

**INVITATION TO SHAPE PEACE ENGINEERING
FROM NOVEMBER 12-16, 2018**

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Abstract—This paper identifies key concepts and philosophies of Peace Engineering. As a cross-disciplinary group of entrepreneurs, professors and professionals, we have developed an outline of one possible framework for the implementation of Peace Engineering. After presenting the relevant foundational materials, we frame the conversations and learning experiences planned for the 2018 World Engineering Education Forum and the Global Engineering Deans Council (WEEF-GEDC) Conference on Peace Engineering in Albuquerque, NM (weef-gedc2018.org). We close with a review of topics for continuing dialogue—as a call for conference papers specifically, and for future research and discussions moving forward. The purpose of this paper, in short, is to encourage key contributors in the ecosystem of purposeful enterprise to engage with each other at this conference to shape the requirements and co-create solution directions for a sustainable future.

Keywords—Peace Engineering; natural ecosystem; WEEF-GEDC2018; engineering education; transforming engineers; technology’s role in the SDGs; industrial revolution 4.0; circular economy; systems thinking.

What is Peace Engineering?

There is a beginning body of work on the subject of Peace Engineering [1]. Some associate it with the military deterrence of war, others have a broader, and perhaps deeper view beyond its prophylactic power.

“The absence of conflict is a necessary but not sufficient condition for peace...Therein a great opportunity for engineers, for they have at their disposal the knowledge and practical skills to ameliorate the many forms of material injustice that are the root causes of most violent conflicts.”– Peace Engineering, P. Aarne Vesilind and W. Richard Bowen [1].

Here, we define ***Peace Engineering*** as the intentional application of systemic-level thinking of science and engineering principles to directly promote and support conditions for peace. ***Peace Engineering*** works directly towards a world where prosperity, sustainability, social equity, entrepreneurship, transparency, community voice and engagement, and a culture of quality thrive. Engineers have the power to play a vital role in the creative solutions that can radically transform and improve the wellbeing of people and other living systems, day to day.

At the core of ***Peace Engineering*** is our planet’s sustainable future, which is calling leaders to act in concert from a systems mindset. It is a call to develop solutions differently: that is, collaboratively; integrating transdisciplinary expertise and education programs; simultaneously applying technology solutions while supporting ethics, policy and living systems. And it is a call in the mingled vernacular of civil society, global institutions, and science and technology. Further, beyond addressing today’s challenges, we must cultivate together the development of next generation leaders to continue to drive momentum.

Why is Peace Engineering the Theme of This Global Education Conference?

It’s a truism that technology is driving economic productivity worldwide even as it is revolutionizing day to day human experiences. Arguably, it will continue to be the biggest force for change that humans can control for the foreseeable future. And, engineers drive technology. Their education and mindset is determining right now what tomorrow holds for billions of human beings.

“Within university communities... we must create an intellectual environment where students can **develop an awareness of the impact of emerging technologies**, an appreciation of engineering as an integral process of **societal change**, and an acceptance of **responsibility for civilization’s progress**,”
Joseph Bordogna, 1990 [2]

Engineers - Their Systems Mindset, Skills, Creativity and Intention will Determine Humanity’s Future
So, just as it continues to enable undreamt improvements in quality of life for many peoples of the world and to generate abundant material value, so too does technological innovation enable unprecedented crises - this is the law of unintended consequences.

“...The crash made it all too clear that *mathematics*, once my refuge, was not only *deeply entangled in the world’s problems but also fueling many of them*. The housing crisis, the collapse of major financial institutions, the rise of unemployment —all had been aided and abetted by mathematicians wielding magic formulas. What’s more, thanks to the extraordinary powers that I loved so much, math was able to combine with technology to multiply the chaos and misfortune, *adding efficiency and scale to systems that I now recognized as flawed...*” - **Cathy O’Neill - Weapons of Math Destruction [3]**.

A crucial variable in determining the impact of innovation, we argue, is intention. And the engineer’s intention carries disproportionate weight in that equation - they are the designers and makers after all. So it’s not surprising that they are now at the center of attention in a movement to align technology with ethical behaviors, human wellbeing and sustainability.

The goal, however, is not for arbitrary intention to drive the agenda, nor can conventional rules alone constrain innovation. Instead, the aim is for the engineer’s own systemic-thinking to be at the center of the effort. The law of unintended consequences has created a situation where the whole of society is suffering mightily because of the casual and myopic intentions of a few.

