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Editorial

Peace Engineering Gains Momentum

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Abstract: To create a sustainable future, technological innovators must become intentional about their designs, rather than design first and worry later. Though this idea appears straightforward, it requires fundamental changes in engineering education and in channels of product commercialization/valorization. This communication describes the Peace Engineering movement and its thrust toward design for peace and human welfare. It describes the movement's history, notably its changes in approach relative to that of the Vietnam war protests and the first Earth Day of 50 years ago; Peace Engineering's potential for reducing waste and loss of life; and the challenges Peace Engineering now faces. It concludes with preliminary ideas on moving past these challenges**.** The nascent field of Peace Engineering will lead to new streams of research and new initiatives in engineering education and practice for sustainability.

Keywords: peace engineering; responsible research and innovation; technology assessment; engineering education; innovation for sustainability

1. Introduction

A November, 2003 symposium at Bucknell University, titled Engineers Working for Peace [1], spurred the current blossoming of Peace Engineering. Peace Engineering has taken the form of a new engineering discipline, a movement to reform engineering education, and a new professional society. Its importance to the profession and to sustainability justifies highlighting it in this journal.

This essay introduces the people, events and organizations involved in Peace Engineering; explains what differentiates Peace Engineering from earlier movements; defines Peace Engineering (to the extent possible, as not all adherents agree on a definition); highlights the importance of Peace Engineering, and the challenges it faces; and suggests a way forward and what to expect as the movement grows.

2. Peace Engineering: The Movement

The Bucknell symposium put forth a principle that shaped what followed. That is, that peace is not a passive condition or the simple absence of war, but rather that "peace is an activity that requires continuous commitment and imaginative input" [1]. Participants aimed Peace Engineering not just at minimizing the warlike application of innovations, but at deliberately innovating to promote peaceful human welfare.

Shortly after, the Responsible Research and Innovation (RRI) movement arose [1,2], complementing peace engineering and emphasizing (as stated in [3])

> innovation activities with a view to their ethical acceptability and social desirability. RRI is promoted by the European Commission and has the status of a cross-cutting

> priority in the European Union's Horizon 2020 Framework Program for Research and Innovation. The European Commission had, by 2009, supported RRI-related projects with nearly €100 million (with project participants from almost 50 European and non-European countries)…. Since 2009, when it was used for the first time by [2], RRI has featured as a topic in more than 300 papers indexed in Clarivate Web of Science.

The year 2018 saw the First Global Peace Engineering Conference, at the University of New Mexico in Albuquerque [4]. Attendees represented UNM, Stanford University, Drexel University, Sandia National Laboratories (SNL), the University of Colorado, Morgan State University, and the Ibero-American Consortium for Education in Science and Technology from the USA; and from overseas, Pontifícia Universidad Javeriana (Colombia), Universidade de Santa Catarina (Brazil), Swansea University (UK), and the Conseil Européen pour Recherche Nucléaire (CERN, Switzerland); as well as a number of New Mexico private companies.

A second New Mexico symposium took place in May, 2019 [5]. Prominent among the participants was Bernard Amadei, founding president of Engineers Without Borders. Still another gathering occurred in November, 2019 in Albuquerque, with a webcast for remote attendees. The movement gathered further momentum in 2019 with conferences in Bogotá and in The Hague. The Hague conference resulted in the formation of a Global Society of Peace Engineers, GSPE. GSPE's press release states the new organization will create a Peace Engineering degree program that universities may share; a professional organization for like-minded "entrepreneurs, government officials, investors, NGOs, students and members of the academic community"; and a formal ongoing professional education certificate. Stanford University will incubate GSPE with the aim of spinning it off as an independent organization. See: https://www.peaceinnovation.com/gspe.

Next, scientists launched a parallel effort. In 2019 Ulrich Betz, Vice President for Innovation at Merck KGaA, promulgated the Berlin-Darmstadt Science Declaration, https://www.curious2020.com/darmstadt-science-declaration/. The Declaration features the phrase (and hashtag) "Make science, not war."

3. Peace Engineering Differs from Anti-War Movements of Earlier Eras

Peace Engineering differs from earlier movements primarily in that it is positive and proactive.

Anti-war American sentiment in the Vietnam war era, for example, expressed itself in negative terms. Scientists and engineers protested against the war. Scientists and engineers refused to let their work be used for warlike purposes. Engineers did not assess the social utility of their work. Engineering schools saw little alternative to preparing grads to work in the defense industry.

In contrast, in 2020, scientists and engineers proactively invent for peace and human well-being. Engineering schools will prepare grads for social entrepreneurship and for building a "peace-industrial complex"—adding more social science and technology assessment content to the curriculum.

Wolfe [6] highlights the earlier negativity: "50 years ago, at more than 30 campuses across the United States, students and faculty debated scientists' responsibility in the Vietnam War. Some held teach-ins; some staged protests; others simply walked out of their labs for the day in quiet acts of refusal." Wolfe's article is titled, "Fifty years after MIT's memorable protest, a key question remains: *Should scientists ask for change or should they demand it?"*

Today's peace engineers would answer, "Neither. We should *create* change."

