Attendance during the open session was as follows:

Board of Governors
President: Said Jahanmir
President Nominee: Richard Laudenat
Immediate Past President: Charla K. Wise
Governors: Stuart Cameron, Robert E. Grimes, Mahantesh Hiremath, Michael Molnar, Karen J. Ohland, Mary Lynn Realff, Karen Thole, and William J. Wepfer
Absent: Joe Fowler
Governors-Elect: Todd Allen, Laura Hitchcock, Thomas Kurfess

Other Officers
Senior Vice Presidents: Kalan Guiley, Public Affairs and Outreach
Sam Korellis, Standards and Certification Sector
Richard C. Marboe, Technical Events and Content
Callie Tourigny, Student and Early Career Development
Senior Vice President-Elect: George Papadopoulos, Technical Events and Content
Secretary and Treasurer: Bryan Erler
Executive Director: Thomas Costabile
Assistant Secretary: John Delli Venneri
Assistant Treasurer: William Garofalo
Corporate Counsel: John Sare

Other Guests
Leila Aboharb Member-at-Large, SECD Council
Howard Berkof Chair, Presidential Task Force on Nomination Process
Andrew Bicos Chair, Presidential Task Force on Membership
John Blanton Chair, Greenville Section
Warren DeVries Past Governor
Tommy Gardner Chair, Industry Advisory Board
Amos Holt Past President, 2009-2010
Julie Kulik DCMA
Larry Luna Sandia National Laboratories
Webb Marner UCLA
John Mulvihill Chair, Group Engagement Committee
1. Opening of the Meeting

1.1. Call to Order: On November 10, 2018, a meeting of the Board of Governors of the American Society of Mechanical Engineers was held at The Westin Convention Center hotel in Pittsburgh, PA. A quorum was present, and the meeting was called to order by President Jahanmir at 9:05 AM Eastern Daylight Time.

1.2. Adoption of the Agenda: The Board voted to adopt the agenda circulated on October 26, 2018.

1.3. Announcements: President Jahanmir acknowledged Past Presidents that were in attendance and thanked everyone who came to observe the Board meeting.

1.4. President’s Remarks: President Jahanmir announced a list of events to attend for the week of IMECE. He thanked all of the staff for their hard work in making this event successful and encouraged all to take the opportunity to attend most events. He discussed the four task forces that are under his leadership this year including the Presidential Task Force on Core Technologies, Presidential Task Force on Nomination
Process, Presidential Task Force on Membership, and Presidential Task Force on Organizational Structure. At his direction, these Task Forces are meeting on a monthly basis.

1.5. Executive Director’s Remarks: Tom Costabile welcomed all to the meeting and thanked everyone for attending. He thanked Tommy Gardner for setting up the opportunity to visit Hewlett Packard and Mahantesh Hiremath for volunteering and being a great tour guide. He stated that Jeff Patterson will provide an update on the FY19 IOP status, and he is working with SVP’s on the FY20 planning, which is on schedule. Lastly, Tom announced that a new Executive Director had been hired for the ASME Foundation.

1.6. Consent Items for Action:

The Board voted to approve the following items on the consent agenda:

1.6.2. Approval of Minutes from October 10, 2018 Meeting

1.6.3. Approval of ASME Positions Papers
(Appendix 1.6.3)

1.6.4. Approval of By-Law B4.2.2.4 for First Reading: Nominating Committee
(Appendix 1.6.4.)

2. Open Session Agenda Items

2.1. FY19 IOP Update: Jeff Patterson provided a Q1 update on the IOP goals for FY19. (Minutes Appendix 2.1.)

2.2. FY19 EDESC Executive Director Goals: Tom Costabile and Charla Wise spoke about the Executive Director goals as discussed with and approved by the EDESC. Charla mentioned that the ED annual goals are set annually and the Executive Director meets with the EDESC to develop these goals. (Minutes Appendix 2.2.)

The Board voted: To approve the Executive Director Goals for FY19 as recommended by the EDESC.

2.3. Industry Advisory Board Update: Tommy Gardner provided a brief overview of the Industry Advisory Board. Tommy Gardner thanked Keith Roe for forming the Industry Advisory Board that was established in 1989, and his contribution working with the Board. He mentioned that the IAB members initial plan was to help ASME address the important issues faced by the Society, and give back to the Society. (Minutes Appendix 2.3.)

At the conclusion of this item, President Jahanmir welcomed Warren DeVries to the podium to share a special presentation. Warren DeVries announced that David Soukup had been named an ASME Fellow. David’s 30 years of service with ASME was recognized by a standing ovation.
Larry Luna was also asked to join President Jahanmir at the podium. Larry was acknowledged and congratulated on being named an ASME Fellow.

Lastly, Bobby Grimes was recognized for being inducted into The University of Texas at Austin Mechanical Engineering Academy of Distinguished Alumni.

2.4. Student and Early Career Development: Callie Tourigny and Anand Sethupathy provided an overview of the Student and Early Career Development Sector. Callie and Anand discussed the needs of Students and Early Career Engineers and how they engage in different ways on a global, local scale, and with programs that they’re involved in. Student and Early Career Engineer aims to attract and retain 100,000 members by 2030 under the age of 35. The overall plan is to prioritize the strong development of a strong volunteer leadership pipeline. (Minutes Appendix 2.4.)

2.5. Group Engagement Committee Update: John Mulvihill and Elio Manes provided a brief overview of the Group Engagement Committee and Group Pathways of Support activities from June 2018 to October 2018. (Minutes Appendix 2.5.)

3. New Business: There were no items.

4. Open Session Information Items

4.1. Dates of Future Meetings

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<thead>
<tr>
<th>DATE</th>
<th>DAY</th>
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<tr>
<td>December 14, 2018</td>
<td>Friday</td>
<td>3:00 PM – 4:00 PM</td>
<td>Conference Call</td>
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<td>Board Dialogue (a)</td>
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<tr>
<td>February TBD (a)</td>
<td>TBD</td>
<td>TBD</td>
<td>Conference Call</td>
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<td>April 9, 2019</td>
<td>Tuesday</td>
<td>8:15 AM – 1:00PM</td>
<td>Washington, DC</td>
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<td>Annual Engineering Public</td>
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<td>Policy Symposium</td>
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<td>April 9, 2019</td>
<td>Tuesday</td>
<td>1:00 PM – 5:00PM</td>
<td>Capitol Hill,</td>
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<td>Congressional Visits</td>
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<td>April 9, 2019</td>
<td>Tuesday</td>
<td>Dinner – Evening</td>
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<tr>
<td>April 10, 2019 (a)</td>
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<td>June 5, 2019 (b)</td>
<td>Wednesday</td>
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a) 2018-2019 Board of Governors  b) 2019-2020 Board of Governors

5. Adjournment: The meeting adjourned on Saturday, November 10, 2018 at 12:12 PM Eastern Daylight Time.
List of Appendices

1.6.3. Approval of ASME Position Papers

1.6.4. By-Law B4.2.2.2 for First Reading – Nominating Committee

2.1. FY19 IOP Update

2.2. FY19 EDESC Executive Director Goals

2.3. Industry Advisory Board Update

2.4. Student and Early Career Development Update

2.5. Group Engagement Committee Update

5.1. SMC Report

5.2. Financial Update

5.3. Presidential Task Force on Core Technologies Update

5.4. Presidential Task Force on Membership Update

5.5. Presidential Task force on Nomination Process Update
Date Submitted: October 19, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: ASME Committee on Government Relations
Agenda Title: Approval of ASME General Position Papers

Agenda Item Executive Summary:
The ASME Committee on Government Relations approved three general position papers for public release:

“Standards and Technical Barriers to Trade” – This paper outlines ASME support for WTO TBT objectives and principles in ensuring that standards maintain high levels of safety, quality, and efficiency while promoting trade and competition.

“ASME Robotics General Position Paper” – This paper outlines policies to encourage growth in the U.S. robotics sector, including R&D, technology commercialization, and workforce development.

“Energy-Water Nexus” – This paper outlines key factors in the Energy-Water Nexus for public policy makers and offers recommendations for addressing key national challenges to support more efficient use of energy-water resources and development of U.S. energy-water infrastructure.

Proposed motion for BOG Action:
Approval for public release per Society Policy 15.1

Attachments: (3)
- PS18-Standards and Technical Barriers to Trade
- PS18-ASME Robotics General Position Paper
- PS18-Energy Water Nexus
Standards and Technical Barriers to Trade

Executive Summary

The World Trade Organization’s (WTO) Agreement on Technical Barriers to Trade (TBT) recognizes the growing impact of standards and conformity assessment on global commerce and the potential to either facilitate or impede international trade. The American Society of Mechanical Engineers (ASME) supports the position that the principal criterion for acceptance as an international standard is the extent of its actual acceptance and use in the global arena.

ASME recognizes the role and authority of the WTO Committee on Technical Barriers to Trade over the implementation of the TBT Agreement and views the principles outlined in the Decision of the Committee on the Principles of International Standards, Guides and Recommendations as key to executing ASME’s mission “to develop the preeminent, universally applicable codes, standards, conformity assessment programs, and related products and services for the benefit of humanity.” The federal government, through its international trade negotiators and representatives, should support industry standards and conformity assessment programs that ensure the high quality and safety of manufactured products, improve the efficiency of production, and facilitate the conduct of international trade. In addition, they should continue to recognize that many U.S. domiciled standards developing organizations apply the WTO principles to their standards-setting process and continue to promote the acceptance of multiple paths to achieving global technical alignment of standards and conformity assessment programs. Standards produced using a process that adheres to the principles of transparency, openness, impartiality and consensus should be designated as international standards.

I. Introduction

Founded in 1880, the American Society of Mechanical Engineers (ASME) is an international not-for-profit engineering society focused on safety, technical, educational, and research issues. It serves a membership of over 130,000 individuals worldwide; there are no corporate members. ASME conducts one of the world's largest technical publishing operations; holds approximately 50 technical conferences, symposia, and workshops; manages a portfolio of over 300 learning and development courses; is responsible for approximately 500 standards, developed and maintained by technical subject matter experts from 60 countries, and used in over 100 countries; and certifies companies in over 90 countries.

The formation of the World Trade Organization (WTO) in 1995 provided the framework for facilitating the development of international markets, with attendant benefits to all WTO members and their citizens. ASME subscribes to the underlying beneficial principle stated in the Preamble of the Agreement establishing the WTO, which calls on members to conduct their trade relations in a manner that will “raise standards of living, ensuring full employment and a large and steadily growing volume of real income and effective demand, and expanding the production of and trade in goods and services, while allowing for the optimal use of the world's
resources in accordance with the objective of sustainable development, seeking both to protect and preserve the environment and to enhance the means for doing so in a manner consistent with their respective needs and concerns at different levels of development.”

The Agreement on Technical Barriers to Trade (TBT), also established in 1995, encourages the development of international standards and conformity assessment programs and seeks to ensure that “technical regulations and standards, including packaging, marking and labeling requirements, and procedures for assessment of conformity with technical regulations and standards do not create unnecessary obstacles to international trade.” In 2000, a Committee Decision was issued on the principles for the development of international standards with respect to the TBT Agreement. The decision established principles concerning transparency, openness, impartiality and consensus, relevance and effectiveness, coherence and developing country interests, as well as a code of good practice for the development, adoption and application of standards.

As a major international standards developing organization (SDO) and engineering Society, ASME has a leadership role in the international community in supporting WTO TBT objectives and principles and in ensuring that standards maintain high levels of safety, quality, and efficiency while promoting trade and competition.

II. Position

ASME supports the concepts of free and equitable access to international markets and supports the TBT Agreement as well as the principles outlined in the Decision of the TBT Committee concerning transparency, openness, impartiality and consensus, relevance and effectiveness, coherence, and developing country interests that characterize process for the development of international standards.

ASME believes the U.S. federal government, through its international trade negotiators and representatives, should:

- Ensure mechanisms promoting free trade incorporate commitments to timeliness, technical merit and public safety;
- Recognize that some U.S.-domiciled standards developing organizations produce standards that meet the WTO Principles on the Development of International Standards;
- Base the relevance and effectiveness of technical standards on objective tests of acceptance and use in the global market;
- Provide industries and governments flexibility in their approaches to technical alignment of standards and recognize that no single standards development methodology is best for every sector;
- Protect intellectual property rights; and
- Serve as a resource for resolving trade disputes emerging from the use of standards and conformity assessment programs as technical barriers to trade.

III. Discussion

A. Discussion on WTO Principles for the Development of International Standards
The impact of standards on international trade and competition, the existence and necessity of sectoral differences, and the market-driven framework of the U.S. standards system are articulated in the U.S. Department of Commerce publication, *Standards & Competitiveness: Coordinating for Results*\(^8\) as well as the *United States Standards Strategy*\(^9\). Both documents recognize standards and conformity assessment programs as being essential to a sound national economy and for the facilitation of global commerce.

For technical standards to facilitate international trade, several conditions must be satisfied. The scope and content of the standard must adequately address a defined need and at the same time incorporate appropriate safety provisions. The TBT Agreement gives preference to performance-based technical regulations; ASME supports this position, noting that at the standards level, more prescriptive provisions are often appropriate, when consented to by affected parties.

Further, the *Committee Decision* establishes principles concerning transparency, openness, impartiality and consensus, relevance and effectiveness, coherence, and developing country interests. ASME develops and maintains hundreds of standards and conformity assessment programs – covering a wide range of products and services – which are used throughout the world and in accordance with these principles.

ASME recognizes the benefits of *coherence* via sustained efforts at international harmonization of standards and conformity assessment activities, while at the same time recognizing that there is no single best approach for achieving this goal. In addition to differing market preferences and the existence of well established historical conventions, other reasons for varying approaches include differences in legal statutes; availability of resources; levels of capacity and economic development; and societal norms of behavior.

Fostering multiple approaches to standards development will afford the flexibility needed in order to ensure that standards and conformity assessment programs are most responsive to the changing needs of industry and governments and most relevant for their intended markets. The determination of which approach to be taken is typically based on how ASME can best respond to the needs of the international and domestic markets in a given sector and to the public health and safety needs of people and governments around the world. For example, in some instances, an existing prescriptive standard will remain dominant for international trade. At other times, a performance-based approach for technical alignment might be taken\(^10\). For instance, it may not be possible to technically align different existing prescriptive design standards with each other but it may be possible to develop a single performance-based standard that would be compatible with each of the different design standards (e.g., a performance-based ISO standard that references ASME and other international standards that achieve the required results); such alignment would be in keeping with the intent of the TBT provisions. While alignment with other international standards is a goal, it is important to note that at times U.S. health and safety standards, as well as trade competitiveness, may be at risk of being compromised when the push for alignment by non-U.S. parties is unrelenting. The flexibility of multiple approaches provides relief from such pressures.

As a professional technical society established to enhance the welfare of the general public, the principles of *transparency, openness, impartiality*, and *consensus* have always been cornerstones of ASME’s standards development activities. Not only are all ASME standards development meetings free and open to the general public, but membership on ASME
standards development committees is free and open to all technically qualified and materially affected stakeholders, regardless of citizenship, nationality or affiliation. Well established procedures are in place to ensure due process and fair and equitable treatment of all – as well as to ensure that relevant stakeholder interests are balanced. In addition, activities related to ASME standards initiatives are published on its public website, including: policy and standards development procedures; membership information; meeting announcements; new project notifications; and availability of draft standards. Solicitation of public comments is conducted via the American National Standards Institute (ANSI) and all comments are subject to peer review and afforded due process. Contributions at every stage of standards development are facilitated via the use of electronic tools in order to minimize limitations based on geographic location. Involvement and impartial treatment of the best and brightest people from around the world is a part of ASME’s vision, and the principles of transparency, openness, impartiality and consensus are keys to ensuring that ASME’s standards and conformity assessment programs are technically sound, commercially relevant and in the public interest.

ASME’s standards are reviewed at least every 5 years for continued relevance, with many being maintained in a continuous state of review to ensure they are optimally responsive to regulatory and market needs, as well as scientific and technological developments. ASME’s commitment to being responsive to stakeholder needs is taken a step further in that it provides technical interpretations (at no cost) in instances where the existing wording in a standard is construed as ambiguous. In addition, ASME has a dedicated organizational unit (“Standards Technology, LLC”) that performs research and development in order to provide a scientific justification for the incorporation of new technology or processes into a standard or conformity assessment program. This helps ensure that standards can rapidly incorporate leading edge technology while also providing for technical safety and quality. In general, ASME will continue to support its standards as international standards, however, in the event there is overwhelming evidence that global markets have chosen a competing standard, ASME would act to withdraw its standard from the international arena. ASME will continue to develop and maintain codes and standards that are used and needed solely by U.S. industries, when appropriate.

The Committee Decision also provides for a development dimension to enable effective participation in standards development and to offer technical assistance to other members (and developing country members in particular). Consistent with these provisions, ASME provides equal access to information, opportunities for direct participation, and immediate support for technical inquiries at no cost. In addition, ASME has been proactive in providing assistance to developing countries (and others, as appropriate). Consultations with both private and government bodies, free or low cost technical training, organizational assistance, and general outreach are all integral parts of ASME’s ongoing operations. ASME will continue to avail itself to play a leading role in public-private partnerships, such as the U.S. Agency for International Development (USAID)-funded Standards Alliance, and its strong engagement in global engineering development programs such as Engineers Without Borders (EWB) and Engineering for Change (E4C).

In addition to addressing standards development, five articles of the TBT Agreement deal with conformity assessment procedures. ASME certifies over 7,000 manufacturers of boilers, pressure vessels and related equipment in over 70 countries. ASME’s conformity assessment programs adhere to Article 5 of the TBT Agreement, and ASME works closely with central, local, and regional governmental entities, and non-governmental bodies, to ensure equitable treatment for all materially affected parties.
B. Discussion on the Differences in Standards Development Processes

Policy makers and stakeholders engaged in international trade should be aware of key differences in the processes leading up to the presumption of consensus within the framework of various standards development organizations. There still exists some misperception that only standards developed by ISO or the IEC are “international standards” \(^\text{11}\). The ISO and IEC standards development processes provide each participating country a single vote, which as a political device may be appropriate. However, when standards are expected to fill both trade normalization and safety roles, this system provides no assurance that appropriate levels of technical review will be achieved. In the case of both ISO and many non-U.S. national standards, technical adjudication provisions are not directly provided and consequently, technical interpretation of standards provisions is cumbersome and subject to lengthy processes. Additionally, most non-U.S. national and regional standards development organizations are closed to nonmembers and as a result, U.S. participation in their processes is inhibited if not altogether proscribed. Lastly, the “one country, one vote” process employed by ISO and IEC could potentially result in regional trading blocks dominating the interests of other member bodies\(^\text{12}\).

ASME’s process ensures that all stakeholders – both direct participants and members of the general public – have the opportunity to submit comments and ensures a formal response is received following due consideration of the comment. Further, votes submitted on new or revised standards are classified by stakeholder interest\(^\text{13}\) in order to ensure that the resulting standard or conformity assessment program – in addition to being technically sound and commercial relevant – reflects a balanced solution. Procedural due process provides the ability for any person or corporate entity to have direct access to the standard development process and to have an impartial hearing of appeals on actions. Such direct access is lacking in many other standards development processes, including those of ISO.

ASME is a strong supporter and believer in ISO; however, clearly, there are international standards other than ISO standards. A standard’s origin, however, may be less important to the manufacturer, user, and regulator than the quality, technical merit, and the standard’s applicability to the problem at hand. This is especially important when applying the language of the TBT Agreement, including the terms *international standards* and *international body*. ISO standards acquire the title of "international standards" solely by virtue of the membership composition of ISO. However, this is no guarantor of the technical quality or commercial merit of the resulting standards. Other standards acquire the title of “international standard” by actual use in the global market; the ones that survive are generally solid technical standards.

C. Discussion on the Protection of Intellectual Property Rights

In order to continue to serve the needs of global stakeholders while incorporating the latest in technological advancements, it is vital that standardization processes respect the rights of intellectual property owners while ensuring users have access to the intellectual property rights (IPR) incorporated in standards. ASME policy discourages referencing patented items and trademarks in standards and instead recommends the development of performance language that would enable the use of patented technology.\(^\text{14}\) However, in some instances, the best technology for a technical standard is a proprietary technology, protected by one or more patents, and a given standards development committee may opt to incorporate patented
technology in proposed standards in order to make the most advanced, best technology available to all, provided that the owner of the technology agrees to make the technology available to users of the standard under reasonable terms and conditions.\textsuperscript{15}

The protection of IPR also extends to the copyright of the standards themselves, as revenue from sales of the standard is generally used to offset the costs associated with managing the standards development process. It is important to understand that the term “reasonably available” does not mean imply “free” standards. The White House Office of Management and Budget (OMB) 2016 update to OMB Circular A-119 reaffirmed that public interests are well served by the Office of the Federal Register’s (OFR’s) policies supporting government use of private sector standards in a context supported by U.S. copyright law and U.S. international trade obligations.

