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Work-in-Progress: Nurturing Innovation in Agriculture, Forestry, and Fishing Occupational Safety

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This work-in-progress submission describes activities to nurture an innovation ecosystem to improve agriculture, forestry, and fishing (AgFF) occupational safety. This ecosystem will be supported through a research-to-practice (r2p) incubator project entitled "IdeasThatWork" that aims to remove health and safety hazards in AgFF, industries that historically have significantly higher than average occupational injury [1] and fatality rates [2], as compared to other industries. This paper describes (1) a data gathering effort to identify best practices utilized in existing technology incubators, (2) the recruitment of an expert advisory board representing the range of expertise needed in the AgFF occupational safety innovation sphere, (3) the development and release of the initial request for applications under this incubator, (4) activities in support of the first recipient of seed funding under this effort, (5) nuances associated with the AgFF safety domain that differentiate this effort from traditional technology incubators, and (6) next steps for the IdeasThatWork Incubator.

Through a transdisciplinary lens at the interface of manufacturing and engineering, epidemiology, and entrepreneurship, we seek to improve occupational safety outcomes for this vital community of AgFF workers. With an incubator-based approach, we are encouraging innovation, be it from those with science, technology, or engineering educational backgrounds, or those whose inventive skills are acquired through industry expertise. With this work-in-progress submission, we seek to share progress to date in this pilot effort and invite feedback as we refine a blueprint for this incubator model going forward.

Best Practices

The literature is rich with publications summarizing incubator design. In the 1990s, Mian published an overview of University-sponsored technology incubators [3] along with assessment of the value-addition of University-sponsored incubators [4]. Within ASEE specifically, numerous papers describe incubator programming to nurture entrepreneurs coupled to the academic environment. A brief, but non-comprehensive list includes [5], [6], [7], [8], [9], [10], [11], [12], [13], [14], [15]. This has been amplified in recent years with the KEEN network's support of instructional design fostering the entrepreneurial mindset [16]. The NSF I-Corps program has played a significant role in transitioning academic research to market [17], and we observe many academic incubators using as a metric of success, participant competitiveness in federally funded Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) submissions [7], [8], [10], [12]. Furthermore, agricultural incubators are prevalent, fostering creative agricultural production technologies. Relatively few incubation activities, however, focus specifically on safety, which has unique challenges to entrepreneurship and profitability.

In designing an incubator to nurture AgFF occupational safety, the research team conducted a review of published literature and existing incubator websites to identify best practices; the effort is described in Milkovich *et al* [18]. That work evaluated 11 papers and 19 incubators, accelerators, government, and venture capital programs via their websites. From the web assessment activity a consistent finding was the presence of training and networking activities for incubator participants. However, the number of AgFF safety inventions touted in publications or by incubators, even those incubators committed to agriculture specifically, were limited. Measures of success in incubator

programs are often viewed via corporate profitability, whereas AgFF safety inventions most commonly result in indirect financial savings through injury prevention and lives saved [19].

This finding was further supported by interviews conducted by the project team. To date, interviews have been conducted with 7 individuals to provide further insight; three from the entrepreneur perspective, three from the nurturer (e.g., incubator, educator, or funder) perspective, and one insurer. The entrepreneurs generally displayed a knack for innovation: two of three pointed toward participating in competitions or programing that required generating a high volume of ideas, and the third demonstrated an ability to pivot from intended market to actual market for their invention. Two of three entrepreneurs interviewed also pointed toward domain-specific knowledge being critical, with one whose work is in commercial fishing coming from a multi-generational fishing family, and the other noting the importance of making connections with partners with industry insight. These themes were reinforced by the nurturers interviewed, two out of three of whom commented on making investments in individuals. The insurer interviewed reinforced the importance of indirect financial savings, noting the significant costs associated with liability (e.g., automobile accidents and equipment fires).

It is with this foundation of knowledge that we seek to build an incubator model that nurtures success in AgFF safety. The current status and future plans for the AgFF r2p incubator are described in the following sections.

Advisory Board

Prior to launching the r2p incubator, the project team recognized a critical need to recruit an expert advisory board to guide incubator activities as well as serve as mentors to seed grant recipients. Recruitment of advisory board members was deliberate to ensure representation amongst the AgFF domains, and to provide a knowledge base in the broad range of skills needed to be successful for product development and launch. One interview subject, as described in the prior section, is also a member of the incubator advisory board. A list of current advisory board members, with their relevant expertise, is provided in Table 1.

Name	**Organization**	**Key knowledge domains**
Jessica Bunting	CPWR – National OSH Center for Construction	r2p in occupational safety
Ted Clark	Acadia Insurance	Insurance
Lili Colby	Mustang Survival	Commercial fishing safety and entrepreneurship
Carrie Edsall	Black Willow Pond Farm	Agriculture
Charles Hall	Retired	Industrial design and entrepreneurship
Insoo Kim	University of Connecticut	Wearable technology for health monitoring
Maria Kontaridis	Masonic Medical Research Institute	Biomedical research
Tony Lane II	Treeline Inc.	Forestry
Andre Marshall	George Mason University	Entrepreneurship; NSF I-Corps
Rachel Moore Weller	Self-employed	Science writing; venture capital

Donald Peterson	Northern Illinois University	Biomedical engineering; codes and standards
Christopher Reid	Boeing	Wearable technology; human factors; codes and standards
Ken Rother	Cornell eLab	Entrepreneurship; NSF I-Corps
Mark Searle	Innovation Acceleration Group	Entrepreneurship and innovation
Jenn Smith	Center for Regional Economic Advancement, Cornell University	Food and agriculture start-ups
Tom St. Claire	Self-employed	Business development and entrepreneurship; fishing; agriculture
Adam Whiting	FisherBroyles	Patent law

