A Cross-Generational Call to Action to the COVID-19 Crisis – Initiative Summary

The COVID-19 crisis placed the world in extraordinary circumstances. In addition to the medical and scientific expertise that has been brought to bear on this challenge, engineers are providing not only their knowledge and skills but also systems approaches and an innovative mindset to combat the contagion and its impact.

On March 30, 2020, the National Academy of Engineering (NAE) issued a call to its Grand Challenges Scholars Program (GCSP) and Frontiers of Engineering (FOE) communities to collectively brainstorm on innovative engineering actions potentially applicable to the COVID-19 crisis and its consequences. The initiative was intended to connect the creativity of engineers of different generations: college students and recent graduates (GCSP), early- and mid-career professionals (FOE), and NAE members.

Initiative Goals

1. Develop potentially actionable ideas for the current COVID-19 and future pandemic crises.
2. Engage the GCSP and FOE communities in collaborative brainstorming and network building.
3. Foster connections and mentorship between the GCSP and FOE communities and NAE members.
4. Highlight NAE's role in providing engineering leadership and service to the nation.

Implementation

NAE developed a digital platform for the GCSP and FOE communities to collectively brainstorm on innovative engineering ideas that might help alleviate the spread and direct impacts of the virus itself or its collateral disruptions—such as impacts on the supply chain and school closures—as well as to innovate for the world after the pandemic subsided. Individuals and teams were challenged to interact and submit ideas via the *COVID-19 Call to Engineering Action* incubator website. Four key themes were identified:

- *Security:* testing centers, resource allocation, equitable dissemination of accurate information, AI, healthcare worker protection
- *Quality of Life:* healthy self-isolation practices, ways to minimize or avoid social distress
- *Health and Medicine:* medical technologies, medical supply production, apps to monitor physical and mental health, tools for the elderly
- *Sustainability and Recovery:* reusable medical materials, economic recovery, social and political recovery

Process

Step 1: Interested parties were first admitted to a virtual workspace. Three categories of participation were offered: those with "individual interest" in participating but lacking specific ideas; those with specific and promising ideas that had yet to be developed ("concept idea"), and those with specific technologies that had at least begun the development process ("complete technology"). A Technical Screening Committee (TSC) comprised of senior-level volunteer engineers [listed in Appendix A] evaluated the entries according to this classification. FOE alumni served as members this committee and also acted as both contributors and mentors. The committee was divided into specialty groups that mirrored the four themes in order to review and triage proposals. Stakeholders could also identify areas of need and offer recommendations of topics on which to focus. It was additionally possible for hackathons and other competitions managed by outside entities to participate by feeding their ideas into the incubator at this step. A total of 807 submission were received.

***Step 2*:** Teams that the TSC recommended for advancement were provided intensive training conducted by the NSF I-Corps Innovation Node Los Angeles to help strengthen their ideas, streamline and solidify their concept, and aid them in advancing to the next stage of implementation. Teams that did meet the criteria for I-Corp training were put into the mentorship program where FOE alumni or NAE members helped them to move their ideas forward.

Step 3: Following I-Corps training or mentorship, teams were selected for review by an Expert Review Committee (ERC) consisting of NAE members [listed in Appendix B]. This committee helped to advance the teams' proposals, giving advice on ways to implement innovation, and at times putting them in touch with stakeholders such as local governments, industries, and other funders in positions to act on them.

The public component of this step was a "pitch event", a webcast where invited teams gave short presentations of their ideas and received feedback from ERC members. Audience members also had an opportunity to submit comments in an ongoing chat. Three events were held, on June 26, August 6, and December 11, 2020 [described in Appendix C]. All were moderated by Dr. Alice Liu, Director of the Viterbi Startup Garage at the USC Viterbi School of Engineering. Videos of the pitches and feedback were subsequently posted to the event page websites for future reference.

Outcome

The COVID-19 Call to Action was brought to a close in early 2021. Seven of the 15 teams that participated in a pitch event responded to a February 2021 request for a status update on their work. Among these, four had applied for and one had already received funding; others were seeking customers or collaborators, or were still in the development phase. All of the respondents indicated that their projects would benefit from funding. NAE member Jon Rubinstein donated $25K that could be used as seed grants for work related to the initiative and, as of Spring 2021, discussions were underway on how this might be distributed.

Project Management

Project Director: Randy Atkins (NAE Staff) and David A. Butler (NAE Staff)

Communications: Brandon Green (NAE staff)

FOE staff officer: Janet Hunziker (NAE staff)

Administrative support: Sherri Hunter (NAE staff)

NAE staff were also responsible for

- Fundraising
- Internal operations and administration, including organizing participation
- Coordination and partnership with the I-Corps training teams

Executive Committee (EC): An Executive Committee provided advice, direction, and considerable effort in support of the COVID-19 Call to Action. The volunteer members of this committee were Professor Yannis Yortsos (NAE, University of Southern California), Andrew Mang (GSCP participant), and Rachel Lau (GCSP participant). They were supplemented and supported by NAE staff.

Volunteers: In addition to the TSC, ERC, and EC members, the program greatly benefited from the work of GCSP student volunteers who served as initial screeners before the TSC as well as helping to support in every stage of the incubator process.