“The trend that has been building in business and society for 25 years is an impulse for socially purposeful enterprise. That trend has now coalesced enough across sectors worldwide to be actionable. What’s needed is intention, skill and will. Engineers are at the center of that skill. Their conscious intention to serve the web of life can be the lynchpin that catalyzes positive collective action at scale.” - **Elsie Maio - Humanity, Inc**

Engineering education needs to change - it is no longer enough to teach the basics of what the previous generation learned. Too often today, educators tweak curricula or develop new classes -- but based on an old paradigm. We too readily retreat to what’s familiar and comfortable even while others innovate for impact. To innovate for impact, progressive school districts in NY, specifically in elementary and middle schools, now focus on “whole child” education [4]. Initiatives driven by the National Science Foundation (NSF) focus on bridging the gap between high schools and universities, such as in the introduction of AP Engineering classes [5]. Finally, Quanser Inc. [6] has applied modern learning technology to mechatronics, controls and robotics education, to create a whole new approach to experiential education. We believe that this, and other initiatives, are what is required to revamp the education system to contribute to a sustainable future.

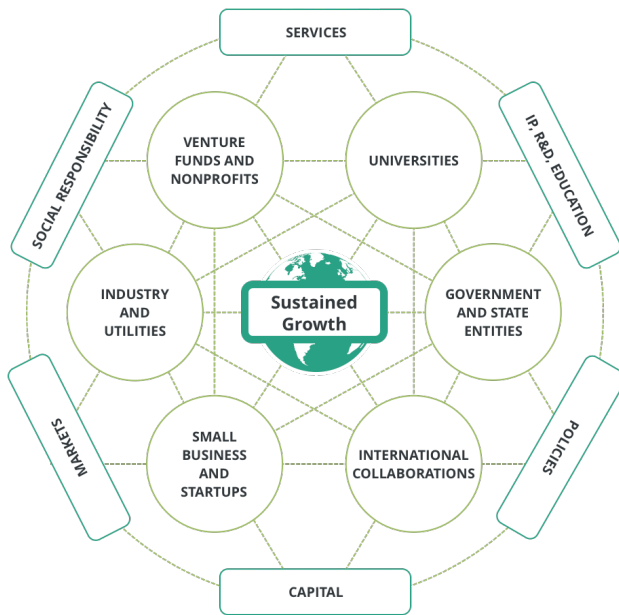
How You Can Contribute to Peace Engineering at This Conference

The education system is a cornerstone to the evolution of any discipline, including engineering. And it is a useful platform for discussing the future of engineering. This conference, being the annual worldwide gathering of engineering educators is the logical forum to expand that discussion.

But unlike these previous gatherings, today’s occurs in the midst of multiple crises of which technology is quite visibly at the core, either as a catalyst or as the potential solution tool. It is simply time for engineering and engineers to take a stand on these issues as a conscious instrument of wellbeing for

humanity and the planet. And we are encouraged by the rousing alignment of millennials and others behind the idea of socially purposeful innovation.

The crises are system crises. The solutions must be system solutions. The solution-creators will be the members of the ecosystem. So of course, the discourse is a full-ecosystem conversation. That is perhaps another way in which this conference is different. We invite all of you, members of what we've called the Natural Ecosystem, to come with your own requirements, learnings, questions, concerns so this forum will benefit from the perspective of the system in which engineers operate.



The ecosystem participants as illustrated in the diagram are members of the investment community, of industry, of governments local, state, regional and national, representatives of civil society that is the people's needs as well as their talent for generating rich collective wellbeing, or you may be a member of the many specialties in engineering and education, in the business of transforming of mindsets and behavioral change. Or more. The richer the inputs, the richer the outcomes.

And even though ecosystem models have their successes, their impact on economic development are uneven. Our facility in managing them is still developing. For instance, the duplication of Silicon-Valley, Silicon-Alley, Silicon-Beach,

Silicon-Slopes are all well known ecosystems that have been established in Northern California, New York, Southern California, and Utah, respectively. In addition, concepts like Rainforest Development [7], have also been developed to establish, create and enhance existing ecosystems. However, historically, we have found that these concepts have lended mixed results.

For the engineer engaged in Peace Engineering, we have identified what we call the Natural Ecosystem™, diagrammed [8]. It represents an ideal state where all the stakeholders are in equilibrium and hold a common focus, or intention. In this case, the center of the Natural Ecosystem™ is the concept of sustained (or sustainable) growth. The question in this group then becomes, What can we do as an ecosystem to co-create systems that contribute to equitable, sustained growth?

The model of an ecosystem more accurately describes the dynamics of purposeful enterprise today. It implies awareness and engagement with the whole, a mutuality of interest, a complementarity of desired outcomes, and a fluid give-and-take flow of contribution and value.

It will take a new kind of Engineer and leader to inhabit this Natural Ecosystem™ [9]. One who is comfortable working in and developing concepts that are not only transdisciplinary, but also cross-



disciplinary. Who starts by envisioning the desired impact on the Meta-System that is the web of life. They understand the dynamics of business concepts like entrepreneurship and finance, political concepts like policies and regulations, and even understanding capital needs.

In the frame of Peace Engineering -- that is, the application of engineering principles, skill and talent directly to humanity's pressing problems -- your contributions are therefore, essential.

