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Building Action-Oriented Collaborations with Industry Advisory Boards to Promote Entrepreneurial Mindset Learning (EML)

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Building Action-Oriented Collaborations with Industry Advisory Boards to Promote the Entrepreneurial Mindset Learning (EML)

Industrial Advisory Boards (IABs) assist academic programs with the accreditation process and ensure that the curriculum maintains currency to meet the demands of the rapidly evolving workplace. In addition, IABs provide students with employment and internship opportunities to bridge the gap between classroom materials and practical experiences. Most IABs have bi-annual or annual meetings at academic institutions to provide feedback and general program assistance. However, this feedback may take a long time to be implemented due to a lack of initiative and follow-up between meetings, leading to a lack of meaningful engagement from the IAB members. To mitigate these issues and generate action-oriented collaborative partnerships between academia and IABs, we have applied Strategic Doing (SD) principles to workshops held with the IAB members. Strategic Doing is a framework developed by the Agile Strategy Lab at Purdue University to help form collaborations quickly and move these collaborations towards actions with measurable outcomes. The SD framework involves ten simple rules which result in a non-hierarchical collaboration between academia and IABs. This framework focuses on action in 30-day cycles, so the IAB members stay engaged as partners for longer periods. In this paper, we present the details of the SD workshop conducted with the IAB members of the University of Wisconsin-Platteville's Mechanical Engineering and Industrial Engineering Department (MEIE) and Rowan University's Civil and Environmental Engineering Department. We also present the partnership projects developed as a part of these workshops at both universities. We believe that these collaborations will lead to industry insights in our programs that will map to Entrepreneurially Minded Learning (EML), a pedagogical framework developed by Kern Entrepreneurial Engineering Network (KEEN) to promote graduates to become value creators for their organizations. This focuses on developing skills in undergraduate engineering students such that they are poised to create extraordinary value in their future organizations. EML seeks to expand the notion that design is focused on technical skills but rather that engineers should also understand the broader context of their decisions and they should recognize the potential impacts.

This approach of generating collaborative partnership projects between IAB members and academic institutions using SD was first done with the University of Wisconsin-Platteville's MEIE Department in Spring 2022. The participants participated in the SD process of 10 rules over 3 hours, to generate Pathfinder projects that have a high impact and are easy to accomplish in a short time frame. Nineteen industry partners, five faculty members, and 4 staff from institutional advancement participated in the workshop to explore the Framing Question "Imagine that University of Wisconsin-Platteville's MEIE graduates exceeded their employer's expectations of how much value they create for their employer. How might we get there?" From this workshop, four partnership projects were developed and implemented for the 2022-2023 academic year. Subsequently, this approach was implemented at Rowan University's Civil and

Environmental Engineering Department during the Fall 2022 semester. The participants of the workshop included 7 IAB members, 3 faculty, and one faculty member from <University3>. The participants were divided into two groups of 6 people each and were provided an appreciative framing question, “Imagine if Rowan University’s CEE department had a strong partnership with local industry, what would that look like?”. These Pathfinder projects will be implemented in early Spring 2023.

Background

Industry advisory boards (IABs) are composed mainly of industry professionals that provide aid and advice to an academic institution. IABs serve many purposes and have different goals depending on the type, size, location, and other variables. In engineering, IABs are a common component among many programs because they help fulfill ABET’s accreditation requirements. ABET is the accreditor of college programs in applied science, computing, engineering, and technology that ensures programs meet standards for educational quality to properly prepare students [1]. Engineering Criteria 2000 (EC2000) was added to the accreditation and required programs to have “a process based on the needs of the program’s various constituencies in which the objectives are determined and periodically evaluated” [2]. The result of EC2000 was the need for programs to identify constituencies to gain evaluation and input from; most programs identified their constituencies as students, industry, and alumni [3]. Hence, IABs were established by many programs to include these constituencies to meet the accreditation requirement.

