Engaging your Industrial Advisory Board to promote Industrial Connections for Student Engagement

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Abstract: The Civil and Environmental Engineering department at Rowan University has successfully engaged its Industry Advisory Board (IAB) to actively involve undergraduate students to build an Entrepreneurial Mindset with the goal of stimulating student curiosity, assistance in making connections that ultimately create value. This multi-institutional effort is supported by the Kern Entrepreneurial Engineering Network (KEEN). The intent is to help advisory boards move from a traditional advisory role to an active partnership in engineering education. This endeavor has allowed our IAB members to become active partners engaged in promoting professional practice. Our IAB members have partnered with us over two years in a) hosting Industry Networking events every semester b) hosting professional panels and c) partnering with a new program titled PIPES. PIPES (Professional Industrial Partnership Engagement for Students) is a unique CO-OP like opportunity for the students to work with key companies or local agencies for course credit. Students can replace their Junior and Senior engineering clinic courses for a total of eight credits if they want to work outside of a faculty-led project. The program gives students a chance to try out the real civil engineering projects and work side-by-side with professionals. Infusing entrepreneurial minded learning in our curriculum with meaningful engagement from industry has been an exciting opportunity for all. This paper and presentation will provide guidance on actively engaging IAB members to transform engineering programs to build an Entrepreneurial Mindset that impacts the future of our students.

Introduction

Industrial Advisory Boards (IABs) are widely established in academic departments, colleges, and schools, serving as advisory bodies focused on curriculum development, accreditation, employment, and scholarship [1-5]. Engineering departments and colleges are no exception, with many incorporating IABs into their structure. However, the roles and activities of IABs vary significantly [6-10]. While most IABs convene annually or biannually, their meetings often lack direct engagement with students and faculty. As a result, many function in a passive capacity with limited student interaction or impact. To address this gap, a strategic approach is needed to create action-oriented IABs that meet regularly and actively cultivate an entrepreneurial mindset among students. This was achieved through a series of workshops utilizing the “Project Unlock Method.” Project Unlock Method [11] is a framework developed with the support of the Kern Entrepreneurial Engineering Network (KEEN) to transform the IABs into Industrial Partnership Boards (IPBs)

During the first year of its inception, approximately seven institutions in the United States (University of Wisconsin-Platteville, Clarkson University, Rowan University, Drexel University, Boston College, University of St. Thomas, and the University of North Alabama) implemented "Project Unlock: Accessing the power of your advisory board” [11] with the support of the Kern Entrepreneurial Engineering Network (KEEN) [12]. Project Unlock aims to provide industry and academic colleagues with a playbook to become active partners. Project Unlock Method is based on the Strategic Doing (SD) framework developed by the Agile Strategy Lab at Purdue University [13]. This method follows a series of steps that allow for a structured ideation process based on an appreciative framing question. The workshop participants are typically advisory

board members from the industry, select faculty, leaders, professional staff, and students. During this ideation process, the "Project Unlock" workshop participants combine their assets to develop Pathfinder projects. These pathfinder projects are spearheaded by the participants at the table and meet every thirty days to ensure progress towards the project tasks. This allows the IAB members to meet more frequently and stay engaged in the academic program.

We further wanted to instill the KEEN pedagogical framework that uses entrepreneurial mindset learning (EML) in our undergraduate engineering students as a foundational driver of the resulting Project Unlock workshop outcomes. KEEN describes EML as a combination of mindset and skillset learning. The KEEN framework that cultivates an entrepreneurial mindset (EM) within the students is [14]:

1. **Curiosity:** Habits that fuel exploration, challenge assumptions, and reveal opportunities:
   - Inquisitive: Leans into work with curiosity about our changing world.
   - Contrarian Thinking: Explores alternative or disruptive views of current or accepted solutions.
   - Opportunity Seeking: Actively identifies trends and unmet needs to uncover new opportunities.
   - Experimentation: Constantly experiments and iterates to refine methods and solutions.
   - Embracing Ambiguity: Develops comfort with uncertainty to make decisions when information is limited.

2. **Connections:** Habits that integrate different perspectives, ideas, and systems to drive innovation and impact:
   - Creativity: Integrates information from disparate sources to spark new ideas.
   - Systems Thinking: Recognizes interdependencies in systems and identifies leverage points.
   - Implications Thinking: Anticipates the long-term impacts and consequences of actions.
   - Strategic Thinking: Develops long-term strategies with clear milestones.
   - Assess and Manage Risk: Proactively incorporates risk management into decision-making.

