genbaryoku (problem finding and solving capabilities at the manufacturing site)". It is to digitize and systematize high-quality data at the manufacturing site and knowledge of individuals depending on their ability, and to systematize them into knowledge assets. For that purpose, it is necessary to change the work process information at the manufacturing site from tacit knowledge to explicit knowledge, and to accumulate explicit knowledge as a shared database. Furthermore, the explicit knowledge is required to be able to be used as information to generate new explicit knowledge by using LEAN, SixSigma, and VE. And it is necessary that the newly created explicit knowledge can be transformed into explicit knowledge that workers at the manufacturing site can easily

understand. In this research, we propose a method to convert work process information from tacit knowledge to explicit knowledge on the premise of applying SECI model. Its validity is evaluated and verified by case studies in which different types of manufacturing methods were tried. Furthermore, it was confirmed that the productivity improves due to the spiral-up effect of the SECI model when the transformed explicit knowledge is used.

ME-02.4 [R] • Distinguishing Absorptive Capacity Based on the Nature of Knowledge: The Casual Relationships among the Sub-components of Absorptive Capacity

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

The purpose of this study is to establish a new distinction regarding absorptive capacity (AC) and to test the causal relationships among its different dimensions. Unlike prior research that divides AC into potential and realized dimensions based on external knowledge-accessing activities, this study provides a new distinction based on both the nature of external knowledge-accessing activities and external knowledge itself. To empirically test the new distinction and causal relationships among each dimension, we collected data from 378 members of 32 research and development (R&D) teams of two leading Japanese manufacturers and analyzed them through partial least squares structural equation modeling. Our findings show that the processes and routines required for marketing knowledge absorption differ from those for technology absorption; however, the former will help organizations better acquire and assimilate external technology. This study deepens the understanding and nature of AC and provides interesting possibilities for further research, such as the reexamination of the effects and antecedents of AC. Further, this study provides managerial contributions by showing the importance of market orientation to managers of R&D organizations, since absorbing market knowledge will promote the effectiveness of external technology search and absorption activities.

ME-03 Internet of Things-1 **Monday, 8/8/2022, 16:00 - 17:30** **Room: Broadway** **Chair(s) Markus Westner; OTH Regensburg**

ME-03.1 [A] • Comprehensive Health Evaluation of Commercial Refrigeration System

Nina Chaichi; *Nike, United States*
Chris Chaput; *Husmann Corporation, United States*
Heidi Perry; *Husmann Corporation, United States*

Internet of Things (IoT) enables the monitoring of various parts and devices in any system based on gathered data. Decentralized and single-point monitoring provides insight into the health of the system at the part level. However, not only each part of the system can be monitored from multiple perspectives but also the health of parts isn't mutually independent from each other in some systems. This paper intends to apply a similar approach as a hierarchical decision-making model (HDM) and analytic hierarchical process (AHP) to calculate the comprehensive health score at multiple levels for a commercial refrigeration system. The main purpose of this approach is to improve the quality and cost of services by optimizing interventions based on a comprehensive health assessment of the refrigeration system. A comprehensive assessment is required for better planning of timely services.

ME-03.2 [R] • Describing Additive Manufacturing as an Industrial Internet of Things System

Simon Hiller; *Ferdinand Steinbeis Institute, Germany*
Heiner Lasi; *Ferdinand Steinbeis Institute, Germany*

Additive Manufacturing, also known as 3D-printing, is a concept for the layer-by-layer manufacturing of three-dimensional parts based on a digital product model. Research in recent years supported the development of new Additive Manufacturing technologies.

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Additionally, a rise of Additive Manufacturing platforms can be observed recently. Business leaders are challenged by the multitude of decisions they must make in structuring, describing, and implementing their business vision of Additive Manufacturing. The paper shows, that via the Industrial Internet Reference Architecture and its four viewpoints, Additive Manufacturing systems can be described. Therefore, Additive Manufacturing systems can be seen as an Industrial Internet of Things systems. To further improve a framework tailored towards Additive Manufacturing, a research agenda of new elements supporting the viewpoints of the Industrial Internet Reference Architecture was developed. Our work is based on an explorative case study with an Additive Manufacturing contract manufacturer and Additive Manufacturing platform and is located in the field of design-oriented information systems research.

ME-03.3 [R] • Relation between Edge Computing and the Internet of Things: A Systematic Literature Review

Jonas Schroll; OTH Regensburg, Germany

Markus K Westner; OTH Regensburg, Germany

The Internet of Things (IoT) is an emerging computing paradigm providing new approaches to collect and analyze environmental data. However, as specific challenges arose, the paradigm of Edge Computing with its potential solution capabilities came into place. The combination of both paradigms is currently highly discussed in industry and research. This paper aims to contribute to this field by conducting a systematic literature review to examine the differences and relation between IoT and Edge Computing on a meta-level. It first investigates conceptual backgrounds, use cases, and implementation types. After that, the differences between the paradigms are highlighted. It becomes clear that the significant distinction is in the architectural composition. However, the scientific consensus reveals that both paradigms have a common historical background, and Edge Computing is perceived as the next step in the evolution of IoT. Furthermore, Edge Computing-based systems can address common IoT challenges identified in the two paradigms' problem-solution space. Ultimately, there is a need for further research in security, edge intelligence, and standardization, with Edge Computing frameworks able to address these in practice.

ME-03.4 [R] • Implementing a Proof-of-concept in IoT-Ecosystems: A Case Study in the Hospitality Industry

Sven Kurrle; Ferdinand-Steinbeis-Institute, Germany

Simon Hiller; Ferdinand-Steinbeis-Institute, Germany

Patrick Weber; Ferdinand-Steinbeis-Institute, Germany

Heiner Lasi; Ferdinand-Steinbeis-Institute, Germany

The Internet-of-Things enables enterprises to collaborate in IoT-Ecosystems. These ecosystems make it possible to create new value scenarios that individual enterprises are unable to offer on their own. Turning IoT-Ecosystems from concept to reality is a challenge, especially for small and medium sized enterprises. We conducted a case study in the early stages of an IoT-Ecosystem. Seven enterprises from diverse backgrounds were forming the observed ecosystem in the German hospitality industry. The case study consists of a series of workshops with business executives and a Proof-of-Concept. Our research focuses on the Proof-of-Concept steps within the process of forming an IoT-Ecosystem. Researchers took an active role in these steps. We condensed our observations into six key factors and structured them along the creation process of IoT-Ecosystems. We show that the Proof-of-Concept is not only dependent on technical but also on business and human factors. The identified key factors help practitioners to implement a Proof-of-Concept in their IoT-Ecosystem. Researchers may use them as a base for further research into the steps of IoT-Ecosystems.

ME-04 TUTORIAL: Beyond Business Analytics: The Special Case of Technology Management

Monday, 8/8/2022, 16:00 - 17:30

Room: Weidler

Speaker(s) Elie Geisler; Illinois Institute of Technology

This tutorial is designed to explore the impact of the notion of beyond business analytics on the field of technology management. The notion of Beyond Business Analytics is a complex concept which is composed of two complementary parts, one quantitative and the other cognitive. The first part is the quantity in the space of Analytics which includes the description of the phenomenon or the notion. The second is the meaning of this quantity to the decision-maker. Analytics is thus the data, whereas beyond analytics is the meaning of the data to the decision maker. This meaning of the data is now extended to the field of technology management. Decisions made in this field will benefit from beyond business analytics. For example, decisions such as "make or buy" technology will be made after an analysis by using the notion of beyond business analytics. The implications for the analysis of "Big Data" are discussed. Finally, the use of beyond business analytics is also analyzed by the benefits this notion offers the decision-maker.

ME-05 Leadership

Monday, 8/8/2022, 16:00 - 17:30

Room: Morrison

Chair(s) Charles M Weber; Portland State University

ME-05.1 [R] • Perspective the Influence of Leadership on Job Satisfaction in E-generation

James K Chen; Asia University, Taiwan

Benson S Sun; Asia University, Taiwan

Employee's turnover rate are dependent on the job satisfaction, working condition of employees, organizational commitment, and leadership factors. Unfortunately, employee's turnover rate is still higher in the mineral industry than the other industries. Although there are many papers that research employee's turnover, there are few studies investigating leadership factors. This research aims to explore the leadership influence on job satisfaction and employee's turnover in the mining industry. The paper conducted through structural equation model (SEM), a confirmatory factor analysis (CFA) and a path analysis of model to test hypothesis. The results of a survey with 368 respondents indicate that leadership has positive effects on both job satisfaction and employee's turnover, and working condition states positive mediation effects with both leadership and job satisfaction. Organization commitment (OC) had strong effects to employee's turnover (estimate values $\beta = .572$, $p < .001$). But, OC is not a good mediator with both leadership and employee's turnover. Consequently, the working condition is an important independent variable and also one of key factors of job satisfaction; the higher estimate values ($\beta = .541$, $p < .001$) of leadership to employee's turnover that mean leadership is key factor to employee's turnover. The mining company can through new technology improvised working condition of employee. The outcome of study can supply industries sector and academics research field do reference in the future.

ME-05.2 [R] • Perspective on the Relationship between Trust and Personal Leadership in the Organization in the Post Covid-19

James K Chen; Asia University, Taiwan

Thitima Sriphon; Asia University, Taiwan

Hsiao-Ching Yang; WuYi University, China

The Covid-19 pandemic has spread all over the world rapidly. Many countries implement some strategies as working from home, isolation of infected people from others, and 14 days self-quarantine for avoiding the spread of infection to other people. Most of the countries also employ closing the entrance gate of the country, which is considered one of the most effective approaches to hinder the spread of Covid-19. These strategies affect trust, communal relationships, and social exchange relationships among people. However, the communal and social exchange relationships are needed in the leadership of organizations and considered as a basis of social network. The trust, communal relationships, social exchange relationships, and the leadership in the organization are very interesting to be studied further, especially in the post Covid-19. This study employs the correlation analysis to examine: 1) the trust in Covid-19 current time has a positive influence on communal relationships, social exchange relationships, and leadership in organizations; 2) communal

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relationships in Covid-19 current time have a positive impact towards leadership in organizations; 3) social exchange relationships in Covid-19 current time have a positive impact towards the leadership of organizations. This study involves the SMEs managers who have worked in the organizations. There are 120 samples covering three types of managers, namely basic, middle, and high managers. This study presents that the Covid-19 pandemic influences the trust among people, and trust affects the communal relationships and social exchange relationships. These relationships show direct impacts on the personal leadership in the organizations. The results offer the CEO of organizations some approaches on how to improve personal leadership performance in the future.

ME-05.3 [R] • Effective Leadership in Virtual Teams During the COVID-19 Pandemic

Alison Nalven; Portland State University, United States
Mareena John; Portland State University, United States
Sara Ferdousi; Portland State University, United States
Shivani Agarwal; Portland State University, United States
Tyler Stahl; Portland State University, United States
Charles Weber; Portland State University, United States

The COVID 19 pandemic has brought about an unprecedented economic and social crisis that has affected many businesses. Due to health concerns, many organizations are being managed virtually. This can be challenging, especially for employees and employers that are used to face-to-face interaction and for those who are not tech-savvy. Organizational leaders need to develop strategies and methods to maintain business, as well as maintain the productivity levels of employees. This research paper investigates the most effective ways to lead virtual teams during a pandemic to answer the question: what challenges did virtual team leaders face during the COVID-19 pandemic and how were they addressed? This paper consists of a study based on a short literature review and the survey responses of a sample size of 42 from working professionals across various job levels. A second survey of an additional 21 managers and leaders was also conducted. The authors identified the key challenges of leading and working in virtual teams from the survey results, including communication hardships and the obstacles with onboarding new employees remotely. Drawing on the team's experiences and knowledge from the related literature review as well, this paper proposes a set of best practices based on the patterns observed in the survey in order to answer the research question. The paper also includes the scope of future work that can be done in this field.

ME-06 Decision Making-2

Monday, 8/8/2022, 16:00 - 17:30

Room: Ross Island

Chair(s) Arnesh Telukdarie; University of Johannesburg

ME-06.1 [R] • A Comparative Study of Evidence-based Policy Making on History and Introduction Process in the United States, the United Kingdom, and Japan

Takuto Miyamoto; Tokyo Institute of Technology, Japan
Yuya Kajikawa; Tokyo Institute of Technology, Japan

Evidence-based policy making (EBPM), which aims to reflect scientifically proven evidence to the policy-making process, has been introduced to the public administration of Japan in the past few years. This comparative study among the United States, the United Kingdom, and Japan shows features of EBPM movement in each country and finds a possible risk in Japanese cases through an in-depth analysis. To eliminate this risk, it is important to fertilize the ecosystem of evidence activities. It is recommended that the Japanese government attempt to not only conduct randomized control trials straight away in the government but also introduce a wider range of evidence-based methodologies by taking advantage of boundary organizations with skilled researchers for generating evidence, including products of synthesis such as systematic review, toolkit, and decision-making guidance. It is also a

realistic option to have national research institutes to promote evidence synthesis.

ME-06.2 [R] • Business Improvement through Automated Signaling Design

Sizwe Memela; University of Johannesburg, South Africa
Arnesh Telukdarie; University of Johannesburg, South Africa

The purpose of this research is to investigate railway signaling designs in view of business optimization using computer drawings, programming software language and management of signaling designs. This research focuses on design automation from the preliminary design stage to the detailed design stage to investigate and resolve the common project challenge of time management. This research finds that software integration of the signaling designs with efficient and innovative computer drawing software and programming software language such as AutoCAD and C#.Net results in reduced resource and time usage when processes are automated. Signaling designs are sophisticated and crucial in an ever-changing railway environment. As a result, there is a demand for efficiency and knowledge within railway signaling to achieve successful project completion target dates.

ME-06.3 [R] • Generative Sensing and Seizing Model: An Adaptive Dynamic Development Framework as a Tool for Strategic Orientation in Aerospace Organizations

Dinah Eluze Sales Leite; National Institute for Space Research, Brazil
Milton de Freitas Chagas Jr; National Institute for Space Research, Brazil

In times of discontinuous change, aerospace organizations, complex and regulated, face situations of uncertainty in which they need the flexibility to renew their technological strategy. The aerospace market is highly competitive and technology-intensive, requiring organizational ambidexterity, which seeks to improve the ability to identify changes in the environment and select an innovative technology portfolio. The article proposes the development of a strategic model, dynamic and adaptive, to improve the success of long-term technological definitions through the opportunities sensing and seizing. The generative sensing and seizing model, based on dynamic capabilities, seeks to improve decision-making over a long-term horizon and the fungibility of the deployment of strategic actions concerning the selection of technologies. The research is based on case studies explored in prospection, and research and development sectors at Embraer. It seeks to take advantage of conditions of uncertainty as a potential source of change in the strategic development of future possibilities.

ME-07 Collaborations-2

Monday, 8/8/2022, 16:00 - 17:30

Room: Sellwood

Chair(s) Sebastian Stegmüller; Fraunhofer IAO

ME-07.1 [R] • Ad-Astra: A Bibliometric Analysis of Lunar and Mars Explorations

Nonthapat Pulsiri; IKI-SEA, Bangkok University, Thailand
Rick R Dobson; International Space Agency, United States
Thierry Isckia; Telecom Ecole de Management, France
Pakorn Apaphant; GISTDA, Thailand

The frontier of space exploration is a magic, which has long fascinated mankind since the introduction of ancient knowledge. Humans are always curious to know why they are here, and what is waiting for them beyond Earth. The research in space exploration is growing from the small community towards more global collaboration. Moreover, successful spin-off programs from space technology can bring sustainable competitive advantage and well-being. It is promising that humanity can live on planet Earth peacefully along with the advancement in outer space knowledge and innovation. Therefore, the research in space exploration is crucial for all mankind. This paper offers a bibliometric analysis of Lunar and Mars explorations between 2016-2019, to clarify the body of knowledge in these research areas. The connection between Lunar and Mars explorations is explained to guide a global

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collaboration into the same direction. Consequently, the research community still needs to promote more scientific activities in these two areas. The United States, as the leading country with strong ties to Germany, France, and Italy, should create more collaboration with Russia, China, and other small countries. According to keyword analysis, both Lunar and Mars explorations have the same main four research topics in Lunar/Mars surface analysis, spaceflight and astronauts, space vehicular engines, and space orbit with international space stations. These research topics also support the future establishment of a Moon base and Mars habitat. However, spaceplane launching facilities still require more international diplomatic discussion to fulfill the missions. Thus, this paper aims to contribute to every country towards the preparation of Lunar and Mars explorations in the near future.

ME-07.2 [R] • Fast Track Innovating Process: A Maker-movement-based Approach to Connect Digital Talents with Companies

Truong Le; Fraunhofer IAO, Germany

Sebastian Stegmüller; Fraunhofer IAO, Germany

Thomas Potinecke; Fraunhofer IAO, Germany

Manfred Dangelmaier; University of Stuttgart IAT, Germany

Franziska Braun; University of Stuttgart IAT, Germany

When companies start innovation projects for smart products, they often face several obstacles: e.g., a lack of tools to select the right ideas, the difficulty to make ideas easy to explain to the management board, and the “culture clash” within the organization. In this paper, we present the Fast Track Innovating approach to link traditional innovation processes with lean and fast development approaches, inspired by the maker mindset “Just do it”.

ME-07.3 [R] • Research on the Identifying Potential Collaborators for Technology Transfer

Shuying Li; Chengdu Library and Information Center, CAS, China

Chunjiang Liu; Chinese Academy of Sciences, China

Lihua Zhang; Shanxi University of Finance and Economics, China

Yi Xu; Chinese Academy of Sciences, China

Xian Zhang; Chinese Academy of Sciences, China

Haiyun Xu; Shandong University of Technology, China

Edwin Garcés; Portland State University, United States

The increasingly competitive global environment is witnessing a great challenge for the technological innovation capability of organizations. It is particularly important for companies to accurately and quickly capture technology opportunities from outside and find potential collaborators. However, it is a challenging task to discover similar patent documents owned by different institutions, such as companies, universities, or research institutions as patent owners, and to promote cooperation among industry, academia, and research institutes in the process of technology transfer. In this study, based on current methods of patent co-classification, citation coupling, and word co-occurrence analysis, we construct technological clusters of an organization due to the similar application fields, citation coupling, and technical elements. The fusion of the above triple matrix will help obtain recommendations of potential collaborators and technology directions among industry, university, and research.

TA-01 PLENARY - 2

DATE: TUESDAY, 8/9/2022

TIME: 08:30-10:00

ROOM: MULTNOMAH

CHAIR: KIYOSHI NIWA; THE UNIVERSITY OF TOKYO

TA-01.1 [K] • Beyond Best Practice: New Developments in Open Innovation

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

In this talk, Professor Henry Chesbrough will describe his well-known model of Open Innovation and then outline recent theoretical and empirical research on that model. This new research extends the earlier concept, and also shows certain limits to that model's use in several economic sectors. The result is an understanding of open innovation that weaves together internal and external flows of knowledge, where each stimulates greater usage of knowledge from the other. Professor Chesbrough will conclude with recent examples of these dynamics at work in innovation.

TA-01.2 [K] • A Strategic Leadership Perspective on the 4th Industrial Revolution: Personal, Organizational and Societal Implications

Robert A Burgelman; Stanford University, United States

Dr. Burgelman will address two high level questions: 1) What are the implications if the 4th industrial revolution creates algorithms that autonomously develop new knowledge, not embodied in humans? and 2) How can humans maintain control of algorithms that autonomously develop disembodied new knowledge? To address these two questions, Dr. Burgelman will draw on some of his own frameworks, as well as on social science, poetics, physics and philosophy.

TB-01 Innovation Management-2

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Multnomah

Chair(s) Hiroko Yamano; The University of Tokyo

TB-01.1 [R] • A Study on the Dynamism of Clusters Using Transaction Network between Companies

Hiroto Suzuki; The University of Tokyo, Japan

Masanao Ochi; The University of Tokyo, Japan

Hajime Sasaki; The University of Tokyo, Japan

Hiroko Yamano; The University of Tokyo, Japan

Ichiro Sakata; The University of Tokyo, Japan

Previous studies suggested clusters between inter-firm relationships encourage knowledge exchange in different fields, which causes innovation. The paper aims to clarify the form factors of clusters generated in the dynamics of inter-firm networks and to obtain suggestions for promoting regional clusters. This study applied network clustering to inter-firm networks from 2006 to 2015 in Japan to identify regional clusters and define the cluster's retention rate to measure the growth and decline of the cluster. Furthermore, this study employed the number of connector hub companies and the metabolism of inter-firm transactions as a candidate of the form factors of clusters. Finally, this study analyzed the correlation between cluster retention and those two formation factors. The result proved that the connector hub companies have an effect of maintaining clusters, and the metabolism of transactions accelerates decomposition and fusion of clusters. Specifically, the more connector hub companies in the cluster, the more retention rate increases, and the more metabolism of transactions, the more merger occurs between clusters. The study reveals the way to develop a regional cluster, which is the ground for innovation. This paper helps the government to foster innovative inter-firm networks and revitalize the local economy in Japan.

TB-01.2 [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

Lewis Wei Liu; 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

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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.

TB-01.3 [R] • Proposal of Meta-Engineering in the Digital Age for Creating Innovation

*Yasutoshi Komatsu; Meta Engineering Research Institute, Japan
Hiroshi Suzuki; Meta Engineering Research Institute, Japan*

At the PICMET '17 conference, we proposed the Meta-Engineering concept and the MECI cycle in the Ba of networks as a radical engineering approach for realizing innovation in the internet environment. The MECI cycle comprises four processes: Mining, Exploring, Converging, and Implementing. We propose a new MECI cycle that incorporates recent digital tools, because various digital tools have advanced explosively in recent years. The MECI cycle has evolved to a MECI spiral that enables successive innovation. Spiral MECI processes can spur breakthrough innovations when advanced along with digital tools. Blockchain technology supports the Mining process by preventing plagiarization of ideas. Advertising websites are effective at finding talented people to found startups during the Exploring process. Equity crowdfunding working together with venture capital firms facilitates financing difficulties of the startup in the Converging process. Furthermore, digital marketing applied for the Implementing process increases users who might become contributors to innovation as investors. These digital technologies are still developing today. Their further progress is anticipated. Innovation achieved through Meta-Engineering will become much further democratized in the digital age beyond the limits of user-centered innovation, which were introduced in "Democratizing Innovation" (E. von Hippel, 2005).

TB-02 Information & Communications Technologies-2

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Holladay

Chair(s) Dilek Cetindamar; University of Technology Sydney

TB-02.1 [R] • Critical Success Factors of Technology Transfer: An Investigation into the Health Sector of Bangladesh Using ISM-DEMATEL Approach

*Ahsan U Murad; University of Technology Sydney, Australia
Farid Ahmad; Bangladesh University of Engineering and Technology, Bangladesh
Dilek Cetindamar; University of Technology Sydney, Australia*

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

most appropriate CSFs for successful TT in context of developing countries. The paper ends with a summary and puts forward suggestions for future studies.

