From Interdisciplinary Education to Effective Global Engineers

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Dr. Ma is an IEEE senior member. He serves as Delegate of Energy Cluster, Chair of Energy Storage Technical Committee and Chair of Shanghai Chapter, IEEE Industrial Electronics Society. He is an Associated Editor for the IEEE Transactions on Industrial Informatics. He and his supervised students won many teaching and research awards at Shanghai Jiao Tong University, such as Koguan Top Ten Best Teacher Award in 2017 and Koguan Top Ten Research Group Award in 2014. He also received Research Excellence Award from AirFuel Alliance, USA, in 2019 (email: chbma@sjtu.edu.cn; lab: http://umji.sjtu.edu.cn/lab/dsc/).

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Prof Pradeep Ray is the Director of the Centre For Entrepreneurship (CFE) at the University of Michigan -Shanghai Jiao Tong University Joint Institute (UM-SJTU JI), China. He designed the Minor in Entrepreneurship program at the UM-SJTU JI, that started in 2017. This program involves a number of practicum courses in collaboration with the industry in China. He has been awarded Shanghai 1000-Telent Distinguished Professor status (2017). The CFE has launched a major initiative called the Technology Entrepreneurship for Sustainable Development (TESD), the defining philosophy for several entrepreneurship projects for social development in the Belt and Road region. He has been the founder Director (2013-2016) of the WHO Collaborating Centre on eHealth at the University of New South Wales (UNSW)-Australia where he is an Honorary Professor in the School of Public Health and Community Medicine (SPHCM).

From Interdisciplinary Education to Effective Global Engineers

Abstract

This paper presents thoughts, practices, and outcomes of interdisciplinary engineering education within the University of Michigan-Shanghai Jiao Tong University Joint Institute (JI) in China. The JI is an equal-partner collaboration in engineering education between two leading institutions in China and the US, the Shanghai Jiao Tong University (SJTU) and the University of Michigan (UM). The JI offers three engineering programs without having a clear departmental structure from the beginning of its establishment. All courses in mathematics, basic sciences, as well as liberal arts are offered in house by the non-engineering faculty of the institute. This approach has built interdisciplinary education into the very nature of the JI. The interactions between faculty in different disciplines greatly promote an interdisciplinary environment and nourish students' interests in multidisciplinary studies. Interdisciplinary education at the JI is reflected in the curricula of the engineering majors and non-engineering minors, in its creative degree programs, and in the extra-curricular activities. This paper presents data as outcomes of the effort in interdisciplinary education. Some new initiatives such as the Global Degree Pathways program, Center for Entrepreneurship and Center for Interdisciplinary Education are works in progress. Thoughts and experiences with those initiatives are also shared.

Background and Introduction

The partnership between the two universities was evolved from a previously successful pilot program in the School of Mechanical Engineering of SJTU. In 2006, the two universities decided to start a joint institute (college) within SJTU based on the pilot program. The JI was officially approved by the Ministry of Education of China in February 2006. It offers B.S., M.S., and Ph.D. degrees in Mechanical Engineering (ME) and Electrical & Computer Engineering (ECE), and has started a Materials Science & Engineering (MSE) program in 2018. The JI has grown from an unknown college that had difficulty recruiting a sufficient number of undergraduate students to one that is able to attract top students in China with its reputation as a highly competitive and fully internationalized engineering program. The JI is essentially an enclave within a Chinese public university that follows a US educational system. It has been regarded as a special zone and "experimental field" for China's reform effort in higher education. It is recognized in China for its autonomous management system, interdisciplinary curricula, internationalized programs, and faculty engagement in teaching and research.

The goal of the JI is to become a highly reputable institution for innovative global engineering education and research activities. In 2016, both the ME and the ECE programs of the JI acquired ABET accreditation. The JI currently has 1,250 undergraduate students including 177 ME majors, 735 ECE majors, as well as 338 students without a declared major. By far, a 100% of undergraduate placement for totally 2006 graduates has been maintained at the JI. Over 80% of the graduates pursued higher level studies in graduate schools, mainly in the US. Among the students who pursued graduate studies in US universities, over 55% were admitted to the top 10 engineering schools. The students who chose employment after graduation were placed in engineering as well as non-engineering organizations.

