



# From Research to Market:

Development of a Transition Process to Integrate Sustainable Scaling Methodologies into Education Innovation Research Design and Development

June 2021

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## Acknowledgments

We wish to thank several individuals who contributed to the completion of this report. First, we are grateful to the Expert Panel members who participated in interviews as part of the data collection for this study. We want to extend a special thank you to our Advisory Council members for their thoughtful input to the report: Rob Horner, Professor Emeritus at the University of Oregon and developer of school-wide positive behavior interventions and supports (PBIS); Malvika Bhagwat, Director of Outcomes and Efficacy at Owl Ventures; Melissa Dodd, Chief Technology Officer of San Francisco Unified School District; and Tim Hudson, Chief Learning Officer, Dreambox. Without their efforts, this report would not have been possible, and we deeply appreciate their assistance.

We are also grateful for the guidance and support from leadership in the Institute of Education Sciences (IES), U.S. Department of Education. In particular, we thank Elizabeth Albro, Commissioner, National Center for Education Research; Joan McLaughlin, Commissioner, National Center for Special Education Research; Anne Ricciuti, Deputy Director for Science; Mark Schneider, Director of IES; and Matt Soldner, Commissioner, National Center for Education Evaluation and Regional Assistance.

In addition, we thank the members of the study team for their thoughtful contributions to the study. In particular, we thank Carl Sumi, Katherine Necochea Tinco, Krystal Thomas, Phil Vahey, and Jennifer Yu.



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This work was supported by the Institute of Education Sciences, U.S. Department of Education, through R305U210001 to SRI International. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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# Executive Summary

Researchers, practitioners, and policymakers agree that schools should be using evidence-based interventions to provide high-quality education for all students, support student achievement, and close opportunity gaps. However, even when innovations have rigorous evidence of impact, they often are not widely adopted by the field, or their use is not sustained. SRI International's Invent-Apply-Transition (I-A-T) framework suggests critical steps and tasks for developing, applying, and transitioning innovations to market or the field that may not be receiving sufficient attention from education researchers. The goal of this project was to modify SRI International's existing I-A-T framework for scaling research to practice so that it can better serve researchers in the education field.

This report first introduces SRI's I-A-T framework and how it has been modified to fit educational contexts. We then present feedback on the framework from interviews with an Advisory Council and Expert Panel members and our recommendations for next steps based on that feedback. We also introduce the concept of an Embedded Entrepreneur Pilot Program, which is a model for bringing in additional personnel at different stages of innovation development to provide support to researchers for scaling activities in the I-A-T framework. As part of the Embedded Entrepreneur Pilot Program, we describe the use of a Selection Tool for identifying IES grantees who could benefit from participating in an Embedded Entrepreneur program. Appendix A presents a more detailed description of the modified I-A-T framework and feedback gathered from interviews we conducted with experts in the field who have successfully scaled educational innovations. Appendix B provides an example request for proposals for an Embedded Entrepreneur program. Finally, Appendix C includes a summary of our initial scan of the literature about scaling new education innovations.

In brief, our initial findings suggest that three key strategic factors should be considered: (1) the feasibility/usability of the innovation (the "Convenience" component of the Performance, Reliability, Convenience, Cost [PRCC] approach), and how it would be incorporated into the operating environment of the school and district; (2) an understanding of the scope of the innovation (i.e., whether it is a product or a feature); and (3) early identification of commercialization strategy that is aligned with the scope of the innovation.

Successful implementation of the above would require a number of tactical steps requiring deeper exploration. These steps would likely include some or all of the following features: modifying the Request for Applications (RFAs) to incorporate a feasibility/usability assessment; providing tools and guidance on feasibility/usability analysis; and incorporating an Embedded Entrepreneur program or a set of workshops and hands-on coaching to help researchers align their research for successful transition.

# Review of the I-A-T Framework

## Background

IES has invested time and resources to develop evidence-based innovations with the goal of realizing transformative change in education. However, this effort has highlighted a research-to-practice gap: Many promising evidence-based innovations have failed to be scaled up or sustained. To address this challenge, SRI has hypothesized that applying transition-focused methodologies at multiple points in the research development cycle could potentially mitigate failure points often encountered during scaling of an innovation. SRI's I-A-T framework has successfully scaled early research in areas such as robotics, healthcare, and enterprise software, leading to the creation of more than 50 companies, with over \$50B in market cap.

The I-A-T framework is founded in the concept of optimizing successful user-defined basic research, as described by Pasteur's Quadrant.<sup>1</sup> At a high level, the three-pronged business model of Invent, Apply, Transition allows SRI to fluidly facilitate collaboration, research, and implementation throughout any stage of a project, ultimately working to bring big ideas to fruition. This is an iterative model to link knowledge generation with productization.



- **Invent** is the process of ideation and spending time understanding the use-case and the need. The goal is to invent a solution concept that is likely to address an unmet need.



- **Apply** sets out to prove the solution and show potential applications. This is where advancements are made to address the problem at hand. A key element of Apply is to get to product-user fit, in which one demonstrates that the technology satisfies the need of its principal direct users. This is often done through a proof of concept.






- **Transition** is all about the route to market and getting to product-market fit, in which one demonstrates that the technology satisfies the needs of all stakeholders, and thereby those of a large or strategic segment of the market. This is a relatively well-understood methodology often used for large corporations and startups.

<sup>1</sup> Stokes, D. (1997). *Pasteur's Quadrant: Science and Technological Innovation*. Brookings Institution.

Although many frameworks exist that focus on scaling activities, SRI’s I-A-T model ensures sufficient attention to the “A” stage (Apply), introducing market requirements during the development cycle to increase the likelihood of successful transition into the field. We highlight key startup methodologies<sup>2</sup>—including developing hypotheses for product-user fit, stakeholder mapping, and product-market fit—that are often missed by researchers during the early development stages. When research teams do not follow the sequenced scaling activities in the I-A-T framework, they may skip steps or perform them too late in the development cycle. Thus, key market requirements may be missed that prevent the team from scaling their innovation.

Exhibit 1 presents an I-A-T framework that has been modified for education research. Key activities are mapped to where we envision education research and development teams will start in the model. An important note is that the stages outlined in the table form a *cyclical* rather than a linear model. The iterative process of innovation drives the repetition of tasks in subsequent stages as research and development teams learn about the needs of their users and the market. Everything is a hypothesis until there is supporting evidence to indicate the team is on the right track. Going back to previous steps and repeating key activities is to be expected.

**Exhibit 1. I-A-T Framework Scaling Activities by Solution Readiness Levels and IES Research Phases**

Solution Readiness Level (SRL)	I-A-T Scaling Activities	IES Research Phases
<b>SRL 1 Invent</b> 	Needs hypothesis Key performance indicators hypothesis Solution hypothesis (minimum viable product) Basic prototype performed Initial PRCC analysis	Exploration Innovation and Development
<b>SRL 2 Apply</b> 	Product-user fit hypothesis Champion(s) identified Stakeholder mapping Initial market and differentiation analysis Product-market fit hypothesis	Innovation and Development Efficacy and Replication Studies Effectiveness Studies
<b>SRL 3 Transition</b> 	Scaling pathway hypothesis 4 T's Pitch deck	Effectiveness Studies

Note: The customized I-A-T framework for the education field is described in detail in [“Appendix A: I-A-T Framework Applied to Education Innovations”](#) on page 16.

<sup>2</sup> Blank, S. (2013). *The Four Steps to the Epiphany: Successful Strategies for Products that Win*. K&S Ranch.

The skills related to constructing an innovation and empirically documenting the efficacy and value of the innovation are complex and challenging. Yet as IES has documented, these skills remain insufficient for large-scale implementation, even when the development process has been overwhelmingly successful. In addition to the conceptual and experimental skills needed for highly effective educational innovations, SRI proposes the importance of embedding skills that support scaling in the mix of talents needed for effectively moving through the stages of Invention, Application, and Transition. For example, skills that rigorously analyze needs hypotheses, product-user fit, stakeholder mapping, market differentiation, product market fit, and scaling pathway hypotheses are needed to support successful scaling and transition. We hypothesize that educational researchers will benefit from collaboration with innovators with demonstrated skills and dedicated time for scaling innovations. Embedded Entrepreneurs are experts with relevant experience who will work alongside the research and development teams and provide support in the activities outlined in the I-A-T framework. We further hypothesize that leveraging the modified I-A-T framework and pairing Embedded Entrepreneurs with research and development teams will improve sustainable scaling of effective innovations. Appendix B includes an example Request for Proposal (RFP) used by DARPA to implement an Embedded Entrepreneur Initiative.

