



Engineering Leadership: A New Engineering Discipline

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Among many highlights of his scholarly work, he was awarded a prestigious National Institutes of Health (NIH) National Research Service Award for his work in neuromuscular control and musculoskeletal biomechanics on children with juvenile rheumatoid arthritis. Dr. Gonzalez's scholarly work includes over 100 publications in journals and conference proceedings many of which are co-authored with his students.

For his efforts and innovation in engineering education Dr. Gonzalez has received the American Society of Engineering Educators (ASEE) Teaching Award, the Minnie Stevens Piper Foundation Award, and LeTourneau University's top research and scholarship award. He was also a Finalist for the IEEE Global Humanitarian Engineer of the Year award in 2013. He serves as an engineering program evaluator for the Accrediting Board for Engineering and Technology (ABET), the sole entity for accrediting engineering programs in the United States.

Dr. Gonzalez is Founder and President of LIMBS International (www.limbs.org), a 501(c)3 non-profit humanitarian organization that designs, creates and deploys prosthetic devices to transform the lives of amputees in the developing world by restoring their ability to walk. Since its founding in 2004, the LIMBS Knee has helped over one thousand amputees in almost 35 countries on four continents.

Dr. Richard T. Schoephoerster, University of Texas, El Paso

Since 2007 Dr. Schoephoerster has been the Dean of the College of Engineering at The University of Texas at El Paso where he leads a College of approximately 85 faculty members, 55 staff members, and 3500 students in 28 different BS, MS, and PhD degree programs. In the past seven years the total number of graduates per year has increased by 40%, and the number of annual doctoral graduates and annual research expenditures has almost quadrupled. During his tenure, UTEP has become one of the largest producers of Hispanic engineers at all levels (BS, MS, and PhD), and UTEP Engineering recently had the largest percentage of female engineering graduates at the doctoral level. For nine years running, UTEP has been listed in the top five engineering graduate schools for Hispanics by Hispanic Business Magazine.

Prof. Jessica Townsend, Olin College of Engineering

Jessica Townsend is a passionate proponent of undergraduate engineering curriculum innovation and is dedicated to finding pathways to innovation in traditional educational settings. She is an Associate Professor of Mechanical Engineering and the Associate Dean for Curriculum and Academic Programs at Olin College. Since joining the Olin College faculty in 2004, Dr. Townsend has worked as a facilitator and consultant with universities and professional organizations looking to improve engineering student engagement, and has contributed to the development of innovative pedagogies, courses, and curricula at Olin College, mainly in the design and mechanical engineering areas. Her technical area of interest is experimental thermal-fluids and she worked for many years on the development and characterization of nanofluids (colloidal suspensions of nanoparticles), mainly for thermal management applications. She now focuses on projects that effectively engage undergraduates in thermal-fluid and propulsion related areas, including recent work on a hybrid solid rocket test stand. Dr. Townsend has industry experience in both air-breathing propulsion, as a gas turbine performance engineer at Hamilton Sundstrand Power Systems, and in rocket propulsion, as a visiting engineer at Blue Origin, a commercial spaceflight company based in Seattle, WA.

Introducing *Engineering Leadership*: Lessons Learned from a Multi-Institutional Collaborative Process to Build a New Engineering Discipline from Scratch

Abstract

The University of Texas at El Paso (UTEP), recognizing the growing emphasis on leadership development in engineering, has established a new engineering discipline called *Engineering Leadership* (E-Lead). The primary educational objective of the E-Lead degree is to develop engineers into leaders with engineering domain knowledge, broad leadership knowledge, and the ability to inspire and lead others. But E-Lead goes well beyond being a program, an initiative, or a cluster of classes added to a degree plan. The E-Lead program also develops a culture where students actively contribute to their own education and where individual contributions are valued and important. E-Lead students strive for excellence because they have a sense of ownership and power over their own education. Building this new discipline has inherent challenges, especially within a large public university.

