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BRIEF REPORT

Navigating the "Valley of Death": A Brief Report on How Incubators Can Nurture Transition of Research to Practice to Benefit Worker Wellbeing

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ABSTRACT
Incubator and accelerator programs are important tools for innovators looking to take their ideas to scale. Unfortunately for agriculture, forestry, and fishing (AgFF) populations who are at high risk for occupational injuries and fatalities, few safety and health solutions have graduated from these programs. This brief report explores what it will take to develop an incubator process specific to AgFF safety and health innovations and ensure that those innovations are accessible to and adopted by workers.

KEYWORDS
Customer discovery; incubator; research to practice (r2p)

Background

Institutionalizing occupational safety and health (OSH) innovations often challenges researchers and practitioners, particularly when working with agriculture, forestry, and fishing (AgFF) workers. These three industries face many unique challenges, including remote worksites, long hours, frequent multitasking, variable weather conditions, and low profit margins, among others.[1–5] Because of these challenges, it can be difficult for employers and workers in these industries to prioritize OSH, particularly when the situation is not immediately life-threatening.[1] While OSH innovations can be difficult to put into practice at a large scale, they are, without question, needed. AgFF workers face disproportionally high rates of injuries (5.3 per 100 workers[6]) and fatalities (19.5 per 100,000 workers[7]) compared to the general working population (2.7 injuries per 100 workers[8] and 3.6 fatalities per 100,000 workers[9]). These injuries stem from a variety of sources including machinery, animal handling, chemical exposures, and weather,[10,11] making prevention efforts even more challenging. Beyond health and safety outcomes, these injuries and fatalities can have broader consequences, including lost productivity, increased financial burden, and business closures.[12]

Though much work has been done to develop innovative solutions to OSH issues among AgFF workers, research has demonstrated that few solutions are ever widely adopted or institutionalized.[13,14] Even those innovations that are can take, on average, 17 years to reach this stage – a widely accepted estimate based on past implementation science efforts.[14] Further, these findings reflect only innovations that are developed in research settings or other manufacturing settings, neglecting many innovative OSH tools developed *in situ* by AgFF workers. These innovations are unlikely to spread far, if at all, as workers within these industries often lack the resources, knowledge, and time needed to evaluate, scale up production, market, and disseminate products, or navigate the legal aspects of such efforts.

Incubators and acceleration programs have been designed to aid entrepreneurs in many business sectors with launching new products or innovations. For instance, the National Science Foundation's Innovation Corps (I-Corps) is a 7-week program designed to "[accelerate] the economic and societal benefits of National Science Foundation (NSF)-funded and other

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basic research projects that are ready to move toward commercialization.[15]" Throughout the process, participants work toward better understanding target consumer needs so that they may effectively market and distribute their solutions.[15] Other incubator programs additionally offer support and mentorship in areas such as product testing, applying for patents, large scale production, distribution, and marketing. While these programs have proven to be quite useful in their goals, OSH innovations for AgFF worksites are rarely found within their portfolios, with incubators often featuring more profitable innovations than those in the OSH domain.

In this brief report, we will discuss a literature review and web search exercise conducted to inform the development of an incubator specifically targeted at OSH innovations for AgFF populations. As a first step in designing the incubator, the study team assessed peer-reviewed literature and websites for existing incubators and accelerators to identify key components of successful research to practice (r2p) efforts.

Methods

Briefly, the literature review replicated a 2017 study of r2p initiatives by Tinc et al,[16] focusing specifically on manuscripts published between 2016 and March 31, 2023. Five databases (PubMed, Scopus, Web of Science, PsychInfo, and ProQuest Dissertations) were searched for studies pertaining to r2p in AgFF safety and health. The specific keywords and inclusion-exclusion criteria used are identical to those presented in the prior study.[16]

R2p examples included in the analysis focused on OSH for AgFF populations, as they are defined by the North American Industry Classification System (NAICS). Though important to the well-being of AgFF workers, education-only initiatives were excluded from this study, as prior research has documented that AgFF workers often face more significant barriers such as cost, access to technologies, or the feasibility of implementing particular technologies when it comes to the adoption of OSH innovations.[17]