## Methods

SRI began this project by conducting a brief literature scan to identify common themes in effective scale-up strategies employed by education researchers (Appendix C contains a summary of the literature scan). This scan helped ground the SRI team in a deeper understanding of where the gaps may be by comparing startup methodologies to existing scale-up strategies leveraged by educational researchers. Next, the SRI team presented the I-A-T model to each of the Advisory Council members to gather feedback on how to tailor the framework for educational contexts and to identify the barriers that prevent evidence-based practices from sustainably scaling.

SRI made modifications to the original I-A-T framework based on the Advisory Council's suggestions, and then recruited an Expert Panel of nine individuals to review the modified framework. This panel included researchers who have successfully scaled educational innovations, researchers who have been unable to scale their promising innovations, executives at EdTech startups, venture capitalists who primarily fund education innovations, and decision makers at the district levels. SRI introduced the framework to the panel and engaged in a semi-structured interview format. Participants responded to only those interview questions relevant to their roles and experiences. SRI synthesized the learnings from the Expert Panel interviews and made relevant modifications to the I-A-T framework. SRI also applied the learnings to formulate a Selection Tool—a rating scale that IES can use to identify grantees that would be potential candidates for a pilot Embedded Entrepreneur program.

During both the Advisory Council and Expert Panel interviews, participants responded positively to elements of the framework and proposed adjustments they felt were appropriate from their own experiences. In the subsections below we highlight key recommendations and additions that were made to the model that were consistently pointed out as critical by the experts during the development cycle. The key learnings we describe come from the experiences of the interviewees regarding their efforts to research, scale, and/or adopt evidence-based innovations. To maintain their anonymity, we do not identify informants in the findings below.

## Key Learnings Influencing the I-A-T Framework

### Learning 1: Knowing the stakeholders and meeting their needs is critical

**Understand the districts' needs, values, and priorities.** When we initially started reviewing the I-A-T framework in an educational context, we hypothesized that it would be unnecessary to provide guidance for Step 1, the determination of stakeholder needs (referred to as Needs Definition). We assumed that education researchers have a solid grasp of the needs definition and would not require additional support in this area. However, 10 out of the 13 interviewees emphasized that the needs definition is often mischaracterized, in whole or in part. Informants reported a disconnect between needs identified by researchers and needs held by administrators of local education agencies (districts).

Districts typically have focused priorities, so it is important to design innovations with those priorities in mind. In general, a solution that addresses a district's top three priorities will take precedence over one that demonstrates high levels of efficacy on lower priority needs. Education researchers do not always have a comprehensive understanding of what it is that schools are looking to purchase.

Another factor that is not always considered by education researchers is how quickly schools need to see an impact. Practitioners look for solutions that begin to show positive outcomes within three to six months. We have incorporated additional guidance for the needs definition and advised that the key performance indicators (KPIs) align with the district values and priorities.

**Know who the gatekeepers are.** The experts affirmed how critical stakeholder mapping is and provided insights on the needs of various types of stakeholders within the education system. They also noted that there are different gatekeepers for different types of innovations. Although researchers may be most interested in the feedback from teachers and students, other groups have influence in the final purchasing decisions. For example, assessments are often sold to the central office. The superintendent, a key gatekeeper at this level, has veto power over what gets purchased by the district. In contrast, decisions about what curricula to purchase are sometimes made by teacher committees. In both examples, the technology office may be a



decision-maker, as their role is to ensure that student privacy policies are in place. Researchers need to understand the priorities of all gatekeepers (students, parents, teachers, administrators, policymakers) to make sure they are meeting all the necessary requirements.

## **Learning 2: Convenience and adaptability are as important as impact and cost, if not more.**

**Prioritize convenience.** The I-A-T framework includes a concept referred to as PRCC, a mnemonic designed to remind developers to consider the value of their innovation to customers and users in terms of Performance, Reliability, Convenience, and Cost. The original model considered each of these characteristics to be of equal importance, though the relative importance of each of these factors would change during different stages of an innovation's development. However, after speaking to the Advisory Council and Expert Panel, we emphasized that convenience must be treated as a minimum requirement independent of performance, reliability, and cost. Components of convenience include ease of implementation, as well as how seamlessly the innovation fits in with the local context. Convenience is crucial for the successful scaling of an educational innovation. Educators will not buy or use an innovation that is difficult to implement. Teachers often work long hours, serve a lot of students with different needs, and are trying to meet many and often competing priorities. As a result, schools need to be pragmatic about how often they ask their teachers to adopt something new. Thus, products have a better chance of scaling if they are designed to be easy to use and fit with existing practices and workflows of the schools and districts.

**Make the innovation adaptable.** Many of the expert panelists emphasized that in addition to the innovation fitting in within the local contexts, it is important to make the innovation adaptable, as well. As different practitioners implement the innovation in different environments and under varying circumstances, it is highly likely that some aspects of the innovation will not be implemented exactly as they were intended. It is important for researchers to acknowledge that, when an innovation scales, there will likely be some loss in the fidelity of implementation. Researchers can address this issue by identifying a set of minimum core components within their innovations that must be implemented to achieve the expected outcome, while allowing other components to be adapted as needed. We hypothesize that understanding and communicating which components need to be replicated and which ones can be adapted to local context will make a meaningful difference in how schools implement the innovation and realize the intended results. Planning for implementation fidelity loss and providing more clarification on what components of an innovation can be adapted and which must be followed with high fidelity were also new components to the framework.

## **Learning 3: Attention to state policies can strengthen interest and support for adoption.**

Experts emphasized the importance of aligning innovations with state policies to drive adoption at scale. Working with political influencers to help create policies to drive adoption of an innovation at the state and federal level was strongly emphasized by many of the researchers who had successfully scaled

programs. Although we are aware that public policies have large impacts and lead to the creation of new companies—for example, new enterprise software companies have been formed around data security and privacy due to recent privacy regulations such as General Data Protection Regulation and California Consumer Privacy Act—identifying state and local policies that could help drive adoption were new additions to the framework. Evaluation of recent ecosystem changes enabled by new legislation should be considered a fundamental part of the initial market analysis.

#### **Learning 4: Different pathways should be used for scaling innovations that augment versus replace versus create a completely new solution.**

The experts noted that many of the innovations funded by IES are individual components or features rather than full solutions. One challenge mentioned by the panelists was that the criteria for grant selection encourage innovations with a narrow focus that can be isolated and measured, rather than a broad and systemic approach. We have encountered this challenge in our own research labs at SRI: Is the innovation a complete solution, or a feature? In our experience, a narrow innovation developed by a single research and development team is often insufficient to achieve broad adoption on its own because it does not provide a complete solution.

At SRI, different labs work together to tackle big problems, typically working collaboratively and bringing different expertise to bear on a single need. To address this challenge at SRI, Embedded Entrepreneurs advise on the requirements of the complete solution and work across multiple labs, combining components from disparate groups to create full solutions. SRI provides an additional funding mechanism to develop a prototype of these multiple components that can demonstrate the promise of the new solution. This prototype is often what helps secure the first round of funding for the new company.

If researchers review the market for currently used practices to assess how their innovations are different from and similar to those already used in the field, they can identify whether their innovation would augment or replace an existing activity or be a new activity for schools. Testing how well the innovation augments a well-established curriculum, assessment, or other education product could be an explicit goal of the research. To the extent that IES has visibility into discrete research efforts being conducted across different organizations, it may be positioned to identify where components from one research group can be combined with those of another to create more complete offerings. While the I-A-T framework by itself cannot solve this problem, it can highlight the need early, thereby providing valuable input into next steps.

## Other Reflections

This section captures concepts conveyed by the Expert Panel that are related to sustainable scaling but not directly tied to feedback on the framework.

### **Implementation evidence needs to be valued at least as much as research evidence.**

Teams wanting to scale their innovations should be prepared to provide evidence of successful use of the innovation in relevant contexts to district decision makers. Most rigorous studies tend to take multiple years and test innovations with a limited set of districts and schools given the cost, the required research design controls, and time and resources schools must commit to participating in the study. However, decision makers and practitioners seek new solutions that have been used successfully across large numbers of students and in districts and schools similar to their own. These two groups approach the definition of “what works” and what constitutes appropriate risk mitigation in fundamentally different ways. Innovations that show a high level of research evidence may not have the implementation evidence of successful widespread use by similar districts, leading to districts not wanting to risk adopting the innovations. Most district decision makers will say they want “evidence-based” innovations, but they (and practitioners) want “evidence” of successful implementation just as much as or more than “evidence” of impact, while researchers may place more emphasis on “evidence” of impact.