To help minimize having to “reinvent the wheel” in starting an ambitious student-centered degree program from scratch, a partnership with Olin College of Engineering was formed. Our institutions’ and faculties’ shared values and objectives have helped us navigate the pitfalls inherent in the development of new discipline. This paper seeks to share our lessons learned and specific strategies for successful program development and implementation. These lessons learned range from issues of program culture to crafting student experiences in the classroom.

Introduction: the case for a new engineering discipline

There is a growing demand for engineers and a need to embed professional, leadership and entrepreneurial skills into an engineering education. The national demand for engineers is well documented as attested by the National Academy of Engineering (NAE) and its 2007 publication *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* [1] in which they urged a focus on developing, recruiting, and retaining engineers. Data supporting this demand is documented in the National Science Foundation’s publication, *Science and Engineering Indicators 2012* [2], using Bureau of Labor Statistics from 2002 to 2018 that project job openings from growth and needs replacement, which will top 160,000.

There is an evermore urgent need for our higher education sector to graduate engineers who possess the knowledge, skills, and abilities to respond to a 21st-century world with its technical, social, and ethical complexities. Indeed, engineers’ abilities to meet these needs has been further highlighted in the NAE 2010 report, *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5* [3]. This call for even more urgent change occurs a mere six years since 2004 when NAE published *The Engineer of 2020: Visions of Engineering in the New Century* [4] in response to industry demand for a new engineer who possesses a skill set beyond the technically proficient ones to compete in the global economy.

The University of Texas at El Paso (UTEP), responding to these needs, and recognizing the growing emphasis on leadership development in engineering, has established a new engineering discipline called *Engineering Leadership*. UTEP is leading the charge by offering the first

Bachelor of Science in Engineering Leadership (E-Lead) degree in the country. The primary educational objective of the E-Lead degree is to develop engineers into leaders with engineering domain knowledge, broad leadership knowledge, and the ability to inspire and lead others. Graduates of the E-Lead program will not only be leaders, but will perpetuate leadership traits in those they serve.

The Bachelor of Science in Engineering Leadership requires the completion of 125 credit hours. All students take 104 credit hours that are specified by the degree plan (general education courses and the engineering core classes) in addition to 21 credit hours to be customized by each student. Within the engineering core, 28 credit hours are within the E-Lead department and the remaining engineering credits are taken in other engineering departments in the UTEP College of Engineering. Students customize their degree plan by choosing 9 credit hours of Technical Electives and 12 credit hours of electives in an area of the student's choice (see below). Technical electives must be engineering courses while the concentration electives provide various paths for students to pursue a focused path of study that can lead to an academic minor. In general, there are several distinct academic customization options that are available to students. These options are summarized below and in Figure 1.

Options of elective study contributing towards:

- An education certification in math, science, or engineering at a K-12 level.
- An engineering academic minor by using upper and lower level engineering core courses, engineering electives, and concentration electives.
- An accelerated MBA and additional engineering coursework. (NOTE: The accelerated MBS program requires an extra year of study).
- A non-engineering academic minor expanding upon the core engineering education. Examples include, Commercial Music, Foreign Language, Art, Military Science, and many more.
- A combined accelerated MBA or a non-engineering academic minor combined with an engineering minor. (NOTE: Several courses beyond the 125 hours will be highly likely. Number of additional courses depends on minor.)
- A focused area of study such as Pre-med, Pre-law, or preparation towards a Peace Corp assignment.

