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When University Met Industry

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Abstract

With rapidly evolving technologies, the university - industry collaboration (UIC) on education and research has never been more important. Traditionally, academic institutions educate industry professionals before they enter the workforce, and the industry provides funding for universities on research projects. However, the current one-way flow of education and research can be enhanced by creating a more diverse and interactive dynamic to comprehensively address the ongoing challenges faced by each party. This paper discusses the opportunities and enhanced strategies for a successful university-industry (U-I) partnership based on the George Mason University-Dominion Energy partnership.

Keywords

Academia – Industry Partnership, Power Engineering Education, Continuing Education, Interactive and Inclusive Collaboration, Recruitment and Retention.

Introduction

A sustainable collaborative partnership between universities and industry is crucial for student success, research, technological and workforce development, as well as recruitment and retention. The culture and practices of U-I partnerships vary from one sector to another. In the electric power sector, the relationship between universities and industry has changed dramatically in the past two decades due mainly to power system deregulation and the growing disciplines of computer and electronics industries. The power system deregulation accelerated utilities mergers which forced utility companies to emphasize financial aspects besides “keeping the lights on”. In addition, many universities downsized or eliminated power engineering programs as a result of the declining student enrollment and the diminished support from the power industry. In consequence, weakened U-I relationships in the electric power sector led to a crisis in power engineering education and workforce shortage, which places risks to the nation’s security given that all critical services and infrastructures rely heavily on electricity.

In light of the ongoing crises of workforce shortage in the power engineering sector, a power engineering program was established at George Mason University through a successful U-I partnership between George Mason University and Dominion Energy. This paper first provides a brief overview of the traditional forms and practice of UICs. Given the changing landscape for U-I partnering, enhanced strategies for a sustainable U-I partnership implemented in the George Mason University-Dominion Energy partnership are proposed. Finally, the process, outcomes and future work of the George Mason University-Dominion Energy partnership are presented and discussed.

Overview of UIC

There are different forms of UIC efforts based on the scale and objectives of the collaboration. The major forms of the UIC[1] include i) Multi-university and Multi-company Collaborations, ii) Single-university and Multi-company Collaborations, iii) Multi-university and Single-company Collaborations, and iv) Single-university and Single-company Collaborations. Although each form serves a different purpose and requires a different scale of supporting infrastructure, collaborations on all levels of education and research are beneficial for the ecosystem.

Traditionally, U-I partnerships include the following activities:

- Classroom Activities: guest lectures by industry representatives, industry supported class projects and capstone projects;
- Seminars: joint seminars for faculty, students, industry professionals and leaderships;
- Field Visits: tours of industry facilities;
- Employment Opportunities: summer internships, co-op programs;
- Research: industry-sponsored research projects, industry-supported research projects;
- Grants and Donations: student scholarships, equipment donations, professorship endowments;
- Joint Publications: conferences, textbooks, journals;
- Advisory Boards: industry leaders advise the direction on program and curricula development;
- Intellectual Properties: patents, licenses.

Through the UIC, the industry has many opportunities to train students through leaning the desired skills, and gain royalty-free licenses on intellectual property produced in joint research. Universities gain cutting-edge industrial technologies and experience and further advise students in highly relevant research areas. A strong UIC also promotes student enrollment and retention as well as technological growth, as it was found that a strong UIC could accelerate knowledge and product transfer to potentially reduce lag times by up to seven years[2].

Strategies for a Sustainable U-I Partnership: An Interactive and Inclusive Model

Although these collaborative models have existed for decades, there are key drivers that can significantly contribute to the new landscape for U-I partnership. Included are merging technologies across sectors, combining society and humanities, and the rise of big data, artificial intelligence, machine learning and digital economy[3]. These trends require universities and industry to adapt to new contexts and translate the research and teaching into valuable applications with beneficial socio-economic impacts. The U-I partnership must expand upon technologies with a focus on embracing communities, diversity, and new business models.

Given the new landscape, benefits and gaps of conventional U-I partnerships, an interactive and inclusive model is outlined below for a sustainable and successful partnership.

- **Developing metrics for evaluating the U-I partnerships**. Evaluation metrics vary from institution to institution depending on the objectives of the collaborations among the stakeholders. A committee can be formed to develop the metrics and periodically evaluate the outcome to ensure the metrics are met.

- **Building diverse U-I partnerships**. Through the U-I collaboration, faculty can invite professionals from minority or under-representative demographics from the industry to give guest lectures. In addition, the university can support industry in recruiting students from those populations as well through scholarships, internships or mentorships.

- **Industry's active participation in university partner's curriculum development**. Creating an industry advisory board dedicated to the academic program will ensure the partnered university prepares students for meeting the combined needs of the workforce and society.

- **Building university programs for upskilling and reskilling industry partner's workforce**. Universities should build or update the degree or certificate programs to address the need of industry workforce development and the challenges of adapting to the rapidly evolving technology.

- **Providing joint appointments for the exchange and diffusion of knowledge between universities and industry**. Universities actively hire adjunct instructors and invite guest speakers from the partnered industry to incorporate real-world experiences into classrooms. Additionally, the industry can offer consulting or summer internship opportunities to faculty to facilitate continued exchanges of knowledge.