### **The timeframe for development, research, and transition for IES-supported innovations does not match the timeframe for venture-capital-backed startup approaches.**

Early-stage venture-capital-backed startups do not work on the same timelines as the IES development cycle. Startups are expected to show viral traction and generate revenue within the first few years of conception. Pre-seed and seed-stage funded startups (\$1M–\$4M of funding) have to show that they have created a differentiated innovation that is on the path of achieving wide adoption in a large market. They typically have 18–24 months to achieve the viral growth that is expected in order to raise the next round of funding. The product is in constant overhaul the first few years because the startup is in a “build-measure-learn” loop, quickly iterating and improving. Often, the product changes dramatically over 6 months. Participation in rigorous studies at the beginning of development is not common, as the product is constantly changing, and early-stage startups have limited time and resources. These startup companies need to work on achieving the metrics that get them to the next stage of funding: viral growth, revenue, and developing a scalable customer acquisition strategy.

**The funding mechanisms used by the interviewed research and development teams to scale innovations have relied heavily on circumstances that are hard to replicate. Therefore, a model for a reliable funding source for sustainable scaling will require additional investigation.**

Researchers who have successfully scaled innovations reported different funding models. In some cases, there was sufficient government and foundation support to allow the company to offer the product for free. In other cases, companies charged for the use of their materials and platforms, as well as for support and training. Other panelists identified private philanthropists that supported their continued scaling of an evidence-based practice. Many of the panelists shared that their path to sustainable scaling was not easily replicable. Therefore, the development of new government funding mechanisms for scaling that continues years beyond the research may be needed. SRI would need to do additional work in this area to provide a recommendation for a replicable path for funding.

**Partnering with existing companies to improve existing solutions may be easier than developing new and competing innovations.**

Because of the difficulty of scaling, some panelists wondered if it might be easier to improve the effectiveness of widely used existing resources than to introduce new resources. Thus, they wondered if IES researchers could identify partnerships with existing education companies that would allow the augmenting and revising of commonly used models (not just testing them for efficacy). For example, a research and development team could work with a commercial organization on a curriculum, learning tool, or assessment to incorporate innovations that have demonstrated evidence of positive impacts on teaching or learning and then test its added value.

## **Recommended Next Steps**

We have used feedback received during our interviews and presentation of the I-A-T framework to tailor SRI's framework to help education researchers' scaling efforts. Based on the feedback from the Advisory Council and Expert Panel, the I-A-T framework has been revised to place a greater focus on (1) definition of need for full and high-priority solutions, (2) the importance of mapping the unique needs of multiple stakeholders/gatekeepers in education, (3) prioritizing convenience and adaptability for customer fit, and (4) understanding existing and potential new legislation that may help drive adoption. We believe our framework will help researchers mitigate some of the failure points that may be encountered during early stages of development. The interview findings suggest that the following supports for researchers may help strengthen their ability to succeed at the I-A-T framework:

1. Require that all IES grant proposals describe in what ways their innovation (a) produces better outcomes, (b) is easier and faster to learn with fidelity, (c) takes less or similar instructional time (can replace something rather than add onto existing expectations), and (d) fits within the existing

context of the host environment. Teams should also list where their innovation fits well with widely used platforms, assessments, and curricula.

2. Provide market assessment/analysis resources for all IES researchers.

3. Understand the mechanisms that may be available to continue the funding of promising solutions.

Before launching an Embedded Entrepreneur program pilot, we recommend IES consider the following next steps to advance their scaling work:

- Adjust RFAs to include the following questions:
  - How is the innovation expected to fit with common district curricula, assessments, data platforms, and professional development models? What does this look like for the user?
  - What amount of time, training, and skills is needed to implement the innovation with fidelity? How can it be modified for local context?
  - Who will benefit from this innovation? What benefits will district and school leaders, teachers, and students experience? Is it cheaper, faster, easier, and more effective?
  - Does this displace or augment an existing solution?
- Review the incoming applications to see how applicants have responded to these new questions to identify future review criteria and topics that a primer or call center could help applicants more deeply consider.
- Determine additional actions needed to support researchers with undertaking scaling strategies.

# Embedded Entrepreneur Pilot Program

## Overview

SRI recommends using an Embedded Entrepreneur Program model to provide support for researchers as they engage in scaling activities. Researchers may find it difficult to perform the key steps outlined in the I-A-T framework and may need an Embedded Entrepreneur to augment the team during the development cycle. An Embedded Entrepreneur will (1) facilitate discussions with the research and development team about key performance indicators, the PRCC, and the product-user fit, and provide them with constructive feedback; (2) help gather information about user and stakeholder needs; (3) develop a product-user fit hypothesis; (4) conduct a market analysis and product-market fit analysis; and (5) identify potential customers and other funding sources.




SRI acknowledges that an Embedded Entrepreneur Program may not be beneficial for all researchers. Only a subset of researchers will respond to this type of support. To better understand what types of researchers may respond, as well as to see how this type of program may positively affect the scaling of a program, SRI recommends that a small pilot program be conducted to collect data and further refine the program before a full rollout.

In an Embedded Entrepreneur Pilot Program, four to six research groups will be selected to work with two or three Embedded Entrepreneurs over 6 months. Together, they will engage in the scaling activities listed in Exhibit 1 above—key activities that we hypothesize are often missed by researchers working alone.

The stages outlined in Exhibit 1 form a cyclical rather than a linear model in which researchers may need to repeat some activities as they learn about the needs of their users and the market. This framework seeks to identify blind spots and mitigate potential failure points that could have been anticipated earlier in the development cycle.

Exhibit 2 below outlines scaling activities in which Embedded Entrepreneurs will be engaged, as well as the characteristics of an appropriate Embedded Entrepreneur at every level, as we anticipate that the needs and roles will shift during the innovation development cycle.

**Exhibit 2. Embedded Entrepreneur activities and key characteristics by SRL and I-A-T Phases**

Solution Readiness Level (SRL)	Embedded Entrepreneur Activities	Embedded Entrepreneur Key Characteristics
<p><b>SRL 1 Invent</b></p> 	<p>Embedded Entrepreneur will support the research and development team with:</p> <ul style="list-style-type: none"> <li>– Generating a needs hypothesis, making sure that it aligns with recognized market priorities</li> <li>– Developing key performance indicators to measure the outcomes</li> <li>– Making sure the team revisits PRCC on a regular basis</li> </ul>	<p>Possesses domain expertise in the industry</p> <p>Familiar with the market and general market trends</p>
<p><b>SRL 2 Apply</b></p> 	<p>Embedded Entrepreneur may lead:</p> <ul style="list-style-type: none"> <li>– Development of a product-user fit hypothesis</li> <li>– Making sure that a champion(s) has been identified</li> <li>– Ensuring that the Stakeholder mapping is complete</li> <li>– Providing support with the Initial market and differentiation analysis</li> <li>– Generating the product-market fit hypothesis</li> </ul>	<p>Has market analysis capabilities</p> <p>Possesses implementation experience in the target market</p> <p>Has strong industry contacts to help with stakeholder mapping and market analysis</p>
<p><b>SRL 3 Transition</b></p> 	<p>Embedded Entrepreneur will lead:</p> <ul style="list-style-type: none"> <li>– Developing funding strategy for future development and implementation efforts</li> <li>– Generating potential customer pipeline for the research and development team to pursue</li> </ul>	<p>Has scaling and sales experience</p> <p>Understands how to sell products in the target market</p> <p>Has prior experience of securing funds and can provide support in exploring different funding channels</p>

# Commitments from Stakeholders for a Pilot Program

For IES, SRI, and the Advisory Council to effectively pilot an Embedded Entrepreneur Program, IES should define the expected outcomes of this program and the metrics that will be used to track it. IES grantees who have been selected for this program, Advisory Council members, SRI personnel, and Embedded Entrepreneurs will also need to commit to responsibilities, as listed below.