The Unique Growth Opportunity (and challenges) Of This Conference

As with prior conferences in this series, this one provides the traditional opportunities to learn, share, publish and network among peers. And more.

First, in our view, this particular joint conference of World Engineering Education Forum (WEEF), and Global Engineering Deans Council (GEDC) to be held in Albuquerque, NM in November 2018 is well-suited to initiate collaboration and inquiry around the common theme of Peace Engineering. For one, it is the first time these conferences will be held together in the United States, a natural stage for global reach and impact in the rebirth of engineering intention.

Second, the locale itself is said to have birthed Big Science into the so-called atomic age. On the brink now of this new era in innovation for social good, science and engineering carry their legacy of brilliant accomplishments and expertise associated with New Mexico to the next level of contribution.

The goal is to bring together key stakeholders to begin the dialogue of how to: define the problems on a systemic level; make the curriculum cogent for the times; develop the right skill sets for the next generation; and to cultivate socially skilled and purposeful next generation leaders.

We are challenging ourselves as organizers, and you as the people and institutions committed to ethical, sustainable growth, to be willing to change, to grow and to learn from each other, no matter their ranking, their professional status, their area of discipline or personal characteristics. For we are each members of the ecosystem, and the flourishing of the ecosystem requires that each be heard and that each flourish.

Your papers, your workshops, your facilitation are important to the wholeness of this conversation - please see website for specific deadlines (www.weef-gedc2018.org). Register. Come. Discover. Share what you know and collaborate with your fellow actors in the ecosystem of sustainable growth. This is a conference of doers, catalysts and change-agents. This is your platform.

Why reach out beyond academia and its immediate stakeholder set for this event, such as the research labs? Inclusivity is a *de facto* requirement for systems effectiveness. If you are looking to affect the sustainable growth of communities or sectors or the world economy as is sorely needed, then *de facto* you engage and orchestrate systems dynamics. You engage all the players.

The esteemed Dr. Joseph Bordogna, humanitarian, emeritus COO of The National Science Foundation, Dean of the the School of Engineering at the University of Pennsylvania and former President of the IEEE, foresaw decades ago this evolved role of engineers:

They appreciate “the economic, industrial, and international environment in which engineering is practiced and the ability to provide societal leadership effectively” [2].

The question they then face is, how do I effectively engage in this system?

That question opens the door to 5 areas to explore at the conference that we hope you find rich with nuance and promise. As you think about these, we welcome your additions to these prompts:

1. Developing the Global Engineer

- How do we develop the next generation engineers (their principled leadership, personal grounding as members of the web of life, curriculum reform, socratic method in engineering, executive programs in engineering, joint and cross disciplinary programs, etc.)?
- How do we create and bring Peace Engineering into the classroom and our daily lives?
- How do we include ethics by design, employability, policy, mobility (displaced people), social responsibility as part of engineering curricula?
- How do we embrace culture of quality: teaching, accreditation, research, innovation?
- How do we create transdisciplinary and trans-sector academic programs to foster innovation, ventures, internationalization and impact?

2. The Societal Problems/Opportunities to Focus On

- How do we reduce the gap between the haves and have-nots?
- How do we equitably spread wealth and wellbeing?
- What can we do to contribute to specific global challenges (food, water, air quality, smart cities, security, food security, climate change, health).
- How do we establish and address sustainable development goals? How to engage with the momentum of the United Nations Sustainable Development Goals and NAE challenges?
- How can we embrace Empathy?

3. Conditions for Effective Engagement

- How do we address diversity? (gender, political, geographical, religious, socio-economic, refugees, people reintegrating to society, other)
- How do we deal with disruption and complexity?
- How do we embrace accountability personally ourselves, and hold each other accountable at all levels (local, national, global, public, private)
- How do we deal and live with transparency?
- How do we embrace culture of quality: teaching, accreditation, research, innovation?
- How can we create a forum where academia, industry, governments, banks, NGOs, multilateral organizations, R&D centers, concerned citizens and leaders interact to continue the conversation/action on Peace Engineering?

4. Ecosystem Functions and Processes

- How to manage for impact global engineering innovations and ventures (social and business innovation and ventures)
- Creation of global natural ecosystems for innovation and entrepreneurship
- International systems to measure the impact of innovations and ventures
- How can we create a forum where academia, industry, governments, banks/finance, NGOs, multilateral organizations, R&D centers, concerned citizens, public stakeholders and leaders interact to continue the conversation/action on Peace Engineering?

5. Emergent Models

- What do the emergent economic models imply for the Natural Ecosystem and Engineering's role in it? (Circular Economy, Industry 4.0/5.0, etc.)

These are the topics for which we Call for Papers, workshops and facilitation at the Peace Engineering Conference in November 2018. We look forward to seeing you there.

Thank you!

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