\textbf{IV. Conclusions and Recommendations}

The United States Trade Representative and other public and private U.S. bodies involved in TBT issues should continue to promote technical regulations and market accepted standards meeting the intent of the TBT provisions as international standards.

Strong emphasis should be given to alternatives to ISO/IEC standards, if these alternatives satisfy the WTO’s Principles for the Development of International Standards. This is especially true in cases when the global market has made effective use of other standards that meet trade and safety needs. Governments should continue to exercise the option of selecting those international standards which best meet their regulatory and public safety objectives.

The federal government should work with state and local government bodies that adopt various standards and/or conformity assessment schemes as means of fulfilling local health and safety statutory obligations to assure a uniform understanding and implementation of the provisions of Articles 3 and 11 of the TBT Agreement.

\textsuperscript{1} The Agreement on Technical Barriers to Trade (TBT) was adopted at the conclusion of the Uruguay Round of General Agreement on Tariffs and Trade (GATT) negotiations in conjunction with the Agreement establishing the WTO.
\textsuperscript{2} Decision Of The Committee On Principles For The Development Of International Standards, Guides And Recommendations With Relation To Articles 2, 5 And Annex 3 Of The Agreement G/TBT/1/Rev.9
\textsuperscript{3} The full Mission of ASME Standards & Certification is to “Develop the preeminent, universally applicable codes, standards, conformity assessment programs, and related products and services for the benefit of humanity. Involve the best and brightest people from around the world to develop, maintain, promote, and employ ASME products and services globally.”
\textsuperscript{4} Preamble to the “Agreement Establishing the World Trade Organization”, Marrakech Agreement, 1994
\textsuperscript{5} Preamble to the World Trade Organization “Agreement on Technical Barriers to Trade”, Uruguay Agreement, 1995
\textsuperscript{6} Article 4 of the TBT Agreement establishes a “Code of Good Practice for the Preparation, Adoption and Application of Standards”. The text of the Code is contained in Annex 3 of the TBT Agreement.
\textsuperscript{7} As used in this document, sectors are different industries or markets (e.g. pressure equipment, telecommunications, pharmaceuticals, etc.)
\textsuperscript{8} “Standards & Competitiveness: Coordinating for Results”, U.S. Department of Commerce, 2004
\textsuperscript{9} “United States Standards Strategy”, American National Standards Institute, 2015
\textsuperscript{10} OMB Circular No. A-119, “Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities” (2016), states a “performance standard” refers to a standard that states requirements in terms of required results, but without stating the methods for achieving the required results. A
performance standard may define the functional requirements for an item, operational requirements, and/or interface and interchangeability characteristics. A prescriptive standard, by contrast, may specify design requirements, such as materials to be used, how a requirement is to be achieved, or how an item is to be fabricated or constructed.”

11 International Organization for Standardization and International Electrotechnical Commission, respectively
12 ISO Technical Committee 85 on Nuclear Energy, for example, has 18 Participating Countries, 8 of which are members of the European Union
13 Examples of interest classifications include: producers and manufacturers; purchasers, owners and consumers; employees and labor interests; governmental bodies having regulatory power or influence over the field in question; specialists having expert knowledge; designers; insurance interests; installers and erectors; utilities; and distributors and retailers.
14 ASME CSP-59, “Referencing Patented Items and Trademarks In Codes and Standards”
Accelerating U.S. Robotics for American Prosperity and Security

Overview
Robotics is driving the world forward in ways previously unimaginable. In the past decade, advances in robotic tools have enabled less invasive surgical procedures, exploration robots have enhanced human presence in planetary systems, robotic vehicles have autonomously driven millions of miles, and manufacturing robotics have positioned the United States as a leader in advanced manufacturing. The benefits of automation, however, do not come without their challenges. According to a recent study by the McKinsey Global Institute, 30 percent of responsibilities in 60 percent of jobs have the potential to be automated—that’s 18 percent of all work. But the same study states that even as jobs become automated, worker demand is likely to grow as new occupations develop alongside the new technologies. Recent advancements in sensing, computational intelligence, and big data analytics have also been rapidly transforming and revolutionizing the manufacturing industry towards robot-rich and digitally connected factories, including efficient and safe coordination between human and robots on the factory floor. The U.S. Federal government has an important role to play in this transition by preparing and equipping society for these new jobs and embracing the benefits that will come with integrated robotics.

The Federal government has a vested interest in the future of the U.S. robotics industry as it will greatly affect the overall U.S. economy, our global competitiveness, and our military capabilities. It is imperative that the U.S. establish policies to encourage growth in the domestic robotics sector so that our technological capabilities do not fall behind those of other nations. This includes making investments in programs that support basic and applied robotics research and development (R&D) and the integration of robotics into society. The Federal government must also monitor and prepare for workforce changes that will come with automation and invest where necessary to ensure proper workforce transition, including in STEM education, training programs, and re-skilling current workers so they are prepared to meet future workforce needs.

Federal Commitment and Leadership
In May of 2018, the White House announced a new Select Committee on Artificial Intelligence (AI) under the National Science and Technology Council and chaired by the White House Office of Science and Technology Policy (OSTP), the National Science Foundation (NSF), and the Defense Advanced Research Projects Agency (DARPA).

“The Select Committee will address significant national and international policy matters that cut across agency boundaries and shall provide a formal mechanism for interagency policy coordination and the development of Federal artificial intelligence activities, including those related to autonomous systems, biometric identification, computer vision, human-computer interactions, machine learning, natural language processing, and robotics.”

This announcement shows that the Federal government recognizes the increasing role for robotics technologies from across Federal agencies and throughout the private sector as well. American leadership
in AI and robotics requires increased emphasis on R&D and workforce development to help ensure the economic prosperity and security of the nation. In considering the future of AI in the United States, the Federal government must invest equally in the development of robotics technologies that enable AI to be more readily utilized in manufacturing and other real world applications. The benefits that come with an AI-integrated society (driverless cars, drones, factory robotics, automated medical procedures, etc.) are all highly dependent on the ability of the robotics technologies to maintain pace with advances in software. Conversely, advances in software are highly dependent on the physical systems that support them. This symbiotic relationship must be maintained to realize the full potential of these new technologies in strengthening the U.S. economy and fortifying the national security supply chain.

Recommendation 1
- Ensure a coherent and holistic approach to robotics R&D, including both the future physical systems and AI technologies.

National Robotics Initiative (NRI)
In the past, the U.S. Federal government has relied on the National Robotics Initiative (NRI) to bolster domestic robotics capabilities. The NRI supports fundamental research in the United States that will accelerate the development and ubiquitous use of collaborative robots (co-robots) that work beside or cooperatively with people. The NRI was founded under the Advanced Manufacturing Partnership (AMP) program at the White House Office of Science and Technology Policy (OSTP) on June 24, 2011. Under the program, Federal agencies can choose to invest in projects that meet their individual mission and needs while advancing the U.S.’s overall robotics capabilities. In FY12, NRI invested just under $50 million in R&D, and in FY13, the program saw $38 million in investments across participating agencies. Due to the success of the program, a renewed effort called “NRI 2.0” was established in FY16, promising $225 million in robotics investments. With anticipated funding of $30M-$45M in FY17, NSF funded 27 NRI projects; the United States Department of Agriculture (USDA) funded 3 NRI projects; and the Department of Energy (DOE) funded 0 despite having received many worthy proposals. Agencies made fewer awards than desired because of the budget uncertainties in FY17. In FY18, with anticipated total funding ranging from $25-$35 million, NSF funded 32 NRI projects; USDA funded 5 NRI projects; and DOE again was unable to make any awards due to funding constraints.

While the NRI continues to successfully fund important R&D, the number of worthy projects that can be funded is highly dependent on the volatile appropriations cycle, especially because there is no line item in the Federal budget dedicated to the National Robotics Initiative. Instead, agencies are expected to fund the projects out of existing appropriations, which has led some agencies to disengage leaving the future of U.S. robotics highly vulnerable. More consistency is needed in current Federal R&D efforts to ensure the U.S. robotics sector continues to grow to meet the needs of the nation. Further, the Federal government must increase its commitment to developing and deploying robotics technologies, and to readying the workforce and society for robotics integration.

Recommendation 2
- Commit to growing robotics R&D—including significantly bolstering available funding of the NRI program—to ensure the fundamental research needed for developing robotics capabilities occurs in the United States, and to ensure the U.S. is able to keep pace with the technological advances by competitor nations that have already invested heavily in robotics R&D.
Global Outlook

While robots were invented in the United States, recent lack of attention and insufficient investment has led to the U.S. falling behind other nations in robotics technology. For the U.S. to regain its position as a global leader in robotics technologies—and in order to achieve the economic and security benefits that result—policymakers must support robust investments in the research and development enterprise, as well as technology integration and deployment efforts.

The International Federation of Robotics reported that in 2016, 30% of total industrial robot sales were for new installations in China, 14% in Republic of Korea, 13% in Japan, 11% the United States, and 7% in Germany. During the same time period, the U.S. GDP was over 1.5 times that of China, 5.3 times that of Germany, 3.7 times that of Japan, and 13.3 times that of Korea. With the U.S. leading the world in GDP, and leading all the aforementioned nations in GDP per capita, it is clear the U.S. has not invested sufficiently to maintain its economic welfare.

The International Federation of Robotics estimates an annual growth rate in industrial robot sales of 14% between 2018 and 2020. Given the forecasted growth in sales in the coming years, governments around the world are increasing their investments in R&D for both existing and potential robotics technologies that support their national interests. In 2015, China announced a $300 billion “Made in China 2025” 10-year plan to invest in China’s advanced manufacturing capabilities and includes robotics as one of its ten key focus areas. In comparison, the United States’ Manufacturing USA program of 14 advanced manufacturing institutes has seen $1 billion of Federal investment with the Advanced Robotics in Manufacturing (ARM) Institute receiving $80 million.

As far as technological trends are concerned, the International Federation of Robotics outlook for 2019 states that companies will be concentrating on the collaboration of human and machine, simplified applications, and light-weight robots; including two-armed robots, mobile solutions and the integration of robots into existing environments. Likewise, customer demand for industrial robots will be driven by an assortment of factors, such as handling of new materials, energy efficiency, better developed automation concepts, and the connectivity of Industrial Internet of Things.

Recommendation 3

- The U.S. must increase robotics investments to double that of our competitor nations to establish itself as a world leader in robotics technologies. Rarely is there a chance to regain footing in a global technology race, however, the new and advancing field of “smart” robotics—robots backed by artificial intelligence (AI)—has provided the U.S. a unique but waning opportunity to take a leadership position in this emerging.

National Robotics Council

Creating a National Robotics Council in line with the ideas presented in the Brooks report titled, “The Case for a Federal Robotics Commission” would provide great benefits to the Federal government. A National Robotics Council would work to streamline investments across agencies and enable focused efforts in areas of national interest.

The National Robotics Council would be set up in a similar fashion to the President’s Council of Advisors on Science and Technology (PCAST) and would serve as an advisory group to policymakers and make recommendations in areas where a deeper understanding of technology is needed. The tasks overseen by this group could include monitoring Federal R&D efforts aimed at solving technology challenges that have far-reaching societal impact, identifying potential hazards of the technology on the wellbeing of society and the economy, and carrying out an overarching national robotics strategy.
Recommendation 4

- Form a National Robotics Council to inform and oversee an overarching national robotics strategy and monitor how robotics technologies are impacting society, the economy, and our national security.

Economic Security: Jobs, Automation, and Education

As automation advances across industries, it is driving a broad range of new job opportunities, from entry-level and blue-collar roles, through professional and high-level positions. These stable, long-term, living-wage positions require employees trained to work with advanced robotic technologies, and the demand for employees with these skills is reaching critical levels. The McKinsey Global Institute suggests that “filling new technical positions is expensive and time-consuming because we have not been turning out enough skilled professionals to keep up with the demand,” and suggests we need to adapt our talent strategy and better manage workforce transitions.

While robotics may replace some routine work, it is also true that robotics technology will enhance many of the jobs that exist today. Historically, advances in technology have always ended up creating more jobs than jobs lost, but how smooth that transition is will be determined by our readiness as a country. Therefore, it is vitally important that in the transition to a robotics-age society the public sector create opportunities for training and retraining of the existing workforce. Further, increases in automation make high-labor rate countries like the United States more competitive, accelerating the reshoring of manufacturing jobs.

In addition to providing training and learning opportunities to current employees and working-age individuals, public policy has a significant role to play in modernizing the educational system to meet the demands of a 21st-century workforce. Investments in robotics programs, STEM education, and vocational and community college curriculum will ensure that the U.S. workforce will be ready for the job opportunities that will come with this transformative technology.

Recommendations 5, 6, & 7

- Support continuous, broad-based improvements in education that are required for our workforce to stay competitive and fill the jobs of the future.
- Monitor the economic impacts of advanced robotics and adapt policies to plan for future shifts in the economy and the job markets.
- Invest in existing Federal programs engaged in workforce development efforts, such as those underway at the Manufacturing USA Institutes aimed at training an advanced manufacturing workforce able to meet the manufacturing challenges and opportunities that will come with increased automation.

Robotics Applications & Impact on Societal Sectors

The increased use of robotics technologies across major industrial sectors will lead to massive improvements in quality of life and economic benefits for all U.S. citizens. Introducing innovative robotics technologies will encourage increased productivity at all levels, ensuring the prosperity of the United States and its citizens. Major industrial sectors that will benefit include, but are not limited to, those listed below:
The following sections address each of these sectors in turn, focusing attention on robotics in manufacturing and autonomous vehicles with the understanding that robotics technologies will have significant impact on all these sectors and others as well.

**Manufacturing and Product Development**

The largest application of robotics in the U.S. has been in manufacturing, with a resulting dramatic improvement in productivity and competitiveness. Innovative products are being designed in conjunction with their manufacturing lines so that new kinds of consumer goods can be built efficiently by new machines capable of extraordinary mass customizability, including robots adapting to specific tasks, environments or people (both verbally and non-verbally) with minimal modification to hardware and software. This transformative technology warrants the attention of policymakers as robotics in manufacturing will create opportunities far beyond lowering the cost of production in the United States.

Robots have and will continue to:

- Keep humans from performing dangerous tasks (e.g., drones can perform hazardous inspections and maintenance scans much more quickly and with greater ease, lessening the perils on the American worker).
- Diminish expensive medical problems crippling American workers and the U.S. economy (e.g., robots can be used to preform hazardous work that for humans would lead to carpal tunnel syndrome, back injuries, burns, and the inhalation of noxious gases and vapors.)
- Save domestic companies from moving abroad by making them more competitive, and create new jobs without a loss of competitiveness, even though wages are higher.

Now and in the future, current technological innovations are ushering in a new age where robots are intelligent and organized to interact with each other and humans around them. The widespread use of these new robots will:

- Allow factories to employ human-robot teams that leverage each other’s strengths (e.g., humans are better at dealing with unexpected events to keep production lines running while robots are better at performing monotonous tasks requiring precision and often strenuous repeatability).
- Allow humans to perform their jobs more safely, which would likely lead to lower Occupational Safety and Health Administration cases while increasing productivity and reducing the load on the healthcare system. (e.g., exoskeletons can be worn by humans so they are able to perform their jobs more quickly and with less physical strain, preventing debilitating injuries).
- Reduce time in the pipeline for finished goods, allowing systems to be more responsive to changes in retail demand.

The benefits listed above can be attained through utilizing technologies pioneered in the U.S. But while other counties are employing these transformative technologies and developing them further, the U.S. hasn’t yet seized this opportunity. This has put the U.S. in an unfavorable position where core
manufacturing capabilities have been lost, compromising both our national security and economic welfare. In an effort to combat the weakening of the domestic manufacturing base the Federal government has created Manufacturing USA, a successful public-private partnership successfully developing advanced manufacturing technologies and capabilities. As previously noted, the Manufacturing USA program is comprised of 14 advanced manufacturing institutes, with one of the institutes specializing in robotics.

Headquartered in Pittsburgh, Pennsylvania, the Advanced Robotics in Manufacturing (ARM) Institute is made up of state and local governments, industry, universities, community colleges, and non-profit organizations from across the country. With the promise of $80 million in Federal funding over five years, the Federal government’s investment has catalyzed over $173 million in non-Federal funding from partnering organizations. The Department of Defense even noted that “The substantial cost matching reflects the importance the U.S. robotics community places on this institute and its value to U.S. businesses, academia, and state and local governments.”

The ARM Institute aims to improve U.S. competitiveness in manufacturing through advancing robotics manufacturing technologies and by creating a strategy for incorporating these technologies. The Institute places an emphasis on creating a workforce that understands the new technologies being developed and able to fill the new roles the technology yields. The Institute is uniquely equipped to fill the gap that exists between basic research in the robotics field and commercialization as it is able to coalesce stakeholders around common goals. Institute members come together to work on pre-competitive projects that will drive the entire robotics industry forward and achieve the mission of the sponsoring Federal agency, partnerships that wouldn’t be possible without the government acting as a neutral convener.

The R&D and workforce development efforts taking place at the ARM Institute are a crucial component for successfully ensuring American leadership in robotics technology.

**Recommendation 8**

- Continue to fund the Manufacturing USA Institutes and support technology transition from early-stage readiness levels to industrial application and usage.

**Autonomous Highway Vehicles and Transportation Infrastructure**

Self-driving robotic vehicles and intelligent highway systems have become part of the national discussion as their benefits range from reducing fatalities to changing the structure of urban mobility. A significant number of technical issues remain, including:

- Intelligent highway systems depend on the self-driving robotic vehicles that are capable for the road infrastructure. As autonomous vehicles enter our national roadways, there is a need for safe introduction in tandem with the upscaling of our national manufacturing capability so that we have a technical and physical infrastructure that supports and enhances the capabilities of the new robotic technologies.
- Safety improvements are already being adopted into today's automobiles, which are yielding great reductions in accident rates (e.g., the adoption of lane departure warnings, impending collision warnings, and parking assist technologies are reducing the number of accidents).
- The potential of spin-off technology. As the price curve for vehicle automation drives costs down, other industries—including the defense, agriculture, and mining industries—will reap the benefits of autonomous vehicle-developed technology.

**Recommendation 9**
• The U.S. Department of Transportation should work with states, automobile manufacturers and suppliers, and industry and trade organizations such as ASME to ensure a safe and thorough testing environment for automated components. The U.S. Department of Transportation should lead the effort for open standards for intelligent vehicles. Shared interfaces to maps, to traffic and weather data, to other vehicles and systems, will all accelerate the ability of large and small players to work together.

Additional Applications

In addition to the above application areas, the Federal government has a key role to play in other areas where robots are having major impact, including:

Medical and Healthcare

The healthcare industry is seeing many advances in patient safety and medical procedures due to the introduction of robotic technologies. Today, robots are used by physicians during orthopedic surgeries, hysterectomy, and prostate surgeries to ensure the procedures are more effective with shorter recovery time for patients. Surgical robots provide a great example of how collaborative robots are revolutionizing the field of medicine. Additional frontiers of medical robotics include:

• Exoskeletons for rehabilitation and for helping paralyzed patients, including direct neural interfaces.
• Telepresence for remote diagnosis and interventions; providing those needing care in rural and remote regions greater access to medical services.
• Robotics assistance for the aging population, which can compensate for the lower number of young people available to care for the elderly.
• Robotic-assisted training and manipulation of soft-tissue, as well as in human tissue engineering.
• Magnetically-steered microbots for medical procedures, e.g., intraocular surgery.

Agriculture and Food Systems

The agricultural robots market is expected to grow from $2.75 billion in 2016 to $12.80 billion by 2022. Everything from harvest management and field mapping, to weather tracking and inventory control will benefit from the use of agricultural robotics. Robotics has the potential for transforming many agriculture applications, such as:

• Promote the usage of sensor-equipped drones and ground-based robotics for an accurate measurement of the nation’s crop yield, water saturation levels and fertility of the soil. Using sensor technologies in the farming process will yield tremendous cost-savings, increase crop yield and proactively fight against diseases within the food chain.
• Utilize autonomous robotic technologies to maximize equipment productivity. Technological advances in the agriculture industry has made food 13 times cheaper than it was 100 years ago. By incorporating modern, state-of-the-art robotics technologies into the food supply chain—such as intelligent autonomous systems using GPS signals to plan and control motion in equipment—the U.S. has the potential to see continued savings passed onto the consumers.

National Security, Defense, and the Military

The Departments of Defense and Homeland Security are considering robotics for a wide range of applications:
• Logistics and supply, from unmanned warehouses to semi-automated convoys and aerial resupply.
• Reconnaissance, surveillance, and intelligence operations involving observations from remote platforms, such as long-endurance loitering drones.
• Hazardous operations, including defusing IEDs.