TB-02.2 [R] • An Analytical Framework for Digital Strategy Focusing on Innovation and Digital Value Creation

*Dan Pettersson; KTH - Royal Institute of Technology, Sweden
Joakim Lillieskold; KTH - Royal Institute of Technology, Sweden*

As a result of the Covid pandemic, many organizations realized they needed to create or update their digital strategies. However, it was not clear what they needed to include. This article examines how digital strategy can be analyzed and what a digital strategy could contain. Literature was reviewed to examine articles on digital strategy and the related topics digital business strategy, digital transformation strategy, and digitalization strategy. It was considered how the articles relate to these topics and some inconsistencies were observed. The results of the literature review contribute to an analytical framework useful for evaluating digital strategies. It can also be used as a map for organizations in the process of developing digital strategies. An evaluation is made on the role of technology in the resulting framework. Specifically, the areas innovation and digital value creation are discussed. An extension to the analytical framework is presented that covers these areas with more detail. Four types of digital value creation mechanisms, and four types of innovation, are introduced to facilitate the evaluation.

TB-02.3 [R] • Measuring the Efficiency and Return to Scale of Korean Logistics ICT Venture Capital Companies

*Mehdi Shamohammadi; INHA University, Korea, South
Sang Yoon Lee; INHA University, Korea, South*

South Korea has prioritized the ICT industry in the past few decades to enhance knowledge-based, socio-economic development. In this respect, the survival of logistics-based ICT startups from the beginning stages of the establishment to the settlement in the market and profitability stages is a vital concern for the Korean economy. This study investigates the efficiency and returns to scale of ICT startups applying the stochastic frontier analysis to a three-year ICT and logistics-related ICT venture panel data. The findings were as follows. First, the average efficiency of domestic logistics ICT startups was low at about 0.33; however, the results showed it was gradually improving over time. Second, the performance of logistics ICT start-ups experienced a decline when receiving government support. Third, most of these companies were increasing their scale. The policy implications are presented based on the three key quantitative evaluations.

TB-03 Technological Change

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Broadway

Chair(s) Tatsuya Kubota; Seijo University

TB-03.1 [R] • The Role of Cognitive Frames That Impede and Drive the Technological Evolution

*Yaichi Aoshima; Hitotsubashi University, Japan
Tatsuya Kubota; Seijo University, Japan*

Many studies have explored the mechanisms that shape a pattern of technological transition. Some focus on the fundamental nature of technology or technological potential to be explored. Others explain it from an economic perspective by referring to the industry players' economic incentives to invest in technology. Despite such a stream of research, we still have limited abilities to project the timing of the technological transition. This is partly because researchers have not considered how industry players recognize a potential of technology and its economic implication. By examining the evolution of optical lithography technology, this paper uncovers how cognitive frames shared by industry players have affected the timing of technology transition. We mainly investigate two technologies, CMP (chemical mechanical polishing) and ArF immersion technology, which had critical impacts on the evolution of lithography. Based on in-depth case studies, we illustrate why these two technologies had

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been ignored for many years, impeding further performance improvement, and why they suddenly drew much attention and induced further development. We illustrate how cognitive frames possessed or shared by engineers affect selection of technologies and, in turn, the timing of the technological transition.

TB-03.2 [R] • A Methodology to Categorize Rapidly Changing Projects of Open Source Software

Shino Iwami; NEC Corporation, Japan

The number and types of Open-Source Software (OSS) are increasing year by year. The information technology (IT) industry uses OSS and utilizes intellectual properties and human resources across organizational boundaries. At present OSS expands across industry boundaries and is used in more industries such as the energy industry, automotive industry, and medical industry. In addition, some OSS have been developed with new concepts. Some OSS organizations such as the Linux Foundation, the Cloud Native Computing Foundation and the Japan OSS Promotion Forum provide categories, but contributors in them are also time-consuming to provide the latest information. Meanwhile, it is inconvenient for every Open-Source Program Office (OSPO), which oversee open-source software management and strategy, to update manual OSS categorization frequently. Thus, OSPOs want to get a universal methodology to restructure OSS categories. This research provides the current categories of OSS and its methodology in order to build a consistent strategy. This methodology aims to be a methodology to support in the standardization of OSS categorization.

TB-04 Intellectual Property-1

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Weidler

Chair(s) Yaeko Mitsumori; Osaka University

TB-04.1 [R] • An Analysis of COVID-19 Related IPRs

Yaeko Mitsumori; Osaka University, Japan

Hiroshi Kato; Nihon University, Japan

Akiko Kato; Nihon University, Japan

Koichi Kamijo; International Professional Univ. of Technology, Japan

In past decades, there have been abundant discussions regarding management of medical Intellectual Patent Rights (IPRs) since India's Indira Priyadarshini Gandhi, then Prime Minister, eliminated medical product patent protection and enacted India's Patents Act, 1970. There were many changes to IPRs related to AIDS drugs during the 1980's and 1990's. The Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement also hosted numerous discussions over the Doha Declaration, an issuance of compulsory licensure, and product patent waivers for least developed countries (LDCs). COVID-19 emerged in January 2020, making salient this controversial issue. Should medical patents be protected, waived, or pooled? Both USA President Joe Biden and Chinese President Xi Jinping stated that they would support waivers for COVID-19 related IPRs in May 2021. The following week, pharmaceutical industry representatives released statements arguing for the protection of pharmaceutical IPRs. Meanwhile, developing countries, the World Health Organization (WHO), and other stakeholders contend that medical IPRs should be limited. This paper will first describe the current global status of the COVID-19 pandemic and then present COVID-19 related medical patent data using a commercial database offered by Clarivate Analytics. Based on this data, we will then closely analyze stakeholder positions on COVID-19 IPRs. In this study we selected three widely used schemes of pharmaceutical IPR and drug/vaccine distribution - COVAX, Medicines Patent Pool (MPP) and voluntary licensing. After close examination, we found voluntary licensing is the most applicable solution for COVID-19 pandemic at the time being.

TB-04.2 [R] • Comparison of Patent Grants within Patent Families

Koichi Kamijo; Int'l Professional Univ. of Technolog in Tokyo, Japan

Yaeko Mitsumori; Osaka university, Japan

Hiroshi Kato; Nihon university, Japan

Akiko Kato; Nihon university, Japan

This paper analyzes differences in the grant/no-grant status of patents within patent families by country. Many companies apply for the same patent across multiple countries with the aim of acquiring rights to goods and services globally. However, it is often the case that patents within the same patent family are granted in one country but not in another. We analyze this discrepancy from two aspects: information on the patent, such as the number of claims and citations, and words used in the patent specifications, such as the usage of "seasonal" words also used in articles published around the time the patent was filed. In this study, we focus on pharmaceutical patents filed in the United States, India, and Brazil. We then build a machine learning model to predict the grant/no-grant status of patents within the same patent family, including the case where a patent is granted in one country but not in another. Experimental results show that our model predicts the grant/no-grant status of patents within a patent family with high accuracy.

TB-04.3 [R] • IP Evaluation and Technology Transfer

Priyadarshini Singh; Indian Institute of Technology Kharagpur, India

Gouri Gargate; Indian Institute of Technology Kharagpur, India

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

TB-05 Artificial Intelligence-1

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Morrison

Chair(s) Lukas Keicher; University of Stuttgart

TB-05.1 [R] • Boosting Innovation by Artificial Intelligence (AI): Effects and Potentials of AI in the Process of Innovating

Lukas Keicher; University of Stuttgart, Germany

Antonino Ardilio; Fraunhofer-Institute for Industrial Engineering, Germany

Georg Nawroth; University of Stuttgart, Germany

Today enterprises must encounter more challenges than ever: besides dealing with global markets/competitors and an increasing flood of freely available information, the rising demand for individualized solutions, the ever-shorter life cycles of technologies and products, the digitalization pressure and the effects of Covid-19 are only a few more examples for challenges. All these challenges have indirect and direct impacts on the company's innovation activities. To face the innovation tasks deriving from the above-mentioned challenges, artificial intelligence (AI) could be a key technology. Due to the increasingly developed capabilities of this technology and the already explored application opportunities, the implementation of AI in the innovation process (as cost-intensive activity) can be highly relevant. Therefore, this study conducts a desktop research of existing application scenarios of AI in innovation management and examines what different subsets of AI (such as learning or speech recognition) are existing. Moreover, it will examine which subsets of AI can additionally support innovation managers in different tasks of the single phases within the innovation process and how to apply these subsets of AI to these tasks. As a result,

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recommendations for the usage of specific subsets of AI for the individual tasks in innovation management will be given.

TB-05.2 [A] • State-of-Art Methods Used in Sentiment Analysis: A Literature Review

Bhavana Ramesh; Grid Dynamics, United States
Charles Weber; Portland State University, United States

Understanding human sentiments on social media is a hot topic. Due to its practical applications, many organizations across several domains are involved and invested in sentiment analysis. Marketers are interested in extracting the voice of customers to gain insights. The challenges to the gathering, decoding, and extracting actionable knowledge from the huge volume of data that is constantly generated has increased manifold. Even with newer technologies, increased computing capacity, crunching social data remains a challenge. This organized study is dedicated to understanding the general state of the art of sentiment analysis including common methods, approaches, and gaps. The contribution of this paper is significant because firstly it identifies the types and techniques of sentiment analysis, and secondly, this study adopts a systematic approach to identify, gather empirical evidence, interpret results, critically analyze, and integrate the findings of all relevant high-quality studies to address specific research questions about the defined research domain.

TB-06 Global Issues-1

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Ross Island

Chair(s) Randall M Shannon; College of Management, Mahidol University

TB-06.1 [R] • Peace Engineering, Innovation, Peace and Trade: A Meta-Analysis

Heidi A Harvey; University of New Mexico, United States
Steven T Walsh; University of New Mexico, United States
Alexis M Rubin; University of New Mexico, United States
Yorgos Marinakis; University of New Mexico, Netherlands

Peace Engineering and Innovation is of great concern to government, corporate and innovation stakeholders. While a number studies have investigated the effects of trade and innovation on Peace Engineering the evidence is inconstant and ambiguous to its value. Here we add to the literature by focusing on one of its subfields of Peace Engineering and Innovation; Interdependence, Peace and Trade. We provide meta-analysis where we first identify four significant categories by integrating the results from 43 prior studies. We add to the growing body of Peace Engineering and Innovation literature by segmenting the field, providing graphical analytical metrics that advance the field and assist researcher, investigating the emerging field of Peace Engineering and Innovation.

TB-06.2 [R] • Using Control Theory and Self-esteem to Explain Older Consumers' Low Use of the Internet

Jul Thanasrivanitchai; Kasetsart University, Thailand
Randall M Shannon; Mahidol University, Thailand
George Moschis; Mahidol University, Thailand

Many studies show that the usage rate of the Internet by older adults is the lowest of any demographic group. This paper explores the reasons for older adults' lower inclination to use the Internet by employing control theory. The theory suggests that as people increasingly experience "losses" with age they also experience loss of control of their environments, including technology. Compensatory secondary control strategies, which allow the individual to protect him or herself from the perceived negative consequences associated with the older persons' inability to control their technological environment, may help explain their low propensity to adopt and make use of the Internet. Findings based on a large-scale study in Thailand suggest that compensatory secondary control may provide an explanation for the low rates of Internet adoption and usage among older consumers. Moreover, self-esteem moderates the negative relationship between compensatory secondary control and preference

for Internet use. Older adults with high self-esteem who scored high on compensatory secondary control tended to have the lowest frequency of Internet use. Implications for theory and practice are offered and directions for future research are suggested.

TB-06.3 [R] • Modeling Social Flux During Catastrophic Events with Time-lapse Optimization

Laurence W Corbett; Portland State University, United States

As resources become scarce, people are periodically forced to move from a home location to where more resources are available. This paper presents a technique to anticipate the direction of that travel, and thus be prepared to manage an influx of immigrants. This is currently happening across the globe as climate change diminishes local crop yields, but events like the COVID-19 pandemic can accelerate local scarcity. Without models to anticipate likely travel paths, disease vectors can spread unchecked. In this paper the authors test such a model against a historical event, the Fimbul Winter of 536 CE. Up to half of the population of Norway perished due to a sudden cooling event, most likely caused by a volcanic eruption half-way around the globe. A very mobile population moved quickly, using wooden ships, and that very scarcity may have precipitated the dawn of the Viking age some 200 years later. Using the past as a lens on the present, we can see similar migrations across the Mediterranean and via overland routes from sub-Saharan Africa and war-torn Syria. Advance knowledge can be used to mitigate the impact of population changes.

TB-06.4 [R] • The Economic Recovery from Covid-19 through the Perspective of Regional Differences: Based on Human Mobility Data in China

Yushan Yang; Beijing University of Posts and Telecommunications, China
Yawen Li; Beijing University of Posts and Telecommunications, China
Jizhou Huang; Baidu Inc., China
Changyuan Jing; University of Chinese Academy of Science, China

The COVID-19 pandemic is considered as the greatest challenge that humankind has faced since the 2nd World War. A series of measures including lockdown and quarantines have been put in place in China. While these strategies effectively brought the spread of the pandemic under control, Chinese domestic economic development has suffered a great impact. Since China has a vast territory, with provinces that differ in levels of economic development, leading industries and transport facilities, economic shock varies from region to region. This paper aims to explore and compare regional differences in the impact of COVID-19 and the speed of economic recovery. Firstly, we set up a complete indicator system that depicts the regional characteristics depends on their performances in economic gradient, internationalization and transportation convenience. After applying Data Envelopment Analysis (DEA) model to indicator data from Chinese Statistical Yearbook, we divide Chinese provinces into different types. Classification results then are matched with the data on numbers of New Venues Created (NVC) and the weekly Volumes of Visits to Venues (V3) from Baidu Maps statistics. Finally, based on the findings, we provide the government with advice on its measures to boost the economy, applying different approaches to different types of regions.

TB-07 Technology Management in Service Industry-2

Tuesday, 8/9/2022, 10:30 - 12:00

Room: Sellwood

Chair(s) Rainer P Hasenauer; WU-Wien

TB-07.1 [R] • Development and Factors of Survival of (New) Business Ideas in the Online Sharing Economy

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

Sharing Economy (SE) is said to be a pool of technology-enabled new business ideas, which are based on the concepts of online platforms (OP), person-to-person markets (P2P), access over ownership (A00), decentralized organizations (DO) and underutilized assets (UA). In this research paper, we study about 280 international OPs from 23 different countries and in

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16 sectors in order to investigate the survival of OPs, labeled as SE, over time. To do so, the data set on SE-OPs is analyzed using a logit model to identify significant features of survival. Our results show that SE-OP in a minority represent the outlined concepts (P2P, AOO, DO, OP), nor do these concepts ensure survival. Moreover, OPs that are business as usual, such as a B2C-concept based on ownership, are more successful in survival. Summed up, OP-technology could scale new business ideas based on P2P, AOO, DO and OP, theoretically. Empirically, however, OP seem to be more of a useful tool for B2C-business that can be labeled as SE but are neither new nor based on the concepts of SE but use OP as business model modification.

TB-07.2 [A] • Living Labs in Social Service Institutions: An Effective Method to Improve the Ethical, Reliable Use of Digital Assistive Robots to Support Social Services

Rainer P Hasenauer; WU-Wien, Austria

Irmtraud Ehrenmueller; University of Applied Sciences Upper Austria, Austria

Carlotta Belviso; Universita Luigi Bocconi, Italy

The measures taken to prevent further damage by the novel coronavirus (SARS-CoV-2) accelerated the negative impact of the shortage of caregivers on the availability of social services, especially in long-term care institutions. Although much has been done in recent years to develop digital solutions to assist people who need care, such as socially assistive robots (SAR), nothing can substitute for human caregivers in times of crisis. The current paper describes a planned research study to work out answers to three research questions of the CareSAR research program: (A) What is the status of digitized assistive tools that are primarily designed and developed to support caregivers in long-term care institutions and home care? (B) What are the main reasons why existing digitized tools and equipment/devices using artificial intelligence are not yet used to the extent that is needed to mitigate the shortage of caregivers in a crisis and critical situations? (C) What kind of support can be provided by a living lab that is designed to develop effective, ethical, and socially acceptable digital devices to assist caregivers in their caring environment? The analysis of projects that were designed to develop assisting robots to mitigate the lack of caregivers and the research of existing living labs conducted in social care institutions shall evaluate the opportunities of how social assistive robots get the chance to be used largely.

TB-07.3 [R] • Empirical Study on Evaluation of Regional Economic Development and Citizens Science Literacy in Mainland China

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

The citizens' science literacy is an important part of citizens' general literacy level. This paper utilizes the data of the Chinese citizenship science literacy survey in 2018 and 2010 along with the data of the statistical yearbook. This is combined along with the actual situation of regional social and economic development in order to construct a statistical index system. Utilizing the method of cluster analysis, the science literacy development level of citizens in 31 provinces and cities in mainland China is divided into four categories, each of which has its own characteristics. Statistical analysis methods are used to explore the advantages and disadvantages of economic development and the improvement of citizens' science literacy in the various regions. Relevant conclusions are drawn, and suggestions and countermeasures are proposed.

TB-07.4 [R] • Science Popularization Strategies of Advertisement for Technology Enterprises

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

The advertisement of science and technology enterprises is not only a channel for enterprises to realize economic value, but also a channel for science and technology dissemination, and also a platform for building science popularization. This article analyzes the status quo of the science popularization strategy of technology-based companies' advertising through a questionnaire survey. The science popularization strategy of technology-based companies helps companies gain consumer recognition and achieve target markets and economic

benefits.

TD-01 Innovation Management-3

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Multnomah

Chair(s) Kazuhiko Itaya; Kagawa University

TD-01.1 [R] • Resilient Strategy with Trial and Error for Open Innovation by Small and Medium-Sized Enterprises

Kazuhiko Itaya; Kagawa University, Japan

To bring out desirable effective policies when small and medium-sized enterprises (SMEs) choose open innovation, authors visited SMEs in areas of Japan that have guided innovative new products to success, conducted interviews, and looked for success factors from the viewpoint of company strategy that led to success. Authors used qualitative research method (Grounded Theory Approach) for our analysis. As a result, authors discovered that in difficult situations where customer requirements could not be realized by presenting a prototype, that just uses external seed technologies, companies found success by making bold changes such as resetting their objectives, changing their target market itself, or making large changes such as switching to developing their technology in-house and reexamining it from scratch.

TD-01.2 [R] • The Effects of Forced Customer-oriented Ideation on Technical Experts

Nanami Furue; Tokyo University of Science, Japan

Masako Shimogo; Ricoh Company, Ltd, Japan

Aiko Otsuka; Ricoh Company, Ltd, Japan

Ryota Yamashina; Ricoh Company, Ltd, Japan

Yoichi Kubota; Ricoh Company, Ltd, Japan

This paper aims to get exploratory deeper understanding towards actual difficulties and benefits on customer-oriented ideation process through an online half day design-thinking workshop experiment with 22 in-house technical experts in a major Japanese manufacturing enterprise. The workshop consists of two ideation parts: free ideation and forced customer-oriented ideation. In addition, all ideas from both ideations were evaluated by judges after the workshop. Through an analysis of answers from questionnaires collected at the workshop and evaluation points of ideas, four tendencies regarding actual difficulties and benefits on customer-oriented ideation process were caught. First, devising ideas in the customer-oriented ideation was more difficult for the participants than the free ideation. Second, proposing improvement ideas for others in the customer-oriented ideation was more difficult for the participants than the free ideation. Third, the participants feel that they could get better improvement ideas from others on the customer-oriented ideation rather than the free ideation. Fourth, target customers were better defined, and the existence of the needs seems more realistic in forced customer-oriented idea planning than free idea planning. This study tries to get to the bottom of the reason why customer-oriented ideation is difficult as well as show what the benefits such ideation has.

TD-01.3 [R] • Impact of New Resources from Unrelated Person on the Entrepreneur Activity Process in Business Succession in Japan

Kazuhide Namba; Ryutsu Keizai University, Japan

Due to the aging of business owners, business succession of small and medium-sized enterprises and family business enterprises has become a social issue. Business succession not only inherits tradition, but also provides an opportunity to realize second founding and innovation by demonstrating entrepreneurship. If the comprehensive management resources of the previous generation can be smoothly passed on to the next generation through business succession, it will be possible to contribute to the realization of a sustainable society and SDGs. In this study, we conducted a literature survey and consideration of each process of the entrepreneurial activity process of business succession, targeting the case of business succession to a third party (unrelated person) through the increasing number of

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small M & A in Japan. As a result of consideration, the following possibilities were obtained. As a successor manager, third-party working practitioners (middle management, managers, etc.) outside the same family can demonstrate their abilities, and business succession by an outside third party can be smoothly realized. In the discussion, in each entrepreneurial activity process, the viewpoint of business administration, the ability of third-party working practitioners (middle management, managers, etc.) outside the family, the candidates for originality in Japan not found in other countries, the candidates for originality in unrelated person not found in the family were considered.

TD-02 Information & Knowledge Management-1

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Holladay

Chair(s) Charla C Griffy-Brown; Pepperdine University

TD-02.1 [R] • Assessing Digital Literacy: A Systematic Review

Dilek Cetindamar; University of Technology Sydney, Australia
Babak Abedin; University of Technology Sydney, Australia

The paper undertakes a systematic literature review on the neglected topic of digital literacy and its assessment, since digital literacy might be influential in seizing the opportunities offered by digital technologies. Findings of this study clearly show that even though assessments of digital literacy have been carried out at the individual and national level, it is non-existent at the organizational level. However, there are many benefits of finding ways of assessing digital literacy for companies. The paper points out why this is important for digital transformation and offers suggestions for further studies.

TD-02.2 [R] • Lean IT: A Review and Comparative Analysis of Practitioner and Academic Literature

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

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

TD-02.3 [R] • Extracting and Quantifying Actionable Knowledge Using Twitter Data

Bhavana Ramesh; Portland State University, United States
Charles M Weber; Portland State University, United States

Knowledge management is essential for businesses to gain competitive advantage. Social platforms like Twitter, Facebook, and others hold important information external to the organization. These platforms are enablers to creating, sharing and forming opinions about topics of interest. External knowledge management of social data possess two types of challenges to knowledge workers and managers: 1) unfamiliarity of methods to obtain data and distill actionable knowledge; and 2) inability to quantify the acquired knowledge. Without familiarity in methods and quantifiable knowledge, justifying return on investments on the knowledge-related programs is inefficient. This research studies existing methods

- topic mining and sentiment analysis - to obtain actionable knowledge, and it formulates a novel framework to mine external knowledge from Twitter. It also identifies the nature of actionable knowledge metrics that can be applied to a broad knowledge discovery process. The framework is applied on a dataset and the results are discussed. This study benefits knowledge workers and managers by identifying and quantifying actionable knowledge from social platforms. Thus, it provides ROI justifications and contributes toward achieving measurable knowledge value for businesses.