## Commitment from IES leadership

- IES must identify the desired outcome of an Embedded Entrepreneur program
- IES must identify metrics that will be used to measure the progress of the pilot Embedded Entrepreneur program
- IES holds quarterly check-ins with Advisory Council and SRI on program progress

## Commitment from IES researchers

- Research and development team must have “opted-in” to this entrepreneurial program
- Research and development team must commit to working closely with an Embedded Entrepreneur and to collaborate on the outlined activities (2-6 hours/week)
- Embedded Entrepreneur candidates and researchers will have a choice of who they would want to work with (needs to be a mutual decision to work together)
- Embedded Entrepreneur and researchers meet on a weekly basis for the duration of the program

## Commitment from Advisory Council

- The role of the Advisory Council is to bridge the gap between research and practice:
  - Quarterly check-ins with IES leadership and SRI on program progress
  - Quarterly check-ins with research grantees participating in Embedded Entrepreneur program
  - Quarterly check-ins with Embedded Entrepreneurs
  - Support for recruitment of Embedded Entrepreneurs

## Commitment from SRI

- SRI will provide program management support:
  - Market analysis support
  - Assistance with recruitment of Embedded Entrepreneurs
  - Weekly check-ins with Embedded Entrepreneurs
  - Bi-weekly check-ins with Embedded Entrepreneurs + research groups
  - Quarterly check-ins with IES leadership and Advisory Council on program progress



## Commitment from Embedded Entrepreneurs

- Embedded Entrepreneurs will meet weekly with the research and development team for the duration of the program and work closely with researchers on all activities outlined in the framework (2-6 hours/week)
- Embedded Entrepreneurs will make decisions together with researchers, but they may lead some of the activities outlined in the framework.

Importantly, the Embedded Entrepreneur Program should be viewed as a “work in progress.” We believe a pilot Embedded Entrepreneur Program with a small group of researchers will lead to adjustments to the program proposed below that are necessary before rolling out to a wider audience. SRI acknowledges that an Embedded Entrepreneur Pilot Program is required to better understand two components which, once explored, might result in substantial change to the program itself:

- (1) IES Phases of Development: Where in the IES innovation development lifecycle will an Embedded Entrepreneur’s support provide the greatest impact?
- (2) Open to Change: The startup product lifecycle is iterative and inquisitive. How open are the researchers to feedback, and how flexible are the innovations itself?

## Selection Tool for the Embedded Entrepreneur Pilot Program

The draft tool in Exhibit 3 includes criteria that could be used to identify IES-funded innovations that would be suited to participate in a pilot of the Embedded Entrepreneur program. Innovations are assessed on four categories: 1) Impact; 2) Feasibility; 3) Team; and 4) Product. Within each category we have listed criteria the innovation should meet. To fill out this tool, read each statement, determine how well the innovation has provided evidence that it meets the criteria, and provide a rating on a scale from 1-5 for each. Analysis of responses to questions regarding these criteria in the Request for Applications can help IES gather examples of responses with varying levels of strength that can be used to refine the criteria and establish a rubric for ratings.

**Exhibit 3. Selection Tool for the Embedded Entrepreneur Pilot Program**

Criteria		Rating: 1 Poor; 2= Fair; 3 Good; 4 Very Good; 5 Excellent	
		IES Rating	External Review Council Rating
<b>Impact</b>	The intended outcomes of this innovation align with stated district priorities.		
	There is potential to meaningfully impact a large subset of the student/teacher population, and/or potential to have an outsized impact in a small but highly underserved population.		
<b>Feasibility</b>	The innovation is easy to use. It does not add to the users' current workload, and/or it decreases the users' current workload.		
	The amount of support needed to implement the innovation with fidelity is feasible within the constraints of the district in terms of time and cost. Support needed may include staffing, training/ coaching of teachers and administrators, and data systems that need to be in place to monitor implementation and outcomes.		
	The innovation is flexible and can be modified as needed to fit different contexts in which it is used.		
	The innovation fits with commonly used platforms or other curricula, assessments, or pedagogical practices used by the school/district.		
<b>Team</b>	The team is highly interested in participating in an Embedded Entrepreneur program and willing to commit to the operational details outlined in the I-A-T framework.		
	The team is open to continuous modifications to their innovation, as needed, throughout the process of implementation and scaling.		
<b>Type of Innovation</b>	The innovation involves an online learning tool or curriculum that can be easily shared with or accessed by high numbers of users.		

# Appendix A: I-A-T Framework Applied to Education Innovations

## Introduction

The purpose of the Invent-Apply-Transition (I-A-T) framework is to provide IES researchers with a systematic approach to sustainably scale educational innovations. SRI hypothesizes that certain activities and key decisions at different stages of innovation could increase the probability of sustainable scaling. SRI started with traditional startup methodologies from its own Entrepreneur-in-Residence program and then added key tasks and considerations that are unique to education.

This framework is intended to be supported by an Embedded Entrepreneur program. In this program, an external Embedded Entrepreneur partners with IES researchers to provide support throughout the development cycle. Education researchers do not typically possess the skill sets required to scale up an innovation, and thus the Embedded Entrepreneur can fill in the gap in knowledge.

We expect that the types of support a research and development team may need from an Embedded Entrepreneur will change as the innovation progresses through the development cycle. For instance, in the early stages, researchers may need help thinking through their product-market fit strategy (the degree to which a product satisfies a strong market demand) and how to differentiate their solution from others in the field. As an innovation progresses, researchers may need help with (1) developing a product roadmap that outlines the vision, direction, priorities, and progress of a product over time and (2) clarifying the requirements that are necessary to enter the market.

This will require an Embedded Entrepreneur who is deeply knowledgeable about the education field and can steer the team in the right direction. As an innovation matures, researchers may need intensive support on how to generate demand for the innovation and build up a sales and marketing strategy. At each stage of the research, the Embedded Entrepreneur would work alongside the research and development team, augmenting scaling up efforts. The framework provides guidance to researchers on tasks that are essential to scaling at all stages of the research process, from discovery to effectiveness testing.

In this document, tasks have not been assigned specifically to an Embedded Entrepreneur or researchers. Depending on team composition, we anticipate that there will be variability in how teams

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“One of the problems with EdTech historically is that university-based research rarely makes it in the EdTech sector because there isn’t a founder who has entrepreneurial instincts.”

– Expert Panel Member

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approach these activities. The framework is intended to guide teams through scale-up activities that may be performed by researchers, Embedded Entrepreneurs, or jointly.

An important note is that the stages outlined below are iterative. Returning to previous steps and repeating key activities is to be expected. The iterative process of innovation drives the repetition of tasks in subsequent stages as research and development teams learn about the needs of their users and the market.

## I-A-T Activities by Solution Readiness Levels

The I-A-T framework activities have been organized by Solution Readiness Levels (SRLs) as shown in Table 1. This is a set of high-level iterative steps that education researchers and Embedded Entrepreneurs can work through together to create an innovation and bring it to market. These tasks are designed to help innovations maximize their transition readiness and to address common points of failure that researchers face when trying to scale their innovations. We anticipate that modifications to the innovation will need to be made based on customer feedback and a deeper understanding of the market requirements.

**Table 1. I-A-T Framework Scaling Activities by Solution Readiness Levels and IES Research Phases**

Solution Readiness Level (SRL)	I-A-T Scaling Activities	IES Research Phases
<p><b>SRL 1 Invent</b></p> 	<p>Needs hypothesis                      Key performance indicators hypothesis                      Solution hypothesis (minimum viable product)                      Basic prototype performed                      Initial PRCC analysis</p>	<p>Exploration                      Innovation and Development</p>
<p><b>SRL 2 Apply</b></p> 	<p>Product-user fit hypothesis                      Champion(s) identified                      Stakeholder mapping                      Initial market and differentiation analysis                      Product-market fit hypothesis</p>	<p>Innovation and Development                      Efficacy and Replication Studies                      Effectiveness Studies</p>
<p><b>SRL 3 Transition</b></p> 	<p>Scaling pathway hypothesis                      4 T's                      Pitch deck</p>	<p>Effectiveness Studies</p>



## Solution Readiness Level 1: Invent

The first level is *exploration*, or problem definition. This phase consists of the following key I-A-T scaling activities:

- Needs hypothesis
- Key performance indicators (KPIs) hypothesis
- Solution hypothesis (minimum viable product)
- Basic prototype or simulation demonstration

In this step, the researcher will formulate a deep understanding of the need, generate a problem/solution hypothesis, and create a prototype to demonstrate that the solution can fulfill the needs of the users. The researcher should have a hypothesis for the questions for each scaling activity below.