**Recommendations 10 & 11**

- Just as the ARM Manufacturing USA Institute accelerates the development and deployment of robotics in manufacturing, the Federal government should find other robotics application areas ready for rapid development and should convene public-private partnerships for joint development and training.
- Federal investments should include emerging robotic application areas that may not be addressed by existing Federal programs, but are of significant importance for U.S. competitiveness and national security.

**Summary**

Robotics has the potential in the near future to transform every aspect of our society in a positive way, saving time, money, and lives while improving the nation’s infrastructure and increasing national and economic security and prosperity. America’s free trade partners have out-invested in robotics technology and workforce development, requiring an in-kind response at scale. This is essential because of the certain ubiquitous nature of robotics in the future, including manufacturing robots, autonomous vehicles, collaborative robots (cobots) working with surgeons, to military applications such as drones and bomb diffusing robots. Robotics has the unique potential to make a high wage country like the United States competitive with low wage countries by increasing productivity. The resulting transformation of society promises economic savings and new capabilities that can positively impact the lives of literally every American.
List of All 11 Aforementioned Recommendations

Federal Commitment and Leadership
1. Ensure a coherent and holistic approach to robotics R&D, including both the future physical systems and AI technologies.

National Robotics Initiative (NRI)
2. Commit to growing robotics R&D—including significantly bolstering available funding of the NRI program—to ensure the fundamental research needed for developing robotics capabilities occurs in the United States, and to ensure the U.S. is able to keep pace with the technological advances by competitor nations that have already invested heavily in robotics R&D.

Global Outlook
3. The U.S. must increase robotics investments to double that of our competitor nations to establish itself as a world leader in robotics technologies. Rarely is there a chance to regain footing in a global technology race, however, the new and advancing field of “smart” robotics—robots backed by artificial intelligence (AI)—has provided the U.S. a unique but waning opportunity to take a leadership position in this emerging.

National Robotics Council
4. Form a National Robotics Council to inform and oversee an overarching national robotics strategy and monitor how robotics technologies are impacting society, the economy, and our national security.

Economic Security: Jobs, Automation, and Education
5. Support continuous, broad-based improvements in education that are required for our workforce to stay competitive and fill the jobs of the future.
6. Monitor the economic impacts of advanced robotics and adapt policies to plan for future shifts in the economy and the job markets.
7. Invest in existing Federal programs engaged in workforce development efforts, such as those underway at the Manufacturing USA Institutes aimed at training an advanced manufacturing workforce able to meet the manufacturing challenges and opportunities that will come with increased automation.

Manufacturing and Product Development
8. Continue to fund the Manufacturing USA Institutes and support technology transition from early-stage readiness levels to industrial application and usage.

Autonomous Highway Vehicles and Transportation Infrastructure
9. The U.S. Department of Transportation should work with states, automobile manufacturers and suppliers, and industry and trade organizations such as ASME to ensure a safe and thorough testing environment for automated components. The U.S. Department of Transportation should lead the effort for open standards for intelligent vehicles. Shared interfaces to maps, to traffic and weather data, to other vehicles and systems, will all accelerate the ability of large and small players to work together.

Additional Applications
10. Just as the ARM Manufacturing USA Institute accelerates the development and deployment of robotics in manufacturing, the Federal government should find other robotics application areas ready for rapid development and should convene public-private partnerships for joint development and training.
11. Federal investments should include emerging robotic application areas that may not be addressed by existing Federal programs, but are of significant importance for U.S. competitiveness and national security.
Energy-Water Nexus

General Position Paper Issued by:
ASME Committee on Government Relations
Energy Public Policy Task Force

Executive Summary

Energy production and water use are intrinsically interdependent. Water is needed for energy production through thermal electric power plants, hydropower, and oil and gas extraction. Energy is needed to operate the public water supply and water infrastructure, for desalination and water reuse, irrigation, agriculture and food production. The industrial sector draws on both water and energy resources in myriad ways.

A shared challenge for improving the infrastructure for energy and water is the regulatory burden. Multiple agency reviews, duplicative requirements coupled with delays in decisions, provides little flexibility to encourage new technologies and hinders efficiency gains and infrastructure improvements. To assist technology development and infrastructure improvements, ASME recommends the following:

- Appropriating funds under the Water Resources Development Act, which will help public water systems upgrade aging water distribution systems to promote energy-water savings and efficiencies;

- Streamlining regulations and reducing the duplicative, multi-agency review processes in most sectors for water and energy will help reduce water usage to produce power and the amount of power required to move water and grow food;

- Providing funding for research, development and demonstration such that the various infrastructures can more quickly become cleaner and more efficient.

The private sector has demonstrated, through technology innovation that it is ready to make investments, but more certainty from regulators is needed to encourage the adoption of new technologies and invest in the high capital cost of some of the projects. Public private partnerships could also be an efficient means to improve the U.S. aging infrastructure while at the same time reducing water losses and energy required for clean water systems production.

Key factors in the Energy-Water Nexus that this paper will discuss include:

**Thermal Electric Power Plants:** Thermoelectric power plants that use heat to generate power are the largest users of water, as defined by total water withdrawals from water resources in the U.S. Most of the water withdrawn for cooling is returned to the source of
the water. Water consumption (water that is not returned to the source) from thermal power facilities comprised 3% of the withdrawals. Several methods for cooling are used based on climate, water availability and regulatory requirements. Policies that promote water efficiency, such as, technology innovations in renewable energy that do not require cooling water (solar photovoltaics (PV), wind and hydro), hybrid-cooling systems, and higher efficiency thermal power systems (gas fired combined cycle power plants) help reduce water withdrawals. Currently, hybrid-cooling systems in a few thermal power plants are effectively striking a balance between plant efficiency technologies, cost-effectiveness, water usage and environmental impacts. A one-size fits all approach should be avoided as various regions and varied climates require different solutions.

**Hydropower:** Hydropower is a clean energy resource that draws on water but does not “consume” the water. Hydropower facilities, operate reliably and without greenhouse gas emissions for 75 to 100 years. Hydro facilities provide electric grid stability and can “load follow” thereby smoothing out the variability on the electric transmission system sometimes caused by more variable renewable sources. In the U.S., energy produced by hydroelectric technologies could be increased by as much as 10% with installation of hydro turbines at only the most ideal existing U.S. dams and conduit sites. Marine and hydrokinetic technologies offer tremendous potential and need more research and development funding. The current regulatory environment that governs the development of new hydropower is fragmented, varies from state-to-state, and requires significant investment of resources, with relatively little certainty that the process will result in an economically viable project. The regulatory hurdles for hydropower can require 10 years or more to overcome which are inconsistent with other renewable sources such as wind and solar power facilities which typically require only 1 to 2 years to obtain permits. The Water Resources and Development Act of 2018 takes significant steps to shorten the regulatory process at the Federal Energy Regulatory Commission, which when implemented should help reduce the regulatory burden.

**Oil and Gas Extraction:** The oil and gas industry is part of the mining industry, the USGS estimates that all mining activities constitute approximately 4% of the annual water withdraws in the United States (U.S. Department of Energy, Energy Information Administration, 2015). Because of the volumes of water involved and the nature of the exploration, development, and production activities which include drilling a large number of wells deep below the surface, particularly for unconventional well types. Considerations on water resources include source and volume requirements to supply initial development of the well, treatment and disposal of water during development and production, and potential impacts to groundwater aquifers and surface water systems. Whether a specific region or locale is suitable depends on local geology (stable low permeability vs. highly porous systems like limestone with highly connected aquifers and hydrology across zones), geography (plains areas versus coastal areas and peninsulas subject to saltwater intrusion) and current and projected adequacy of local water supplies (consider any existing stresses due to drought or usage exceeding availability).

**Industrial Plant Usage:** Industrial water usage comprises 4% of total water withdrawals in the U.S. In 2010, the total U.S. water withdrawals for industrial purposes were approximately 15.9 billion gallons per day. Due to increasingly efficient manufacturing practices, industry has reduced water use by 30% since 1985. Advancements in process efficiency aim to reduce water
consumption within the industrial processes and utilize water recycling within the facilities where possible. While the industries reduce water usage during the manufacturing processes, the end consumers are often less efficient at recycling or reusing products. Policies to improve water and energy efficiency should consider both the production facilities and end use of products in the industrial sector.

**Public Water Supply and Urban Cycle:** The urban water cycle consists of hydraulic systems that move water into, within, and out of defined boundaries and relies upon treatment facilities to modify water quality so it will meet the regulatory requirements of its intended uses. Potable water systems convey, store and extract raw water for treatment and distribution of drinking water to urban populations. Wastewater systems collect, convey, treat, and discharge or reclaim wastewater for suitable environmental applications. Stormwater systems protect water resources and minimize flooding through the removal of pollutants and reduction of flows. Many urban areas have aging and leaking water systems that need replaced but such projects are expensive. Additional funding sources are needed to meet the gap in infrastructure investment. Funding mechanisms such as The Water Resources Development Act (WRDA) are a possible funding source; however, appropriations need to be approved. The greatest opportunity for embedded energy reduction of public water supply and urban cycle lies in source location and proper design and operation of pumping systems for the conveyance and distribution of the water. Additional energy savings are possible through improved aeration systems in wastewater systems.

**Desalination and Water Reuse:** Desalination and water reuse are important current and future components of the water portfolio needed to meet growing population and water demands. Desalination has been commonly considered to be an energy intensive treatment in the water industry; however, more recent developments in energy recovery technologies, enhanced materials, and new membrane arrangements have helped reduce these energy related operating costs. Desalination has become an attractive option for coastal communities requiring a new water source or as a drought contingency. The potential to pair desalination plants with renewable resources and co-locate with power plants or wastewater treatment facilities may further reduce energy demands and permitting requirements.

Regulatory policies are needed to alleviate the challenges of brine disposal by streamlining permitting requirements and helping navigate the studies required to minimize impacts on marine life. Environmental impacts could be further reduced through partnerships with power plants. Water reuse for non-potable and potable uses can provide increased conservation and create a “new” water source for water constrained areas of the U.S., but also provides the potential to reduce energy consumption. Again, streamlined regulations are needed to expedite permitting of facilities and evaluate treatment processes with lower energy consumption for production of indirect and direct potable reuse.

**Irrigation, Agriculture and Food Production:** As of 2015, approximately 37% of the water withdrawal rates are for irrigation, animal husbandry and aquaculture. A concentration of irrigation implementation is focused on 17 Western States that cumulatively account for 93% of total surface-water irrigation withdrawals and 69% of total groundwater irrigation withdrawals. Further research and development of higher efficiency irrigation methods has the potential to
significantly curtail water usage. Implementation of renewable energy sources may allow for distributed energy supplies in the agriculture sector.

I. **Background**

The ASME provides insights on the intrinsic connection between energy and water. There is an inverse relationship in that to clean and distribute water requires large amounts of energy, and to produce energy typically requires large amounts of water. Technology policy and decisions regarding energy and water cannot be separated. The ASME members focus on specific areas including; electricity production, oil & gas extraction, industrial plant usage, the public water supply and distribution system.

Mechanical engineers build, design, install and innovate to improve critical energy and water systems so that they are more robust, efficient and cost effective. From a technical perspective, mechanical engineers recognize that different regions of the U.S. have varied resources and terrain, which limits the practical choices of certain technologies.

Water consumption in the United States is dominated by three main categories; thermoelectric power, irrigation and public water supply based on data gathered by the U.S. Geological Survey, see Figure 1. These three categories comprised over 90% of the water withdrawn in the United States in 2015. Many of these uses are directly or indirectly connected.

Energy is required for a variety of public and industry activities. As it relates to the energy-water nexus, energy is used for pumping water resources, potable water treatment and wastewater treatment facilities to ensure that discharged water meets the local and federal regulations. The amount of energy or electricity required to operate water systems depends on the location, terrain, proximity of available water sources and discharge receiving water bodies.

Figure 1 draws on the U.S. Geological Survey estimated water use in 2015. Approximately 41% of the water withdrawn relates to thermoelectric power production. Water for thermoelectric systems is required for steam generation and more significantly for cooling systems. It should be noted the amount of water depends on the source of the water as well as the thermoelectric system and cooling system used.
Climate change may have started to affect precipitation and temperature patterns across the United States. The overall security, reliability, and resilience of energy and water systems is a national issue and will become further problematic as the impacts of climate change accumulate. These intertwined systems will require specific attention and combined policy development to enable continued reliable operation. While there is significant uncertainty regarding the magnitude of the effects, water availability and predictability may be altered by shifting precipitation patterns, increasing variability, and more extreme weather. Shifts in precipitation and temperature patterns, including changes in snowmelt, will likely lead to more regional variation in water availability for energy generation by hydropower and thermoelectric generation, posing challenges for energy infrastructure resilience.

Decision making related to the energy-water nexus is shaped by political, regulatory, economic, environmental, and social factors, as well as available technologies. Incentive structures are overlapping, inconsistent, and constantly changing, based on state and local government budget conditions. Water is inherently a multi-jurisdictional management issue and is primarily a state and local responsibility. The following sections describe some of the major components of the energy-water nexus and, where appropriate how policy related improvements may assist future implementation and operations.

II. Water Use in Thermal Power Plants

In 2015, approximately 67% of the electricity generated in the US was from fossil fuels (coal, natural gas, and petroleum) and 20% from nuclear for a total of 87% from thermal generation. All thermal power plants (including certain biomass, geothermal and concentrated solar thermal plants that currently constitute <1% of total electricity mix) operate on the thermodynamic principal of the Rankine steam cycle. Thermal energy is used to generate steam or other fluids (e.g. ammonia, pentene) at a high temperature and pressure which passes through a steam turbine to generate electricity. The exhaust from the steam turbine is cooled and the condensate is returned to the thermal energy source to again make steam in a cyclical process.

The “working” fluid, most frequently steam, is heated to high pressures and temperatures and then passes through the turbine to generate electricity. The steam is cooled and then reheated in a continuous, closed loop cycle. The steam, or other working fluid, needs to be very pure to not to ruin the turbine. The steam coming out of the turbine is cooled and condensed in a cooling condenser that uses water or air as the cooling medium. In thermal power plants, cooling condensers are the primary draw of water.

There are four steam exhaust cooling technologies currently used in the thermoelectric plants:

- **Direct or once-through cooling (from lakes, rivers, or oceans)** - If the power plant is in close proximity to the sea, a big river, or large inland water body, cooling is performed simply by running a large amount of water through the condensers in a single pass and discharges the cooling water back to the source a few degrees warmer and with little loss of water from evaporation. The water may be brackish (high chloride content; almost salt water) or fresh. A small amount of evaporation will occur off site due to the water being a few degrees warmer. Once-through systems are the simplest method of cooling and require low capital and operating costs. The drawback of once through systems pertain to the slightly warmer water on marine and estuarine life and future once through cooling applications will require extensive review. In California, the State Water Resource Control Board has proposed technology-based standards to implement federal Clean Water Act section 316(b) to eliminate once through cooling for power plants by 2024.

- **Recirculating, closed-loop or wet cooling (with mechanical, forced draft, natural draft cooling towers or cooling water reservoirs and spray ponds)** - If the power plant does not have access to abundant water, cooling may be performed by passing the turbine exhaust steam through the condenser and utilizing a cooling tower to cool water using an updraft of air through water droplets. In some cases, an on-site pond or canal may be sufficient for cooling the water. The cooling is normally achieved through evaporation, with thermal heat transfer to ambient air resulting in little to no environmental impact. The cooling tower evaporates up to 5% of the cooling water flow through the steam condenser in a cyclical process. The evaporated water in the cooling tower must be continually replenished. Evaporation can lead to an increase in the total dissolved solids (TDS) that can result in scaling of the heat transfer surfaces and reduced cooling efficiency. Blow

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down is performed to prevent scale build-up and maintain a concentration of TDS below 5 parts per million (ppm); however, the blow down process requires fresh water makeup. New chemical treatment of cooling water is being evaluated to allow concentrations up to the 10-15 ppm TDS level to accumulate, resulting in a reduction of 1/3 to 1/2 the required water makeup for blow down in a conventional cooling tower.

- **Dry (air) cooling** - A small number of power plants are cooled simply by air, without evaporation. This may involve an air cooled condenser with a closed circuit, or high forced draft air flow through a finned assembly similar to a radiator. Air cooled condensers for large power plants do not require the high water usage of other evaporation systems, but have a high capital cost and performance is very dependent on ambient temperature that can vary +/-30°F (+/-16°C) during a day. Ambient temperatures above 85°F (30°C) can significantly reduce cooled condenser performance; therefore, implementation of dry cooling systems are limited by the local climate.

- **Hybrid cooling** – a combination of wet and dry cooling. Advantages of the hybrid cooling towers include plume abatement limiting environmental impacts, significant water savings over traditional water-cooled equipment, and suitability for high temperature cooling. The design features of hybrid cooling address environmental concerns, minimize installation costs over dry air cooled condensers, maximize year-round operating reliability, and simplify maintenance requirements. Only a few hybrid-cooling systems have been installed but are demonstrating an effective balance of plant efficiency, cost-effectiveness, water usage and environmental impacts. Additional test plants are needed to demonstrate the benefits of these systems.

According to the U.S. Energy Information Agency (US EIA), thermal electric cooling system usage in the U.S. includes 43% once-through cooling, 42% wet recirculating cooling, 14% cooling ponds and 1% dry (air) cooling or hybrid, which can switch between dry and a type of wet cooling depending on the ambient temperature and availability of water. Table 1 provides estimates of water used, or consumed, in power plants for cooling in gallons/MWh and water withdrawal rates. The water withdrawal rate value in Table 1 is the amount of water a power plant takes in from a source such as a river, lake, or ocean for the purpose of cooling steam. Consumption, is the amount of water lost through evaporation and other uses during the power generation and cooling process. According to the USGS, the total consumption of water for the thermoelectric sector in 2015 was 4.31 Bgal/day, which was 3% of the total thermoelectric water withdraw.

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Table 1 – Use and Water Withdrawal Rates for Thermal Power Plants

<table>
<thead>
<tr>
<th>Generation Technology</th>
<th>Estimated Water Consumption by Cooling Method</th>
<th>Estimated Water Withdrawal Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Once Through</td>
<td>Cooling Tower</td>
</tr>
<tr>
<td>Nuclear</td>
<td>100-400</td>
<td>581-845</td>
</tr>
<tr>
<td>Coal</td>
<td>100-317</td>
<td>480-1100</td>
</tr>
<tr>
<td>Gas - Combined Cycle</td>
<td>20-100</td>
<td>130-300</td>
</tr>
</tbody>
</table>

The water required for the non-cooling requirements in power generation is significantly lower than required by the cooling systems and can be further reduced by recycling boiler blowdown water for dust control, and boiler sluicing.

Table 2 provides an estimate of other water use in thermal power plants as % of cooling water requirements.6

Table 2 - Water Withdrawal Rates for Thermal Power Plants

<table>
<thead>
<tr>
<th>Process</th>
<th>Percentage of water use in thermal power plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler/Steam Generation and Blowdown</td>
<td>1% of total water</td>
</tr>
<tr>
<td>Boiler sluicing and dust control</td>
<td>&lt;1% of total water</td>
</tr>
<tr>
<td>Wet FGD</td>
<td>~5-10% of total water</td>
</tr>
</tbody>
</table>

Another factor that has impacted the energy-water nexus is energy efficiency standards at the Federal and the State levels. The combination of energy efficiency, Renewable Portfolio Standard (RPS) implementations and the 2008-2009 recession resulted in a flat demand for the power generation over the 10 year period of 2005 to 2015. Between 2010 and 2015, water use for thermal power generation decreased 9% (Dieter, C, et al.). It is expected that with economic recovery, the demand for power generation will increase, but major utilities forecast a growth rate 2-2.5% or less annually due to increased adaptation of energy efficiency and distributed self-generation, resulting in lower demand for water for thermal power generation.

The National Renewable Energy Laboratory (NREL) and the Lawrence Berkeley Laboratory (LBL) have jointly estimated water savings from renewable energy penetration (RE) under no RPS, existing RPS and high RPS scenarios.7 Under the Existing RPS scenario, water consumption is 4% lower in 2030 and 7% lower in 2050 relative to the No RPS baseline. Greater impacts could be seen in the High RPS scenario compared to the No RPS baseline, where water consumption is 20% lower in 2030 and 25% lower in 2050. The NREL/LBL projections through

2050 under the three RPS scenarios for water consumption and water withdrawal rate for power generation are shown in Figures 2 and 3 respectively. The study assumes that power generation through renewable energy sources, primarily wind and solar will continue to grow with or without the RPS standards due to economic competitiveness and favorable tax incentives for these renewable energy technologies.

