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Scaffold to Build and Sustain Industry-University Partnerships

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Abstract- *One of the most difficult tasks for higher education leadership is to initiate and sustain industry partnerships. There are many reasons why. A particular one is that industry and academia have different cultures and values. This paper provides a scaffold or framework to engage with the productive sector and provides answers to some of the questions involved: Why do higher education, institutions need to reach out to industry? Who needs to be involved? What can each of the partners' roles, responsibilities and expectations be? How can industry help academia in strategizing to better educate the engineering workforce the country/region need? How to best approach industry? What are the benefits for the institution, industry, students and faculty of strong industry-university relationships? How to assess partnership outcomes? Finally, the author shares her experiences in participating and catalyzing three successful partnerships between industry and academia: the Learning Factory, the ASEE-NSF Industry Post Docs Program and the NEU@UNH, a new engineering education platform developed in California.*

1. Introduction

"Partnership between industry and university has become even more important in the global marketplace… Engineers will have to…acquire the ability to communicate as they work in the demanding international marketplace corporations are hoping to depend more and more on government and university" (Norman Augustine, Former CEO, Lockheed).

When you consider that economic studies conducted before the information technology revolution show that as much as 85 percent of measured growth in U.S. income per capita was due to technological change (US National Academy of Engineering, 2007), a strong case can be made for seeing engineers as the key knowledge workers for capacity building and sustainable economic growth in both developed and emerging economies. Engineering has been and will always be vital for civilization. Most, if not all of the world's most important contributions to human well-being have come from the creative genius of engineers. Some of the pressing challenges – water, food, energy, environment, health, housing, climate change and others also require the creative and innovative solutions that only skilled engineers can provide. Engineers play an essential role not only in solving local problems but also in developing knowledge, transferring knowledge, driving economic development, thus critical becoming critical for sustaining knowledge based economies. They become part of public and private enterprises as well as not-for profit organizations and professional societies engaging with almost all dimensions of society.

To be globally competitive, countries not only need a larger number of engineers and technology workers, but they should possess specific set competencies (defined by the author as the sum of knowledge, skills and attitudes/values) that allow them to use and apply what they know in an effective and efficient manner. Moreover, there's an increasing role of innovation and entrepreneurship in all dimensions of engineering and business strategies which are requiring engineering graduates to be knowledgeable in these areas (Gonzalez, 2013) to be successful in a work environment that is ever changing, complex and uncertain.

Yet the training of engineers is not at all like the work environment. Many will argue, why does it have to be? Universities mission is to have students learn concepts, theories and the like. But should the universities mission include - besides the development of knowledge and works of art service to society and the development of the human resources needed to sustain its well-being? Shouldn't universities be developing talent with the knowledge, skills and attitudes needed now and in the future? Would it be better for universities and their constituents to partner to better understand what is needed, how to leverage each other's ideas and resources to plan and develop that human talent?

Due to the ever changing nature of technology this discussion and partnership is of utmost importance and has been the subject of increased interest. In many countries accreditation requirements, like those of ABET in the US, are requiring engineering programs to consult with the productive sector to validate the engineering graduates' competencies. This, in turn, is considered to enhance curricula and learning experiences, research and service.

Governments are also promoting research and education partnerships between the academic and industry sectors to enhance the knowledge creation process. The US National Science Foundation and European Commission are two examples. Both have consistently increased the requirement of collaborations among institutions, researchers and industrial partners. In Singapore, STAR* funds a "PhD's in Industry Program" in which students complete their first year of the PhD in the university and the rest in industry with an real life industry research project and mentored by academic and industry mentors. In another dimension, engineering and technology companies like Math Works, Dassault-Systèmes, and Quanser are sponsoring engineering student competitions worldwide to catalyze the learning of new skills and tools for the workforce. There are multiple other examples of R&D and education collaboration that result in engineering competencies development.

It makes sense for industry and engineering schools to partner and develop both the human resources and the innovations to develop and sustain knowledge-based economies and the well-being of people. Industry can partner with universities to help educate locally relevant, globally competent engineers, who can serve the needs of employers and at the same time help address national, regional, global needs. Academics can partner with industry to promote innovation, enhance curricula, provide real life experiences (internships, projects) to students and faculty and learn best practices in managing complex organizations, among other things.

