Summer 2024 Strategic Initiative: Design

Description of work completed and use of funds

Our initiative focused on bringing people within the college together around engineering design. Past conversations and gatherings related to design have been well received yet unsustainable as far as frequency and yielding impactful change. While past events have been light on agenda items, this session was more structured in order to provoke conversation on multiple fronts. This working group was focused on answering 3 questions:

1) What do we do? Defining design and exploring our existing design experiences.
2) What do others do? Asking those in our networks about design experiences at their institutions and reviewing published work from the capstonedesigncommunity.org site.
3) What should we do next? Identify new opportunities as well as areas where current work should be changed or sunsetted.

During the summer, this group met four times, a kick-off 1-hour meeting followed by three two-hour meetings. Each meeting had a different focus: (1) Planning meeting to set goals, (2) design internal to Bucknell, (3) design at other engineering institutions external to Bucknell, and (4) possible initiatives for the college to pursue. The meetings were held on 6/7, 7/12, 7/25, and 8/12.

At the first meeting, participants shared their motivations for participating in the group, and we set goals for the rest of the summer.

Prior to the second meeting, participants documented what each dept and IDSD do for design, including definitions and experiences. We then discussed these internal design findings at the first meeting, looking for common themes and opportunities.

Prior to the third meeting, participants reached out to colleagues at other institutions and/or reviewed the literature (including the Capstone Design Community site) to learn more about best practices at other institutions. We then discussed these external findings at the second meeting, looking for common themes and opportunities and comparing our internal findings to these external findings.

Prior to the last meeting, participants brainstormed and documented possible initiatives for the college to pursue based on the findings from internal and external research and discussions at the previous meetings.

The funds were spent on food for the meetings and stipends for the regular participants.

Description of stakeholder engagement

This group sought to engage faculty members in each department who work regularly with departmental design experiences, especially capstone courses, as well as instructors of IDSD. Interactions/contributions of the faculty members have been documented above (Description of work

completed). As discussed above, external constituents (faculty and design-focused individuals at other institutions) were consulted as part of the initiative work.

Regular participants: Stu Thompson (organizer), M. Laura Beninati, Alan Cheville, Donna Ebenstein, Kevin Gilmore, Charles Kim, Deborah Sills, Brandon Vogel, Kat Wakabayashi

One-timers: Eric Kennedy, Jonathan Torres, Ryan Snyder

Findings

Internal - see Appendix A
External - see Appendix B

Recommendations for implementation

The group believes that engineering design has become a larger part of the student experience and each department's focus. We are not dissimilar to other places with this growing focus (*c.f.* Froyd, Wankat, and Smith 2012) and there seems to be an interest within the group to continue to grow this part of the experience. Creating through design is of interest to students, supported by many faculty, and the results of the process often provide things we can show off to the outside world.

After discussing the different proposed initiatives at our final meeting, the initiatives were grouped into three categories:

- Engineering Design Focus & College Branding,
- Curriculum Development & Interdisciplinary Integration, and
- Partnerships & Project Sourcing.

There was a realization that to grow engineering design within the college would require additional time and staffing. We believe that it would be advantageous to the college to find someone with considerable design experience to help lead and support some of the proposed efforts, especially those related to Curriculum Development & Interdisciplinary Integration. A professor of practice would be best suited to support these efforts but without the additional load of a TT faculty member, these folks would have the time to lead and support multiple efforts, as well as the experience in industry needed to enhance design solutions' success.

We recommend the college "double down" on engineering design. Such an action reflects the increased interest in design across the college by adding design to the Bucknell COE brand. Students come to engineering to "do" and develop their skills as 'makers', so we should lean into that. The departments and College have a sufficient number of design experiences–with some departments having multiple semesters of design–that this doesn't require much additional work. In other words, we argue that not much is actually needed to emphasize how design plays a major role in our engineering programs. To show support for the existing efforts and to give more time to these efforts, we believe that the college needs a group to support collaboration across departments; we hesitate to call it a committee because that makes some shudder, but more structure in this space would help keep ideas flowing and communication growing.