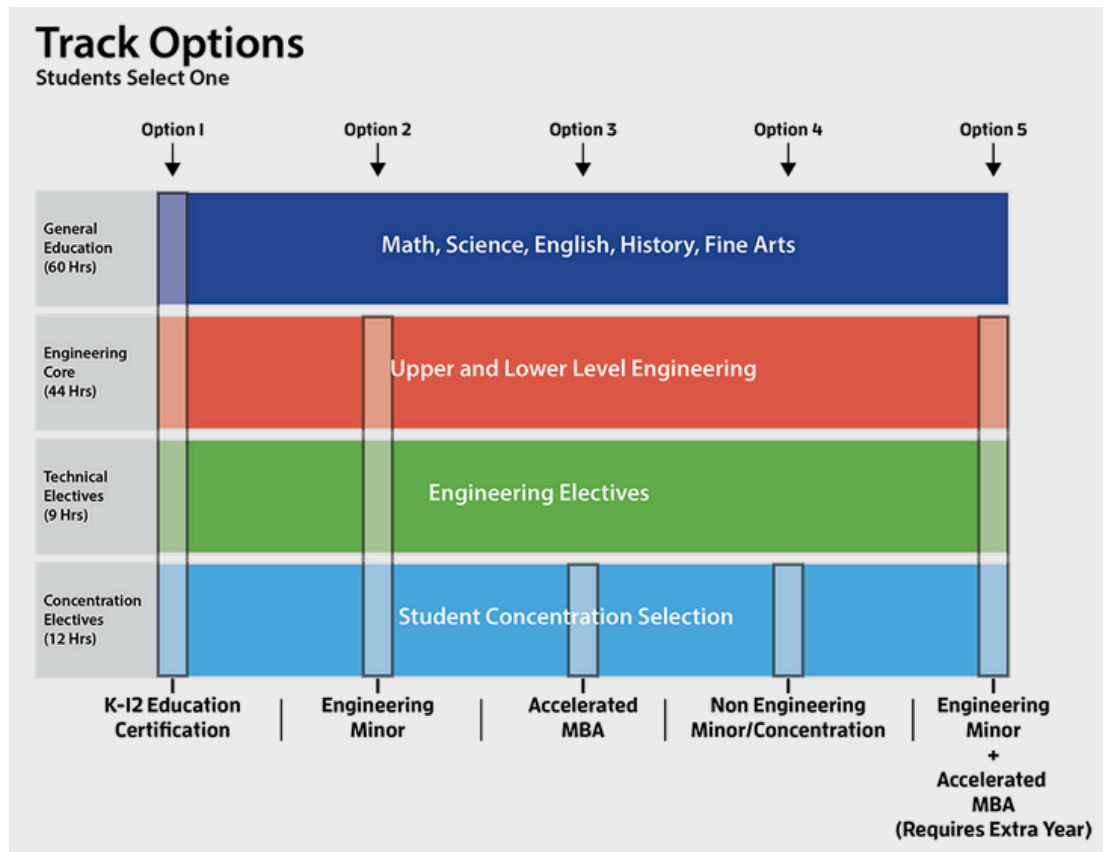


Figure 1: Track Options for the Bachelor of Science in Engineering Leadership

UTEP is uniquely poised to craft the first undergraduate program around this new discipline. With a motto of “Access and Excellence”, UTEP strives to attract a student demographic not well represented in engineering today and arm them with the skills, mindset, and experience that allows them to make a positive impact in the communities in which they live and work. UTEP’s student population is 80% hispanic and reflects the region’s ethnic makeup. UTEP’s extraordinary success is validated by Washington Monthly magazine’s 2014 ranking of UTEP as one of the top 10 universities in the nation, with UTEP being ranked #1 for the third consecutive year among all U.S. universities in the social mobility category for its success in helping students achieve the American Dream. At the same time, this program is designed to attract students that might not normally consider engineering as a career by allowing them envision and experience the kind of impact they could have as engineering leaders.

The program was initially housed directly under the Dean of the UTEP College of Engineering, but is now formally offered by the newly created Department of Engineering Education and Leadership. The program is designed to satisfy ABET Engineering Accreditation Commission criteria for a general engineering program, and such accreditation will be sought once the first cohort of students have graduated in 2017. Students who elect exclusively engineering track courses will likely graduate with more engineering coursework than most other traditional engineering disciplines and be more focused in a particular engineering expertise. Thus, for those

who choose to develop strong technical expertise, this degree is far from “engineering-lite”. The program flexibility also give students options on paths to licensure.

Engineering Leadership as a model for change in engineering education

There is a larger vision for this program – it will serve as a national model for incorporating a leadership mindset into an undergraduate engineering program. The program was created not only to attract and retain the best students to UTEP and to infuse a leadership mindset into these students, but to be a model to other engineering programs hoping to do the same.