3. **Creating Value:** Habits focused on delivering meaningful outcomes that benefit others at scale:
   - Value Awareness: Focuses on solutions where extraordinary value can be created.
   - Customer-Centric Thinking: Frames efforts in terms of the customers' actual needs.
   - Scale: Leverages systems and networks to expand reach and maximize outcomes.
   - Persistence: Maintains sustained effort to achieve goals despite obstacles or delays.
   - Socially Mindful: Prioritizes creating meaningful and positive societal impacts.

In addition, the engineering skillset equips students to identify opportunities and add impact to design. We believe Entrepreneurial Mindset coupled with Engineering Skillset can be strengthened with strong industrial involvement.

The details of the Project Unlock workshop conducted at xx University in the Department of Civil and Environmental Engineering have been reported by Torlapati et al. [15]. This endeavor

has allowed our IAB members to become active partners in promoting professional practice emphasizing EML. The goals of this project were to

1. Stimulate our IAB members to become active partners in student engagement
2. Promote EML via our IAB members

The participants developed two Pathfinder projects as part of the Project Unlock workshop.

a) Industry Networking events every semester
b) Hosting professional panels

In addition to the two partnership projects developed by the workshop, the IAB members initiated a new program titled PIPES (Professional Industrial Partnership Engagement for Students) for our rising juniors and seniors. This effort was possible due to the trust built by running the pathfinder projects.

Implementation Strategies

Industry Networking Events and Professional Panels: Our IAB members initiated several Industry Networking events each semester to connect undergraduate and graduate students with local civil engineering companies. These events provide a platform for companies to showcase their career opportunities and ongoing projects. IAB members have played a pivotal role in promoting the events and ensuring strong participation from area companies. During the events, companies set up tables where students can engage with industry professionals, learn about their work, and explore internship and job opportunities. Attendance is mandatory for all seniors enrolled in our core Civil Engineering Practice course during the Fall semester, preparing them for graduation in the following Spring. Students also have the opportunity to share their resumes and LinkedIn profiles with potential employers, enhancing their job prospects.

During the Spring semester, the networking event is open to all civil engineering students, not just the graduating class. This provides juniors and sophomores early exposure to the profession and opportunities to seek internships. A typical networking event is shown in Figure 1.

Figure 1: A typical networking night

In addition, a video was prepared to showcase the industry night and was published on the Project Unlock webpage [16].

The industry panels are organized through our ASCE student chapter, featuring professionals arranged by our IAB members who share their career journeys and industry experiences. These panels are open to all civil engineering students, providing valuable insights into various career paths. A significant benefit of these events is that they are extremely valuable in promoting EML's core values: spark Curiosity, assist in making Connections with the industry, and create value from the experiences. In addition, connecting with industry professionals allows the students to identify opportunities and see the impact on the various stakeholders of industry projects.

PIPES (Professional Industrial Partnership Engagement for Students): This program offers students unique CO-OP like experience for the students to work with key companies or local agencies for course credit [17]. Students can opt to replace their Junior and Senior engineering clinic courses for eight credits if they want to work outside instead of a faculty-led project. In the Junior and Senior Engineering Clinic (JSEC), students work in small teams on real-world projects sponsored by industry or government agencies through faculty-led grants [18]. Students choose their top choices from a bank of over 100 projects at the start of each semester and then complete the research or design according to the stakeholder's specifications. JSECs give our students experience working with clients on real-world projects that lead to tangible results [17]. Students must submit a technical report at the end of the semester and make a professional presentation to the faculty and students. Their supervisor at work is also invited to attend along with area companies who can learn about the PIPES program and recruit students in the future.

Following the Project Unlock Method ™ workshop, our IAB members introduced the PIPES program as an alternative pathway for students to gain real-world experience while fulfilling their Junior/Senior Clinic requirements. The PIPES program’s final deliverables align with traditional clinics' ones, ensuring academic rigor. To enroll, students must apply by outlining the scope of their proposed work. The department PIPES coordinator and department head review the application and grant approval. Once enrolled, students maintain ongoing correspondence with their company liaison to ensure meaningful contributions to the approved project and compliance with course expectations.

The PIPES program offers students an immersive opportunity to work alongside industry professionals on real-world civil engineering projects. IAB members and other local companies play a vital role in recruitment and program support, ensuring students gain valuable, career-relevant experience.

