

TMS Initiatives and Sustained Thrust in Manufacturing and ICME

G. Spanos

The Minerals, Metals & Materials Society
TMS Technical Director
(3.5 years)



Formerly, Naval Research Lab.
Section Head
(21 years)



Talk Overview

- Highlight some recent, new, & upcoming TMS initiatives
- Focus on initiatives couched in terms of a sustained thrust in:
 - Integrating *manufacturing* & materials innovations, as well as
 - Integrated Computational Materials Engineering (*ICME*)
 - Dovetail with **MGI**



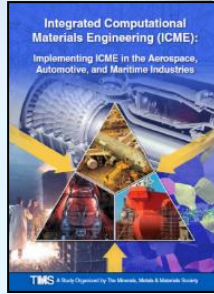
Motivation for TMS Manufacturing Emphasis

- President Obama at CMU, June 2011: Advanced Manufacturing Partnership (AMP)... Manufacturing Innovation Institutes (also rolled-out MGI)
- Four Manufacturing Institutes approved & awarded to date:
 - **America Makes** – National Additive Manufacturing Innovation Institute (NAMII)
 - **DOE Clean Energy Manufacturing Innovation Institute** (focused on wide bandgap semiconductors)
 - **Lightweight and Modern Metals Manufacturing Innovation (LM3I) Institute**
 - **Digital Manufacturing and Design Innovation (DMDI) Institute**
- Many more Manufacturing Innovation Institutes planned
- Due to large government investment & interest, our volunteer members, and entire materials community, flocking to materials related manufacturing issues
- Fits very well into TMS's strategic goals (especially goals 3 & 5)
- Matches with TMS core/historic strengths & interests in light metals, manufacturing, structural materials, etc.
- **This thrust dovetails directly with TMS's strong role in ICME, and the MGI**



Overview of TMS Sustained “Thrust”

- ICME Implementation Study report (7/13)
- ICME Imp. Study Team began developing new initiatives (1/14)
- TMS 2014 Keynote Session - Matls. & Manufac. Innov. (2/14)
- Lightweighting Summit (5/14)
- ICMEg workshop (6/14)
- 3DMS-II (7/14)
- JOM feature - Additive Man. (8/14)
- Quad City Mfg Lab Workshop (9/14)
- MS&T14 manufacturing & ICME sessions (10/14)
- TMS15 manufacturing & ICME events (2/15)
- ICME 3rd World Congress (6/15)
- **TMS Manufacturing Summit (11/15)**
- A “culmination” - build up to this from prior events



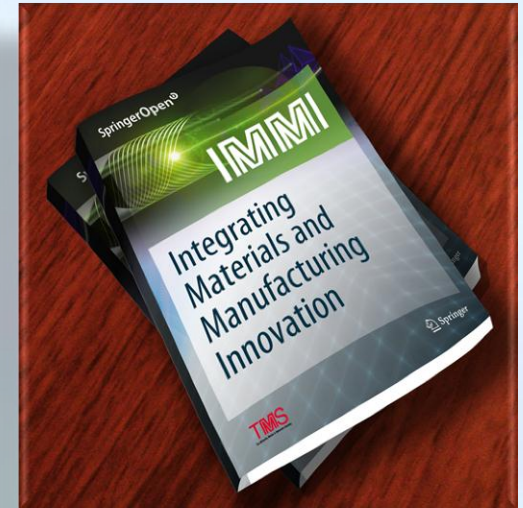
TMS Journals to Support Manufacturing Related Initiatives

IMMI - Integrating Materials and Manufacturing Innovations

www.tms.org/pubs/journals/immi

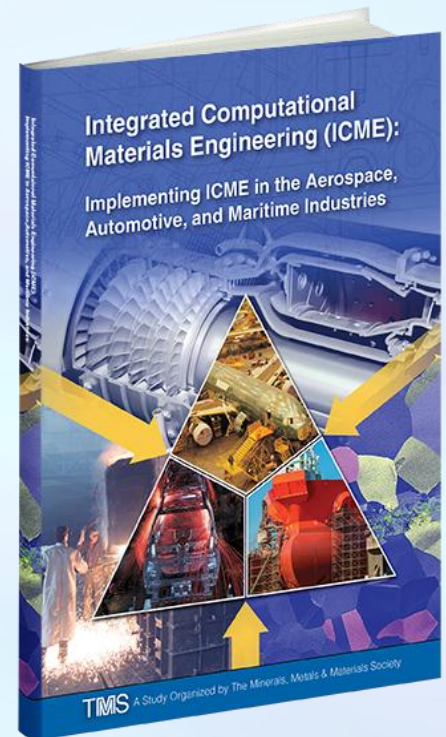
JOM – TMS member journal (and beyond)

www.tms.org/pubs/journals/JOM



TMS Study on Integrated Computational Materials Engineering (ICME)