TD-02.4 [A] • Cyber Risk Case Analysis in Wearables and Medical Devices: Developing a Cyberbio Security Risk Framework

Charla C Griffy-Brown; Pepperdine University, United States
Howard Miller; LBW Insurance, United States
Mark Chun; Pepperdine University, United States
Karen Johnson; Pepperdine University, United States

Potential new cyber-attack vectors at the intersection of the cyber-physical and biological interfaces continue to proliferate. For years there has been a growing convergence between data, the digital world, and devices expanding from wearables that collect biometric information to medical devices critical for survival. Malicious actors opportunistically take advantage of unknown weaknesses in the rapid development of these new biodigital systems. Given the disruptive nature of this technology, there is a growing need to understand the associated cyber risk in order to develop a risk-based cyber security approach to help safeguard the emerging cyberbio economy. With this in mind, this investigation posed the following research questions: What are the risks associated with these devices? Can a risk-based approach be validated or extended by exploring breach scenarios and highlighting risks? Multiple qualitative methods were used to analyze case data, business data, and to identify trends. Based on the results, a cyber bio-physical risk-based approach was developed and tested. The results demonstrate that beyond technological and data architecture there is a strong need to further identify and analyze risk associated with cyber-bio convergence.

TD-03 Digital Transformation-1

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Broadway

Chair(s) Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

TD-03.1 [R] • Digital Transformation of Identity - A Crisis Mechanism

Jonathan Barella; Portland State University, United States
Whitney M Langford; University of Oregon, United States
Gary O Langford; Portland State University, United States
Daniel P Burns; Home Port Solutions, United States

The inability to perform identity management in an organization results in extreme harm to information and operational security - both individual and organization are harmed. We apply a highly structured ontological systems approach to explore the implications of identity as it is embedded and used in operational and support infrastructures. The symptoms of a deep-seated insufficiency of identity (access denial, long-waits for adjudication, lost files) have fostered a naive appreciation for managing a person's individuality, distinguishable attributes, validity metrics, trustworthiness, privacy concerns, intentionality, character, and roles. A multidisciplinary definition of identity was developed and evaluated through a stimulus-response / response-stimulus (SR-RS) model. The model results suggest why interactions of one's identity within different contexts present the single, most reliable opportunity for managing identity within a mereological paradigm. Specifically, enacting mechanisms of assertion and ascertainment through processes and directives illustrates why both extensional and intensional logics are necessary for a proper mix of digital and analog mechanisms. Certain digital transformations within the SR-RS model clarify how identity interactions can be used to enable new security structures by applying intensional logic. Whereas complete reliance on extensional logic - user name, fingerprint, passwords, and tokens - results in a demonstrably less secure environment. Identity and trust are essential

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factors for communicating identity.

TD-03.2 [A] • Assessing Relations between Sustainable Business Models and Digital Transformation: A Bibliometric Analysis

Arnauld M Schaller; Bangkok University, Thailand, Germany
Ronald Vatananan-Thesenvitz; Bangkok University, Thailand, Thailand
Amaury A Schaller; Bangkok University, Thailand, Germany

Almost every industry is facing a real risk of disruption from cutting-edge technologies. New technologies drive the digital transformation (DT), which induces significant changes in the business landscape. This reality forces companies to change and adapt their business models to remain competitive. While transforming digitally, companies also face the challenge of complying with sustainability aspects. There is a growing understanding by politicians, managers, investors, and scholars that it is not enough for companies to be concerned with short-term profits because natural disasters, social unrest, and economic inequality can affect long-term prosperity. This paper explores publications related to sustainable business models (SBM) and digital transformation (DT) to uncover common ground between the underlying concepts of sustainability and digitalization. A science mapping approach is applied to review Scopus indexed articles and conference papers related to SBM and DT. This paper aims to reveal the size, growth path, and geographic distribution of the knowledge base and trends in the common SBM and DT literature. It is the first attempt of a bibliometric review for this merged research field and shall guide practical implications and future research possibilities.

TD-03.3 [R] • Exploring Patterns of Academic-Industrial Collaboration for Digital Transformation Research: A Bibliometric-enhanced Topic Modeling Method

Hongshu Chen; Beijing Institute of Technology, China
Yi Zhang; University of Technology Sydney, Australia
Qianqian Jin; Communication University of China, China
Xuefeng Wang; Beijing Institute of Technology, China

Interactions between industry and academia provide inspiration for knowledge fusion, and more importantly serve as a stimulus for both basic and applied research, creating impact and potential opportunities. From the perspective of text mining and co-authorship network analysis, this paper aims to explore the patterns of academic-industrial collaboration using publication data. We propose a bibliometric-enhanced topic modeling method to profile the core constituents of industry and academia collaborative hotspots in digital transformation research, using a 10-year publication dataset from 2009 to 2018 extracted from Web of Science. We then examine interactions and distinctions between topics authored by only academic researchers and having industrial collaboration to further develop a comprehensive understanding of the content and driving force of industrial engagement. The empirical insights of this paper provide a detailed picture of academic-industrial linkages, which potentially can be used to lead academics to engage with industry, and assist innovation management and problem-solving in digital transformation research and practice.

TD-04 Intellectual Property-2

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Weidler

Chair(s) Scott Schaffer; Schaffer IP Law, LLC

TD-04.1 [R] • Structuring the Core Competencies of a Major Car Manufacturer in a Technology Field: Applying Semantic Anchor Points to General Motors' Gearing Technology

Lena L Kronemeyer; University of Bremen, Germany

In order to stay competitive, companies develop a set of core competencies, many of which are based on technological know-how. This technological know-how, along with the efforts of R&D projects, is displayed in those companies' patent portfolios. Large companies often

have a large patent portfolio, comprising various technologies. In order to understand a company's position within a technology, it seems helpful to structure its core competencies. For a similar purpose, several authors developed a method based on semantic anchor points. While this method works well for smaller companies with a limited number of patents in one field, the question arises, whether and how this method can be applied to a major manufacturer with a comparatively large number of patents. In this paper, General Motors and their patents in the technology field of gearings are used to test the method. We have to divide the data set of General Motors due to their special patenting strategy. Using the cluster-specific semantic anchor points, specific technological know-how of General Motors is identified, and the competencies are analyzed in the course of time. For instance, three clusters of competencies could be identified. Two clusters describe the core competence of General Motors - the application of planetary gear sets. One cluster comprises a basic set of diverse competencies, which we call the follower-cluster.

TD-04.2 [R] • Patenting Strategies of Domestic and Foreign Players in the Indian Machine Tool Industry: A Comparative Study Using Multidimensional Scaling Approach

Mahak Bisen; Indian Institute of Technology Madras, India
L Prakash Sai; Indian Institute of Technology Madras, India

Capital goods industry, termed mother industry, has been garnering the attention of developing economies for several decades. Given the strategic importance of the machine tool industry in the manufacturing sector, the Indian Government has been supporting the industry with policy impetus founded on the self-reliance principle to close the import-export gap. The present study analyzes the trends in the machine tools imports and also the patents filed in India. Comprehensive research studies to explore various facets of macro-micro linkage at national and firm levels have been warranted to augment technology foresight exercises. We propose to investigate patenting strategies of foreign firms in the domestic market. The study involves a review of 1180 patents on CNC metal cutting machine tools filed in India. The analysis of patents-related data using multidimensional scaling (MDS) approach provides insights into the R&D capabilities and technology positioning of the machine tool firms - both domestic and foreign. The MDS utilizes three patent indicators, namely, priority year, IPC classification codes and inventor count. CNC metal cutting machine tool segment has been selected for exemplification of the multivariate approach adopted for the study.

TD-04.3 [R] • Intellectual Property Rights Management Standard, Innovation Capability and Market Value: Evidence from China's Firms

Ling Wang; China University of Political Science and Law, China
Yating Li; China University of Political Science and Law, China
Qianyu Zhai; China University of Political Science and Law, China
Xiaodan Yu; University of Nottingham Ningbo China, China

Intellectual Property Right Management Standard (IPRMS), as a voluntary-based and non-traditional IPR policy, is advocated by China National Intellectual Property Administration (CNIPA) to enterprises in China to improve their corporate IPR management. Based on the theory of knowledge management and corporate political action, this paper aims to assess the hypothesis that IPRMS affects the innovation capability and market value of enterprises and then explores the moderating role of industrial attribute, i.e., high-tech industry. Exploring a panel data of listed firms in China from 2013 to 2019 and adopting the propensity score matching and difference-in-difference method, we find that IPRMS display a positive role on firms' innovation capabilities but show a negative effect on corporate market value. Furthermore, the high-tech attribute of industries enhances the positive effect on a firm's innovation capabilities while it strengthens the negative effect on corporate market value.

TD-05 Artificial Intelligence-2

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Morrison

Chair(s) Naoshi Uchihira; Japan Advanced Institute of Science and Technology

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TD-05.1 [R] • The Impact of Artificial Intelligence on Firm Performance

Taekyun Kim; KAIST, Korea, South

Yejin Park; KAIST, Korea, South

Wonjoon Kim; KAIST, Korea, South

Artificial intelligence has not only the potential to influence services and products but also change the existing innovation process itself. While AI creates economic and technological disruption within firms' competitiveness by serving as a General Purpose Technology (GPT), the focus of the previous literature has been made to the impact on AI on macro economy and employment substitution. To fill this gap, this paper investigates the relationship between the adoption of AI technologies and firm performance such as firm value, profit and cost structures. We identified 105 listed firms in the U.S. that have adopted AI technologies from 2008 to 2014, and tested the relationship using Difference-in-differences (DID). Our empirical findings indicate strong evidence for the positive relationship between AI and firm value. In addition, we find that automation AI has significant and positive impacts on the firm's cost structure, while we do not find evidence of the effect of augmentation AI on the firm's profit and cost structures. Finally, we discuss implication of AI adoption by firms for academic literature and firm strategy for AI technologies.

TD-05.2 [R] • Project FMEA for Recognizing Difficulties in Machine Learning Application System Development

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

Digital Transformation (DX) is spreading across all industries. AI, especially machine learning, is inevitable for effective use of data collected and stored in DX, and systems that utilize machine learning have been developed in various industries and companies. The development of machine learning application systems (MLASs) has many difficulties different from the traditional IT system development. Therefore, software engineering (especially project management) for MLASs becomes one of the most important issues in these days. We classified the difficulties of MLAS development based on various documents and interviews and created a difficulty map consisting of 12 categories. Unique features of this difficulty map include introduction of the relationship between difficulties and the dual MLAS development process (implementation process and exploitation process). Then, we propose a method of expressing and sharing these difficulties among stakeholders based on MLAS Project FMEA (Failure Mode Effect Analysis). The proposed method is evaluated using two illustrative MLAS examples.

TD-05.3 [R] • Quantum Science and Technology to Support of Technology Management in Combating Technological Singularity

Karoly Nagy; BME-UBT Joint Transformative Research Centre, Kosovo

Edmond Hajrizi; UBT Higher Education Institution, Kosovo

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

TD-06 TUTORIAL: Improve Your Innovation Odds - Share and Explore Innovation Processes with International Practitioners Who Are Developing ISO Standards for Innovation

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Ross Island

Speaker(s) Irene C Makar; ISO 56002 Innovation management

Innovation is hard work at best, and managing essential components of innovation, such as IP, is even more of a challenge. Both public and private entities are increasingly concerned about the performance and cost effectiveness of research and development and related innovation investments. At the firm or institutional level, the critical issues lie with understanding what factors can affect the "Effectiveness and Efficiency" of innovation activities. Everyone involved with innovation is looking for the magic formula. This tutorial will engage attendees, share experiences, and help participants gain an understanding of a systems and component-approach to innovation. The discussion will also demonstrate the ISO approach to the developing international standards, and how such standardization can contribute to more effective innovation. The tutorial will facilitate discussion about how participants are managing innovation today, the problems they confront in managing innovation, why innovation standards might be beneficial to them, and how they can participate in the on-going innovation standards development process.

TD-07 S&T Policy-2

Tuesday, 8/9/2022, 14:00 - 15:30

Room: Sellwood

Chair(s) Nasir Sheikh; Portland State University

TD-07.1 [R] • Acquisition of Commercial-off-the-shelf (COTS) Unmanned Aerial Systems: Lessons Learned from the South Korean Military

Sungjin Kim; The State University of New York, Korea, South

Nasir J Sheikh; Portland State University, United States

To promote Industry 4.0, the Korean government encourages the military to introduce commercial unmanned aerial systems (UAS). The following issues have arisen as a result of introduction programs implemented since 2017. First, different legacies for each military unit make it difficult to establish common terms. This leads to confusion when it comes to drafting common policy guidelines for policymakers. Second, the rapid introduction of commercial technology is hampered by the existence of separate bureaucratic organizations and document systems. The bureaucratically separated acquisition system makes it difficult to document the military's requirements for applications not fully specified and changes in requirements are inordinately slow. Third, acquisition strategies continue to be dominated by a platform-centric concept. By default, the commercial UAS relies heavily on civilian information and communications technologies. Because of platform-centric technology planning, it is difficult to envision the commercial UAS as a portal of diverse connected industries. Based on South Korea's experience, we highlight lessons learned when using the military to drive Industry 4.0 technologies at the strategic national level. The areas covered include legacy of different military units, immediate decision-making structures, and the use of open platforms.

TD-07.2 [R] • A Study on the Policy Instrument and RIS Framework for Mekong Delta Region

Wonju Hwangbo; Ewha Womans University, Korea, South

Young Il Park; Ewha Womans University, Korea, South

This study investigated the policy instruments of key tasks required to deal with industrial and technological innovation issues and establish a regional innovation system in the Mekong Delta region in order to find countermeasures by injecting scientific and technological factors to solve the current problems of the region. First, we conducted the research with regard to the status and environment of the region. Second, a field visiting survey was implemented

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to analyze the results of international efforts and regional capacity to solve the problems attendant upon introducing technologies related to the Fourth Industrial Revolution. Third, we derived the key policy issues and challenges from the results of field visiting survey and experts' conference with a deep focus on technological transfer and international cooperation to enhance the capability in the science and technology field. Fourth, we conducted the opinion survey of the experts from Korea and Vietnam, to converge local opinions from both countries, and analyzed the results. Sixth, we transformed the RIS Framework by a basic model of Cooke & Memedovic (2006). The range of research subjects is responding to climate change, managing water resources, coordinating energy and industrial structure, making a resilient Mekong regional ecosystem, smartification of local cities, and improving life quality of citizens, and so on. The results of this study are expected to be the beginning of fundamental research in the mid- to long-term view of the Mekong Delta region innovation system of Korea and Vietnam and to evaluate the master plan.

TD-07.3 [R] • Exploratory Identification of Factors Affecting GDP by Ensemble Machine Learning

Shino Iwami; NEC Corporation, Japan

This research computed the importance of the Organization for Economic Cooperation and Development (OECD) data for gross domestic product (GDP) by the means of ensemble machine learning in an exploratory way. The factors with high importance scores will be beneficial to make decisions about what should be invested in for economic growths. In the previous century, the Solow-Swan model suggested that GDPs are affected by capital stock, labor force, and productivity with technology. Currently, in addition, new factors such as bank interest and energy are identified in the field of development economics. Ensemble machine learning can compute a model with 165 factors and reveal shifts of the factors affecting GDP. Consequently, this research found that renewable energy and transport are increasing contributions to GDP.

TE-01 Innovation Management-4

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Multnomah

Chair(s) Oliver Yu; San Jose State University

TE-01.1 [R] • Innovation Marketing in the 21st Century: A Total-System Approach to Meet Future Challenges

Rainer P Hasenauer; WU-Wien, Austria

Oliver Yu; San Jose State University, United States

Innovation, simply defined as an idea implemented with significant impact, faces unprecedented marketing challenges for the 21st century, resulting directly from the paradigm shifts in human needs and values as well as in the global environment. This paper first introduces the interactive system of key innovation participants, and their common investment perspective for idea implementation, followed by a new model for human needs to explore the participants' investment values and risks. It proceeds to present a unified application of marketing concepts to the innovation process based on the key participants' needs and values. The paper then discusses the conditions for innovation market entry in an integrated economic-ecological-societal system. It next describes how these conditions have fundamentally changed in the 21st century due to multi-century economic expansion, exponential technological growth, and rapid environmental deterioration. It analyzes the long-term causal effects of these major changes on new market emergence and existing market behavior in the 21st century. Finally, the paper outlines a total-system approach to innovation marketing for the 21st century that aligns the values of all key innovation participants to meet the enormous challenges of the critical, fast-changing yet unknown futures, which requires analysis of the impacts on participants' values in the integrated economic-ecological-societal system and studies of critically important unknowns in the future through new tools like advanced IT and neuroscience.

TE-01.2 [R] • Measuring the Innovation Capacity and Performance of

Organizations: A Balanced Scorecard Approach Combined with Analytical Network Process

Wellington L Rocha; PUC-Rio, Brazil

Maria F Almeida; PUC-Rio, Brazil

In light of the previous works carried out within the scope of Balanced Scorecard (BSC) theoretical framework and the multicriteria decision-making methods, this paper's main issue is to enable organizations to measure and evaluate their innovation capacity and performance with a systemic approach based on the BSC framework. This paper proposes a model for measuring and evaluating organizations' innovation capacity and performance adhering to the following principles: multi-dimensional structure, cause-effect relationship analysis, strategic innovation orientation, and easy implementation. Aligned with these principles, the proposed model combines the BSC framework with the Analytical Network Process (ANP) method and fuzzy logic. The ANP method considers the interdependencies among and between the model components and provides synthetic scores associated with the strategic innovation objectives, established according to the BSC methodological approach. The conceptual model here proposed and the future empirical developments of this research may improve current innovation capacity and performance measurement practices. The integration of the ANP method into the BSC management framework can be considered a differential compared to these practices.

TE-01.3 [R] • Self-Assessment Model Based on ISO 56002:2019 Standard for Evaluating the Innovation Management System of Organizations

Felippe V Gomes; PUC-Rio, Brazil

Maria F Almeida; PUC-Rio, Brazil

The ISO 56002:2019 standard is the international reference for guiding the establishment, implementation, maintenance, and continual improvement of an innovation management system in established organizations that seek sustained success by their capacity to manage Research, Development, and Innovation (RD&I) activities. Based on ISO 56002:2019 guidelines, we propose a self-assessment model for evaluating innovation management systems at the organization-level, integrating the Analytic Network Process (ANP), fuzzy logic, and the Importance-Performance Analysis (IPA) method. This model's applicability could be demonstrated in the context of an innovative electricity distribution company in Brazil. The conceptual model here proposed and the empirical results concerning an application in a corporate context may improve current innovation management practices adopted by organizations in general. This multicriteria approach combined with fuzzy logic can contribute significantly to the assessment of innovation management systems since it can absorb the subjectivity of human judgments during evaluation processes and enable the criteria interaction in the focus standard. The potential contributions of the proposed self-assessment model for the continuous improvement of innovation management systems at the organization level are discussed.

TE-02 PANEL: Meet the Editors

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Holladay

Panelist(s) Harm-Jan Steenhuis; Hawaii Pacific University

Jin Chen; Tsinghua University

Charla C Griffy-Brown; Pepperdine University

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.

TE-03 Digital Transformation-2

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Broadway

Chair(s) Gary O Langford; Portland State University

TE-03.1 [A] • A Service Model to Support Digital Transformation of SMEs

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Takashi Iwamoto; Keio University, Japan
Jiro Matsuba; Neo Career, Japan

Various cloud applications have been developed to support digital transformation of LEs (large enterprises) in the world, but there are not so many cloud applications to support digital transformation of SMEs (small and medium enterprises) in Japan. One big reason is that it is not easy to develop low-cost cloud applications for which SMEs are capable of paying service fees. Neo Career, which is one of the fastest growing cloud application vendors in Japan, could develop low-cost cloud applications for SMEs and released a product by the name of "jinjer" in January 2016. Jinjer has been rapidly deployed and about 11,000 SMEs are using jinjer as of October 2019. The survey was conducted to study an ideal service model to support digital transformation of SMEs. From the results of the survey for 1,000 jinjer users, it was found that the following two factors were most effective to accelerate digital transformation of SMEs. The first factor was that various workflows were automated and real-time, and the second factor was that jinjer could accommodate various functions on a single platform. Also, an ideal service model for the future cloud application was proposed through analysis of the survey.

TE-03.2 [R] • Knowledge Path Versus Goal-driven Strategy for Digital Transformation

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

Traditional organizational strategy is meant to create change from how your customers think you rationalize sales and support to what your customers and you need. By fostering a sense of stability, providing consensus view, directing resources, and controlling activities, strategic planning is an expected cornerstone in modern organizations. Over the past 80 years, goal-driven strategies have led digital transformations to unlock new markets, enhanced value-driven revenues, and created a closer kinship between customers and providers. While one presumes goal-driven strategies are best practice for digital transformation, this article explores knowledge paths as an alternative approach. Habitual, emotional, associative, rule-based, and knowledge paradigms do not require embedded goals. Using a systems approach that clarifies the ontological differences between influences and objects, we propose a new explanation for limiting goal-directed strategies. Applying a mapping function that relates functional performance to loss, we construct a novel dataset allowing us to compare like kind results of goals and knowledge-path strategies. These findings offer organizations, with strong identities and experienced management teams, rapid integration of digitally transformed processes into a comprehensive business model. We illustrate how data (rather than process) organizes product/service competition and objectifies purchasing behaviors.

TE-04 Intellectual Property-3

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Weidler

Chair(s) Yaeko Mitsumori; Osaka University

TE-04.1 [R] • An Analysis of the Indian Pharmaceutical Industry's Business Model

Yaeko Mitsumori; Osaka University, Japan

The Indian pharmaceutical industry ranks third globally in terms of volume. Due to the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which was enforced in 1995, India revised its patent law in 2005 and reintroduced product patents. Taking advantage of this, large Indian pharmaceutical companies started investing significant amounts of resources into research and development (R&D) and launched new drug development. Today, such companies have pipelines and have been conducting pre-clinical and clinical studies. In addition, they started exporting their products not only to developing countries but also regulated markets and have been successfully expanding their market shares in these countries. This study examined the transformation of the Indian pharmaceutical industry by analyzing intellectual property rights (IPR) data. This study may provide useful information to other developing countries that would develop their

own industries.