Web searching activities were designed around existing incubators, accelerator programs, venture capital, and governmental programs, including those with a specific focus on AgFF innovations. Going forward we use the term "incubator" to refer to all four forms of support. Incubators searched included: The Yield Lab Institute and The Yield Lab Latin America, SproutX, Sparklabs Cultiv8, RootCamp, Cornell University College of Agriculture and Life Sciences, Techstars, Alaska Fisheries Development Foundation, Nebraska Combine, NSF I-Corps, Capital Factory, Rockstart, Urban Future Lab, Innovation Incubator, AG Launch365, Le Camp, Blueprint Health, the Agricultural Incubator Foundation, and Launch Academy. There are several important nuances to gathering this data worth noting. Specifically, many incubators include multiple programs. We sought to include that program or family of programs which appeared to be the culmination of the incubator's activities or most closely related to AgFF OSH. Numerous incubators offer multiple forms of support, ranging from cash investment to competition opportunities to access to resources (cloud computing credits, land, laboratories, etc.). In our assessment we attempt to differentiate cash versus in-kind support based on publicly available information. Some incubators, largely those that are backed via venture capital, require renumeration in the form of equity in the company whereas other incubators charge for access to resources. The degree of transparency in presentation of these costs online varies significantly, introducing some uncertainty into our findings. In summary, the key limitation of this assessment is the ability to parse publicly available website data into a common framework.

Results and discussion

In total, 182 unique articles were identified via the literature search; of these just 11 publications pertaining to 7 innovations met the inclusion criteria. The web search activity identified two success stories related to AgFF OSH innovations; notably both involved robotic solutions that improve safety and in parallel reduce workforce effort. Table 1 provides a brief description of each included innovation and the relevant citation(s) or weblink.

Though the aim of this study was to understand what factors are necessary to develop a successful incubator for AgFF OSH solutions, this proved

Table 1. Innovations identified via the literature review and web searching activities.

Innovation name	Innovation or study description	Relevant citations or weblinks
Scoping Review		
Unnamed	This publications describes the results of a survey to identify barriers to implementing OSH innovations on farms.	Bailey J, Dutton T, Payne K, Wilson R, Brew BK. Farm Safety Practices and Farm Size in New South Wales. *Journal of Agromedicine*. 2017;22(3):229–234.
Unnamed	This study describes an effort to distribute reflective marking kits for farm implements to farmers who complete a survey about lighting and roadway safety.	Gibbs JL, Faust K, Cheyney M, Anthony TR, Ramirez M. Distributing best practices for lighting and marking: Translating research regarding farm equipment signage into practice. Paper presented at: 2017 ASABE Annual International Meeting2017.
Safety, Health, and Welfare at Work Legislation	This study describes the use of a Risk Assessment Document and Code of Compliance to help farmers comply with OSH legislation.	McNamara J, Griffin P, Kinsella J, Phelan J. Health and Safety Adoption from Use of a Risk Assessment Document on Irish Farms. *J Agromedicine*. 2017;22(4):384–394.
Fishermen First Aid and Safety Training	Fishermen First Aid and Safety training adapts Wilderness First Response programs to address the unique needs of commercial fishermen.	Miner T, Kincl LD, Bovbjerg VE, Vaughan A, Jacobson K. Emergency Medical Training for the Commercial Fishing Industry: An Expanded Role for Wilderness Medicine. *Wilderness & Environmental Medicine*. 2019;30(3):281–286.
Certified Safe Farm	Certified Safe Farm provides farmer education and resources pertaining to a range of health and safety topics along with wellness screenings.	Storm JF, LePrevost CE, Tutor-Marcom R, Cope WG. Adapting Certified Safe Farm to North Carolina Agriculture: An Implementation Study. *Journal of Agromedicine*. 2016;21(3):269–283. Storm JF, LePrevost CE, Arellano C, Cope WG. Certified Safe Farm Implementation in North Carolina: Hazards, Safety Improvements, and Economic Incentives. *Journal of Agromedicine*. 2018;23(4):381–392.
National ROPS Rebate Program	The National ROPS Rebate Program provides technical assistance and funding for farmers to install Rollover Protective Systems (ROPS) on their tractors. ROPS are 99% effective in preventing death and serious injury in the event of a tractor overturn.	Tinc PJ, Jenkins P, Sorensen JA, Weinehall L, Gadomski A, Lindvall K. Key factors for successful implementation of the National Rollover Protection Structure Rebate Program: A correlation analysis using the consolidated framework for implementation research. *Scandinavian Journal of Work, Environment & Health*. 2019;46(1):85–95. Tinc PJ, Sorensen JA, Weinehall L, Lindvall K. An exploration of rollover protective structures (ROPS) rebate program media coverage: strategies for implementation and sustainment. *BMC Public Health*. 2019;19(1):1257. Tinc PJ. *Raising the (roll) bar: exploring barriers and facilitators to research translation in US public health*, Umea Universitet; 2019. Tinc PJ, Sorensen JA, Lindvall K. Stakeholder Experiences Implementing a National ROPS Rebate Program: A Grounded Theory Situational Analysis. *SAGE Open*. 2020;10(2).
Several; some unnamed	This conference paper provides an overview of best practices for implementing OSH innovations in AgFF settings using several specific and non-specific examples.	Wickman A. Best Practices in Engagement and Research to Practice. Vol 26: Taylor & Francis; 2021:73–74.
Web Search		
Grain Weevil	The Grain Weevil is a grain management robot used in grain bins. It's use allows farmers and workers to stay out of the grain bin, therefore eliminating the risk of grain entrapments.	https://www.grainweevil.com/.
Hylio	Hylio manufactures pesticide application drones. These drones remove individuals from the application area and limit pesticide drift, thereby reducing exposures and related illnesses among pesticide applicators.	https://www.hyl.io/.