But why is it difficult for institutions and industry to partner? Why is change in academic institutions so hard? Because of centuries old cultural barriers.

2. Barriers to Build Industry- University (I-U) Partnerships

"In the spirit of honoring traditions, universities hang on to past practices imperiling their future" (Clayton Christensen, Harvard University).

Industry and academia have different cultures, different values, different needs and different expectations. They are like water and oil, like Mars and Venus. Many academics believe that partnership with industry is not "appropriate". We hear things like: "We don't need or want their input". "What can they tell us?" "We know what is needed!" "We need to maintain our autonomy!" Many industrials believe that academics do not have anything to contribute. Academia is too slow for their implementation speed. They may not know how to approach someone with graduate degrees.

The result? Curricula are still designed and offered by academics with little or no experience in the real world. Professors earn masters and PhD degrees, engage in scientific research and then become professors. Their performance and productivity is often times measured by number of papers written, amount of external funding obtained and other research focused metrics. Consulting or industry experience is not rewarded. Educating

students lies a second distant priority. The result? Students are seldom exposed to what entails to be an engineering professional, with all the due roles and responsibilities. A Curricula is just a list of topics to be learned. Skills like teamwork, communication, business constraints and other important skills and attitudes are not formally developed nor measured as part of the learning experience. Open ended problems like those in the practice of the profession are only perhaps only considered in the last year of study as part of the final project (which many institutions call 'research').

Industry and universities have been isolated from each other so long neither knows how to approach the other. Human nature and arrogance has also play a role. So, if we want to develop I-U partnerships we need to start from the basic human relationship skills. The first step in any kind of human relationship is to understand oneself, your strengths, and opportunities for improvement. Then comes empathy, understanding the other, being able to put yourself in the "other's shoes". Making assumptions on who the other is, does not work. Failing to understand oneself can only promote superiority and self- importance hindering trust. Tables 1 and 2 show lists the differences between industry and academic culture and their needs. Besides some commonalities focused on people, it seems that what matters to universities is the opposite of what matters to industry! According to a recent study commissioned by the European Commission, there are various levels of barriers/challenges to effective I-U engagement and collaboration (European Commission, 2014). At a national level, there may be uncoordinated higher education and science and technology cooperation policies. There may be also limits to higher education institutions' autonomy, incentives and /or underdeveloped accountability schemes. At the regional level, there may be weak leadership and fierce intra- and inter-institutional competition typical of academics. And at the institutional level, there may be weak management and leadership and/or a lack of entrepreneurial culture, including lack of incentives for individuals to be creative and innovative in the internal realm. Why change if it's not going to matter?

Summarizing, the biggest barrier that may exist is the failure to recognize that each sector has different needs and, therefore, each is driven by different values and actions.

Table 1. Academia and Industry Cultures

Academic Culture	**Industry Culture**
Non-profit institution	For profit
Individual oriented	Team oriented
University thrives when its individual PI's do well	Employees thrive when the company makes a profit
Is it original, interesting, publishable?	Will it make money?
Knowledge is to be shared	Knowledge is to be protected
Analyze perfect	Implement good
Develop the equations, analysis, from first principles	Fit a curve through the data, modify a previous product
Informal, ad hoc management process	Formal management process, risk planning, contingencies
Publish, graduate students, publish	Customer, sell product, customer

Table 2. Academia and Industry Needs Industry and Academia Needs (adapted from Allen Soyster, NSF)

Industry Needs	Academia Needs
Cutting edge products and services	Good curricula
Satisfy customer needs	Good graduates
Educated workforce	Good researchers and teachers
Latest technologies	Adequate facilities (classrooms, laboratories, offices)
Effective execution of technical and management process	Appropriate budget
Provide value to stakeholders	
Increase employment engagement	Service to their communities
Management of ethics issues	
Aware of global trends	Aware of research trends
Reduce operation costs	Bring external funding

Yet, in spite of all these differences there are commonalities which might provoke the need to approach each other: they are both interested in knowledge (innovation) and human development (people), two of the four basic pillars for knowledge-based economies according to the World Bank (World Bank Institute).So if industry and academia want to initiate collaboration it is not surprising they find themselves lost and uncertain on how to make the first approach. Worse, if they have tried and failed, fear keeps them for approaching the other again.