Figure 2 – Water Consumption Estimate for Power Generation

![Figure 2](image)

Figure 3 – Water Withdrawal Rate Estimates for Power Generation

![Figure 3](image)

The power generation industry continues to move toward reducing greenhouse gas emissions despite on again off again policy requirements. The increase in natural gas as a fuel source in combined cycle power plants, replacing older, less efficient coal fired power plants has been the largest contributor to reducing greenhouse gas emissions in the United States (Taylor, 2017). While reductions in greenhouse gas emissions have been also been achieved through the increase
in renewable energy technologies, many provide intermittent power from wind and solar resources. There is a need for more baseload power generation that can help stabilize the grid and/or for more energy storage such as large-scale batteries or pumped storage hydro. Pumped storage hydro continuously transfers water from a lower elevation storage pool to an upper storage pool. The water is not consumed and the system is operational for 50 to 100 years, significantly longer than battery storage facilities. Baseload power could be achieved through CO₂ capture and sequestration from fossil fuel plants, currently only in demonstration projects. Policy decisions regarding greenhouse gas emissions and incentives for technology development will direct water use in the energy sector.

III. Hydropower

Hydropower is driven primarily by the hydrologic cycle that is responsible for the movement and distribution of water that supports all life. The potential energy of water can be harnessed as it returns to the sea via lakes and rivers in the U.S. and the majority of countries around the world. Hydropower generation does not release carbon dioxide, or criteria pollutant gases into the atmosphere. Hydropower is generally a more constant and dependable source of renewable energy, when compared to more intermittent sources of wind and solar technologies. Hydropower systems are typically very flexible and can help with grid stability especially where a high percentage of solar and wind powered systems are installed. Unlike thermoelectric power and agriculture, water used for hydropower generation is completely non-consumptive. The water used for energy generation passes through a hydroturbine and is returned to the river and may be used again for power generation downstream, as long as an adequate drop over dams or similar structures is available.

Hydropower currently provides about 17% of the world’s electricity production, and about 7% of the production in the U.S., utilizing advanced turbine, generator, and control system technologies. In many cases turbine efficiency values may be as high as 95% and overall system efficiencies are in the 90% range. The theoretical potential of hydropower worldwide is estimated to be about five times the output currently installed. Environmental and social impacts will likely preclude the development of significant portions of new hydropower, even on the existing 80,000⁸ (Hadjerioua, 2012) dams in the U.S. that do not have installed hydropower. The scarcity of capital investment due to environmental and regulatory uncertainty is a limiting factor in the implementation of hydropower potential projects in addition to no long-term tax incentives that are in place for solar and wind power technologies.

There are many diverse types of hydropower facilities and applications including:

- **Reservoirs**: Dams or natural impoundments are used to store water that is then released through the turbines to produce hydropower when needed. The reservoir may also be used for other purposes like flood control, irrigation, recreation and water supply.

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• **Run-of-River:** Flowing water is passed through a turbine. The water flow is not stopped behind a dam or other structure. Water that is not passed through the turbine passes around the turbines over a spillway.

• **Pumped Storage:** Water is pumped from a lower reservoir or river up to an upper reservoir (usually man-made) using energy generated during the low demand periods, mostly evenings and weekends. This water is then run through turbines to generate power during high demand periods. Both pumping and generating is accomplished using a reversible type pump/turbine connected to a reversible type generator/motor. The water goes back to the lower reservoir to start the cycle over again.

• **Marine and Hydrokinetic:** The motion of ocean waves, tides, currents, the natural flow of water in rivers, and marine thermal gradients can also be used to produce hydropower, although it is not as well developed as the prior described systems.

Hydropower is very often one component included in the comprehensive development of water resources, which frequently includes dams for storage of water supply or diversion for irrigation, sediment control, flood control and damage reduction/mitigation, as well as providing navigation and recreational opportunities. An “Assessment of Energy Potential at Non-powered Dams in the United States”, compiled by the Department of Energy's Oak Ridge National Laboratory (ORNL), assesses the ability of existing non-powered dams across the country to generate electricity. The 80,000+ non-powered dam facilities represent most of the dams in the country; more than 90% of dams are used for services such as regulating water supply and controlling inland navigation, and lack electricity-generating equipment. The study found that the nation has over 50,000 suitable non-powered dams with the technical potential to add about 12 gigawatts (GW) of clean, renewable hydropower capacity. Considering only the 100 largest capacity facilities - primarily locks and dams on the Ohio, Mississippi, Alabama, and Arkansas rivers operated by the U.S. Army Corps of Engineers - these existing dams could provide 8 GW of power combined. These existing dams can likely be retrofitted at a lower cost than creating new powered dam structures without impacting critical habitats, parks, or wilderness areas. Together, these facilities could power millions of households and avoid millions of metric tons of carbon dioxide emissions each year. Hydropower provides electric grid stability due to its flexibility to load follow, thereby allowing a larger percentage of wind and solar power into the electrical system.

To enable the development of hydropower at the best existing dam sites, policy changes are necessary. The licensing process for new hydropower, including on long standing existing dams, can take up to 7 or 8 years, and requires an investment of several million dollars. Even near the end of the process, several uncertainties persist, particularly related to water use and water quality. Duplicative studies are frequently required by different agencies, complicating the permitting process. In October 2018, Congress passed the Water Resources Development Act of 2018 that included several provisions requiring two year licensing processes for powering non-powered dams and closed loop pumped storage hydro. The regulatory implementation of the changes made by the law will help provide some certainty for these types of hydropower projects going forward. Further reforms eliminating duplicative efforts at multiple agencies are still needed.
The Department of Energy (DOE) estimates that drawing on all the marine and hydrokinetic resource potential energy in the United States could produce 1700 terawatt hours per year, almost half of the nation’s total annual electricity usage (U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, Wind and Water Power Technologies Office, 2016). Not all of the potential from the waves, tides, ocean currents, and natural water flows can be developed, but the potential demonstrates the need for further government support for research and development.

IV. Oil and Gas Extraction

Approximately 63% of U.S. primary energy consumption is in the form of oil and gas, with nearly all transportation fuels from petroleum products. As of July 2015, natural gas fueled 35% of U.S. electricity generation by surpassing coal. Oil and gas production have a substantial interdependency with water, in terms of water withdrawal and return of water used in the process to the environment. Further water interdependencies pertain to the impact of exploration and production activities on groundwater and surface water systems.

Major increases in U.S. domestic oil and gas production have been achieved with “unconventional” oil and gas production with enhanced recovery methods that include hydraulic fracturing and horizontal drilling. There are over 100,000 unconventional well sites in the U.S., with water usage per well ranging from 2 million to 13 million gallons. The trend has resulted in an increase in water usage. By 2014, median annual water volume estimates for hydraulic fracturing in horizontal wells were more than 4 million gallons per oil well and 5.1 million gallons per gas well.

Water is used in the well development stage of hydraulic fracturing as the medium to pressurize the rock and prop it open, involving large volumes of water delivering various chemicals down into the formation. At depths of thousands of feet or miles below the surface, wells penetrate through many subsurface geological and hydrological structures and systems to reach oil and gas formations. Water is used in the process of releasing oil and gas from the formation and, then, during production, large volumes of water come to the surface from the formation. This “produced water”, globally, amounts to 3 or more barrels of water for every barrel of oil.

Water from oil and gas wells, associated with development of the well or ongoing production must be managed, which includes treatment and disposal processes. Some amounts of the water coming out of a well are re-injected deep below the surface.

The energy and water link in oil and gas development and production is crucial. Because of the volumes of water involved and the nature of the exploration, development, and production

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activities which include drilling a large number of wells deep below the surface, particularly for unconventional well types, the potential interdependencies and impacts are numerous. Considerations include source and volume requirements to supply initial development of the well, treatment and disposal of water during development and production, and potential impacts to groundwater aquifers and surface water systems. Considerations are inherently regional and local. Whether a specific region or locale is suitable depends on local geology (stable low permeability vs. highly porous systems like limestone with highly connected aquifers and hydrology across zones), geography (plains areas versus coastal areas and peninsulas subject to saltwater intrusion) and current and projected adequacy of local water supplies (consider any existing stresses due to drought or usage exceeding availability). Exploitation of the oil and gas resource is precluded where there are excessive risks to water resources due to the interdependencies.

V. Industrial Plant Usage

Industry uses water for various purposes including steam production, fabricating, processing, washing, diluting, cooling, transporting a product, incorporating into a product, and sanitation/cleaning needs within the manufacturing facility. Several industries that use large amounts of water to produce commodities such as food, paper, chemicals, refined petroleum, or primary metals. Water for industrial use may be delivered from public water supplies or be self-supplied either from groundwater or surface water. In 2015, the total U.S. water withdrawals were approximately 14.8 billion gallons per day for industrial purposes, a 9% reduction since 2010. Due to increasingly efficient manufacturing practices, industry has reduced water use by 30% since 1985. While many industries are reducing their waste and conserving water, American consumers are often less efficient. In 2008 for example, Americans threw out approximately 34.5 million tons of paper and 27.9 million tons of plastic — both of which are water-intensive materials that could be re-used or recycled to reduce industrial water and energy usage.¹⁴

Water usage in industrial processes fall into two main categories: fresh water usage and recycled water.

Freshwater is used by most industrial facilities for a variety of different purposes depending upon the industrial process and the facility. The usage is dependent on location, water needs and regulatory constraints. Some of the general categories include:

- **Steam production** – similar to thermoelectric plants, industrial plants use freshwater as makeup for several uses including boiler feed water to produce steam that is either used in the process for heating, electric generation or power (turbine drive) use, cooling on the exhaust system and intermediate process equipment in the power cycle, and cleaning of plant equipment (e.g., steam drums) during outages

- **Fabricating** – water is used in fabricating both as a cleaning agent and as a coolant. Examples include the rinsing of metal parts after degreasing, plating or painting and used during the tempering process. For the automotive industry, it requires approximately

75,000 gallons to produce 1 ton of steel. The average car contains about 2,150 pounds of steel which translates into 80,000 gallons of water.\textsuperscript{14}

- **Processing** – within the food, paper, chemical, refining and pharmaceuticals industry water is used for a variety of purposes including as a carrier or solvent of raw materials and intermediates, washing/cleaning of process equipment, as a diluent of raw materials/products, as a catalyst, as well as for cooling and steam production.

- **Incorporation into a product** – within the food, chemical and pharmaceutical industries water is added to products during or after production depending upon the concentration needed. Some examples include:
  - Sodium hypochlorite is produced at approximately 35% but when sold, the product is diluted by water to 8% - 17% depending upon the customer need.
  - Intravenous (IV) solutions are predominately water with minimal amounts of active pharmaceuticals added.
  - Soft drinks, teas and other beverages are produced through the addition of water to manufactured syrups.
  - Sanitation at industrial facilities use water for cafeterias/lunchrooms, bathrooms and laundry facilities for uniforms/work clothes.

In addition to freshwater supplied by either public water or self-supplied, industrial facilities recycle large quantities of water within the manufacturing facility. Water recycling is reusing treated wastewater for beneficial purposes and offers resource and financial savings. General applications include cooling water for industrial plants and oil refineries, industrial process water for such facilities as paper mills and carpet dyers, toilet flushing, dust control, construction activities, and concrete mixing. Recycled water can satisfy a great many water demands, as long as it is adequately treated to ensure water quality appropriate for the use. In some cases, the treatment process is regulated by U.S. EPA or States.

### VI. Public Water Use and Systems Cycle

Population and urban boundary growth dramatically increase energy and water consumption. The public water cycle consists of hydraulic systems that move water into, within, and out of defined boundaries for public use and relies upon treatment facilities to modify water quality so it will meet the regulatory requirements of its intended uses. Potable water systems extract raw water for treatment, store and distribute drinking water to the general public. Wastewater systems collect, convey, treat, and discharge or reclaim wastewater for suitable environmental applications. Storm water systems protect water resources and minimize flooding through removal of pollutants and reduction of flows. In drought-stricken regions, storm water and wastewater are also being considered as potential potable supply sources. Water reuse helps to reduce pumping requirements although the water would require more energy intensive treatment.

Energy needed for potable water treatment facilities vary from 10.78 to 144 kWh per one million gallons depending on plant size, water source and type of treatment.\textsuperscript{15} Increasing energy costs are problematic for potable water production as well as sewage treatment facilities. Growing water distribution systems require energy for pipe manufacturing and construction.

\textsuperscript{15} Pacific Gas and Electric August 28, 2006; EPRI CR-106941 (2013)
Water treatment and delivery systems constitute critical infrastructure which are aging and need updating. The drinking water crisis in Flint, Michigan underscores the challenges that municipalities and local governments face in addressing water infrastructure issues. Many cities are heavily reliant upon pipeline infrastructure that was built in the nineteenth century. An analysis by the EPA estimated a 20-year capital gap for clean water infrastructure spending of $122 billion ($6 billion per year) in 2001 dollars. In 2010 alone the total water funding gap was $55 billion and expanding rapidly.

Unrestricted urban growth could eventually reach a point where water consumption exceeds the water supply replenishment rate especially in areas of drought unless other distant potable or non-potable water sources that require energy intensive filtration methods are available. For example, saltwater desalination using reverse osmosis plants uses about 11,240 kWh per one million gallons of fresh water produced according to the National Renewable Energy Laboratory studies. Careful urban planning and establishing growth boundaries could further reduce energy and water consumption by creating denser urban areas. Energy savings can be designed into municipal systems by proper placement of water treatment and waste water treatment systems through proper sizing of pumping equipment, pipelines and site locations. Designing piping systems that are gravity fed instead of pumped systems (when possible) will also reduce energy costs.

Waste water treatment facilities need to design systems to reduce energy costs associated with pumping systems and aeration needed for the biological waste treatment. More advanced technologies like membrane bioreactors use more energy than activated sludge or extended aeration.

Good water system design practices can lower energy usage with water infrastructure designs that reduce friction losses, improved control systems and utilizing energy efficient electrical motors for pumps. Hydraulic modeling using quality data can prevent oversizing or under sizing a piping system. Additional water and energy savings are attainable with elimination or control of water leakage in public water system infrastructure, power plants, industrial processes, commercial activities, agricultural and even domestic plumbing fixtures. Pipe leakage can result from corrosion, aging pipe joints, poor maintenance, and poor pipe installation. For instance, a dripping faucet at 0.03 gallons per minute equals 15,768 gallons per year in water losses with the added repercussion of energy losses.

Public Water Supply and Recommendations
Potable water facilities can minimize energy requirements through consideration of four key strategies:

- Implementation of water-use efficiency programs through promotion of demand-side conservation or supply-side facility enhancements.

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16 Drinking Water Infrastructure Key Points
17 U.S. Water Infrastructure Needs & the Funding Gap
http://water.epa.gov/infrastructure/sustain/infrastructureneeds.cfm
• Avoidance of higher embedded energy supplies due to pumping demands (e.g., groundwater or imported supplies) or treatment requirements (e.g., desalination) when possible
• Adaptation of distribution-system energy water quality management systems (EWQMS), particularly in regions with flat tariff rates and systems with high storage capacities.
• Increased reliance on energy from renewable fuel sources through direct and indirect strategies.

Five key strategies can assist wastewater facilities in minimizing their energy requirements:

• Restricting collection system infiltration and inflow through detection of structural failures
• Optimizing activated sludge aeration systems through off-gas monitoring with mathematical modeling
• Optimizing ultraviolet disinfection systems through flow-pacing or utilization of low-pressure lamps when appropriate;
• Capitalizing on combined heat and power installation opportunities to use biogas to simultaneously generate electricity and heat with a prime mover that drives the overall system
• Capturing latent energy in digested biosolids through capture of methane from aqueous anaerobic digestion of the wastewater treatment facility sludge.

The Water Resources Development Act of 2016 (WRDA) authorizes funding for upgrading public water systems and creates an Innovative Water Technology Grant Program to support research for innovative water technologies. However, Congress must appropriate funding for these authorizations; funds allocated could not only help create jobs but save millions of gallons of lost water and reduce unnecessary energy consumption. Public-Private Partnerships (PPP) may be another approach to encourage private sector investments with a possibility of low interest government financing and/or the creation of Water Savings contracts, whereby the savings in reduced water and energy consumption could pay for the upgraded infrastructure. However, the financial feasibility of the PPP approach may vary by project type.

VII. Desalination and Water Reuse

Desalination and water reuse are critical technologies in the U.S. Water portfolio to meet future population water demands. While these systems are typically more expensive than traditional water sources and treatment methods, they will inevitably be required to meet future water needs in certain coastal communities.

Desalination is the process of removing salinity from water, most commonly by pumping water at high pressures through semi-permeable reverse osmosis membranes. Water sources treated by desalination may be defined as either brackish water (typically under 10,000 parts per thousand of salinity) or seawater (typically 35,000 parts per thousand of salinity). The energy costs for desalination are proportionally related to the salinity in the water, therefore, seawater desalination has been considered one of the costlier water treatment options in the water industry. Desalination has been utilized in the U.S. for decades for both industrial needs and public drinking water, but only recently have large-scale desalination water treatment plants been installed. The recent large desalination plants include the 25 MGD seawater desalination plant
in Tampa Bay, FL, the 27.5 MGD inland brackish desalination plant in El Paso, TX, and the 50 MGD seawater desalination plant completed in Carlsbad, CA in 2016. While these plants represent a small fraction of the total water supply treated in the United States, these projects are critical in providing reliable water resources to the communities where they have been constructed.

The energy consumption and costs of desalination are cost prohibitive in regions where abundant water resources exist and are in proximity to the populations and industries that they serve. However, in coastal regions with limited water resources (California and Texas) or environmental drivers (Florida), desalination has become a significant consideration in the water portfolio. Drought preparedness in the southwest and western United States is a key driver for identifying “new” water sources for water contingency. In Texas and California, some communities rely on water pumped hundreds of miles to supply the industries and growing population demands. The capital investment for water transmission, operational pumping and maintenance costs approach the capital costs and energy requirements for desalination projects. Coastal desalination requires less water transmission because water resources and disposal locations are proximate to consumer demand and power.

Desalination in the U.S. has predominately been achieved using reverse osmosis membranes. Energy reduction in the desalination market continues to develop. Alternative designs with 16 inch diameter membrane elements instead of the traditional 8 inch diameter elements can reduce the ancillary piping and equipment required and minimize capital costs. Energy recovery turbochargers have been incorporated into modern designs to reduce energy consumption. Researchers are continuing to evaluate nanotechnology materials to improve flux rates and alleviate the pumping energy requirements for membrane treatment. Furthermore, the locations where desalination appears to be most viable from a water resources perspective are in warmer coastal regions and may be able to draw on renewable energy resources to power the desalination facilities.

A key barrier to entry and energy cost for desalination projects is the disposal of concentrated brine generated during the treatment process. The capital investment of pumping waste brine to off-shore ocean outfalls can be an economic and energy challenge depending on terrain, elevation changes, and proximity to appropriate discharge locations. To mitigate costs and environmental impacts, desalination plants may co-locate with power plants to utilize existing intakes and outfalls and blend brine discharge with power plant discharge waters.

A more uncertain challenge for future desalination facilities are the requirements to obtain an outfall permit to discharge waste brine without impacting marine habitats. The recent Carlsbad Desalination Plant completed in 2016 required over 7 years of permitting, which extended the planning, design, and construction period. Legislation and regulations should consider the need for streamlined, consistent, and expedited evaluations for permitting. Regulatory certainty would allow critical projects to be implemented efficiently to meet growing population demands, changing availability of water supplies, and drought preparedness. Where possible, opportunities and incentives to use existing intakes and outfalls and co-locate with power plants or wastewater

20 Carlsbad Desalination Plant: http://carlsbaddesal.com
treatment facilities should be encouraged to expedite projects and minimize energy costs for disposal.

Water reuse may be defined as non-potable or potable. Non-potable reuse encompasses land application of treated wastewater or use of grey water in homes or building applications. Potable reuse is the application of wastewater treated to a sufficient quality for consumption as drinking water. Reusing water, minimizes reliance on the energy requirements to convey water sources from distant reservoirs or deep groundwater wells. Within potable reuse, the level of treatment required and energy costs differ depending on if it is intended for indirect potable reuse (conveyed to a groundwater or surface water source) or direct potable reuse (conveyed directly into the water distribution system). Indirect potable reuse provides an additional natural “buffer” for water before being consumed as drinking water. Additional pumping energy is required to first convey the water to the aquifer or other storage source, secondly pump the water from that source to the drinking water treatment plant, and thirdly re-treat the water to potable drinking water standards. Direct potable reuse can eliminate the pumping energy and treatment energy needed for indirect potable reuse; however, the treatment process by which water has been treated for this application is more complex than conventional treatment and requires additional energy.

The regulatory requirements for potable reuse are at a nascent stage, federal standards are needed. Currently, the State of California follows a potable reuse treatment process referred to as Full Advanced Treatment (FAT), which has been modified for limited implementation in Texas. The process includes a multi-barrier treatment that incorporates microfiltration/ultrafiltration (MF/UF), reverse osmosis (RO), ultraviolet (UV) light disinfection, and advanced oxidation (AOP) technologies. The treatment process is considerably more energy intensive than conventional treatment processes, but research continues to demonstrate the efficacy of alternative treatment processes such as ozone followed by biologically active filtration (BAF) that may replace the energy intensive RO process and still achieve properly treated, potable water.

