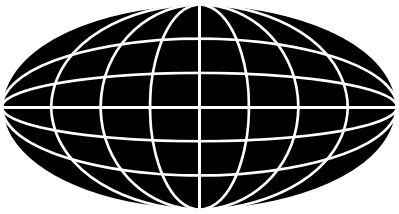

PICMET '16

PORTLAND INTERNATIONAL CONFERENCE ON MANAGEMENT OF ENGINEERING AND TECHNOLOGY

PROCEEDINGS

TECHNOLOGY MANAGEMENT FOR SOCIAL INNOVATION

EDITOR

Dundar F. Kocaoglu

CO-EDITORS

Timothy R. Anderson
Tugrul U. Daim
Dilek Cetindamar Kozanoglu
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PREFACE

The Technology Age is upon us. It is a challenge to think of any activity in any part of our lives that is not affected or driven by technology. PICMET ’16 emphasizes technology management for innovation that meets social goals by providing effective, efficient and sustainable solutions to social problems and creates value to society as a whole. It includes both for-profit and non-profit innovation by the public sector, private sector and NGOs.

PICMET defines the primary role of Technology Management as the management of technologies to assure that they work for the betterment of humankind. Using this definition, technology management has a critical role to play in the proper utilization of technology to meet the world’s needs.

This is a big challenge for the leaders and future leaders in the Technology Management field. Recognizing this challenge, the PICMET ’16 Conference explores the role of technology management for social innovation.

Some examples of technology management for social innovation are:

- Partnerships among industry, government, NGOs and the public for collaborative creation of value for growth through technology
- Managing technology for micro-credits institutions
- Managing health technologies to eradicate HIV, TB, malaria and other diseases
- Managing transportation technologies to meet safe and effective transport needs
- Managing energy technologies to provide uninterrupted energy
- Providing technological solutions to address global warming issues
- Developing and managing technologies to eliminate water shortages
- Managing information technology to bring education to remote areas of the world
- Elimination of the digital divide in societies
- Managing the convergence of biotechnology, nanotechnology and information technology for early detection of chronic diseases
- Managing genetic engineering to boost crop yield
- Managing nanotechnology for improvements in agricultural products and their distribution
- Managing technology for improved infrastructure and services
- Managing technology for pollution control

It is our expectation that, by focusing on this crucial aspect of technology management, PICMET will encourage researchers to engage in significant scholarly work in the areas listed above in the years to come.

PICMET ’16 received 779 submissions. After a double-blind refereeing process, 331 papers were included in the conference. The referees were from around the world. The authors represent more than 300 academic institutions, industrial corporations and government agencies in 37 countries.

The PICMET '16 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 41 sections, listed below, each containing several papers on the topic.

Collaborations for Technology Management
Commercialization of Technology
Competitiveness in Technology Management
Convergence of Technologies
Decision Making
E-Business
Educational Issues
Emerging Technologies
Enterprise Management
Entrepreneurship/Intrapreneurship
Environmental Issues
Global Issues in Technology Management
Information & Knowledge Management
Information/Communication Technologies
Infrastructure Management
Innovation Management
Intellectual Property
Manufacturing Management
New Product Development
Productivity Management
Project/Program Management
Quality Management
Science and Technology Communication
Science and Technology Policy
Social Innovation
Software Process Management
Strategic Management of Technology
Supply Chain Management
Sustainability Management
Technical Workforce
Technology & Knowledge Transfer
Technology Adoption
Technology Assessment and Evaluation
Technology Diffusion
Technology Forecasting
Technology Management Framework
Technology Management in the Energy Sector
Technology Management in the Financial Sector
Technology Management in the Health Sector
Technology Management in the Service Sector
Technology Roadmapping

A large number of colleagues around the world contributed to the success of the PICMET ’16 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 designed, maintained and managed the information systems, and formatted the papers for the *Proceedings*; Caroline Mudavadi, as the Executive Assistant, provided continuous support throughout the planning process and managed the registration process; Kenny Phan, as the Executive Director of PICMET, coordinated the overall planning for the conference. Tugrul Daim was the Director of Technical Activities and Director of Student Activities, Kiyoshi Niwa and Dilek Cetindamar Kozanoglu were the Co-Directors of International Activities, and Charles Weber was the Director of Awards. Songphon Munkongsujarit and Byung-Sung Yoon

coordinated the on-site activities; Ibnu Wibowo Tandiono managed the documentation together with Pei Zhang; and Jeff Birndorf developed graphic arts for the conference.