Before suggesting some steps to initiate and to sustain I-U relationships, let's describe the various kinds of collaborations.

3. Types of I-U Collaborations

There may be an infinite number of I-U collaborations at various levels of engagement. The EU sponsored report cites eight categories of partnerships (European Commission, 2014):

1. R&D
2. Mobility of academics
3. Mobility of students
4. Commercialization of R&D
5. Curriculum development and delivery
6. Lifelong learning
7. Entrepreneurship
8. Governance

Each and every one has its own characteristics and attributes as well as outcomes and impact. And each entails diverse efforts and resources to develop, manage, evaluate and grow. All of them require basically the same factors for building and sustaining success (Banerjee et al., 2010), as described below.

3.1.Basic Factors for Successful I-U Collaborations

"There is nothing more important to leadership and organizational success than collaboration" –(Meghan M. Biron, Forbes).

We have been using the terms partnership and collaboration indistinctively in this paper. They are closely associated. A collaboration is often defined as the action of working with someone to produce or create something. A partnership is an arrangement in which parties agree to cooperate to advance their mutual interests Therefore, partners collaborate in order to advance their mission and goals, enhancing each other's capacities. Business partnerships most likely have business outcomes (growth, profit). Academic partnerships most likely have academic outcomes (talented graduates, papers). But given the different cultures, expectations and values of industry and academia, I-U partnerships and collaborations may have multiple different outcomes (some addressing academic goals, some industry goals) and thus are more difficulty to build and sustain.

I-U partnerships need to have the following basic factors or elements to be successful (Colecchia, 2004) (NCURA, 2004 ; Morell, 1999).

Leadership – even though the partnership may

involve various initiatives and sectors of one or both organizations, there has to be a leader, a one point of contact on each partners' side responsible for the collaboration and catalyzing meetings, initiatives, understandings and communication with partners' organization. This person is the 'fairy godmother' who is willing to invest time to make the effort a success (Albani and Henderson, 2014). He or she needs to be passionate, credible and courageous and have the people skills to lead the partnership. Leadership also entails continuously exploring and expanding joint activities, seeking other partners and resources.

- Shared Vision – there has to be a common vision both industry and university agree upon. It may be, for example, enhancing each other's capacities by student & faculty development, integration of tools into the curriculum, joint research and innovation, sales, philanthropic gifts,
- Mutual Understanding – roles, responsibilities and expectations need to be clearly discussed and agreed. No surprises!
- Communication – documenting and sharing the partnership shared vision, understandings and outcomes is key to partnership trust as well as its growth.
- Mutual Benefit – partners need to benefit individually by the partnership. The synergy should result in more than what the parts bring to the table.
- Honesty – because partners have different cultures and philosophies they should be act with integrity, truthfulness, and straightforwardness with each other. Being loyal, fair, and sincere will solidify the relationship.
- Trust – partners should have a strong belief in the reliability, truth, ability, or strength of each other and in the partnership. They should believe that they can undertake the task of building and nurturing the partnership and that they can jointly address the challenges and opportunities that arise. In I-U partnerships, partners need to come together drawn by an initial motivator or a specific need, then get to get to know each other, to then move to make commitments focused on enhancing each other and the partnership. Resources (e.g., time, money, people, and ideas) may be exchanged. Partnerships may start with opportunistic initiatives to move to more strategic ones as time goes by, but all joint activities must be based in trust and on flexibility (see Figure 1).

Industry may need to recruit engineering students and may visit campus to organize with the Career Office. It may want to increase sales and may come to present their technology products and solutions. The university may want to provide real life projects and mentors to students and may approach industry to set up a project clinic. There must be a compelling need or business reason for both to engage and has to be clearly outlined. Roles and responsibilities of each need also to be described, as well as evaluation of results and discussions of challenges and opportunities to improve.