IABs also inform engineering curricula by keeping coursework current. IABs gain feedback on employee experiences and needs by involving external industry professionals. In turn, academic institutions alter their curriculum so that their graduates have the most in-demand skill sets and knowledge [4]. Increased communication between course instructors and industry professionals also leads to more valuable learning in the classroom for students. The course content can become integrated with more real-world examples so students can directly apply concepts and theories learned in the classroom to industry, which gives them a better understanding of the material while simultaneously preparing them for the workforce [5].

IABs are sometimes used to provide opportunities for students to benefit through offering internships and employment opportunities. The Structural Design, Construction, and Engineering Technology Advisory Board at Penn State Harrisburg [6] emphasizes networking between external professionals and students at specific career job fairs, through guest speaking in-class lectures, and assistance on field trips. The result is consistent opportunities for internships and permanent jobs for students. Other IABs set up more direct partnerships that offer internship and employment programs specifically for their students. East Carolina University’s College of Technology and Computer Science has a partnership with Cisco that gives 12 co-ops and internships each year. In their program, co-ops and interns are expected to work 40 hours per

week, work towards industry certifications, and maintain a 3.0 GPA. Graduates receive valuable work experience and are often offered full-time jobs before graduation [4].

Not only are IABs valuable for the academic institution but also prove beneficial for participating industries. IABs create more job-ready and skilled students entering the workforce, so less time and energy is spent training new hires. Potential student hires are often a "neglected population," but are an important group that can increase the efficiency and productivity of a company [7].

Industry-based projects, or capstone projects, are a common example of how IABs can directly implement their experiences in the industry to make students familiar with their day-to-day work. [3] researched the role of IABs in the two-semester capstone design project in the Electrical Engineering Department at the University of San Diego. The advisory board was highly involved in the project: attending the presentations, changing the structure of and brainstorming ideas for the project, and aiding lectures on professional topics. The result for students was more current, hands-on knowledge related to the industry. In a study by Hurtig and Estell [8] at Ohio Northern University, industry involvement in their capstone design project also received positive feedback from students. In the Electrical and Computer Engineering and Computer Science (ECCS) Department, they have a year-long, three-course senior design sequence with projects sponsored by both faculty and industry. The ECCS IAB provided external feedback through project group interactions. The result of IAB involvement has improved the quality of the project designs and enhanced the student experience. Student evaluations gave positive feedback on the course, and many students indicated their enjoyment of taking a starting idea to an actual working product at the end of the project.

Entrepreneurial Mindset (EM) is defined as mental habits that empower the ability to question, adapt, and make positive changes. KEEN is a network of institutions that are working to change the face of engineering education to include not only instruction in technical skills but to provide space and guidance to develop this Entrepreneurial Mindset. KEEN refers to this Entrepreneurial Mindset Learning (EML) as the 3 Cs: Curiosity, Connections, and Creating Value. Applying the KEEN framework to engineering education transforms instruction and better equips graduates to solve engineering challenges in a way that adds value to their organizations and society as a whole [9]. The need for teaching an entrepreneurial mindset goes beyond business schools and is especially important for engineers. Combining EM with the problem-solving nature of engineering leads to open-minded engineers that can effectively work as a team to offer innovative solutions. It is also recognized that many engineering graduates enter roles in an industry that require business and entrepreneurial skills [10].

In an undergraduate statistics course [11] teams of students chose topics of interest to them to present the challenge of "A World Without Statistics." Throughout the project, EM was integrated as students were able to explore ideas, they were curious about, draw connections

about the value of statistics in topics that did not seem naturally statistics-related, and understand the value of statistics. Implementing project-based learning into the course showed the potential of engineering students in developing an EM. Similarly, at Rose-Hulman Institute of Technology, the 3C's are incorporated into their summer program. In the program, teams of multi-disciplinary students are given a unique geographic location and tasked with finding issues that need to be addressed there, enabling their curiosity. Students draw connections from their respective disciplines to work together to come up with a unique solution, and value is created as their solutions are meant to improve the quality of life for the people in their region [12].