Timothy Anderson, Tugrul Daim, Kiyoshi Niwa, Dilek Cetindamar Kozanoglu and Gary Perman conducted the review process for the papers as the Associate Editors; 155 colleagues from around the world constituted the Panel of Reviewers. They each reviewed up to 10 papers submitted to PICMET ’16. Each paper was reviewed by two or more reviewers to assure high quality. Caroline Mudavadi did the scheduling of the accepted papers for presentation at the conference. Hamad Alanazi, Edwin Garces, Liliya Hogaboam, Jiali Ju, Rafaa Khalifa, Joao Lavoie, Inthrayuth Mahaphol, Caroline Mudavadi, Byung-Sung Yoon, Chih-Jen Yu and Pei Zhang were the Editorial Assistants to check and verify that the finalized papers included all the revisions recommended by the reviewers.

Vince Reindl and Rob Bossingham of Omnipress worked with PICMET from the beginning to the end of the conference planning effort. Their professionalism and superb 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 ’16 made this conference possible. We extend special thanks to all of them: Portland State University Department of Engineering and Technology Management, Maseeh College of Engineering and Computer Science, Portland State University Foundation, InFocus Corporation, Hawaii Visitors and Convention Bureau, Hawaii Pacific University, and University of Hawaii.

We believe the PICMET ’16 *Bulletin* and *Proceedings* contain some of the best knowledge available on Technology Management for addressing the challenges and opportunities in a world where services and infrastructure are being integrated. We hope they will contribute to the success of technology managers and emerging technology managers throughout the world.

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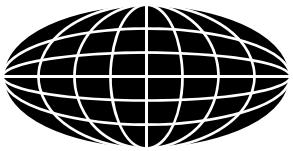
DEDICATION

PICMET '16 is dedicated to
all researchers, educators and practitioners of Technology Management
who are contributing to the establishment and growth of this field
throughout the world.



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Papers submitted to PICMET conferences are subjected to a double-blind review process. Each paper included in the PICMET '16 conference was reviewed by two or more members of the Panel of Reviewers to assure a very high quality. The panel had 155 members from around the world. They are listed below in alphabetical order by last name.

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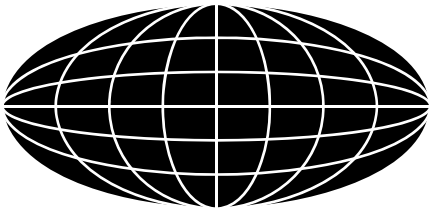

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INFORMS – Technology, Innovation Management and Entrepreneurship Section
IEEE Hawaii Section
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PICMET '16

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: Ying Huang

ADVISOR & CO-AUTHOR: Dr. Alan L. Porter

UNIVERSITY: Beijing Institute of Technology, China

PAPER TITLE "Exploring Technology Evolution Pathways to Facilitate Technology Management: A Study of Dye-Sensitized Solar Cells"

Abstract: Market competition drives attention to the prospects of new and emerging science & technologies (NESTs), which are fast changing and, so far, have relatively limited applications. Technology evolution pathways, as a powerful representation of the development of technology, have caught researchers' interest as a tool to trace historical progression, explore knowledge diffusion, and forecast future NEST trends. Citation analysis approaches are actively applied to structure a large number of patents, map patent distribution, and capture knowledge transfer and change in technologies or industries. This paper (1) introduces the indicator of connectivity and modularity in the interior citation network to identify the technology development stage; (2) takes family patent information into the process of building a comprehensive patent citation network; and (3) extracts technological trajectories by applying integrated approaches of main path analyses, namely global main path analysis and global key-route main analysis, among different technological stages. We illustrate this approach with dye-sensitized solar cells (DSSCs) as an example of a promising NEST, contributing to the remarkable growth in the renewable energy industry. The results show how our method can trace the main development trajectory of a research field and discern the technology focus to help decision-makers facilitate technology management.

In addition, there were four Honorable Mentions.