4. What is Peace Engineering?

Adherents will admit that there is as yet no clear definition. Some hold that Peace Engineering is the intersection of system engineering, technology assessment, and peace and conflict studies.

Others would draw a different Venn diagram, with Peace Engineering at the intersection of peace technology R&D (aimed at generating new ventures), holistic education (aimed at generating more effective engineering graduates), and community outreach (to highlight the potential, the achievements, and the promise of Peace Engineering).

Is Peace Engineering a discipline, a framework for educating, or a philosophy for action? This question is far from settled. All adherents agree, however, that Peace Engineering aims for inventions and innovations that enhance human welfare, ameliorate pressing global problems, reduce the prospects of war, and discourage weaponization for purposes of aggression or increased destructive capability.

The *Technological Forecasting and Social Change* Special Issue on "Peace Engineering and Innovation: A New Techno-Socio-Economic Development Framework" uses both "framework" and "discipline" in its call for papers [7]: "Peace Engineering and Innovation provides a new framework for viewing and shaping emerging technologies and innovations. It is an integrative discipline that creates technologies, processes, and approaches that have the potential to increase peace in the world…." (*Technological Forecasting & Social Change* was the first journal to publish a paper on Responsible Research and Innovation [2], and is the first to offer a special issue on Peace Engineering).

Peace engineers seek new, financially viable ways to positively serve people and the planet. Their emphasis on reducing prospects of war, while not Peace Engineering's sole focus, recognizes the terrible toll that war takes on people and planet.

5. Why Peace Engineering Is Important

People of compassion abhor the tragic human cost of war. In particular, New Mexico engineering Associate Dean Ramiro Jordan, whose passion drives the Peace Engineering Working Group, grew up in a war-torn country. His aversion to violence is visceral as well as intellectual. As Jordan notes, US federal laboratories in New Mexico gave birth to atomic weapons. It is fitting that the State of New Mexico will lead the movement for Peace Engineering.

Nuclear war could end human civilization. Humanity's other most threatening problems are similarly global in nature and impact. They include the ecological crisis; the known probability of pandemic, one of which has now become reality; and the possibly malignant nature of artificial intelligence. The latter problems require international cooperation; we cannot allow the distractions of war or even excessive competition. Scientists and government are coming to understand that resolving the questions of environment, disease, and A.I. requires quick action. Any armed conflict diverts attention and investment, carrying the risk that we attend too late to other existential threats.

Then too, as the Conflict and Environment Observatory has noted (https://ceobs.org/topics/military-and-the-environment/), "during peacekeeping operations or during wartime, the environmental bootprint of military operations remains considerable. "We may smugly drive electric cars, and even reduce the overall carbon footprints of civilian production, distribution and consumption, but the world's militaries remain the world's worst polluters [8]. Addressing the root causes of war, Peace Engineering will ultimately allow military operations to contract, thus aiding the environment.

6. Challenges for Peace Engineering

Peace Engineering's most glaring challenge is the fact that almost anything can be weaponized. Furthermore, it is the job of someone in every government to monitor all innovations—regardless of the inventors' peaceful intentions—in order to determine how the new machines or algorithms can be weaponized. This dynamic is grist not only for normal politics but for the dramatic arcs of fictional works. *The Trigger* [9] is an outstanding example, co-authored by the inventor of the

communication satellite. In this novel, an idealist's invention that disables conventional weapons is co-opted by a government that wishes only to incapacitate the weapons of other nations.

Peace engineers, therefore, will have to build entire, fast-growing civilian value chains around their innovations, so that the economics of peaceful application become quite visibly more attractive than the gains from destructive uses. Currently, the shares of defense contractors—the "military-industrial complex"—significantly outperform civilian stocks on Wall Street. Reversing this situation will not be easy.

This is especially true in light of current reversals of global free trade. Mentioning "the weaponization of trade," Lind [10] writes, "As economic nationalism rises, and as the post-Cold-War peace thaws, countries are remembering that they need to maintain strong manufacturing economies to build weapons, if the need for war arrives."

The author recalls a case in which the US National Security Agency quashed a patent for hiding a message in white noise. The patent applicant thought it wise to leave the country forever. He might have been wiser in the first instance to innocuously title the application "A novel messaging method" instead of signaling its cryptographic nature. Or he might have filed the application in another, less militaristic country to begin with. The military-industrial complex should understand that such tricks, whether on the government's part or the applicant's, causes ill will and national brain drain. Yet the peace engineer might feel obliged to engage in them.

Sun Tzu's *The Art of War* [11] is popular among corporate executives. A challenge for Peace Engineering is to influence executives to read and cite Ueshiba's *The Art of Peace* [12], instead.

7. What Is the Solution?

There are no easy solutions. Yet we do have a good understanding of the causes of war. Therefore, we should, collectively and as individuals, create technologies and products that weaken the causes of war. Quickly build the supply chains and the markets that will create a peace-industrial complex.

We should revise collegiate engineering curricula accordingly, emphasizing technology assessment [13,14], and teaming social science students with business students and engineering students in order to create engineering innovations that imply positive social impact and quickly find growing markets [15].

Students, teachers, and practitioners should join the inter-university Peace Engineering Working Group, and publish their Peace Engineering research in this and other journals.

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