To incorporate EM learning (EML) into academic institutions, industry involvement is essential, and IABs ought to play a major role. Yet IABs are often an "untapped resource" for their academic institution. Many different tools and surveys exist to assess and evaluate the effectiveness of an IAB [1], [13]. These tools serve to address the common weaknesses of IABs; common weaknesses include vague roles and responsibilities of board members [14], meeting organization concerning how often IABs meet, the dedication of board members [1], and the lack of short-term plans to achieve long-term goals [15].

Strategic Doing

To address the issues that are commonly faced by traditional approaches used with IABs, a consortium of five universities plans to use Strategic Doing (SD) workshops with IAB members to promote collaborations and accomplish their objectives. The objective is to transform Industry Advisory Boards into Industry *Partnership* Boards (IPBs) to give members a more active role to directly contribute to program outcomes, and course materials, assist in capstone projects, and more. SD is a framework specifically designed to help form collaborations quickly and move these collaborations towards actions with measurable outcomes. It identifies common objectives between organizations and allows them to define, test, and iterate their objectives. The process has four main questions and ten simple rules. The four questions essentially ask about the potential opportunities that the organization can accomplish, then narrow down to what options should be pursued, followed by how they will pursue the chosen opportunity, and plan the next meeting in 30 days. The ten rules are outlined below in Figure 1. The result is a non-hierarchical collaboration between organizations that is focused on action in 30-day cycles, so momentum is not lost like in a traditional approach.

10 Rules of Strategic Doing

- Create and maintain a safe space for deep, focused conversations.
  - Frame a conversation around an appreciative question.
  - Uncover hidden assets that people are willing to share.
- Link and leverage your assets to create new opportunities.
  - Rank all your opportunities to find your "Big Easy."
- Convert your "Big Easy" into an outcome with measurable characteristics.
  - Define at least one Pathfinder Project with guideposts.
- Draft a short-term section plan with everyone taking a small step.
  - Set up a 30/30 meeting to review progress.
- Nudge, connect and promote relentlessly to build your new habits of collaboration

Figure 1. Ten Rules of Strategic Doing.

This method has been implemented numerous times by a variety of organizations including a citizen planning commission in Ascension Parish, Louisiana. Ascension Parish is a site of major, potentially dangerous chemical plants with a growing residential population starting in the 90s. Residential development was reaching closer to the site of the chemical plants as conservative politics made it difficult to pass zoning ordinances. SD was implemented as citizens met monthly and explored the challenges of the new residential development to draft a development code that would be submitted to the county's council. SD played a crucial role in getting the development code passed as the participants were given a full understanding of the process, worked under rules of civility to think strategically, and visualized what they wanted their county to look like with the new zoning ordinance. The resulting development code passed the council unanimously and was enacted three years later [16].

Strategic Doing Implementation at the University of Wisconsin-Platteville

Pre-workshop Preparation

The University of Wisconsin-Platteville's Mechanical and Industrial Engineering (MEIE) IAB meets bi-annually as a full board but has a campus steering committee that supports planning. This steering committee consists of members of the faculty from both programs, the senior design coordinator, and the department chair. This group met to plan out a Strategic Doing workshop for the Spring 2022 IAB meeting. The framing question "Imagine that University of Wisconsin-Platteville's MEIE graduates exceeded their employer's expectations of how much value they create for their employer. How might we get there?" was discussed by the steering

committee. This framing question is connected to the Entrepreneurial Mindset to find ways that collaboration between academia and industry could prepare our students for future careers and excel at them.

The workshop was communicated to the MEIE IAB members, department faculty, and other University staff. In that communication, attendees had to commit to attending the entire 3-hour workshop. From the responses, tables and therefore project teams were assigned.