There is an opportunity to break out of traditional silos. UTEP can take a fresh look at their students and stakeholders as well as regional and national needs. The challenges in creating a new program meant to push the boundaries of what an engineering education is are magnified when operating within an existing institutional structure. Departmental boundaries, constraints on resources, and even student and faculty culture can make program reinvention or curricular change difficult. These challenges will not look unfamiliar to other institutions and programs seeking to drive change and it is intended that the creative solutions developed at UTEP could have traction for others as well.

Forging a multi-institutional collaboration

Although UTEP has developed relationships with a number of institutions and programs centered on engineering leadership, they sought out a significant partnership with the Olin College of Engineering. Olin College was started from scratch in 1999 through a generous gift from the Olin Foundation to address calls for transformation in engineering education, and graduated their first class in 2006. Olin is a small private engineering school with a competitive admissions process, an extremely high retention rate, and sought after graduates. Olin College dealt with many of same challenges and opportunities that the UTEP E-Lead Program is facing now. They have experience in partnering with schools in program creation, student engagement, and curriculum innovation. The focus for these partnerships is on the program and curriculum development process (with Olin-centric experiences as inspiration) rather than direct adoption of Olin curriculum. The process includes elements of user-centered design, design thinking, with a strong focus on culture development and faculty and student engagement. Olin has experience in ABET accreditation for new and unusual-looking programs, in recruiting and retention of students, and in marketing of a new institution and new programs.

Olin’s mission is to be a catalyst for change in engineering education - to be a model for other schools, and to actively facilitate change with their partners. The Olin College Collaboratory, staffed and run by Olin College faculty, is dedicated to co-designing transformational educational experiences with and for other institutions. For Olin, collaborating with an institution like UTEP – a large state university, with a diverse student demographic – was attractive in and of itself. But to forge a partnership in which both partners seek to be a model for change for other institutions allows for a deeper collaboration. UTEP and Olin are not only co-designing and co-creating the new E-Lead Program, but are also working together to expand the network of institutions looking to meet the new for a new kind of engineer to solve local and global challenges.

Guiding principles for collaborative new program creation

A number of high level insights and principles for program creation and collaborative co-creation have been developed through Olin College's partnership with UTEP and other institutions. For each of these insights, we will provide some context for why it is important, some examples of how we applied it in the UTEP-Olin partnership, some key impacts, and some strategies for building this insight into the program creation process. Many of these insights may seem obvious, but often it is challenging to operationalize a simple sounding insight in a concrete way. It is more than just having awareness; intentionality around these insights is key.

1. You may think you are on the same page but you probably are not. It is not easy to start a new program, especially one centered around an emerging discipline that may be unfamiliar to many stakeholders. At UTEP, the high-level vision for the program was clear – to create engineering leaders by embedding a leadership mindset into an engineering degree. There was significant financial support from external sponsors, and strong internal support from the Dean of the College of Engineering. However, the department heads and faculty in the College of Engineering had varying views on the value of this program and what it might do for students. Some engineering faculty wondered if Engineering Leadership was more like “engineering-lite.” Prospective students were interested in the promised hands-on, project-based approach, but wondered if anyone outside of UTEP would know what a degree in Engineering Leadership meant, and wanted some assurance that they would be competitive for post-graduate opportunities. Even the faculty and staff tasked with developing the program didn't feel as though they had a succinct elevator pitch to communicate what this program would be about.

Having an institutional partner like Olin College provided several advantages in defining vision. Olin leadership, faculty and staff dealt with many of these same issues when the college was created from scratch (and have continued to wrestle with refining the curriculum vision over time). The Olin College faculty have been serving as liaisons and workshop facilitators to UTEP and bring their experience, passion for what UTEP is trying to do, and a focus on helping the team develop a vision and a plan that suits UTEP's unique culture and context.