TE-04.2 [R] • Comparing IP Policy on Access to COVID-19-related Medical Products between Japan and India

Akiko Kato; Nihon University College of Law, Japan
Yaeko Mitsumori; Osaka University, Japan
Koichi Kamijo; Int'l Professional Univ. of Technology in Tokyo, Japan
Hiroshi Kato; Nihon University, Japan

It is thought that Japan is one of a handful of countries that have sufficient R&D ability to develop new pharmaceutical products. However, Japan has recently been revisiting its national policy to reinforce the local production ability for medical products combating infectious diseases, based on the failure to develop a COVID-19 vaccine. In contrast, India has a long experience exporting generic and/or voluntarily licensed pharmaceutical products to the world. However, India has not been able to fulfill its national demand, caused partly by the national provision system. Confronted with this contradiction amid the COVID-19 pandemic, India has no choice but to restrict their exportation of medical products responding to COVID-19, and India and other developing countries have proposed to the WTO TRIPS Council to ask for WTO members to recognize an IP protection waiver as far as needed to deal with the pandemic. This paper analyzes what divides the postures of these two countries, by comparing their national and global policy on pharmaceutical R&D and IP protection, before and after COVID-19.

TE-05 Environmental Issues-1

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Morrison

Chair(s) Kelly R Cowan; University of New Mexico

TE-05.1 [R] • A Critical Analysis of Developing an Eco-Industrial Park

Takalani Nemarumane; University of Johannesburg, South Africa
Jan-Harm C Pretorius; University of Johannesburg, South Africa
Andre Vermeulen; University of Johannesburg, South Africa

This study conducted a critical assessment on the development of Eco-Industrial Parks. The aim of the research was to identify if there is a gap in the development of Eco-Industrial Parks in South Africa. The focus on Eco-Industrial Parks in South Africa is necessary as it would lead to the reduction of the informal Industrial Parks so that it may be on par with competitive countries in terms of the innovation and environmental preservation. The objective of the study was to identify the necessity to develop the current industrial parks into Eco-Industrial Parks. This study was conducted through literature analysis. The researcher developed assessment criteria that focused on the application sector, location and business type. It was found that a gap in the development of Eco-Industrial Parks existed in the service sector. It was also found that there was no development of Eco-Industrial Parks in South Africa, South Western Townships, and in the informal sector.

TE-05.2 [R] • Analysis of Key Contributors to Process Safety Incidents in the Chemical Process Industry

Rialivhuwa Nekhwevha; University of Johannesburg, South Africa
Arnesh Telukdarie; University of Johannesburg, South Africa

Process safety incidents involve the release of hazardous chemicals from primary containment, which are potentially catastrophic to personnel, assets, and the environment. The severity of process safety incidents is determined by the rate of release, chemicals properties, and the quantity of hazardous chemicals released. Occupational Safety and Health Administration (OSHA) developed 14 PSM elements, with the objectives of reducing catastrophic process safety incidents in the chemical process industry. This research aims at investigating the key contributors to process safety incidents in the chemical process industry. The research study results should assist the chemical process industry to ascertain key contributors to incidents across the world. It remains crucial for organizations to understand process safety incidents' root causes and share the learnings from previous incidents. Sharing of learning

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from previous incidents remains critical in the incident prevention efforts. In this research paper, a multiple case studies approach is selected for critical evaluation of 63 case studies to determine incidents root causes. The identified root causes are further analyzed using process safety incident evaluation framework to determine PSM element failures. The case studies are obtained from several process safety incidents databases such as the Centre of Chemical Process Safety (CCPS), Health and Safety Executives (HSE), and Chemical Safety Board (CSB). Based on the results the key contributors are identified to be operating procedure (21% of total process incidents), process hazard analysis (17%), mechanical integrity (16%), management of change (14%), and training (11%). In-depth analysis on individual PSM element is made for better understanding of element failure causes.

TE-05.3 [R] • Corporate Behavior toward Environmental Regulation

Kenji Nagasato; University of Hyogo, Japan

In recent years, environmental regulations have become more complex and uncertain. What kind of response should chemical companies make to these environmental regulations? There are many chemical companies in the world, and they are likely to have different ways of responding to regulations. In such a case, how should corporate behavior be carried out? The purpose of this study is to examine how corporate behavior takes place when there are multiple players. As a result of a case study of chemical companies belonging to an industry association, it was found that they were divided into two groups seeking the same direction, and that each group acted to gain social legitimacy. One group attempted to gain legitimacy by making sacrifices, such as discontinuing the production of their main product. These series of actions involve the existence of institutional entrepreneurs, and I would like to discuss their role in these actions. In this paper, I have used the case of chemical companies' responses to environmental regulations, but I believe that it will provide useful suggestions for corporate behavior in other industries as well.

TE-05.4 [R] • Climate Change, Energy Transition, and Evolving Social Values: Reflecting on a 'Clean Energy Decade'

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

Addressing climate change caused by greenhouse gas emissions from fossil fuel use has been a matter of great urgency for decades and has only grown in importance over the last 10 years. The development of technologies, such as those used for renewable electricity generation, have proven to be important tools for the reduction of greenhouse gases and the mitigation of climate change. While many of these technologies have steadily improved their performance characteristics and cost effectiveness, particularly over the past decade, social values regarding related issues have not always proceeded in a similarly consistent fashion. In fact, the values linked to climate change mitigation technologies appear to be dependent on a complex mix of variables. This paper examines and updates work from two studies on these topics in 2009 and 2013 and looks at overall progress that has occurred in the field over the last 10 years. With the benefit of hindsight, we can now go back and see how trends in these areas developed both technically and socially. Thus, this paper examines the technological and social progress that has occurred over the last decade and proposes ways that various factors and data points could be incorporated into new models to predict where future trends may develop.

TE-06 R&D Management-2

Tuesday, 8/9/2022, 16:00 - 17:30

Room: Ross Island

Chair(s) Charles M Weber; Portland State University

TE-06.1 [R] • Selective Absorption of Knowledge: How R&D Project Groups Can Harness the Power of Absorptive Capacity

Patravadee Ploykitikoon; NECTEC, Thailand
Charles M Weber; Portland State University, United States
Nitin Mayande; Telligence Corporation, United States

An empirical study of 208 R&D projects in the national laboratories of one country finds that the impact of knowledge stocks and knowledge flows on project performance is highly nuanced and differentiated. Knowledge within an R&D project group—the knowledge stock—tends to moderate knowledge that flows into the group. Whether the knowledge in the stock acts as a complement to or a substitute for knowledge inflow depends upon combinations of a variety of factors: the original source of the knowledge; the pathways and mechanisms through which knowledge flows into the project group; the nature of that knowledge; and whether the R&D project was primarily exploitative or exploratory. These findings imply that managers can selectively absorb knowledge by choosing types of internal knowledge, types of external knowledge and knowledge pathways, which—in conjunction—enhance the performance of a specific project. Conversely, they can deemphasize knowledge pathways or filter out types of knowledge that diminish performance or add little value. The paper contributes to the literature on the micro-foundations of absorptive capacity by providing a more granular view of absorptive capacity in project groups.

TE-06.2 [R] • Team and Members' Contribution to Inventions: Diversity from Individual and Team

Taro Daiko; Tokyo Institute of Technology, Japan
Yuya Kajikawa; Tokyo Institute of Technology, Japan

Effective team building is widely considered to be an essential factor of research and development. The purpose of this paper is to explore how team profiles and individual profiles affect team performance, respectively. We focus on technological diversities as a vital profile of both teams and individuals. We examine the relationship between diversity and team performance using patent bibliographic data and patent citation analysis on U.S. patents. Our results show that both interpersonal diversity and generalist inclusion affect teams' inventive performance. From the perspective of team construction, the result indicates that management could flexibly apply interpersonal diversity or generalist inclusion. We hope that our findings could be helpful for team management and human resource in research and development.

TE-06.3 [R] • A Project Classification System for R&D Portfolio Management in the Oil and Gas Sector

Milton F Chagas Junior; INPE, Brazil
Gabriel T Jesus; INPE, Brazil
Irineu S Yassuda; IFSP, Brazil
Marcos Nóbrega; Petrobras, Brazil
Feliciano Silva; Petrobras, Brazil
Pedro M Sousa; Petrobras, Brazil
Carlos Alexandre F Gama; Petrobras, Brazil

Properly selecting technology development projects is critical for a sustainable competitive advantage. Strategic buckets and adequate prioritization tools need to be crafted by the business environment. The literature on R&D portfolio management has evolved in the last decades, but still, it does not tackle some specificities of innovation dynamics in Complex Product Systems (CoPS). The research objective is to develop a project classification system for R&D portfolio management in CoPS, using oil and gas projects as case studies. The research method uses Design Science Research applied in projects from an R&D portfolio of a Brazilian oil and gas owner. The proposed method combined elements from the diamond model to innovation, product and technology development management tools, and strategic systems development, emphasizing the appropriate balance between technology-push and demand-pull in CoPS innovation dynamics. The method comprises a unique set of strategic buckets, a customized version of the diamond model considering uncertainties for CoPS and commercial development for oil and gas, and a set of evaluation tools recommended for each strategic bucket. The research contributes to CoPS R&D portfolio management, especially in the oil and gas sector.

TE-07 S&T Policy-1

Tuesday, 8/9/2022, 16:00 - 17:30

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Room: Sellwood

Chair(s) Deok Soon Yim; Science and Technology Policy Institute

TE-07.1 [R] • Macro-Innovation 2.0: Re-birth of Large-scale Innovation

Mel Horwitch; MIT-Sloan School, United States

This paper examines ongoing roles and evolution of large-scale technology undertakings, called macro-innovation, from World War II to the present. It identifies two types of large-scale innovation undertakings. Macro-innovation 1.0 refers to those efforts, common from World War II until the 1970s, which, although huge and complex, were generally finite in lifespan, bounded, and well-defined in terms of mission. Macro-innovation 1.0 was especially prevalent in defense, aerospace, and infrastructure, e.g., the Polaris, Apollo, and US Interstate Highway programs. Macro-innovation 2.0 refers to more recent initiatives, which, although also huge and complex, are also more open-ended, less specific in end objectives, more knowledge-intensive, and often have as overall purposes enhancing sustainability, national competitiveness, and other society-wide innovation capabilities. Offered as illustrative examples of macro-innovation 2.0 are smart city, startup accelerator, and national artificial intelligence (AI) strategy initiatives. The advent of macro-innovation 2.0 signals a re-birth of macro-innovation after a period of disappointment and transition. The evolution of industrial policy is also discussed and shown to provide a mirror for understanding how macro-innovation overall has changed over the last 75 years and how macro-innovation has more recently regained its prominence. Implications for the salience, implementation, and success of macro-innovation today are also provided.

TE-07.2 [R] • A Study on the Sustainability of Science, Technology and Innovation (STI) Official Development Assistance (ODA) Projects

Deok Soon Yim; Science and Technology Policy Institute, Korea, South
Eun Joo Kim; Science and Technology Policy Institute, Korea, South
Ji H Kim; Science and Technology Policy Institute, Korea, South
Seona Lee; Science and Technology Policy Institute, Korea, South

As the internal technological capacity building in developing countries is critical for the national development, the official development assistance projects of international society are moving to more on the science and technology capacity related subjects. In case of Korean ODA, the topics of the projects vary from consulting S&T policy to establishing related institutions. This study identifies the factors affecting the sustainability of those projects by visiting cases. It is found out that the absorptive capacity and willingness to learn of recipient organizations are critical factors to ensure the success and sustainability of those Science, Technology and Innovation (STI) ODA projects. Based on this study, it is suggested that those factors of the recipient organizations should be more considered from the when the projects are designed and planned.

TE-07.3 [R] • A Study on the Method of Calculating S&T ODA Statistics

Hee Jong Kang; STEPI, Korea, South
Deok Soon Yim; STEPI, Korea, South

It is important for the developing countries to secure the technological capacity using the international aids of development countries. It is also known that the Science and Technology (S&T) ODA have a greater impact on the economic growth of recipient countries than other sectors such as education, health and energy. However, there is not an officially recognized definition of S&T ODA and the research on S&T related ODA is not enough. In this study, the authors define the S&T ODA concept and present the method of calculating S&T ODA statistics using Creditor Reporting System (CRS) purpose code, channel code, project description and ODA disbursement. S&T ODA statistics were calculated using the original ODA statistics provided by the OECD Development Assistance Committee (DAC). It is found out that the spending on S&T ODA in major countries (Korea, USA, Japan, Germany, France, UK) is about 4 billion dollars (2017), which is 4 percent (2017) of the total ODA spending. Korea's spending on S&T ODA was about 39 million dollars (2017), and it is far below education (190 million dollar), health care (120 million dollar), agriculture, forestry and fisheries (100 million dollar) and administration (80 million dollar) sectors. In this research,

the method of calculating S&T ODA was presented and S&T ODA trend can be found using authors' methodology. It is hoped that the methodology is further developed and refined and officially recognized by concerned international authorities. In this way, it could provide valuation information for S&T ODA which is necessary to strengthen the technology capacity building of developing countries.

TE-07.4 [R] • Identifying Quantitative Research Levels in Nanocarbons Using Semi-automatically Extracted Vocabularies

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

In natural science, research levels can be classified as "basic" or "applied." Identifying transition processes from basic to applied research helps to understand the science and technology strategies of countries and companies. The field of nanocarbons has undergone a transformation phase whereby the technology has become matured after many years of basic research, and applied research is currently flourishing. However, the identification of research levels for a comprehensive understanding has only been done in the biomedical field. Here, we develop a novel method that quantitatively captures the macroscopic maturity of nanocarbon research. By statistically extracting nearly 7,000 technical terms based on a topic model, the method calculates continuous scores of technology maturity for each scientific paper. The transition of the scores over the past 50 years for the five countries shows that the research trend has been tending towards applied research with the passage of time. In China especially, research levels go to "applied" faster than in other countries. In technological fields that require a long period of basic research, this method enables us to capture research maturity in a macroscopic and quantitative manner. Such a comprehensive perspective can provide a view on the commercialization of technologies. Therefore, comparing the index among countries and research institutions may help make investment decisions for technologies that require basic scientific research.

WA-01 PLENARY - 3

DATE: WEDNESDAY, 8/10/2022
TIME: 08:30-10:00
ROOM: MULTNOMAH
CHAIR: HARM-JAN STEENHUIS; HAWAII PACIFIC UNIVERSITY

WA-01.1 [K] • Do We Need a New Science of Technology and Its Management?

Aaron Shenhar; Rutgers University, United States

Yes, we do! At a time when technology is our most powerful driver of growth, prosperity, and life-improvement, there is still no common definition of what exactly is technology, and no common science for studying it or its management. Needless to say, as humanity is facing growing challenges such as climate change, global health hazards, pollution, and cyber and terror attacks, the need for more extensive management studies only intensifies. Dr. Shenhar will claim that society's mounting challenges today require a multidisciplinary approach for integrating distinct technologies, and management, into a unified field. Technology should be seen as the deliberate pursuit of collective creation, that combines the knowledge and the means for doing it. Technology management science will emerge as an integrative field, dedicated to studying how modern society generates its complex solutions, and to educating future leaders of such efforts. Since technology is built by people and for people, this science will not only involve STEM graduates, but also graduates of the humanities, fine arts, and social sciences, who would study, among other things, the emotional, risk, and ethical sides of technology, while jointly creating a deeper comprehension of humanity's creative spirits.

WA-01.2 [K] • The Dynamics of Competition and of the Diffusion of

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Innovation

James M Utterback; Massachusetts Institute of Technology, United States

The purpose of this talk is to briefly review our understanding of the emergence and diffusion of innovation and to provide a new and more nuanced model of diffusion. The point of departure is to abandon the idea that innovation results only in pure competition, or a zero-sum game, between new and established practices. Given evidence from many cases, the authors believe it more likely that at least at the beginning of races between new and older products, processes and services, growth of one will often stimulate growth of the others. We will term this symbiotic competition. Later the interacting technologies may fall into a cyclic state termed predator-prey competition, and finally a zero-sum game of pure competition may ensue. A main contribution is formulation of a general solution for multi-technology, multi-mode competition. The equations derived can be used to model the interaction of any finite number of technologies where the interaction among any pair can either be pure competition, predator-prey or symbiosis. The model allows determination of the mode and strength of the interactions of competing technologies as they evolve. It includes work with Calie Pistorius (Stellenbosch University) and Erdem Yilmaz (MIT SDM 2017).

WB-01 Technology Roadmapping-1

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Multnomah

Chair(s) Nathasit Gerd Sri; Mahidol University

WB-01.2 [R] • Customization of Roadmap: Human-in-the-loop Topic Modelling Approach

*Jae-Yun Ho; Yonsei University, Korea, South
Keeheon Lee; Yonsei University, Korea, South*

Since the first application of technology roadmapping in the late 1970s to support integrated product-technology planning in consumer electronics, roadmapping concepts and methods have been widely extended to general strategy and policy applications across diverse areas of technological domains and innovation contexts. This is mainly due to the communication benefits associated with roadmapping to support effective decision-making, along with its flexible and adaptable nature to suit the particular needs of individual organizations in diverse contexts. While this demands careful design of the roadmap structure that is appropriate for different purposes and needs of roadmapping, there is a lack of specific guidance supporting the experts for effective customization of roadmap framework. Recently, however, an increased degree of customization is required in designing roadmap structures and frameworks, due to extended scopes and needs of roadmapping in a wide variety of application contexts, where different meanings of the word 'roadmap' are used. In this regard, this paper examines how various meanings and uses of roadmapping are applied across diverse thematic contexts with different focus of issues, by analyzing scientific publications on 'roadmap' using a proposed human-in-the-loop topic modelling approach. It is expected that such analyses will provide roadmapping practitioners greater insights to design appropriate roadmap structures that can support effective dialogue and communication across diverse contexts where roadmapping is increasingly being used.

WB-01.3 [R] • Applying System Dynamics to Enhance the Development of Scenario-Based Roadmaps

*Pawat Tansurat; Mahidol University, Thailand
Nathasit Gerd Sri; Mahidol University, Thailand*

Technology roadmapping (TRM) has been recognized as the approach for strategic planning, especially for technology-driven companies. The recent research aims to enhance the robustness of the TRM process in order to cope with rapid change of technologies, business uncertainties, and constant shift of customer behavior. Scenario analysis is one of the techniques that has been considered to integrate with roadmapping so that the management team can gain insights on future possibilities. This paper extends the analysis to strengthen scenario-based roadmapping by applying system dynamics (SD) to generate conditions for different scenarios and then integrate into roadmaps. With the proposed approach, it will

make a roadmap not only more responsive to deal with uncertain circumstances but also it can be used for mitigating foreseeable risks while aiming to pursuing potential opportunities.

WB-02 Technology Adoption

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Holladay

Chair(s) Khaleel Malik; The University of Manchester

WB-02.1 [R] • The Dynamics of Innovative Industry Networks During Digitalization

*Sehee Park; Korea Institute for Advancement of Technology, Korea, South
James Larson; Stony Brook University, SUNY Korea, Korea, South*

Digitalization rapidly transforms the network structure of industries. The diffusion of mobile technology has changed not only our daily lives but also business strategies. According to the Sectoral Innovation Systems (SIS) theoretical framework, digitalization is one of the main factors that co-evolves with actors, market or non-market interactions, and institutions. However, most recent research focused more on the life cycle of products or the learning process than on the interactive dynamics among SIS factors. There is limited empirical evidence about the extent to which digital technology co-evolves with industrial networks. This research applies social network analysis (SNA) methodology with the SIS framework, to examine the rate of network evolution and the behavioral changes of firms in the game software industry (GSI) in Korea undergoing digitalization. The GSI network had 1,813 firms with 2,210 directed business transactional links between 2008 and 2017. Major empirical findings are as follows. Firstly, the GSI network structure was highly sparse, with an average density between 0.002 and 0.006 on a scale from 0 to 1. The network diameters varied from 2 to 5. Secondly, the largest component of the GSI network had a dramatic transformation between 2011 and 2014, after the adoption of smartphones in 2010. Digitalization completely transformed the GSI. Finally, the Stochastic Actor-Oriented Model (SAOM) could not confirm a significant role of digitalization on the evolution of the GSI network. However, it indicated a negative influence of knowledge stock in the network evolution.

WB-02.2 [R] • Adoption of Digital Tools: Insights from a MNC Technology Roll-out Project

Khaleel Malik; The University of Manchester, United Kingdom

This paper presents an exploratory research case study on issues related to the adoption of digital tools inside a multinational company (in FMCG sector). It examines how R&D engineers react to adoption of digital technologies, to what extent they see new tools as an opportunity for them to improve their performance and whether there are any changes in work routines. We briefly introduce international technology transfer literature where technology roll-out is linked to disseminating key knowledge to foster continuous organizational learning. We present insights from a case study based on inputs from 12 semi-structured interviews with staff using new digital tools after the MNC rolled out a technology from a European R&D centre to the firm's China and USA R&D laboratories. Few studies have examined the behavioural issues arising from the introduction of digital tools for use in pilot plants inside R&D laboratories. The attitude to digital adoption has been mostly positive across both R&D sites. Now the process is more digital allowing better data capture, which also provides opportunity of data sharing across the firm's global R&D sites. We also present some management implications with regards to lessons learned from some challenges faced by the technology adopters.

WB-02.3 [R] • Understanding Mobile Payment Adaption with the Integrated Model of UTAUT and MOA Model

*Tzu Fang Hu; NTU, Taiwan
Ruey-Shan Guo; NTU, Taiwan
Chialin Chen; NTU, Taiwan*

This study focuses on mobile payment adaption and proposes a new technology acceptance model validated by Partial Least Squares (PLS) method. 1) Based on UTAUT and the

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Motivation-Opportunity-Ability (MOA) model, this study proposes an integrated technology acceptance model: the actual mobile payment adoption behavior is affected by behavior intention, cash payment habit, and coverage of mobile payment context (CMPC). 2) The results indicate that behavior intention, cash payment habit and CMPC have significant impact on actual behavior, and CMPC has a positive moderating effect on the influence of behavior intention on actual behavior. 3) With high coefficient of determination (0.77), this new model shows better prediction of adaption behavior and emphasizes the importance of habits and context to behavior in addition to behavior intention.

WB-03 Technology Management in Biotechnology Industry

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Broadway

Chair(s) Xin Li; Beijing University of Technology

WB-03.1 [R] • Effect of External Innovation on Advanced Pharmaceutical

R&D: The Case of Monoclonal Antibody Drug Development

Yayoi Kawata; Tokyo Institute of Technology, Japan

Kota Kodama; Ritsumeikan University, Japan

Shintaro Sengoku; Tokyo Institute of Technology, Japan

With the progress of biotechnology, the strategic foci of research and development (R&D) in drug discovery have diversified from small molecules to biologics and new modalities, such as cell and gene therapies. To create innovative drugs, pharmaceutical companies are actively adopting external innovation approaches to acquire complicated and diversified technologies. Although pharmaceutical companies have built their own R&D models and accelerated collaborations with external organizations, the impact of this on R&D productivity has not been fully clarified. In this study, we analyzed the typology of external collaborations for R&D in the case of monoclonal antibodies and explored its relation to the effectiveness of new drug discovery. Specifically, the monoclonal antibody drugs approved in the United States to date (n=66) were examined and described in terms of technological differences, the pattern of collaborations, and the sequence of key milestones. Our observation of the new drug creation processes of top-ranked pharmaceutical companies (n=12) revealed that they tend to internalize external expertise to improve their intrinsic R&D capabilities. These findings suggested that the contribution of phased external innovation models to monoclonal antibody drug development. Further, the findings highlighted the significance of internal mechanisms to internalize external innovation experiences, which leads to sustainable innovation.