Workshop

Nineteen industry partners, five faculty members, and 4 staff from institutional advancement participated in the workshop. These 28 participants were divided into 4 groups, each of which had a faculty member acting as a "Table Guide". Each Table Guide is a trained faculty member that has undergone a Strategic Doing workshop to lead a session of Strategic Doing with one group. The session was led by a Strategic Doing certified practitioner. One of the four groups attended the workshop virtually while the table guide was seated in the room. This team worked together on Zoom using an online collaboration space through Mural. This interaction added a level of technology complication to the workshop but with advanced preparation of the online workspace, the table was able to work through the same 10 Strategic Doing rules with the rest of the in-person teams. The list of projects and their descriptions from this Strategic Doing session are listed in Table 1.

Table 1: List of Pathfinder projects and their descriptions

Project Name	Description
Alumni Professional Preparedness Assessment	The team created a survey that assessed a variety of skill sets that are commonly expected of engineering professionals. The team created several iterations of the survey and administered it in October 2022. The responses are currently being analyzed and a summary will be presented at the Spring 2023 IAB meeting
Scrap Challenge	The intent was to have students utilize scrap materials donated by a company to design and manufacture something, competing against other teams. This was designed to provide student participants an opportunity to interact with the company and do something fun and hands-on at the same time. The event was held in November 2022 with one team competing.

Engineering Seminar Series	This team envisioned a seminar series to leverage industry experience to help faculty and students understand the primary motivations in hiring employees based on educational attainment and professional achievements. The objectives are to foster student growth and development through exposure to industry practices through live, in-person seminars. One seminar has been provided so far in September 2022.
Introduce Industry Projects in Courses Before Senior Design	This project sought to build on the success of our senior design course by soliciting companies to provide projects for courses in the sophomore and junior years. This project is still in progress.

Post-workshop

After the workshop, attendees were asked to give feedback through an online survey. While the response was positive and attendees enjoyed the process, we noted a couple of areas that we would have done differently.

The framing question was developed by a core planning group and was disseminated at the beginning of the workshop. This likely contributed to some confusion about our overall goal as well as some internal conflict as some tried to shift to brainstorming solutions while they were still thinking through the framing question. We shared this with our collaborators so that the next group could spend more time with the framing question before starting the rest of the Strategic Doing workshop.

Table guides continued to set follow-up meetings as recommended by the Strategic Doing method. The 30/30 meetings, as they are called in Strategic Doing, should update everyone on the status, decide the next steps, and establish action items for the next meeting. We noticed that groups were continuing to meet on the projects they defined, but that they were no longer meeting on things they were previously working on for our IAB. Overall, IAB has 4 sub-committees: ME Curriculum, IE Curriculum, Resource Development, and Alumni Engagement. In retrospect, forming tables to mirror these committees may have encouraged more activity in these established areas as opposed to forcing IAB members to choose which to focus their time on.

Strategic Doing Implementation at Rowan University

Pre-workshop Preparation

Based on some of the discussions and lessons learned from the University of Wisconsin-Platteville implementation, some changes were made to the Rowan University implementation. The appreciative framing question was developed using input from the faculty and administrative staff in the department. An email was sent with a survey with three different questions generated by the Department Head and the table guide. The appreciative question was also discussed during the department meeting due to the low response rate to the survey. The appreciative question was chosen during the department meeting after a short discussion with all the faculty present during the meeting.

To maintain a safe space for deep focused conversations, according to rule 1, round tables were used so nobody was leading the group. An agenda was prepared with a general timeline for each rule as well as a short lunch. The appreciative framing question was also presented in the agenda and for Rowan University, the appreciative framing question was, "Imagine if the Rowan University CEE department had a strong partnership with local industry, what would that look like?" The IAB members were also sent a short introduction to Strategic Doing and a blank biographical sketch as shown in Appendix A. This biographical sketch was asked from each participant attending the meeting to make them contemplate their assets ahead of the workshop. Extra copies of the biographies were also printed for the workshop day and were given to the IAB members who did not fill out this form ahead of time. The IAB members were also given links to the Engineering Unleashed website which showcased the Entrepreneurial Mindset Framework. The total time allotted for the workshop was about 2 hours and 45 minutes with 1 hour and 40 minutes allotted to the workshop itself and the remainder of the time was spread between welcome remarks, lunch, reflection, and concluding remarks.

