Have We Met the Vision of Engineering 2020 and What is Our Vision for 2040?

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***Abstract*— In this special session, we will reflect back on the early years of the 21st century, when much had been written about the future of engineering and engineering education. There had been global calls on changing the culture of engineering in the new century. In 2004, the National Academy of Engineering published the consensus report titled, The Engineer of 2020: Visions of Engineering in the New Century. The accompanying report came out the following year, with the title, Educating the Engineer of 2020: Adapting Engineering Education to the New Century. The first one envisioned the future, and the second one explained how we prepare for that future. As we entered the year 2020, it is now time to look back, review, and reflect: Have we met the vision of engineer 2020? This session will promote thought-provoking, reflective thinking about the past and visionary thinking about the future of engineering education.**

Keywords—engineering education; vision; year 2020

I. Introduction

As we enter the year 2020, it is now time to look back, review, and reflect: Have we met the vision of engineer 2020? Or, is it time to re-visit and rethink the vision for the future, especially in these uncertain times, considering the recent dramatic change. Early 2020 presented an unimaginable global challenge that paralyzed the world with the COVID-19. The decisions in managing this issue required not simply healthcare but also managing human beliefs and behaviors.

Calls for changing engineering education have been presented at regular intervals, beginning in the U.S. with 1918 Mann Report [1]. More recent calls for change are illustrated in Figure 1. Influential reports have been released worldwide. In 2004, a consensus report was published by the National Academy of Engineering – The Engineer of 2020: Visions of Engineering in the New Century [2]. The 2004 NAE report envisioned the future and its follower, the 2005 report explained how we prepare for that future [3]. Others, such as Sheppard and colleagues (2018), have written in depth reviews that go beyond these national reports [4]. Another report by Grahams (2018) offers bold trends for future direction for the engineering education sector [5]:

- The **first anticipated trend** is a tilting of the global axis of engineering education leadership.
- The **second anticipated trend** is a move towards socially-relevant and outward-facing engineering curricula.
- The **third anticipated trend** for the sector is therefore the emergence of a new generation of leaders in engineering education that delivers integrated student-centered curricula at scale.

This session will promote thought-provoking, reflective thinking about the past and visionary thinking about the future of engineering education.

Figure 1. Visions of Engineering Education

II. Special Session Structure

This special session will be divided into four segments. The first quarter will start with a summary of the 2004 and 2005 consensus reports. Next, the audience will be invited to take a moment to remember how life was like in 2004 and 2005 and reflect on the technical, social, and political state of the U.S. in those years. Fourteen recommendations were outlined in the 2005 report [3]. These recommendations published in *Educating the Engineer of 2020* can be summarized under five categories as:

1. Funding efforts to support systematic data collection and analysis on diversity and workforce development (recommendation 14)
2. Graduate Education: Pre-engineering degrees and professional master's degrees (recommendations 1,2,11)

3. Innovations in undergraduate education emphasizing design, life-long learning, case studies (recommendations 3,4,7,8,9,10)
4. Faculty promotion based on engineering education research, professional development, and re-visiting qualifications (recommendations 5,6)
5. Supporting K-12 math, science, and engineering education and promoting public understanding of engineering (recommendations 12,13)

The second quarter will review other reports and initiatives that occurred since 2004. For example, FIE hosted several special sessions led by Shuman [6] in 2002 and Richards in 2017 and 2018 [7, 8]. Since then, there have been other, particularly global calls for reform in engineering education and the National Academies has published additional reports, leading the prominence of engineering in K-12 education.

During the third quarter of the session, the audience will be working in teams based on their role/title in 2005. These groups will be labeled as waves of engineering educators.

- 1st wave of engineering educators- Frontiers who authored/impacted these early reports.
- 2nd wave of engineering educators - Those who were tenured/on the path to tenure in 2005 based on research in engineering education.
- 3rd wave of engineering educators - Those who were doing engineering education research as graduate or undergraduate students in 2005.
- 4th wave of engineering educators – Those who were K-12 or college students in 2005.

Our hope is that our audience will represent all four waves expressed above. Role playing will be encouraged if the session does not include participants representing a specific wave. We will invite the audience to develop a vision of engineering education of 2040 with a global, collaborative outlook, as we ask: What's the landscape from your vantage point? What are the strengths and affordances of engineering education today? What are the challenges and opportunities for future from your perspective? The audience will also determine 2-3 metrics for evaluating progress towards this visionary outlook. What evidence is needed to evaluate progress, how would we know? Each team will record their vision and metrics in the form of a slide. Finally, the session will conclude with a report out and an agreement to re-visit these visions in 2025, 2030, 2035, and ultimately in 2040.

III. Organizers & Facilitators

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