As industry and the institution get to know each other (through meetings with dean, department chairs, students, other companies), companies and academic representatives may want to expand and grow the relationship to other dimensions (research, advisory boards, student competitions, etc.), as describe in the next section.

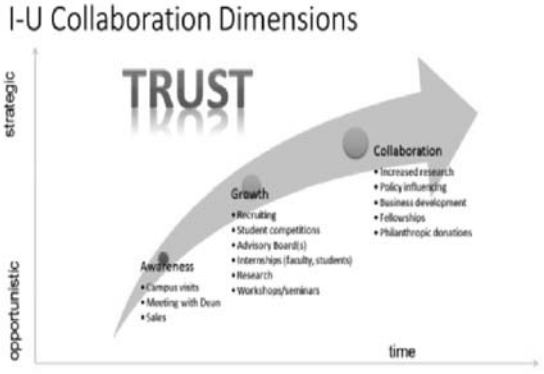

Figure 1. Dimensions of I-U Collaboration

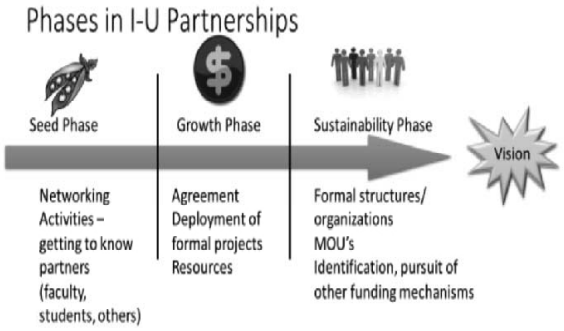

Figure 2. Phases in I-U Partnerships

4. Scaffold to Build and Sustain I-U Partnerships

As shown in Figure 1, there are three phases in building I-U partnerships. The awareness, or seed phase, the growth phase and the collaboration phase. Before engaging in these phases either partner (industry or academia) needs to envision the future. In other words, it needs to create a vision of how the partnership will look like in the future. The best way to proceed is to close ones eyes and describe how the industry and university's activities have changed because of the partnership. For example, industry representatives walking on campus, meeting with dean, chairs and students; students and faculty engaged in research with industry partners, etc. Benchmarking helps a lot in this phase. There are many institutions worldwide that have very good I-U partnerships.

By envisioning the future, you have a better idea what needs to be done, who needs to be involved and when. After crafting this vision, then you proceed through the three phases, as seen in Figure 2.

In describing these phases, we will use the personal building relationships analogy (courtship, commitment, marriage). Let's describe each one below.

4.1. Awareness or seed phase: "Dating"

This is the beginning, the courtship, the time to get to know each other, culture, values, and expectation and start building trust. Good opportunity to share strengths, needs and common interests.

a. Recommendations - Neither industry nor academia have tons of time to spare. If academia desires the engagement, the dean, rector, department chair, professor should invite industry representative(s) to a short meeting with a very specific agenda or project in mind. Set simple, achievable expectations and goals. Best to start with alumni who feel compel to pay back to the institution in time and ideas (although not with a hefty check book!). Purpose could be to ask for general support of an idea or project and to exchange ideas. Other reasons for meeting: the engineering program is seeking accreditation and needs to validate graduates competencies in view of industry needs; the school is developing a new laboratory and needs to understand best equipment to consider; a workshop to help design the classroom of the future in view of current or future engineering engagement/collaboration practices. If it is industry approaching academia, who to contact first may depend on the desired outcome. For example, if it is for recruiting graduates or interns, the head of the placement office may be the best place to start. If it is for joint research, start at the dean or department chair office, or browse the university webpage and contact an individual faculty member or research center. In all cases, the deliverable should occur in a reasonable time and be acceptable to both parties' needs. Depending on the idea or initiative, a memorandum of understanding

(MOU) or agreement needs to be signed, understanding intellectual property policies. Documentation of outcomes is critical to share results and prepare the road for next engagement.

b. Avoid - NEVER, NEVER ask for funding from the get go (unless of course, there's contract research or services involved). Offer refreshments, lunch, dinner but don't ask to provide resources in this phase. There will be ample time, when trust and confidence are built to learn ways industry can contribute and parties are comfortable in discussing these issues.