**VIII. Irrigation, Agriculture, and Food Production**

As of 2015, approximately 37% of the water withdrawal rates are for irrigation, agriculture and aquaculture (USGS, 2018). Irrigation water use includes water that is applied by an irrigation system to sustain plant growth in all agricultural and horticultural practices. Irrigation also includes water that is used for pre-irrigation, frost protection, application of chemicals, weed control, field preparation, crop cooling, harvesting, dust suppression, and leaching salts from the root zone. Estimates of irrigation withdrawals include water that is lost in conveyance prior to application on fields as well as water that may subsequently return to a surface-water body as runoff after application, water consumed as evapotranspiration (ET) from plants and ground surfaces, or water that recharges aquifers as it seeps past the root zone.

Surface water was the primary source of water in the arid West, except in Kansas, Oklahoma, Nebraska, Texas, and South Dakota, where more groundwater was used, with 17 Western States cumulatively accounting for 93% of total surface-water irrigation withdrawals and 69% of total groundwater irrigation withdrawals. The major irrigation methods include sprinkler systems (51
Irrigation of golf courses, parks, nurseries, turf farms, cemeteries, and other self-supplied landscape-watering uses also are included in the estimates. The national average application rate for 2010 was 2.07 acre-feet per acre (1 acrefoot = 325,851 gallons). Irrigation water use includes self-supplied withdrawals and deliveries from irrigation companies or districts, cooperatives, or governmental entities. Some irrigation water is reclaimed wastewater from nearby treatment facilities or industries. All irrigation withdrawals are considered freshwater.

Livestock water use is water associated with livestock watering, feedlots, dairy operations, and other on-farm needs. Livestock includes dairy cows and heifers, beef cattle and calves, sheep and lambs, goats, hogs and pigs, horses, and poultry. Other livestock water uses include cooling of facilities for the animals and products, dairy sanitation and wash down of facilities, animal waste-disposal systems, and incidental water losses. The livestock category excludes on-farm domestic use, lawn and garden watering, and irrigation water use. Withdrawals for livestock use were an estimated 2,000 Mgal/d for 2010, about 1% of total freshwater withdrawals. Groundwater was the source for 60% of total livestock withdrawals.

Aquaculture water use is water associated with raising organisms that live in water—such as finfish and shellfish—for food, restoration, conservation, or sport. Aquaculture production occurs under controlled feeding, sanitation, and harvesting procedures primarily in ponds, flow through raceways, and, to a lesser extent, cages, net pens, and closed-recirculation tanks. Total withdrawals for aquaculture during 2010 were 9,420 Mgal/d, about 81% from surface water. Much of the surface water was used for flow through raceways and was returned to the source after use. Aquaculture withdrawals were 3% of total withdrawals for 2010.

Affordable solar panels could be employed to produce electricity and hot water for farms. There are commercial organic solar panels that are less expensive than the silicon crystal type, though with a shorter life. Reasonably sufficient areas to capture the sunlight should not be problematic in rural areas, as compared to urban areas that hinder the solar radiation from being efficiently tapped. Energy from the sun, wind, and water (mini-water turbines) should be employed for the electricity needs of a farm.

When considering water for irrigation, the solar drip irrigation system should be investigated for use in dry areas. It has been successfully carried out in many parts of the world. Drip irrigation is known for being successful in agricultural areas with dry climates. Additional technologies such as infiltration trench irrigation methods could be implemented instead of traditional lawn with sprinklers, which would assist in groundwater recharge. The technology has been shown to have a recharge efficiency of 58 to 79% was achieved by the infiltration trench, as compared to 8 to 33% achieved by a regular lawn. These kinds of low-impact development (LID) methods and best management practices may be followed to assist in the urban, water-stressed areas.

21 Newcomer. Et al. Urban Recharge beneath low impact development and effects of climate variability and change. Water Resources Research
Mechanical Engineers have minimal involvement with water usage in agricultural systems. This is predominately the purview of, among others, Agricultural Engineers, hydrologists, agronomists, farmers, State Cooperative Extension Services, and manufacturers of irrigation, drainage and erosion control equipment, components and systems.

**IX. Conclusion**

Energy and water are intrinsically dependent. As engineers and the technical communities who operate in energy-water industries strive to develop new technologies and upgrade the existing infrastructure, government can assist by:

- Appropriating funds under the Water Resources Development Act, which will help public water systems upgrade aging water distribution systems to promote energy-water savings and efficiencies;

- Streamlining regulations and reducing the duplicative, multi-agency review processes in most sectors for water and energy will help reduce the amount of water to produce power and the amount of power required to move water and grow food;

- Providing funding for research, development and demonstration such that the various infrastructures can more quickly become cleaner and more efficient.

The private sector has demonstrated, through technology innovation that it is ready to make investments, but more certainty from regulators is needed in order to encourage the adoption of new technologies. Public private partnerships could also be an efficient means to improve the U.S. aging infrastructure while at the same time reducing water losses and the energy required for the water systems.
I. References


APPENDIX A – Water Leakage Case Study - Forrest Kemp
Population and urban boundary growth dramatically increase energy and water consumption as illustrated with an example in the Forest Kemp, a residential neighborhood of Houston, Texas. This subdivision’s estimated water consumption and distribution piping serving it are summarized in the following tables:

### ESTIMATED FOREST KEMP SUBDIVISION WATER CONSUMPTION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>Comments and Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subdivision Area</td>
<td>0.18-square miles</td>
<td>Goggle Earth Photo</td>
</tr>
<tr>
<td>Subdivision Perimeter Distance</td>
<td>1.9-miles</td>
<td>Google Earth Photo</td>
</tr>
<tr>
<td>Number of Residences in Subdivision</td>
<td>429</td>
<td>Goggle Earth Photo</td>
</tr>
<tr>
<td>Number of Swimming Pools</td>
<td>86</td>
<td>Goggle Earth Photo</td>
</tr>
<tr>
<td>Average Residential Water Usage</td>
<td>101-gallons per residence per day</td>
<td>DOE Bldgs. Energy Data Book</td>
</tr>
<tr>
<td>Average Swimming Pool Evaporation</td>
<td>120-gallons two day or 3.6-gpm</td>
<td>Lone Star Chapter Sierra Club</td>
</tr>
<tr>
<td>Daily Residential Water Consumption</td>
<td>30.1-gpm or 43,330-gallons</td>
<td>gpm equals gallons per minute</td>
</tr>
<tr>
<td>Daily Swimming Pool Evaporation</td>
<td>5,160-gallons</td>
<td>86 swimming pools</td>
</tr>
<tr>
<td>Total Daily Water Consumption</td>
<td>33.7-gpm or 48,490-gallons</td>
<td>Residential and Swimming Pools</td>
</tr>
<tr>
<td>Total Annual Water Consumption</td>
<td>17,698,500-gallons</td>
<td></td>
</tr>
</tbody>
</table>

### ESTIMATED FOREST KEMP WATER DISTRIBUTION PIPING

<table>
<thead>
<tr>
<th>Description</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 inch Diameter Pipe</td>
<td>3,620 feet</td>
<td>*Ductile Iron buried–4 feet</td>
</tr>
<tr>
<td>6-inch Diameter Pipe</td>
<td>4,130-feet</td>
<td>*Ductile Iron buried–4 feet</td>
</tr>
<tr>
<td>Fire Hydrants and Valves</td>
<td>39-each</td>
<td>*1,500-gpm fire flow residential</td>
</tr>
<tr>
<td>Residential Water Meters</td>
<td>429-each</td>
<td>1-inch</td>
</tr>
<tr>
<td>Cross Tees 6” X 12” X 6”</td>
<td>13-each</td>
<td>*Ductile Iron</td>
</tr>
<tr>
<td>Isolation Gate Valves 6 inch</td>
<td>26-each</td>
<td></td>
</tr>
<tr>
<td>Isolation Gate Valves 12 inch</td>
<td>13-each</td>
<td></td>
</tr>
<tr>
<td>1 inch Diameter Copper Pipe</td>
<td>5,150-feet</td>
<td>Assumed average 12-feet distance from water main connection to meter box</td>
</tr>
</tbody>
</table>

*Source: City of Houston Infrastructure Manual

Note: According to Houston Public Works Department statistics, the Houston metropolitan area with a 2.2 million population uses 392 million gallons per day that requires a water supply system with over 7,000 miles of pipe including pump stations, wells, treatment plants, control center and storage tanks.
Furthermore, pipe friction losses, elevation differences and leakage increases the amount of electricity a pump needs to deliver water as shown in the following equation.

\[
P_{\text{Pumping Cost}} = 1.65 \times H_L \times Q \times \left( \frac{a}{E} \right)
\]

Where:
- \( H_L \) = Hydraulic gradient or head loss that includes pipe, valve and fitting friction losses.
- \( Q \) = flow, gallons per minute or gpm
- \( a \) = unit cost of electricity, $/kW-hr
- \( E \) = total efficiency of pump system (pump, motor, transmission), %/100

Source: American Water Works Association Ductile-Iron Pipe and Fittings AWWA M41 page 153

A Pacific Gas and Electric report titled “Municipal Water Treatment Plant Energy Baseline Study” August 28, 2006 and Electric Power Research Institute report CR-106941 stated that water distribution pumping uses about 1,000 kWh per one million gallons. Annual water supply for Forest Kemp example would need approximately 17,700 kWh of electricity where Houston electrical rates equal $0.082 to $0.091 per kWh.
ASME Board of Governors  
Agenda Item Cover Memo

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**Date Submitted:** October 17, 2018  
**BOG Meeting Date:** November 10, 2018  
**To:** Board of Governors  
**From:** Committee on Organization and Rules  
**Presented by:** Fred Stong, COR Chair  
**Agenda Title:** Change to Nominating Committee By-Law

---

**Agenda Item Executive Summary:**

The Nominating Committee proposed and the Committee on Organization and Rules has approved the change shown at the bottom of this page to By-Law B4.2.2.4.

The change clarifies the number of Past President Advisors and one of their roles.

**Proposed motion for BOG Action:**

To approve for first reading the change to By-Law B4.2.2.4.

**Attachments:** By-Law change with underlined material denoting an insertion and strike-out meaning deletion.

The Nominating Committee shall will be assisted by a non-voting group of Advisors consisting of up to three consenting and available past Presidents who have been out of office for one year or more. These Advisors, invited by the Nominating Committee, shall will attend all meetings of the Nominating Committee and participate in all its discussions. At the option of the committee, they may also be present during the casting of votes for the slate of nominees, although they shall remain impartial and not communicate to the Nominating Committee their opinions regarding any Proposed Nominee. The functions of this group shall be:

a. to acquaint the Nominating Committee of the short and long range Society plans;

b. to make available their experience in, and their knowledge of the requirements for Society offices
AGENDA ITEM
Cover Memo

Date Submitted: 10/24/18
BOG Meeting Date: 11/10/18

To: Board of Governors
From: Jeff Patterson
Presented by: Jeff Patterson
Agenda Title: FY19 IOP Update

Agenda Item Executive Summary: Jeff Patterson to provide a Q1 update on the IOP Goals for FY19.

Proposed motion for BOG Action: None

Attachments: Goal Status Table
<table>
<thead>
<tr>
<th>#</th>
<th>1-Year Operating Goal</th>
<th>EMT Owner</th>
<th>Unit Owner</th>
<th>Q1</th>
<th>Executive Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Launch at least one new product in each of the five technologies by 6/30/19</td>
<td>Patterson</td>
<td>Patterson</td>
<td>On Track</td>
<td>Development is progressing. Working on the alpha prototype (approx. 70 words) and processes for testing and obtaining feedback from ASME collaborator.</td>
</tr>
<tr>
<td>2</td>
<td>In Conferences, achieve in FY19 at least 4% growth in revenue (sum of paid attendance plus exhibition revenue) over FY17 baseline</td>
<td>Patterson</td>
<td>Graves</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Increase addressable audience in the 5 strategic technologies by growing customer/prospect database by 11% over FY18 baseline. FY18 year-end baseline is 100,000 prospects.</td>
<td>Patterson</td>
<td>Heisenrether</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Working with the IAB and TAFs, host at least three Phase II experimental industry events focused on the five strategic technologies by 6/30/19.</td>
<td>Patterson</td>
<td>Samojeden</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Convene a minimum of four Congressional Briefings by 6/30/19 to discuss policy and technical issues relating to ASME's five strategic technologies</td>
<td>Costabile</td>
<td>Hasselmann</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Launch revamped and redesigned ASME.org by 6/30/19 to better attract individuals and level of engagement, plus sustain a significant percentage improvement in end user search results (Q4FY18 vs. Q4FY19).</td>
<td>Patterson</td>
<td>Heisenrether</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Complete and launch Bioengineering season by 6/30/19 for use by engineers and biologists to enable better cross-disciplinary collaboration.</td>
<td>Patterson</td>
<td>Samojeden</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Maintain 80% Conformity Assessment Pressure Vessel Equipment Retention Rate. The FY18 year-end baseline is 80% to be added in July (2019)</td>
<td>Patterson</td>
<td>Labrador</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Assess current standards development methodologies, from new opportunity identification through release, and recommend ways to improve and/or streamline methodologies by 6/30/19</td>
<td>Patterson</td>
<td>Rampeck</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Launch 8 new courses by 6/30/19</td>
<td>Patterson</td>
<td>Kihan</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Integrate implementation phase of ASME Vision 2030, including ABET accreditation change advocacy toward more industry, manufacturing, and innovation – oriented undergraduate programs.</td>
<td>Costabile</td>
<td>Sethupathy</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Achieve a conversion rate target for student members transitioning to professional member status. FY18 Goal of 27% was met; Actual for FY17 - 26%</td>
<td>Patterson</td>
<td>Heisenrether</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>30% increase in number of students impacted by E-Fests and EFx over FY18 baseline. FY18 year-end baseline is 1,500.</td>
<td>Patterson</td>
<td>Sethupathy</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Increase addressable audience in the 5 strategic technologies by growing customer/prospect database by 11% over FY18 baseline. FY18 year-end baseline is 100,000 prospects.</td>
<td>Patterson</td>
<td>Papagianakis</td>
<td>On Track</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Fully implement the financial system upgrade (including &quot;Vanilla&quot; GP and Jovaco budgeting replacement), and other seasonal causes (e.g., high out of pocket expenses during the first quarter (30%)).</td>
<td>Patterson</td>
<td>Rodriguez</td>
<td>At Risk</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Will have formed at least one external alliance to accelerate product development within Robotics or Manufacturing by 6/30/19.</td>
<td>Patterson</td>
<td>Patterson</td>
<td>On Track</td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- **Off Track**
- **On Track**
- **At Risk**

Notes:
- The Student Transition to Professional Rate for 2018 was 73%, indicating we are on-track to achieve our goal of 75% or greater by the end of FY2019.
- The agenda for the IAB Fall Meeting in Q2 (Oct 15-16) will focus on the ASME events for 2019.
- 10% lower volume in the summer months (due to university summer schedules in Europe/Asia and other seasonal causes) saw 620 out of 695 companies renew during the first quarter (91%). Expectation for this high renewal rate to drop during the baseline Summer months this fiscal year.
- The agenda for the IAB Fall Meeting in Q2 (Oct 15-16) will focus on the ASME events for 2019.
- The agenda for the IAB Fall Meeting in Q2 (Oct 15-16) will focus on the ASME events for 2019.
ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 25, 2018
BOG Meeting Date: November 10, 2018 Open Session

To: Board of Governors
From: EDESC
Presented by: Tom Costabile & Charla Wise
Agenda Title: FY19 EDESC Executive Director Goals

Agenda Item Executive Summary:

FY19 Executive Director Goals

Proposed motion for BOG Action:

To approve the Executive Director Goals for fiscal year 2018-2019

Attachments:

FY19 EDESC ED Goals
ED Annual Goals

Charla Wise and Tom Costabile
October 23, 2018 EDESC Meeting
November 10, 2018 BOG
ED Goals – General Framework

• Set annually
  • EDESC works with ED to develop
  • BOG has final approval

• Reflect BOG expectations of the ED in next FY

• FY19 – unique planning cycle due to ED assimilation
  • Tom developed his 100-day plan
  • EDESC worked with Tom to propose goals going beyond his original plan
  • Requesting BOG approval via consent agenda, in November 10, 2018 BOG Meeting

• For FY20 and Beyond – proposing a new timeline
  • Philosophy is to get ED and BOG on same page earlier
  • Will have input from President Elect to reflect focus for his/her term
  • EDESC work with ED to develop goals for final BOG approval
  • Should be approved by BOG before/at beginning of new FY
  • Goals should be limited in number
## FY19 ED Goals: Recommended by EDESC and ED for BOG Approval

**General Construct:**
- Stated Goals are generally broad measures of desired outcomes; generally harder to measure
- Stated Objectives are generally measurable and observable and reflect success in achieving the goal
- Goals may be fairly consistent year to year, but stated objectives, or success metrics may vary
- Progress reports begin with Q2 for FY19

<table>
<thead>
<tr>
<th>Goal</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational Excellence</strong></td>
<td>• Develop a dashboard for clear presentation of key metrics</td>
</tr>
<tr>
<td></td>
<td>• Launch FY20 IOP development plan</td>
</tr>
<tr>
<td></td>
<td>• Strengthen EMT bench - Report on staff organizational changes</td>
</tr>
<tr>
<td></td>
<td>• Report on succession planning</td>
</tr>
<tr>
<td></td>
<td>• Work with EDESC to assess and refine incentive compensation plan</td>
</tr>
<tr>
<td><strong>Delivering on the Strategy</strong></td>
<td>• Develop plans and deliver outcomes for the 5 focus technologies</td>
</tr>
<tr>
<td></td>
<td>• Develop an international strategy</td>
</tr>
<tr>
<td></td>
<td>• Develop the path forward on Membership</td>
</tr>
<tr>
<td></td>
<td>• Explore and report on M&amp;A opportunities</td>
</tr>
<tr>
<td></td>
<td>• Update BOG on enterprise SWOT, with a focus on IBR</td>
</tr>
<tr>
<td><strong>Strengthen Volunteer/Staff Partnership</strong></td>
<td>• Build volunteer engagement/relationship and report on insights from reaching out to volunteers and staff</td>
</tr>
<tr>
<td></td>
<td>• Develop top issues list and report</td>
</tr>
<tr>
<td></td>
<td>• Report on initiatives to improve communication</td>
</tr>
<tr>
<td></td>
<td>• Report on initiatives to improve staff culture</td>
</tr>
<tr>
<td></td>
<td>• Conduct a staff culture survey</td>
</tr>
</tbody>
</table>
## FY19 ED Goals: Q1 Update

<table>
<thead>
<tr>
<th>#</th>
<th>FY19 ED Goals</th>
<th>Q1</th>
<th>Executive Commentary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Operational Excellence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Develop a dashboard for clear presentation of key metrics</td>
<td>On Track</td>
<td>Initial draft &amp; format discussed with PEDT October, 2018; Update to be provided monthly.</td>
</tr>
<tr>
<td>2</td>
<td>Launch FY20 IOP development plan</td>
<td>On Track</td>
<td>Schedule provided to PEDT October, 2018; Plan development on track</td>
</tr>
<tr>
<td>3</td>
<td>Strengthen EMT bench - Report on staff organizational changes</td>
<td>On Track</td>
<td>Initial 3 phase restructuring plan presented to PEDT, BOG, SVPs in July, 2018; Phase 1 of the plan completed in August, 2018 releasing 8 individuals and realigning 4 departments; Completed internal movement of 40 plus staff; Currently reviewing departmental needs with select MD's and EMT; Began restructuring of ASME Foundation Staff.</td>
</tr>
<tr>
<td>4</td>
<td>Report on succession planning</td>
<td>On Track</td>
<td>Initial Succession plan discussed with PEDT in September, 2018; Currently evaluating needs and priorities for identifying secondary open positions.</td>
</tr>
<tr>
<td>5</td>
<td>Work with EDESC to assess and refine incentive compensation plan</td>
<td>On Track</td>
<td>Initial discussions with EDESC regarding selection of consultant conducted in August/September, 2018; In process of retaining consultant.</td>
</tr>
<tr>
<td>#</td>
<td>FY19 ED Goals</td>
<td>Q1</td>
<td>Executive Commentary</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td><strong>Delivering on the Strategy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Develop plans and deliver outcomes for the 5 focus technologies</td>
<td>Start Pending</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Develop an international strategy</td>
<td>On Track</td>
<td>Assembled team of ASME staff to develop draft outline for detailed development of</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>International strategy consistent with overall ASME strategy and IOP; Initial draft</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>to be distributed in Q2 FY2019.</td>
</tr>
<tr>
<td>8</td>
<td>Develop the path forward on Membership</td>
<td>On Track</td>
<td>Working with consultants, staff and Task Force regarding development of new membership</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>model; Currently surveying key constituents regarding development of questionnaire for</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>distribution to full membership.</td>
</tr>
<tr>
<td>9</td>
<td>Explore and report on M&amp;A opportunities</td>
<td>On Track</td>
<td>Have commenced discussions with 4 entities, 1 will not continue.</td>
</tr>
<tr>
<td>10</td>
<td>Update BOG on enterprise SWOT, with a focus on IBR</td>
<td>Start Pending</td>
<td>Start Pending</td>
</tr>
<tr>
<td>#</td>
<td>FY19 ED Goals</td>
<td>Q1</td>
<td>Executive Commentary</td>
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</tr>
<tr>
<td></td>
<td>Strengthen Volunteer/Staff Partnership</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Build volunteer engagement/relationship and report on insights from reaching out to volunteers and staff</td>
<td>On Track</td>
<td>Review relationship matrix of 36 divisions and began discussions with 4 key disgruntled divisions; Discussions to date have been positive &amp; focused on rebuilding relationships; Working with Organizational Task Force regarding restructuring of sections which will facilitate the development of a staff realignment plan to improve communication with professional and student sections.</td>
</tr>
<tr>
<td>12</td>
<td>Develop top issues list and report</td>
<td>On Track</td>
<td>Working concurrently with development of key metrics dashboard noted above.</td>
</tr>
<tr>
<td>13</td>
<td>Report on initiatives to improve communication</td>
<td>On Track</td>
<td>Implemented All Hands meetings &amp; podcasts; currently developing ED Social Media platform.</td>
</tr>
<tr>
<td>14</td>
<td>Report on initiatives to improve staff culture</td>
<td>On Track</td>
<td>Implemented changes to dress code and building access; Currently reviewing other policies; Began Management by Grazing; Introduced ED Open door policy.</td>
</tr>
<tr>
<td>15</td>
<td>Conduct a staff culture survey</td>
<td>On Track</td>
<td>Working with HR staff regarding development of survey and retaining a consultant.</td>
</tr>
</tbody>
</table>
Proposed motion for BOG Action:

To approve the Executive Director Goals for fiscal year 2018-2019
ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 19, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Industry Advisory Board
Presented by: Tommy Gardner, Chair
Agenda Title: Industry Advisory Board Update

Agenda Item Executive Summary:

The IAB Chair will update the BOG on the IAB action plan for better strategic engagement with ASME.