Different forms of multi/inter-disciplinary effort have been tried with some successes achieved and lessons learned [1][2][3]. Publications suggest that integrating curricula and organizing activities across disciplines are not easy [4][5]. Yet it is believed that interdisciplinary curricula and activities relate to engineering students' interdisciplinary skill that is defined as "capacity to engage in interdisciplinary thinking, collaboration, and problem solving" [6]. Previous research has revealed the relationship between interdisciplinary activities and success in emerging technology research [7]. Studies have also showed that increased satisfaction and quality of a cross-disciplinary collaboration are achieved when the collaborators are aware of different disciplinary perspectives of the people they are working with [8]. Therefore, it was decided early on that the strategic characteristic of the JI would be its global approach to structural and operational development, leading to a long-term vision of interdisciplinarity. This strategy has been reflected in one of the Program Education Objectives (PEOs): *Within 3-5 years after graduation from the JI, the graduates should be able to apply their creativity and global perspective in their engineering or non-engineering professions*. We use this paper to report to the community our thoughts, practices, and outcomes of the interdisciplinary engineering education at the JI.

Interdisciplinarity in Engineering Curricula

The curricula of the engineering programs at the JI are enriched with elements beyond technical training. There is a first-year Introduction to Engineering course that allows students to have a taste of engineering in an interesting subject area before they claim a major; the capstone design projects allow the students to join each other again as different majors to form multidisciplinary teams and work on industry-sponsored projects; the Global Multidisciplinary Design Project (GMDP) extends the boundaries of capstone design projects to involve international collaborations; liberal arts courses broaden students' horizon beyond engineering fields and help students to think about engineering problems from different perspectives. The JI offers minors in non-engineering fields including entrepreneurship, data science, and computer science, to provide concentrated studies in the non-engineering fields. Through the engineering curricula, our goal is to train effective engineers with interdisciplinary experience, technical knowledge, innovative minds, a deep understanding of professional ethics, and "soft" skills such as leadership, communication skills, social awareness, etc. Figure 1 illustrates the kind of engineers we want our graduates to be through the interdisciplinary curricula we designed for them.

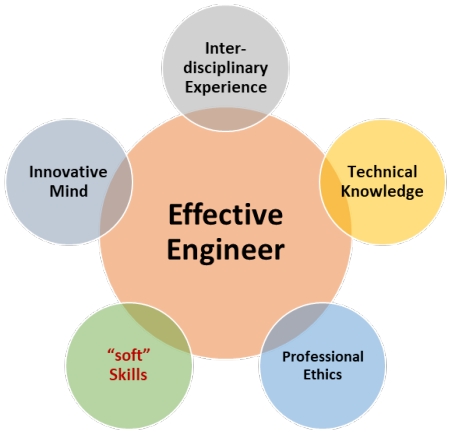

Figure 1. Goal of our interdisciplinary curricula

Multidisciplinary Design Projects

The freshman students matriculated into the JI do not declare a major until the sophomore year. In the first year, all students take an Introduction to Engineering course where they work in teams on self-proposed engineering design projects. In this course, they go through the entire engineering process from an initial idea to the design to manufacturing and finally to a working prototype. They learn about the skills and knowledge needed for an engineering project, how to communicate with their peers and potential users about their ideas and designs, and what the social impacts of their work might be. The responsibilities in a project are partitioned among the team members based on their interests and skills. This is considered their very first multidisciplinary project experience.

After selecting majors in the sophomore year, students take courses separately in their own programs. They still have the opportunity to take some courses together, in mathematics, math-intensive engineering, physics, as well as humanities and social sciences. In the senior year, the students in different programs once again join together in the capstone design course. This team-based course is designed to embrace the idea of multidisciplinary teamwork in each project, just as in real world industrial settings. The project-oriented course allows senior students to bring together their knowledge and perspectives from different majors to tackle engineering design problems. The capstone projects are team based. Each team typically consists of 5 students, with 3-4 from the ECE program and 1-2 from the ME program. The MSE program has not produced any senior students yet. Figure 2 shows the number of students participating in the capstone design course at the JI in each academic year since 2010 when first cohort of graduates were produced. Because there is no departmental structure within the JI, intermingling of the students from different programs presents no problems at all.