- Final report rolled out 7/13
- Funded by DoD (ONR, AFRL), DOE, NSF (15 month study)
- ICME Implementation in Aerospace, Automotive, and Maritime Industries
- Centered about Lightweighting
- Next slides provide some highlights...



www.tms.org/icmestudy

ICME Implementation Team Leaders

- **Aerospace: Tresa Pollock**
 - Univ. of Cal. at Santa Barbara - Dept. head
 - Chair of 2008 National Academies study on ICME
- **Automotive: John Allison**
 - Univ. of Michigan (much of career at Ford)
 - Co-Chair of 2008 National Academies study
- **Maritime: John Deloach**
 - Naval Surface Warfare Center - Division Head (& ONR)
 - Handles many materials issues for Navy platforms
- **Crosscutting: Brad Cowles**
 - Consultant - retired Pratt & Whitney (37 years)
 - Oversaw tech. projects & technology development programs
- **Report Review: Justin Scott**
 - TMS Technical Projects Leader
 - Also worked on ICME-related studies at Inst. for Defense Analysis



ICME Implementation Teams By Affiliations

| Aerospace |
|-------------------------------------|
| University of California - S. B. |
| Cowles Consulting /Pratt&Whitney |
| GE-GRC |
| GE Aviation |
| AFRL |
| Lockheed Martin |
| Pratt & Whitney |
| Boeing |
| Boeing |

| Automotive |
|------------------------------------|
| University of Michigan |
| Timken |
| Hydro Aluminum |
| Ford |
| GM |
| University of British Columbia |
| Pacific Northwest National Lab. |
| Ford |
| Consultant |
| Alcoa |

| Maritime |
|---|
| Naval Surface Warfare Center |
| EWI |
| Ingalls Shipbuilding |
| Naval Surface Warfare Center |
| Arcelor Mittal |
| Naval Research Laboratory |
| Office of the Secretary of Defense (OSD) |
| Hill-Newport News |
| NAVSEA |

| Cross-Cutting |
|-------------------------------------|
| Cowles Consulting /Pratt&Whitney |
| Thermocalc |
| Georgia Tech. |
| Pratt & Whitney |
| Alcoa |
| Purdue |
| ESI |
| University of Oklahoma |
| Northwestern University/Questek |

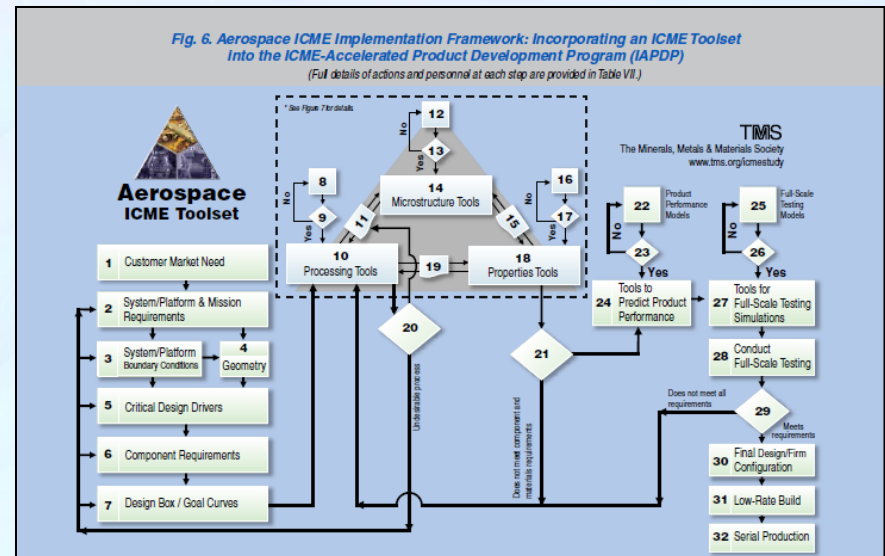
| Review |
|------------------------------|
| TMS |
| Naval Research Laboratory |
| University of North Texas |
| NIST |
| General Electric (retired) |
| General Motors |
| Oak Ridge National Lab. |
| University of Michigan |
| Tinken Steel |