Next we have a collection of curricular and class ideas that could be explored. These are listed below. Many focus on broadening the number of opportunities for our students and students across campus to engage in design. The people in the group with chair experience note that the path to additional positions and resources is related to increasing the number of people in seats, especially if those people are from outside of the college. Engineering has long been a consumer of the rest of the university. We need to reposition ourselves to be more of a supplier and look for ways to attract students across campus to come do engineering. We also see engineering as a leader in preparing students to understand and be able to work with the technology of today and the future - skills increasingly being referred to as 'technological citizenship'. Artificial intelligence is a really simple example of how technology can reshape what's happening across the workforce. The final item in this list relates to IDSD and "calling the question" on the course. Those in the group could not find consensus on the course except around the need to either better support it or let it go. We see benefits and challenges on both sides.

Lastly the group saw the need to think more about how design in the college connects with the outside world and seeks external grants through sponsors. With Logan's departure and the known challenges of sustainably finding projects for courses it is clear that a different approach is needed. Additionally, there is a need to continually get feedback from the outside world related to design and continue to understand how it is done and how it evolves. We believe this also relates to where projects come from because societal interests change over time as well.

We believe there are a lot of good things happening related to engineering design right now and we see great opportunities in the future but additional resources and structures are needed to take advantage of those and ensure the long-term viability of the college.

List of initiatives:

0. Hire Professors of the Practice to Support Interdisciplinary Design

Initiative: Hire Professors of Practice for Interdisciplinary Design

- **Priority:** Medium (rationale: support for interdisciplinary teaching and alignment)
- **Timeframe:** Long (2+ years)
- **Desired Outcome:** Hire experts to teach and align disciplinary and interdisciplinary design. These experts would also support many of the other proposed recommendations below, especially those under Curriculum Development and Partnerships.
- **Involved Parties:** Dean, advancement, design instructors

1. Engineering Design Focus and Rebranding

Initiative: Branding the COE with a focus on engineering design

- **Priority:** Medium (rationale: emphasis on future impact and student opportunities)
- **Timeframe:** Medium (1 to 2 years)
- **Desired Outcome:** Establish COE as a leader in engineering design, enhancing student career prospects and societal impact.
- **Involved Parties:** Various departments, admissions, alumni

Initiative:Create a college group focused on Engineering Design

- **Priority:** High (rationale: facilitates coordination and branding efforts)
- **Timeframe:** Short (1 to 2 semesters)
- **Desired Outcome:** Create a group focused on design collaboration and brand development.
- **Involved Parties:** Faculty, SBDC, CCA, advisory boards, advancement

2. Curriculum Development and Interdisciplinary Integration

Initiative: Design Courses for Non-Majors

- **Priority:** High (rationale: expands course access and improves reputation. We argue that technology and design should be part of a liberal arts education)
- **Timeframe:** Medium (1 to 2 years)
- **Desired Outcome:** Offer design courses to non-majors to enhance resumes and integrate engineering with other disciplines. This also provides us with students who can take our courses and increase enrollments in the college.
- **Involved Parties:** Faculty, curricula committees, Dean's office, Provost

Initiative: ENGR 200: Interdisciplinary Sophomore Design (possibly with SBDC)

- **Priority:** Medium (rationale: promotes early interdisciplinary exposure)
- **Timeframe:** Medium (1 to 2 years)
- **Desired Outcome:** Offer interdisciplinary design experiences with local industry.
- **Involved Parties:** Design faculty, SBDC, industry partners

Initiative: Minor/Concentration in Engineering Design

- **Priority:** Medium (rationale: the minor would attract non-engineering students, and the concentration would provide an avenue for engineering students interested in design and a way to engage with this more formally.)
- **Timeframe:** Medium to long (1 to 2 years to 2+ years)
- **Desired Outcome:** Develop a minor to engage non-engineers in design.
- **Involved Parties:** Faculty, design instructors

Initiative: Ethics in Design

- **Priority:** To be determined (importance of ethical considerations in design)
- **Timeframe:** To be determined
- **Desired Outcome:** Integrate user-centered design and ethical considerations. Improve adherence to ABET outcome 4 across all departments in the College.
- **Involved Parties:** Faculty, ethics committees

Initiative: Calling the Question on "Interdisciplinarity" of Design

- **Priority:** High (rationale: need for assessment and clarity on interdisciplinarity)
- **Timeframe:** Medium (1 to 2 years)
- **Desired Outcome:** Evaluate and refine interdisciplinary design initiatives. This was framed as 'calling the question' since while interdisciplinary design is an espoused value, it is not currently well supported and has not substantially changed over the last several years.