The first significant interaction with Olin College dealt with finding a shared vision. In a workshop run by Olin faculty facilitators before the launch of the program, UTEP department heads, faculty and staff were guided through a process to define a shared vision for the E-Lead Program. Participants considered the needs and interests of the incoming and future students, the goals of the program, how to identify important stakeholders for the program, and how a shared vision could help begin define the components of the program itself. The goal was to create a compelling narrative for the E-Lead Program that was useful in describing the program to both internal stakeholders (other faculty, students, staff) and external stakeholders (donors, other engineering programs, employers).

It may seem obvious that having a shared vision is crucial to the success of a new program; but the process of getting to a shared vision can be messy. If it is driven entirely from the top, the faculty, staff and students that create and participate in the program may not feel the kind of ownership that motivates them to deal with hurdles that will surely come. Similarly, lack of support and commitment from the top can stifle efforts that begin at a grassroots level.

In this case, UTEP had a commitment from leadership as well as passionate faculty, staff and students willing to do the hard work to develop this program. The motivation for this new program was clear but communication with key internal stakeholders was shaky, and support was needed from them to move forward.

With this as a starting point, getting to a shared vision had to be an iterative process. The general strategy was to test out a number of possibilities. This was done by capturing a vision that initially felt comfortable to the stakeholders and then checking to see how it played out when used as a framework to develop program goals and activities. In addition, starting at the detailed curriculum level (by identifying initial assumptions for what students will experience in the program), and then building up the program goals and vision from those activities can uncover where there is alignment (or mis-alignment) in intent and understanding. Spiraling up and down several times can help elicit reactions, tease out implicit assumptions, bring conflict and disagreement to the forefront, and let the team start to make decisions about what is important.

Many of the internal UTEP stakeholders walked in with specific ideas about who this program should serve and what kinds of activities students should engage in. For example, several faculty felt strongly that the program should allow transfer students from regional community colleges to enter the program during the third year (which is a hallmark of the UTEP model). Others felt that the first foundational two years of the program were crucial and could not be missed. The pros and cons of this could have been endlessly debated, but in the end, the vision that the group felt most strongly about included the creation of a strong, cohesive community and a desire to retain excellent students who would otherwise transfer away from UTEP to other universities after several years. Consensus around this vision and clear acknowledgement that initially this program would not initially be able to serve every possible student allowed the team to move on from the transfer issue. As a result, transfer students are allowed but students must still be in the program the last three years of their B.S. degree.

The shared vision developed by UTEP faculty and other stakeholders prior to program launch is shown in the table below. This served as a framework for the initial design of the first year curriculum.

Key Aspects of a Shared Vision for the UTEP Engineering Leadership Program

A “home away from home” for students

An immersive and supportive community; “esprit de corp”

A desire in students to lead and effect positive change in their communities

An innovative engineering curriculum that radically enhances
student engagement and student experience

Graduates who are sought after for their leadership mindset
and their real-world technical breadth

A culture where students are partners

2. Create the culture you want from the beginning. Culture can be described as the implicit assumptions and expectations that define how players act and behave within a given system or situation. The creation of culture can be intentional or unintentional. The creation of a new program is a perfect opportunity to articulate the kind of culture that is desired, and to design features and artifacts that support the growth of the desired culture.

The UTEP-Olin partnership provided early opportunities for UTEP faculty to immerse in the Olin culture and understand what it meant for students and faculty. The Olin culture is one of ownership and autonomy, freedom to explore, scaffolding that provides early support but drops away as skills and knowledge grow, and a feeling of a safe place to take risks and to iterate. A key aspect of the Olin culture is the idea of students as partners. Olin doesn't create *for* students, Olin creates *with* students. These tenets appealed to the founding faculty of the E-Lead Program and several approaches were taken to intentionally embed a similar culture that fit UTEP.

First, UTEP involved students in the earliest workshops focused on the development of program and curriculum. This created an early sense of student ownership and involvement. Clear evidence for creation of this culture of student partnership and ownership was seen when the first cohort of E-Lead students proposed that they design and implement the Introduction to Engineering Leadership class that all new students take in their first semester. This class is the first interaction new students have with the program, and creating activities and experiences that highlight the cultural values the program holds is crucial. The students, having experienced the first version of the class, felt that they could improve upon the experience. They had firsthand knowledge on what it felt like to enter this program, and knowing what experiences were to follow in the second semester of the first year, they felt uniquely qualified to introduce the culture, community and early foundational skills that would create a strong second cohort of E-Lead students. This is a great example of how culture is transmitted and adopted by those who enter the program. Going forward, they hope that each cohort will contribute to introductory experience for the students entering after them.