❖ **Mixture from Big Industry, Smaller Companies, Academia, Government**

Some Key Study Outputs

- A strong Executive Summary (especially for those not able to read entire report)
- “Frameworks” detailing steps needed to execute an ICME-Accelerated Product Development Program (IAPDP) in each industrial sector
- Detailed actions at each step in the frameworks, and flow paths of information between steps

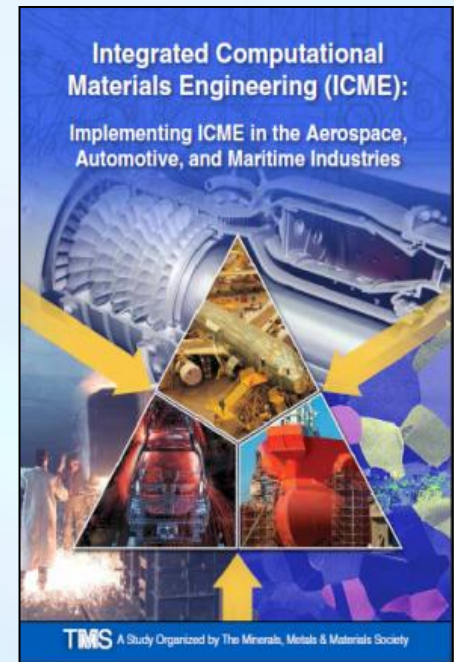
- Personnel needed for each step
- Detailed strategies for addressing needs & barriers to ICME implementation
- Recommendations for > 50 specific application opportunities for Implementing ICME



- Pervasive, crosscutting issues & recommendations
- References and “additional reading” list

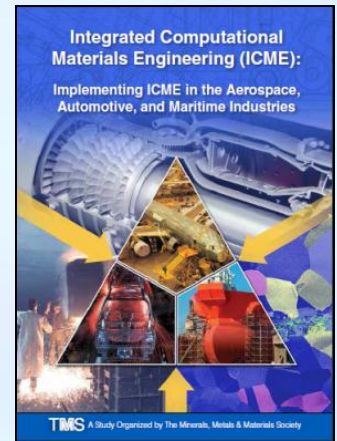
ICME Implementation Study

- Pdf version can be downloaded (free) at www.tms.org/icmestudy
- > 875 electronic copies of report downloaded from TMS Web site;
> 750 hardcopies distributed (in 8 months)
- I have some free hardcopies here – please see me (sign up sheet so we can track copies)



ICME Implementation Team New Initiative Development (1/14)

- **Going forward:** Team members agreed to continue to work together after study, on TMS initiatives to accelerate ICME implementation - as per study recommendations
- Working on initiatives, assigning volunteer “working groups” to work with TMS staff to plan and execute initiatives
- 1st initiative: CE - ICME Implementation Study Course



Keynote Session at TMS2014 (Feb. 18)

- **“World Views on Materials and Manufacturing Innovation: Regional Perspectives from Government Organizations”**
- Presentations from five higher level international speakers in gov. organizations, then audience-interactive panel discussion
- After Session: Speakers provided input to us on TMS Manufacturing Summit & other initiatives



Infocast-TMS Lightweighting Summit

- **May 19-21, 2014**, Detroit MI
- Infocast: For-profit conference group *targeting business leader audiences in technical industries*
- TMS was asked to partner: Infocast leads event, TMS as cosponsor provides technical input and co-marketing
- TMS helped with shaping technical program
 - Helped set up sessions, technical topics, and target audience
- G. Spanos also giving a talk (not a “keynote”) on ICME Implementation in lightweighting



www.infocastinc.com/events/lightweight

Infocast-TMS Lightweighting Summit

Featured Speakers:



Alan Taub,
*Professor, Material
Science & Engineering,
UNIVERSITY OF MICHIGAN;
Former Vice President
of Global Research and
Development,
GENERAL MOTORS*



Paul Krajewski, Ph.D.,
*Engineering Group
Manager/Technical Fellow,
Global Mass Strategy,
GENERAL MOTORS*



Julie Christodoulou,
*Director of Naval Materials
Division, Office of Naval
Research, Lightweight
and Modern Metals
Manufacturing Innovation
Institute (LM3I),
US DEPARTMENT
OF DEFENSE*



Dr. Marc Wiseman,
*Principal,
RICARDO STRATEGIC
CONSULTING*



Tim Skszek,
*Senior Manager,
Government Partnerships,
MAGNA COSMA
ENGINEERING*



Mark Shuart,
*R&D Director, Structures
& Materials, Advanced
Manufacturing Office,
US DEPARTMENT
OF ENERGY*