- **Involved Parties:** Faculty from multiple departments, Dean, AD

3. Partnerships and Project Sourcing

Initiative: Explore Project Sourcing Options

- **Priority:** High (rationale: address the need for sustainable project sourcing)
- **Timeframe:** Short (1 to 2 semesters)
- **Desired Outcome:** Identify and implement sustainable project sourcing strategies following Logan's resignation. Finding projects at a department level places a large burden on design instructors.
- **Involved Parties:** To be determined

Initiative: Relationship Building with Community and Industry Partners

- **Priority:** High (rationale: strategic partnerships enhance student opportunities)
- **Timeframe:** Short (immediate action needed)
- **Desired Outcome:** Establish and maintain strategic partnerships with industry.
- **Involved Parties:** COE deans, SBDC, BEAA, Innovation and Entrepreneurship Center

Initiative: Establish Industry Advisory Board

- **Priority:** Medium (rationale: ensure curriculum relevance and industry readiness)
- **Timeframe:** Medium (1 year, ongoing)
- **Desired Outcome:** Keep curricula aligned with industry needs.
- **Involved Parties:** Dean's Office, department chairs, advisory boards

Measures of success if implemented

Bucknell has long been known as a leader in engineering education. Examples of this include: Mike Prince's CATALYST and his participation in NETI workshops, Margo's BFab workshop, our leadership in the KEEN network, and the ECE RED grant. We continue to show, year after year, that we have ideas that others are interested in and we offer innovative solutions for the challenges that many engineering programs are faced with today. Success in a nutshell is related to recognition of the Bucknell name as a leader in engineering education by faculty, parents, peers, and current and prospective students across the country to improve our recruitment efforts.

Many possible measures of success can be considered if these initiatives are pursued. For example, enhancing our interdisciplinary design experiences for all students could give Bucknell more visible name recognition among similar schools and provide a framework for enrollment management to better communicate the value of a Bucknell education. Enhancing design opportunities for students may also help us increase and/or target enrollment if we get the message out in a way that has broad appeal (we would need to work with enrollment management) across many demographic groups. In addition, enhanced design opportunities early in the curriculum may increase retention if the efforts impact more on the program's first two years since they provide alternative pathways to student degrees.

Some specific sample success metric could be:

- An increase in the number of engineering education publications (papers, workshops, etc.) related to design, over the next 3 years.
- An increase in the number of students connecting with the various design opportunities that fall outside of their requirements, especially those from outside the college.
- The connection of a university requirement with engineering - currently, it is challenging to offer an engineering course that connects with a CASCC requirement.
- An increase in the number of engagement opportunities with engineering design. For example: a new curricular track/minor/thread/certificate/stamp centered around “engineering design” is available for students, and the number of students receiving it is sustained over the next 5 years.
- An increase in the number of non-engineering students who receive credit in engineering courses.

How this will connect to or enhance existing resources or programs on campus

The initiatives proposed here leverage and enhance existing resources and experiences and create new ones. Some examples are provided below.

Leverages existing resources and experiences:

- SBDC
- Disciplinary design courses (and instructors)
- CoE advisory board
- BEAA
- Innovation and Entrepreneurship Center

Enhances:

- Interdisciplinary design opportunities for engineers
- Ability to form long-term relationships with industry and other local partners
- Communication between departments about best practices in design courses

Creates:

- Engineering design course opportunities for non-engineers
- Opportunity for branding that leverages Bucknell’s unique identity as a liberal arts university with three vibrant colleges

How this will positively impact students

From assessment data, we know that some of the most valued experiences students have in engineering degree programs at Bucknell are those obtained in design courses. A significant amount of research (e.g., Capstone-to-Work) points to the value of design experiences post-graduation. Investing in design opportunities for our students, such as by leveraging advisory boards and industry partners to ensure that our design courses prepare students for the workplace, hiring professors of the practice to ensure consistent and quality design education, and opening up design courses to the entire university to provide true interdisciplinary student design experiences, has the potential to positively

impact students in engineering and across the university. If we are successful in making connections with industry and other external stakeholders, we believe more resources will become available which can be used to support more opportunities for students further into the future.