challenging. Though some of the peer-reviewed studies specifically examined barriers and facilitators to scaling up innovations, these same studies neither defined success nor demonstrated widespread adoption of innovations,[18–23] making it difficult to extract key factors for success. Though true, many of the factors described fit well within existing models of implementation research, which considers aspects of the intervention, individuals involved in implementation, inner and outer contexts, and the implementation process.[24]

Included incubators did provide examples of innovations that have been taken to scale and could be considered successes. Presumably, the design of the incubators that support these innovations contributed to their success; though detailed information regarding these trajectories was beyond the

scope of this work. Table 2 provides a summary of key characteristics of the 19 incubators reviewed. While incubator duration, financial supports, and renumeration vary, the most consistent finding is that nearly all offer mentorship and/or networking and some form of entrepreneurial curriculum or training opportunities.

While these searches provided limited novel information, a key finding relevant to this effort, as well as efforts of AgFF OSH researchers in general, was that solutions deemed successful via incubators tended to be financially lucrative for innovators and their champions. This is relevant, as few OSH innovations, particularly those developed for AgFF populations, will be immediately profitable, with workers and employers favoring low-cost solutions.[18,19,25] Instead, examples from the peer-reviewed literature demonstrated indirect financial savings, such as costs related to injury prevention, rather than significant profits.[20] Thus, it is necessary to harness other benefits of moving innovations to scale

Table 2. Characteristics of incubator support, based on our understanding of information found on publicly available websites. Note: financial supports listed focus on direct support and/or farm or lab access. Some incubators provide or facilitate AWS,[1] Google,[2] or other cloud computing credits.

Incubator	Duration	Financial support	Entrepreneurship curriculum or training	Mentorship or networking	Renumeration
Yield Lab Institute[3]	Unknown	$10,000 GroundBreakers grants[4] and challenges with cash awards[5]	Yes[6]	Yes[1]	None[2]
Yield Lab Latin America[7]	34 weeks[8]	$100,000 to $1mil[9]	Yes[7]	Yes	Unknown
SproutX[10]	6 months[8]	$100,000 AUD of "in-kind value"[8]	Yes[8]	Yes[8]	2% equity[8]
Sparklabs Cultiv8[11]	6 months[17]	$100,000 AUD and access to agricultural trial sites[13]	Yes[10]	Yes[10]	"Flexible investment terms" [10]
RootCamp[14]	3 month accelerator program[12]	€6000, with additional funds for pilot projects[15]	Yes[12]	Yes[12]	None[12]
Cornell Univ. College of Agriculture and Life Sciences[16]	4–8 week real-time webinars[17]	Unknown	Yes[14]	Yes[14]	Course fee based on means; range from $199–$299 for 6-week course[15]
Techstars Farm to Fork Accelerator[18]	3 months[17]	$20,000 plus optional $100,000 convertible note investment[19]	Yes[20]	Yes[17]	6% equity[17]
Alaska Fisheries Development Foundation[21]	Unknown	None[19]	Previously hosted event on commercial fishing innovation[19]	Yes[19]	Unknown
Nebraska Combine[22]	Unknown	Provides access to investors[20]	Yes[23]	Yes[20] including access to "Insights Network" of farmers in the state[24]	Unknown
NSF I-Corps[25]	7 weeks[23]	$50,000[26]	Yes[23]	Yes[23]	None[23]
Capital Factory[27]	6 months co-working[25]	Provides access to investors and VC firms[25]	Yes[25]	Yes[25]	1%[25]
Rockstart AgriFood[28]	6–12 months[27]	Up to €2 million[29]	Yes[27]	Yes[27]	€65,000 fee and Simple Agreement for Financial Equity (SAFE) [27]
Urban Future Lab ACRE Incubator[30]	2–3 years[28]	Competition for $50,000[31]	"bespoke approach" [28]	Yes[28]	$450/month fee[28]
Innovation Incubator[32]	Unknown	$250,000 in technical assistance at the National Renewable Energy Laboratory (NREL)[33]	Via Channel Partners[31]	Yes[31]	None[30]
AG Launch365[34]	6 week accelerator, up to 2 years farm trials[33]	Cost share for farm trials[35]	Yes[33]	Yes[36]	$100k in future equity on $2mil valuation cap via SAFE[33]

(*Continued*)

Table 2. (Continued).