WB-03.2 [A] • Exploring Associations within Disease-Gene Pairs:

Bibliometrics, Word Embedding, and Network Analytics

Mengjia Wu; University of Technology Sydney, Australia

Yi Zhang; University of Technology Sydney, Australia

Xin Li; Wuhan University, China

Topic extraction and relationship identification are attracting increasing interests from the bibliometric community, as well as from relevant fields in biomedicine. Recently many biomedical studies reveal the pairwise associations between various genes and diseases, which lead to the problem of predicting and investigating new emerging pairs. This paper proposes a method to generate disease-gene pair prediction and ranking, based on both semantic similarities between textual contexts and topological similarities between nodes within a disease-gene network. Specifically, genes and diseases are identified via a term clumping process and the association strengths are calculated based on co-occurrence frequency and a pre-trained Word2Vec model. Meanwhile, an integrated disease-gene network is constructed and we capture potential emerging disease-gene pairs through a modified link prediction approach. We applied the proposed method to a dataset with 27,727 scientific articles in the atrial fibrillation area to demonstrate the reliability of the model. The empirical insights derived from the case highlight implicit associations within those highly ranked disease-gene pairs and provide references for stakeholders in cardiovascular areas.

WB-03.3 [R] • How Do Patent Claims Reflect Scientific Knowledge: Insights from Human Genomics

Mei Yun Lai; University of Bremen, Germany

Patent claims are written in legal jargon and primarily read by patent experts. Most scientists and researchers struggle to comprehend scientific knowledge behind patent claims. Drawing upon literature in science-innovation, I ask the following questions: 1) how to make patent claims available as early-source information to R&D frontiers? and 2) how to measure the quality of science in each embodiment disclosed within every patent claim? Leveraging on recent extensive curated database of patent citations to scientific articles, I use sentence encoder to reveal the knowledge behind each independent patent claim. I train Bidirectional-Encoder-Representation-Transformer model on patent data in human genomics, then fine-tune with expert validated data, to predict the most similar scientific sentence to each claim based on maximum cosine similarity value. I observe that the first independent claims which reflect quality science are usually shorter than their comparable claims. The extracted scientific sentences can help scientists 1) to detect the presence of simultaneous discovery in order to reduce duplication of R&D expenditures and 2) to locate useful data in large-scale open science resources (e.g., genetic sequences, chemical compounds, etc.).

WB-03.4 [R] • Identifying Areas of Technology Commercialization in the Biomedical Sector: An Integrated Analysis of Patents and Publications

Hyunjin Shin; Ajou University, Korea, South

Sungjoo Lee; Ajou University, Korea, South

Representative sources of technical information include papers, which are the results of research, and patents, which are the core of technologies. The number of papers and patents is increasing rapidly, and technology commercialization activities in which papers are linked to technology patents are also rapidly developing. Therefore, the necessity of using papers and patents to discover new technological opportunities is emerging. However, despite the semantic similarities between papers and patents, the format and classification systems of documents are very different, so it is difficult to exchange information between documents. This study utilized papers and patent documents to discover new technologies and identify technological opportunities. To overcome the limitations of using paper and patent documents mentioned above, mutual information was utilized by integrating the paper and patent documents and constructing a keyword network using LDA topic modeling and W2Vec methods. In this study, through the results of comparative analysis between papers and patents, first, the research results were uncovered in the white space of technologies that are not linked to patent technologies. Second, a technology potential index is present to evaluate the possibility that the research results can be linked to technology. Third, a technology marketability index that can evaluate the commercialization value of technology is presented. Fourth, through core keyword network analysis, technology trends were identified and technology gaps were discovered, thereby discovering areas in which new technology development is possible. This study contributes to the use of more information by overcoming the limitation of mutual information exchange, even though paper and patent documents contain a lot of technical information. Furthermore, new technologies were discovered, technologies were identified, and technological gaps were uncovered through the results of linking and comparing the paper and patent documents. The technology index, the outcome of this study, enables analyzing the potential and marketability of the technology and evaluating its value. Core keyword network analysis contributed to discovering technical gaps and identifying new technical sectors by utilizing technology connection information through paper and patent documents. This study is expected to be useful for the development of new technologies and the identification of opportunities by presenting information utilization plans through linking papers and patents.

WB-04 Strategic Management of Technology-1

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Weidler

Chair(s) Marthinus W Pretorius; University of Pretoria

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WB-04.1 [R] • Development of Technology Strategies Under Volatility and Uncertainty

Günther Schuh; Fraunhofer-Institute for Production Technology IPT, Germany
Marc Patzwald; Fraunhofer-Institute for Production Technology IPT, Germany
Bastian Studerus; Fraunhofer Institute for Production Technology IPT, Germany

The dynamics and uncertainty of the environment in which companies operate have been increasing steadily over the past years. Subsumed under the acronym VUCA, more and more industries are confronted with transformative change in ever shorter time. The more dynamic and uncertain the environment becomes, the more important it becomes for companies to ensure a meaningful long-term development orientation of their capability base. Maintaining and expanding sustainable competitive advantage through building the technological capability basis is the mandate of a technology strategy. However, established methodologies for this are very time-consuming and only hardly situation-adaptive due to their discrete-sequential approach in combination with extensive analyses. Hence, a continuous iterative procedure for high turbulence environments is proposed. For such, the re-conception of the strategic analysis phase must be emphasized in order to achieve shorter development and reaction times while ensuring high decision quality. Therefore, the present paper aims to conceptualize such an analysis model. For this, the preliminary work for the overall methodology is briefly presented as the overarching framework of the analysis model. Subsequently, two analysis modes are differentiated, and the model structure is derived.

WB-04.2 [R] • The Strategic Management of Technology-enabled Capabilities: A Dynamic Capabilities Approach to Strategically Aligned Value Creation in a Fourth Industrial Revolution Context

Jonatan Jacobs; University of Pretoria, South Africa
Marthinus W Pretorius; University of Pretoria, South Africa

The increasingly complex and dynamic technology and business environments of the Fourth Industrial Revolution require dynamic capabilities to enable effective value creation and support the continued existence of organisations. Dynamic capabilities, as defined from a system perspective, function to enable strategic alignment, which is a key challenge in technology-enabled value creation efforts. A model was proposed to conceptualise the strategic management of technology-enabled capabilities, by linking a generic value creation system hierarchy to strategic alignment and the enabling dynamic capabilities perspective on technology-driven value creation. Through a deductive research approach that built on developed theory, the model was tested by testing operational hypotheses through quantitative analyses and finding correlations between the defined dynamic capabilities approach to strategic alignment and more effective value creation capacities within large organisations.

WB-04.3 [R] • Location, Location, Location: The Hidden Metrics of GNSS Measurements

Oludare Olorunniwo; Obafemi Awolowo University, Nigeria

Quantum leaps in recent developments of GNSS technologies - especially in the areas of interference, obscuration and multipath mitigation - have placed increased emphasis on the GNSS community to resolve potential barriers in spatial positioning. However, trends in wireless location-based services (LBS) reveal that existing solutions are far from cost-effective with intended accuracy. Why? Several factors are attributed, ranging from ineptitude of the subject matter (positioning technology) to complex evolution of measurement systems. To that end, an in-depth knowledge of GNSS signals, measurement and performance is indispensable. This paper on the basis of definitive terms in positioning technologies presents a three-fold objective: 1. Interpolations on the current developments to outline convergences in industrial thrusts. 2. Extrapolations on future telemetry expansions to predict strategic and cost-effective projections. 3. Evaluate conceivable implications of the industrial transition on the integration of wireless sensor networks (WSNs) and navigational signals. The divergences in the techno-economic paths are indicators of shortfalls in the innovation management model and transformations in capacity growth.

WB-04.4 [R] • Regional Innovation-driven Entrepreneurship System: A Diagnosis Methodology for Engagement

David Guemes-Castorena; Tecnológico de Monterrey, Mexico
Armando Elizondo-Noriega; Texas Tech University, United States

The current study presents a brand-new methodology to diagnose the performance of regional innovation-driven entrepreneurship systems (RIDES), known as RIDES methodology. The RIDES methodology allows policymakers to engage critical economic actors in a studied region to evaluate the performance of its innovation system and design more suitable strategies to spur future economic growth. The validity of the RIDES methodology lies in its strong theoretical foundations like the MIMAC tool for strategic planning and the MIT Regional Entrepreneurship Acceleration Program framework (MIT-REAP). For instance, the MIT REAP is a successful framework that states that in order to obtain a significant regional economic impact, innovation policies must be based on comparative advantage. Such comparative advantage must be the result of the combination of two crucial capabilities: entrepreneurship and innovation. Each of these capabilities has five dimensions: human capital, infrastructure, funding, demand, and culture and incentives. Such detailed classification of variables in the MIT REAP helps to highlight the leading role of five economic actors (universities, governments, corporates, venture capitals, and entrepreneurs) that must take an active role in the strategic creation of new innovation policies. On the other hand, the MICMAC tools gather experts' knowledge from those five critical economic actors to assess the current state of a system and generate strategies to improve such system. To illustrate how to use the RIDES methodology, this paper provides an application of the methodology to study Monterrey's innovation systems. Monterrey is a suitable area to apply this methodology because it is a highly Mexican industrialized city that is well-known for its robust entrepreneurship ecosystem. The results of the application of the RIDES methodology in Monterrey show that innovation has been mainly funded by government agencies hindering the low participation of risk capital.

WB-05 Supply Chain Management

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Morrison

Chair(s) Christina Ruschitzka; RWTH Aachen University

WB-05.1 [R] • Roles of Brokers and Clusters in the Inter-firm Network Dynamics: Evolution Map Perspective

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

The inter-firm network is affected by changes that sometimes occur as a result of unexpected external crises, such as financial collapses or natural disasters. Major parts of the inter-firm network are disrupted or replaced by new links after such crises. However, we know little about which parts and kinds of networks are more resilient to such external changes. In this study, we focus on the brokers that connect distant clusters. By using a quantitative index to detect brokers in the inter-firm network, we investigated how they updated their transactions and clusters over a recent 10 years in Japan. Our findings show that brokers tended to have fewer neighbors, high transitions, and high mobility among clusters. The results were evaluated using three case studies extracted from an evolution map perspective: stable clusters with local diversity, regional clusters with local hubs, and small temporal clusters with brokers.

WB-05.2 [R] • Methodology for the Development of Value Propositions within Subscription Models

Günther Schuh; RWTH Aachen University, Germany
Volker Stich; Research Institute for Rationalization FIR, Germany
Christian Dölle; RWTH Aachen University, Germany
Christina Ruschitzka; RWTH Aachen University, Germany
Christian Holper; Research Institute for Rationalization FIR, Germany

Ongoing digitalization and Industry 4.0 enable the development of new business models due

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to the increase in available data and digital connected products. A promising business model type for the machinery and plant engineering industry are subscription models, consisting of products and services offered in return for continuous payments. However, subscription-based business models are associated with extensive changes in the traditional machinery and plant engineering industry, in particular, for small and medium-sized companies (SMEs). Established concepts for the development of value propositions and business models neglect important aspects, such as the integrated development and optimization of products and services across the entire life cycle or the data infrastructure. This paper presents a concept for a methodology to support SMEs developing value propositions within subscription models. Therefore, the systematic identification of customer benefits, the determination and prioritization of subscription relevant functionalities as well as the design of product and service elements addressing those functionalities are the main aspects on which the focus is placed on. The result is a subscription value proposition canvas for SMEs to address the impact of subscription models on products and services.

WB-05.3 [A] • Blockchain Technology Adoption in Outbound Logistics for the Fourth Industrial Revolution

Liezl Steynberg; University of Pretoria, South Africa

Lourence D Erasmus; Council for Scientific and Industrial Research, South Africa

Leon Pretorius; University of Pretoria, South Africa

There are opportunities for disruptive applications of blockchain technology in outbound logistics management, especially with peer-to-peer networking support to keep records of verified transactions in distributed ledgers without control by an intermediate party. The impact of implementing a blockchain solution in logistics processes and the effect on process parameters is not well understood or quantified in the literature. The objective of this study is to investigate whether there are opportunities in outbound logistics operations to benefit from the application of blockchain technology and to evaluate the impact of implementing a blockchain technology solution in a specific industry use case. A design science research process, which combines qualitative and quantitative research methods, guided this study. A stochastic discrete event simulation model was developed to evaluate the impact of a blockchain solution for an industry use case in an outbound logistics process. The time to reach visibility is quantified for a Hyperledger Fabric implementation. The results indicated that it would have a significant effect on the time it takes to gain insight into the process and transparency. This study provides evidence that a blockchain solution can have a notable impact on information availability and transparency in an outbound logistics process.

WB-06 Educational Issues-1

Wednesday, 8/10/2022, 10:30 - 12:00

Room: Ross Island

Chair(s) Charles M Weber; Portland State University

WB-06.1 [R] • 4IR Skills Development: A Comparative Analysis of the South African and Global Skills Development Systems

Mabatho Gaula; University of Johannesburg, South Africa

Arnesh Telukdarie; University of Johannesburg, South Africa

Megashnee Munsamy; University of Johannesburg, South Africa

4IR brings additional demands on skills development. The workforce of the future will need to be adequately educated and trained to work with technologies that do not yet exist and to solve problems not known today. Education and training programs need to respond to this challenge by enhancing people's capabilities for the utilisation of and collaboration with 4IR technology. Various regional and country specific skills development systems exist specifically to deliver skills within a context. The South African skills development system is driven by various structures, with the SETAs being central to the skills development strategy as a bridge between the demand for and supply of relevant skills. This research provides a comparative analysis of the South African and global skills development systems.

WB-06.2 [R] • The Impact of 4IR on the Future Skills in Food and Beverage

Industry

Radhakrishnan Viswanathan; University of Johannesburg, South Africa

Arnesh Telukdarie; University of Johannesburg, South Africa

Globalization impacts the economy of every nation, worldwide. The global impact of the Fourth Industrial Revolution (4IR) is impending. In an aim to achieve excellence amidst dynamic/volatile market with difficult environmental conditions, there is a growing demand for competent personnel in all fields inclusive of technological and other. Sectors such as the food and beverage sector are not immune to changes. This paper conducts a tier-one analysis of global publications in the food and beverage sector, extracting trends and changes. The secondary data analysis focuses on the focus themes as defined in the literature, specific to country, region, research area, and highest cited papers. The core objective is to provide a detailed analysis for further studies in focusing on the demand for future skills in this sector. The research team provides for key data analysis to guide sector skills investment in order to provide skills training for future skills.

WD-01 Innovation Management-5

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Multnomah

Chair(s) Thomas Scheuer; Fraunhofer Institute for Production Technology IPT

WD-01.1 [R] • Technical and Non-Technical Enablers Required for the Design of a Process- and Product-Innovation Framework to Enable a Client-Centric Culture

Anne-Marie van wyk; University of Johannesburg, South Africa

Jan-Harm C Pretorius; University of Johannesburg, South Africa

Leon Pretorius; University of Pretoria, South Africa

The journey to client centricity through structured innovation has a beginning but no end. It starts with the conceptualisation of an idea, and develops through organisational alignment and iterations of implementation, learning and improvement. Client centricity has proven to be an elusive goal for many organisations. Agile disruptive innovation is required to remain relevant in the areas in which they operate. A paradigm shift is required, and organisations need to change the strategies from being product centric to focusing on client centricity instead. The biggest issue and major challenge typically faced by organisations attempting make this shift is the organisational culture. Qualitative research, combined with action-based research, was conducted to assess the technical and non-technical enablers required to implement a generic product and process innovation framework to establish a client-centric culture in a diverse and decentralised international logistics solutions organisation.

WD-01.2 [R] • Identification of Innovation Potentials by Extending the Value Analysis to the Product Lifecycle

Michael Riesener; RWTH Aachen University, Germany

Maximilian Kuhn; RWTH Aachen University, Germany

Alexander Menges; WZL of RWTH Aachen, Germany

Katharina Nixdorf; WZL of RWTH Aachen, Germany

Christina Ruschitzka; RWTH Aachen University, Germany

Günther Schuh; WZL of RWTH Aachen, Germany

In order to ensure manufacturing companies' competitiveness, it is necessary to offer the right products in the right quality at the right time to the market. In an increasingly dynamic market environment that is characterized by volatility, uncertainty, complexity and ambiguity (VUCA), it is difficult for companies to systematically identify the customer needs and fulfill those by corresponding products. A solution to address these difficulties is the value analysis. The value analysis aims to perfectly fulfill customer value and simultaneously keep the cost range by preventing overengineering. The value analysis is generally performed once for a specific product. With the potential that arises with new technologies and connected products, the value analysis can be performed continuously by analyzing IoT data during the product lifecycle in order to identify innovation potentials. Thus, the customer value can

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be increased systematically. The aim of this paper is to extend the value analysis over the product lifecycle to identify innovation potentials by integrating IoT data.

WD-01.3 [R] • Maturity Oriented Description Model for Innovation Ideas of Technical Systems

Günther Schuh; WZL, Germany

Thomas Schwarberg; Fraunhofer Institute for Production Technology IPT, Germany

Thomas Scheuer; Fraunhofer Institute for Production Technology IPT, Germany

Today, innovation is more crucial for companies than ever. The prerequisite for every innovation is an innovation idea (referred to as “idea” within this paper). Especially the implementation of ideas for technical systems requires financial and capacitive resources. Due to resource constraints, companies only pursue the most promising ideas. The understanding of a promising idea may differ from company to company. Therefore, an evaluation process, including company specific evaluation criteria, is applied in order to identify those promising ideas. The basis of this evaluation process is the idea description, presenting all relevant aspects of an idea in a structured manner. Today’s existing models for the description of ideas require a specific type and format of information (the so called “specification format”). However, these specification formats remain unchanged over the course of the idea development process. Consequently, the same type and format of information are used to describe any idea of any development status. This regularly leads to a distorted idea description, ultimately resulting in an erroneous basis for the idea evaluation. To prevent this, the idea description model has to be oriented at the idea’s current development status. Therefore, this paper aims at the development of a model for the maturity-oriented description of ideas for technical systems assuring both a meaningful as well as efficient idea description.

WD-02 Digital Transformation-3

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Holladay

Chair(s) Blaize H Reich; Simon Fraser University

WD-02.1 [A] • Realizing Value from Digital Transformation: Benefits Management Re-imagined

Blaize H Reich; Simon Fraser University, Canada

Joe Peppard; MIT, United States

When organizations first harnessed information technology to solve business problems, automate processes and provide information, it could take many months, even years, to deploy an application. This situation changed two decades ago when Software-as-a-Service products, hosted in the cloud, became available. Today, technology has matured sufficiently, and it is possible to install an IT platform to support a global business process in a matter of weeks and to stitch multiple applications together into a reliable and agile architectural foundation. While legacy technology still poses a major problem, technology for new investments is no longer the bottleneck that it once was. This is likely one of the reasons why it is widely acknowledged that achieving digital transformation ambitions is less about technology deployment and more about the ability of the organization to adopt it and adapt to it, and to ultimately create real business value. But here is the conundrum: while the time to implement technology has been significantly compressed, achieving the organizational changes needed to reap benefits still require months and even years to achieve. A weakness in mainstream project management literature, especially when applied to technology-enabled business investments, is the assumption that the project is complete once the software is released, stabilized, and “accepted” by the project’s sponsor. Sometimes, a window of time is allocated to “finish” the project; an after-action or lessons learned report is produced, the project team disbands, and victory is declared. When considering the success or failure of projects, discussions usually revolve around the budget, schedule, the software and its acceptance, but generally not about the changes that the organization has experienced as a result of improved processes or enhanced capabilities or whether the expected benefits were delivered. Despite recognizing that benefits come from organizational changes, project

management is still premised around scope, resources and time. This can be because benefits have not yet happened; the nature of most IT projects is that benefits only emerge many weeks and months after “go-live.” Victory is often declared prematurely. To promote the achievement of benefits from IT investments, the concept of Benefits Management was introduced in the 1990’s. Its aim was to focus on what business benefits were expected to be delivered from the investment and to accelerate the realization of these benefits from harnessing the capabilities of technology. This was achieved by identifying the organizational changes necessary to release these benefits, as well as tracking the benefits realized throughout the entire initiation-to-realization cycle. It also advocated that expected benefits should be aligned to key strategic drivers. Since the original work on Benefits Management was undertaken, the context for IT investments has changed dramatically. The initial research was focused on improving the performance outcomes from large enterprise system investments; these systems had an internal organizational focus and took considerable time to implement. Back then, how systems were built was also different, due primarily to the constraints imposed by technology, development frameworks and dominant practices. Technologies like AI and analytics pose particular challenges for managing benefits in that it is difficult to specify them prior to technology deployment. Moreover, today, technology is a competitive necessity; it is shaping business models and customers expect to engage with an organization in a digital way; and systems can extend outside the organizational boundary to ecosystem partners. Speed, innovation, and agility are critical determinants of success in a digital-first world, fundamentally changing how an organization competes. All of these changes impact the nature of projects and how they are set up and run. Although benefits management is an established concept in the project management and technology literatures, it is not well-known as an organizational practice. In this paper, we revisit the benefits management concept, discuss some of the adoption barriers, and suggest a number of ways to adapt benefits management to digital transformation programs.

WD-02.2 [R] • Successful Digital Transformations Demand Process and Measurable Functions

Elizabeth Pacyna; Portland State University, United States

Gary O Langford; Portland State University, United States

A common notion underscoring popular beliefs of organizational growth in the digital future involves transforming processes to sustain or improve operations. Although a plethora of measures and metrics abound, digital transformation must begin with a strict ontological separation into those that are counted and those that are measurable/measured. The results of organizational processes can be counted. Thus, the aim is to characterize processes as distinct from functions, where the difference provides a basis for evaluating an organization’s existing and proposed processes through countable items; and developing functional performances with measurable impacts, consequences, and costs. The result is an understanding of the measured value and worth of the transformations. By applying an ontological framework, we find that measurement theory captures the losses often missed or misinterpreted when planning and executing digital transformation. Significantly, these losses also hinder work and mask the true nature of the impacts of transformation. We posit the reported “failures” of digital transformation may implicate procedural counting and presumed measurements - both of which violate measurement theory.