When it started in the spring of 2024, the program had four students, and the enrollment increased to 21 in the Fall of 2024. Companies that have participated in the event are listed below in Table 1.

Table 1: List of Civil Engineering Companies participating in PIPES

AECOM	Hopewell Valley Engineering
Amtrak	J.F. Creamer
Avila Engineering	Johnson, Mirmiran, and Thompson
Cherry Hill County Engineering Department	RE Pierson
City of Vineland	Remington & Vernick Engineers
CME Associates	Roux Engineers
Cumberland County Engineering Department	Shropshire Associates LLC
Earle Asphalt Company	Universal Forest Products
Earth Engineering	YU & Associates
ECS Mid Atlantic LLC	American Water
Envision Consultants	
Ferreira Construction	
HNTB	

Students present their work via poster during final exam week. Figure 2 provides select images from our Fall 2024 semester.

Figure 2: Select images from the Fall 2024 semester PIPES Final Poster Presentations

Our IAB initiatives have raised awareness of the civil engineering profession for our students. All initiatives have allowed our students to grow by sparking their curiosity about what the local

companies do and making connections with industry. The events create tremendous value as the students prepare to enter the job market. Students working with the PIPES program are consistently involved in projects that include working with stakeholders with competing needs and identifying real-world parameters during the design process. During the presentations, the students highlighted working with clients and some operational challenges beyond their control that cause project delays. This valuable insight is not gained through classroom instruction and is only possible through experience coordinated with the industry.

Preliminary Assessment

To assess the impact of our networking events, we conducted the first survey in the Fall of 2024 for seniors enrolled in our CE Practice course. The following questions were posed:

1. The CEE Industry Networking event sparked my **curiosity** to learn about the work that our local civil engineering companies are involved with.
2. The CEE Industry Networking event allowed me to make **connections** with local civil engineering companies.
3. The CEE Industry Networking event **created value** for my professional preparation.
4. Civil engineers have an Entrepreneurial Mindset.
5. What does EM (Entrepreneurial Mindset) mean to you?

The students responded to questions 1-4 using a rating score of 1-5 (1=Strongly Disagree, 5= Strongly Agree) while question 5 allowed them to provide comments on their understanding of Entrepreneurial Mindset. We have a total of 54 responses from a class of 68. Figure 3 shows the results from Questions 1-4.