How this connects to the strategic goals of the college and/or university

Connecting with the university strategic plan
Design is an activity that is common across all human endeavors and extends beyond academic siloes. As the philosopher Steven Goldman points out (S. L. Goldman, “Why we need a philosophy of engineering: a work in progress,” *Interdisciplinary Science Reviews*, vol. 29, pp. 163–176, 2004), engineering presents a different way of looking at the world, which is valuable in today’s technological age, to create a more expansive definition of liberal arts that can be unique to Bucknell. Expanding interdisciplinary design opportunities for all students on campus supports the strategic goals at the college and university level of working at the intersection of the three colleges and leveraging our unique identity.

Cross campus opportunities
Engineering design is one of the few areas of engineering where we can actively engage students from across campus. We must have the input of multiple stakeholders and multiple disciplines and engineering design to make appropriate and reasonable decisions. We should be looking for ways to engage students and faculty across campus to help us improve what we are doing and help us understand the impact of our designs.

Building and sustaining a diverse community
Engineering design has shown time and time again to be a way to engage students from a variety of disciplines and from a variety of backgrounds. Engineering design is known to be a way to attract students from underrepresented groups to engineering and also a way to increase retention of all students and engineering. The traditional model of engineering education focused a lot on engineering science where engineering design is a much broader category of engineering albeit a subset of engineering but there's a lot more space within engineering design to allow a diverse community of students to focus on things beyond just math and science.

Creating a sustainable future
Engineering is the way to create a sustainable future for the University and for all entities. technology is the way we have changed what we do and how we do it in order to lessen our footprint on the planet and better use the resources we have. By engaging more students and faculty and staff in engineering design we will help others understand the challenges and the approaches to helping the planet.

Connecting with the college strategic plan - Enhancing our engineering educational experience
Having a good balance of engineering science and engineering design helps a program not only instill the fundamental concepts in students but allows them to practice those concepts and better understand them. Engineering design is often the way that students engage with authentic real world problems and learn more about how engineering solutions can help the world as well as develop guiding principles for a transition to a more sustainable future..

Fostering a diverse and Equitable environment
(see comments related to the university strategic plan)

Champion our distinctive identity
Engineering can happen in a bubble or it can happen in a well-informed environment. Bucknell's three College structure and the ease of working across the different silos in the University presents a unique opportunity for our students to engage with students outside of engineering as well. Engineering in the liberal arts with students minoring in Arts & Sciences is a strength that can be better harnessed to yield better design solutions and improved systems-level methodologies. Facilitating these connections for students and guiding the transfer of skills would be the focus of these design experiences. We should be looking for opportunities to bring others into our classrooms and go into their classrooms so that our students are better suited to deal with the challenging problems of today and tomorrow. We can also leverage our close faculty student interactions to help students get excellent mentoring and support as they explore new and interesting authentic challenges.

Foster existing connections and cultivate new ones
A major aspect of ensuring the sustainability of engineering design at Bucknell is finding a sustainable way to get new and interesting projects for students. We believe this is built on fostering relationships with external entities including companies, community organizations, and entrepreneurs looking to create new ideas. by expanding the number of avenues we use to find projects we can build new relationships and create new opportunities for students. We believe those will pay off in the short run with projects and experiences for students as well as in the long run by more support and connections for the college as a whole.

Proposed implementation timeline and approximate budget with justification

Form a task force (2 to 3-year commitment - engineers, SBDC rep + others outside engineering with interest in design) to prioritize and develop an implementation plan and budget. Membership for this task force could change with new folks being hired or recruited. Task them with:

- Explore interest in developing minor/concentrations, including plan for developing and launching courses for non-majors
- Investigate best practices in developing long-lasting industry partnerships and work with past industry partners to identify their needs and wants and evaluate past partnerships
- Identify viable software and/or platforms to solicit sponsors, as well as gauge student interest in particular projects to possibly sustain ‘design clubs’ or ‘design competitions’.
- Explore how to integrate different types of projects and partnerships into existing courses (community engagement, corporate, etc.). Ensure multiple sustainable paths are in place to ride out changes in partner interest to ensure a steady stream of projets from year to year.
- Meet with BEAA and CoE Advisory Board annually to discuss industry-ready skills
- Develop plans and budgets for future initiatives
- Supporting the search for one or more professors of practice (fundraising, creating the job description, searching, etc.)