### **Needs Hypothesis**

- What is the specific problem the innovation is meant to address?
- Is the problem widespread enough that it has been acknowledged by practitioners?
- Is the problem in line with the needs and top priorities identified by school districts, state education agencies, and schools?
- How is the proposed solution believed to be better than existing options (the competition)?

### **Key Performance Indicators**

- What outcomes, including intermediate outcomes, would the innovation improve, if effective? Are those well-aligned to the problem identified in the needs hypothesis?
- What measures could serve as “key performance indicators” that, if monitored, would suggest the innovation is likely to be efficacious once adopted?
- If adopted, could a state, district, or school begin to see evidence of “success” on those KPIs within 3 months to secure continued buy-in?

### **Solution Hypothesis - Minimum Viable Product (Core Components)**

- What are the key components of the intervention?
- What is the smallest number of components needed to produce the targeted effect (“core components”)?
- What components can be adapted to fit local context, if any, and which must remain true to the model?
- Who are the key users of the solution?

- Does the innovation fit with existing practices and workflows of typical schools?
  - How does it fit with current data systems, assessments, curricula, and learning platforms?
  - What level of effort is needed to learn, use, and sustain the innovation?

After the solution hypothesis, teams should begin to formulate a customer value proposition. This is a succinct statement of 1 to 2 sentences that conveys how users will benefit from this innovation. In other words, what is the value that the innovation is bringing to the customer? Consider:

- What is the need being addressed?
- What benefits does the innovation offer?
- How is the innovation different from existing solutions?
- How do these differences benefit the user?
- How does the innovation fit within the context of the existing ecosystem?

Crafting the customer value proposition is a challenging exercise. Researchers tend to create value propositions that appeal to researchers, without recognizing that the value proposition needs to appeal to the customer and end user. An Embedded Entrepreneur can help keep stakeholder and user needs at the forefront. It's best to be simple and direct. The customer value proposition will change over time as the innovation evolves. However, it is a good exercise to summarize the innovation and its value from the start, such as during the initial grant proposal phase. The value proposition can be tested and refined during the recruitment of schools and districts before large-scale studies are conducted.

### ***Demonstration of Basic Prototype or Simulation in Terms of Performance, Reliability, Convenience, and Cost (PRCC)***

As teams move through the framework for a particular innovation, they also need to assess the customer value of the innovation in terms of Performance, Reliability, Convenience, and Cost.

- **Performance** refers to what kind of impact the innovation has on educational outcomes. Researchers should consider the innovation's efficacy and how this compares with the efficacy of existing innovations.
- **Reliability** refers to how well the innovation can be implemented in a variety of contexts and whether the innovation will be able to achieve its intended outcomes for all intended users.

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“It had the right ingredients, it had early-stage traction, it showed a good effect size (though not as good as others), but it only took 4 minutes whereas others took 15 so it was the right combination of convenience and efficacy. Schools are pragmatic, and if it's good enough and convenient and usable, they'll use it.”

– Expert Panel Member

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- **Convenience** refers to how easy the innovation is to implement and how smoothly it fits within the existing educational context in which it is being used.
- **Cost** refers to the financial and labor investment needed to implement the innovation.

Researchers focus on performance, reliability, and cost, but tend to underestimate the importance of convenience.

**Table 2. Questions For Assessing PRCC**

PRCC	Questions researchers should be asking
<b>Performance</b>	<p>Is the solution’s improvement on student outcomes incremental or significant?            Can this improvement be demonstrated within 3 months of adoption?            Does augmentation with other approaches strengthen the solution?            How superior will the performance be to existing solutions?</p>
<b>Reliability</b>	<p>Has the team accounted for the typical implementation fidelity loss in the anticipated levels of reliability that happens when the developer or researcher is no longer overseeing implementation?            Has the team identified the key components that must be implemented to achieve the intended outcomes?            Has the team accounted for the different kinds of environments in which it will be implemented?            What resources, training, and organizational support are required to achieve implementation fidelity?</p>
<b>Convenience</b>	<p><b>Usable</b>            Does the solution make the user’s life easier? Does it require less time than existing solutions?            Is it practical and easy to use?            How does the innovation compare to non-education consumer products that people are accustomed to using every day?</p> <p><b>Adaptable</b>            Define what components of the innovation can be flexibly adapted and what parts need to be replicated?</p> <p><b>Easily Integrated</b>            Does the innovation seamlessly fit with existing systems in the host environment such as technology systems and equipment, curricula, assessments, professional development models, and class schedules?</p>
<b>Cost</b>	<p>What are the initial adoption costs and the ongoing operation costs?</p> <ul style="list-style-type: none"> <li>• Personnel</li> <li>• Facilities</li> <li>• Materials</li> <li>• Consulting or vendor costs</li> <li>• Other costs</li> </ul>



## Solution Readiness Level 2: Apply

The second level is *development*, identifying user and market requirements. During the early development cycle of an innovation, it is critical to understand the market requirements necessary for wide adoption. What are the existing companies or organizations that exist in the system, and what factors will convince a user and purchaser to make the change? Expect significant iteration across the multiple activities within the development level: As the team dives deeper into a greater understanding of the user and market, former hypotheses may be debunked, and the team may need to start all over again. Modifications to the innovation will need to be made as the team gathers more user feedback and develops a deeper understanding of market requirements. This level consists of the following I-A-T scaling activities:

- Product-user fit hypothesis
- Champion(s) identified
- Stakeholder mapping
- Initial market and differentiation analysis
- Product-market fit hypothesis

### **Product-User Fit Hypothesis**

Product-user fit is the idea that the innovation satisfies the needs of the primary user. The user is sufficiently satisfied with both the approach and results that they want to continue to use it. One example metric of a strong product-user fit is: At least 80% of the faculty identify that the problem exists and agree that adopting the proposed solution will be one of the top three goals for the school over the next 24 months.

Creating user stories is a simple way to convey how a user may use the innovation, the intended outcome, and the reasons why the user will want to adopt it. The team should create user stories of a day *before the innovation* and a day *after the innovation*, with a focus on the user: What does their day look like and what are all of the activities and tools used today? Then, what will their day look like with this new innovation? How does this new innovation fit with existing workflows, and how does this solve the problems that exist today? Why would they enjoy using it, and does it directly address one of their existing pain points?

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“We work with teachers in the development process; we learn things in the process that can be very simple that gets enthusiasm.”

– Expert Panel Member

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User feedback should be consistently collected throughout the development cycle of an innovation. In the early stages of development, the team should talk to at least 20–30 end users, present the user



stories, and gather feedback on what works and what doesn't work. Through iteration, the goal is to build a user story that makes end users immediately ask, "When can I have it?" Soliciting feedback from end users is critical, so teams need to get out in the field and prioritize engaging with users on a weekly basis. Questions to ask them include: How are you solving the problem today? What is missing from existing solutions? If you had a magic wand, what type of new solution do you want to see? Can you see yourself using the innovation every day? What do you think are the barriers for this to be widely adopted?

### **Champions**

One indication of strong product-user fit is the emergence of cheerleaders enthusiastically supporting the innovation and going out of their way to help the innovation succeed. These individuals are called champions. A champion could, for example, be a teacher who enthusiastically asks to continue to use an innovation after a study or demonstration and highly recommends it to peers. A champion could also be a superintendent who is a strong advocate and helps the innovation scale at a broad level. Having a champion is a clear indication that the team has developed something that offers a promising way to address an acute pain point. A champion who understands the logic behind the innovation can also help the team to market the innovation to other schools and districts by providing testimonials and by reviewing marketing materials. The champion can also help the team learn about ways other stakeholders in the school or district would like to see the innovation be adapted in the future so that it will better "fit" the local context. A champion who has the political and organizational power to move the innovation forward in a district can be invaluable.

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"A lot of people don't know how to put something in front of users to learn what's wrong with it; they want to know what's right with it."  
– Expert Panel Member

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### **Stakeholder Mapping**

Although user feedback is collected in the prior steps, it is necessary to also document the requirements of the functional roles that serve as gatekeepers for school districts. A stakeholder is defined as someone who has influence in the adoption of a new innovation (and in most cases are not end users of the innovation). This exercise is called stakeholder mapping. A detailed stakeholder map is necessary to understand the individual requirements of all decision makers and influencers across the system. Depending on the innovation, stakeholders could include roles such as Directors of Curriculum, School District Superintendents, Parents, Teacher Committees, or Chief Technology Officers. It is necessary to map out the pain points, priorities, and needs of these decision makers to create a plan to fulfill the different requirements. It is highly recommended that the research and development team and Embedded Entrepreneur team go out into the field and

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"Researchers need to deeply understand the gatekeepers and determine how and why they make their decisions."  
– Expert Panel Member

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conduct customer discovery interviews to receive firsthand feedback of the requirements that need to be met for each functional role.