For the E-Lead founding faculty and student partners, the Olin College facilitators brought a number of strategies into the program and curriculum development workshops. First, they asked the UTEP faculty and students to identify and articulate what the culture should be. They introduced the strategy of using a cultural lens to look at all aspects of the program, and helped UTEP examine decisions to see what effect they have on culture. Early on this can feel onerous, but early decisions (and often what feel like small, unimportant decisions) can have a strong effect on culture. As the program launches, the responsibility for transmitting culture can be shared amongst all the participants.

Another strategy is to experience what it feels like to live in the kind of culture you desire. One aspect of the UTEP-Olin partnership was supported through the Argosy Collaborative Faculty Exchange Program. Through this program, Olin hosted four UTEP faculty sabbatical visitors over four semesters. The UTEP faculty visitors to Olin had a unique opportunity to embed themselves in the Olin culture and to directly experience the factors that enhance Olin's shared cultural values (and those that detract from it). Each UTEP visitor joined a teaching team for a hallmark Olin class (often required foundational engineering classes for first year students) and was supported by a dedicated Olin faculty mentor.

3. Use local context to shape the program. This means designing a degree program that addresses the needs of UTEP students, the constraints of UTEP as an institution, the interests of other stakeholders (like faculty and employers), and also takes advantage of the unique opportunities present within the local context.

One of these needs was identified by the UTEP College of Engineering leadership well before the UTEP-Olin partnership began. They wanted the E-Lead Program to be a seed for change for the other engineering departments in the college. To do this, a team of faculty from the existing departments were chosen (and in some cases volunteered enthusiastically) to be deeply involved in co-design and creation of the new program (as well as spending extended time at Olin College). These faculty have begun to infuse pedagogical and programmatic changes into their teaching and advising in ways that would not have happened without their involvement in the E-Lead program.

Through working with Olin College on a student-centered approach to curriculum design, it became clear that E-Lead students could become unintentional evangelists for the type of student engagement they experience in the E-Lead program. The degree program for E-Lead includes requirements across a number of engineering departments (see the Appendix for more information), and it is hoped that students will bring their expectations for more authentic student engagement with them. In order for this to work well, and not result in frustrated students and annoyed faculty, E-Lead students need to be able to identify their own learning needs, and communicate these needs effectively and constructively to faculty. Involving the first cohort of E-Lead students in the design of the program resulted in much greater awareness of how faculty plan learning experiences, the constraints that faculty deal with, and how those constraints can differ across programs. For example, E-Lead courses are small (15 – 20 students), are taught in a studio environment, and are highly project-based. Many courses in the other engineering departments will look and feel quite different to these students, and E-Lead students understand that what is possible with 20 students in a project-based class may not work for a larger, lecture-based class. E-Lead hopes to eventually draw students from other departments to its classes, while continuing to raise expectations for better student engagement across the board.

The UTEP student demographic defines both a set of needs and a set of opportunities. The student population is 80% Hispanic and students are drawn primarily from El Paso and the surrounding region. One need that E-Lead hoped to address was to attract new students to engineering who might not see anything for themselves in a traditional engineering department. Olin College has experience in reformulating the ubiquitous college “Info Session” into an interactive weekend experience that provides applicants with a taste of what being an Olin College student will feel like. These Candidates’ Weekends are primarily run by current Olin College students, and include design-build activities, opportunities to share passions with peers, and a chance to experience some aspects of the student culture and social life at Olin. As the E-Lead program worked to recruit their first students, Olin College student leaders traveled to El Paso to share their knowledge of planning fun and engaging design activities, and worked with UTEP students to plan and run the first E-Lead Candidates’ Day in 2013.