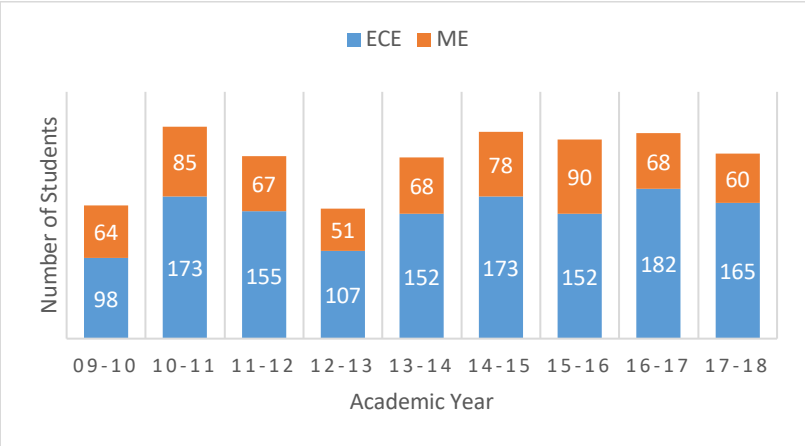

Figure 2. Number of students participating in the capstone design course

Almost all of the capstone design projects are proposed by multi-national or local companies, and financially and/or technically sponsored by the companies. The proposed projects are carefully reviewed and selected by a group of faculty in charge of the capstone design course to sort out projects that demand knowledge of multiple engineering disciplines including ME, ECE, and Computer Science. The course is cross-listed for two different programs (ME and ECE) with

two separate course codes to facilitate the mixing of the students. Through the open-ended design problems, students learn how to approach such problems in a systematic way and how to use the engineering knowledge and skills acquired from various courses to tackle the technical issues. In addition, students are exposed to topics related to professionalism, ethics, entrepreneurship, environmental sustainability, etc. All these happen in a 4-credit course in one semester.

Global Multidisciplinary Design Project (GMDP)

To enhance the education of the students in the UM and the JI in unique ways, a Global Multidisciplinary Design Project (GMDP) course was introduced in 2016. This course consists of a two-semester long project with teams composed of students with different majors from both the College of Engineering (CoE) of the UM and the JI. There are typically 5 to 6 students on each team with 2-3 students from the UM and 3 students from the JI. A single multi-national corporate sponsor is selected in each year to provide real-world engineering problems for the teams to work on using different approaches. During fall semester, the UM students study in China for one semester and work together with their teammates of the JI as well as the technical mentors from the headquarter in the foreign country and/or the China branch of the sponsoring company. The teams follow through a design process similar to the one adopted in the senior capstone design course. They devise a solution to the engineering problems under supervision of the JI faculty members and design and implement a prototype at the end of the fall semester. The sponsoring company evaluates and provides feedback on the preliminary designs of the teams.

In the following winter semester of the UM, the teams are split geographically from January to March. The UM students return to the US while the JI students remain in China. The students continue working remotely, thereby simulating the global working environment of multi-national companies. This is partially because the JI has a longer vacation in the winter time until late February due to the Chinese New Year holiday. During this winter break, students from the JI and the UM students receive technical advice from the sponsoring company and refine their designs based on the feedback from the sponsoring company under supervision of a CoE faculty member. In the last month of the UM's winter semester (March-April), the JI students travel to the US and reunite with their teammates on the UM side. They work together to create the final delivery and participate in the Design Expo at the CoE of the UM. The JI students receive 2 credits for their effort in the second half of the project.

It is desired that the sponsoring company has offices and facilities in both China and the US in order to provide local technical support. In 2016-2017 and 2017-2018 academic year, the sponsoring company was General Motors. In the current (2018-2019) academic year, it is Bosch. In the Fall 2016 semester, six UM students studied at the JI and worked on the GMDP projects with nine students of the JI in 3 teams. In Fall 2017, five UM students participated in the GMDP program and formed 2 teams with six students from the JI. In Fall 2018, six UM students and six students from the JI formed 2 teams and have successfully completed the first phase of the program when this report is written. The UM students have majored in mechanical engineering, electrical engineering, and computer science & engineering in the UM. On the JI side, both ME and ECE students have participated in the program every year. The project topics provided by the sponsoring companies were real engineering problems that the companies have been trying to

solve. The companies were very satisfied and highly appreciated the solutions that the students developed in the GMDP program. The program has also been well liked by the students on both sides.

Challenges for this kind of program include: 1) attracting US students to study in China for an entire semester while working on the projects; 2) financial and organizational challenges for Chinese students' one-month trip to the US during the regular spring semester of typical Chinese universities; 3) attracting students with diverse engineering background to form teams for the projects; 4) recruiting a multinational company that is able to provide technical support on the same project in different locations. While we are aware that all of these factors represent challenges to the sustainability of the GMDP program, we see special features of the JI that contribute to the success of the program so far and in the future. These features are discussed as follows:

1) The beauty of the GMDP program is its multidisciplinary nature in a cross-national setting. Therefore, being able to attract students from the US to spend an entire semester of time in China is crucial. The JI's curricula were modeled after those of the corresponding programs of the UM. Many courses offered at the JI are equivalent to the corresponding UM courses, and the credits can be transferred to the UM. In our GMDP program, the semester when the US students study in China is Fall semester. It has been suggested by our US partner universities that the students usually are reluctant to attend study abroad programs during the regular semesters because they are afraid of missing important courses. In our case, a long list of transferable courses offered in the Fall semester assuages this concern. The UM students are able to take certain courses required by their own degree programs along with the GMDP projects.
2) In a typically Chinese university, the Spring semester runs from late February to the end of June. Sending students to the US for an entire month of time would be challenging. However, the two major semesters of the JI are Fall and Summer. The Summer semester runs from mid-May to early August. The Spring term at the JI (late February to late April) is a minor term and resembles the concept of the summer term in many US universities that adopt a semester system. Senior students are not required take any courses in the Spring term. Another logistic issue is financing. It is not easy for the students to cover the one-month cost while they are in the US. To get the program running, both JI and the UM set aside a scholarship to help those students in this program who are financially challenged. To make the program more attractive, the JI also recognizes the first part of the GMDP project as a capstone design experience that satisfies the corresponding Bachelor's degree requirement, and at the same time grants extra credits for students' effort in the second part of the GMDP project.
3) Attracting students with different engineering background to work on the same project makes this collaboration multidisciplinary. However, accommodating the students in the same school working on the same project is non-trivial in typical Chinese universities. The pre-existence of multidisciplinary capstone design projects and blurry to non-existent departmental structure at the JI certainly helped. In typical Chinese universities, the disciplines are separated in individual schools. For instance, there are School of Mechanical Engineering and School of Electronic Information and Electrical Engineering within SJTU. It

would be difficult for any of those schools to host the students and offer courses for them to take.

4) Each team works on the same project in the first and second phase of the program but in different countries. It is preferred that the sponsoring company is able to provide technical support and design outcome evaluation in both countries. Finding a multinational company able to support suitable multidisciplinary engineering projects can be difficult. It requires strong connections and pre-existing collaborations between the universities and the industrial partners to make it happen.

Minors

At the beginning of the JI's establishment, the engineering curricula were predominantly technical. Some flexible elective credits were required for general education, but only a very limited number of non-engineering courses was offered. As a result, students took technical courses to fulfill the flexible elective requirements. From 2010 to 2016, the JI was able to increase the size of its non-engineering faculty and started offering more non-engineering subjects, such as history, philosophy, literature, German language, business, management, entrepreneurship, economics, political science, mathematics, physics, statistics, computer science, etc. These courses give students a deeper understanding of the human society as well as their social responsibilities as future engineers. They also help students to develop an ability to view engineering problems from different perspectives. It was commented upon by employers in various fields that students who graduated from the JI have interests and experience in both engineering and non-engineering fields and that they were more competent and welcomed.

However, it was also observed that many students took those elective courses in a scattered manner even if they did want to focus their interest and explore more in certain non-engineering areas more deeply. Students did not receive effective information about what courses to take unless they actively sought advices from the relevant faculty members. In Fall 2016, the JI created the first minor, the Minor in Entrepreneurship, to provide a focused study in a non-engineering area and to encourage students to learn practical skills that may help translate their innovate ideas into real impact. This part of the curriculum change is shown in Figure 3. The minor requires a minimum of 15 credits of courses, including:

- Core (required) courses (5 credits)
  - Entrepreneurship Basics (3 credits)
  - Managing a Business (2 credits)
- At least 6 credits of Practicum from the following:
  - Capstone Design Projects (4 credits)
  - Intrapreneurship (3 credits)
  - Mobile Applications for Entrepreneurs (3 credits)
  - Technology Entrepreneurship (3 credits)
- At least 3 credits of Elective courses selected from the following list
  - Leadership and Management (3 credits)
  - Branding and Brand Management (2 credits)
  - Advanced Branding and Brand Management (2 credits)
  - E-Business Management (3 credits)
  - Introduction to Social Entrepreneurship (3 credits)

- Business and Natural Environment (3 credits)