Mei Li, Ph.D.,
*Technical Expert and Group
Leader of Light Metal
Research and ICME,
FORD RESEARCH AND
ADVANCED ENGINEERING*



Matthew J. Zaluzec, Ph.D.,
*Global Materials &
Manufacturing Research
– VES Technical Advisory
Board, Research &
Advanced Engineering,
FORD MOTOR COMPANY*

www.infocastinc.com/lightweight

Lightweighting Summit – Highlights

(Taken from Infocast Brochure)

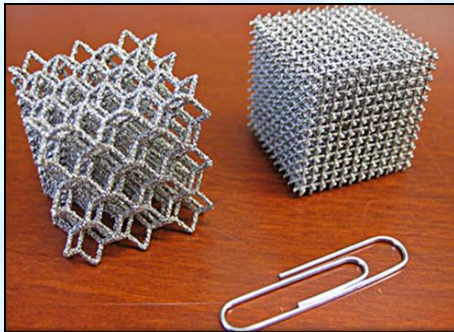
- Will bring together key strategists, decision-makers, innovators, & investors in transportation & materials markets
- Will provide a survey of latest initiatives of global OEMs & designers, highlight funding opportunities, and showcase plans and capabilities from a range of suppliers and R&D groups
- An environment for networking & relationship-building (attendees can set up meetings with other participants before the event)

“.....will help chart a practical course for corporate innovation and investment in lightweighting..... in a wide range of lightweighting areas, including creating new supply chains, achieving greater return on capital investment, satisfying government standards, elevating performance, and addressing sustainability.” - Jim Robinson, Executive Director, TMS



JOM Additive Manufacturing Feature Article

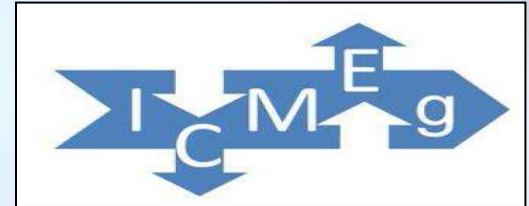
- **August 2014** issue - cover feature
- Justin Scott and Lynne Robinson - organizers
- Multifaceted format
 - Individual interviews on history of field
 - Case studies examining application spaces
 - Roundtable discussion - experts from industry, academia, gov.



- ❖ Idea: Similar special features for other manufacturing or ICME related initiatives or groups
 - e.g., Northwestern Center for Hierarchical Materials Design (CHiMaD) - perhaps lead a feature topic or technical topic

ICMEg Workshop

“1st International Workshop on Software Solutions for ICME”

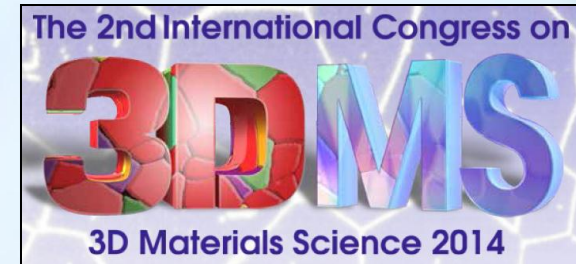


- **June 24th to 27th 2014**, in Aachen, German
- Led by Georg Schmitz & Ulrich Prahl, Germany
- ICMEg - the ICME expert group - aims at developing a global open standard for information exchange on simulation tools
- Workshop is especially focused on ICME software tools
- Defining a global and open standard for information exchange between the huge variety of models & simulation tools
- TMS Co-Sponsorship of this workshop (cross promotions)