Brad W. Hosler Outstanding Student Paper Honorable Mentions

AUTHOR: Mustafa Abbas

ADVISOR & CO-AUTHOR: Dr. Dundar F. Kocaoglu

UNIVERSITY: Portland State University, USA

PAPER TITLE "Consistency Thresholds for Hierarchical Decision Model"

Abstract: The objective of this research is to establish consistency thresholds linked to alpha levels for hierarchical decision model's (HDM) judgment quantification method. Measuring consistency in order to control it is a crucial and inseparable part of any AHP/HDM experiment. The researchers on the subject recommend establishing thresholds that are statistically based on hypothesis testing and are linked to the number of decision variables and alpha level. Such thresholds provide the means with which to evaluate the soundness and validity of an AHP/HDM decision. The linkage of thresholds to alpha levels allows the decision makers to set an appropriate inconsistency tolerance compatible with the situation at hand. The measurements of judgments are unreliable in the absence of an inconsistency measure that includes acceptable limits. All of this is essential to the credibility of the entire decision-making process and hence is extremely useful for practitioners and researchers alike. This research includes distribution fitting for the inconsistencies. The superb fits obtained give confidence that all the statistical inferences based on the fitted distributions accurately reflect the HDM's inconsistency measure.

AUTHOR: You-Na Lee

ADVISOR & CO-AUTHOR: Dr. John Walsh

UNIVERSITY: Georgia Institute of Technology, USA

PAPER TITLE "Distributed Loci of Innovation in Firms: R&D and non-R&D Innovation"

Abstract: Innovative ideas can be generated from knowledge built throughout a firm. However, the innovation management literature that is based on an economic perspective has emphasized R&D, i.e., intended and organized inventive activity, as an essential input for innovation, while often neglecting the importance of informal inventive activity outside R&D. In contrast, the learning by doing literature addresses innovation by outside-R&D activity, primarily focusing on process improvement, although it has the potential to provide additional insights for understanding significant product innovation generated outside R&D. Bridging the innovation management literature and organizational learning literature, and adopting a sociology of work perspective, we show that non-R&D work, by building on learning processes separate from R&D, can generate product innovation as well as process innovation. We also show rates of non-R&D invention are

relatively higher in knowledge environments that are less general (i.e., lower mobility/transferability) and more visible (i.e., tighter links between actions and outcomes). The paper concludes with a discussion of the implications of these insights for innovation management.

AUTHOR: Anja Herrmann-Fankhänel

ADVISOR & CO-AUTHOR: Prof. Dr. Stefan Huesig

UNIVERSITY: Technische Universität Chemnitz, Germany

PAPER TITLE "How Much Social Innovation is Behind the Online Platforms of the Sharing Economy?: An Exploratory Investigation and Educing of Clusters in the German Context"

Abstract: The paper aims to generate insight about conceptualization of the sharing economy. With a field research of 76 online platforms associated with the German sharing economy (SE), a generalized conceptualization is formed. With the inferred attributes and developed categories, clusters are built. The German sharing economy is outlined as a conglomerate of business models that are effecting classical consumption by online platform-using business organizations, peer-to-peer consumption without business intermediates, and hybrid forms between commercial and non-commercial users. Within these and their frequency, conclusions about possibilities for alternative consumption and social innovations are discussed. A minority can be directly linked to alternative consumption that acts without business intermediates or without monetary reward. Seldom can cases be interpreted as social innovations, because improvements in social concerns are enabled through online platform technology. The frame of the German economic system for the sharing economy is considered briefly to underpin assumed developments and effects, which led to the actual status and will influence the sharing economy's future. The study is theoretically based on the resource-dependence approach and on related fields. Concluding hypotheses are derived from our results for further research on SE.

AUTHOR: Rahul Z. More

ADVISOR & CO-AUTHOR: Dr. Karuna Jain

UNIVERSITY: Indian Institute of Technology Bombay, India

PAPER TITLE "T-Shape Competence Model for Firms to Leverage Innovation Capabilities and Create Impact in a Cluster"

Abstract: Automobile clusters, driven by innovation capabilities, have emerged as competence centers and engines of new economic growth in India. Identified as a high potential sector, the automobile industry has been targeted under the "Make in India" initiative to foster inclusive growth in the country. The dynamism within a cluster emerges from the interaction between

innovation systems and global value chain systems, which contribute to developing a framework for evaluating the innovation performance and maintaining competitiveness of firms. While evaluating innovation performance, this research examined the innovation capabilities of auto component firms and analyzed how firms in the Pune automobile cluster integrate technology management and innovation strategies with their business strategy. A mixed research methodology was adopted for this study. Structured equation modeling (SEM) was used to test the hypotheses, and the results show how firms utilize innovation capabilities and leverage their innovations through emerging practice domains. A T-shape competence model is proposed to achieve global competitiveness and create sustainable impact through social innovations.