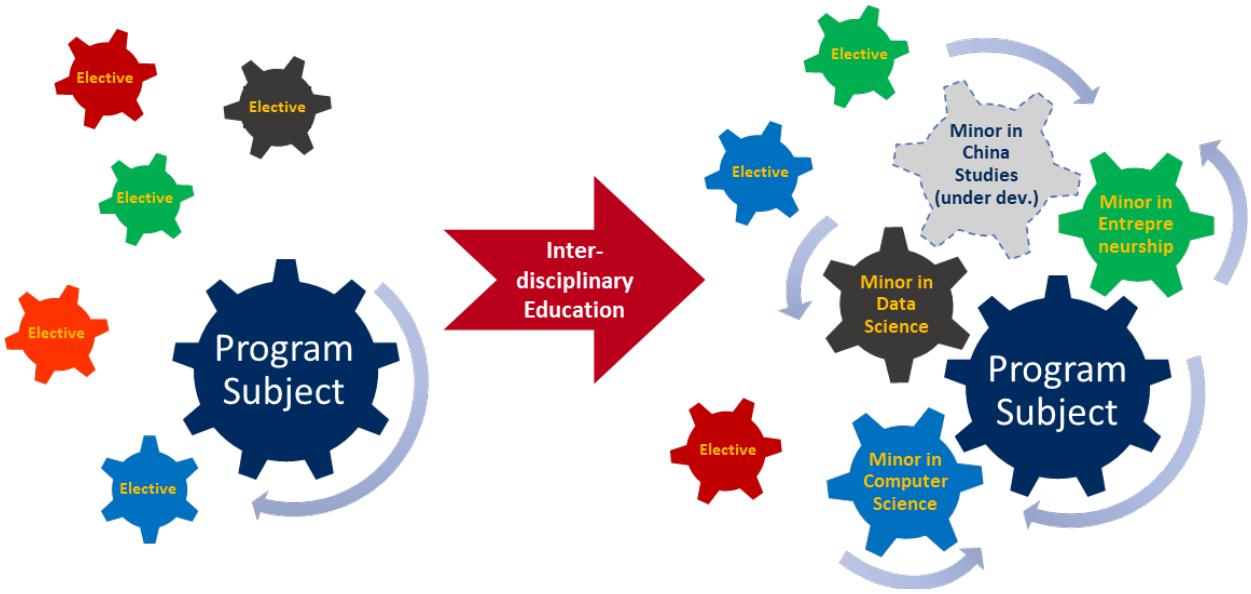

Figure 3. Curriculum change driven by interdisciplinary education

The minor was open to the JI students that have declared a major and are in good academic standing. If planned well in advance of the senior year, the program should not add to the credits required for a Bachelor's degree at the JI. A certificate for the Minor is issued to the students when they receive their B.S. degree. So far, 11 students have graduated from the JI with a Minor in Entrepreneurship and the number is increasing rapidly.

For the similar purpose, the JI created two more minors, the Minor in Data Science and the Minor in Computer Science (for students with an ME major only), in 2017. The courses and credits required for Minor in Data Science include:

- Core (required) courses (8 credits)
  - Probabilistic Method in Engineering (4 credits)
  - Bayesian Data Analysis (4 credits)
- At least two courses from the following list:
  - Applied Regression Analysis using R (4 credits)
  - Introduction to Machine Learning (4 credits)
  - Data Mining (4 credits)
  - Artificial Intelligence (4 credits)
  - Random Processes (4 credits)
  - Methods and Tools for Big Data (3 credits)

The courses and credits required for Minor in Computer Science include:

- Prerequisites
  - Calculus II (or equivalent)
  - Introduction to Computer and Programming
- Core (required) courses (12 credits)

- Discrete Math (4 credits)
- Programming and Introductory Data Structure (4 credits)
- Data Structures and Algorithms (4 credits)

- At least 3 credits of Elective courses from the following list
  - Introduction to Machine Learning (4 credits)
  - Introduction to Cryptography (4 credits)
  - Introduction to Algorithms (4 credits)
  - Introduction to Operating Systems (4 credits)
  - Compiler Construction (4 credits)
  - Data Mining (4 credits)
  - Web Systems (4 credits)
  - Interactive Computer Graphics (4 credits)
  - Introduction to Artificial Intelligence VE493
  - Advanced topics in AI

Winter Study Abroad Program

The JI's winter break is much longer than that of typical US universities, lasting from Christmas to the end of February. During the winter break, the JI offers students a variety of study abroad opportunities in Europe, Asia, Australia, and America. These short-term winter study abroad programs are intended to give JI students opportunities to study subjects outside their majors while experiencing different cultures overseas. They are typically designed to take 3-5 weeks. Students may also transfer back a number of credits depending on the program, currently ranging from 2 to 12.