- **Building a secure data-sharing platform**. The field data collected and shared by the industry is highly valuable to universities conducting research, in addition to being utilized in solving real-world challenges faced by the industry. A secured date-sharing platform can greatly benefit stakeholders and further strengthen the partnerships.

The George Mason University - Dominion Energy Partnership: Combating the Crisis in Power Engineering Education and Power Industry Workforce Development

The power and energy sector is fundamental to global decarbonization and responsible for providing the world with affordable and clean power for the future. The rise of energy transition and grid modernization requires technical skills across all sectors. Like other power companies, Dominion Energy has been facing the challenges of workforce shortage and losing talents out to computer sectors. This is happening during a time of national crisis in electrical engineering education including power engineering. Enrollment in electrical engineering has been observed to be in decline across the nation[4]. To address the crisis, the academia, industry and government must work together to promote education, research and workforce development in power and renewable energy engineering.

George Mason University started building the power engineering program in 2018. The George Mason University - Dominion Energy collaboration was initiated in 2019 by a need in Dominion Energy's workforce development and a summer research faculty position offered to the ECE department at George Mason University by Dominion Energy. The faculty internship program was not new; however, the George Mason University faculty identified three loose connections in UIC, including (1) the two-way learning between faculty and industry professionals, (2) the insufficient real-world experience in the program curriculum, and (3) the gap between teaching and research. The loose connections are shown in the dotted lines of Figure 1.

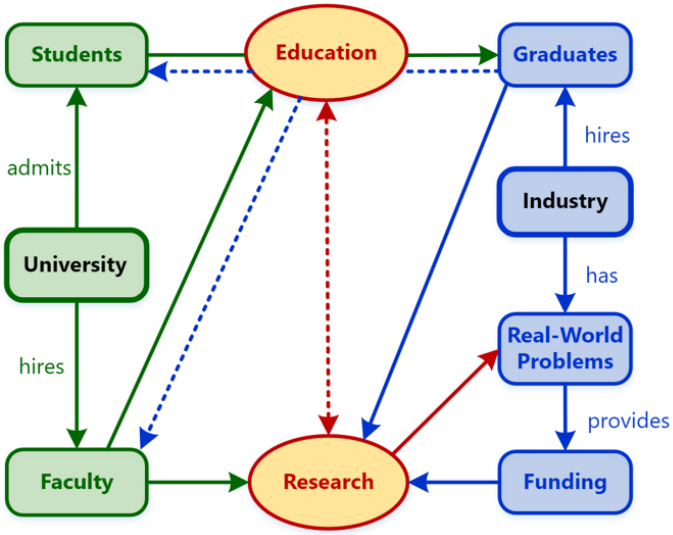

Figure 1 The University-Industry Collaboration

The George Mason University faculty worked with the special study group at Dominion Energy in exploring the ongoing research projects and observing how the power system was planned, designed, procured and operated, broadening the faculty's view on research and educational topics. Furthermore, the faculty networked with prominent professionals at Dominion Energy, and later recruited them to develop and teach the power engineering curriculum to strengthen weaker connections. Industry professionals have the opportunity to educate future power engineers or the future employees of the company through classroom teaching, research and class project collaborations as well as guest lectures.

The collaboration did not end after the faculty completed the summer internship at Dominion Energy. The faculty continued providing commentary and academia-related experience on Dominion Energy's internal training program. The outcomes show that the two-way teaching partnership improved recruitment and retention. The enrollment of the power engineering program at George Mason University experienced high rates compared with other internal programs. Based on the four-year survey results, an average of 70% of students who enrolled in power engineering courses decided to pursue the concentration or career in power engineering mainly due to the strong U-I partnership between George Mason University and Dominion Energy.

Another existing weak connection is the imbalance between research and teaching. Research and teaching are equally important missions for universities. However, the evaluation of excellence in higher education has largely been focused on research output and thus less resources are allocated to undergraduate education. The imbalance between research and teaching in higher education eventually burdens the industry with new employee recruitment and training. An interactive and inclusive UIC can help to bridge the gap between research and teaching as well as promote a smoother transition for new employees in the workforce.

The George Mason University - Dominion Energy collaboration continues to evolve multidisciplinary research, diversity and new business models with the aim of building a sustainable partnership that can benefit all stakeholders.

Conclusion

Establishing sustainable U-I Partnerships is crucial to the success and continued improvement of universities, industry, and society. While U-I collaborations can be formed through curriculum development and research collaboration, the partnership can be strengthened via implementation of proposed interactive and inclusive model. George Mason University has made much progress with the newly established power engineering program in strengthening the value and trust of U-I partnership with Dominion Energy. It would be highly beneficial for the Single-university and Single-company Collaboration between George Mason University and Dominion Energy to evolve into Multi-university and Multi-organization Collaborations to benefit the broad spectrum of stakeholders and communities. With rapidly evolving technologies and socio-economic landscapes, it has never been more crucial for universities, industry and government agencies to work hand in hand to break through barriers toward thriving and successful partnerships.

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