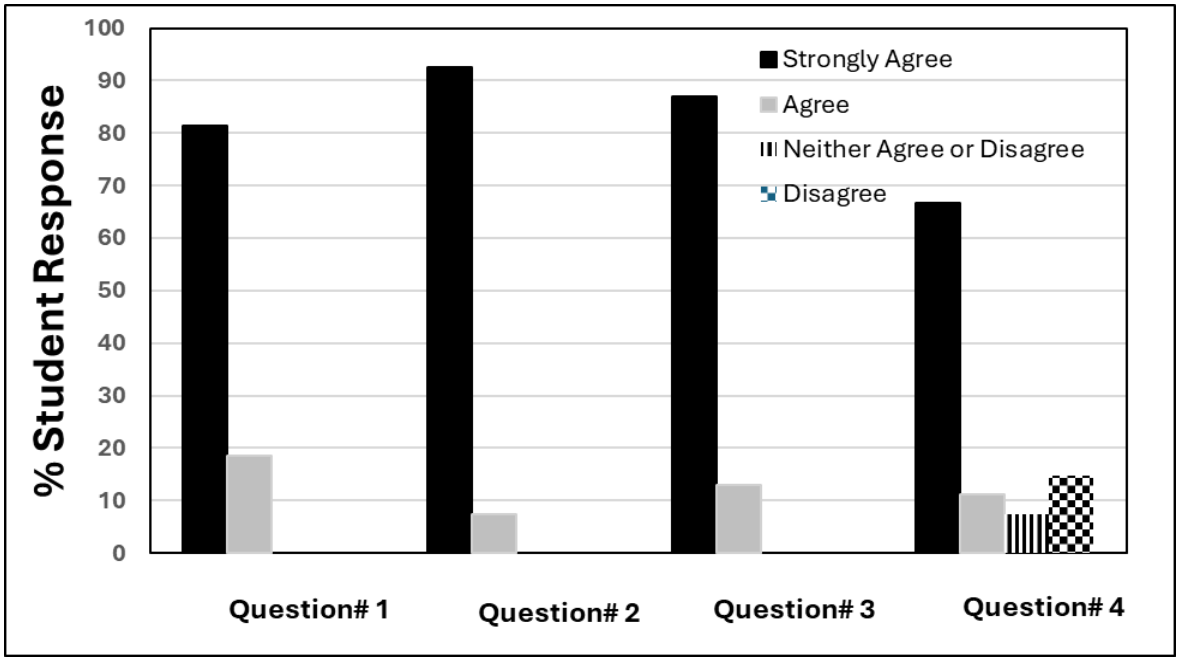

Figure 3: Survey Results for the Fall 2024 Networking Event

The results indicate that all respondents agreed/strongly agreed that the networking event sparked their curiosity, helped them make connections, and created value. However, only 66% strongly agreed that civil engineers had an Entrepreneurial Mindset, while 15% disagreed. Many people perceive civil engineering as lacking innovation and entrepreneurial spirit [19]. This perception arises from the traditional nature of many civil engineering projects, where the focus is often on large-scale infrastructure that does not appear as cutting-edge or innovative. As a result, the public often assumes that civil engineers are not pushing the boundaries of creativity and technology in the same way other engineers might [20-21].

However, innovation in civil engineering differs from that in other engineering disciplines, such as Electrical, Mechanical, or Chemical engineering, which tend to be more product or process-oriented [23-25]. Civil engineering innovation often involves improving designs, materials, and construction methods to meet the needs of an evolving society, rather than focusing on creating entirely new products or processes. Innovations in civil engineering are typically driven by the need to address complex societal challenges, such as urbanization, sustainability, climate change, and resource management. These innovations can take many forms, from developing new materials and construction techniques to integrating digital technologies like Building Information Modeling (BIM), artificial intelligence, and smart sensors into infrastructure projects [26-28]. While it may not always be as immediately visible or flashy, the innovations in civil engineering play a critical role in shaping the modern built environment.

In this light, civil engineering innovation might not always be as visible or dramatic as the breakthroughs seen in other fields, but it plays a crucial role in addressing some of society's most pressing issues. Furthermore, the collaborative and interdisciplinary nature of civil engineering projects means that engineers in this field often work alongside professionals from diverse industries, contributing to the development of solutions that are both technically advanced and socially responsible [29-30].

Thus, while civil engineering may not always fit the conventional image of high-tech, product-driven innovation, it remains a vital and constantly evolving field that is essential for meeting the needs of modern society. Civil engineers continue to innovate to enhance the quality of life, improve the sustainability of our built environment, and ensure infrastructure resilience in the face of emerging challenges. The civil engineering curriculum needs to address innovation and creativity.

The students responded to the open-ended question, “What does EM (Entrepreneurial Mindset) mean to you?”, in a variety of ways. These responses were mapped to the KEEN EM framework to assess their understanding of the Entrepreneurial Mindset.

1. Students reported the following statements that mapped to **curiosity**:
   Inquisitiveness:
   “*An entrepreneurial mindset is one in which someone is seeking out opportunities and advancements for their personal and professional growth.”*

   “It also means that you should be constantly learning and be content in yourself.”

   And opportunity-seeking:

"Always thinking in an innovative way and always trying to find solutions to complex problems."

"To me, the EM means that the individual can think of a solution/idea that goes outside the box of what would usually be done."

However, did not mention contrarian thinking, experimentation, and embracing ambiguity.

2. Students reported the following statements that map to making **connections**:

   Creativity:

   "The passion and willingness in someone to lead on their own/original ideas, which they aim to make it grow and sometime(s) even build on it their own business."

   "Always thinking in an innovative way and always trying to find solutions to complex problems."

   "To be more creative and less analytical."

   "Being creative"

   "To me, the EM means that the individual can think of a solution/idea that goes outside the box of what would usually be done."

   "Think outside the box and look for new solutions"

   And assessing and managing risks:

   "It involves leadership and risk. Never limit yourself to engineering work and stay curious."

   None of the students mentioned system thinking, implications thinking, and strategic thinking.

3. Students reported the following statements that map to **creating value**:

   Value awareness:

   "To create a demand for a product or service through one's merit and means. Mindset for working in a challenging environment."

   "To think outside the box, break from corporate bounds, and start a new idea, concept."