Conclusion

The COVID-19 crisis separates us physically, but it also compels us to work together to address its societal and economic challenges, ranging from production of vaccines to efforts to ensure that all our children have access to the technology needed to continue learning outside a structured environment. These are challenges ideally suited for engineers, and the first step is bringing together people with great ideas. This project provided a mechanism for that to happen. Through this initiative, a cross-generational framework has been created to help address future challenges which can be utilized when the need arises.

NAE Response to COVID-19 Call to Action Technical Screening Committee

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NAE Response to COVID-19 Call to Action Concept Pitch Events

June 26, 2020

Wearable Sensors for Remote Monitoring of COVID-19 Patients (Team Lead: Sheng Xu, University of California, San Diego)**:** *A first-of-its-kind wearable bandage incorporating a wireless sensor that could monitor five vital signs pertinent to the COVID-19 patients, enabling better isolation of patients and enhanced data collection.*

Handless Door Opener (Team Lead: Logan Kocka, Miami University of Ohio): *An international team of students who met at a Global Grand Challenges Summit in London, will present a design for a foot-operated door opener compatible with lever and knob latch handles.*

More efficient and effective COVID-19 vaccine delivery (Team Lead: Burak O Ozdoganlar, Carnegie Mellon University): *An innovation to administer considerably smaller doses of vaccine using needleless delivery directly into the skin, where immunological response is enhanced, through a mechanism that could allow immunization of more people per batch.*

At-Home Diagnostics for COVID-19 Infection and Immunity (Team Lead: Jin Kim Montclare, New York University): *A single paper-based test, like a pregnancy-test, would show an instant color change if either you are currently or have previously been infected with the novel coronavirus.*

Self-disinfecting N-95 masks (Team Lead: Melissa Banks, University of Southern California): *Traditional masks trap COVID19 in filter fibers sitting directly atop the nose and mouth. As the virus accumulates, infection becomes increasingly likely. The proposed method would integrate a copper coating that is able to destroy both viral and bacterial pathogens without the need for manual disinfection.*

August 6, 2020

Remote Wearable Monitoring System for COVID-19 Patients (Team Lead: Lili Deligianni, Columbia University): *A remote wearable monitoring system that measures stress and inflammatory responses providing insights about the response of the immune system. Healthcare providers will be able to track disease progression and understand the point when the immune response becomes overactive.*

Combating Misinformation on COVID-19 (Team Lead: Yan Liu, University of Southern California): ***An*** *information dashboard designed to combat misinformation by identifying and monitoring unreliable, misleading, and malicious information around COVID-19 on social media platforms. The dashboard provides visibility into social media discussions surrounding COVID-19.*

Early COVID-19 Detection and Neurovascular Recovery in Pre-Symptomatic and Asymptomatic Individuals (Team Lead: Amina Qutub, University of Texas, San Antonio): *An integrated AI-based system linking sensors and imaging scans to detect COVID-19 non-invasively in pre-symptomatic and asymptomatic individuals and to track neurovascular recovery following infection.*

Wearable Patch for Remote Monitoring of COVID-19 Patients (Team Lead: Emily Cho, University of Maryland)**:** *A wearable patch that allows for remote patient monitoring using real-time data transmission of health vitals. This team was a finalist in the 2019 Global Grand Challenges Summit business competition and includes student members from the U.S., U.K., and China.*

Self-disinfecting Mask (Team Lead: Xing Xie, Georgia Institute of Technology): *Wearing an effective mask for COVID-19 patients and their health-care persons are necessary to prevent the transmission. Most of available masks are designed for short-term uses, and it is difficult for the users to know when the masks need to be replaced. This team aims to develop a low-cost mask that can not only collect potential airborne pathogens but also inactivate them.*

December 11, 2020

Health Documentation Solution for the World's Most Vulnerable (Team Leads: Lauren Yen, Laura Roed, University of Southern California): *A modular, cloud-based health documentation solution for the world's most vulnerable patient groups and their providers. This system uses advanced user-friendly technologies to collect reliable medical data and empower patients, physicians, and healthcare administrators.*A

Reusable Filterless Respirators through Ultraviolet Germicidal Irradiation (Team Lead: Nicholas Gans, University of Texas, Arlington): *A filterless respirator that uses ultraviolet light to inactivate viruses and other microorganisms in moving air without the need for N95 filters. This mask can be repeatedly used and for long periods of time by health care providers, essential workers, and at-risk persons, reducing strains on medical equipment and decreasing risk of transmission.*

Securing the Physical Domain During the Covid-19 Pandemic-Innovation Bank (Team Lead; Daniel R. Robles, PE, CoEngineers, PLLC): *A widely distributed challenge such as COVID-19 requires the STEM professions to decentralize widely in its response. The purpose of The Innovation Bank is to deliver the right knowledge to the right place at the right time with speed, accuracy, scale, and interdisciplinary collaboration.*

COVID-19 Transmission Reduction Through Saliva-Modifying Products (Team Lead: Michael Kinzel, University of Central Florida): *It is now understood that Covid-19 is spread through airborne pathways involving droplets and aerosol which are blocked through conventional approaches of facemasks. Our product aims to modify the droplet and aerosol formation using food-grade products that both reduce saliva content and make it thicker; this overall product enables methods to enhance the effectiveness of a mask or safely reduce their need.*

Digital News Validation Tool (Team lead: Aman Singal, Indian Institute of Technology Dharwad): *A software solution in the form of a mobile and web-based app which will be used to validate news and display true and relevant information via generated video, animations, images and links.*