Location	Course Areas
Argentina	Data analysis, language and culture
Australia	Engineering Acoustics
Canada	Business Studies
France	Project management, language
Germany	Language and culture, mechanical engineering, programming, business
Japan	Language and Culture
Russia	Electrical Engineering
Spain	Machine learning, language and culture
United Kingdom	Humanitarian engineering
United States	Robotics

Table 1. Winter Study Abroad programs at the JI

The winter study abroad programs have been very popular with students, especially freshman and sophomore students. They consider this a good chance for them to be exposed to engineering and non-engineering subjects as supplements to their engineering studies. The number of students attending the winter study abroad programs has experienced rapid growth, as shown in Figure 4.

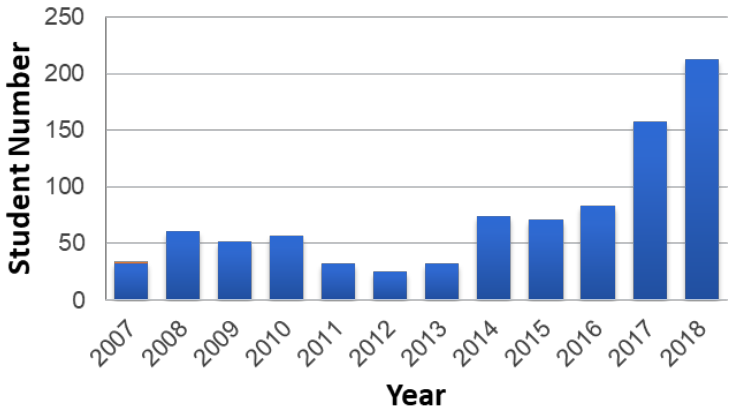

Figure 4. Number of students attending the winter study abroad programs

Interdisciplinarity in Creative Degree Program

In addition to the regular degree programs, the SJTU-UM partnership and its internationalized system give the JI good opportunities to offer creative degree programs. The dual-bachelor's degree (DD) program allows JI students to pursue two undergraduate degrees in two different but closely related engineering or science disciplines at the JI and UM within just 4 years of time. The global degree pathways (GDP) program creates pathways for the JI students to have an integrated BS/MS study experience whereby they are able to earn a Bachelor's degree from the JI and a Master's degree in engineering or non-engineering disciplines from a global partner university.

Dual-Bachelor's Degree (DD) Program

This program is designed to allow a student entering the JI's undergraduate program to earn a Bachelor of Science degree from the UM and a second B.S. degree from the JI in two different disciplines. It offers students of the JI a high-quality multidisciplinary education and an enriched international experience. In the fall semester of the sophomore year, students who are interested in the dual-degree program apply for transfer admission to the UM. Usually, about one hundred sophomore students are admitted to the dual-degree program every year. These students may choose to study in one of the nineteen engineering programs of the CoE or alternatively, mathematics or physics in the College of Literature, Science, and the Arts (LSA) in their junior and senior years for a Bachelor's degree at UM. During the first summer semester after these dual-degree students go to the UM, they may choose to return to the JI to complete courses required for the bachelor's degree at the JI. They will come back to the JI to complete the senior design and other requirements for their SJTU degrees in the second summer semester. This has been a very popular option among the JI students from the outset and remains a powerful recruitment tool for the JI.

After completing each university's requirements, students will receive a B.S. Degree from the UM, the Graduation Diploma from the Ministry of Education of China, a B.S. Degree Ordinance from the SJTU, and a Study Certificate from the JI jointly granted by SJTU and UM.

Global Degree Pathways (GDP) Program

In the spirit of innovation, the JI offers a Global Degree Pathways (GDP) program that allows the undergraduate engineering students to seek further development in and beyond engineering, with a more direct, simple and accelerated way. The GDP program offers a pathway that allows students to get a Bachelor's degree in engineering at the JI and a Master's degree in an engineering or non-engineering discipline at a global partner university, as shown in Figure 5.

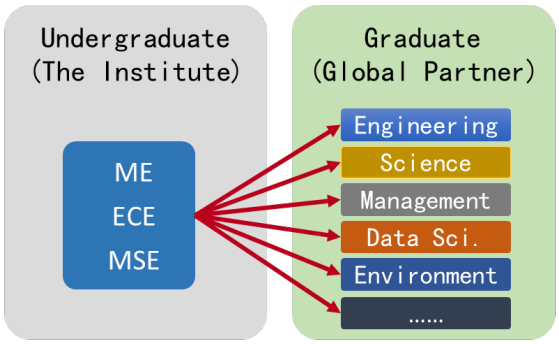

Figure 5. Global Degree Pathways program of the JI

Students of the JI usually apply in their junior or senior years depending on the different GDP program application timelines. A typical GDP program is a 5-year program with the combination of 3.5+2 or 4+1 years of study at the JI and its partner, respectively. The program generally involves some modest double counting of credit in accordance with the academic policies of the governing schools and colleges. Students participating in the GDP programs may be offered a provisional admission to a Master's program in as early as their junior year of study. Some GDP programs allow students to study graduate-level courses in a global partner university in the senior year of study for one to two semesters. Because of the special semester system of the JI, the summer semester (mid-May to early August) allows these students to come back to the JI and complete the rest of the BS degree requirements including the capstone design. After graduating from the JI, the students will return to the global partner university and continue their Master's study.