Incubator	Duration	Financial support	Entrepreneurship curriculum or training	Mentorship or networking	Renumeration
Le Camp[37]	1 week-24 months[38]	None	Yes[36]	Yes[36]	Fee based programming[36]
Blueprint Health[39]	3 months[37]	$20,000[40]	Yes[39]	Yes[39]	6% of founder shares[41]
Agricultural Incubator Foundation[42]	Monthly[41]	None, but research farmland available for lease[43]	"business development services"[40]	Yes[40]	Rental fees[41]
Launch Academy[44]	Minimum 6 months[42]	Scholarships for self-paced "Launch Your Startup" program[45]	Yes[42]	Yes[42]	Fee based programming: $200/month or 2000/year CAD[42]

Abbreviations: AWS, Amazon Web Services; AUD, Australian dollars; CAD, Canadian dollars; NSF, National Science Foundation.
[1]https://www.theyieldlabinstitute.org/about.
[2]https://www.theyieldlabinstitute.org/apply-for-a-grant.
[3]https://www.theyieldlabinstitute.org/challenges.
[4]https://www.theyieldlabinstitute.org.
[5]https://theyieldlablatam.com.
[6]https://incubatorlist.com/the-yield-lab-latin-america/.
[7]https://theyieldlablatam.com/about-us/.
[8]https://www.sproutx.com.au/accelerator/.
[9]https://www.sparklabscultiv8.com.
[10]https://www.sparklabscultiv8.com/programs.
[11]https://www.linkedin.com/company/sparklabs-cultiv8/.
[12]https://www.root.camp/early-stage-startups.
[13]https://msmeafricaonline.com/call-for-applications-root-camp-acceleration-program-2023grant-up-to-e-6000/.
[14]https://smallfarms.cornell.edu/projects/.
[15]https://smallfarms.cornell.edu/online-courses/#faq.
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[25]https://www.capitalfactory.com/accelerator/.
[26]https://rockstart.com/agrifood/.
[27]https://rockstart.com/faq/.
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[31]https://in2ecosystem.com/about/.
[32]https://aglaunch.com.
[33]https://aglaunch2024.flywheelsites.com/aglaunch-365/.
[34]https://aglaunch2024.flywheelsites.com/mentorship/.
[35]https://lecampquebec.com/en/.
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[39]https://www.blueprinthealth.org/is-it-worth-6/.
[40]https://www.agincubator.org.
[41]https://www.agincubator.org/aif-rescources.
[42]https://www.launchacademy.ca/launchpad/.
[43]https://launch.launchacademy.ca.
[44]https://aws.amazon.com/startups.
[45]https://startup.google.com/cloud/.

when designing safety innovations or an AgFF OSH-specific incubator.

However, this begs the questions; what are those alternate benefits, how do we learn about them, and how do we use them to our advantage to take AgFF OSH solutions to scale? We note anecdotal feedback from our target population that innovations that reduce regulatory burden, insurance

costs, work effort, or task time are opportunities for innovators.

As prior studies have suggested, planning for effective r2p in the earliest stages of innovation development is imperative for developing solutions that AgFF workers want and can access.[16,26] This includes understanding the perceived benefits of those innovations, as well as what barriers to adoption need to be overcome. As such, for those innovators without research backgrounds, a key component of this incubator or future efforts should be training in this area, such as through the I-Corps Customer Discovery course.[15] In addition to engaging innovators in the I-Corps Customer Discovery course, this incubator will connect innovators with diverse professionals who can help them navigate identified r2p barriers. Supporting this incubator are 17 advisory board members with expertise in a range of fields; for example, manufacturing, patent development, and marketing.

Conclusions

As researchers working within AgFF OSH, it is our responsibility to ensure that workers have access to and adopt the innovations that we dedicate our careers and resources to developing. Similarly, with our strong connections to multi-sector partners, we are ideally suited to help innovators from within the workforce, and who have the greatest knowledge of it, bring their ideas to fruition. As in many fields, this process has thus far been slow and resulted in relatively few adoption success stories. The exploratory searches described here aims to identify ways to make this process easier. To further probe for commercialization potential of safety innovations, one must track the innovations through to implementation to identify the "how" as well as the degree of impact on AgFF OSH, a task that was not possible within this particular review. Additionally, it may be of value to conduct a similar review of patents focused on AgFF OSH. This article provides an initial exploration of the factors that may improve the journey from idea conceptualization, to execution and worker adoption. However, there is much we don't know about successful AgFF OSH r2p initiatives, and we invite others who are interested in this work to join us in improving our understanding of what it takes to get research into practice.

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