Table 1: r2p Incubator Advisory Board Members

Initial Request for Proposals (RFP)

In the fall of 2023, the r2p incubator launched its first request for proposals, offering $10,000/year over two years to support people with big ideas for reducing health and safety hazards in agriculture, forestry, and/or fishing. The guiding principle behind the RFP design was inclusivity. As such, prompts for submission were relatively brief, and it was explicitly stated that submissions from farmers, loggers, commercial fishermen, researchers, and industry professionals were all welcomed. Specifically, the RFP asked:

- What is your name?
- Tell us about yourself. (200 words maximum)
- Industry/Sector [pull down menu with three options: agriculture, forestry, and commercial fishing]
- What health or safety problem does your idea address? (200 words maximum)
- Tell us about your idea. (500 words maximum)
- Why do you think your idea will work? (200 words maximum)
- Have you talked to potential users of your solution? [pull down menu with yes/no]
    - If yes: What was the feedback, and who did you talk with? (200 words maximum)
- What help do you think you need from the Northeast Center? (200 words maximum)

The RFP was released in both English and Spanish, and as an alternative to written submission, a 3-5 minute video submission addressing the stated questions was also permitted. The RFP was shared via email to the Northeast Center for Occupational Health and Safety listserv and other industry/academic partners that would be interested in participating, including more than 360 organizations in academia and industry. In response to this RFP, 19 submissions were received, seven of which were focused on the agricultural sector, seven in fishing, and two were focused on logging safety. Three were focused on all three AgFF sectors. The r2p project team narrowed the original list down to two applicants and the advisory board selected from among these two proposals. Those two entrepreneurs were invited to present their idea to the incubator advisory board, which made the final selection for seed funding.

Nurturing Seed Grant Recipient

The incubator used a combination of structure and custom supports to nurture the initial seed grant recipient's project to develop an ergonomic sea scallop knife handle. Shortly after selection, the

recipient was encouraged to participate in a regional I-Corps program facilitated by a member of the advisory board. The I-Corps program provided the seed grant recipient with baseline knowledge of entrepreneurship and customer discovery. From there, the incubator team have met nominally biweekly with the recipient to identify needed supports such as advice on rapid prototyping, guidance on developing a human subjects test protocol and navigating the institutional review board (IRB) process for human subjects research, and facilitated introductions to experts in human factors testing and assessing financial viability. The incubator's IRB has served as the IRB of record for the recipient's human subjects testing. In addition to the initial seed grant, the incubator has also provided funding to a biomechanics expert to support the use of surface electromyography sensors to better determine if the proposed intervention improves health and safety aboard sea scallop vessels. The seed grant recipient also provides quarterly updates to the incubator's advisory board, which offers opportunities for feedback leveraging the advisory board members' unique expertise.

AgFF Safety Entrepreneurship Considerations

It is worth highlighting that many of the workers in the population this incubator seeks to serve are operating as entrepreneurs. That is to say, within the AgFF sector, those running family farms, operating commercial fishing boats, or running a sawmill are already well-acquainted with the key aspects of launching a small business, from marketing to accounting to building customer relationships. Amongst AgFF safety interventions specifically, a survey of literature and incubators identified relatively few that are successful under typical commercialization metrics [18]. While these are high-risk professions, these industries also work on narrow profit margins [20] or are subject to profit unpredictability [21]; therefore it is challenging to attract widespread adoption of safety interventions, short of significant fiscal backing for the intervention or regulatory input. A key aspect of the coaching this incubator seeks to provide is supporting entrepreneurs on finding mechanisms to reach profitability, whether it is through dual-use of their invention or seeking ways to monetize liability reduction.

Going Forward

At the time of this writing, four significant endeavors in support of the incubator are ongoing. First, reflection upon the inaugural year of the r2p incubator led to the realization that much of the incubator's target demographic do not relate to the phrase "research to practice." As such, an effort was undertaken to rebrand the incubator as the "IdeasThatWork Incubator" with imagery that reflects the incubator's AgFF mission. Second, the incubator team is preparing to launch the second request for proposals to identify a second entrepreneur for investment and nurturing. Based on feedback from the incubator advisory board on the initial solicitation, and in recognition of the number of proposals received in round one for training programs that were outside the scope of this incubator, the team considered implementing a pre-proposal or letter of intent stage to the proposal structure. A two-phase proposal structure could permit an initial and rapid feedback mechanism, however it was determined that a two-phase process might add to load for potential entrepreneurs, and as such, the team is moving forward with a concise set of asks for a single round process. Third, in an effort to reach entrepreneurs beyond those funded by the incubator, the project team is working with the incubator advisory board to develop an asynchronous, online curriculum with planned focus areas on: nurturing occupational safety entrepreneurship, customer discovery, starting a business, finding investors, intellectual property and technology transfer, and connecting with industry and trade organizations. The curriculum is being intentionally designed to emphasize

those aspects that are unique to agriculture, forestry, and fishing occupational safety interventions as discussed above. And finally, in an effort to spread word of this opportunity outside of traditional incubation networks, the team has been working to engage with potential entrepreneurs in a wide range of settings. In addition to presentation at conferences focused on AgFF safety [22], [23], the incubator team has also spoken about this initiative on a podcast [24],[25], and sought to engage with stakeholder groups such as logging contractor companies and trade association events, for example, the Pacific Marine Expo in Seattle and the Northeast Logger Association Expo in Vermont. As this effort constitutes work-in-progress, assessment of the incubator performance is ongoing.

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