WD-02.3 [R] • Enabling Digital Transformation through Organizational Design: The Emergence of the ‘Business Model Innovation Function’

Matheus Franco; University of Campinas, Brazil

Vinicius Minatogawa; Pontificia Universidad Católica de Valparaíso, Chile

Ruy Quadros; Universidade Estadual de Campinas, Brazil

The role of the business model underlying structure and the Organizational Design in managing business model innovation for digital transformation are still critical gaps in the literature. This study aims to answer how organizations can manage Business Model Innovation for Digital Transformation through Organizational Design. To answer this question, we deploy a qualitative multiple-case study approach with two Brazilian leading companies. Our findings show that companies with successful Digital Transformation,

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in a continuous fashion, built a specific new division for business model innovation. This new structure is at the top management team level. It has the autonomy to conduct digital transformation efforts, combining technological capability and business modeling capability. Every company adopted an open innovation approach, connecting internal resources to external resources to comprise the project teams' capabilities. We contribute to theory by better elucidating organizational design's role in the business model innovation management. We also contribute to practice by providing managers with a practical roadmap to guide their digital transformation efforts.

WD-02.4 [R] • Digital Transformation for Managing Sudden Peak of Passenger Flow: A Comparison Study between Researches, Reports, Regulations, and Patents

Zheng Li; *China Association for Science and Technology, China*
Di Liu; *Beijing University of Technology, China*

Passenger flow under emergencies has been a very crucial, complex issue and a rich ore for cross-disciplinary studies involving many areas such as computer sciences, social psychology, transportation engineering, urban planning, public safety management, laws and policies, etc. This study collected literatures that related to managing sudden peaks of passenger flow at public stations in China, including four types of open sources: a) academic papers, b) social media and newspaper, c) industrial or governmental regulations and laws, and d) patents. By using Qualitative Data Analysis through NVivo software, cross analyses were conducted that compared data dependency, data integration, and data innovation capacity in around 100 documents from 2008 to 2019. The conclusion demonstrated importance evolution of digital transformation for managing emergency of passenger flow in different times and areas.

WD-03 Information & Knowledge Management-2

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Broadway

Chair(s) Dilek Cetindamar; University of Technology Sydney

WD-03.1 [R] • Value Proposition Framework in Digital Archive Management System

Md. Mukhlesur Rahman; Japan Advanced Institute of Science and Technology, Japan
Kunio Shirahada; Japan Advanced Institute of Science and Technology, Japan

Although digital archives ensure long-term preservation and wider access to important historical, cultural, and administrative evidence as primary sources of information, existing archive management systems cannot contribute to education and research as expected. The basic reason is lack of cooperation, collaboration, and knowledge-sharing practice among stakeholders, users, and archive staffs. Accordingly, this research aims to develop a value proposition framework integrating different archival service entities. Therefore, this study reviewed literature and analyzed primary data collected from people in charge of 68 local archive centers of Japan. The collected data were analyzed using SPSS and SmartPLS. The result shows that archival value co-creation is associated with stakeholders' involvement, staff's motivation, users' participation, and organizational effectiveness. Each component has different essence in archival value co-creation. Considering the essence, the study proposed a conceptual archival value proposition framework for promoting archival value. The proposed framework can ensure wider access for users, generate new ideas for archive centers, and provide accurate management for stakeholders.

WD-03.2 [A] • Using Visualization to Facilitate Knowledge Acquisition and Dissemination for M&A

Caren H Weinberg; Ruppin Academic Center, Israel

Acquisition researchers pointed out that to understand real world complexity it is necessary to look at mergers and acquisitions (M&A) from different perspectives. Thus, we investigated the presentation of M&A research in a dynamic and illustrative way that provides rare insights into the potential outcomes of acquisitions. Through an iterative process and much trial and

error, it was found that large amounts of information can be combined in a single page to facilitate overall understanding and enable instantaneous comprehension of complex data. In the context of this research, using such illustrations enhanced both the seller's perspective and that of the potential buyers in the M&A process. Visualization techniques have been accepted as a key tool to manage knowledge for strategic purposes and clearly the addition of the visualization diagrams enhanced this case-based acquisition research, in addition to being found useful and relevant in the decision-making process for those players in industry considering entering into the M&A process.

WD-03.3 [R] • The Rebirth of Knowledge Management in the Era of Technological Singularity

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

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

WD-04 Strategic Management of Technology-2

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Weidler

Chair(s) Bastian Studerus; Fraunhofer IPT/ RWTH Aachen University

WD-04.1 [R] • Methodology for the Startup Lifecycle-dependent Design of Cooperation between Corporates and Startups

Günther Schuh; RWTH Aachen University, Germany
Bastian Studerus; Fraunhofer IPT/ RWTH Aachen University, Germany

Disruptive innovations are putting incumbent companies under increasing pressure to defend their competitive position in globalized markets. Hence, they form cooperation agreements with startups aiming for the creation of technical innovations and, thus, ensuring access to novel technologies and growth. Due to an insufficient explication of cooperation objectives and an unsystematic approach of selection of the cooperation forms, the cooperation poses a major challenge for both partners. As the target system is strongly influenced by the needs of the respective life cycle phases, startups in particular find it difficult to achieve their objectives in the cooperation. Therefore, the aim of this paper is to conceptualize the constituent parts of a methodology for the selection and the design of a cooperation between corporates and startups based on the explication of target systems and a comparison of objectives and corresponding requirements. Thus, the theoretical background is presented and existing approaches for the selection and the design of a cooperation between corporates and startups are examined. To derive the requirements on the methodology, the identified deficits are discussed and design-relevant requirements are integrated in the context of cooperation. Subsequently, the methodology and its sub-models are derived.

WD-04.2 [R] • The Effect on the Innovation Performance of ICT Venture Companies by the Types of Government Support: Focusing on Funding and

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R&D Support

Do Bum Chung; KISTI, Korea, South

Hwasun You; KISTI, Korea, South

Byungil Kim; Andong National University, Korea, South

Today, ICT venture companies play a key role in the national economy, but they are having a lot of difficulties in their growth due to rapid changes in external environments and limitations in internal resources. To solve this problem, the government is pursuing various support policies, but its effectiveness is still being questioned. Therefore, this study aims to examine the effect of each type of government support on the innovation performance of ICT venture companies. For the empirical analysis, the ICT venture panel survey data provided by Korea Information Society Development Institute was used, and the innovation performance of ICT venture companies was measured by the number of patent applications. The reason is that, above all else, it is important to continuously create the innovation performance in order to secure the competitiveness of ICT venture companies. In addition, the types of government support were analyzed by dividing them into funding and R&D support. Finally, the propensity score matching was applied to solve the problem of selection bias and to determine the pure effect of government support. As a result of the analysis, it was found that funding and R&D support had a positive effect on the innovation performance of ICT venture companies. This suggests that the necessary support for ICT venture companies should be provided first, rather than promoting various support policies. The results of this study can be used as basic data when implementing government support policies.

WD-04.3 [R] • The Analysis of Global Joint Research Activities in Future Prospective Field: Focusing on the Field of Bio-pharmaceuticals

Hwasun You; KISTI, Korea, South

Do Bum Chung; KISTI, Korea, South

Although R&D international cooperation is becoming more active in the era of the Fourth Industrial Revolution, science and technology convergence and technology change, South Korea lacks international joint study activities due to inferior research capabilities, closed R&D ecosystems, and lack of an international cooperation system. In the 2020 National Science and Technology Innovation Competency Assessment, South Korea's international cooperation category index ranks 16th among 35 OECD countries, but is lower than average, requiring strategies to enhance international cooperation activities. In this study, the analytical data selected SCI papers consisting of a joint study in the field of biopharmaceuticals. The KDD/KM Co-author methodology, a big data analysis methodology, was utilized to conduct international joint research status and network analysis among key researchers. Through this, the development plan for vitalizing the international cooperation network was derived, and the results of this study will contribute to the development of government support policies for vitalizing international cooperation centered on key researchers in South Korea.

WD-05 Project & Program Management-3

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Morrison

Chair(s) Richard C Sperry; Portland State University

WD-05.1 [R] • A New Theory on Temporary Systems That Explains Project Behavior and Performance

Richard C Sperry; Portland State University, United States

Although adaptive approaches to managing complex projects have shown performance improvement, projects are still not controlling the scope of work and exceed schedule and budget. Therefore, these performance problems must be caused by other factors affecting the project's behavior. This paper proposes a new system's theory that explains project behavior and performance. A project is a temporary system of resources that possess the knowledge and skills to fulfill the output scope (i.e., product, service, or result). The natural variation in project behavior and performance is the uncertainty within the project resources to fulfill the complexity of the project output. The theory is based on the following principles. First, there is natural variance in all systems. Second, the more natural variance in a system, the

more chaotic a system will behave. Third, improving the system's performance can only be achieved by reducing the natural variance in the system. The theory was developed from studying the behavior and performance of 10 longitudinal IT projects that ranged in complexity over a period of seven years.

WD-05.2 [R] • Opportunities for System Dynamics Implementation in Project Management Evaluation

Naveen Tiruvengadam; Kettering University, United States

Armando Elizondo-Noriega; Tecnologico de Monterrey, Mexico

David Guemes-Castorena; Tecnologico de Monterrey, Mexico

Mario G Beruvides; Texas Tech University, United States

Project Management (PM) provides a framework to employ, track, and control the organizational resources required to undertake a project and manage all its associated attributes like risks and costs. However, oftentimes, practitioners head into projects without a clear foresight into the cost overruns and schedule delays that are caused by the various inherent risks. System Dynamics (SD) is a powerful tool to model a complex system and the interdependencies of its parts that can help identify such intrinsic risks and their time-delayed impacts, especially on project-related expenses, thereby helping PM practitioners use capital effectively. With the intent of exploring one part of this vast intersectionality between PM and SD, from a very specific end-objective of assessing only literature with published SD models, a state-of-the-art (SAM) analysis of the extant literature was carried out to determine the trends in the research in this space and identify opportunity areas. First, peer-reviewed articles were systematically collected and classified per the PRISMA-P protocol, which also enabled generation of descriptive statistics and trend analysis. Following this, a SAM analysis of the gathered articles was carried out. The preliminary results confirmed the growth of use of SD within the PM space but also highlighted the limited availability of actual SD models modeling PM issues, thereby establishing the scope for more such studies. Among the identified studies with published SD models, none was found employing the concept of isomorphism (similarity between systems of different origins) to simulate complex projects or any SD archetype.

WD-06 Technology Management in the Health Sector-1

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Ross Island

Chair(s) Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

WD-06.1 [R] • The Emerging Technology Identification of Ambulance Technologies in Thailand

Nonthapat Pulsiri; IKI-SEA, Bangkok University, Thailand

Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

Teera Sirisamut; National Institute for Emergency Medicine, Thailand

Porntip Wachiradilok; National Institute for Emergency Medicine, Thailand

The research in emerging technologies has long been crucial to many countries, ranging from public to private organizations. There are also various approaches to identify the emergence of technologies including bibliometric analysis. In the area of health policy, Emergency Medical Services (EMS) presents a key role to save lives and reduce death rates. These services use ambulances to take patients to the nearest hospital in emergencies, and many ambulance technologies are useful to support emergency medical personnel during their operations. Henceforth, the new creation of practical ambulance technologies benefits all mankind. According to Pulsiri et al. (2019), the new definition of "ambulance technology" in the digital world should cover its arising three main clusters, which are Intelligent Transportation System, eHealth, and Telecommunication Infrastructure. Therefore, this paper aims to identify emerging ambulance technologies in the three main clusters by using bibliometric analysis. VantagePoint software is selected to analyze 177 publications from SCOPUS, Web of Science, and PubMed databases, to create the list of emerging ambulance technologies. These emerging technologies will be validated based on two criteria that are radical novelty and prominent impact, with healthcare experts. The validated list of emerging

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ambulance technology is also meaningful to support Thailand's EMS policy in technology and innovation.

WD-06.2 [R] • Health 4.0 and its Potential Adoption and Contribution to the Mexican Health System

Lorena del Carmen Álvarez-Castañón; University of Guanajuato, Mexico

Pilar E Arroyo; Tecnológico de Monterrey, Mexico

Marco Contreras-Cruz; University of Guanajuato, Mexico

Carlos Villaseñor-Mora; University of Guanajuato, Mexico

The pandemic exposed the weakness of the Mexican health system and put forward the need for its urgent reconversion. Additional to the increase of the health budget, physical and human resources, and dynamic capabilities of health organization, the implementation of technologies for data automation and coordination is acknowledged as an opportunity to improve healthcare, decrease outpatient care costs, and develop efficient surveillance systems. This work aims to build a technological forecast for Health 4.0 in the case of the health system of Guanajuato, one of the Mexican entities with the largest population, economic, and industrial growth rates. A qualitative research approach was used to perform a scientometrics analysis using as inputs selected academic articles and official healthcare reports. This analysis was complemented with information collected through semi-structured interviews and participatory techniques with technology experts, and visits to the largest unit of the Mexican Institute of Social Security of the entity. The technological forecast showed that Health 4.0 represents a solution to some critical issues of Guanajuato's health system. Nevertheless, Health 4.0 conveys a major social challenge because of medical personnel's and patients' low technology proficiency and their resistance to adopt novel technological applications, and the poor coordination of health organizations.

WD-06.3 [R] • A Qualitative Study on Barriers and Opportunities of Digital Health

Iffat T Haque; American International University Bangladesh, Bangladesh

Rashed Mazumder; Jahangirnagar University, Bangladesh

Digital Health has been recognized as the most convenient and cost-effective health service during the COVID-19 pandemic. However, in many developing countries, challenges, as well as opportunities, have been found regarding using this technological advancement. The proper utilization, accessibility, and knowledge are required to adopt this service in the post-COVID era, or in other words, it is needed as a "new normal" situation instead of physical health service provision. To understand digital health from the perspectives of developing countries, a study has been conducted in three steps. The study was based on the context of Bangladesh and in the first step, we used a systematic review of the literature to understand how COVID-19 has created the digital transformation in health care services. Secondly, we conducted a qualitative study among 15 patients who perceived digital health services to explore the barriers and challenges. Finally, based on the issues found in the context of developing countries, we developed a model on how we can propose better and cost-effective solutions and establish digital health along with the traditional health system. Therefore, in the increasing trend of pandemics, adopting digital health by reducing the possible barriers could be a sustainable solution in the post-COVID era.

WD-07 Quality Management

Wednesday, 8/10/2022, 14:00 - 15:30

Room: Sellwood

Chair(s) Jens Neuhuettler; Fraunhofer IAO-KODIS

WD-07.1 [R] • Case Study Analysis on Value Co-creation Through Positive Participation of Customers in Technology Application Services

Miwa Nishinaka; Kagawa university, Japan

Hisashi Masuda; Kyoto University, Japan

The purpose of technology application services is often to pursue internal efficiency. In addition, when a service is provided by a non-human interface in a technology application

service, the perceived service quality by the customers changes from the case of a human service, which affects external efficiency. In previous studies, it is said that internal and external efficiencies are interrelated to each other. In this paper, we examined the relationship between internal efficiency, external efficiency, and perceived service quality by analyzing the cases of technology application services. As a result, we found that even if the internal efficiency was pursued in the technology application services, the external efficiency was not impacted and the perceived service quality was maintained or raised. For that, new value co-creation was required through the "positive participation" of customers. In addition, in terms of external efficiency, new standards different from the conventional ones were adopted in some cases. These are also considered cases of Blue Ocean strategy. This study contributes to the following points. Firstly, it clarifies the effect of applying IT on service quality from the viewpoints of both management theory and service theory. We explained the appropriateness of the perspective based on the prior research. There is only a few research of this perspective in the reviewed papers, whereas opposite viewpoint exists. Secondly, it focuses on service quality considering an entire company, not just the customer encounter part. Based on these, practically, we will provide a perspective that can be effectively used to build a service-oriented company.

WD-07.2 [R] • The 50th Anniversary of Quality Function Deployment Research

Chih-Hung Hsieh; Yuan-Ze University, Taiwan

Chechena Kuular; Yuan Ze University, Russia

Ever since Akao and Mizuno introduced the Quality Function Deployment (QFD) in 1972, the model has been widely applied and studied around the world. In celebrating the 50th anniversary of QFD, this study aims to use Main Path Analysis (MPA) in order to analyze the trajectory of QFD study over the past 50 years and to propose possible research trends for further study. The authors use keywords, such as "QFD" and "House of Quality," to collect data from the Scopus database. There were 6,736 articles extracted, which were further analyzed with the use of MPA. As the result of our analysis, we found that in the past 50 years the QFD research main path was focused on methodology improvements and the combination of QFD with other methods to ensure the accuracy of "voice of customer" interpretation. First of all, one needs to solve the problem of transforming CRs to ECs. The main path literature addresses this problem with a variety of methods, which include MCDA, MCDM, fuzzy logic, Fuzzy QFD, etc. The second issue is related to the prioritization of CRs. Some authors used MILP, Kano modeling fuzzy methods to solve this problem. ECs optimization constitutes the third issue that QFD users face. The MIGP, the rough set, the grey relational analysis, hierarchical structures, and other techniques and methods were exploited to solve the third problem.

WD-07.3 [A] • Quality Based Testing of AI-based Smart Services: The Example of Stuttgart Airport

Jens Neuhuettler; Fraunhofer IAO-KODIS, Germany

Sibylle Hermann; Fraunhofer IAO, Germany

Walter Ganz; Fraunhofer-Institute for Industrial Engineering, Germany

Dieter Spath; Acatech, Germany

Riccarda Mark; Flughafen Stuttgart GmbH, Germany

The paper presents an approach for quality-based testing during the development of AI-based smart services. It describes central components of testing and illustrates the connection between them. Components include the creation of prototypes, the use of a configurable framework for assessing perceived quality and a process model that comprises testing objectives, tasks and supporting methods. The practical implementation of the approach is demonstrated by two use cases at Stuttgart Airport.

WE-01 Innovation Management-6

Wednesday, 8/10/2022, 16:00 - 17:30

Room: Multnomah

Chair(s) Leon Pretorius; University of Pretoria

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WE-01.1 [R] • A Literature Review of Frameworks for Evaluating Potentially Disruptive Innovation

*Dan Pettersson; KTH - Royal Institute of Technology, Sweden
Joakim Lillieskold; KTH - Royal Institute of Technology, Sweden*

This article examines the support from the disruptive innovation literature in recognizing potentially disruptive innovations. A literature review was carried out resulting in 11 articles containing frameworks for evaluating disruptive innovation. Potentially disruptive innovations are by their nature hard to deal with. Being able to recognize them is a first step in dealing with them, but recent disruptive innovation literature describes the field as fragmented and misunderstood. The overview presented in this article can be used as a guide by academics and practitioners that intend to approach the field. Among the frameworks three types were observed: frameworks for classifying into disruptive or not, frameworks for classifying into types of disruption, and frameworks assessing disruptive potential. A comparison is made within and between framework types to illustrate similarities and differences between how they characterize types of disruption and which factors they consider for evaluating disruptive potential. The frameworks are applied to the IoT innovation of usage-based auto insurance. It was previously the subject of a case study, showing disruptive potential as a part of the digital transformation of insurance companies. Then the frameworks are evaluated based on the learnings from the case study.

WE-01.2 [R] • Innovation Strategies to Counter Client-Led Business Disruption

*Anne-Marie van wyk; University of Johannesburg, South Africa
Leon Pretorius; University of Pretoria, South Africa
Jan-Harm C Pretorius; University of Johannesburg, South Africa*

The availability of big data, supported by advanced technologies, has given rise to a more informed and empowered global consumer, resulting in extreme pressure on organisations to continuously find new innovative ways to serve these clients. When operating under tough economic conditions companies tend to challenge the timing of innovative initiatives. The truth is that they simply have no choice. Clients now have more information and more choices than ever and an ever-growing list of demands and expectations. Simultaneously, there is increased competition for the same share of wallet. They must rise to the challenge, gear up for the battle and understand that they need to innovate and operate differently to survive. Qualitative research was conducted to assess the impact of client-led business disruption on a diverse and decentralised international logistics solutions organisation. This article will detail the proposed strategies that were derived from the business experience of the authors, to not only counter the threats of the client-led disruption, but also to embrace the opportunities that this will create for the organisation.

WE-01.3 [R] • An Exploratory Study of Creativity in Business Domain: A Systematic Literature Review

*Tomoyasu Hiranuma; Japan Advanced Institute of Science and Technology, Japan
Rihyei Kang; Japan Advanced Institute of Science and Technology, Japan*

This paper reports on a systematic literature review of creativity in the business domain to develop the study of individual and organizational creativity in innovation management. A transition of study of essential topics in business creativity was observed, qualitatively organized and discussed. Using the SCOPUS database, this paper studied 197 articles, reviews, or conference papers on business creativity with over 50 citations, out of 3,073 published by 2020. We have found the following. The research of creativity in the business domain began to occur in the 1970s and has attracted much interest from the latter half of the 1980s. In addition, we have confirmed that there was high interest in the research topics such as entrepreneurial creativity, creative leadership, creativity management, and creative thinking processes. That research was conducted by cross-sectional study and literature review. Alternatively, there are few long-term studies through careers of businessperson across educational institutions and multiple organizations. This paper provides implications for future business creativity research and significantly change the way recruitment and organizing for innovation by discovering a research void that the research period is a snapshot

in time, and there are few long-term studies toward specific individuals or organizations.

WE-02 Digital Transformation-4

Wednesday, 8/10/2022, 16:00 - 17:30

Room: Holladay

Chair(s) Aki Tomita; Toyo University

WE-02.1 [R] • Aligning Digital Transformations with Value Creation Based on International Integrated Reporting

Aki Tomita; Toyo University, Japan

Owing to the pervasiveness of low-cost high-performance computers and communication networks, the whole society is digitalizing. Digitalization has transformed the way in which businesses operate and individuals behave; digitalized interactions between businesses and individuals on a multi-sided platform bring about big data, then the businesses and individuals are linked together through the data on the platform. In a digital society, businesses and people are inextricably linked on global scale. Companies are confronted with rapidly changing business environments, and their business models are required to adapt to such change while expected to sustainably create value over the short, medium, and long time. Integrated reporting provides a framework for companies to disclose how to create value over time. In this framework, value is thought not to be created by or within an organization alone. It is influenced by the external environment, created through relationships with stakeholders, and dependent on various resources. To make digital transformations through big data more effective and sustainable, this paper proposes a framework to align digital transformation of a company with value creation over time based on the International Integrated Reporting Framework. This paper also points out that highly digital businesses should recognize license to user data and content as intangible assets on their balance sheets.