<http://web.access.rwth-aachen.de/MICRESS/ICMEg1>

3DMS-II

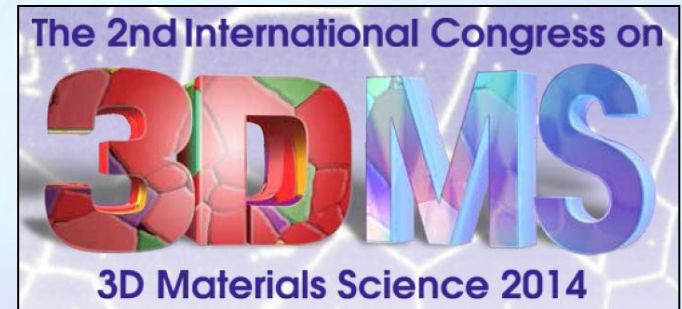
- **2nd International Congress on 3D Materials Science 2014 (3DMS-II)**
- **June 29 - July 2, 2014**, in Annecy, France
- Organizing Committee:
 - Jean-Yves Buffiere - INSA-Lyon, France
 - Tresa Pollock - University of California Santa Barbara, USA
 - Tony Rollett - Carnegie Mellon University, USA
 - Mike Uchic - US Air Force Research Lab, USA
 - Henning Poulsen - Technical University of Denmark, Denmark
 - Dominique Bernard – Inst. of Condensed Matter Chem., Bordeaux, France
- ❖ Note: Annecy is only ~ 6 hr. drive from Aachen (ICMEg workshop), and begins the Sunday (June 29) after ICMEg finishes on Friday (June 27)
 - \$50 discount to 3DMS-II for attendees of ICMEg; 50€ ICMEg discount to 3DMS-II attendees



www.tms.org/Meetings/2014/3DMS2014

3DMS-II

- Forum for presentations & discussion on 3D characterization, visualization, quantitative analysis, modeling, and investigation of structure-property relationships in 3D
- Intimate environment for rich discussions and interactions
- Not only assess state-of-the-art within 3D Materials Science, but Roadmap key areas of future research as well (last day)
- Topic Areas
 - Experimental techniques for 3D data acquisition
 - Advances in reconstruction algorithms
 - Image processing and digital representation of 2D and 3D microstructural data
 - Advances in 3D materials modeling
 - Microstructure property relationships in 3D
 - 3D interfaces and microstructural evolution
 - Future directions & challenges for 3D materials science



❖ These 3D modeling and characterization methodologies are critical to accurate ICME modeling, and Verification & Validation of ICME models/simulations

Quad Cities Manufacturing Lab (QCML) Workshop

Date: September 9-12, 2014

Location: Rock Island, IL

Projected size: ~100 - 125 attendees

Program Chair: Eric Faierson-QCML/WIU

Technical Topics:

- Additive Manufacturing
- Friction Stir Welding
- Casting
- Spark Plasma Sintering
- Metal Powder Production
- Composites
- Computational Modeling in Advanced Manufacturing



www.tms.org/meetings/2014/AMM2014

MS&T 2014 (October 12-16, 2014)

- Many Manufacturing and/or Computational Materials Sci. & Engineering related talks and symposia
- “Processing and Product Manufacturing” Track - 15 symposia, some of these include:
 - Advanced Manufacturing Technologies
 - Advances in Titanium Manufacturing
 - Materials Technology Aspects in Product Remanufacturing
 - Processes, Applications, Performance of Matls. in Additive Man.
 - Materials Science of Additive Manufacturing
- Computational MS&E Sessions include:
 - Computational Design of Ceramic Materials
 - Multiscale Modeling of Microstructure Deformation in Material Processing



TMS 2015 Annual Meeting (March 15-19, 2015)

- Manufacturing-related talks and symposia
- Computational/ICME sessions
- Possible beta version of ICME Implementation Study CE course
- Build up to:
 - ICME 3rd World Congress in June, 2015
 - TMS Manufacturing Summit in Nov., 2015



3rd World Congress on ICME

- **May 31 - June 4, 2015**, Colorado Springs, CO
- Strong Organizing Committee:
 - Warren Poole (UBC)
 - Xin Sun (PNNL)
 - Steve Christensen (Boeing)
 - Jonathan Madison (Sandia)
 - Dierke Raabe (Max-Planck Institute)
 - Surya Kalidindi (Georgia Tech.)
- Builds on success of first two ICME World Congresses
- Focus even more on the I and E in ICME
- Expand beyond structural metals focus
- New TMS ICME Implementation Study CE Short Course offered there



www.tms.org/meetings/2015/icme2015

TMS Manufacturing Summit

- “The First TMS Summit on Integrated Manufacturing and Materials Innovations”
- November 15-19, 2015, in Pittsburgh
- Core Organizing Committee:
 - **Frank Gayle** - Deputy Director, Advanced Manufacturing National Program Office, NIST
 - **Bob Hyland** - Director, Process Technology, U S Steel Research & Technology Center
 - **Jim McGuffin-Cawley** - Chair, Case Western Reserve; Executive Committee member of first AMP Manufacturing Institute (America Makes)
 - **Bill Mullins** - Office of Naval Research, Program Officer, Naval Materials Division
- Recurring event - inaugural summit focused heavily on manufacturing-related institutes and consortia