4.2. Growth Phase: "Commitment"

This is the stage to continue to build upon the initial partnership proof of concept and expand initiatives and collaboration to more diverse and complex projects. The partnership begins to solidify, individuals know each other and are comfortable visiting, reaching out, and exploring new ideas for collaboration. MOUs and agreements may start to surface as more individuals and groups within each organization meet.

a. Recommendations- given the growth of complexity of initiatives and people involved it may be good to start discussing the desirability of establishing a formal structure for managing relationship, who the principal point of contact in each side will be and how to document initiatives and outcomes to continue to grow. Be flexible and be ready to re-invent roadmap as needed. It could be bringing real life industry projects as capstone (end of degree) experiences. It may be providing scholarships for underrepresented or needy students. It may be establishing a Co-op Program on Campus to provide semester long industry experiences for credit and as part of the curriculum. It could be setting up a laboratory for research. Begin strategic planning for collaboration sustainability involving all stakeholders, especially potential funding/support agencies. Engage with both parties higher level management. Establish advisory boards (dean, program, university levels). Continue to assess outcomes and share results.

b. void–blaming the other for miscommunications or mistakes. Assume responsibilities, if something goes wrong, be the first to approach the other.

4.3. Sustainability Phase: "Marriage"

This is the stage of greater productivity. Partners know and trust each other, have ample examples of collaboration outcomes and are continuously exploring new cooperation ideas built on synergy. Strategic planning becomes more important to guide and manage the relationship as well as to share collaboration model with other potential partners. In this phase, industry can play a key role and lead the dialogue for education and innovation policy making with high level government officials. Industry can be effective conveners of likeminded companies interested in supporting education and innovation university initiatives (Lamancusa et al., 2008), (Morell, 2010), (Morell, 2008).

a. Recommendations - Expand relationship to other levels and areas, thinking outside of the box to take the partnership to the next level. Use documented initiatives and outcomes to seek new and/or external resources to support growth (government, foundation programs). Continue to share outcomes and plan.

b. Avoid - blaming the other for miscommunications or mistakes. Assume responsibilities, if something goes wrong, be the first to approach the other.

5. Benefits to I-U Partners

A university-industry partnership works by combining the better of two worlds to exchange experience and new knowledge (Department of Further Education, Employment, S & T, and Government of Australia)

We have mentioned that I-U partnerships work when all stakeholders enhance their capacities. Table 3 describes some benefits to the stakeholders involved:

6. Where to Start? Three Suggestions

"Industry and academe collaborate most smoothly when everyone is proceeding from the same basic understanding" (Theresa Colecchia, Chronicle of Higher Education).

There are many examples of successful I-U partnerships, but selecting the first 'dating' initiatives that result in success sets up a foundation on which to build commitment. So here are three proven experiences to consider.

6.1. Organize an Industry Advisory Board

This should represent the kinds of industry and employers of your graduates. Start contacting alumni

Table 3. Benefits to Stakeholders

Benefits to Students	Benefits to Faculty/Institution	Benefits to Industry
Exposure to industry projects for capstone design course & other multidisciplinary curriculum projects	Exposure to industry projects	Low risk/cost investigation of "back-burner" and fresh ideas
Experience research with a business outcome	Opportunity for consulting	Recruiting graduates and interns
Find internships, practicum and job opportunities	Networking with companies	Project management experience for junior staff engineers
Develop critical engineering skills like teamwork, communication, design under business constraints	Research with a business outcome opportunities	Networking with other companies and university leadership and faculty
	Multiple criteria for grading	Community service
	Exposure to industry challenges and needs	Enterprise to Enterprise business
	Enterprise to Enterprise business	Input to curricula and program outcomes assessment
	Opportunity to sabbaticals and practicum experiences	
	Accreditation processes support	

and companies that hire graduates. Develop charter and rules. Consider the following to invite industry representatives: discuss graduates competencies, curriculum/course advice, evaluation of student projects, innovation ideas, accreditation requirement/ process. Organize short meetings, perhaps ½ to start, then 1 day, with dinner night before and only once or twice a year. If the company is recruiting during job fair, hold meeting concurrently. Agenda could include: brief description of college, program, and specific issue/idea for discussion. Agenda could also provide some time for visiting facilities but should have ample time for discussion. Finally, it is a great idea to hold a short 15-30 maximum debriefing of discussion with the higher authority on campus (rector, president, provost).