Proposed motion for BOG Action: No motion at this time.

Attachments: PowerPoint Presentation
The Industry Advisory Board

A Unit of the Public Affairs & Outreach Sector
What to Expect from Presentation

- **Brief Description** – From IAB to IAB 2.0
- **Desired Outcome** - “Information Only” to raise the BOG’s awareness and knowledge of the current Industry Advisory Board.
- **Questions** – Please hold questions until after the presentation.
- **Duration** – 30 minutes
Public Affairs & Outreach (PAO)

PAO, a sector of ASME, has the mission to expand global awareness, knowledge, and application of engineering and technology through education and advocacy with the public, industry, academia, and government.

The PAO Council consists of 3 Members-at-Large and the Chairs of the following units: Diversity & Inclusion Strategy, Engineering for Global Development, Engineering Education, Government Relations, the Industry Advisory Board, and Pre-College Education.

PAO is led by a Senior Vice President (volunteer).
From Industry Advisory Board (IAB) to IAB 2.0
IAB Mission

ASME established the IAB in 1987 to help ensure that ASME programs are relevant and effective for its members in industry. The IAB also aims to strengthen the Society’s relationship with industry.

The majority of ASME’s members are employed by industry, representing a wide range of companies, all of which have strong technical components.

The IAB is bolstered by the solicitation of ideas and recommendations from its members to benefit ASME, industry, and the engineering profession.
Membership

- The IAB is comprised of industry executives in the C-suites of large, medium, and small companies that employ ASME members. The IAB meets twice a year to focus on a wide range of topics of mutual interest to industry and ASME.

- IAB is working to better align itself with the 5 core technology areas and to create IAB 2.0, more closely aligned with the ASME BOG and overall organization.

- IAB is well represented in the energy and manufacturing sectors, and is working to add more bioengineering and robotics-related companies.
Membership (cont.)

- The company holds the seat on the IAB, not the individual. So companies tend to stay on the IAB for several years.

- Current IAB membership process:
  - Staff prepares a list of potential companies for the IAB membership chair (coordinating with ASME technical staff) and then he/she presents the list to the Executive Committee for a vote.
IAB Members Represent the Following Companies, Among Others:
IAB Action Plan

- IAB members want to help ASME solve its big problems, and give back to the Society.
  - The IAB formed a China subgroup, which met in September. IAB execs provided ASME with insights into doing business in the China market.
  - The IAB is providing input into ASME’s industry events.
  - The IAB is also contributing nominations for ME Magazine’s emerging technology awards.
  - The IAB and the ASME Foundation will be discussing the IAB’s philanthropic giving in FY19.

- The fall meeting was held October 15-16, 2018 in Palo Alto, CA at HP. The meeting focused on ASME’s industry events (connected to FY19 IOP), and gave IAB execs a chance to identify pain points and unmet needs related to ASME’s strategic technology areas.
IAB Action Plan

- Strengthen ASME’s connection to the BOG and overall organization
  - Vice Chair of the IAB sits on the Strategic Advisory Committee (SAC) —this connection could be better utilized.
  - IAB should be part of ASME industry-related unit strategies including the Technology Advisory Panels (TAPs).

- Update operating documents and membership requirements for consideration by the IAB Executive Committee and PAO Council (FY19).
  - Currently in the process of analyzing membership data of current and potential IAB members. Want to add more IAB members in the areas of bioengineering and robotics.
IAB Action Plan

- Stronger connections to IAB companies’ DC or government relations representatives
  - 7 GR reps attended IAB spring 2018 meeting—John Hasselmann to host a follow-up event in spring 2019.

- As necessary, hold webinars that inform/engage the IAB related to ASME’s mission and strategic direction related to the five technology strategy areas. One webinar on ASME’s engineering education activities was held in late May of 2018.

- Establish greater linkage of IAB to the other PAO units. IAB is slated to co-locate the spring meeting with the Mechanical Engineering Education Summit.
Discussion

- Comments?
- Questions?
Date Submitted: October 19, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Student and Early Career Development Council
Presented by: Callie Tourigny, Senior Vice President, Student and Early Career Development Council; and Anand Sethupathy, Managing Director, Programs and Philanthropy
Agenda Title: Student and Early Career Development Strategy Update

Agenda Item Executive Summary:

Volunteer and staff leadership of the Student and Early Career Development (SECD) Council will share our strategies to attract, engage, and support the participation of student and early career engineers in ASME. The presentation will highlight plans that foster society wide collaboration and fulfill our society needs.

Proposed motion for BOG Action:

None.

Attachments:

PowerPoint Presentation.
Student and Early Career Development (SECD) Sector

Callie Tourigny and Anand Sethupathy
November 10, 2018
What to Expect from Presentation

• Brief Description – To share information about the Student and Early Career Development Council strategy
• Desired Outcome – Information Only
• Questions – At end of presentation
• Duration – 15 Minutes of Presentation; 15 Minutes of Q & A
Agenda

• Student and Early Career Development Sector (SECD) Mission and Vision
• Addressing Two Major Challenges for ASME
• Addressing the Needs of Student and Early Career Engineers
• Defining Success
• SECD’s Focus and Role
• Path to the Summit
SECD Mission & Vision

• MISSION: Fostering innovative experiences and growth opportunities for student and early career engineers to contribute and connect with ASME and the engineering community.

• VISION: A global community that inspires, connects, and empowers student and early career engineers

*Proposed Mission and Vision resulting from September 2018 Strategic Planning meeting
## Addressing Two Major Challenges for ASME

### Insufficient Membership and Leadership Pipelines

<table>
<thead>
<tr>
<th>Membership Pipeline</th>
<th>Leadership Pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our future members, subscribers and periodic volunteer participants</td>
<td>Our future Committee Leads, SVPs, BoGs, Presidents</td>
</tr>
<tr>
<td><strong>SCALE</strong>: Grow to Tens of Thousands over Next 10 Years</td>
<td><strong>SCALE</strong>: Attract 1,000 new volunteer leaders over the Next 10 Years</td>
</tr>
<tr>
<td><strong>REACH</strong>: Scale Out Globally</td>
<td><strong>REACH</strong>: Select Markets with strong ASME volunteer presence</td>
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<tr>
<td><strong>STRATEGY</strong>: (broad and shallow)</td>
<td><strong>STRATEGY</strong>: (narrow and deep)</td>
</tr>
<tr>
<td>• Must be financially and operationally scalable</td>
<td>• Strong personal connections</td>
</tr>
<tr>
<td>• Multimodal engagement (digital, programs, groups)</td>
<td>• Deep engagement over a long span of time</td>
</tr>
<tr>
<td>• Focus on value and experiences</td>
<td>• Deliberate mentoring</td>
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</tbody>
</table>
Addressing the Needs of Student & Early Career Engineers
Keeping our Audience in Mind as SECD Designs Programs

• They engage in different ways (Digital, Local/Global, Programs, COPE)
• They are interested in Building and Growing Careers
• They appreciate competitions and experiential learning
• They are not a homogenous group; have varied pathways and interests
• They respond best to a multimodal approach
• They adapt rapidly with their ever changing environment
Solving ASME’s Challenges: Defining Success

Success #1: Membership Pipeline
SECD aims to attract and retain* 100,000 new ASME Members by 2030 who are under the age of 35

Success #2: Leadership Pipeline
SECD will connect, track, retain and develop the next generations of ASME leadership through partnerships and collaboration across the society.

*Retain may encompass things beyond membership renewal such as volunteer engagement on committees, learning and development, and conferences
Moving Upward with SECD’s Focus & Role

VISION: A global community that inspires, connects, and empowers student and early career engineers

Content
- Identify and leverage content of interest to our communities
- Develop relevant content to fill gaps
- Content for Critical Transition Points
- Create Once Publish Everywhere (COPE)

Digital
- Web, Social, Webinars, etc.
- Goes beyond “posting” and includes digital programs/content
- Global Reach & Asynchronous Consumption
- Engages Everyone (not just attendees)

Programs
- Globally Scalable
- Responsible cost structure; returns value to ASME
- Template Centrally; Customize Locally
- Identify & Develop Leaders through Program Delivery

EXAMPLE: EFx Pilot in India

SECD’s Role:
- Developed the EFx Program Model
- Created Content for EFx
- Partnered with 7 Student Sections to execute events for 131 Universities and 2,600 students
- Inspired the creation of 9 new student sections and the enrollment of 900 new members
- Provided digital platforms to propagate EFx story globally and cultivate more interest

GPS’s Role:
- Engagement with all 131 Student Sections and support their local needs such as student leadership succession and faculty advisor support
- Charter 9 new student sections
SECD’s Path to the Summit

• Focus on what Students and Early Careers need (experiences & growth)

• Attract 100,000 members under age 35 by 2030

• Prioritize the development of a strong volunteer leadership pipeline

• Leverage a multimodal approach

• Grow SECD’s role with content, digital, and scalable programs
Date Submitted: October 23, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors

From: Group Engagement Committee (GEC)
Group Pathways of Support (GPS)

Presented by: John M Mulvihill, Chair, GEC
Elio Manes, Director, GPS

Agenda Title: BOG GEC & GPS Update

Agenda Item Executive Summary:

This will be an informational presentation to provide the BOG with a brief summary of the Group Engagement Committee (GEC) and the Group Pathways of Support (GPS) activities from June 2018 – October, 2018 and their focus and goals for the upcoming year.

Proposed motion for BOG Action: None

Attachments: PowerPoint Presentation
What to Expect from Presentation

- **Brief Description** – A brief summary of the Group Engagement Committee (GEC) and the Group Pathways of Support (GPS) activities from June 2018 – October 2018.

- **Desired Outcome** – Update the Board of Governors on the GEC’s & GPS’s current engagement activities and their focus for the upcoming year.

- **Questions** – Please ask clarifying questions throughout the presentation but hold general questions until after the presentation.

- **Duration** – Presentation: 15 Minutes; Discussion: 15 Minutes
GEC Committee Activities

- GEC Monthly Teleconferences to review engagement issues. Most recently October 16, 2018 to prepare for the IMECE Meeting.
- The Group Operations Guide was revised, reviewed by TEC, and approved by the SMC on August 8, 2018
- Revisions to the Dedicated Service Award (DSA) were recommended to the Committee on Honors for approval.
- The Group Engagement Committee Operations Guide was drafted and reviewed by the GEC Team.
- A number of issues in the Group Procedures Guide were drafted and will be finalized by the GEC at their November meeting.
- GEC and ASME Staff continued to develop KPI’s to evaluate Group performance.
GEC Engagement Activities

• The GEC Sections Representative continued to hold monthly teleconferences with the Professional Sections. Expanded to two separate Geographical Teleconferences.

• GEC members Mohammad Mahanfala and Elio Manes participated in a strategic planning meeting with the Student & Early Career Development (SECD) on September 7-9 in Baltimore. Coordinated effort to enhance Student and Professional Section Engagement.

• The GEC Technical Division representative worked to resolve an MER Division issue.

• GEC Training Coordinator and ASME Staff is finalizing the Agenda and Presentations for the GLDC 2019. (Focus on Cross Sector Collaboration)

• The GEC Tools and Communications Coordinators continued to work with ASME Staff on testing and resolving the issues related to the GMEC and VLD systems.
GPS Activities

• GPS staff organizing the SLTC Conference to be held at the 2018 IMECE in Pittsburgh (over 150 student applications received).
• GPS staff has deployed over 130 e-mails from Groups using the Group Mass Email Console (GMEC) between July 1 – Sept 30
• GPS staff produced a total of 784 awards – and $187K in honoraria – between Sept and Oct. for Division conferences.
• Staff from GPS, IT and Marketing conducted a User Acceptance Testing webinar on 10/12/18 with volunteer users of the GMEC
• Volunteers from over 30 sections assisted in contacting Members who had not yet opted-in to receive emails from ASME and urged them to do so using the new Preference Center.
• GPS held two webinar on October 23, 2018 to provide all group volunteers the details relating to ASME’s communications guidelines.
GEC – GPS Focus – Upcoming Year

- The GEC will meet on Monday, November 12, during the 2018 IMECE in Pittsburgh, Pennsylvania.
- The GEC Operations Guide will be finalized and presented to the SMC for approval.
- Provide support for Groups with Centennial Celebrations in 2019 – 2020.
- Finalize Group Procedures Guide to include process for activating, merging or sun setting Groups, Local Training initiatives, etc.
- Rules for use of Segregated Accounts for Grants, Awards & Scholarships will be finalized and presented to COFI in January 2019.
- Review and document its 1 year, 1-3 year and 4-10 year goals in support of the FY 2020 IOP.
GEC – GPS Focus – Upcoming Year

- Identify the GEC Volunteer and GPS Staff Structure and resources required to fully support, nationally and internationally, pathways for engagement and collaboration between ASME Membership Groups.
- Identify the process and Organizational Structure to better assist Student Sections to improve alignment with Professional Sections.
- Assist Sectors with implementing the Integrated Cross Sector Collaboration initiatives.
- Review and modify, as necessary, the Criteria for approving Section and Student Section Activity Funding.
- Discuss Professional Section and Division Leader training and coordinate this action with ASME GPS Staff and VOLT.
- Provide additional Information and Training Webinars focused on information and alignment with ASME strategy.
- Evaluate North American and International Sections for transition into a Technical Chapters.
ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 19, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Sector Management Committee

Agenda Item Executive Summary:

The report updates the BOG on SMC activity and is for information only. There is no action required.

Proposed motion for BOG Action:
No action

Attachments:
One
SMC Report to the Board of Governors
November 2018

SMC Operations

- A meeting of the Senior Vice Presidents and elect, Chair of the Group Engagement Committee and staff counterparts took place in October to do a deep-dive brainstorming session on cross-sector integrated projects that will be part of a pilot in FY20.

- The committee will meet in November (IMECE) to continue the discussion in preparation for the IOP planning which will begin in January.

Sector Highlights

Technical Events and Content (TEC) - Rick Marboe/Tim Graves

Quarterly Highlights:

- The initial funding round of the TEC Development Fund was distributed for use in FY 2019 in July. 16 projects were awarded funds across the 5 Segments totaling the $150,000 investment of ASME. Over the course of the year, we will be reporting the results of these awards in terms of participation, outcomes and longevity.

- Nine R&D Conferences were held in Q1 of FY 2019. Of the nine, two conferences achieved their revenue targets as per the FY 2019 budget. Of the nine, 4 returned a net surplus after expenses and the labor overhead allocation. Given that this is performance for conferences developed and budgeted before the pilot program in division incentivization, the TEC segments and staff will work with the division leadership for these and upcoming conferences to extract the lessons learned, adjust marketing and exhibition efforts, and make adjustments for the FY20 conference budget planning.

- These conferences were:
  - PVP, ICONE, Fluids, IEDCT/CIE, NEMB, ISPS, InterPACK, SMASIS and IPC

- Segment Leadership Teams meetings were held by all 5 SLT’s during the quarter. A Cross-Segment Leadership luncheon is scheduled for IMECE.

- Promoted Common Conference Elements initiative within SMC for cross-sector collaboration and participation.

- SMC discussed several possible events related to Robotics and Advanced Manufacturing that could integrate activities of all of the sectors for FY20.

Upcoming Activities/What’s on the Horizon?

- New Conferences on the Horizon:
  - The 1st International Offshore Wind Technical Conference (IOWTC) is scheduled for November 4-7 in San Francisco.
The Advanced Manufacturing and Repair for Gas Turbines (AMRGT) inaugural event is scheduled for March 19-20, 2019 in Berlin, Germany.

The Asset Integrity Management – Pipeline Integrity Management Under Geohazard Conditions Conference (AIM-PIMG) will present the advances in managing ground movement hazards that have been made in the last decade on March 25-28, 2019 in Houston, Texas.

### VOLT Academy – Howard Berkof/Clare Bruff

**Highlights:**

- A VOLT workshop entitled “Developing the Next Generation Leaders of ASME 2050” was offered twice during the Annual Meeting. The Presenter was Adrienne Troilo of the American Society for Engineering Education.

- There was a reception for ECLIPSE interns and invited guests during the Annual Meeting on Saturday, June 2.

- A communications training for ASME’s Governors, Governors-Elect, Senior Vice Presidents, and Senior Vice Presidents-Elect was offered during the Annual Meeting on Monday, June 4.

- A communications training for invited volunteers, entitled “Communicating with Confidence” was offered during the Annual Meeting on Monday, June 4. This is being delivered as part of VOLT’s trained volunteer trainer communications program.

- There was a briefing for the Nominees for Governor via teleconference on June 29 to prepare them to participate in the Board Planning Meeting and future BOG meetings.

- The VOLT Academy Executive Committee held its annual retreat in Washington, DC September 21-23. At the retreat, the committee planned out its activities for the coming year.

**Upcoming Activities/What’s on the Horizon?**

- A VOLT workshop entitled “Fostering an Innovative Environment” will be offered twice during IMECE. The presenters will be Liz Kisenwether, from Penn State University, and Matt Barnes, from Carnegie Mellon University.

- A communications training for ASME’s Governors, Governors-Elect, Senior Vice Presidents, and Senior Vice Presidents-Elect will be offered at IMECE on November 12. The session will be facilitated by Brenda McClain. This will be the fourth offering in our continuing development of ASME’s senior volunteer leaders’ communications skills. We plan to survey senior leadership about the effectiveness of the training and other communications topics they would like to have covered in the training.

- VOLT will deliver a training for Chairs and Vice Chairs of Committees reporting into the Board on Conformity Assessment on November 13, during Boiler Code Week in Atlanta, GA. This will include an overview of ASME, and training on the skills required of committee Chairs and Vice Chairs.

- In January, VOLT will offer a new training for individuals who are considering running for governor. It will provide information that will help them decide if they want to run, and helpful tips for preparing their nomination packet. The training will be held via web conference.
• Between January and March, VOLT will deliver 3 training sessions via web conference for the Nominating Committee: an “Orientation to ASME and the Role of the Nominating Committee;” a “Briefing with the PEDT,” and “An Inclusive Approach to Nominating ASME’s Leaders.” We will be doing a thorough review and revision of all three presentations in collaboration with the PEDT.

• The ECLIPSE Orientation and Leadership Workshop will be held April 7-9 in Washington, DC, to coincide with the Engineering Public Policy Symposium. 14 ELIPSE interns participated.