To conduct a stakeholder mapping, researchers should consider the following questions:

- Who are the people whose needs must be satisfied for an innovation to be adopted, and what are their functions in the adoption process? How does this vary across large and small school districts? How does this vary across urban and rural school districts?
- What are the critical criteria that must be met for different types of stakeholders and what is the plan to meet those criteria?

Stakeholder mapping should be done early in the development process to identify critical requirements that could impact the adoption of their innovations. For example, if a research and development team is developing a math intervention with a technology-based component, they should know early on the technical requirements for computer-based apps of their target school districts. For instance, if the innovation is built within Apple's ecosystem, but the districts exclusively use Chromebooks, there is a mismatch from a convenience perspective. At best, it will cost time and money to reprogram and validate the innovation in the actual operating environment. At worst, the initial friction will stall any adoption, and the research output will not be adopted. An early understanding of the actual operating environment could mitigate this failure mode. Similarly, if a research and development team is developing an assessment tool for early childhood learning, they should know early on the language requirements for the target states. In some states, early childhood assessments will not be adopted unless they include supports for dual language learners, such as assessing children in Spanish or other home languages.

To increase the chance that an innovation will be adopted, research and development teams need to conduct customer discovery interviews with stakeholders who make the decisions about state and district purchases and adoption of new innovations. Receiving first-hand feedback of the requirements that need to be met is invaluable. Table 3 shows a high-level example of Stakeholder Mapping and areas in which particular functional roles may be most interested.

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“There are many people who can say no, and very few people who have the power to say yes.”

– Expert Panel Member

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**Table 3. Example Questions for Mapping Stakeholder Innovation Requirements**

Potential Stakeholder	Potential Needs and Priorities
<b>District Superintendent</b>	<p>Will the innovation support one or more of the district's top priorities?</p> <p>Does the innovation adhere to state and federal policy?</p> <p>Will the innovation improve achievement for all students? How well will it support students with disabilities, English language learners, or other important student populations?</p> <p>If applicable, will the teacher union support expected teacher training, assessment, and implementation?</p> <p>Do their principals and teachers want this innovation?</p> <p>What will it cost to adopt and sustain it? Is it worth it?</p>
<b>Director of Curriculum or Assessment</b>	<p>Will the innovation improve achievement, student behavior, or course or school completion? What is the likely size of improvement?</p> <p>How difficult is it to achieve high fidelity of implementation?</p> <p>What qualifications do staff need to be able to implement it well?</p> <p>How well is the innovation operationalized?</p> <p>Will it support district coaches in their current work with teachers?</p> <p>Has the innovation worked well in similar districts/schools?</p> <p>Will changing the curriculum or practice be worth the amount of effort and resources to train and support adoption?</p> <p>Does the innovation fit well with the other parts of instruction (e.g., the learning standards, assessments, and curricula used)?</p> <p>What reporting functions are available to help administrators and teachers easily track implementation and progress?</p>
<b>Chief Technology Officer</b>	<p>Is the innovation compliant with data privacy regulations?</p> <p>Does the innovation integrate well with the current identity management system?</p> <p>Are software updates easy to make?</p> <p>What tech support is available to users?</p>
<b>Principal</b>	<p>Does the innovation support instructional leadership goals?</p> <p>What supports are provided to school administrators to support their staff with adoption and implementation?</p> <p>What will be eliminated to make room for this new innovation?</p>
<b>Teachers</b>	<p>Is the innovation easy to implement?</p> <p>Does the innovation fit well with the other parts of instruction (e.g., learning standards, assessments, and curricula used)?</p> <p>Will teachers be able to see meaningful results within 3 months of using the innovation?</p> <p>How will the innovation replace (not add to) what teachers are expected to do?</p>
<b>Parents</b>	<p>Does the innovation enable parent engagement in learning?</p> <p>Does the innovation match the values of school community?</p> <p>Are there privacy or equity concerns regarding who has access to information or services?</p>

## ***Initial Market and Differentiation Analysis***

A market analysis is necessary to understand other innovations that address the same or similar problem, how the new innovation is differentiated from those currently available, and how many customers exist in the target market. Despite a new innovation holding promise, there is a sense of fatigue and saturation on the side of the purchasers due to the sheer volume of new innovations. It is critical to understand how the new innovation compares to existing solutions. There are multiple components in the market analysis described below—including Differentiation Hypothesis, Feature vs. Solution, Market Sizing, Ecosystem Shifts—that need to be revisited multiple times throughout the lifecycle of development. Further, the field and market may change over time, such as the introduction of new competitors or their offerings, new legislation that impacts relevant policies or funding streams, or events (e.g., COVID-19) that fundamentally change how education is delivered.

### ***1) Differentiation Hypothesis***

Understanding how the problem is being addressed today will be the first step in creating what is known as a “competitive matrix,” that is, a mapping of direct competitors and their product features, pricing, funding sources, and value propositions. What are the characteristics of competing products, including their convenience, increase in productivity, contextual fit, or cost? The competitive matrix will clarify how crowded the market is and what types of characteristics the innovation must include in order to compete with existing solutions. Here are the questions to consider:

- How is the innovation differentiated from the competition?
- Does it enable a capability that does not exist already?
- What are the compelling reasons why a user or customer would choose this over competing solutions?

### ***2) Feature vs. Solution***

Is the innovation a complete solution or a single feature that augments a larger solution? Solutions are composed of multiple features. Understanding whether the innovation is a complete solution or a feature is a highly important milestone in the framework. All of the information collected in the competitive matrix in the step above, in addition to the requirements of the stakeholders, can help make an initial hypothesis. Additional customer interviews and user feedback will also help determine whether additional components are required for a customer to adopt the innovation as a full solution.

An early hypothesis of whether an innovation is a feature or solution can help steer the research and development team into one of the potential scaling pathways.

- Does the innovation augment an existing solution?
  - If there are early indications that the innovation does not have enough features to be a standalone solution, a transition target may be an existing company that can incorporate the

innovation into an existing solution. Start the conversations early with the existing companies to gauge their level of interest in transitioning technology from researchers.

- Does the innovation displace an existing solution?
  - If there are early indications that the innovation has the potential to be a complete solution, the innovation may be in a position to displace an existing solution. The competitive analysis started in the step below will help the team understand what features are necessary to displace an existing solution.
- Is the innovation a completely new solution?
  - If there are early indications that the innovation has the potential to be a complete solution that creates a new market and does not displace existing solutions, it may be able to create a new market. For instance, Google Classroom did not exist 10 years ago. It has created a new ecosystem of digital tools, adopted by schools, that previously would not have been possible. New markets can be created by fundamental ecosystem changes (technological advancements or public policy).

### **3) Market Segmentation and Market Sizing**

Who is the target market, how many customers exist within this market, and what are their requirements? Defining the market segment and the size of that market segment will help teams formulate short-term and long-term customer acquisition (sales and marketing) strategies.

**Market segmentation.** First, the team will need to define the customer and the market segments into which they may fall. What is the target market and what are the solutions that are typically adopted? Market segmentation questions include:

- Is the innovation targeting a specific student population?
  - For instance, a research and development team has developed an interactive science curriculum for students with disabilities in K-5. However, the analysis of how districts adopt similar products for this student population (market segment) finds that school districts tend to adopt curriculum programs that encompass all students with features that support access and learning for students with disabilities. Thus, to serve this market segment, the researchers may need to include their curriculum within a broader curriculum package, or partner with others to meet the market requirements.
- Is the innovation targeting urban or rural districts?
  - For example, if the innovation requires prolonged internet access (cannot be used offline), some rural districts with limited internet bandwidth may face challenges. Therefore, the research and development team may not want to target this market segment at the initial launch.
- Are there certain requirements that are typical of a state depending on the student population?
  - For example, to support access to grade-level learning of multilingual learners, states may desire innovations focused on science or math that use students' home languages or use

learning strategies that provide learning in formats less reliant on language. Assessing the size of such a market can inform whether development of language-specific versions will be of sufficient interest.