Customer-centric thinking:

"A mindset where anybody like(s) to apply his knowledge and make practical use of it and at the same time serve the society from a business perspective"

Socially Minded thinking:

"A mindset where anybody like to apply his knowledge and make practical use of it and at the same time serve the society from a business perspective."

The students did not mention scale and persistence.

Based on the responses above, students emphasized the importance of thinking outside the box, constantly seeking innovative solutions, and being resourceful with the tools and knowledge they have available. Students also expressed that an entrepreneurial mindset is also about independence and business acumen. Many students express a desire to move beyond a traditional salaried job, creating value, generating opportunities, and making a broader impact. Ultimately, students view EM as a mindset that fosters creativity, leadership, and self-reliance while enabling them to navigate challenges and build a successful future on their own terms.

4. KEEN has recently added **Action Orientation/Agency**, defined as habits that drive initiative, persistence, and proactive problem solving, to their mind set framework and the students reported many of those attributes in responding to the open-ended question.

   Initiative:

   "To me, EM just means that you have the drive to want to work for yourself or do things that is by yourself if that makes sense."

   "You aren't comfortable with stagnant growth."
   "An entrepreneurial mindset is one in which someone is seeking out opportunities and advancements for their personal and professional growth."
   "It can take the form of the littlest daily life choices."

   Resilience:

   "It means rolling with the punches thrown our way."

   "When an obstacle hits, you need to quickly find solutions and try to make it work."

   "Working to overcome challenges and take opportunities in unique ways."

   Continuous Improvement:

   "The Entrepreneurial mindset involves betting on yourself taking a different approach to a career."

   "It also means that you should be constantly learning and be content in yourself."

"To me, EM just means that you have the drive to want to work for yourself or do things that is by yourself if that makes sense."

"You aren't comfortable with stagnant growth."

"An entrepreneurial mindset is one in which someone is seeking out opportunities and advancements for their personal and professional growth."

"It can take the form of the littlest daily life choices."

Adaptable:

"It means having flexibility and understanding to be able to go out on your own and complete varying work."

Resourcefulness:

"It is a way to be creative and resourceful with the items they may have on hand"

The students clearly understand the need to be action oriented and express the independent nature of EM. In fact, the drive for independence is closely tied to resilience and a growth mindset, as students believe EM means not settling for stagnation but instead striving for continuous improvement. Adaptability is another key aspect, as EM requires the ability to quickly find solutions when facing obstacles, embrace change, and continuously learn in a dynamic environment. and initiative also play a significant role, with many students associating EM with taking ownership of ideas, leading projects or businesses, and being willing to take risks. Beyond leadership,

The responses indicate that students can articulate EM and what it means to them and their profession. This semester, we will develop assessment tools based on EM for our PIPES program.

Conclusions

The initiative to actively engage Industrial Advisory Boards (IABs) in student-centered activities has proven to be a valuable enhancement to our civil engineering program. Through structured efforts such as Industry Networking Events, Professional Panels, and the PIPES program, we have successfully fostered meaningful industry connections that contribute to the professional development of our students. Implementing the Project Unlock Method has been instrumental in transforming our IAB from a traditional advisory body into an active partner in engineering education, directly aligning with the KEEN framework and its emphasis on entrepreneurially minded learning.

Student feedback indicates that these initiatives improve career readiness, and the student perception of EM indicates innovation, leadership, and adaptability. The survey results from our Industry Networking Event reinforce the importance of these engagements, demonstrating that students recognize the value of professional exposure and industry collaboration. However, the

mixed perceptions of entrepreneurship within civil engineering highlight an opportunity to showcase the innovations within the civil engineering discipline and integrate them into the curriculum.

The PIPES program has emerged as a significant success, offering students hands-on experience with real-world engineering projects while bridging the gap between academia and industry. The program's rapid growth from four students in its inaugural semester to 21 students the following term underscores the demand for experiential learning opportunities beyond the classroom. Moving forward, we will focus on expanding industry partnerships, refining assessment tools, and embedding EM principles into the civil engineering curriculum. As these efforts evolve, they will serve as a model for other engineering programs seeking to create action-oriented, industry-integrated learning experiences that prepare students for the challenges of a rapidly changing professional landscape.

The initiative to engage IABs in a more active, meaningful way that directly impacts the students to date has been highly successful in our program. Initial student feedback is very positive, and we take note that the students can articulate what EM means in their professional world and are able to connect the three Cs. The IAB active measures may not be new innovative ideas; however, these measures have led to strong industry-departmental connections and partnerships.

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