• The Cross-Sector Leadership Development Workshop will be held in the spring in New York. This event typically coincides with the April BOG meeting, which will be in Washington, DC this year, so VOLT is looking for an alternative date.

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**Student and Early Career Development (SECD) – Callie Tourigny/Anand Sethupathy**

**Quarterly Highlights**

**Operations**

• The SECD Council held a three-day strategic planning meeting in Baltimore in early September.
  
  o Participants included not only representatives of the SECD and its committees but also staff and volunteers from Student Section Enterprise Committee, Group Engagement Committee, Old Guard Committee, Engineering Education, Marketing/Membership, and BOG ECLIPSE.
  
  o Key results included an updated look at the Sector mission and vision; plans to work more effectively with groups and sections, especially student sections; introduction of new budgeting and financial practices to increase transparency and foster staff-volunteer partnership; and short-term work plans for both student and early career engineer programming.

• Two Members-at-Large (Leila Aboharb and Nishant Trivedi) appointed with focus on supporting scalable student programming and on student-to-early career transition.

• A Tiger Team was created by reaching out to interested 2017-2018 ECLIPSE Interns to address plans for young engineers programs and activities with divisions/sectors and also for industry/employer packages to showcase benefits of their involvement with ASME. Past proposals are being reviewed as a guideline for other areas.

**Student Programming and ASME E-Fests**

• The ASME E-Fest series for FY2019 began with ASME E-Fest South America in Rio de Janeiro, Brazil. This event had 611 total registrations (504 students) and the highest Net Promoter Score (NPS) 49 of all 2017 and 2018 ASME E-Fests.

• ASME EFx series launched in Q1 with 5 events in India that:
  
  o reached more than 1500 attendees
  
  o resulted in nearly 500 new member signups (75% of attendees at EFx events were not members)
o prompted the formation of at least five new student sections to be created from the India events, plus four additional sections (pending receipt of applications)

- Two additional EFx events in India concluded at the beginning of October. Those results will be confirmed and reported on in the next SMC report.
- A webinar was conducted on ASME’s student programming and engagement for more than 400 students at Indian universities.

Early Career Engineer Programming Committee - Operations
- ECEPC held a 90-minute ECE planning strategy meeting on Saturday, September 22, 2018 in preparation for developing scalable program models which will have the greatest impact on incremental growth in ECE engagement starting FY20 and beyond.
- Recruited new members to apply to the ECEPC. Candidates have been identified and invited to attend the IMECE ECEPC committee meeting in November as special invitees.

Programming
- Published July and September issues of ME Today.
- ASME FutureME Mini-Talks & Social Meetup were held at Power & Energy Conference (P&E18) - 4 presenters, 30 attendees, NPS 33; Social Meetup NPS 58. ASME FutureME also exhibited during the P&E18 opening reception (Sunday only) to meet n’ greet with conference attendees.
- ASME FutureME Social Meetup (professional networking event) was held with the ASME Orange County Section on Thursday, May 24, 2018 at The Net Zero Plus Electrical Training Institute (19 attendees/12 reg, NPS 40%) and with the ASME Metro Detroit Section on Saturday, June 9, 2018 at the Automotive Hall of Fame (20 attendees/20 reg, NPS 53).
- Released an ASME FutureME BLOG Series featuring eight (8) written personal early career engineers telling their stories on transitioning from school to career on ASME FutureME Community captured from the E-Fest mini-talks (West/East).
- Released sixteen (16) video clips (June – August) on our YouTube channel, and released on social media (FB and Twitter).

Upcoming Activities/What’s on the Horizon

Operations
- Continued collaboration with Group Engagement, Membership and Marketing teams to partner on deploying programming and scaling the portfolio of ASME offerings for Students and Early Career Engineers.

Student Programming and ASME E-Fests
- Planning underway for three additional ASME E-Fest events in FY2019: ASME E-Fest Asia Pacific (India); ASME E-Fest West (California); and ASME E-Fest North (Michigan)
- Student Design Competition finals to be held at IMECE in Pittsburgh, with ~20 teams anticipated.
- Planning underway for additional EFx events in Mexico, Lebanon and the United States
- Planning for refresh of Student Leadership Seminars (SLS) and “SLTx” (Student Leadership Training X) to be offered in conjunction with ASME E-Fest and ASME EFx events.
• Initial target for FY19 was to reach 4,000 students; programming is now projected to reach over 5,000 students.

**Early Career Engineer Programming**

- Pivoting in FY19 to model new ECE programming; identifying the BIG Ideas, determining stakeholders, collaborative partners, resources and infrastructure. ECEPC to have a particular focus on strategy in the near term.

- Plans are underway for ASME FutureME Mini-Talks at IMECE2018 along with a Social Meetup which would be open to Pittsburgh local ECEs not connected to the conference. Mini-Talks will be recorded for post-production and release on YouTube later.

- ECEPC conversations are underway with various ASME professional sections to hold social meetups.

- Publishing ME Today November issue.

- Post-production continues to finalize ECE interview on ASME VOLT and the PE18 Mini-Talks with Technology Services. IMECE mini-talks will also result in more videos to be edited for online consumption.

- Releasing seven (7) ECE video clips highlighting ECE transitional experiences on the ASME E-Fest website (Video Gallery). Also four (6) promotional clips will be released highlighting why to volunteer and ASME FutureME.

- Launch ASME FutureME Showcase LinkedIn page + plus build engagement around topic discussion.

- Finalize recruitment for new ECEPC MAL’s to fill open positions and continue to recruit team members.

- Release the Abridged Basics for Career Development (ABCD) module on Communication in November and continue to work on the Career Transitions and Ethics modules to include in the series of content.

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**Council on Standards & Certification – Sam Korellis/Claire Ramspeck**

**Quarterly Highlights**

- The Council on Standards and Certification last met in June 2018 in conjunction with the Annual Meeting in Vancouver.

- The Council’s Focus Group on China continues to investigate (1) what is the current state of programs, (2) project future intentions / potential, and (3) recommend new activities

- The Council’s Focus Group on The Digital Future of Standards and Codes continues to work with SWISS (Semantic Web for Interoperable Specifications and Standards). SWISS transforms static engineering documents into “Smart Connected Documents” which know their meaning and their status, contain active links to all their references, and can notify users downstream when any part is updated that impacts other documents, applications, or processes. ASME is one of approximately 10 Standards Developing Organizations (SDOs) that have agreed to make select industry standards available in the SWISS format to a pilot group of approximately 12,000 DoD users, pending final terms and details.

**Upcoming Activities/What’s on the Horizon?**
• The Council will hold a teleconference meeting Friday, November 2 to review reports from the Supervisory Boards that oversee standards development, including Boards on Nuclear, Pressure Technology, Safety, and Standardization & Testing. They will also hear reports from the Board on Strategic Initiatives and the Energy and Environmental Standards Advisory Board.

• The Council will hold their next face to face meeting in conjunction with Boiler Code Week in Atlanta to encourage greater interaction between Council members and Boiler Code Week attendees. The Council will meet Friday, November 16.

**Group Engagement Committee / Group Pathways to Support – John Mulvihill/Elio Manes**

**Quarterly Highlights**

• The Group Operations Guide was revised, reviewed by TEC and approved by the SMC on August 8, 2018.

• Revisions to the Dedicated Service Award (DSA), approved by the SMC, were submitted to the Committee on Honors for approval.

• The GEC Sections Representative continued to hold monthly teleconferences with the Professional Sections.

• A number of issues in the Group Procedures Guide were drafted and will be finalized by the GEC at their November meeting.

• GEC members Mohammad Mahanfala and Elio Manes participated in a strategic planning meeting with the SECD on September 7-9 in Baltimore.

• The GEC Technical Division representative worked to resolve a Materials and Energy Recovery (MER) Division issue.

• GEC Training Coordinator and ASME Staff worked on developing the Agenda and Presentations for the GLDC 2019.

• The GEC Tools and Communications Coordinators continued to work with ASME Staff on testing and resolving the issues related to the Group Mass Email Console (GMEC) System.

• GEC and ASME Staff continued to develop KPI’s to evaluate Group performance.

• GPS has received 150 applications for funding to attend the Student Leadership Training Conference (SLTC) at the 2018 IMECE in Pittsburgh.

• GPS staff has deployed over 130 e-mails from Groups using the GMEC between July 1 – Sept 30

• GPS staff produced a total of 784 awards – and $187K in honoraria – between Sept and Oct. for Division conferences.

• Staff from GPS, IT and Marketing conducted a User Acceptance Testing webinar on 10/12/18 with volunteer users of the GMEC

• Volunteers from 28 sections assisted in contacting Members who had not yet opted-in to receive emails from ASME and urged them to do so using the new Preference Center.

**Upcoming Activities/What’s on the Horizon?**
GPS has a webinar scheduled on October 23, 2018 to provide all group volunteers the
details relating to ASME’s new communications guidelines.

The Group Engagement Committee (GEC) will meet on Monday, November 12, during the
2018 IMECE in Pittsburgh, Pennsylvania.

Planning for the 2019 Group Leadership Development Conference (GLDC) will continue.
The event will take place March 1-3 in San Antonio, TX.

GEC will work with the Sectors on coordinating and implementing Section, Student Section
and Technical Division Cross Sector Collaboration programs.

Rules for Segregated Accounts will be finalized and presented to COFI in January 2019.

GEC will review and document its 1 year, 1-3 year and 4-10 year goals in support of the FY
20 IOP.

GEC will discuss Professional Section and Division Leader training and coordinate this
action with ASME GPS Staff and VOLT.

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Public Affairs & Outreach – Kalan Guiley/John Hasselmann

Quarterly Highlights

Diversity & Inclusion Strategy

- The Diversity and Inclusion Strategy Committee (DISC) met in-person in June 2018 during
  the Annual Meeting in Vancouver and via teleconference in September 2018.
- On a Public Affairs and Outreach (PAO) Council teleconference in September 2018, the
  session started with a “Diversity and Inclusion Moment”—an update on diversity initiatives
  and issues within ASME that PAO will continue to solicit.
- DISC was instrumental in establishing a new incentive in which ASME will provide financial
  support toward childcare services for parents attending IMECE in November 2018.

Engineering Education (EE)

- In June 2018, the ASME 2018-2019 Graduate Teaching Fellowships were selected and
  announced.
- ASME’s EE committees met in July 2018 in conjunction with the ABET Commission
  meetings in Baltimore.
- In July 2018, ASME secured $250,000 in funding from the NSF (National Science
  Foundation) to convene a conference focused on Women in Mechanical Engineering for
  spring 2019.
- In July 2018, a conference call with six out of eight HBCU (historically black colleges and
  universities) ME department heads focused on engaging HBCUs with ASME-accredited
  programs.
- In August 2018, ASME’s Director of EE delivered a presentation and connected with
  stakeholders at the National Deans and Department Heads Conference in China.
- ASME secured $50,000 in additional funding from NIST (National Institute of Standards and
  Technology) to develop more educational modules focused on standards development.
Engineering for Global Development (EGD) & Engineering for Change (E4C)

- In July 2018, the EGD Committee convened in Portland, Oregon as guests of the Lemelson Foundation to discuss fundraising and program alignment.
- In August 2018 in Quebec City, submissions and attendance increased for the EGD Research Forum’s sixth year at IDETC.
- In September 2018, the third annual E4C Research Fellowship concluded with 16 fellows from nine countries, including India, Kenya, Spain, and Tunisia for the first time. Sixty percent of the fellows are female engineers.
- In October 2018, 150 people attended the second Impact.Engineered Forum and Awards where 60 percent of speakers were female. The event was hosted at NYU in partnership with the Tandon School of Engineering. Keynote speakers included the lead for social impact from ConsenSys—a blockchain development company—and the head of the UN Conference on Trade and Development.
- In October 2018, Winners from the ISHOW network participated in a hardware boot camp at ASME headquarters, where they received ISHOW’s signature Design and Engineering Review and one-on-one advice with 25 design, engineering, and business experts.

Government Relations (GR)

- Working with the Congressional Manufacturing and R&D Caucuses, the U.S. Department of Commerce, and others, GR sponsored three Congressional briefings on the following:
  - Commercial nuclear technology: Participating organizations included the Department of Commerce International Trade Administration (ITA), Westinghouse, Curtiss-Wright, the U.S. Nuclear Industry Council, the Nuclear Energy Institute, and experts from across the nuclear field.
  - Biomanufacturing: Speakers included Dean Kamen, Advanced Regenerative Manufacturing Institute (ARMI)/BioFabUSA—a Manufacturing USA institute focused on regenerative medicine; Senator Jeanne Shaheen, D-New Hampshire; Michael Golway, Advanced Solutions Life Sciences; and Jennifer Hagan-Dier, Tennessee Manufacturing Extension Program.
  - Advanced Robotics: Featured two panels of experts focused on high-powered electronics, machine tools, healthcare, Manufacturing USA, and skills and workforce development.
- In conjunction with the advanced robotics briefing in October 2018, GR convened an expo and reception on manufacturing technology, partnered with the U.S. House Manufacturing Caucus and the Manufacturing USA network of institutes.
- Since May 2018, GR has released seven position statements, supporting U.S. investments in manufacturing innovation, clean energy research, and engineering workforce development.

Industry Advisory Board (IAB)

- In September 2018, the IAB convened a meeting focused on insights into the Chinese market to help inform ASME’s strategy with a select working group, comprised of IAB members and ASME leadership.
• In October 2018, the IAB conducted its annual fall meeting in Palo Alto at HP headquarters, which included a tour of the facilities there and at Stanford University. The program focused on ASME’s industry events, best practices, and strategies going forward.
  o Notable speakers included an entrepreneur and investor at GV (formerly Google Ventures) and HP’s Chief Engineer.
  o Twenty IAB members were in attendance as well as ASME’s Executive Director, Past President, and President-Elect.

Pre-College Education
• In the fifth year of ASME’s INSPIRE program, 25,850 students were engaged via its in-class platform—an increase of 27 percent from last year. Accordingly, teacher participation has increased by 11 percent (639 teachers using the program in Q1).
• The United Engineering Foundation (UEF) awarded ASME a $65,000 grant toward INSPIRE.
• The first INSPIRE scholarship has been awarded to a freshman at Drexel University.
• Moving the Engineering Ambassadors Network (EAN), developed at Penn State, to ASME has been assessed, with ongoing surveys and discussions with EAN faculty advisors as well as the development of programing models and funding plans.
• ASME has sent a solicitation to last year’s INSPIRE teachers to encourage them to host ASME volunteer visits this year. To date, 14 visits are planned in Florida, Georgia, Mississippi, North Carolina, and Texas.

Upcoming Activities/What’s on the Horizon:

Diversity & Inclusion Strategy
• DISC will meet in-person in November 2018 at IMECE in Pittsburgh and via teleconference in January 2019.

Engineering Education (EE)
• Collaboration with HP and A.T. Kearney on developing a survey for more than 300 top tech universities focused on additive manufacturing across 12 countries.
• Partnership with the Center for Strategic and International Studies (CSIS) to publish a report in fall 2018 on additive manufacturing training programs and workforce development.
• In November 2018, EE will have a presence at the ABET Board of Delegates governance meetings. At IMECE, it will convene department head events, a committee meeting, and a working lunch with the Committee on Government Relations.
• EE has finalized the location and chairs for the ASME International Mechanical Engineering Education Leadership Summit (MEED), which will be held in New Orleans in March 2019 with both co-chairs hailing from HBCUs for the first time.
  o The Industry Advisory Board will co-locate its spring meeting with MEED to foster discussions on crossover programming.

Engineering for Global Development (EGD) & Engineering for Change (E4C)
• The annual ISHOW competition will launch in November 2018 to coincide with IMECE.
• In a pilot program with the World Bank, E4C has benchmarked clean tech companies from their investments in Morocco and Ethiopia using the E4C Solutions Library methodology, which will provide design and engineering reviews with eight of these companies in Casablanca in December 2018.

• In the upcoming quarter, EGD/E4C will focus more on fundraising and partnership building than programming.

Government Relations (GR)
• The United Engineering Foundation (UEF) has approved GR’s grant proposal for an outreach program on manufacturing issues:
  o GR is currently planning Congressional briefings on robotics (December 2018), safety standards for autonomous vehicles and drones, bioengineering, and clean energy.

• Applications for the 2019-2020 ASME Congressional Fellowship program are being accepted until January 2019.

• Planning is underway for the 2019 Engineering Public Policy Symposium and corresponding Congressional briefing, Congressional visits, and Board of Governors meeting.

Industry Advisory Board (IAB)
• The IAB will co-locate its annual spring meeting with MEED in New Orleans in March 2019, to foster collaboration between ASME stakeholders in industry and academia.

Pre-College Education
• An EAN Stakeholders Workshop is in development for January 2019 to further examine the proposed model for ASME powering EAN.

• Planning is underway to host an EAN Training Workshop in conjunction with E-Fest West at the Los Angeles County Fairgrounds in March 2019.
  o A regional K-12 STEM Festival is scheduled to coincide with this event as well. Outreach efforts have been initiated to fully leverage this opportunity to engage pre-college students within the E-Fest experience.
ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 3, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Committee on Finance and Investment
Presented by: William Garofalo, Associate Executive Director Finance
Agenda Title: Fiscal Year 2019 First Quarter Financial Results

Agenda Item Executive Summary:

Presentation of the Fiscal Year 2019 First Quarter Financial Results.

Proposed motions for BOG Action:

None

Attachments: Financial Presentation
ASME FY 2019 Q1 Financial Report

William Garofalo, Associate Executive Director, Finance

November 10, 2018
Table of Contents

• Drivers vs. Budget Page 4
• Drivers vs. Prior Year (FY18) Page 6
• ASME Statement of Financial Position Commentary Page 8
• ASME Investment Trends Page 10
• Equity Investment Portfolio [as of Q1 FY19] Page 11
ASME FY19 Q1 Financial Results – vs. Budget

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Budget</th>
<th>Variance $</th>
<th>Variance %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>$26.2</td>
<td>$25.3</td>
<td>$0.9</td>
<td>3.6%</td>
</tr>
<tr>
<td>Expense</td>
<td>$27.1</td>
<td>$30.5</td>
<td>$3.4</td>
<td>11.1%</td>
</tr>
<tr>
<td>Net</td>
<td>($0.9)</td>
<td>($5.2)</td>
<td>$4.3</td>
<td></td>
</tr>
</tbody>
</table>
Drivers vs. Budget

Conformity Assessment

Learning & Development

Expense favorability due to timing of consulting spend for course development driven by staff turnover

Technical Events

Decreased revenue from 6 out of 9 conferences in Q1 missing revenue targets, with only 4 achieving a net surplus.

Operational Underspend
### Actual vs. Prior Variance

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Prior</th>
<th>Variance ($)</th>
<th>Variance %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenue</strong></td>
<td>$26.2</td>
<td>$29.8</td>
<td>($3.6)</td>
<td>-12.1%</td>
</tr>
<tr>
<td><strong>Expense</strong></td>
<td>$27.1</td>
<td>$26.1</td>
<td>($1.0)</td>
<td>-3.8%</td>
</tr>
<tr>
<td><strong>Net</strong></td>
<td>($0.9)</td>
<td>$3.7</td>
<td>($4.6)</td>
<td></td>
</tr>
</tbody>
</table>

---

**Revenue vs. Expense**

- **Revenue:**
  - Actual: $26.2
  - Prior: $29.8
  - Variance: ($3.6)
  - Variance %: -12.1%

- **Expense:**
  - Actual: $27.1
  - Prior: $26.1
  - Variance: ($1.0)
  - Variance %: -3.8%

- **Net:**
  - Actual: ($0.9)
  - Prior: $3.7
  - Variance: ($4.6)
Drivers vs. Prior Year (FY18)

1. Technical Events

Increase in revenue and expense driven by Cyclicality of conferences in odd vs even years

2. Conformity Assessment

Increased revenue and expense due to companies renewing and buying new ASME certification both internationally and in the domestic market.
<table>
<thead>
<tr>
<th>Assets</th>
<th>September 30, 2018</th>
<th>June 30, 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash and cash equivalents</td>
<td>$13,026,111</td>
<td>$8,090,012</td>
</tr>
<tr>
<td>Accounts receivable, less allowance for doubtful accounts of $226,000 in 2019 and $226,000 in 2018</td>
<td>$12,401,269</td>
<td>$15,856,240</td>
</tr>
<tr>
<td>Due from The ASME Foundation, Inc.</td>
<td>__</td>
<td>__</td>
</tr>
<tr>
<td>Inventories</td>
<td>691,022</td>
<td>656,976</td>
</tr>
<tr>
<td>Prepaid expenses, deferred charges, and deposits</td>
<td>3,191,711</td>
<td>3,109,710</td>
</tr>
<tr>
<td>Investments</td>
<td>121,437,452</td>
<td>133,047,764</td>
</tr>
<tr>
<td>Property, furniture, equipment, and leasehold improvements, net</td>
<td>19,683,994</td>
<td>19,540,459</td>
</tr>
<tr>
<td>Total assets</td>
<td>$170,431,559</td>
<td>$180,301,160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Liabilities and Net Assets</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Liabilities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts payable and accrued expenses</td>
<td>$8,493,802</td>
<td>$10,408,184</td>
</tr>
<tr>
<td>Due to The ASME Foundation, Inc.</td>
<td>261,382</td>
<td>63,364</td>
</tr>
<tr>
<td>Accrued employee benefits</td>
<td>8,224,381</td>
<td>17,415,567</td>
</tr>
<tr>
<td>Deferred publications revenue</td>
<td>8,493,634</td>
<td>11,332,346</td>
</tr>
<tr>
<td>Deferred dues revenue</td>
<td>4,236,578</td>
<td>2,339,030</td>
</tr>
<tr>
<td>Accreditation and other deferred revenue</td>
<td>20,213,615</td>
<td>19,821,179</td>
</tr>
<tr>
<td>Deferred rent</td>
<td>10,290,115</td>
<td>10,539,157</td>
</tr>
<tr>
<td>Total liabilities</td>
<td>60,213,507</td>
<td>71,918,827</td>
</tr>
</tbody>
</table>

| Commitments                                                          |                   |               |
| Net assets:                                                          |                   |               |
| Unrestricted                                                         | 109,713,015        | 107,883,545   |
| Temporarily restricted                                                | 368,470            | 362,220       |
| Permanently restricted                                                | 136,567            | 136,567       |
| Total net assets                                                     | 110,218,052        | 108,382,332   |

| Total liabilities and net assets                                     | $170,431,559       | $180,301,160  |
The decreased balance is associated with a liquidation of $15M of investments to meet operational needs, partially offset by positive investment returns of 2.6% fiscal year to date.