WE-02.2 [R] • Entering the Age of Technological Disruption: Digital Convergence in the U.S. Broadcast, Printing, Publishing, Paper and Postal Industries

Humberto Merritt; Instituto Politecnico Nacional (IPN), Mexico

Since the turn of the century, information and communications technologies have expanded their circle of influence through the so-called digital convergence. Relentlessly, this process has been transforming many economic activities, with the paper, printing, postal delivery, publishing, and broadcasting industries feeling the pinch from shrinking markets and volatile customers' choices. As a result, increasing organizational changes have rendered several job routines and labor skills obsolete. Although technology change has produced declining employment rates, average wages have nonetheless kept on growing. In this paper, we carry out trend analysis to test the following hypotheses: 1) digital convergence has altered traditional routines and skills, resulting in a shrinking rate of employment in sectors related to the communications industry. As a result, 2) productivity has grown, and firms have recruited more skilled workers with higher wages. To test these hypotheses, we analyze employment and wage tendencies in these five sectors by comparing historical data in each industry from 2004 to 2018. In this endeavor, we take advantage of the Occupational Employment Statistics (OES) Survey produced for the Bureau of Labor Statistics of the U.S. Department of Labor.

WE-02.3 [R] • Digital Transformation Can Threaten Your Organizational Survival without Digital Self-Awareness

*Bud Fujii-Takamoto; Portland State University, United States
Gary O Langford; Portland State University, United States*

Organizations undertaking digital transformation efforts often seriously underestimate the difficulties of initiatives to design a digitally responsive and mature organization. Beyond merely digitally archiving documents and developing a file structure, a digitally transformed organization has transcended the analog-to-digital conversion when digital technologies are at the core of the business model. Organization digital awareness (ODA) is a necessary organizational skill to keep up with the increasing rate of technological change and navigate

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digital transformation-actions commensurate with long-term organizational investment, rather than adopting digital technology for technology's sake. This study provides a definition of ODA and develops a digital transformation self-awareness model (DXSAM) based on a systems engineering process model combined with an organizational learning model. The findings indicate prior research has identified ODA as a necessary organizational trait for digital transformation, but the concepts suffer from a lack of a unifying framework. Digital transformation models must make explicit accommodation for ODA and incorporate a feedback mechanism to enable adaptation in the digital transformation strategy process.

WE-02.4 [R] • The Impact of COVID-19 on Micro Firms and SMEs and Their Reactions: Is Digital Transformation a Solution?

Yi-juen Chen; N. Kaohsiung University of Science and Technology, Taiwan
Yu-Chen Wei; N. Kaohsiung University of Science and Technology, Taiwan

The outbreak of the pandemic COVID 19 has caused great impact to the world economy. This paper aims to investigate its impact on micro firms and small and medium enterprises (SMEs) in Taiwan; these firms contribute one third of the local economy but generally have lack of scale and resources. This paper investigated three questions: First, impacts of COVID-19 on micro firms and SMEs. Second, how micro firms and SMEs deal with problems caused by the pandemic. Third, a special focus is on the digital tools micro firms and SMEs implement to come through to the post-pandemic era. Through this analysis we seek to understand the digital capabilities of the micro firms and SMEs and how they may work towards digital transformation and meet the future challenges. A questionnaire was used to collect data about the impact of the pandemic and what measurements micro firms and SMEs take to deal with the impact. Then a proposal of digital transformation for micro firms and SMEs is formed. This paper contributes to the analysis of digital capabilities of micro and SMEs, and how they may migrate to a solution of digital transformation.

WE-03 Information & Knowledge Management-3 **Wednesday, 8/10/2022, 16:00 - 17:30**

Room: Broadway

Chair(s) Yi Zhang; University of Technology Sydney

WE-03.1 [R] • Measuring Career Growth Related to Organisational Movement for Junior and Senior Researchers

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

Global competition for talented researchers has intensified in recent years, and increasing organisations, such as Google and Microsoft, are growing rapidly by attracting talented researchers. In the computer science field in particular, more young researchers have been engaged in research. From the researcher perspective, they want to move to an organisation that will allow them to experience more career growth; however, existing organisational metrics equate organisational growth with individual growth and do not quantify whether a researcher can really grow after moving. In this study, we clarify researcher growth from organisational movement using 5.6 million articles published between 1970 and 2018 via Scopus. By analysing the characteristics of the influx of researchers to growing organisations in recent years by career stage, we identify the differences in the impact of research organisations on junior and senior researchers and consider the current strategies of various organisation. The findings show that, while they move to similar organisations, the organisational environments in which junior researchers and senior researchers can experience career growth differ. This analysis contributes to a better understanding of researchers' career trajectories and organisational strategies for scientific innovation.

WE-03.2 [R] • The Anatomy of a Corporate Venture Builder: Factors Influencing Failure

Carla M Kitsuta; UNICAMP, Brazil
Ruy Quadros; Universidade Estadual de Campinas, Brazil

Digital transformation opens numerous opportunities for companies. Corporations look at startups and entrepreneurship to seize such opportunities, integrating new organizational forms and practices to their existing innovation management capabilities. Corporate startup programs, accelerators, incubators, venture builders, and CVC have gained momentum. This paper aims to explore factors that affect the unsuccessful development of a corporate venture builder (VB). VBs are organizational units that build new ventures with external entrepreneurs. Relying on an in-depth case study of the experience of a Brazilian software firm during the three-year life of its VB, ended in 2019, we analyze which aspects of the company's innovation management capabilities affected the unsuccessful outcome. Our findings suggest that the lack of alignment between the VB initiative and the company's top management was a critical determinant for discontinuity. While the new ventures management unit that has pulled the VB was aiming at rather explorative, long-term growth-oriented objectives, the Board of the company and its C-level expected rather short-term results. This case provides insights into how current innovation management capabilities and related organizational forms deter the development of corporate venturing initiatives and interact with the entrepreneurial behavior of founders that participate in such endeavors.

WE-03.3 [R] • The Impact of Data Utilization Capability on Japanese Companies: Findings from the Questionnaire Surveys

Hirofumi Tatsumoto; Graduate School of Business Sciences, Japan
Yuri Hirai; National Institute of Science & Technology Policy, Japan
Fumihiko Ikuine; Graduate School of Strategic Management, Chuo Univ, Japan

This study investigates the impact of data utilization on the business results of Japanese companies by using the dataset of the questionnaire survey conducted in 2020 by Research Institute of Economy, Trade and Industry. To capture the landscape of companies' data abilities across industries, we used data utilization capability (DUC) scores and conducted industry-wise comparison on the relationship between DUC and business results. The results of the analysis show that the DUC's effect in the service industries is statistically positive, whereas that in the manufacturing industries is not. The evidence suggests that the benefit of data utilization is much evident in the service industries than that in the manufacturing industries. Additional analysis supports this difference and poses a risk that the gap between both industries will not be closed. This fact suggests that we should consider such industry-wise difference when planning corporate strategies and industrial policies.

WE-04 TUTORIAL: The 4Cs: Climate, Covid, Culture, Convergence **Wednesday, 8/10/2022, 16:00-17:30**

Room: Weidler

Speaker(s) Charu Nair; Keys 2 DEI Consulting Group LLC

In its purist form, "Technology" is the "art, skill, cunning of hand," "the science of craft," simply "applied science." From a time in the 20th century the term has hardened into being connoted with industrial arts and techniques. Given the truly unprecedented convergence of the emerging technologies and the increasing and widespread trepidation of people towards the real and perceived future effects, it is critical to revisit, better understand and incorporate what we as a civilization know all about "culture" and how it manifests in human systems across the globe. Through case studies, interviews, literature review and other analysis, we uncover how a robust understanding of the "technology of culture" is core to us as technology managers and practitioners, so we can make ethical use of this understanding as an ally to our objectives particularly in the fraught oncoming spheres of the convergence of key emerging technologies. As climate surrounds us, Covid assails us, culture embeds us and convergence of emerging technologies threatens us, we are peering onto a "convergence" at a new unprecedented level. In this tutorial, the speaker will take a robust look at the vista of varying scenarios as to how these 4 Cs can intersect and how we, as Technology Managers, can best design for this.

WE-05 Technology Forecasting-1

Wednesday, 8/10/2022, 16:00 - 17:30

Room: Morrison

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Chair(s) Petrus T Letaba; University of Pretoria

WE-05.1 [R] • Framework for Assessment of Societal Impact of Innovation: a Case of Transport and Mobility Sector

Petrus T Letaba; University of Pretoria, South Africa

A slow-down in economic performance of various countries created a huge attention in seeking the solutions and new sources of growth that can improve the GDP growth. These include the role of science, technology and innovation. However, there is also a recognition that innovation can be used for improvement of society in terms of health, education, mobility, food security, water security, security, etc. While there is a plethora of frameworks that deal with research, technology and innovation assessment for economic impact, there is still a knowledge gap regarding the impact on society. The challenges include the absence of common assessment framework and in some cases the lack of comparable indicators. A framework for assessment of innovation for social impact is proposed in this paper by identifying internationally comparable social indicators. Through citation analysis of scientific publications, the identified societal issues are then mapped to the science, technology and innovation activities. A transport and mobility sector is used as a case study. Both transport and mobility have great influence on the societal dynamics and quality of life.

WE-05.2 [A] • Future Food and Its Business Strategy Based on the Science and Technology Foresight

Yuko Ito; NISTEP, Japan

In the realm of food, a lot has changed in recent years. The food needs of people have diversified considering health, cost efficiency, and safety issues. This study analyzes the overall outlook for the food-related science and technology sector that will create the future food and food business strategy, using a combination of technology foresight and statistical surveys. The 11th Science and Technology Foresight Survey of the National Institute of Science and Technology Policy in 2019 addressed 702 science and technology topics. Of these, 35 topics that were food-related were extracted and analyzed. The results indicate that these technologies will be utilized by society in the form of products and services beginning around the year 2030. Additionally, health-related food technology trends show both a high degree of importance and high global competitiveness. An examination of the Survey of Research and Development (R&D) published by the Statistics Bureau of Japan reveals that some Japanese businesses undertaking food-related R&D were also conducting pharmaceutical R&D. This situation, wherein the development of pharmaceutical and food products has become closely linked, is likely to enable development of new revolutionary products.

WE-06 Emerging Technologies-1

Wednesday, 8/10/2022, 16:00 - 17:30

Room: Ross Island

Chair(s) Brent Zenobia; Novillus

WE-06.1 [R] • 4IR Youth Readiness: A Case Study of 3D Printing Program in South Africa

Chuks Medoh; University of Johannesburg, South Africa

Andre Vermeulen; University of Johannesburg, South Africa

Arnesh Telukdarie; University of Johannesburg, South Africa

The youth of South Africa face significant challenges, and the digital age brings significant opportunities. The South African Government is strategically positioning the role out of 4IR through the Sector Education and Training Authorities (SETA). The key objective is youth skills development aligned to 4IR. The research team have developed and delivered a 4IR orientated 3D printing program focusing on engineering and entrepreneurship. The program approach, structure, learnings and future works are the focus of this paper. The research team presents a review of international best practices and the status of 3D printing. The approach to practical business development and opportunities using 3D printing is explored. The skills, software, and business development requirements are reviewed. The research

is incorporated into a practical 3D printing course. The research team have delivered the first program and extract lesson learnt and improvement opportunities. The research team presents a strategic view on the establishment of an operational support center for basic to advanced 3D printing including research opportunities.

WE-06.2 [R] • Consideration on the Standardization and Industrialization of Human Microbiome Technologies in Japan

Takaharu Jibiki; Tokyo Institute of Technology, Japan

Shintaro Sengoku; Tokyo Institute of Technology, Japan

Kota Kodama; Ritsumeikan University, Japan

Human microbiome technologies have attracted attention as a new therapeutic modality. However, in order for the technologies to form a new industry, standardizing human microbiome analysis should be the first priority to ensure the reliability and quality of human microbiome data. The objective of this study was to clarify the current situation regarding the standardization of human microbiome analysis and the potential of human microbiome technologies to be industrialized in Japan. This study considered the future perspectives of the standardization of microbiome analysis along with its challenges. In addition, the industrialization of human microbiome technologies was discussed with particular consideration of the situational differences between Japan and the United States. The following challenges were identified: 1) "Innovator's Dilemma" in human microbiome technologies, 2) obsolescence of consortium-driven standards, 3) fragmentation of microbiome data, 4) insufficient collaborations between organizations, and 5) inadequate government funding for basic research. Further, the following requirements were identified for the industrialization of human microbiome technologies in Japan: 1) facilitation of the microbiome analysis business, 2) development of diagnostic technologies, 3) development of peripheral technologies, 4) improvement in the quality of and access to open data on the human microbiome, and 5) investment in drug discovery research.

WE-06.3 [A] • If You Build It, Will They Come? An Adoption Analysis of the HL7/FHIR/Da Vinci Healthcare Interoperability Stack

Brent Zenobia; Novillus, United States

The COVID-19 pandemic exposed glaring flaws in the exchange of electronic health information (EHI) in the United States. EHI interoperability has become a top priority for the Center for Medicare and Medicaid Services (CMS) and the Office of the National Coordinator for Health IT (ONC). Beginning in July 2021 these agencies are enforcing legal mandates under the 21st Century Cures Act to compel full EHI interoperability throughout the US healthcare industry by 2025. If this ambitious goal can be met EHI interoperability will trigger a major disruption and force industry realignment during the coming decade. Toward this end, CMS and ONC have embraced the Fast Healthcare Interoperability Resources (FHIR) framework as promoted by the Health Level 7 (HL7) international standards organization. A key unanswered question is whether the HL7/FHIR framework is mature enough to support this goal, particularly with regard to the sharing of unstructured health information content. This paper assesses the HL7/FHIR technology stack and forecasts its adoption potential using the PRISM framework and historical interoperability movements. It discusses likely adoption windows; identifies adoption risks associated with the technology stack; discusses expected patterns of adoption behavior among healthcare payers, providers, and vendors; and recommends organizational strategies to mitigate risk.

WE-06.4 [R] • Identifying Technology Opportunity Based on Scientific Papers and Patents: A Case of Triboelectric Nanogenerator Technology

Xin Li; Beijing University of Technology, China

Yundi Wu; Beijing University of Technology, China

Lucheng Huang; Beijing University of Technology, China

With the high integration of science and technology development, how to early identify technology opportunity is crucial for the governments' and enterprises' research and development (R&D) strategic planning and innovation policy to gain a first-mover advantage

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in the market competition environment. Most researchers have used scientific papers or patent data and applied quantitative methods (e.g., bibliometrics, patent analysis, text mining) to identify technology opportunities, but few researchers have combined information from both scientific papers and patents to study technology opportunity using text mining method based on semantic analysis. Therefore, this paper proposes a research framework that uses scientific papers and patents as data resources and applies subject-action-object semantic analysis to identify technology opportunity. In this framework, we firstly use subject-action-object semantic analysis to mine the technical knowledge contained in scientific papers. Secondly, we use subject-action-object semantic analysis to mine the technical information contained in the patents. Finally, we analyze the comparison of scientific papers and patents data mining results, and a gap analysis between science and technology is used to identify technology opportunity. The triboelectric nanogenerator technology is selected as a case study to verify the feasibility and effectiveness of this framework. This paper contributes to technology opportunity study and will be of interest to triboelectric nanogenerator technology R&D experts.

WE-07 Manufacturing Management-1
Wednesday, 8/10/2022, 16:00 - 17:30

Room: Sellwood

Chair(s) Fabio Lima; Centro Universitario FEI

WE-07.1 [R] • Estimation of Energy Consumption in Manufacturing Lines Using Machine Learning into Industry 4.0 Context

Fabio Lima; Centro Universitario FEI, Brazil

Lucas K. B. Y. Nonogaki; Centro Universitário FEI, Brazil

João Chang Jr.; Centro Universitário FEI, Brazil

Alexandre A Massote; Centro Universitário FEI, Brazil

This paper deals with the simulation of production lines focusing on opportunities of reducing the energy consumption. The simulation of systems is one of the pillars of the so-called Industry 4.0. It has been used as a digital manufacturing software, which allows the creation of digital twins, to carry out the models. Once the model has been created and validated, a machine learning approach, more specifically a neural network, was trained to estimate the energy consumption of the line. The estimation of the energy consumption allows one to use this variable to make decisions about the production scheduling. Moreover, the neural network package is embedded into the digital manufacturing software which provides more flexibility to solve the problem using one single software tool. The results validate the proposal, and, for future work, the effective creation of the digital twin should be performed.

WE-07.2 [R] • Design for Additive Manufacturing (DfAM): Analysing and Mapping Research Trends and Industry Needs

Matthias Guertler; University of Technology Sydney, Australia

Lee Clemon; University of Technology Sydney, Australia

Nick Bennet; University of Technology Sydney, Australia

Jochen Deuse; University of Technology Sydney, Australia

Since its early days as a rapid prototyping technology, additive manufacturing has significantly evolved and become an important enabling technology for advanced manufacturing. Despite the benefits, its application in industry is not trivial as, for example, products need to be re-designed and processes changed, and it is not always the optimal manufacturing technology. Design for Additive Manufacturing (DfAM) is a key approach to support the successful use of additive manufacturing in industry and to bridge the gap between research and practice. Aside from design process and technology related methods and tools, DfAM also considers organisational and procedural aspects. To support the success of DfAM and as a result additive manufacturing, it is important to understand how industry needs are addressed by current DfAM methods/tools and related research activities. In this respect, a comprehensive analysis is missing. Therefore, this paper systematically analyses current research topics, fields and trends as well as industry needs and DfAM requirements from an engineering

management perspective. Mapping them allows for a systematic discussion between academia and industry to identify the most pressing research needs.

WE-07.3 [R] • Increasing Labor Productivity in Intelligent Manufacturing Enterprises: An Approach to Identify Relevant Capability Bundles

Günther Schuh; WZL of RWTH Aachen University, Germany

Thomas Scheuer; Fraunhofer Institute for Production Technology IPT, Germany

Manufacturing companies operate in a competitive landscape that forces them to constantly evolve. Traditionally, optimization cycles focus on manufacturing process improvements and material costs reductions to continuously increase productivity. Today, however, manufacturing companies have arrived on the horizon of the fourth industrial revolution. Where in history steam power, electricity, as well as information and communication technologies were the big enablers for productivity increases, the next step is based on the use of data. Strategies for collecting, storing, using, and transforming data give "intelligent" enterprises access to insights and business knowledge that previously remained underexploited. Only when these companies can identify the specific capabilities needed to realize the vision of an "intelligent manufacturing enterprise" they can effectively use these data technologies to sustainably increase labor productivity. The authors present a model structure to decompose mechanisms for data-driven labor productivity increases and relate the relevant capabilities to unlock those potentials. This will support managers of manufacturing enterprises to set the course towards further productivity increases, ultimately helping the company to persist in its competitive environment.

HA-01 PLENARY - 4

DATE: THURSDAY, 8/11/2022

TIME: 08:30-10:00

ROOM: MULTNOMAH

CHAIR: DILEK CETINDAMAR; UNIVERSITY OF TECHNOLOGY SYDNEY

HA-01.1 [K] • Digitalization Mitigates Climate Change and Moves Us to a Sustainable Future

Dietmar Theis; Institute for Physics of Electrotechnology, Germany

Progress in containing the uncontrolled increase in anthropogenic global warming will depend strongly on enhancing energy efficiency and accelerating decarbonization in all economic sectors. The deployment of the arsenal of the digital revolution offers essential support in this effort. The power sector is at the heart of this digital energy transformation. The provision of renewable energy like solar and wind power generation must be accelerated, simultaneously digitalization offers innovative business models and provides new ways of system operation. In the past electricity was generated in large power plants, transferred through transmission and distribution networks, and was flowing one-way to end users in all sectors. Digitalization is the enabling tool to cope with the intermittent character of wind and solar power generation, and thus enables efficient, renewable, clean, and multi-directional, distributed energy systems (smart grids). The benefits of digitalization in electrification and transformation of road transport, buildings and industry will be touched briefly. The presentation will highlight some essential features of the symbiosis between digital technologies and mankind's fight against climate change. However, at present there is a painful ambition gap between what needs to be achieved for a sustainable future and the actual commitment of societies and governments.

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

John McDougall; National Research Council, Canada

Arguably, the most serious challenge confronting the world is the rapid rise in greenhouse

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gas (GHG) emissions. Scientists, engineers and business people are all challenged to address the global GHG challenge in a major way. To make a significant difference, solutions must be scalable to billions of tonnes or more per annum, require no or very low external conventional energy inputs, and be very cost effective. It must not simply push the problem down the road, thereby creating another issue. Solutions will likely be found at the forefront of current scientific capability. Pushing the limits of science to address GHG on such a macro scale pushes us toward biological systems which have demonstrated chemical and physical processes that convert GHG inputs (CO₂, CH₄, NO_x, etc.) to useful outputs of various kinds. Biological systems are self-replicating, and under some circumstances demonstrate runaway genetic duplication effects, essentially becoming self-assembling machines at very high rates. GHG solutions will involve capabilities including biology, synthetic biology, bio-engineering techniques which are enabled, developed and knit together with applications of digital technologies and machine learning bio-algorithms. This presentation will explore how that may occur.

HB-01 Manufacturing Management-2

Thursday, 8/11/2022, 10:30 - 12:00

Room: Multnomah

Chair(s) Harm-Jan Steenhuis; Hawaii Pacific University

HB-01.1 [R] • Production Flow Analysis in the Era of Industry 4.0

Laura Tomidei; University of Technology Sydney, Australia

Nathalie Sick; University of Technology Sydney, Australia

Jochen Deuse; University of Technology Sydney, Australia

Lee Clemon; University of Technology Sydney, Australia

In the context of Industry 4.0, manufacturing companies have been increasingly adopting digital technologies such as Internet of Things, data analytics and cyber-physical systems to seize opportunities for productivity improvements. At the same time, established manufacturing philosophies such as Group Technology have assisted companies in managing the complexity of production processes for decades. To support manufacturing management with more informed decision-making tools, the literature has been proposing new approaches that exploit the potential of digital technologies to enhance the effectiveness of traditional manufacturing techniques. This study focuses on Production Flow Analysis (PFA) as an established approach for Group Technology. Although the existing literature has been focusing on Artificial Intelligence (AI) based approaches to plan the change to Group Technology for decades, few studies rely on production data directly extracted from the factory floor. This is partly due to the fact that technologies such as sensors and data analytics have been increasingly adopted in recent years, and this has led to an increasing amount of data that can be exploited to develop models that can support decisions. In particular, in the context of Industry 4.0, process mining has gained increasing interest, as it provides a data-driven methodology to capture real production processes. The goal of this study is to explore how PFA has evolved in the last decade thanks to the adoption of digital technologies, and to investigate potential synergies between PFA and process mining. This study uses a structured literature review to map advances in industrial applications of PFA in relation to digital technologies, as well as process mining applications in manufacturing to present a future research agenda. This provides manufacturing managers with a structured overview of existing industrial applications and the digital technologies adopted to enhance decision-making tools.

HB-01.2 [R] • Light Smart Factories: Introducing Peruvian SMES to the I4.0

Jose Manuel Cardenas; Universidad Nacional de San Agustín, Peru

Ricardo Aguilar; Universidad Nacional de San Agustín, Peru

Gledy Huahuala; Universidad Nacional de San Agustín, Peru

The fourth industrial revolution has generated some changes and concerns to the big industries, which means that they need to consider investing a lot of money in order to introduce themselves to the I4.0. However, this is not the concern for little entrepreneurs that could benefit from the leanness practices and at low-cost technology. The paper reviews

how these little entrepreneurs can take advantage of the I4.0 approach through a “light smart factory” approach.