Since that time, E-Lead faculty have further shaped this event to better appeal to their prospective students more directly. They have moved from the Candidates’ Day model to what they call Innovation Sessions, which are offered not at UTEP, but in communities closer to their

prospective students. They focus on attracting students who have misconceptions about engineering, but would make great engineers and would likely be attracted to what the E-Lead program offers. The idea of these sessions is to give prospective students opportunities to work together to solve problems that matter to them, and to begin to experience the student culture that differentiates E-Lead from other engineering programs at UTEP. This program was also conceived of as something that could differentiate UTEP as an institution and draw students from other parts of the state as well as El Paso.

A constraint that the program needed to address was the fact that UTEP is mainly a commuter school. Many UTEP students live at home with their families and work in addition to going to school. During the Olin-facilitated workshop to help the E-Lead faculty develop a shared vision for the program, the theme of “home away from home” emerged as a critical concept in terms of building strong community and culture for this program. It was needed to bring cohesion among the students in the degree plan who are scattered across the city with a history of coming from local competing high schools. Making the E-Lead program a home away from home helps to bring a special identity to students in the program and to signify that E-Lead was going to do things differently from the other engineering disciplines. Crafting social and academic activities outside normal classroom hours has led to a strong E-Lead community. Both faculty and students often co-participate in university and community activities. These formal and informal interactions build a strong attachment between students and the faculty.

However, how this is actualized in the program looks quite different than a residential college, which is literally is a home away from home. The process Olin faculty defined to craft a shared vision for the program was instrumental in identifying key ways that E-Lead could create this culture of home away from home. E-Lead faculty had to imagine not only what students would do while they were in class, but what would happen in the spaces and times “in-between.” Some ways to address this were quite simple. For example, one of the E-Lead faculty established a tradition of taking E-Lead students for frozen yogurt every Friday afternoon which provided a informal setting for faculty-student interactions and community building. Other steps were less obvious. For example, E-Lead faculty envisioned team projects in every class, but had to think about when and where student teams would meet outside of class if they only came to campus to attend classes and then left by 5 pm. This drove the need for more dedicated team time within classes, and for provision of spaces to support team activities outside of class. The E-Lead faculty and staff have also dedicated space within our own administrative office area that welcomes students hanging out. This not only provides informal team interaction amongst them, but also provides opportunities to interact with faculty as they come and go from their offices. This alone has provided significant opportunities for spontaneous discussions and co-ownership of the program

Olin’s role in shaping the E-Lead program in response to local needs and opportunities initially included crafting the *process* for designing this program. However, Olin faculty facilitators spent time learning about the unique history of UTEP, including the mining industry that thrived earlier in the century, the city of El Paso, the relationship with the cross-border city of Juarez, the relationships with local industries, and the local culture. With this context in mind, they were also able to work directly with the E-Lead faculty to develop the *content* and *artifacts* that embody the E-Lead program.

Throughout this process of shaping the program Olin faculty continually challenged assumptions and unearthed implicit constraints, particularly when E-Lead faculty considered adopting approaches that have been successful elsewhere.

Another key insight from working within the local context (and the associated constraints) is that what feels like limited flexibility at a large state institution does not always have to kill innovative ideas. UTEP faculty focused on developing ideas around what was possible and tried to avoid bemoaning what they could not do.

4. Know when to reinvent the wheel (and when not to). There is a tension between the desire to carefully and intentionally design experiences that are appropriate for UTEP students and the UTEP culture, and the availability of resources (time, people, space, funds) that the E-Lead faculty team has access to in order to do this. The decision to adopt an existing approach wholesale (such as a class from another institution) versus starting from scratch depends on the situation. Olin has a partnership with a new engineering program at Insper, a private college in Sao Paulo, Brazil, that began two full years before their first class of students arrived. Olin classes served as inspiration for the curriculum, but any classes that were adopted were carefully recrafted to meet Insper students' needs.