**Market sizing.** Next, the team will need to quantify the number of potential customers that exist within the target market segment (or segments). Using a disciplined approach to quantify the market in incremental steps will help determine the type of resources required to scale up as well as the type of customer acquisition strategy required to access these markets. Three tiers of market sizing are presented below:

- What is the Total Addressable Market (TAM), the total potential market demand for the innovation?
  - For instance, if the research and development team is selling a kindergarten literacy curriculum, every single school district in the country that serves kindergarteners would be the TAM.
- What is the Serviceable Addressable Market (SAM), the total segment of the market that is within reach today)?
  - For example, for a kindergarten literacy curriculum that is tied to certain standards used by only a portion of the states, the number of school districts within these states is the SAM.
- What is the Serviceable Obtainable Market (SOM), the total segment of the market that can be captured with the research and development team’s immediate resources?
  - For example, if a team can only support up to 10 districts in the next 12 months, that number of districts is the SOM.

#### **4) Ecosystem Shifts**

External factors may significantly change the way innovations may be adopted. These changes could be fueled by forces such as legislation, budgetary changes, and increased acceptance of digital solutions. Tracking changes that are relevant to the innovation and aligning the development with the ecosystem changes is also one component of the market analysis activities. It is typically impossible to predict the type of shifts that may occur, but here are examples of questions that may be relevant:

- Has there been recent legislation or upcoming legislation that may help propel wider adoption?
- With the proliferation of such digital tools such as Google Classroom, are there opportunities to integrate into emerging ecosystems?

## ***Product-Market Fit Hypothesis***

Has the team identified whether the innovation meets the needs of all the stakeholders and, therefore, meets the needs of the whole market? To conduct this analysis, the following set of questions should be considered:

1. Does the solution address the requirements of all stakeholders? If it does not, there needs to be a plan formulated to address requirements at a later stage of development.
2. Are champions advocating for the innovation and creating natural momentum behind the innovation?
3. Have the efforts of champions led to potential customers enthusiastically requesting access to the innovation?
4. Is this a scalable solution? For example, can the team support a large number of districts with their adoption and operations at the same time?
5. Do significant ecosystem forces exist that can help drive adoption?

If the team is able to answer yes to the first four questions above, there are early indications that they have achieved product-market fit.



## Solution Readiness Level 3: Transition

### *Solution Pathway Hypothesis*

What are the potential transition pathways? The ideal pathways (or business model) for promising innovations are the formation of a new company or licensing the technology to another entity. During the analysis of whether an innovation is a feature or a solution, a scaling hypothesis was formed. However, during more mature stages of the innovation development, changes to the innovation or ecosystem shifts may have impacted the hypothesis. It is challenging to be prescriptive on which path should be prioritized over another, as this will depend on timing, funding availability, and the preferred pathway of the research and development team. To consider which pathway makes sense, the team should consider the following questions, some of which will have been answered in Level 2 - Apply:

- What intellectual property (IP) is protectable?
- Is it a feature or a complete solution?
- What evidence exists regarding traction/demand for the new innovation?
- What is the size of the market and its potential for growth?
- What are the funding mechanisms available to continue the work?

If the preference is to license the innovation to another company, it is a good idea to begin conversations with possible target companies to gauge their interest. If there are any early indications that the innovation may be a natural licensing target for a larger company as it augments an existing solution, possible partners should be contacted early in the development cycle to understand the requirements necessary to be integrated into an existing solution.

If the preference is to form a new company to sell the innovation and related technical supports, we recommend recruiting the team and identifying funding paths to support the continued development. Some researchers may want to make their innovations publicly available for free and charge only for training, coaching, local adaptations, and upgrades. Providing these services at scale and keeping the free innovation resources accessible and updated still requires the development of a company.

If it does not seem feasible to license the innovation or form a new company, we recommend going back and revisiting some of the earlier activities to understand what happened. Although an innovation may not have all of the right elements to scale, the learnings are invaluable and should be shared with the wider research community.



## Team, Technology, TAM, Traction (4 T's)

We recommend using the 4 T's (Team, Technology, Total Addressable Market, and Traction) as a structured approach to the creation of a sustainable venture (Table 4).

**Table 4. Assessment of the 4 T's and the Likelihood of Sustainability**

4 T's	Questions to Consider If Not Answered Earlier:
<b>Team</b>	Does the founding team comprise members with the necessary skill sets to achieve scale? Do they have implementation experience? Are they knowledgeable about possible funding mechanisms to continue this effort?
<b>Technology</b>	Does the innovation provide measurable outcomes that address top priorities of the state or districts? What is the "secret sauce" that creates a sustainable differentiation from the competition?
<b>Total Addressable Market (TAM)/ Market Segmentation</b>	Is there evidence that the innovation comprises the minimum number of features to be a product? Is there a scalable implementation strategy? What types of resources are required by a customer for the innovation to be adopted? Is the target market accessible? How will new customers be accessed?
<b>Traction</b>	What feedback is the team receiving from users and potential customers about wanting to adopt or scale up the innovation? Is this a product that has the potential for viral growth? Are users loving it so much that they are recommending it to their peers?

## Pitch Deck

We recommend capturing all of the answers to the questions in the 4 T's table above in a Pitch Deck. This is generally a PowerPoint or Keynote presentation that captures the following information in fewer than 15 slides:

1. What is the problem being addressed, and is this a recognized need by districts, teachers, or others?
2. What is the solution, and how is it differentiated from existing innovations?
3. What is the proposed outcome, and what is the potential impact of the intervention on the outcome?
4. What is the Customer Value Proposition?
5. Who is the target customer? What are the characteristics required of the customer?

6. How is this problem being addressed today? Who is the competition? How is the innovation different from existing solutions or business as usual?
7. What is the team composition?
8. How much grant funding is required before the innovation is capable of sustainably scaling?
9. What will be achieved with this funding?
10. Is a champion identified, and why are they advocating for this solution?
11. Are there early signs of traction? Who has committed to using this solution?
12. What is the business model (transition pathway), and is there a hypothesis on how potential customers may be accessed?

# Appendix B: Example RFP for an Embedded Entrepreneur Initiative

## DARPA Embedded Entrepreneur Initiative

To catalyze the conversion of scientific discovery to impact, the Microsystems Technology Office offers applicants the opportunity for additional funding and transition assistance through participation in the Embedded Entrepreneur Initiative. The DARPA Embedded Entrepreneur Initiative will provide additional funding, up to \$250,000, to employ one entrepreneur-in-residence or one corporate business development lead. The entrepreneurial lead's ultimate goal is to develop a robust go to market strategy for entering into defense and commercial markets. All commercialization and transition activities will be timed to suit the Performer's stage of maturity. Often, the Embedded Entrepreneurial work is most useful in year two or three of a Program. Activities conducted can include, but are not limited to; cost modeling, end user engagement, market analysis and mapping, competitive analysis, techno-economic analysis, manufacturing and scale-up strategy, IP securement strategy, and financial plan creation. Embedded Entrepreneur participants will work closely with DARPA's Commercial Strategy team and their extensive network of U.S. investors, strategic partners, and mentors.

Proposers wishing to participate in the Embedded Entrepreneur Initiative must:

- Include an initial hypothesis describing how the proposed technology will transition from its current state to future integration into a product or capability.
- Include separately costed tasks describing plans to build and refine a viable Go to Market Strategy over the course of the DARPA program. Tasks contributing to the build of a robust Go to Market Strategy can include, but are not limited to; cost modeling, end user engagement, market analysis and mapping, competitive analysis, techno-economic analysis, manufacturing and scale-up strategy, IP securement strategy, and financial plan creation.
- Participation in the Embedded Entrepreneur Initiative is voluntary but highly recommended. Participants are not expected to form a new company or leave their current research positions to pursue transition, but are expected to, throughout the lifecycle of the proposed effort, identify appropriate partners for enabling transition. Embedded Entrepreneur Initiative funding requests should be consistent with the proposed work scope and proposed timeline, but they are anticipated to be in the range of \$250,000 per Performer.