Presently, the JI has signed GDP agreement with the UM, UC Irvine, North Carolina State University, Stony Brook University, Trinity College Dublin, and KTH (Sweden), offering MS degrees in a variety of engineering disciplines, engineering design, management, applied statistics, data analytics, user experience and design, as well as environment & sustainability. Most of the collaborations favor the combination of 3.5+2 years of study. From the beginning of the JI, a sequential undergraduate-graduate study program with the UM CoE in the form of 4+1 format has existed as the sole GDP program until KTH joined in 2015. Since 2016, when we started investing effort in developing more GDP programs with other schools of UM and other global partner universities, we have had over 70 students participated in the GDP programs. In this current academic year, over 80 junior students are applying for participation in the GDP programs.

The GDP program is beneficial to both the JI and the partner universities. Figure 6 shows the placement summary for all graduates of the JI from 2010 to 2018. Over 80% of the students chose graduate studies in the US, China or other countries. Out of the students who pursued graduate degrees in the US, the majority entered top 20 engineering graduate schools. The GDP program provides a fast track to a graduate program in the partner universities which is transparent and foreseeable for students even when they enter the JI in their first year. Being able to take some graduate level courses in a discipline area of interest in the senior year allows the students to learn better about the discipline, the graduate school, as well as what graduate study is like before making a commitment. Furthermore, the JI has been able to recruit the most elite students in China into its undergraduate programs. From the perspective of the global partner universities, these students are the main target group for their graduate programs. The GDP program is a good channel for the universities and their faculty to evaluate the students more thoroughly before officially admitting the students to a MS program or potentially a PhD program. This program is still a work is in progress. Further results will be reported back to the community in the future.

Placement Summary (2010 – 2018)		
Number of Graduates	2006	
US Graduate Schools	1372	68.39%
*US Top 10 Eng. Grad. Schools	756	55.10%
*US Top 20 Eng. Grad. Schools	1062	77.40%
Other Int'l Graduate Schools	115	5.74%
Chinese Graduate Schools	144	7.18%
Employment	375	18.69%

* based on 2019 US News rankings

Figure 6. Summary of Undergraduate Placement at the JI

Extra-Curricular Activities

The JI has established two centers, the Center for Entrepreneurship (CFE) and the Center for Interdisciplinary Education (CIE) to facilitate extra-curricular activities in non-engineering fields and create an atmosphere of interdisciplinary education.

Center for Entrepreneurship (CFE)

The CFE was established at the JI in 2017, as an extension of collaborative work across the UM and SJTU on entrepreneurship education. The mission of the CFE is to become a leader in entrepreneurship education in Asia demonstrating interdisciplinary entrepreneurial activities with global organizations and industry partners. The main objectives of the CFE are:

- To promote entrepreneurship education on undergraduate, graduate and practitioner levels based on ongoing developments at the JI as well as the SJTU;
- To develop academic programs and courses on entrepreneurship;
- To provide support to students on their entrepreneurial endeavors;
- To help students apply technologies in social works through social entrepreneurship.

Entrepreneurial education at the JI is focused on equipping students with the ability to understand the business needs in bringing a given technology to the society in the form a product or service. In addition to the technical skills, students need to understand the business aspect of issues from the perspectives of start-up companies (entrepreneurs) as well as of established businesses (intrapreneurs). The extra-curricular activities organized by the CFE include:

- "Meet the Entrepreneurs" Talk Series
- Entrepreneurship Competition
- Entrepreneurship Week
- Interdisciplinary Social Outreach Projects