6.1. Start an Industry Project Clinic

Senior student team work with industry and non-profits to develop e solutions to real world problems. Projects could be from small start-ups, medium to large companies. This initiative has multiple benefits. It helps students bridge the gap between academia and industry, learning to solve problems in teams while addressing real constraints. It helps comply with outcomes-based accreditation criteria. It helps businesses and organizations access expertise and resources at the university and identify possible joint research projects. It serves as a 'matchmaker' service by supporting faculty to provide technical assistance to industry and businesses, thus enhancing engineering educators engineering practice. Projects are designed with the appropriate scope and expectations of both industry and academia.

Figure 3. Penn State Engineering Project Showcase

6.1. Industry Project Showcase

This event features projects showcasing the work developed by engineering students. These could include departmental capstone design and multidisciplinary team projects of all levels from

freshmen to seniors with faculty representation from each engineering department. Industry attend and evaluate projects, as well as may provide prizes for outstanding teams and attend other events on campus (such as job fair, advisory board meetings, etc.) Figure 3 shows the Project Showcase at Penn State University.

7. Measuring the Impact of I-U Collaborations

As with any other project or initiative, one needs to measure outcomes, analyze results, share them with stakeholders and make decisions to improve. If the I-U collaboration has set strategic goals and measurable objectives, the metrics to be used to collect data should be easy to identify. For example, for R&D and innovation, metrics could include, joint publications, patents and solutions as well as quality of those (e.g., publications in peer review journals, invited presentations in world-class scientific gatherings). In the project clinic, metrics could include number of companies providing projects, number of projects, number of students engaged, training seminars offered, etc. Other metrics across a multi-stakeholder partnership could include (Morell, 1997), (European Commission, 2014), graduates hired by industry partners, industry donations, and industry satisfaction of graduates, retention of students in their field of study and in university due to partnership, research, and other partnership endeavors.

A simple and straightforward assessment, evaluation and decision-making plan can help partnerships build a foundation on which to grow as well inform stakeholders of success and challenges encountered.

8. Successful I-U Collaborations the Author has Participated in and Catalyzed

8.1.The Learning Factory (Lamancusa, 2008)

On February 21, 2006, the National Academy of Engineering recognized the achievements of the Learning Factory with the Bernard M. Gordon Prize for Innovation in Engineering and Technology Education. The co-founders were commended "for creating the Learning Factory, where multidisciplinary student teams develop engineering leadership skills by working with industry to solve real-world problems." The specific innovations of the Learning Factory partnership were: active learning facilities, called Learning Factories, that provide experiential reinforcement of engineering science, and a realization of its limitations; strong collaborations with industry through advisory boards, engineers in the classroom, and industry-sponsored capstone design projects; practice-based engineering courses integrating analytical and theoretical knowledge with manufacturing, design, business concepts, and professional skills; and dissemination to other academic institutions (domestic and international), government and industry. The author expanded the academic model and with NASA funding established other academic tracks with industry experience in remote sensing and global positioning systems at the University of Puerto Rico at Mayagüez. The Industrial Biotechnology program on campus also followed the academic-industry model (Buxeda, et al., 2002).