# Appendix C: Literature Scan

SRI conducted a scan of existing literature that addresses issues of scaling in education. The purpose of this literature scan was to inform our revisions of the I-A-T framework ahead of our discussions with the Advisory Council. This initial research ensured that the framework was based on what is already known about the unique challenges of scaling educational innovations. The SRI team identified and used key themes from the literature to understand the varying definitions of scale used in the literature, identify any shared challenges in the scaling of educational interventions and other interventions, and understand what challenges are unique to education. Additionally, the SRI team identified themes that are important to scaling that were absent from the educational scaling literature but have been identified as key factors to successful scaling up of interventions in other industries.

## Definitions of Scale

Bringing educational innovations to scale is a problem that researchers, policymakers, and innovators alike have been facing for decades. There is a plethora of educational interventions that demonstrate positive outcomes, work well in a few sites, and show potential for expansion. Commonly, however, these educational interventions fail when they attempt to expand into more schools, and ultimately fizzle out due to lack of engagement, time, funding, or leadership. To understand how and why these interventions fail to scale, it is first necessary to understand what it even means to “scale.”

Coburn’s (2003) well-known piece, “Rethinking Scale: Moving Beyond Number to Deep and Lasting Change,” provides a foundation for current thinking around what it means to scale an innovation or reform. Coburn argues that scaling is more than just increasing the number of users for a particular innovation and that it needs to encompass additional dimensions to capture the complex nature of scaling educational reforms. Her reconceptualization of scale contains four interrelated dimensions:

- **depth:** the extent to which teachers’ norms, beliefs, and/or pedagogy change, and that change goes beyond the use of new materials, activities, and organization provided by the reform;
- **sustainability:** the extent to which the reform is sustained even in the face of challenges that could include competing priorities and/ or administrative and teacher turnover;
- **spread:** the extent to which the reform is scaled to an additional number of schools; and
- **shift in ownership:** the extent to which districts, schools, and teachers take ownership for the reform and are able to sustain, spread, and deepen use of it internally, without external support.

Morel et al., (2019) challenge Coburn (2003) and other well-known conceptualizations of scale on their assumption that there is only one model for scaling. They explain that assuming there is only

one model for scaling fails to recognize that conceptualizations of scale can vary depending on the innovation and can also change over the lifecycle of a single innovation. They instead define scale based on the innovator's own goals for the end-state of their innovation's use, specifically, how they envision large numbers of users will use the innovation. The four ways in which they conceptualize this end-state are:

- **adoption:** the innovation is used widely without specifying how the innovation is implemented and used;
- **replication:** the innovation is used widely, but it is also implemented with fidelity and achieving its intended outcomes;
- **adaptation:** the innovation is used widely, but allows for adaptations to meet the needs of its specific users; and
- **reinvention:** the innovation is used by educators to create something new, like a musician would remix a song.

These four conceptualizations of scale each require different research questions, study designs, data sources, and outcome measures (Morel et al., 2019).

Because the literature defines scaling in education in multiple ways, we did not use one definition of scaling in our work to revise the I-A-T framework. Rather, we adopted a conceptualization of scaling that encompasses the ideas put forth by both Coburn and Morel et al. In particular, we recognize that scaling educational innovations is complex, multi-dimensional, and varies depending on the expected end state.

## Factors for Successful Implementation

A critical component of scaling any innovation is successful implementation. Implementation addresses the “how” of getting evidence-based interventions into schools. Without an effective model for implementation, evidence-based practices will be unlikely to scale widely. Research into implementation science has begun to identify a number of factors that are key to successful scaling (Coburn, 2003; Cook et al., 2013; Cook & Odom, 2013; Fixsen et al. 2013; Foorman & Moats, 2004; Hopkins & Woulfin, 2015; Horner et al., 2014; Horner et al., 2019; Kincaid & Horner, 2017; Morel et al., 2019; Olswang & Goldstein, 2017; Redding et al., 2017; Rowan & Miller, 2007; Ward et al., 2018). Similarities between implementation science and I-A-T scaling factors emerged in our literature scan. The shared concepts included close attention to the needs of local stakeholders and the fit of an innovation to local systems, the need for developing buy-in through champions, and strong and supportive leadership.

## Importance of Local Stakeholders and Systems

Literature from implementation science shows that to bridge the research-to-practice gap and get more evidence-based interventions into the hands of practitioners, researchers must actively engage and collaborate with local stakeholders (Olswang & Goldstein, 2017). There are a variety of stakeholders in education key to successful implementation that include students, parents, teachers, school staff, community members, district and state administrators, and national politicians (Mascia, 2018). Mapping the needs of all stakeholders and assessing the fit of the product to the users is critical in the I-A-T scaling framework. Collaboration between researchers and local stakeholders helps to ensure the innovation will fit within the broader school context and that it will continue to be used after external support from the researchers is no longer present (Redding et al., 2017).

Involving local stakeholders in both the design and implementation phase allows the stakeholders to develop a sense of ownership over the innovation. This is important because it leads to more user buy-in, which is necessary for depth of scaling, as defined by Coburn (2003). When there is scale at depth (i.e., teachers believe in the innovation and it has changed norms of behavior, rather than just being superficially added to the classroom practices), the intervention can continue scaling without the need for continued external support (Coburn, 2003; Redding et al., 2017).

## Champion Users and Schools

The literature also shows the benefits of researchers identifying pilot schools willing to try out and champion the innovation before the researchers attempt to implement the innovation at a larger scale. Horner (2018) explains that successful scaling up of Positive Behavioral Interventions and Supports (PBIS) began with a small set of pilot schools that could demonstrate the feasibility and impact of PBIS. Successful implementation of PBIS in pilot schools in various states developed the sense of commitment and level of investment needed to scale PBIS more broadly throughout those states (Horner et al. 2014; Horner et al., 2018; Kincaid & Horner, 2017).

Identifying pilot schools also helps to begin the process that Horner coins as “resource leveraging.” Resource leveraging is a process in which initial investments in resources such as staff, materials, and other activities can be renewed and built upon with additional investment in later years. Horner explains that districts will be more willing to make large investments in innovations that have already shown success after smaller investments were made in them. He describes how PBIS’s success in pilot schools helped them gain more resources to build upon their work in those schools, and to scale PBIS to other schools and districts. For example, staff that were trained to implement the innovation in the first year could be leveraged in upcoming years to train additional staff to implement the innovation (Horner et al. 2014; Horner et al., 2018; Kincaid & Horner, 2017).

## Strong and Supportive Leadership

The literature on scaling widely recognizes strong leadership as important to implementation success (Fixsen et al., 2015; Fixsen et al., 2018; Kincaid & Horner, 2017; Metz & Bartley, 2012; Ward et al., 2018). Fixsen et al. (2013) outline a set of drivers, derived from implementation science, that are key components of implementation. Leadership is a key component of the implementation drivers they identify. They go on to explain that there are different leadership strategies useful in different types of situations. “Adaptive leadership” styles are useful at the beginning of implementation, when the activities needed include active problem solving, reallocation of resources, and someone to “champion change” (Fixsen et al., 2015; Kincaid & Horner, 2017; Fixsen et al. (2013)). Then, as systems are established, “technical leadership” is needed to conduct activities that include maintaining the systems and processes, establishing performance assessments, providing training, and other more traditional management roles to maintain long-term success of the innovation’s implementation.

Foorman & Moats (2004) also emphasize the importance of strong leadership in their piece, “Conditions for Sustaining Research-Based Practices in Early Reading Instruction.” They explain that the primary challenge in scaling early reading initiatives results from a lack of leadership to maintain the innovation’s implementation in a sustainable way over the long term. They explain that the people most suited to be a part of a successful leadership team are principals, specialists, and teachers who have expertise in reading instruction.

## Gaps in the Literature

Notably missing from the literature on scaling educational innovations is close attention to the concepts of “solving for a user’s need” and “convenience” (ease of implementation). Further, the Expert Panel and Advisory Council confirmed the importance of these concepts for the successful scaling of an educational innovation. SRI understood from the original I-A-T framework and from SRI’s experience scaling research outside of education that these two concepts are generally necessary for scaling. Therefore, despite their small presence in the education literature, we incorporated these concepts into the revised I-A-T framework that we presented to the Advisory Council and expert interviewees.

## Conclusion

The literature scan informed our initial revisions of the I-A-T framework. It helped us develop a nuanced understanding of the meaning of scale and how it may differ depending on the time and context in which the innovation is being implemented. Furthermore, it helped us identify the additional factors necessary for successful implementation. The final I-A-T framework presented in this report is a reflection of both our learnings from the literature scan as well as the conversations we had with the Advisory Council and expert interviewees.

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