It has been reported that socially engaged engineers have comparable engineering competence while showing broader interests and motivations and have a stronger desire to do good and help others as a motivator to study engineering [9]. Therefore, one year after establishment of the CFE, we decided to build the strength of the CFE around Technology Entrepreneurship for Sustainable Development (TESD), i.e. amplifying the social benefit of technology through entrepreneurial effort in a sustainable manner. This strategy brings together technical education, business perspectives, and social awareness. As an example, the CFE was successful in launching the Bangladesh Challenge project (funded jointly by SJTU and partners) in 2018. A CFE faculty member led a group of 12 students with various disciplinary backgrounds (mechanical, electrical, computer, biomedical, media, and physics) and practicing Chinese entrepreneurs (JI alumni) to Bangladesh in January 2019. The students were selected from the JI and other schools of the SJTU. The objective of the project was to re-examine the social impact of certain technology based on existing research projects on mobile health. Students produced two documentary films, one on the technology for social good, and another on the problems that they were able to bring back and brainstorm solutions for in consultation with local partners (Yunus Center, University of Dhaka, ICDDRB, and others). The project progress has been well received by the students as well as by the societies in Bangladesh and China. The CFE Bangladesh team has now been expanded to include faculty from all disciplines of JI to undertake real life Technology for Society projects in Bangladesh by JI and SJTU students.

Center for Interdisciplinary Education

To explicitly emphasize the importance of interdisciplinary education and to further enrich interdisciplinary activities outside the classroom in the JI, a Center for Interdisciplinary Education (CIE) was established in 2018. The CIE serves the interests and efforts of faculty and students in all fields, especially non-engineering fields. It brings educational resources to encourage and sponsor interdisciplinary initiatives in the JI. So far, the CIE has organized a series of talks in corporate management, venture investment, art and design, branding and art, and environment change. Perhaps surprisingly, the presentation series attracted a lot of students from other schools of the university and served as a platform for the JI students to exchange ideas with students from these schools. This has only enhanced the spirit and sense of purpose of the CIE.

Student Placement and Conclusion

So far, a 100% of undergraduate placement has been maintained at the JI. Figure 6 shows the undergraduate placement for the class of 2010 (first class of graduates) to the class of 2018. Over 80% of the students chose graduate studies in the US, China or other countries. Out of the students who pursued graduate degrees in the US, the majority entered top 20 engineering graduate schools, as shown in Figure 7. Over 18% (totaling 375) of the undergraduate students totaling 375 students from 2010 to 2018 chose to commence work in industry directly after their graduation from the JI. Figure 8 shows the distribution of the industries these students went to.

These statistics illustrate the competence of our graduates no matter where they were placed after they graduated from the JI. We are not trying to demonstrate the direct correlation between the student competence and our effort in interdisciplinary education. But the placement statistics show that our attempts in interdisciplinary education in the forms of curricular development, creative degree programs, and extra-curricular activities at least have not jeopardized the outcomes of engineering training.

Ranking*	US Graduate Engineering School	No.
#1	Massachusetts Institute of Technology	10
#2	Stanford University	46
#3	University of California Berkley	41
#4	California Institute of Technology	2
#4	University of Michigan—Ann Arbor	509
#6	Carnegie Mellon University	72
#7	Purdue University—West Lafayette	14
#8	Georgia Institute of Technology	34
#9	University of Illinois—Urbana-Champaign	23
#10	University of Southern California	92
#10	University of Texas—Austin	16
#12	Columbia University	60
#12	Texas A&M University—College Station	14
#12	University of California—San Diego	48
#15	Cornell University	21
#16	University of California—Los Angeles	31
#17	Princeton University	8
#18	Johns Hopkins University	8
#18	University of Pennsylvania	28
#20	Northwestern University	7
#20	University of Wisconsin-Madison	3

* Based on 2019 US News Graduate Engineering Schools Ranking

Figure 7. Number of students that entered top 20 engineering graduate schools in the US

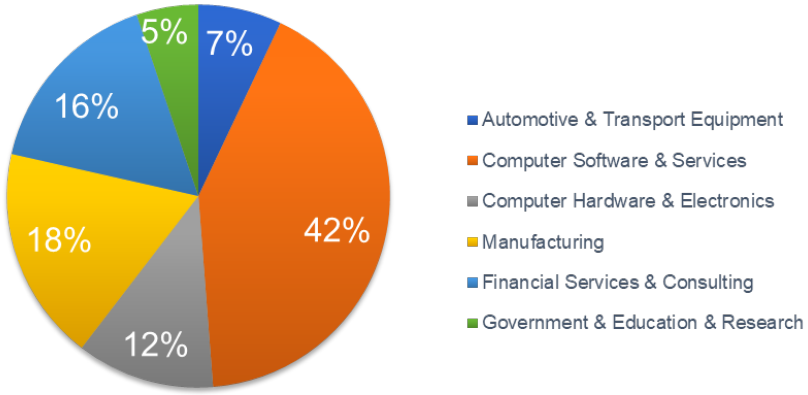

Figure 8. Distribution of industries students were employed in from 2010 to 2018

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