Website coming soon at: www.tms.org/meetings

TMS Manufacturing Summit

- Forum for presentations & networking of MS&E community engaged in manufacturing-related innovation, research, development, implementation
- Forum for manufacturing institutes and consortia to report out and coordinate as needed
- Industry, government, and academia
- Intimate environment: rich discussions/interactions
- Assess state-of-the-art in materials-related manufacturing innovations
- Also roadmap key areas of future directions



Integrating Materials and Manufacturing Innovations (IMMI) Journal

Great venue for many of the manufacturing-related initiatives just discussed

- Special issues
- Individual technical articles
- Publish technical data with articles
- Open access online journal - so anyone can access & download
- Continuous stream in addition to quarterly in-print volumes - rapid publication



www.tms.org/pubs/journals/immi

JOM

Good venue for manufacturing & ICME initiatives just discussed, including less technical topics - e.g. program overviews, institute/consortia topical highlights, etc.


- Special issues - in the technical section (“JOM the Journal”)
- Feature articles – less technical front section (“JOM the Magazine”)
- Advertisements

www.tms.org/pubs/journals/JOM



Brief Change of Topic That May be of General Interest: TMS Diversity Summit

THE FIRST TMS SUMMIT
ON CREATING AND SUSTAINING
DIVERSITY IN THE MINERALS, METALS, AND
MATERIALS PROFESSIONS (DMMM1)



Honoring the First Female Member of AIME: Ellen Swallow Richards

July 29-31, 2014
The National Academy of Sciences Building
Washington, DC

www.tms.org/meetings/2014/diversity

Diversity Summit - Overview

Key Themes

- **Gender and Race Diversity:**
 - From perspectives of government, academia, and industry
 - Professionals, at three career stages - early, mid, leadership
- **Unique Format:** Plenaries & keynotes, Panel discussions, Facilitated working sessions, Professional development training
- **Skills Development and Tangible Outputs:** emphasis on development & implementation of personnel skills and “tools” that can be used and shared upon returning to respective workplaces

“Think Globally, Act Locally”

Tangible Outputs (live beyond the summit)

1. Final report on diversity in the profession
2. Toolkit (on-line) to help individuals navigate diversity in the workplace and create an environment of inclusion

Diversity Summit - Speakers

Speakers and Panelists Include:

- **Linda Abriola**, *Tufts University*
- **Keith Bowman**, *Illinois Institute of Technology*
- **Dianne Chong**, *Boeing*
- **Julie Christodoulou**, *Office of Naval Research*
- **Johnnie Deloach**, NSWC, *Office of Naval Research*
- **Mary Galvin**, *National Science Foundation*
- **Dawne Hickton**, *RTI International Metals*
- **Andrea Hodge**, *University of Southern California*
- **Katie Kosloski**, *Luck Stone*
- **Beth Lewis**, *PCC Forged Products*
- **Julia Philips**, *Sandia National Laboratories*
- **Orlando Rios**, *Oak Ridge National Laboratory*
- **Linda Schadler**, *Rensselaer Polytechnic Institute*



Professional Trainers

- **Valerie Young**, *author of The Secret Thoughts of Successful Women: Why Capable People Suffer from the Impostor Syndrome and How to Thrive in Spite of It*
- **Jean Mavrelis and Thomas Kochman**, *co-authors of Corporate Tribalism: White Men/White Women and Cultural Diversity at Work*

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ON CREATING AND SUSTAINING

DIVERSITY IN THE MINERALS, METALS, AND MATERIALS PROFESSIONS (DMMM1)

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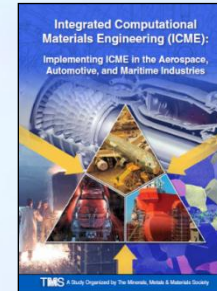


If interested in attending and contributing to the discussion, please see Web site for registration and other details (or see me)

www.tms.org/meetings/2014/diversity

Back to Closing Comments on TMS Sustained Thrust in Manufacturing and ICME Initiatives

- Described motivation/driver
- Showed a number of TMS initiatives with a sustained, interrelated thrust
- Culminate with TMS Summit on Integrated Manufacturing & Materials Innovations (Nov., 2015)
- Activities map to TMS strategic goals & strengths
- Perhaps multiple points of interest with folks in this room
 - Please feel free to chat with me after this talk



Thank You

Questions & Discussion



- ❖ Note: I have some hardcopies of the ICME Implementation Study for those interested - please see me
- ❖ Next slide.....

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