In the case of E-Lead, the UTEP-Olin partnership began six months before the first students matriculated. UTEP made some strategic decisions early on to deal with this short time frame. They initially ran a Candidates' Day modeled after Olin's Candidates' Weekend in order to kickstart their recruiting, but then went back and redesigned the experience the next year to better meet the needs of their prospective students. This redesign of student recruitment is now a "road show" called *E-Lead Innovation Sessions* the E-Lead students themselves developed and administer these half-day sessions at high schools throughout the area. These sessions have been a tremendous success in helping high school students understand what E-Lead is about and developing ownership of the program by the UTEP E-Lead students. They also adopted Design Nature, Olin's first semester foundational design class, including projects, assignments, and assessment methodologies. While much was learned during the implementation of the class, there was a missed opportunity to leverage the unique UTEP culture and the needs of the UTEP students in the design of the class.

This was a true lesson learned for both partners. Olin faculty were uneasy with the wholesale adoption of a course that had been specifically designed for Olin students, and were concerned that the many aspects of the class would fall short of meeting UTEP students' needs. E-Lead faculty were working within a very compressed timeline and did not have the bandwidth to make major adjustments to the class. Both partners were worried about how the class would turn out.

However, during a feedback session about halfway through the semester, the UTEP students described that they "felt like engineers" because they were doing things that engineers do – they were designing, making decisions, fabricating and testing. They made positive comparisons to the experiences of their peers in other UTEP engineering programs and felt that the class validated their choice to pursue an Engineering Leadership degree. For Olin and UTEP faculty, this was a reminder that with a strong partnership and a shared vision, things will work out even when the conditions are not ideal. The insight here is to know that not all things will be wildly

successful the first time, but that they will generally make a positive impact on students, especially when continuing to assure students you in it together with them.

5. Face to face time is crucial in a collaboration. Since the beginning of the partnership in March 2013, the amount of time that Olin and UTEP faculty spent together was the single biggest factor contributing to impacts we saw in the development of the E-Lead program. The workshops at UTEP run by Olin faculty, the sabbatical visits by UTEP faculty to Olin, and the meetings and phone calls between Olin faculty and UTEP faculty throughout the year are the most valuable aspects of this program. (This has also been noted in Olin's partnership with the Brazilian school, Insper.)

6. Co-designing, not co-dependency. The biggest challenge at this point in the relationship is how to empower UTEP E-Lead faculty to truly own their program and their curriculum development, especially since there are a limited number of faculty who have been fully engaged as part of the E-Lead team in the first year. Future partnership activities are focused on creating opportunities for UTEP faculty to run workshop activities themselves (with Olin faculty as advisors in the background).

Impacts of the partnership and program to date

The largest measurable impact to date has been the development and transformation of the UTEP faculty directly involved in the partnership. This transformation can be described as a new way of thinking about engineering education and student experience, bolstered by a set of tools and approaches for program and curriculum design. Certainly students at UTEP are having experiences that they wouldn't have had if this partnership did not exist.

At Olin, the opportunity to work with faculty from an institution so different from Olin, with a much more diverse student demographic has resulted in the insights described previously. This will make future collaborations with educational partners even more fruitful and enhance Olin's ability to help faculty design creatively in spite of the constraints faced in a traditional university setting.

Conclusion

This partnership is rooted in a shared passion to see engineering education improve throughout the country. The fact that Olin and UTEP operate from what appears to be the opposite sides of the academic spectrum has given both sets of faculty insights that would not have been gained otherwise. It has immensely benefitted the curriculum development of the new Engineering Leadership degree and helped the E-Lead faculty develop a clear vision of the program as it is built one year at a time. We anticipate that E-Lead faculty will bring these growing insights to institutions of its type via focused interactive faculty sessions, such as the workshops offered by the Olin College Collaboratory. We believe that students at a variety of institutions can benefit from the practices that both Olin and UTEP seek to model, and that partnerships like the UTEP-Olin collaboration are necessary for educating a new kind of engineer. Yet, challenges remain in educating the broader industry and academic community about E-Lead and its benefits. It is easy for E-Lead to be misunderstood by potential employers, parents and prospective students. As a

result, learning from the introduction of Systems Engineering in the 1970's could benefit how we help form our message.

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