8.2. The NSF-ASEE Post Doc Program (Morell, , 2010)

In March 2009, the author while working at HP Labs and with the support of several other corporate research labs - approached the US National Science Foundation (NSF) with the idea of establishing an Industrial Research Innovation Post Doc Fellowship Program. This program run by the American Society for Engineering Education allows top science and engineering post docs to work on industrial research and development and partner with industrial scientists in developing the next generation of engineering and IT-related technologies, increase opportunities for tech transfer into new businesses opportunities, advance their careers and finally, enhance the possibility of creating innovations in the engineering and science curricula. This initiative was seen as particularly relevant to the contemporaneous

economic situation, enhancing participants' likelihood of obtaining a job and/or creating new jobs through new business creation while the US and global economies recovered. The program, successfully implemented still exists focused on providing post docs the opportunity to work in start-ups across the US providing opportunities for future engineering professors to acquire real-life engineering experience and impact the engineering/science curriculum.

8.3. NEU@UNH

In June 2013 the author was recruited as Provost of a new engineering school in Silicon Valley, California. Thus in cooperation with the University of New Haven, University Ventures and industry, NEU@UNH was born1.

Focused on talent development to support economic development and industry in Silicon Valley, the university's mission was to educate world class engineers, equipped to attain full employability, through a constructivist learning environment that revolutionizes how students think and feel about engineering education. Its vision is "Making engineering 'REAL' (Realistic, Enjoyable, Accessible, Lean)". The new start up meant to provide a learning experience that was:

- Transformational and life changing, leading to employment opportunities
- Synergistic, as characterized by "Iwe", meaning than an individual's power can be raised exponentially with the help of a collaborative team
- Industry-coupled and practical
- Affordable and pledged to continuous quality improvement
- Enjoyable, including fun and motivating learning spaces

Early in the school's development process, industry partners like IBM, VMWare, Facebook and others were consulted with. From needs (for example, competencies needed in graduates), to curriculum/program areas (Big Data was selected as the first program to be offered) to business issues (for example, business model) to strategic issues (like industry projects, internships).

An Advisory Board reviewed and approved the strategies that were set to accomplish the mission. Among them:

1. Understanding the needs of our stakeholders and defining the desired competencies of our graduates (knowledge, skills and values) to develop degrees, certificates and other learning experiences taking into consideration how people learn.
2. Developing engineering and master of engineering degrees in areas at the intersection of industry needs to generate employability and student interest.
3. Developing innovative and fun learning spaces and experiences for students (and faculty) to learn knowledge, practice skills and develop institutional values.
4. Implementing a continuous quality improvement culture, assessing outcomes to grow and expand.
5. Drawing students capable and interested in completing an engineering degree, particularly underrepresented minorities and women who, for a multitude of reasons unrelated to skill and ability, are choosing other paths.
6. Offer a learning experience that is more engaging and responsive to student learning styles (mix of learning resources and modes), employer-relevant and practical (project-based learning) than traditional engineering programs at a lower price point.
7. Professors who are a smart blend of engineers + educators, who explore innovative teaching, and are mentors.

ln pairing technical training with 21st century skills, the school hoped to mentor a rising generation of "T-shaped" professionals who in turn meet the increasingly global need for a more innovative class of engineers. Industry partners were essential for developing the competency-based curricula and were involved in various ways: in defining graduates' competencies, in developing course material (co-developed by a team of industry/academic experts),

In July 2014, NEU@UNH was acquired by Galvanize, a tech startup company and became GalvanizeU.

in teaching and in providing mentorships and practice for students and faculty.

9. Conclusion

Across the ever-changing global landscape, societies urgently need "locally relevant but globally competent engineers" who possess the knowledge, skills, attitudes and values to make a better world. More than ever, engineering education needs a huge (r)evolution, one that should include understanding society's needs, developing learning experiences for all types of learners, and finally, one that rewards exemplary teaching (Morell, 2014).

Although industry and academia have different cultures and values, they have the common pursuit of knowledge and human resources development. Thus, they should collaborate to enhance each other's capacities leveraging resources and ideas. Successful I-U partnerships require leadership, a shared vision, frequent and consistent communication, mutual understanding of cultures, mutual benefit, honesty and trust. Similar to the development of personal relationships these organizational partnership undergo series of phases, awareness or seed, growth and sustainability. Each one entails opportunities and challenges and success can only be attained if there's planning, outcomes assessment and evaluation for further growth.

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