Workshop

On the day of the workshop, we had a total of 12 participants in attendance consisting of 7 IAB members and 4 faculty from the Civil and Environmental Engineering Department. In addition, we also had a faculty from a collaborating university, Drexel University, as one of the participants. We split the participants into two groups with six participants per table. The participants started the workshop after a brief introduction to the Strategic Doing process and the 3 Cs of the Entrepreneurial Mindset.

The workshop started with Rule 3 (refer to Figure 1) and in Group 2, there was some difficulty generating projects by linking the assets as a part of Rule 4. Group 1 followed the traditional format of generating projects based on the assets available. This was resolved by going into a divergent process where the participants listed all the possible projects that are possible about the appreciative framing question. This list of projects was narrowed down to something achievable with the available assets in the Group as a part of Rule 4. Three projects were selected from the total list of these projects and were ranked for "High Impact" and "Low Difficulty for Implementation". The project that ranked high among these criteria was chosen as a Pathfinder

project. The Pathfinder projects were then converted to measurable outcomes to describe the success of the project. Finally, a task list was prepared and assigned to different IAB members. In addition, a follow-up meeting was scheduled for each Group at the end of the workshop. A brief description of the Pathfinder projects, their descriptions, success metrics, and task lists are shown in Table 2.

Table 2: Brief description of the Pathfinder projects and their milestones

	GROUP 1	GROUP 2
Pathfinder Project	Social Event with Industry	Industry Seminar Series for Student Organizations
Description	Students pursue career paths they are interested in, and industry professionals provide experiences and expectations.	IAB members will facilitate a panel that will be hosted by ASCE for other student organizations. This will be hosted every month rotating panels with different themes/disciplines
Success Metric	• Number of participants • Student elective and guest area of expertise • Feedback from students and guests	• Survey showing the student interest after the event. • Connection/engagement with the panelists (# of questions asked) • Student Attendance
Task List (Goal Post)	• Schedule of Events (Nov 7th) • Talking Points (Nov 7th) • List of Guests (Dec 7th) • Actual Meet up (Jan 2023)	• Identify themes/divisions/speakers (Nov 7th) • Build Agenda (Dec 1st) • Identify logistics (Jan 31st) • Event Date (Feb 2023)
Follow-up Meeting (30/30)	Meeting Date: 1 PM, 11/7/2022, Virtual	10 AM, 11/10/2022, Virtual

Post-workshop

After the workshop, the teams were able to attend the follow-up meeting in November. All IAB members that were part of the workshop continued to stay in touch with the team and were able to complete the tasks assigned as part of the workshop. Group 1 was able to complete the “Social Event with Industry” ahead of schedule. This event was conducted as a part of a course called “Civil Engineering Practice” which is a required course for all Civil and Environmental Engineering students in their fourth year. Several local industries were invited to this event and included some of the alumni. This also included one of the IAB members from Group 2. The

companies that attended this event were: American Water, Langan Engineering and Environmental Services Inc., J Fletcher Creamer & Sons Inc., NJEDA, Envision Consultants Ltd. Sevenson Environmental Services Inc., and AECOM. The event was a tremendous success as it was attended by all the fourth-year students who were able to talk to the industry members. The industry members presented their areas of expertise and the projects in which they are currently involved. The students were asked to dress professionally and bring printed copies of their resumes. The students were divided into small groups and were rotated among the companies by the graduate students. This event was also attended by some of the faculty of the Civil and Environmental Engineering department. Based on the feedback received from the companies and the students, this event was well-received by both groups. However, some of the students felt that they needed to be prepared better by the faculty to attend this event. The emails from the alumni who attended with their companies and the students who participated in the event showed a lot of positivity and enthusiasm. Students were excited to meet and interact with the companies.