HB-01.3 [R] • A System Dynamic-based Archetype for Capital Leasing of Industrial Robots

Armando Elizondo-Noriega; Tecnológico de Monterrey, Mexico

Naveen Tiruvengadam; Kettering University, United States

David Guemes-Castorena; Tecnológico de Monterrey, Mexico

Mario G Beruvides; Texas Tech University, United States

Over the past 40 years, leasing has gained ground as a competitive alternative to test and possibly absorb new technology, especially in light of the increasing costs of technology and capital. Additionally, leasing has allowed companies to mitigate financial risk associated with new equipment acquisition. Given these benefits of leasing, its popularity as a technology acquisition alternative can be expected to grow further. Unfortunately, despite the existence of a large body of extant literature on the technical aspects of automation, little is known about the economic effects of industrial robot leasing in manufacturing organizations. Given such information scarcity, both in literature and data published by companies, simulation presents itself as a viable solution to study the economic effects. In fact, simulation using System Dynamics (SD) has been demonstrated to be robust and reliable in the face of information scarcity. Unlike operating leasing, for which SD-based archetypes have previously been published, no such SD-archetype exists for capital leasing because of its complexity. To illustrate a basic difference, an operating lease is recorded as an expense on the income sheet, whereas the upfront cost or the entire leasing value of a capital lease is recorded as an asset on the balance sheet. To address this lacuna in literature, our work presents an SD-archetype to model the economic effects of capital leasing of industrial robots on a manufacturing facility. The development of an SD archetype is the main contribution of this work.

HB-02 Digital Transformation-5

Thursday, 8/11/2022, 10:30 - 12:00

Room: Holladay

Chair(s) Ronald Vatananan-Thesenvitz; Bangkok University

HB-02.1 [R] • What Are the General Mechanisms that Push a Company to Transform Digitally?

Arnould Schaller; Bangkok University, Thailand

Amaury Schaller; Bangkok University, Thailand

Ronald Vatananan-Thesenvitz; Bangkok University, Thailand

There is broad acknowledgment among the majority of leaders in almost every industry that the role of digital technology is rapidly shifting, from being a driver of minor efficiency to a source of significant disruption and innovation. In our fast-paced world of digital and technological advancement, being prepared for digital disruption as well as being able to transform a business digitally is indispensable and will ensure the survival of the organization in the competitive market. Consequently, the growing digitization and digitalization of business processes, products, and services make it imperative for companies to develop a better understanding of the critical drivers for a digital transformation (DT). The digital age already started, and far too many companies do not take advantage of the possibilities or even understand the consequences of the rapidly changing economy. However, in order to stay competitive and to avoid disruption by a new market entrant, incumbents' companies need to adapt and even remodel their core business models in alignment with the digitalization trend. Organizations need to make decisions on which technologies to adopt and how to incorporate them into their day-to-day operations. However, to do this efficiently, organizations first need to understand the critical drivers of DT that affect their business as well as their industry sector. This paper reports the result of an explanatory mixed-method research project to discover the most relevant key drivers for a DT. The quantitative as well qualitative analysis has highlighted two drivers in particular: rising customer expectations and continuously changing customer needs. These two drivers represent the most significant challenge, as

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well as opportunity, companies face nowadays in the business environment. The overarching objective of this conference paper is to give a universal outlook about the general mechanisms that could alert and subsequently drive a company to undergo a DT.

HB-02.2 [R] • Reality Capture as a Tool for Digital Integration of the Planned Furniture Industry Measuring Process

Gustavo H Dalceno e Silva; FEI University, Brazil

Alexandre A Massote; FEI University, Brazil

Fabio Lima; FEI University, Brazil

In Brazil, the planned furniture industry, characterized by the production of unique and customized lots, has been undergoing important transformations in its processes, focusing in recent decades on replacing the electromechanical base by microelectronics. Thus, computer-aided drawings, already present in this industry, provide information such as shape, dimensions, tolerances, materials and other details required for manufacturing, and integrate the activities of product development sectors with other tools such as computer-assisted engineering (CAE), computer-aided manufacturing (CAM), among others. However, the future scenario of industries has been driven by a new revolution, Industry 4.0, which brings a new concept to design, plan and manufacture a new product. The present work proposes a low-cost automated method for scanning and measuring 3D environments using the concept of digital photogrammetry, also known as "reality capture", through smartphones, integrating the customer with the point-of-sale activities in the sector, contributing to end-to-end digitization, one of the fundamental concepts of industry 4.0. For this, experiments were carried out to test the applicability of the method in several dormitory configurations present in apartments with useful areas of 50 to 149m².

HB-02.3 [R] • Digital Transformation and New Business Models in Urban Mobility: The Case of Carsharing in Brazil

Pietro P Gonzalez; University of Campinas, Brazil

Ruy Quadros; Universidade Estadual de Campinas, Brazil

Digitalization has brought new business opportunities, leading to deep changes in how organizations create, deliver and capture value in their respective markets. Carsharing is no different. Having first appeared as grassroots initiatives in small European communities, carsharing operations were analogic, from vehicle access to control and management of the fleet. With digitalization, the activity has gained momentum and new business models have emerged, including those which do not require an own car fleet. In Brazil, carsharing businesses have developed in the past decade. Yet, with just a handful of carsharing operators (CSOs), a list of as many closed companies, and lacking adequate regulation and supporting public policies, there is a lot to overcome. In this paper, we discuss what are the main resources and competencies which have been mobilized by Brazilian CSOs operating under distinctive business models. Based on in-depth multiple case studies, we analyzed four Brazilian CSOs, according to the main elements defined in the Business Model literature (Chesbrough, 2007; Teece, 2010). Findings reveal a general reliance on cloud computing, smartphone applications, and competencies related to software development and data analytics. Nonetheless, the importance of resources such as owned car fleets, onboard hardware, and parking spaces differ between operators.

HB-03 Entrepreneurship & Intrapreneurship-1

Thursday, 8/11/2022, 10:30 - 12:00

Room: Broadway

Chair(s) Thomas Gillpatrick; Portland State University

HB-03.1 [R] • Entrepreneurial Orientation on Clinical Development in Pharmaceutical Industry: Fixed-model Analysis

Dai Matsuda; Waseda University, Japan

Tohru Yoshioka-Kobayashi; Hitotsubashi University, Japan

Kanetaka M Maki; Waseda University, Japan

Success in pharmaceutical clinical development requires organizational management

capabilities. "Entrepreneurial Orientation (EO)" is a strategic construct that reflects the extent to which firms are innovative, proactive, and risk taking in their behavior and management philosophies. This study elucidates how EO influences clinical development in pharmaceutical firms. Panel-data analysis was conducted using a fixed-effect model. The panel data consists of 29 global pharmaceutical firms focusing on novel drug development for 14 years from 2004 to 2017. Accumulative numbers of novel drug approval in the United States are set as a dependent variable. Independent variables are EO components, stock beta value, and annual turnover. The EO consists of three entrepreneurial factors of innovativeness (R&D expense per sales), proactiveness (R&D expense per EBITDA), and risk taking (stock volatility). The study results indicate that innovativeness and risk taking showed a significant positive association with an increase in the cumulative number of new product approvals. Risk taking also showed positive association both when excluding bio-tech firms and in bio-tech firms, but proactiveness was negative only when excluding bio-tech firms. As a result, the study showed that EO impacts novel drug approval in the pharmaceutical industry. Traditional large firm should take risks in separate small organization.

HB-03.2 [R] • Identifying Commercialization Challenges for Entrepreneurial Firefighting Start-ups

Jasleen K Sandhu; University of the Fraser Valley, Canada

V. J. Thomas; University of the Fraser Valley, Canada

Wildfires are recurring, costly disasters that pose significant challenges for many nations and regions. The increasing scale and frequency of forest fires across the United States necessitate the development of an optimized wildfire response management system. While several firefighting start-ups have emerged to commercialize various technologies to address wildfires, few if any are successful. This study begins by examining existing firefighting technologies and analyzes their drawbacks. Emerging technologies that facilitate the gathering, storing, and visual analysis of large amounts of real-time data to support effective wildfire response are also assessed in relation to the technology needs of firefighters. Beyond technology development, the public and private funding secured by US-based firefighting start-ups are compiled and analyzed. In doing so, this study provides a comprehensive view of both the technology development as well the commercialization challenges faced by firefighting start-ups in the United States. Recommendations are offered to support the commercialization of these technologies by firefighting start-ups.

HB-04 Strategic Management of Technology-3

Thursday, 8/11/2022, 10:30 - 12:00

Room: Weidler

Chair(s) Shino Iwami; NEC Corporation

HB-04.1 [A] • The System to Visualize Certified Workloads of Peer-Review with Blockchain

Shino Iwami; NEC Corporation, Japan

Peer-reviews are maintained by voluntary activities, which are invisible for evaluating workloads. However, the voluntary activities have become heavier burdens following the increase of scientific publications. Peer-reviews are important to maintain the current evaluation system for science and technology. In this research, regarding workloads of peer-review tasks, the prototype system with blockchain proposes to make invisibles visible. Blockchain has been discussed to be utilized for certifying documentations such as educational background and for guaranteeing research data. This research explores new possibilities about the visualization of conventional peer-review tasks and the function to show researchers' peer-review contributions to their employers.

HB-04.2 [R] • An International Collaboration Strategy Based on the Scientific Strengths and Weaknesses in Security Domain

Shino Iwami; NEC Corporation, Japan

For security, no matter how high some countermeasures are, if there is a weakness the attacker will break the defense at least focusing on the weakness. Observing the security

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domain with scientometric approach, there are strengths and weaknesses in each country. Exporting the strengths will enhance the defenses of the others, and gaining support for our own weaknesses will be enhancing our defenses. This research extracts the strengths and weaknesses of each country, and identifies the science and technology that should be exported and that should be incorporated. The data retrieved from Web of Science are used to identify the strengths and weaknesses of each country in security.

HB-04.3 [R] • The Role of the Project Manager in the Agile Methodology

Arik Sadeh; HIT Holon Institute of Technology, Israel
Keren Rogachevsky; Holon Institute of Technology, Israel
Dov Dvir; Ben-Gurion University of the Negev, Israel

The role of the Project Manager was well defined by the PMBOK (Cleland, 1995) before the introduction of the agile approach to organizations. The basic assumption of this study is that the development methodology impacts the role of the PM. Therefore, the research's basic assumption is that the functioning of a PM in agile is different than the way the traditional PM is functioning. In the literature survey, we found new management roles in the agile world: The manager of the agile team (or the scrum master) and the agile trainer (a function that is meant to help the organization define new agile processes and embeds the agile methodology). Based on the literature review, we found an overlap between these functions and the PM role in agile.

HB-05 Technology Forecasting-2

Thursday, 8/11/2022, 10:30 - 12:00

Room: Morrison

Chair(s) Charles M Weber; Portland State University

HB-05.1 [R] • Evaluating Emerging Technologies on the Gartner Hype Cycle by Network Analysis

Yoshiro Kondo; The University of Tokyo, Japan
Kimitaka Asatani; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

Gartner's Technology Hype Cycle (THC) is widely used as a method for evaluating new technologies. Gartner positions each technology concept in consideration of various factors such as the maturity of complementary technologies, social acceptability, and development of technological infrastructure. However, since THC is a snapshot-like prediction made once a year, there is a lack of time information. Thus, it is not easy to judge the best timing for resource investment. Based on the above awareness of the problem, this study conducted a network analysis of the time concept missing in THC. A new indicator is incorporated to evaluate the speed of dynamic and continuous technology growth. We focused on the number of clusters in the network to consider the calculation of speed and examined two cases to compare two display technologies, OLED and QD. In a previous study, we found that a fast-changing QD dataset could be difficult to predict. This graph network analysis made it possible to understand the status of each display R&D and to compare both technologies by acceleration. This research will contribute to the development of tools for resource allocation at appropriate times.

HB-05.2 [A] • Forecasting the Use of Decontamination Robots in the COVID Era

Angel Contreras-Cruz; Portland State University, United States
Ozgul Ayyildiz; Portland State University, United States
Aynur Kirbac; Portland State University, United States
Ashwaq Al Khalil; Portland State University, United States
Kelly R Cowan; University of New Mexico, United States

This paper explores the introduction and possible adoption of robots that are designed to clean or decontaminate public spaces, such as airports, lobbies, or medical facilities. Such robots are capable of performing autonomous or semi-autonomous cleaning functions. They offer the advantage of cleaning areas that may contain harmful biological agents, like the

Sars-Cov-2 virus (also known as COVID-19), without exposing human cleaning crews to the risk of infection. Such robots offer a number of additional advantages, including the ability to work 24 hours a day, 7 days a week, to decontaminate more precisely than human cleaning crews, and a variety of operational characteristics that may make them more efficient and cost-effective than traditional cleaning methods. The initial part of the paper involves a case study of a company called Build with Robots, which is in the process of commercializing robots to perform these types of functions. An overview is provided of the general technology involved with these types of robots, as well as an analysis of the industry, and discussion of commercialization prospects. The paper then conducts a technology forecast to determine overall trends for the development and adoption of this technology. The authors use a bibliometric approach and literature review to gather data sets and perform S-curve analysis. This forecast is then used to provide overall conclusions and recommendations about the current state of this technology and its commercialization prospects.

HB-05.3 [R] • Extending Hype Cycle Prediction by Applying Graph Network Analysis

Yoshiro Kondo; The University of Tokyo, Japan
Kimitaka Asatani; The University of Tokyo, Japan
Ichiro Sakata; The University of Tokyo, Japan

One of the most commonly used technology forecasting methods in the industrial world is Gartner's technology hype cycle (THC). The THC is a yearly forecast of technology maturity based on a comprehensive assessment of various pieces of information such as news, papers, and research budgets. However, annual updates pose a problem in that it is difficult to utilize the information for management decisions in a timely manner. To deal with this problem, a variety of methods for drawing THCs have been studied. We proposed an approach to draw THC based on an integrated analysis of various information sources, such as papers and patents, by applying graph network analysis. The effectiveness of our approach was demonstrated using display technology as an example. In this study, we confirmed that the same approach can be applied to quantum computer technology to predict technology maturity, demonstrating the versatility of our approach.

HD-01 PANEL: PICMET '22 Debrief and Future PICMET Planning

Thursday, 8/11/2022, 14:00 - 15:30

Room: Multnomah

Panelist(s) Nasir Sheikh; Portland State University

Fayez Alsoubaie; Portland State University

Jin Chen; Tsinghua University

Tim Anderson; Portland State University

Dilek Cetindamar; University of Technology Sydney

Angel Contreras Cruz; Portland State University

Tom Gillpatrick; Portland State University

Antonie Jetter; Portland State University

Dundar F Kocaoglu; Portland State University

Caroline Mudavadi; Portland State University

Kiyoshi Niwa; The University of Tokyo

Liono Setiowijoso; Portland State University

Harm-Jan Steenhuis; Hawaii Pacific University

Charles M Weber; Portland State University

Pei Zhang; Portland State University

The hiatus caused by Covid-19 made this year's conference unique. We invite the entire PICMET community to join us for this interactive session. The PICMET organizing committee will be present to hear feedback about this year's conference, discuss lessons learned, and talk about future PICMET conferences.

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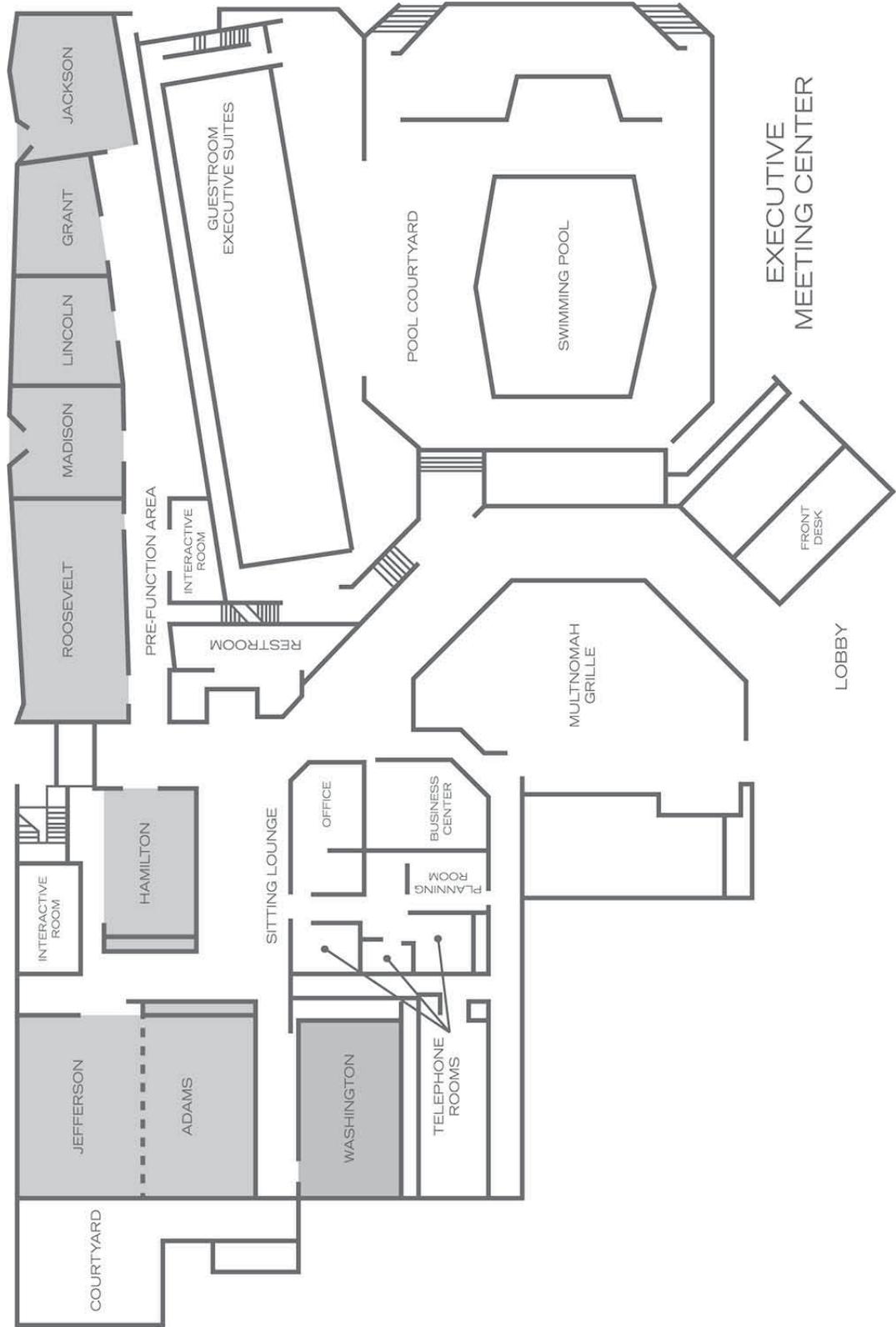
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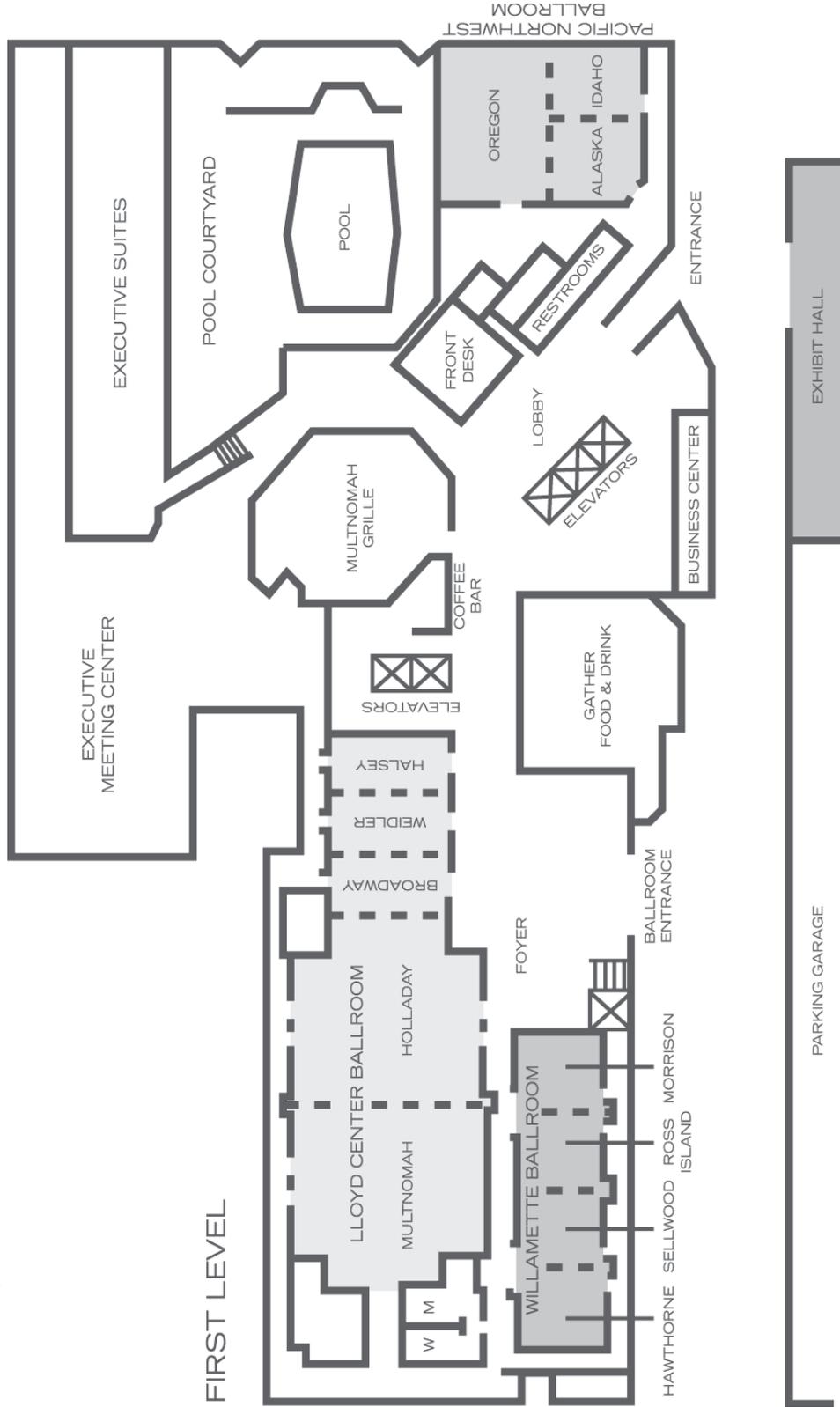
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