The decrease is associated with the July $10M pension plan contribution.

This decrease reflects the recognition of revenue related to year 2 of the BPVC publication cycle.
ASME Investment Portfolio
[as of Q1 FY19]

- Large Blend 20%
- Large Value 11%
- Treasury Inflation-Protected Securities 3%
- Core Bond 36%
- International 19%
- Hard Assets 3%
- Small Blend 6%
- Tactical Equity 1%
- Tactical Non Equity 1%
Equity Investment Portfolio
[as of Q1 FY19]

- Bridgeway: 4.11%
- Vanguard Instit. Index: 7.70%
- Leuthold Core: 1.59%
- Vanguard Small - Cap Index: 4.77%
- Johcm International Select: 0.21%
- Dodge & Cox Int'l: 0.81%
- Vanguard Energy: 1.67%
- T. Rowe Price New Era: 2.03%
<table>
<thead>
<tr>
<th>Cash flows from operating activities:</th>
<th>September 30, 2018</th>
<th>September 30, 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in net assets</td>
<td>$1,835,720</td>
<td>$10,052,270</td>
</tr>
<tr>
<td>Adjustments to reconcile increase in net assets to net cash provided by (used in) operating activities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation and amortization</td>
<td>848,763</td>
<td>1,276,697</td>
</tr>
<tr>
<td>Loss on disposal of fixed assets</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Realized and unrealized gain on investments</td>
<td>(2,796,690)</td>
<td>(3,959,958)</td>
</tr>
<tr>
<td>Bad debt recovery</td>
<td>(52,000)</td>
<td>(1,000)</td>
</tr>
<tr>
<td>Change in operating assets and liabilities:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>3,506,970</td>
<td>298,430</td>
</tr>
<tr>
<td>Due from The ASME Foundation, Inc.</td>
<td>—</td>
<td>279,289</td>
</tr>
<tr>
<td>Inventories</td>
<td>(34,046)</td>
<td>(24,851)</td>
</tr>
<tr>
<td>Prepaid expenses, deferred charges, and deposits</td>
<td>(82,002)</td>
<td>(1,823,191)</td>
</tr>
<tr>
<td>Accounts payable and accrued expenses</td>
<td>(1,914,382)</td>
<td>1,839,471</td>
</tr>
<tr>
<td>Due to the ASME Foundation, Inc.</td>
<td>198,018</td>
<td>—</td>
</tr>
<tr>
<td>Accrued employee benefits</td>
<td>(9,191,186)</td>
<td>(7,623,551)</td>
</tr>
<tr>
<td>Deferred publications revenue</td>
<td>(2,838,712)</td>
<td>7,004,189</td>
</tr>
<tr>
<td>Deferred dues revenue</td>
<td>1,897,548</td>
<td>2,038,972</td>
</tr>
<tr>
<td>Accreditation and other deferred</td>
<td>392,436</td>
<td>220,463</td>
</tr>
<tr>
<td>Deferred rent</td>
<td>(249,042)</td>
<td>(141,655)</td>
</tr>
<tr>
<td>Net cash provided by (used in) operating activities</td>
<td>(8,478,605)</td>
<td>9,435,575</td>
</tr>
</tbody>
</table>

| Cash flows from investing activities: | | |
| Purchases of investments            | (482,107)          | (3,348,315)        |
| Proceeds from sales of investments  | 14,889,109         | 2,843,209          |
| Acquisition of fixed assets         | (992,298)          | (492,365)          |
| Net cash (used in) provided by investing activities | 13,414,704 | (997,471) |
| Net (decrease) increase in cash and cash equivalents | 4,936,099 | 8,438,104 |

| Cash and cash equivalents at beginning of period | $8,090,012 | $12,028,868 |
| Cash and cash equivalents at end of period     | $13,026,111 | $20,466,972 |
## ASME FY19 Q1 Financial Results – vs. Budget

<table>
<thead>
<tr>
<th>Products, Programs &amp; Services</th>
<th>Actual</th>
<th>Budget</th>
<th>Actual vs Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue</td>
<td>Expense</td>
<td>Net</td>
</tr>
<tr>
<td>Standards</td>
<td>$8,625</td>
<td>$2,363</td>
<td>$6,263</td>
</tr>
<tr>
<td>CA &amp; Process Mgmt</td>
<td>6,486</td>
<td>3,079</td>
<td>3,406</td>
</tr>
<tr>
<td>Publishing</td>
<td>3,566</td>
<td>1,886</td>
<td>1,679</td>
</tr>
<tr>
<td>Learning &amp; Development</td>
<td>864</td>
<td>1,057</td>
<td>(193)</td>
</tr>
<tr>
<td>Technical Events</td>
<td>3,141</td>
<td>3,345</td>
<td>(203)</td>
</tr>
<tr>
<td>Constituent Engagement</td>
<td>3,360</td>
<td>1,592</td>
<td>1,768</td>
</tr>
<tr>
<td>Programs &amp; Philanthropy</td>
<td>80</td>
<td>1,170</td>
<td>(1,090)</td>
</tr>
<tr>
<td>New Product Development</td>
<td>(0)</td>
<td>360</td>
<td>(361)</td>
</tr>
<tr>
<td><strong>Products, Programs &amp; Services Subtotal</strong></td>
<td>$26,121</td>
<td>$14,852</td>
<td>$11,269</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating</th>
<th>Actual</th>
<th>Budget</th>
<th>Actual vs Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue</td>
<td>Expense</td>
<td>Net</td>
</tr>
<tr>
<td>Marketing Services</td>
<td>$0</td>
<td>$1,277</td>
<td>($1,277)</td>
</tr>
<tr>
<td>Public Information</td>
<td>0</td>
<td>429</td>
<td>($429)</td>
</tr>
<tr>
<td>ASME.org</td>
<td>0</td>
<td>359</td>
<td>(359)</td>
</tr>
<tr>
<td>Sales &amp; Customer Care</td>
<td>0</td>
<td>511</td>
<td>($)511)</td>
</tr>
<tr>
<td>TABD</td>
<td>0</td>
<td>528</td>
<td>($528)</td>
</tr>
<tr>
<td>Global Public Affairs</td>
<td>0</td>
<td>884</td>
<td>($884)</td>
</tr>
<tr>
<td>Human Resources</td>
<td>0</td>
<td>1,290</td>
<td>(1,290)</td>
</tr>
<tr>
<td>Facilities</td>
<td>0</td>
<td>2,335</td>
<td>(2,335)</td>
</tr>
<tr>
<td>Technology Services Group</td>
<td>0</td>
<td>1,884</td>
<td>(1,884)</td>
</tr>
<tr>
<td>Finance &amp; Accounting</td>
<td>0</td>
<td>1,145</td>
<td>(1,145)</td>
</tr>
<tr>
<td>Executive Office</td>
<td>0</td>
<td>1,163</td>
<td>(1,163)</td>
</tr>
<tr>
<td>Global Alliance &amp; Board Ops</td>
<td>0</td>
<td>168</td>
<td>(168)</td>
</tr>
<tr>
<td>Governance</td>
<td>(2)</td>
<td>196</td>
<td>(198)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>110</td>
<td>114</td>
<td>(5)</td>
</tr>
<tr>
<td><strong>Operating Subtotal</strong></td>
<td>$108</td>
<td>$12,283</td>
<td>($12,175)</td>
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</table>

<table>
<thead>
<tr>
<th>Operating Surplus / (Deficit)</th>
<th>Actual</th>
<th>Budget</th>
<th>Actual vs Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Revenue</td>
<td>Expense</td>
<td>Net</td>
</tr>
<tr>
<td><strong>Operating Surplus / (Deficit)</strong></td>
<td>$26,229</td>
<td>$27,135</td>
<td>($906)</td>
</tr>
</tbody>
</table>
## ASME FY19 Q1 Financial Results – vs. Prior Year (FY18)

### Products, Programs & Services

<table>
<thead>
<tr>
<th></th>
<th>Actual Revenue</th>
<th>Actual Expense</th>
<th>Actual Net</th>
<th>Prior Revenue</th>
<th>Prior Expense</th>
<th>Prior Net</th>
<th>Actual vs Prior Revenue</th>
<th>Actual vs Prior Expense</th>
<th>Actual vs Prior Net</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standards</strong></td>
<td>$8,625</td>
<td>$2,363</td>
<td>$6,263</td>
<td>$14,418</td>
<td>$3,541</td>
<td>$10,877</td>
<td>($5,793)</td>
<td>$1,178</td>
<td>($4,614)</td>
</tr>
<tr>
<td><strong>CA &amp; Process Mgmt</strong></td>
<td>6,486</td>
<td>3,079</td>
<td>3,406</td>
<td>4,978</td>
<td>3,516</td>
<td>1,462</td>
<td>1,508</td>
<td>437</td>
<td>1,944</td>
</tr>
<tr>
<td><strong>Publishing</strong></td>
<td>3,566</td>
<td>1,886</td>
<td>1,679</td>
<td>3,322</td>
<td>1,800</td>
<td>1,522</td>
<td>244</td>
<td>(87)</td>
<td>157</td>
</tr>
<tr>
<td><strong>Learning &amp; Development</strong></td>
<td>864</td>
<td>1,057</td>
<td>(193)</td>
<td>890</td>
<td>919</td>
<td>(28)</td>
<td>(26)</td>
<td>(138)</td>
<td>(164)</td>
</tr>
<tr>
<td><strong>Technical Events</strong></td>
<td>3,141</td>
<td>3,345</td>
<td>(203)</td>
<td>2,514</td>
<td>2,517</td>
<td>(3)</td>
<td>627</td>
<td>(828)</td>
<td>(201)</td>
</tr>
<tr>
<td><strong>Constituent Engagement</strong></td>
<td>3,360</td>
<td>1,592</td>
<td>1,768</td>
<td>3,541</td>
<td>1,434</td>
<td>2,108</td>
<td>(182)</td>
<td>(159)</td>
<td>(340)</td>
</tr>
<tr>
<td><strong>Programs &amp; Philanthropy</strong></td>
<td>80</td>
<td>1,170</td>
<td>(1,090)</td>
<td>81</td>
<td>1,181</td>
<td>(1,100)</td>
<td>(1)</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td><strong>New Product Development</strong></td>
<td>(0)</td>
<td>360</td>
<td>(361)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>(0)</td>
<td>(360)</td>
<td>(361)</td>
</tr>
<tr>
<td><strong>Products, Programs &amp; Services Subtotal</strong></td>
<td>$26,121</td>
<td>$14,852</td>
<td>$11,269</td>
<td>$29,744</td>
<td>$14,906</td>
<td>$14,838</td>
<td>($3,623)</td>
<td>$54</td>
<td>($3,569)</td>
</tr>
</tbody>
</table>

### Operating

<table>
<thead>
<tr>
<th></th>
<th>Actual Revenue</th>
<th>Actual Expense</th>
<th>Actual Net</th>
<th>Prior Revenue</th>
<th>Prior Expense</th>
<th>Prior Net</th>
<th>Actual vs Prior Revenue</th>
<th>Actual vs Prior Expense</th>
<th>Actual vs Prior Net</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Marketing Services</strong></td>
<td>$0</td>
<td>$1,277</td>
<td>($1,277)</td>
<td>$0</td>
<td>$955</td>
<td>($955)</td>
<td>$0</td>
<td>($323)</td>
<td>($323)</td>
</tr>
<tr>
<td><strong>Public Information</strong></td>
<td>0</td>
<td>429</td>
<td>(429)</td>
<td>0</td>
<td>416</td>
<td>(416)</td>
<td>0</td>
<td>(12)</td>
<td>(12)</td>
</tr>
<tr>
<td><strong>ASME.org</strong></td>
<td>0</td>
<td>359</td>
<td>(359)</td>
<td>0</td>
<td>454</td>
<td>(454)</td>
<td>0</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td><strong>Sales &amp; Customer Care</strong></td>
<td>0</td>
<td>511</td>
<td>(511)</td>
<td>0</td>
<td>365</td>
<td>(365)</td>
<td>0</td>
<td>(146)</td>
<td>(146)</td>
</tr>
<tr>
<td><strong>TABD</strong></td>
<td>0</td>
<td>528</td>
<td>(528)</td>
<td>0</td>
<td>546</td>
<td>(546)</td>
<td>0</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td><strong>Global Public Affairs</strong></td>
<td>0</td>
<td>884</td>
<td>(884)</td>
<td>0</td>
<td>218</td>
<td>(218)</td>
<td>(0)</td>
<td>(667)</td>
<td>(667)</td>
</tr>
<tr>
<td><strong>Human Resources</strong></td>
<td>0</td>
<td>1,290</td>
<td>(1,290)</td>
<td>0</td>
<td>636</td>
<td>(636)</td>
<td>0</td>
<td>(654)</td>
<td>(654)</td>
</tr>
<tr>
<td><strong>Facilities</strong></td>
<td>0</td>
<td>2,335</td>
<td>(2,335)</td>
<td>14</td>
<td>2,485</td>
<td>(2,470)</td>
<td>(14)</td>
<td>149</td>
<td>135</td>
</tr>
<tr>
<td><strong>Technology Services Group</strong></td>
<td>0</td>
<td>1,884</td>
<td>(1,884)</td>
<td>(1)</td>
<td>1,920</td>
<td>(1,921)</td>
<td>1</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td><strong>Finance &amp; Accounting</strong></td>
<td>0</td>
<td>1,145</td>
<td>(1,145)</td>
<td>0</td>
<td>1,225</td>
<td>(1,225)</td>
<td>0</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td><strong>Executive Office</strong></td>
<td>0</td>
<td>1,163</td>
<td>(1,163)</td>
<td>1</td>
<td>1,148</td>
<td>(1,147)</td>
<td>(1)</td>
<td>(15)</td>
<td>(16)</td>
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### Operating Surplus / (Deficit)

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ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 19, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Mike Molnar, Chair, Presidential Task Force on Core Technologies
Presented by: Mike Molnar
Agenda Title: Presidential Task Force on Core Technologies Update

Agenda Item Executive Summary:

The Presidential Task Force on Core Technologies was created to review the current strategy, status of work and implementation plans for the ASME Strategy for Core Technologies, then to develop recommendations for improving the strategy to accelerate growth in the core technologies, including but not limited to provisions for collaborations and M&A.

The task team has held four meetings and presented a summary assessment along with preliminary recommendations at the October BOG meeting. The team plans to continue development, begin coordination with the other task teams, and have discussions during IMECE. The team does not anticipate presenting recommendations at the November BOG meeting.

Proposed motion for BOG Action:
Information only

Attachments: None.
Date Submitted: October 26, 2018  
BOG Meeting Date: November 10, 2018

To: Board of Governors  
From: Andy Bicos, Chair, Membership Task Force  
Presented by: Andy Bicos

Agenda Title: Presidential Task Force on Membership Update

Agenda Item Executive Summary:

A brief update is provided for the Membership Task Force.

Proposed motion for BOG Action:

None

Attachments: PowerPoint Presentation with updated information.
Membership Task Force Report to Board of Governors
November 2018

Chair: Andy Bicos*

Members: Stuart Cameron*, Josh Heitsenrether*, Mahantesh Hiremath*, Julie Kulik*, Tom Costabile, Julia Goodrich, Said Jahanmir, Jeff Patterson, Khosro Shirvani, Charla Wise

Submitted 10/19/18
Charge and Scope

- ASME is a membership organization and our membership has been shrinking AND aging.
- Much thought, research and study has taken place over more than a decade by ASME, now is time for action.
- What concrete actions are needed to not just recruit new members but to retain members?
- What is the value proposition for ASME membership – The New 21st Century Membership Model?
- Develop plan of action with both staff and volunteer viewpoints, and in coordination with other task forces and outside consultant.
- Present preliminary recommendations and plan at April 2019 BOG meeting followed by final recommendations and plan for implementation at June 2019 BOG meeting.
Task Force Recent Activities

✓ Deep Dive into Membership Data & KPIs
✓ Audit of available ASME research: 2017-2018 Member Segmentation Study, 2017 Lapsed Member Study
✓ Overview of staff-driven New Member Model Initiative and consultant engagement; agreement with approach; recurring updates and input
✓ Completion of Membership Task Force (MTF) ideation questionnaire & generative discussion; input provided to consultant for inclusion in research & benchmarking
✓ Welcoming Julia Goodrich, new Director of Membership, to the Task Force
✓ TF Presentation to Board of Governors during October meeting; show-of-hands agreement and support of Task Force’s work and parallel staff initiative
✓ Deployment and fielding of Task Force survey to BOG, SMC, SVPs, EDESC, COR, COH, COFI, Audit, Past Presidents, SAC, EMT and staff counterparts. Results will be presented at later date. (30/86 responses as of 10/19/18)
✓ MTF October Meeting (10/30/18) to review and discuss survey results
✓ Phase 1 of Staff-led initiative continues on schedule (next slide)
## Phase 1 Project Status (as of 10/19/18)

### Project Steps

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<th>JULY</th>
<th>AUGUST</th>
<th>SEPT.</th>
<th>OCT.</th>
<th>NOV.</th>
<th>DEC.</th>
<th>JAN.</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
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<tr>
<td><strong>Internal Review of ASME Membership Model &amp; Existing Research Data. Includes Staff/Stakeholder Interviews (10-12)</strong></td>
<td>✔️</td>
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<td><strong>Create and Deliver Product Dashboards</strong></td>
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<tr>
<td><strong>Develop Membership Model Options and Scenarios Including Market Testing and Recommendations</strong></td>
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<td><strong>Begin Phase II: Build ASME's Pilot Membership Model; Prepare for Launch and Testing</strong></td>
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Minutes Appendix 5.4. 
Page 5 of 6
Upcoming Task Force Activities

- Deliver November Task Force Report to BOG (sent Oct 19)
- Review of Results from TF Survey to BOG, etc. (late Oct)
- Review of Preliminary Research Findings (Oct/Nov)
- Review of Preliminary Situation Analysis Report (Jan)
- Review of Preliminary Membership Model Options & Scenario (Feb)
- Discussion of New Membership Targets (March)
- Results of Market Test of Model Pilot Soft Launch (April)
- Present Preliminary Recommendations and Plan to BOG (April)
- Phase II Overview & Continuity into FY20 (May/June)
- Present Final Recommendations and Plan to BOG (June)
ASME Board of Governors
Agenda Item
Cover Memo

Date Submitted: October 10, 2018
BOG Meeting Date: November 10, 2018

To: Board of Governors
From: Nomination Process Task Force
Agenda Title: Presidential Task Force on Nomination Process Update

Agenda Item Executive Summary:

Identified Items
  • Uncertain path for Volunteers – Need to fix the Volunteer Pipeline
    • Identify volunteers ready to take on enhanced leadership positions.
    • Identify path for them to take on increasing roles and responsibilities.
  • Educate Volunteers and Staff
    • How do we identify our future leaders?
    • What are the requirements to be an effective Board Member and President?
  • Barriers to Serving on the Board and running for President
    • Time commitment: Has being on the board become another full time job?
  • Evaluate the Board structure and process for selection

The taskforce is currently in the process of gathering data and preparing a report to the BOG.

Proposed motion for BOG Action:
None.

Attachments: None.