The Group 2 Industry seminar series is currently scheduled for February 24th as a part of the ASCE Chapter meetings. We have invited three speakers from the water utility industry from two different states. In addition, the speakers are also at different points in their careers as their graduation dates are 2005, 2015, and 2020. The purpose of this seminar series was to introduce the day-to-day activities of an engineer in the field as well as the granularity of their work at different career levels. Each speaker was provided with 10 minutes to present their career progression as well as details of a project. After 30 minutes, the students asked questions and the panel was moderated by the ASCE Chapter President. We have also prepared a list of questions for the panelists to discuss in case there are fewer questions from the students. This event was attended by 30 students of different students at different levels. The presentations from the speakers were general enough that the students were able to connect to their professions in different ways. The event was a success with student participation and engagement. In addition to this, we also had an industry panel with experts from the construction and contracting industry on March 24th, 2023. This seminar series had similar attendance in terms of the number of students. Overall, the students that attended these series were enthusiastic and engaged with the speakers by asking them relevant questions.

Finally, we related all the Pathfinder projects presented in this workshop with the 3 Cs of the Entrepreneurial Mindset as shown in Table 3 below.

Table 3: How do these projects relate to EM and 3 Cs?

Curiosity	• Students are exposed to new fields of civil and environmental engineering in practice. This develops curiosity to learn more about these concepts

Connections	• Students make connections to real-world practice through the talks by industry professionals. • Students talk to industry professionals and fellow students during social events and build networks
Creative Value	• Students will see the value created by the industry professionals through the projects presented during these industry panels

Summary

The IABs at both universities were pleased with the SD process; the workshops were fast-paced, and all participants were actively engaged. Participants were complimentary of the overall framework, found it to be well-structured, and used the word 'energizing' to describe the workshop. Participants nearly uniformly left the meeting with high hopes based on informal exit interviews.

Unlike traditional brainstorming, the SD projects arising from the workshop were based on assets that participants were willing to share, greatly increasing the probability that they would be implemented. We also observed that the process has the potential to lead to 'emergent ideas' as opposed to participants coming in with pet projects. It seems likely that the process will lead to the board acting as a collaborative network (i.e., committed to co-creation) in the future.

We have also learned that facilitating a Strategic Doing IPB session from scratch requires a broad skill set, significant training, an active and skilled support team, and extensive preparation. We have observed that some projects require significant work by academia members as opposed to industry members, in carrying out. Faculty/staff need to carry out preparations for some events (e.g., reserve rooms, order catering) that represent additional work for them. In two instances at the University of Wisconsin- Platteville, the industry members were very invested and committed to the project and were disappointed when only a few students participated. In subsequent iterations of SD with IABs, we have made sure to have students participate in the IAB SD workshops – they bring a real voice about what is appealing to students and can tap their network of fellow students to attract participants.

We are very pleased with the projects that have been started and/or completed; they represent true industry/academia collaboration. Although none of these have necessarily been ground-breaking, they have built trust among participants, and trust will lead to future projects and future success. We believe that transformational change happens in a stepwise manner by people who are invested in and inspired by an appreciative Framing Question and who build trust through co-creation.

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Appendix A – Biographical Sketch for Rowan SD Implementation

Rowan University Civil and Environmental Engineering Department Industrial Advisory Board Strategic-Doing Workshop

Strategic Doing teaches people how to form collaborations quickly, move them toward measurable outcomes and adjust along the way. In today's world, collaboration is essential to meet our complex challenges. Strategic Doing enables leaders to design and guide new networks that generate innovative solutions. It is a new strategy discipline that is lean, agile, and fast—just what organizations, communities, and regions need to survive and thrive.

During the day of the workshop on October 7th, we will generate ideas for collaborative projects based on the framing question, "*Imagine if the Rowan CEE department had a strong partnership with local industry, what would that look like?*" To streamline the process, please complete your profile below. An example profile is provided on the second page.

Name	
Title	
Affiliation	
Short Biography (1 or 2 lines)	
Hobbies	
Assets you are willing to share (physical, skill, social, or capital)	

Please note that the **assets** in the above table must be specific and actionable assets that you are willing to share. You should also have immediate access to these assets. For example: instead of saying that you have good connections, you can specify that you have connections in the county office (for example).